



THURBER ENGINEERING LTD.



**FOUNDATION INVESTIGATION AND DESIGN REPORT
NEW SALT/SAND STORAGE BUILDING
MTO PATROL YARD – DRYDEN SITE
CITY OF DRYDEN, ONTARIO
LAT. 49.792542, LONG. -92.849897
AGREEMENT NO. 6015-E-0023, ASSIGNMENT NO. 5
G.W.P. 6054-16-00**

GEOCRES No. 52F-59

Report to

Ministry of Transportation of Ontario

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PART 1: FACTUAL INFORMATION

1. INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the site of a proposed salt and sand storage building located at an existing Ministry of Transportation of Ontario (MTO) Patrol Yard in Northwestern Ontario. The patrol yard is located on Highway 17 (Grand Trunk Avenue), across from Wice Road, in the City of Dryden, Ontario.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, provide a borehole location plan, record of borehole sheets, a stratigraphic profile, laboratory test results and a written description of the subsurface conditions.

Thurber carried out the investigation as a consultant to the MTO under the Ministry of Transportation Ontario (MTO) Agreement Number 6015-E-0023.

2. SITE DESCRIPTION

The patrol yard is located on Highway 17 (Grand Trunk Avenue), across from Wice Road, in the City of Dryden, Ontario.

The site includes an existing sand dome, salt shed, and 4 door garage and office. There is an asphalt access road to the site which extends to the existing sand dome and garage and office and surrounds the existing salt shed and sand dome. The remainder of the site has a gravel surface. The site terrain is generally flat. The site is bounded by Wabigoon River to the west,

Highway 17 (Grand Trunk Avenue) to the east, and residential properties to the north and south. Photographs of the site are presented in Appendix C.

The general site area is located within an area characterized by glaciolacustrine deposits consisting of silt and clay, minor sand, basin and quiet water deposits over granite bedrock.

3. SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project was carried out between June 12 and 13, 2017, and consisted of drilling and sampling four boreholes (DRY-01 to DRY-04) near the corners of the proposed salt and sand storage building. The boreholes were advanced through the overburden to depths ranging from 7.7 to 12.9 m below ground surface and terminated on or within bedrock (Elev. 361.0 to 356.3 m).

The approximate borehole locations are shown on the Borehole Locations and Soil Strata Drawing in Appendix F. The boreholes were drilled near the corners of the proposed building that were staked out by the MTO prior to commencement of the field investigation. The coordinates and elevations of the boreholes are given on these drawings and on the individual Record of Borehole Sheets in Appendix A.

Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

Hollow stems augers were used to advance the boreholes in the overburden. Samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with the Standard Penetration Test (SPT). Field vane tests (FVTs) were also performed in the cohesive soils to obtain undrained shear strength measurements. Where bedrock was encountered, N casing with a NQ core barrel was used to core the bedrock.

A member of Thurber's engineering staff supervised the drilling and sampling operations on a full time basis. The supervisor logged the boreholes, visually examined the recovered samples, and transported the samples to Thurber's laboratory in Oakville, Ontario, for further examination and laboratory testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. A standpipe piezometer consisting of a 25 mm diameter PVC pipe with slotted screen was installed in DRY-02 to permit monitoring of the groundwater level. Details of the piezometer installation and other borehole completion details are on the Record of Borehole Sheets in Appendix A.

The boreholes in which no piezometers were installed were backfilled with bentonite and cuttings to the ground surface in general accordance with MOE Regulation 903. The piezometer in Borehole DRY-02 was abandoned in accordance with Reg. 903 upon completion of the field program.

4. LABORATORY TESTING

All recovered soil and rock samples were subjected to Visual Identification (VI) and natural moisture content determination. At least 25% of the recovered soil samples were also subjected to grain size distribution analysis (sieve and hydrometer) and Atterberg Limits testing where appropriate. The results of the testing program are shown on the Record of Borehole Sheets in Appendix A and on the Figures contained in Appendix B.

5. SUBSURFACE CONDITIONS

Details of the encountered soil and rock stratigraphy are presented on the Record of Borehole Sheets in Appendix A and the Borehole Locations and Soil Strata Drawing in Appendix F.

The stratigraphic boundaries shown on the borehole sheets and on the interpreted stratigraphic profile and cross-sections are inferred observations of drilling progress and from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole locations.

In general, the subsurface conditions at the site consist of a surficial gravelly sand layer overlying a layer of silty clay fill, which is in turn underlain by, in succession, deposits of silty clay, sandy silt, and sand and gravel, overlying granite bedrock.

A more detailed description of the subsurface conditions encountered in the boreholes is provided below.

5.1 Gravelly Sand Fill

A 0.2 to 0.8 m thick layer of brown gravelly sand fill was encountered from the ground surface in all of the boreholes between Elev. 368.7 and 369.6 m. The gravelly sand fill was described as containing trace amounts of silt and clay and organics as well as some asphalt fragments. The base of the gravelly sand fill was encountered between Elev. 369.0 and 368.4 m.

The measured SPT 'N' values within the gravelly sand fill ranged from 12 to 38 blows per 0.3 m penetration suggesting a compact to dense relative density. Natural moisture contents measured on samples of the fill ranged from 1 to 5%.

The results of a grain size analysis conducted on a selected sample of the gravelly sand fill is provided on the Record of Borehole sheets in Appendix A, and illustrated in Figure B1 of Appendix B. The results of the grain size analysis are also summarized in the table below.

Soil Particle	%
Gravel	23
Sand	66
Silt + Clay	11

5.2 Silty Clay Fill

A 0.1 to 0.4 m thick layer of brown silty clay fill was encountered underlying the gravelly sand fill in Boreholes DRY-01, DRY-02, and DRY-03. The silty clay fill was described as being sandy and gravelly to containing trace amounts of sand and gravel. The fill was also noted as containing trace organics. The upper boundary of the silty clay fill layer was encountered between Elev. 368.8 and 368.4 m in the boreholes. The base of the silty clay fill was encountered between Elev. 368.7 and 368.2 m.

The measured SPT 'N' values within the silty clay fill ranged from 6 to 14 blows per 0.3 m penetration suggesting a firm to stiff consistency. Natural moisture contents measured on samples of the silty clay fill ranged from 20 to 28%.

The results of a grain size analysis conducted on a selected sample of the silty clay fill is provided on the Record of Borehole sheets in Appendix A, and illustrated in Figure B2 of Appendix B. The results of the grain size analysis are also summarized in the table below.

Soil Particle	%
Gravel	0
Sand	0
Silt	48
Clay	52

5.3 Silty Clay

A 3.5 to 5.8 m thick deposit of brown to grey silty clay was encountered underlying the silty clay fill in boreholes DRY-01, DRY-02, DRY-03, and below the gravelly sand fill in Borehole DRY-04. Trace organics were encountered within the deposit in Boreholes DRY-01 and DRY-04. The upper boundary of the deposit was encountered between Elev. 369.0 and 368.2 m. The base of the deposit was encountered between Elev. 364.8 and 362.9 m.

The measured SPT 'N' values within the silty clay ranged from 6 to 23 blows per 0.3 m penetration, indicating a firm to very stiff consistency. In general, the 'N' values ranged from 7 to 13. The natural water moisture content measured on samples of the silty clay ranged from 23 to 36%.

The results of grain size analyses conducted on selected samples silty clay are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figures B3 and B4 in Appendix B. The results of the grain size analyses are also summarized in the table below.

Soil Particle	%
Gravel	0
Sand	0
Silt	46 to 84
Clay	16 to 54

Atterberg limits testing carried out on four samples of the silty clay measured plastic limits of 17 to 21%, liquid limits of 27 to 48%, and corresponding plasticity indices of 10 to 27%. The results, which are plotted on Figure B7 of Appendix B, indicate that the deposit consists of low to medium plasticity silty clay.

The results of an Oedometer (one-dimensional consolidation) test carried out on a sample of the silty clay are summarized in Table 5.1 below. The test was performed by TBT Engineering, of Thunder Bay, Ontario. The test results are graphically presented in Appendix B following the grain size distribution and plasticity charts.

Table 5.1: Oedometer Test Results

Borehole	DRY-03
Sample No.	TW1
Depth (m)	2.7
Elevation (m)	366.9
Soil Type	Silty Clay
Clay Content (%)	51
Moisture Content (%)	31.4
Liquid Limit (%)	23
Plasticity Index (%)	18
γ_b - Bulk Unit Weight (kN/m ³)	17.7
G_s - Specific Gravity	2.80
e_o - Initial Void Ratio	1.033
P'_0 - In situ effective vertical stress (kPa)	48
P'_c - Preconsolidation Pressure (kPa)	350
OCR - Overconsolidation Ratio	7.3
C_{ce} - Compression Ratio	0.126
C_{re} - Recompression Ratio	0.011
C_v - Coefficient of Consolidation in NC range (m ² /yr)	0.4 – 2.7
C_{vr} - Coefficient of Consolidation in OC range (m ² /yr)	2 - 16

5.4 Silty Sand to Sandy Silt

A 3.3 to 4.9 m thick deposit of grey silty sand to sandy silt was encountered underlying the silty clay deposit in all of the boreholes. The sandy silt contained trace amounts of clay but was noted to contain occasional thin lenses of silty clay. The upper boundary of the deposit was encountered between Elev. 364.8 and 362.9 m. The base of the deposit was encountered between Elev. 361.0 and 359.4 m.

The measured SPT 'N' values within the silty sand to sandy silt ranged from 12 to 26 blows per 0.3 m penetration suggesting a compact relative density. The natural water moisture content measured on samples of the silty sand to sandy silt ranged from 3 to 23%.

The results of grain size analyses conducted on samples of the silty sand to sandy silt are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figure B5 of Appendix B. The results of the grain size analyses are also summarized in the table below.

Soil Particle	%
Gravel	0
Sand	0 to 22
Silt	72 to 84
Clay	6 to 16

5.5 Sand and Gravel

A 0.4 m thick deposit of sand and gravel was encountered underlying the silty sand to sandy silt deposit in Borehole DRY-04. The upper boundary of the deposit was encountered at Elev. 359.9 m and the lower boundary was at Elev. 359.5 m.

An SPT 'N' values of 50 blows per 0.075 m penetration was measured within the sand and gravel, indicating a very dense relative density. The natural water moisture content measured on a sample of the sand and gravel was 19%.

The results of a grain size analysis conducted on a sample of the sand and gravel are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figure B6 of Appendix B. The results of the grain size analysis are also summarized in the table below.

Soil Particle	%
Gravel	45
Sand	50
Silt + Clay	5

5.6 Granite Bedrock

Granite bedrock was encountered underling the sandy silt deposit in Borehole DRY-01 and underlying the sand and gravel deposit in DRY-04. Boreholes DRY-02 and DRY-03 were also likely terminated on refusal on probable bedrock although rock coring was not undertaken in those boreholes.

The granite bedrock is generally grey with white, pink, and black specs. The rock was described as lightly weathered, with discolouration visible on the joint surfaces. Total Core Recovery (TCR) in the core runs ranged from 92% to 100%. The Rock Quality Designation (RQD) determined from the cores recovered ranged from 36 to 100%, indicating poor to excellent rock quality.

The table below summarizes the depth to bedrock and the bedrock surface elevations encountered in the boreholes.

Table 5.1 – Depth and Elevation of Top of Bedrock

Location	Borehole	Depth to Bedrock Below Existing Ground Surface (m)	Elevation of Top of Bedrock (m)
SW Building Corner	DRY-01	8.8	360.1
NW Building Corner	DRY-02	7.7*	361.0
SE Building Corner	DRY-03	10.2*	359.4
NE Building Corner	DRY-04	9.7	359.5

*probable bedrock

5.7 Water Levels

Water levels were observed in the boreholes during and upon completion of drilling. A standpipe piezometer was installed in Borehole DRY-02 to monitor the groundwater level at the site. The following table summarizes the water levels measured in the open boreholes and piezometer.

Table 5.2 – Water Level Measurements

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
DRY-01	June 12, 2017	Dry	Dry	In open borehole
DRY-02	June 13, 2017	Dry	Dry	In piezometer
DRY-03	June 13, 2017	Dry	Dry	In open borehole
DRY-04	June 13, 2017	Dry	Dry	In open borehole

As per the above table, groundwater was not observed within the open boreholes or in the piezometer. However, these are short term readings and seasonal fluctuations in the groundwater table are expected. In particular, the groundwater table may be higher during spring snowmelt or after heavy precipitation.

6. MISCELLANEOUS

The boreholes locations were surveyed by Deltasurvey Inc. following completion of drilling.

RPM Drilling of Thunder Bay, Ontario supplied and operated the drilling, sampling and in-situ testing equipment for the field investigation. The field investigation was supervised on a full time basis by Mr. Simon Paxton of Thurber. Overall supervision of the field program was provided by Mr. Geoff Lay, P.Eng., of Thurber.

Routine laboratory testing was carried out at Thurber's geotechnical laboratory in Oakville, Ontario. Interpretation of the field data and preparation of this report was carried out by Mr. Geoff Lay, P.Eng. The report was reviewed by Mr. Keli Shi, P.Eng., and Dr. P.K. Chatterji, P.Eng, a Designated Principal Contact for MTO Foundations Projects.

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Geotechnical Engineer



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PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7. INTRODUCTION

This report presents interpretation of the geotechnical data in the factual report and provides foundation design recommendations to assist the design team to select and design a suitable foundation system for the proposed salt and sand storage facility.

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

The discussion and recommendations presented in this report are based on our understanding of the project and the factual data obtained during the subsurface investigation.

8. GENERAL

The proposed salt/sand storage building will consist of reinforced concrete foundation walls and a steel frame superstructure and will be approximately 18.3 x 24.4 m in dimension. A typical General Arrangement drawing for the proposed sand/salt storage structure provided to Thurber by MTO is attached in Appendix G.

9. BUILDING SUBGRADE PREPARATION

The typical General Arrangement drawing indicates that the surface of the interior of the facility will consist of 50 mm of asphalt pavement overlying 400 mm of Granular A. The top of the pavement will be approximately at the existing ground surface.

Any topsoil, buried topsoil, organics, soft or deleterious material should be stripped from the site surface. The exposed subgrade should be proofrolled to detect any potential soft areas. Where soft areas are detected, these areas should be subexcavated and replaced with well-compacted Granular "A" satisfying the requirements of OPSS.PROV 1010 (*Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material*). The final subgrade surface should be uniformly compacted to 98% of Standard Proctor Maximum Dry Density (SPMDD).

10. FOUNDATION RECOMMENDATIONS

The following alternative foundation types were considered for the sand and salt storage building:

- Strip footings founded below the frost depth on native undisturbed silty clay
- Strip footings placed near the surface on existing gravelly sand fill or native silty clay

While both foundation options are considered feasible, supporting the structure on strip footings founded below the frost depth in the firm to very stiff silty clay will mitigate the risk of frost movement of the footings.

Alternatively, the frame structure could be supported on strip footings placed at a minimum depth of 0.5 m below the ground surface on the compact to dense gravelly sand fill or native silty clay. If frost protection is not provided, frost-related footing movements should be expected.

10.1 Strip Footings Founded Below the Frost Depth on Silty Clay

The highest permitted founding elevations for footings founded below the frost depth on firm to very stiff silty clay are given in Table 10.1. Frost depth at the site is 2.5 m.

Table 10.1 – Highest Permitted Founding Elevations

Location	Borehole	Min. Depth (m)	Highest Elevation (m)
SW Building Corner	DRY-01	2.5	366.4
NW Building Corner	DRY-02	2.5	366.2
SE Building Corner	DRY-03	2.5	367.1
NE Building Corner	DRY-04	2.5	366.7

Strip footings founded on the firm to very stiff silty clay below the above noted elevations should be designed using the following resistance values, assuming a minimum 1 m wide footing subjected to vertical concentric loading:

Factored Geotechnical Resistance at ULS = 200 kPa

Factored Geotechnical Resistance at SLS = 125 kPa

The geotechnical resistance at SLS is based on an estimated settlement not exceeding 25 mm. This settlement should be essentially complete by the end of construction.

The resistance values are for vertical, concentric loads. Where eccentric or inclined loads are applied, the resistance values used in design must be reduced in accordance with the CHBDC Clause 6.7.3 and Clause 6.7.4.

The lateral resistance developed along the base of concrete footings founded on the firm to very stiff silty clay may be computed using an ultimate friction coefficient of 0.35.

The footing subgrade should be inspected by a geotechnical engineer following excavation, in accordance with OPSS 902 (*Construction Specification for Excavating and Backfilling – Structures*) to confirm that the soil conditions at the founding level are consistent with the design assumptions and that the base has been adequately cleaned of disturbed soil. The footing bases should be kept free of water and a 50 mm skim slab should be placed over the founding surface if structural concrete cannot be placed within 24 hours of excavation. Subgrade preparation should be carried out in the dry.

Where subexcavation is required to remove unsuitable material from below the design founding level, the founding surface should be re-established using engineered fill or concrete of the same class as the footing. The subexcavation should be stepped down gradually at slope not steeper than 1H:1V and no individual step should be greater than 200 mm. The engineered fill must consist of OPSS Granular “A” placed in 150 mm lifts and compacted to 100% of SPMDD.

10.2 Strip Footings on Existing Gravelly Sand Fill or Native Silty Clay

Consideration could be given to supporting the building on strip footings founded near the ground surface on the gravelly sand fill or native silty clay. The footings must not be placed on any layers of buried topsoil. As indicated earlier, if no frost protection is provided, some vertical movement of the footing due to frost action should be expected. If this is not acceptable, then the footing must be insulated from frost action by installing a minimum 50 mm thick layer of extruded polystyrene insulation over the top of the footing, extending a minimum distance of 2.5 m away from the outer edge of the footing.

Strip footings founded a minimum 0.5 m below the ground surface should be designed using the following resistance values, assuming a minimum 1 m wide footing subjected to vertical concentric loading:

Factored Geotechnical Resistance at ULS =	150 kPa
Geotechnical Resistance at SLS =	100 kPa

The geotechnical resistance at SLS is based on an estimated settlement not exceeding 25 mm.

The resistance values are for vertical, concentric loads. Where eccentric or inclined loads are applied, the resistance values used in design must be reduced in accordance with the CHBDC Clause 6.7.3 and Clause 6.7.4.

The lateral resistance developed along the base of concrete footings placed on the compact to dense gravelly sand fill or native silty clay may be computed using an ultimate friction coefficient of 0.35.

11. SLOPE STABILITY AND FOUNDATION SETTLEMENT

The proposed facility will store sand/salt stockpiles to an estimated height in excess of 8 m. Foundation stability and settlement associated with the stockpiling of the sand/salt are addressed in the following sections.

11.1 Stability

Global stability analyses have been completed for the stockpiles using the commercially available program *Slope/w* from GEO-SLOPE, to check that the target minimum factor of safety is achieved against foundation instability.

A target minimum factor of safety of 1.3 is normally used for design of slopes under static conditions. This factor of safety is considered appropriate for the stockpiles at the site.

Appendix E presents the results of the slope stability analysis. It is assumed that the sand/salt will be stockpiled at stable slopes inclined at 34 degrees from the horizontal or approximately 1.5H:1V. Two stockpiling scenarios were assessed as follows:

- 1) Sand/salt stockpile sloping up from the base of concrete walls on the finished grade;
- 2) Sand/salt piled against the 2.5 m high concrete stem wall of the foundation footing.

The analyses indicate that the sand/salt stockpile will be stable with a factor of safety greater than 1.3 for scenario 1 as shown on Figure E1. For scenario 2, to achieve a satisfactory factor of safety against slope instability of 1.3, the foundation footing must be embedded a minimum 0.5 m below the finished grade as demonstrated on Figures E2 to E4.

11.2 Settlement

Settlement analyses has been carried out to evaluate the effect of the placement of sand/ salt stockpile on the foundation soils using the commercially available computer program *Settle-3D* from Rocscience. The settlement has been evaluated using estimated elastic deformation moduli for the cohesionless soils and consolidation parameters for the cohesive silty clay deposit, which were based on Oedometer testing.

The analyses indicate that the placement of the stockpile will result in about 10 mm of immediate settlement in the gravelly sand fill. The ground will subsequently experience an additional 30 to 40 mm of settlement associated with consolidation of the cohesive silty clay. These settlements were estimated under the full height of sand/salt stockpile. It is expected that most of these consolidation settlements will be completed within 6 months assuming the full height of the stockpile. It is estimated that up to 25 mm of total settlement will occur at the foundation footing locations.

12. BACKFILL

Excavation for footing construction should be backfilled with free-draining granular materials such as per OPSS.PROV 1010 Granular A or Granular B Type II. Care should be taken to maintain backfill on both sides of the wall at approximately same level to minimize unbalanced lateral forces. Care should be taken to not “over-compact” adjacent to the walls in order to not impose excessive lateral stresses. Compaction equipment to be used adjacent to the foundation walls should be restricted in accordance with OPSS.PROV 501 (*Construction Specification for Compacting*).

13. LATERAL EARTH PRESSURE

The lateral earth pressures acting on the foundation wall from the backfill or stockpiled sand/salt may be assumed to be triangularly distributed. For a fully drained condition, the lateral pressure should be computed in accordance with the CHBDC 2014 but generally are given by the following equation:

$$p_h = K (\gamma h + q)$$

Where: p_h = horizontal pressure on the wall at depth h (kPa)

K = coefficient of lateral earth pressure (see table below)

γ = unit weight of retained sand/salt (see table below)

h = depth below top of stockpile where pressure is computed (m)

q = value of any surcharge (kPa)

Recommended values of earth pressure coefficients for backfill and sand/salt stockpile are shown in the table below.

Loading Condition	OPSS Granular A or Granular B Type II $\phi = 35^\circ$; $\gamma = 22.8 \text{ kN/m}^3$		OPSS Granular B Type I (modified) $\phi = 32^\circ$; $\gamma = 21.2 \text{ kN/m}^3$		Sand/Salt Stockpile $\phi = 32^\circ$; $\gamma = 16 \text{ kN/m}^3$	
	Horizontal Backfill	Sloping Backfill (2H:1V)	Horizontal Backfill	Sloping Backfill (2H:1V)	Horizontal Backfill	Sloping Backfill (1.5H:1V)
Active (Unrestrained Wall)	0.27	0.40	0.31	0.48	0.31	0.69
At-rest (Restrained Wall)	0.43	0.62	0.47	0.70	0.47	0.73
Passive	3.7	-	3.3	-	3.3	-

For non-yielding structures, at-rest horizontal earth pressures should be used for design. Active pressures should be used for any unrestrained wall.

14. EXCAVATION

All excavations must be carried out in accordance with the requirements of the Occupational Health and Safety Act (OHSA). For the purposes of the OHSA, the gravelly sand fill above the water level, silty clay fill and native silty clay may be classed as Type 3 soil. The gravelly sand fill should be classed as Type 4 soil below the water table. Temporary shallow excavation may be

formed unsupported with side slopes no steeper than 1H:1V. Flatter slopes may be required at locations where soils are less competent or where water seepage affects surficial stability.

The excavation and backfilling for foundation construction must be carried out in accordance with OPSS 902.

The selection of the method of excavating soils is the responsibility of the contractor and must be based on his equipment, experience and interpretation of the site conditions.

Excavations should be inspected regularly for evidence of instability if they have been left open for extended period of time and following heavy rainfall. If required, remedial actions must be taken to ensure the stability of the excavation and the safety of workers.

15. GROUNDWATER CONTROL

The groundwater table was not observed in the open boreholes or in the standpipe piezometer with screen installed in the cohesionless silty sand underlying the native silty clay. Therefore, if the footings are founded within the silty clay, the excavations are not expected to extend below the groundwater table and difficulties associated with groundwater control are not expected during construction. Any groundwater seepage into the excavation which does occur may be removed using perimeter ditches and filtered sump pumping.

The design of an effective dewatering system is the responsibility of the contractor.

16. CORROSION POTENTIAL

All metal structural elements and concrete foundations will be exposed to chlorides in the de-icing salt and must be provided with appropriate protection measures against the high chloride corrosion potential.

17. CONSTRUCTION CONCERNS

Care must be exercised during excavation to minimize disturbance of the founding subgrade. The exposed subgrade soils should be inspected, approved and protected from disturbance as soon as practicable.

Field inspection during construction is recommended to confirm the subgrade conditions. Accordingly, items such as building and pavement subgrade condition, backfilling methods, compaction of granular material should be inspected and tested by geotechnical personnel.

Groundwater seepage into the open excavations for footing construction is not anticipated over the course of construction; however, should groundwater seepage occur, it is anticipated that perimeter ditches and filtered sump pumping will be adequate for the control of groundwater prior to concrete placement.

18. CLOSURE

Engineering analysis and preparation of the foundation design report was carried out by Mr. Geoff Lay, P.Eng. The report was reviewed by Mr. Keli Shi, P.Eng., and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.



Geoff Lay, P.Eng.
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Review Principal, Designated MTO Contact



Appendix A

Record of Borehole Sheets

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
 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

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

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

<u>TERMS</u>		Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
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 percentage 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			

METRIC

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			20 40 60 80 100	20 40 60 80 100	W P W W L			
368.9	GROUND SURFACE											
0.0	Gravelly SAND , trace silt and organics, some asphalt fragments		1	SS	14							
0.3	Compact Brown Moist (FILL)		2	SS	14							
0.7	Silty CLAY , trace sand and gravel, organics Stiff Brown Moist (FILL)		3	SS	10							
	Silty CLAY , trace organics Firm to Very Stiff Brown to Grey Moist		4	SS	7							0 0 58 42
	Becoming sandy		5	SS	7							
			6	SS	9							0 0 74 26
			7	SS	14							
363.4	Sandy SILT , trace clay, containing lenses of silty clay Compact Grey Moist		8	SS	18							0 22 72 6
5.5	Wet		9	SS	12							
360.1	GRANITE BEDROCK , slightly weathered, grey with white pink and black specs		10	SS	50/0.0							RUN #1 TCR=100% SCR=75% RQD=62%
8.8			1	RUN								

+³, ×³: Numbers refer to Sensitivity

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RECORD OF BOREHOLE No DRY-01

2 OF 2

METRIC

GWP# 6054-16-00 LOCATION SW Building Corner, NAD 83-16 N 5 517 214.7 E 315 581.7 ORIGINATED BY SMP
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2017.06.12 - 2017.06.12 CHECKED BY GRL

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									
	Continued From Previous Page							20	40	60	80	100					
			2	RUN			358										RUN #2 TCR=100% SCR=36% RQD=36%
			3	RUN													RUN #3 TCR=100% SCR=80% RQD=68%
357.0																	
11.9	END OF BOREHOLE AT 11.9m. BOREHOLE DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No DRY-02

1 OF 1

METRIC

GWP# 6054-16-00 LOCATION NW Building Corner, NAD 83-16 N 5 517 237.6 E 315 583.9 ORIGINATED BY SMP
 HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.13 - 2017.06.13 CHECKED BY GRL

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					
								○ UNCONFINED	+	FIELD VANE							
								● QUICK TRIAXIAL	×	LAB VANE							
368.7	GROUND SURFACE							20	40	60	80	100					
0.0	Gravelly SAND , trace silt																
368.4	Compact		1	SS	12									○			0 0 48 52
368.2	Brown													○			
0.5	Moist (FILL)																
	Silty CLAY , trace organics		2	SS	11									○			
	Stiff																
	Brown		3	SS	10									○			0 0 57 43
	Moist (FILL)																
	Silty CLAY																
	Stiff to Very Stiff		1	TW													
	Brown																
	Moist																
	Sandy		4	SS	19									○			0 0 84 16
			5	SS	15									○			
364.7			6	SS	16									○			
4.0	Silty SAND																
	Compact		7	SS	17									○			
	Grey																
	Moist																
			8	SS	16									○			
361.0			9	SS	50/									○			
7.7	END OF BOREHOLE AT 7.7m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE DRY UPON COMPLETION OF DRILLING. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.				0.075												

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

RECORD OF BOREHOLE No DRY-03

1 OF 2

METRIC

GWP# 6054-16-00 LOCATION SE Building Corner, NAD 83-16 N 5 517 213.7 E 315 599.6 ORIGINATED BY SMP
 HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.13 - 2017.06.13 CHECKED BY GRL

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					
369.6	GROUND SURFACE							20 40 60 80 100		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
0.0	Gravelly SAND , trace silt, trace clay Dense Brown Moist (FILL)		1	SS	38		369						23 66 11 (SI+CL)
368.8													
368.8	Silty CLAY , sandy, gravelly Firm Brown Moist (FILL)		2	SS	6								
0.9													
	Silty CLAY Firm to Very Stiff Brown to Grey Moist		3	SS	7		368						0 0 46 54
			4	SS	10								
			1	TW			367						
			5	SS	7								
							366						
			6	SS	8		365						
							364						
			7	SS	23		363						
362.9	Sandy SILT Compact Grey Moist to Wet												
6.7			8	SS	20		362						0 19 72 9
							361						
			9	SS	24		360						

Continued Next Page

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

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RECORD OF BOREHOLE No DRY-03

2 OF 2

METRIC

GWP# 6054-16-00 LOCATION SE Building Corner, NAD 83-16 N 5 517 213.7 E 315 599.6 ORIGINATED BY SMP
 HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.13 - 2017.06.13 CHECKED BY GRL

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									
	Continued From Previous Page																
359.4																	
10.2	END OF BOREHOLE AT 10.2m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No DRY-04

1 OF 2

METRIC

GWP# 6054-16-00 LOCATION NE Building Corner, NAD 83-16 N 5 517 237.1 E 315 600.7 ORIGINATED BY SMP
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2017.06.13 - 2017.06.13 CHECKED BY GRL

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						WATER CONTENT (%) w _p w w _L						
369.2	GROUND SURFACE							20	40	60	80	100								
0.0																				
0.2	Gravelly SAND , trace silt Loose Brown Moist (FILL)		1	SS	6															
	Silty CLAY , trace organics, with black staining Firm to Very Stiff Brown to Grey Moist		2	SS	13															
			3	SS	13															
			4	SS	8															
			5	SS	8															
	Some sand lenses		6	SS	7															
			7	SS	8															
364.8																				
4.4	Sandy SILT , containing lenses of silty clay from 4.6m to 6.2m Compact Grey Moist to Wet		8	SS	16															
			9	SS	26															
			10	SS	22															

Continued Next Page

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

METRIC

[illegible]



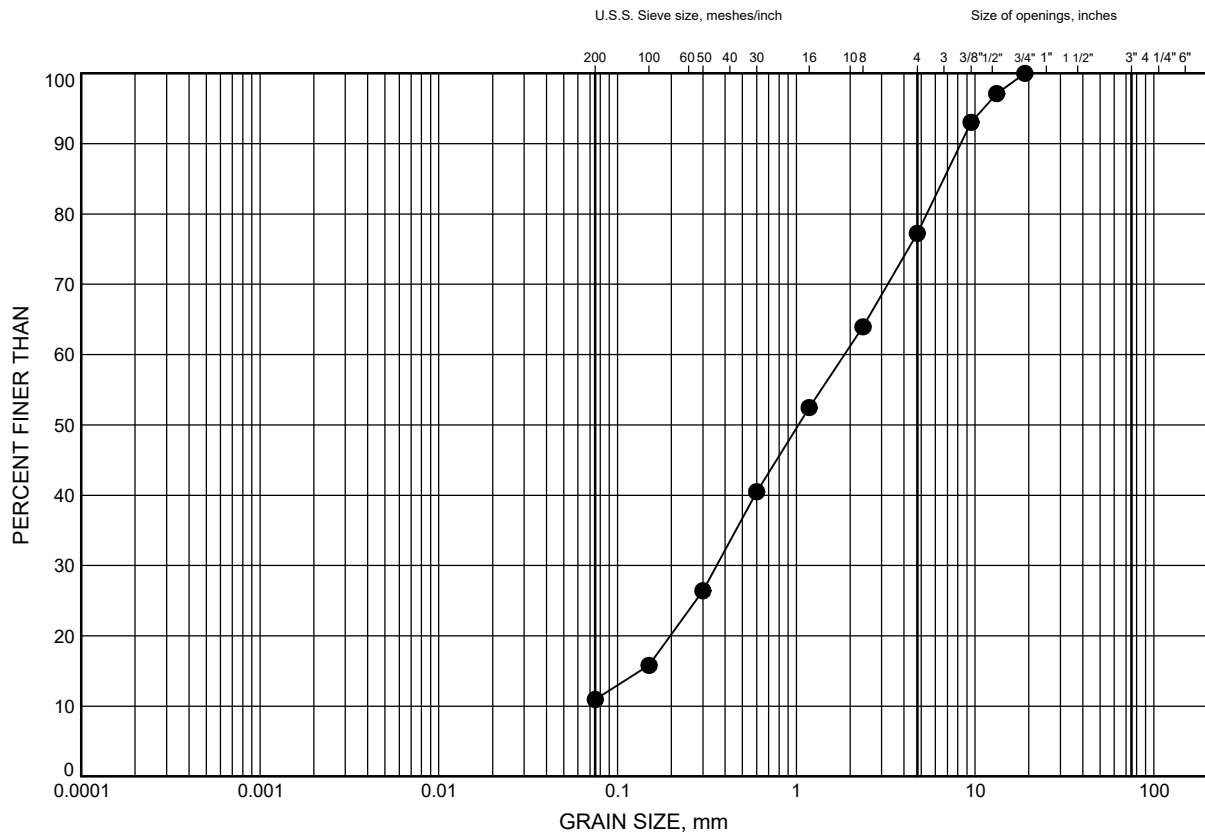
Appendix B

Laboratory Test Results

GRAIN SIZE DISTRIBUTION

FIGURE B1

Gravelly SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DRY-03	0.3	369.3

Date August 2017
GWP# 6054-16-00

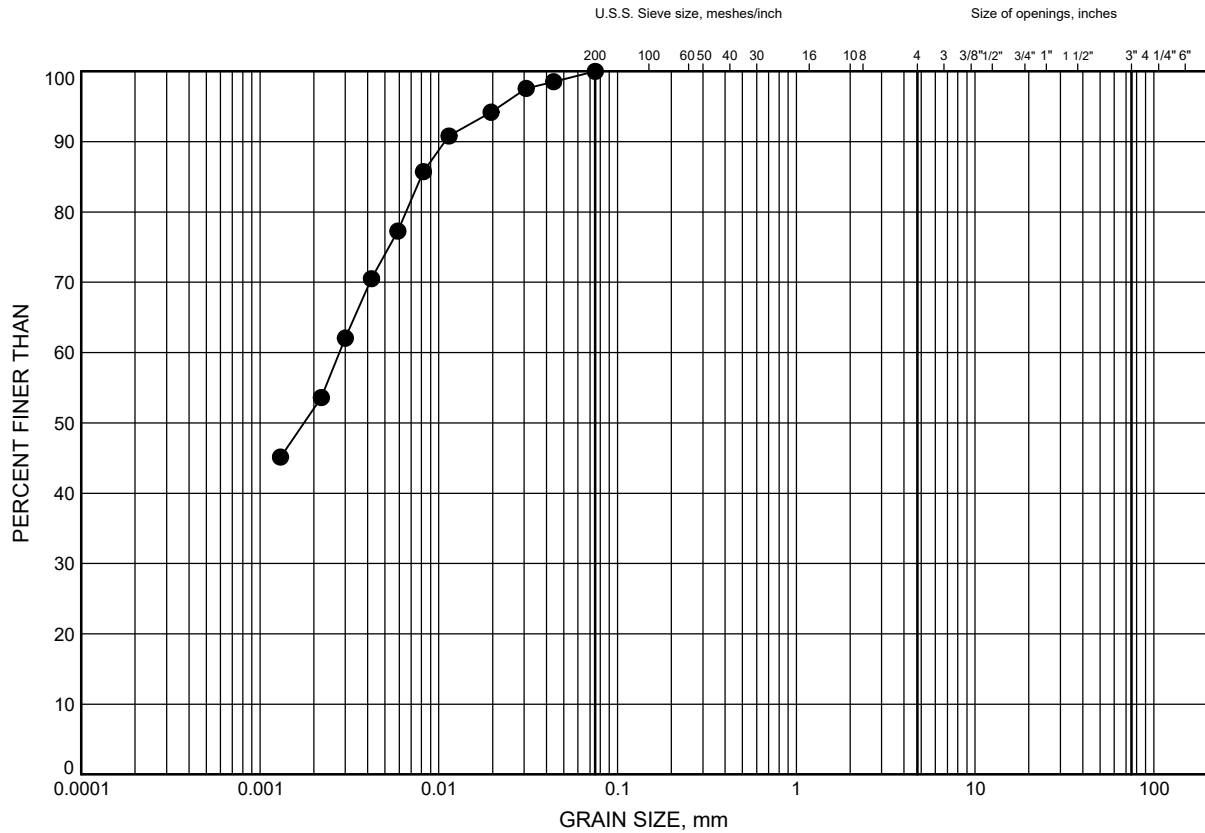


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Chkd. GRL

GRAIN SIZE DISTRIBUTION

FIGURE B2

Silty CLAY FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DRY-02	0.4	368.3

Date August 2017
GWP# 6054-16-00

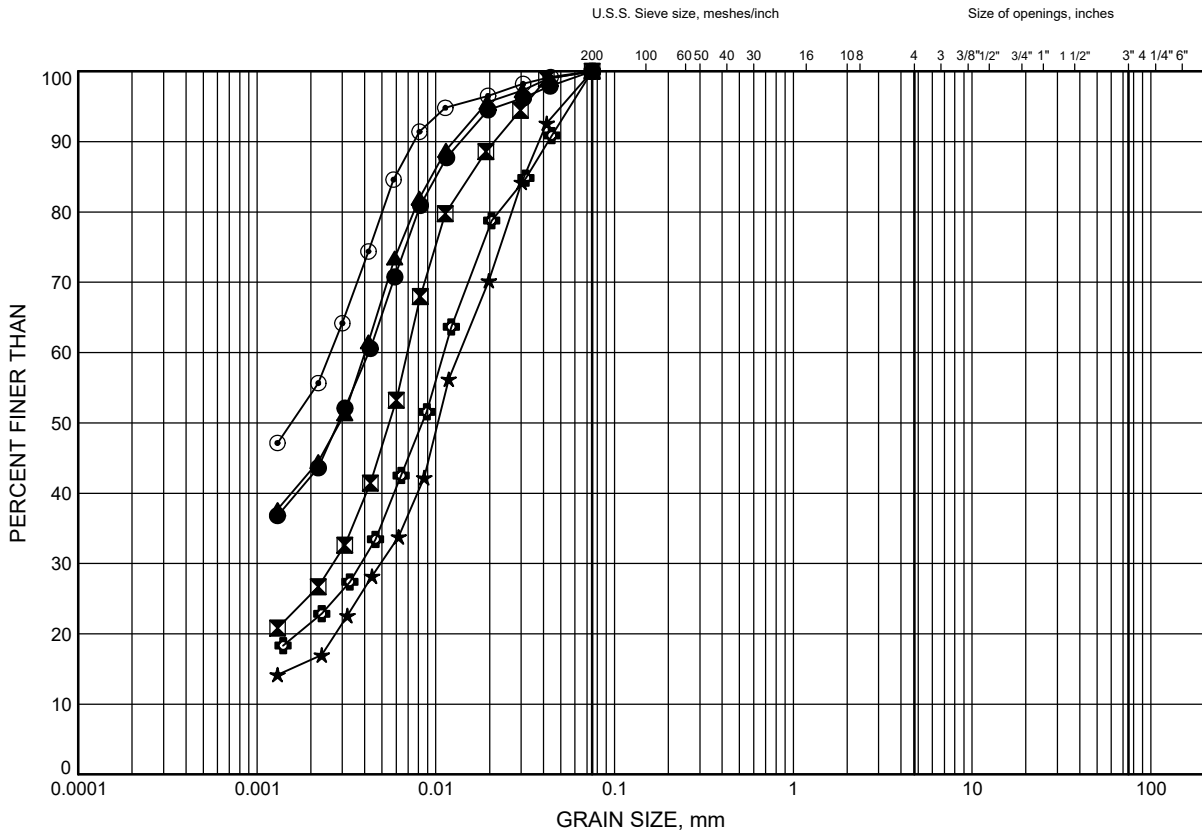


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GRAIN SIZE DISTRIBUTION

FIGURE B3

Silty CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DRY-01	2.4	366.5
⊠	DRY-01	4.0	364.9
▲	DRY-02	1.5	367.2
★	DRY-02	2.7	366.0
⊙	DRY-03	1.5	368.1
⊕	DRY-04	4.1	365.1

Date August 2017

GWP# 6054-16-00



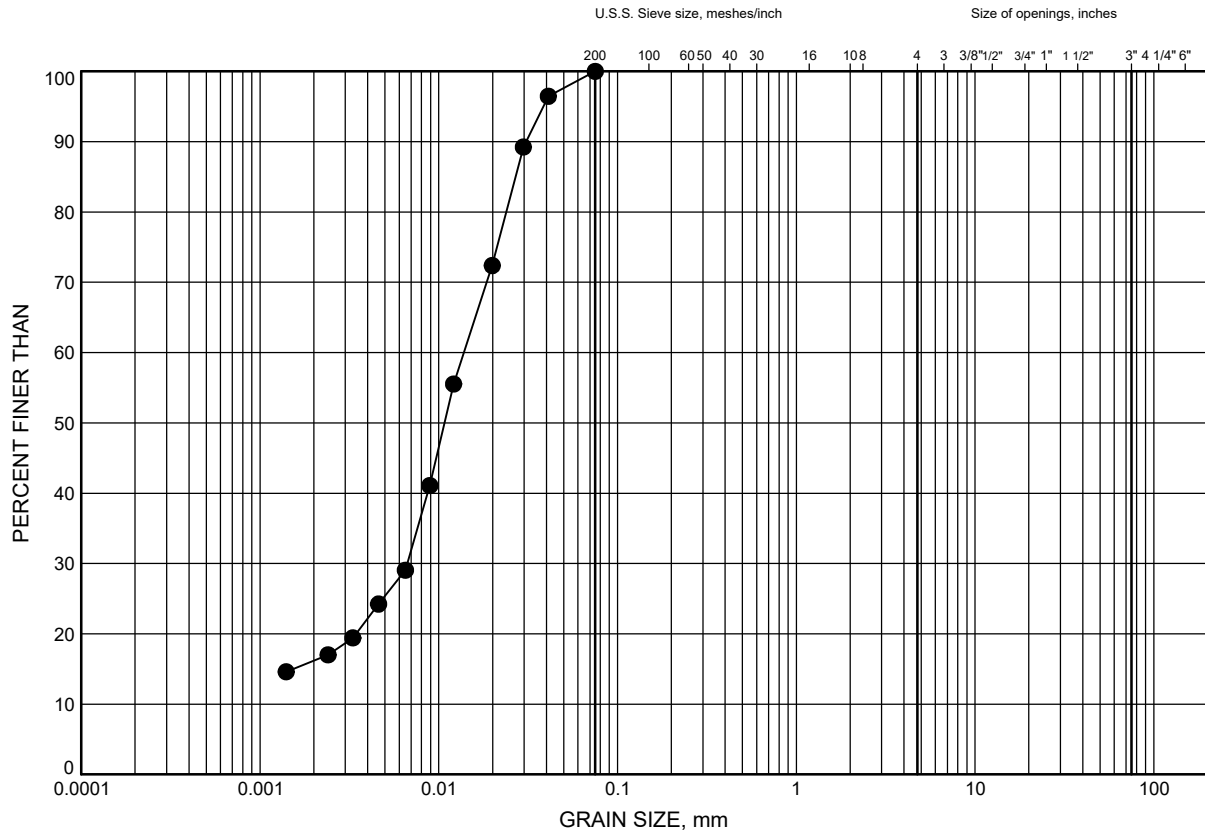
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GRAIN SIZE DISTRIBUTION

FIGURE B4

Silty CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DRY-04	4.6	364.6

Date August 2017
GWP# 6054-16-00

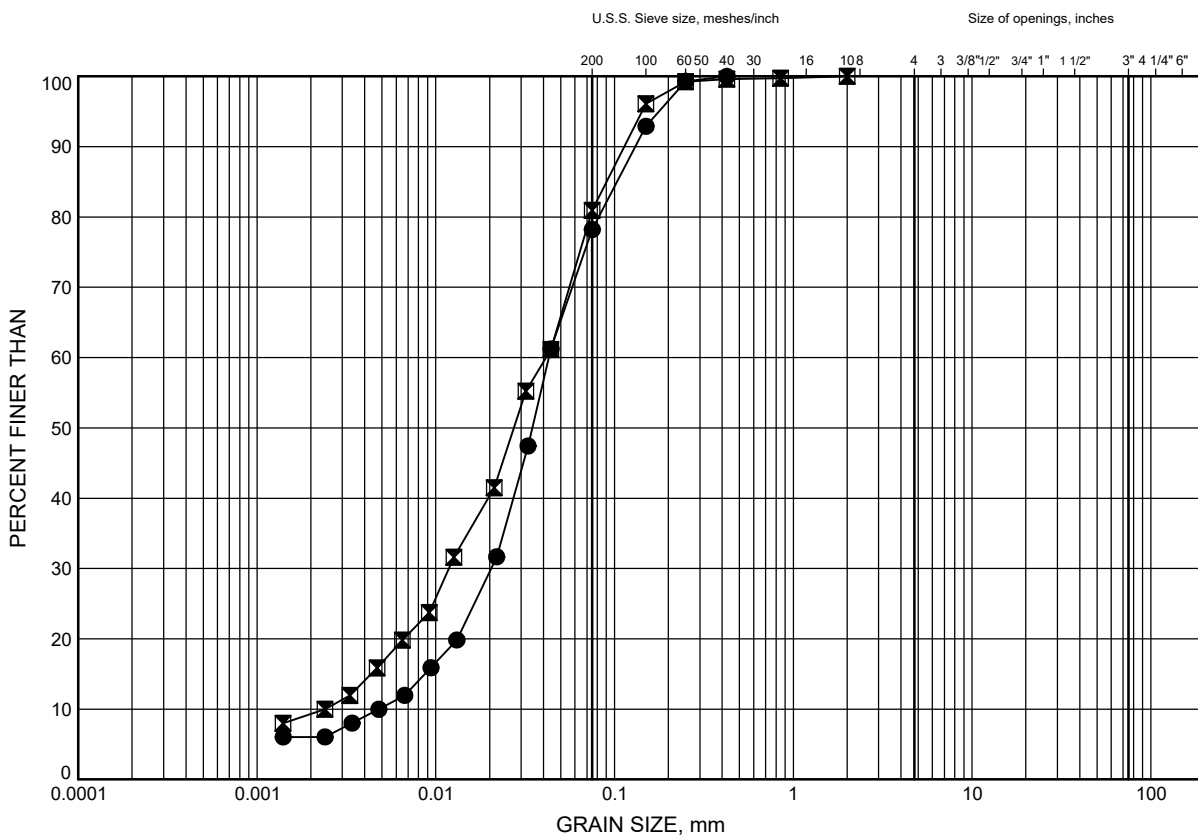


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GRAIN SIZE DISTRIBUTION

FIGURE B5

Silty SAND to Sandy SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DRY-01	6.4	362.5
⊠	DRY-03	7.9	361.7

Date August 2017

GWP# 6054-16-00



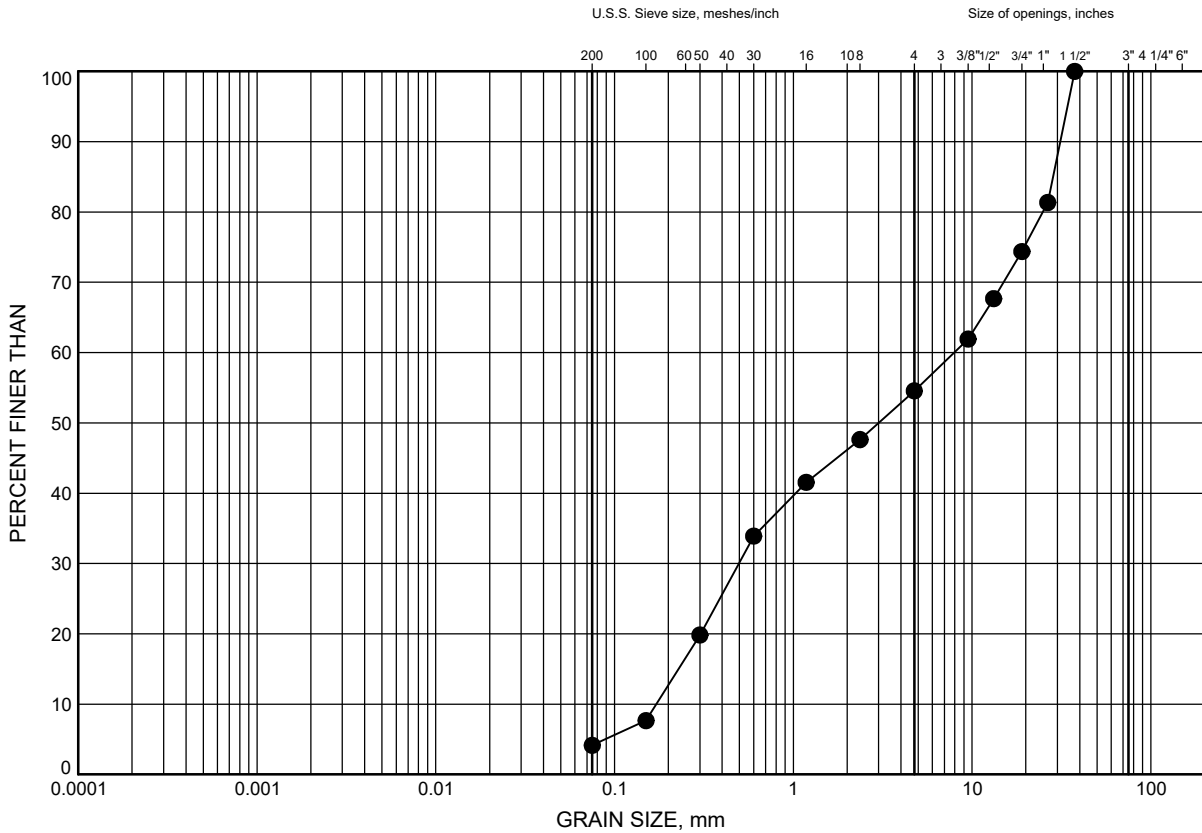
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GRAIN SIZE DISTRIBUTION

FIGURE B6

SAND & GRAVEL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DRY-04	9.5	359.7

Date August 2017
GWP# 6054-16-00

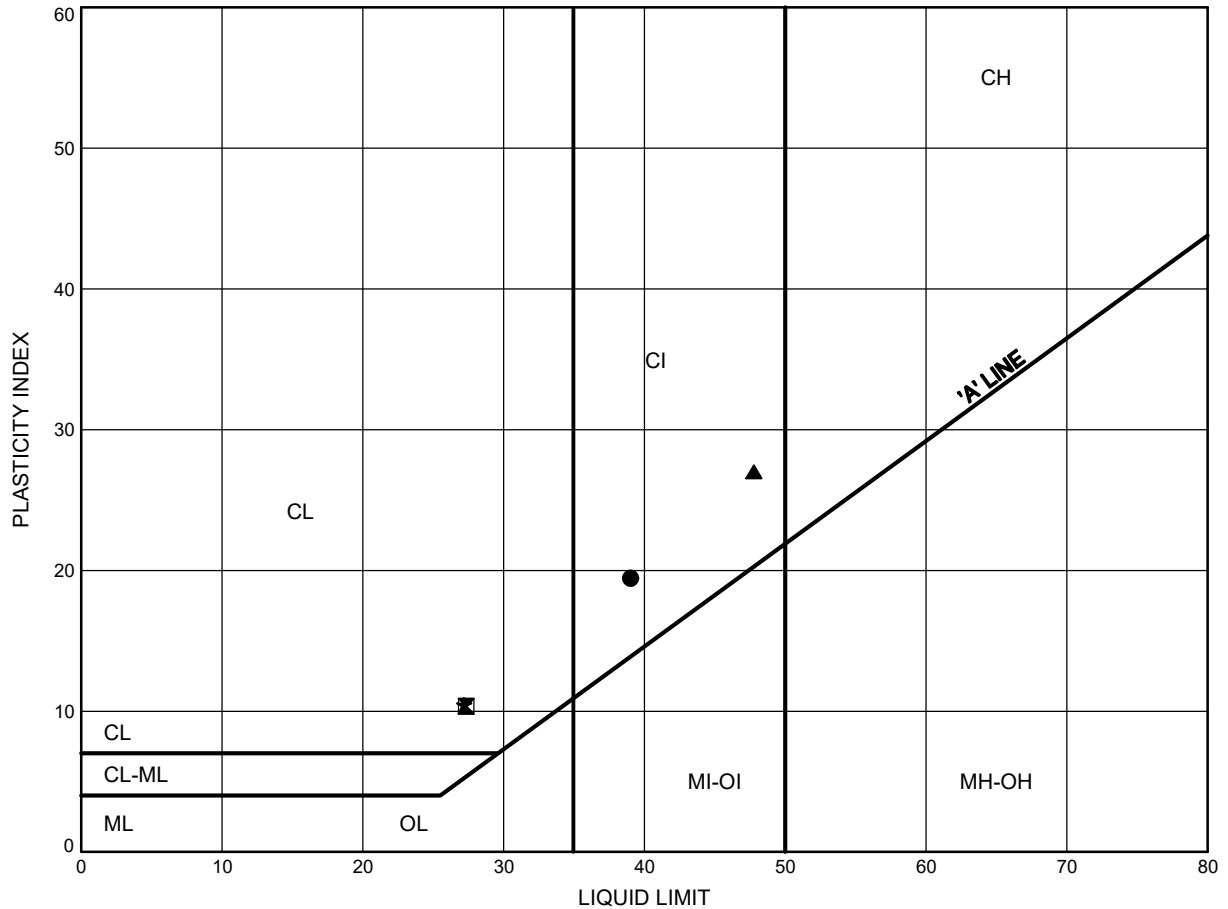


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ATTERBERG LIMITS TEST RESULTS

FIGURE B7

Silty CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DRY-01	2.4	366.5
⊠	DRY-01	4.0	364.9
▲	DRY-03	1.5	368.1
★	DRY-04	4.1	365.1

Date August 2017

GWP# 6054-16-00

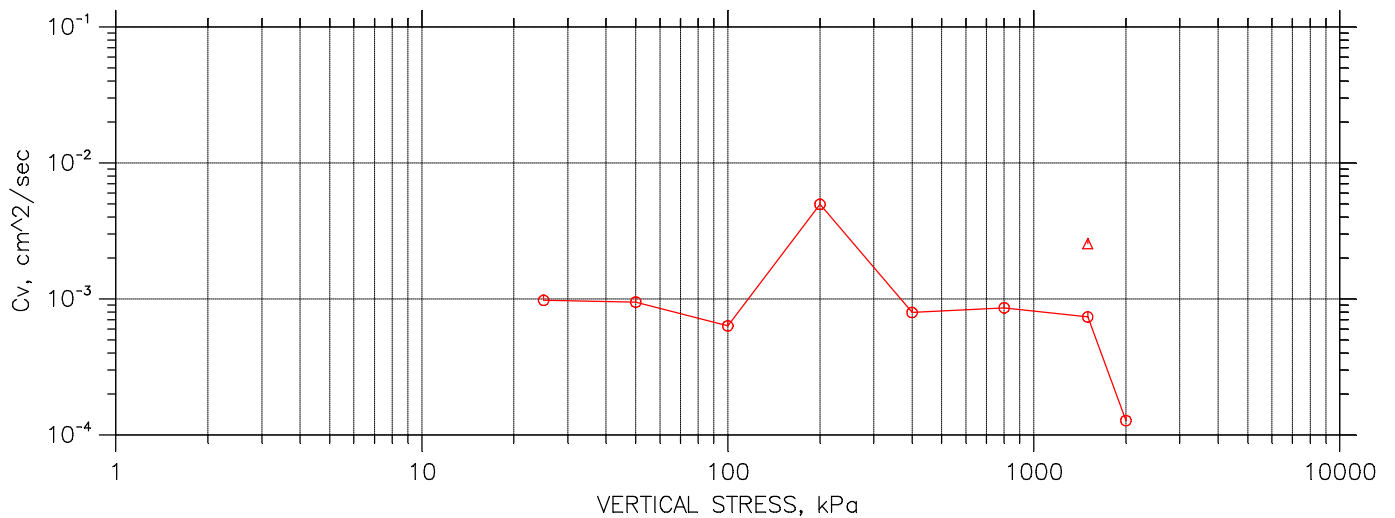
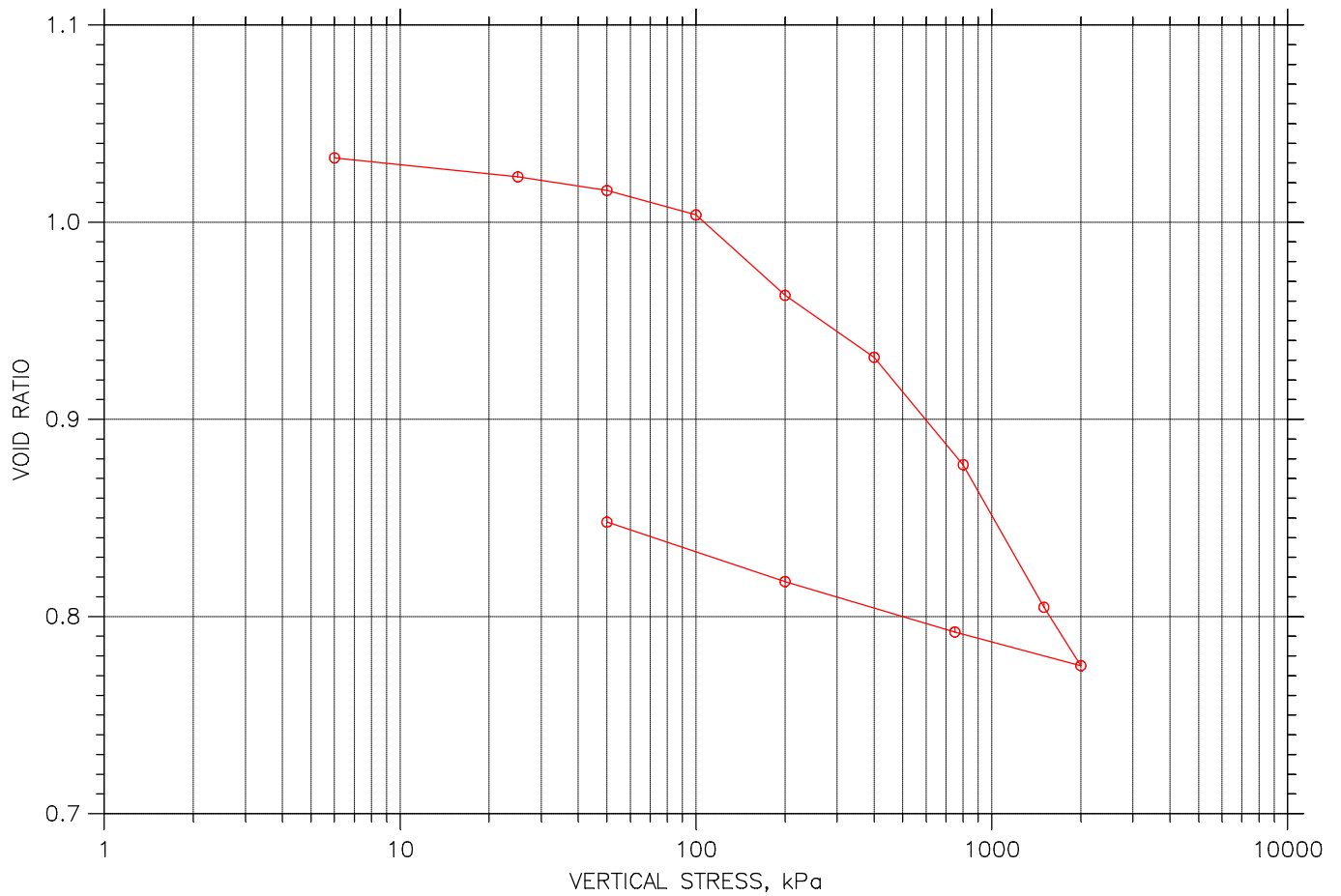



Prep'd AN

Chkd. GRL

CONSOLIDATION TEST DATA

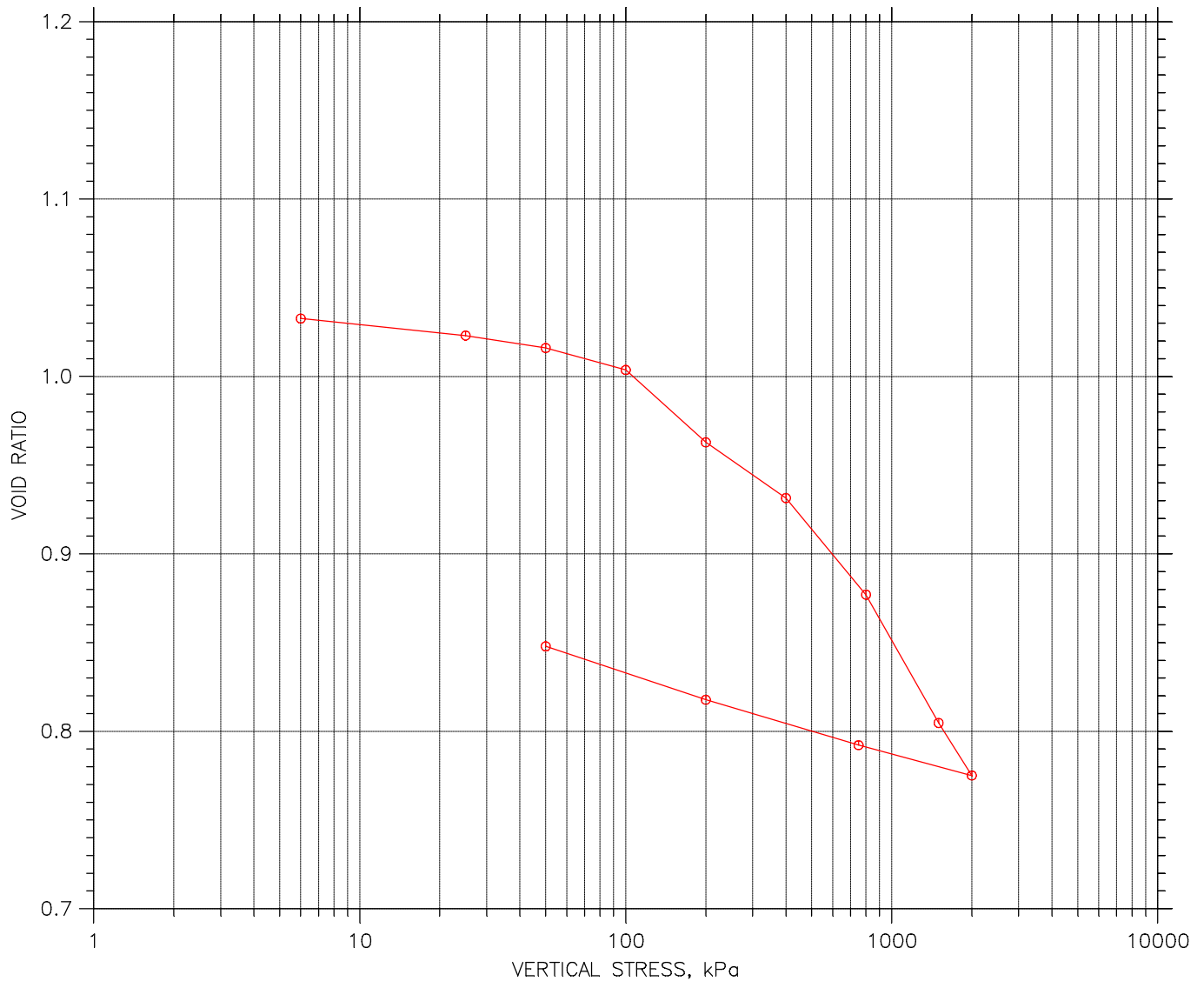
SUMMARY REPORT




	Project: MTO Patrol Yard	Location: Dryden ON	Project No.: 17-252
	Boring No.: ST6	Tested By: FV	Checked By: TF
	Sample No.: 17-469	Test Date: June 23,17	Depth: 8 - 10 ft
	Test No.: 3	Sample Type: TW	Elevation:
	Description: Clay, light grey		
	Remarks:		

CONSOLIDATION TEST DATA

SUMMARY REPORT



				Before Test	After Test
Overburden Pressure: 0 kPa				31.35	33.19
Preconsolidation Pressure: 0 kPa				13500	14860
Compression Index: 0				84.88	109.62
Diameter: 50.15 mm		Height: 18.9 mm		1.03	0.85
LL: 23	PL: 18	PI: 5	GS: 2.80		

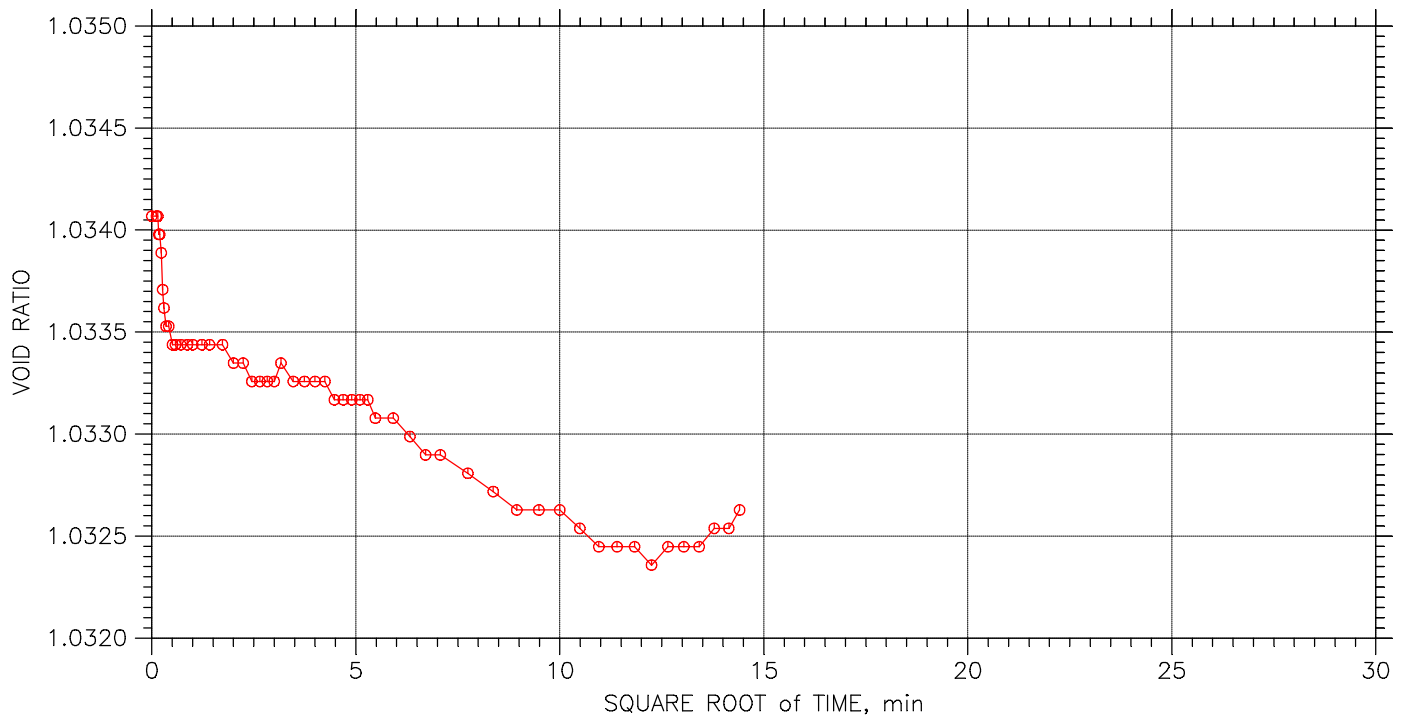
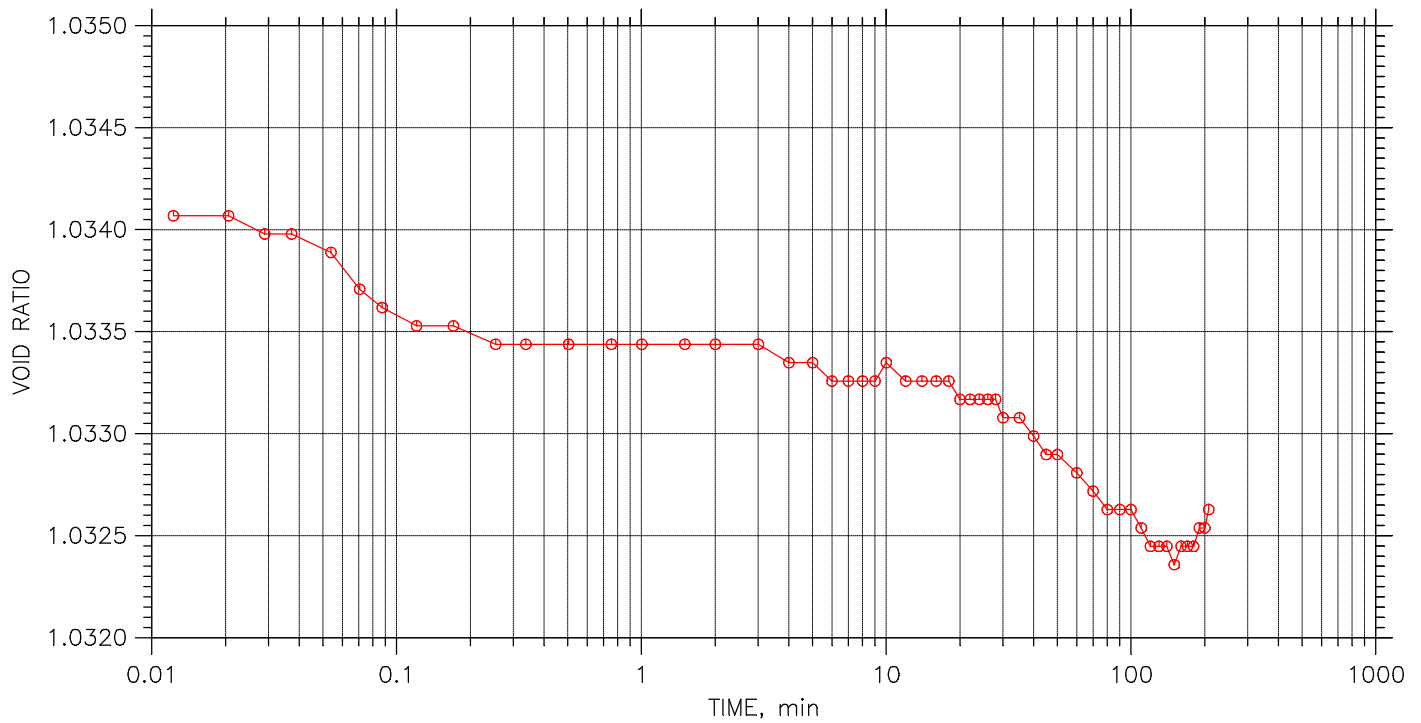
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	Boring No.: ST6	Tested By: FV	Checked By: TF
	Sample No.: 17-469	Test Date: June 23,17	Depth: 8 - 10 ft
	Test No.: 3	Sample Type: TW	Elevation:
	Description: Clay, light grey		
	Remarks:		


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 1 of 12

Stress: 6. kPa



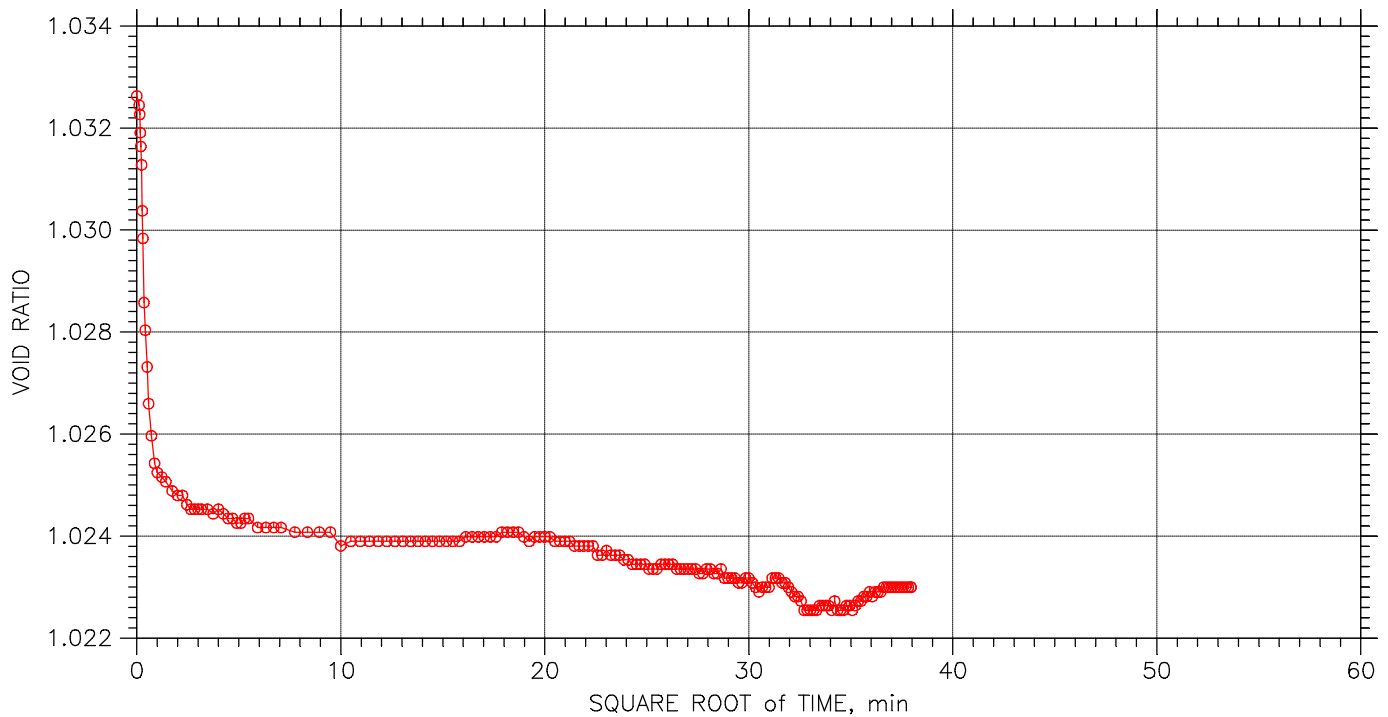
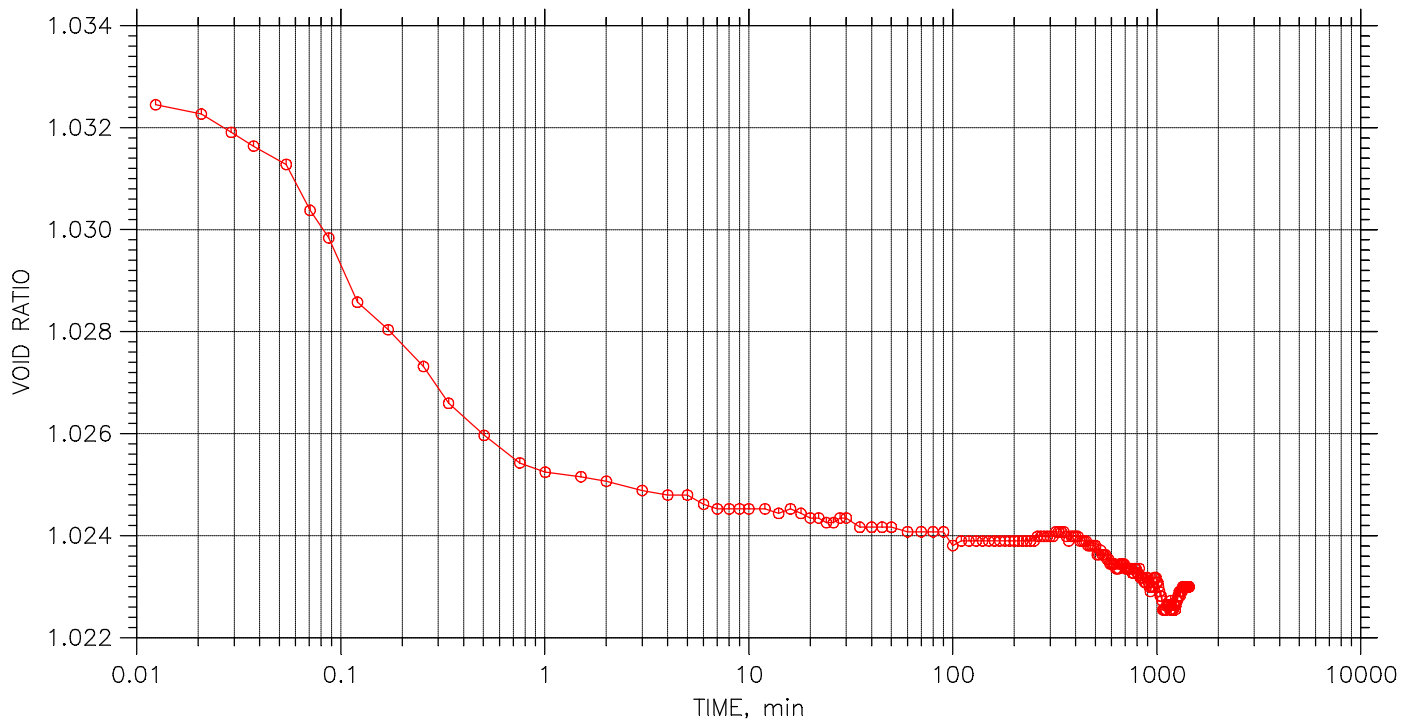
	Project: MTO Patrol Yard	Location: Dryden ON	Project No.: 17-252
	Boring No.: ST6	Tested By: FV	Checked By: TF
	Sample No.: 17-469	Test Date: June 23,17	Depth: 8 - 10 ft
	Test No.: 3	Sample Type: TW	Elevation:
	Description: Clay, light grey		
	Remarks:		


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 2 of 12

Stress: 25. kPa



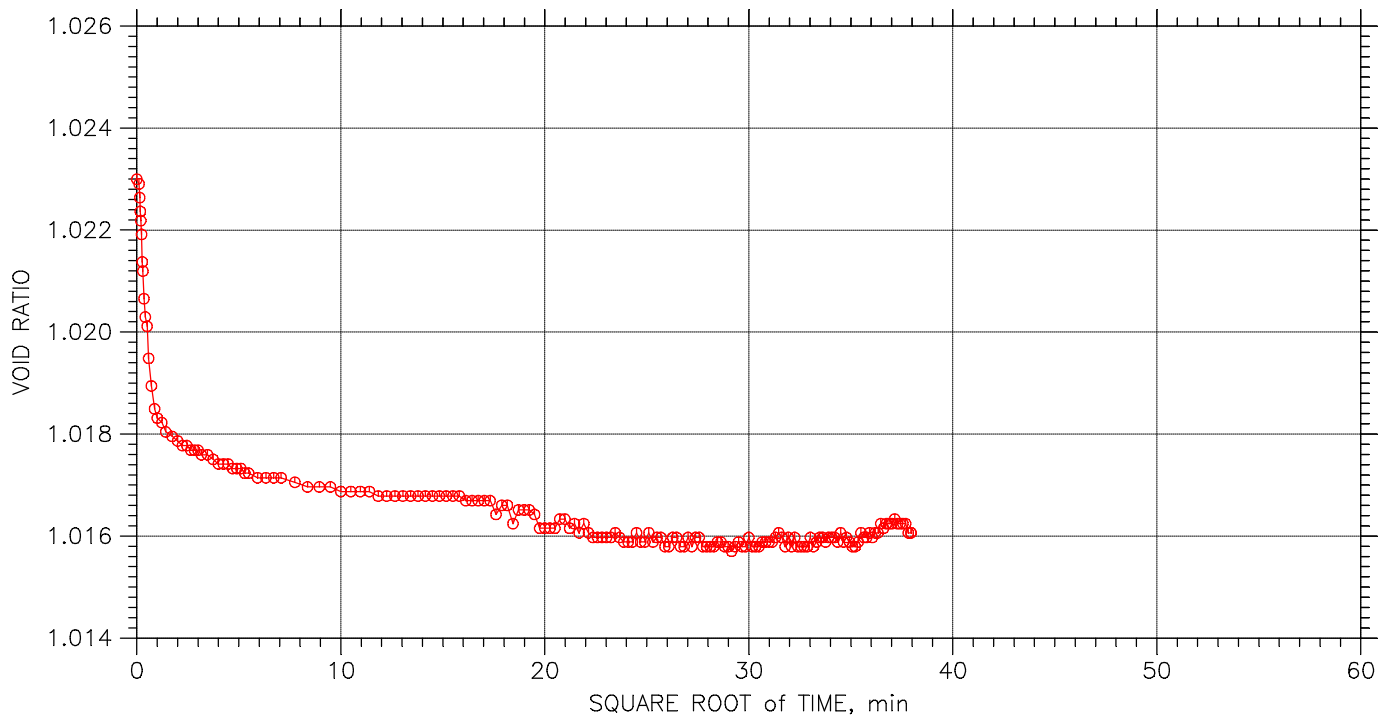
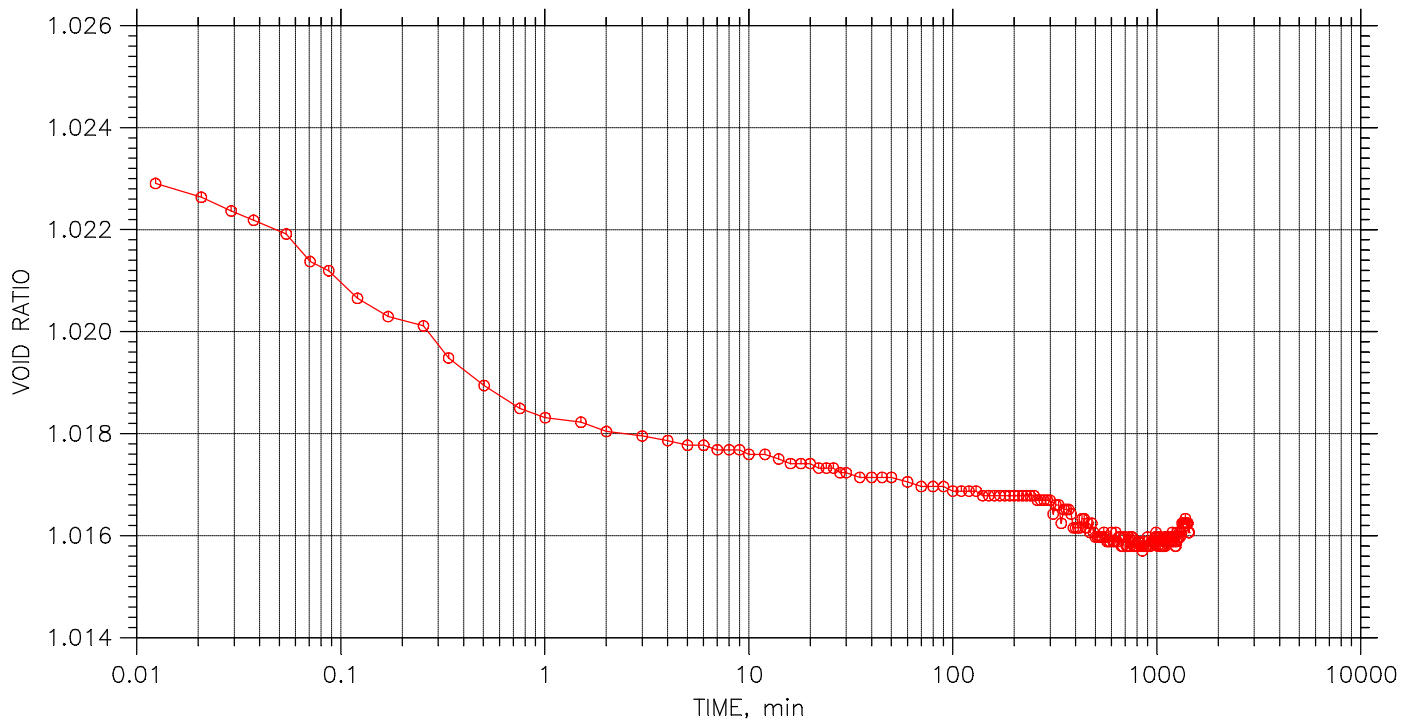
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	Boring No.: ST6	Tested By: FV	Checked By: TF
	Sample No.: 17-469	Test Date: June 23,17	Depth: 8 - 10 ft
	Test No.: 3	Sample Type: TW	Elevation:
	Description: Clay, light grey		
	Remarks:		


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 3 of 12

Stress: 50. kPa



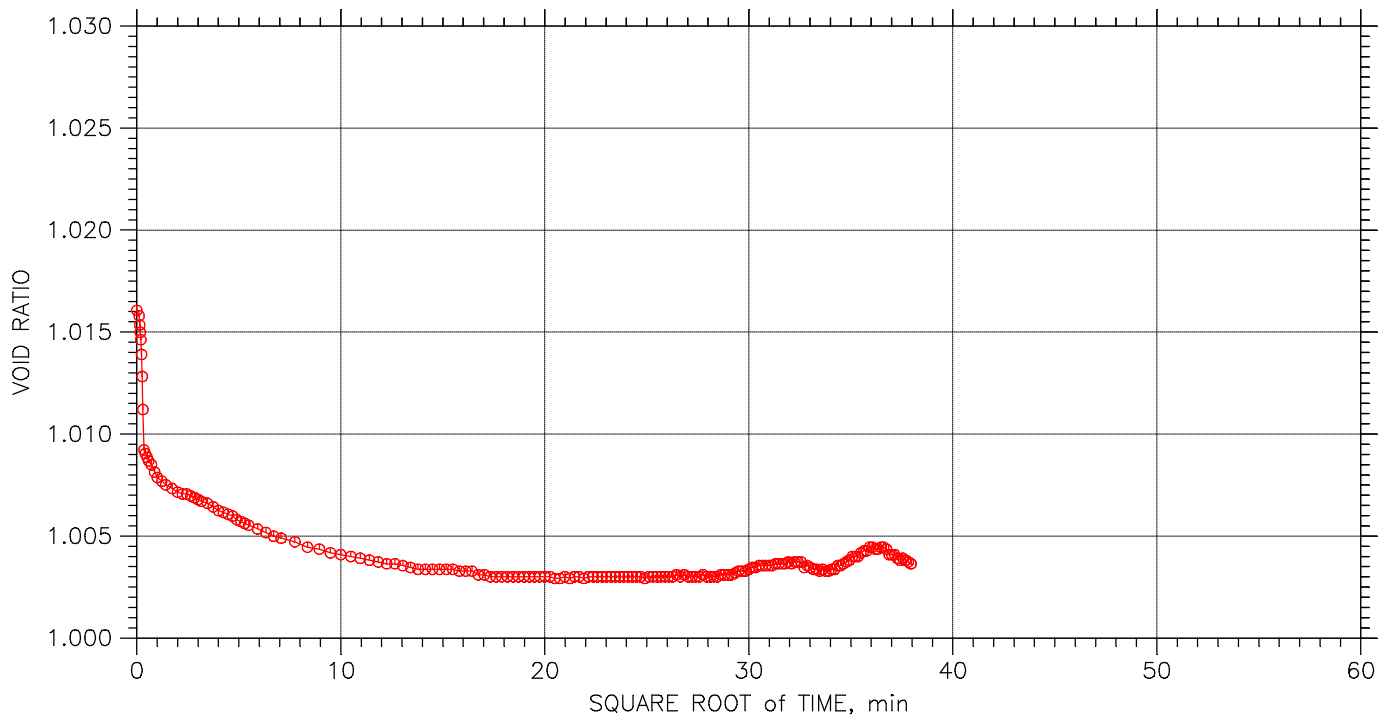
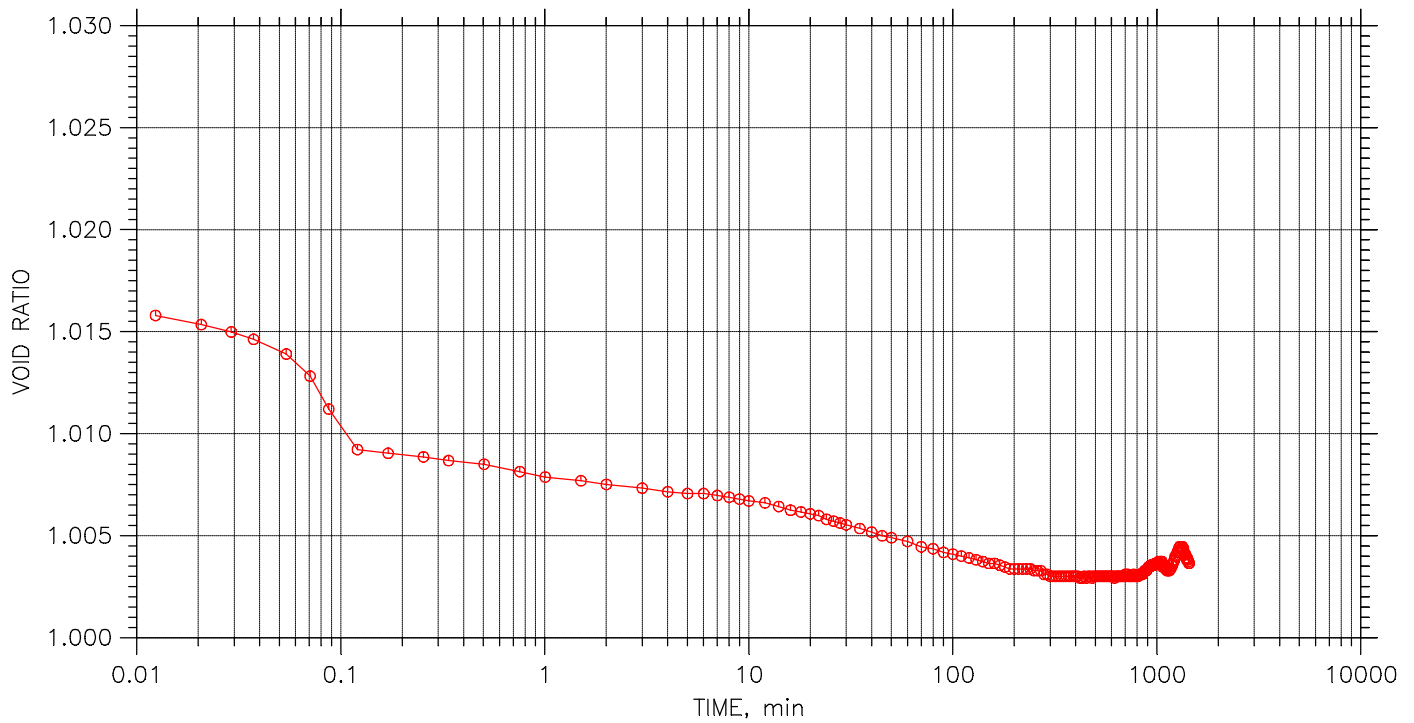
	Project: MTO Patrol Yard	Location: Dryden ON	Project No.: 17-252
	Boring No.: ST6	Tested By: FV	Checked By: TF
	Sample No.: 17-469	Test Date: June 23,17	Depth: 8 - 10 ft
	Test No.: 3	Sample Type: TW	Elevation:
	Description: Clay, light grey		
	Remarks:		


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 4 of 12

Stress: 100. kPa



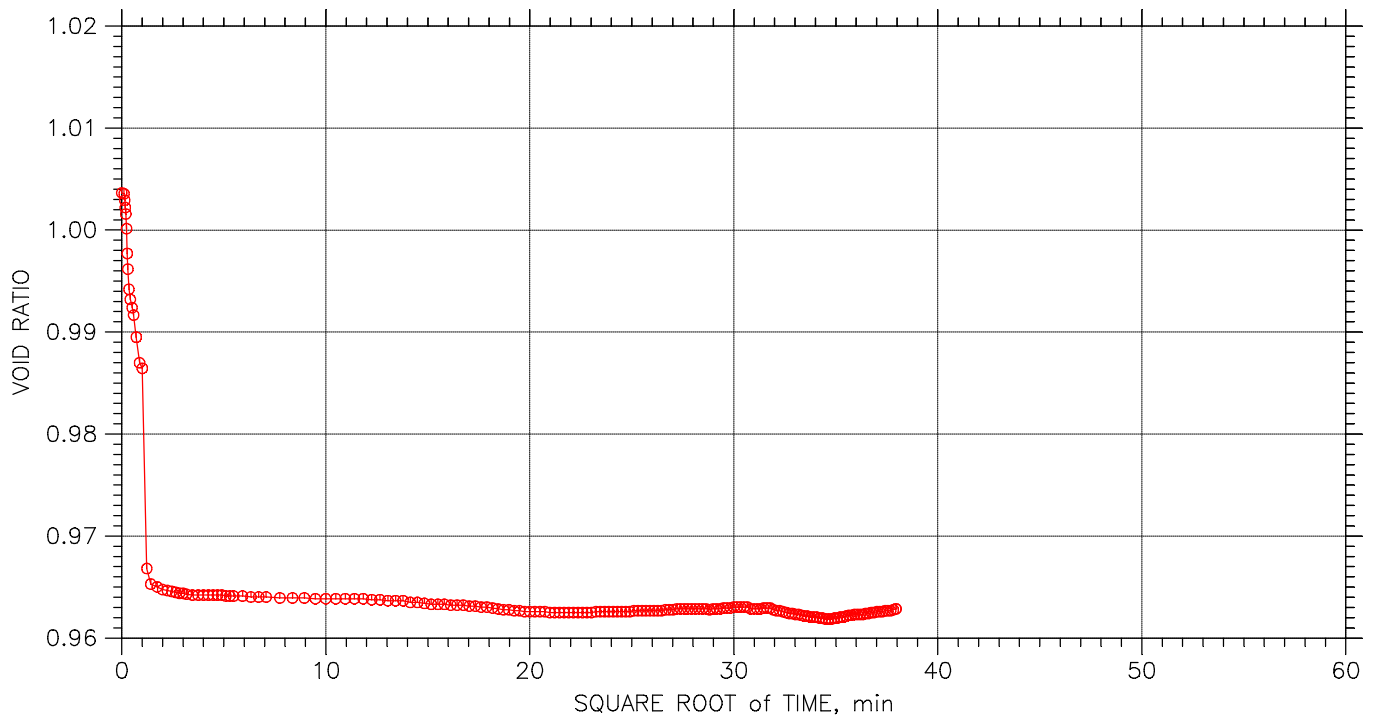
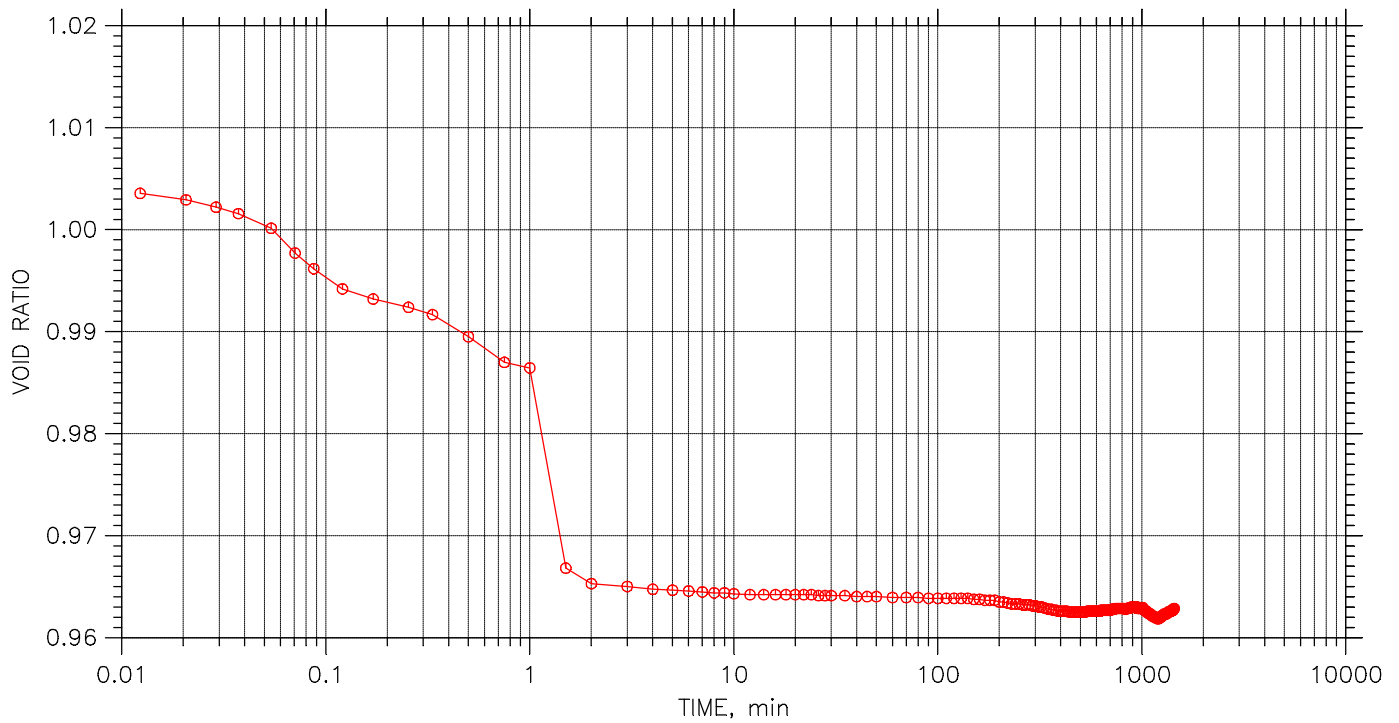
	Project: MTO Patrol Yard	Location: Dryden ON	Project No.: 17-252
	Boring No.: ST6	Tested By: FV	Checked By: TF
	Sample No.: 17-469	Test Date: June 23,17	Depth: 8 - 10 ft
	Test No.: 3	Sample Type: TW	Elevation:
	Description: Clay, light grey		
	Remarks:		


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 5 of 12

Stress: 200. kPa



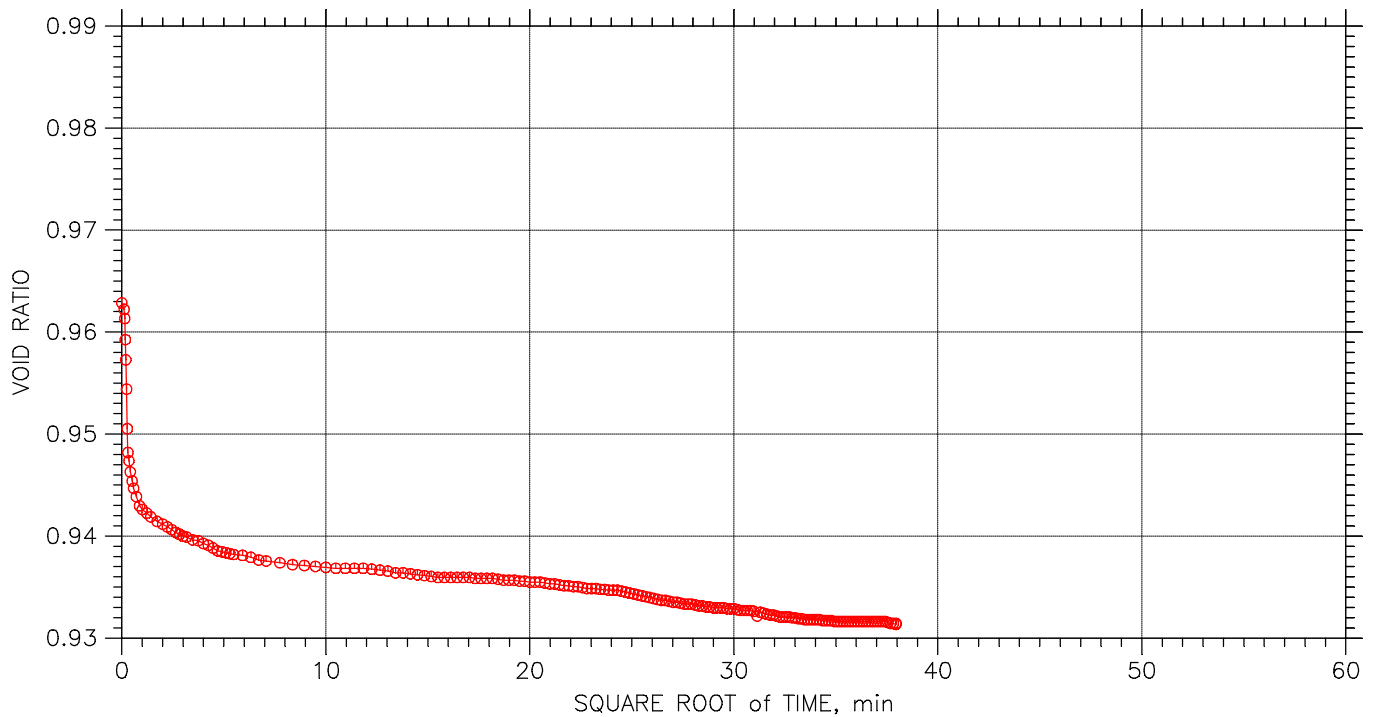
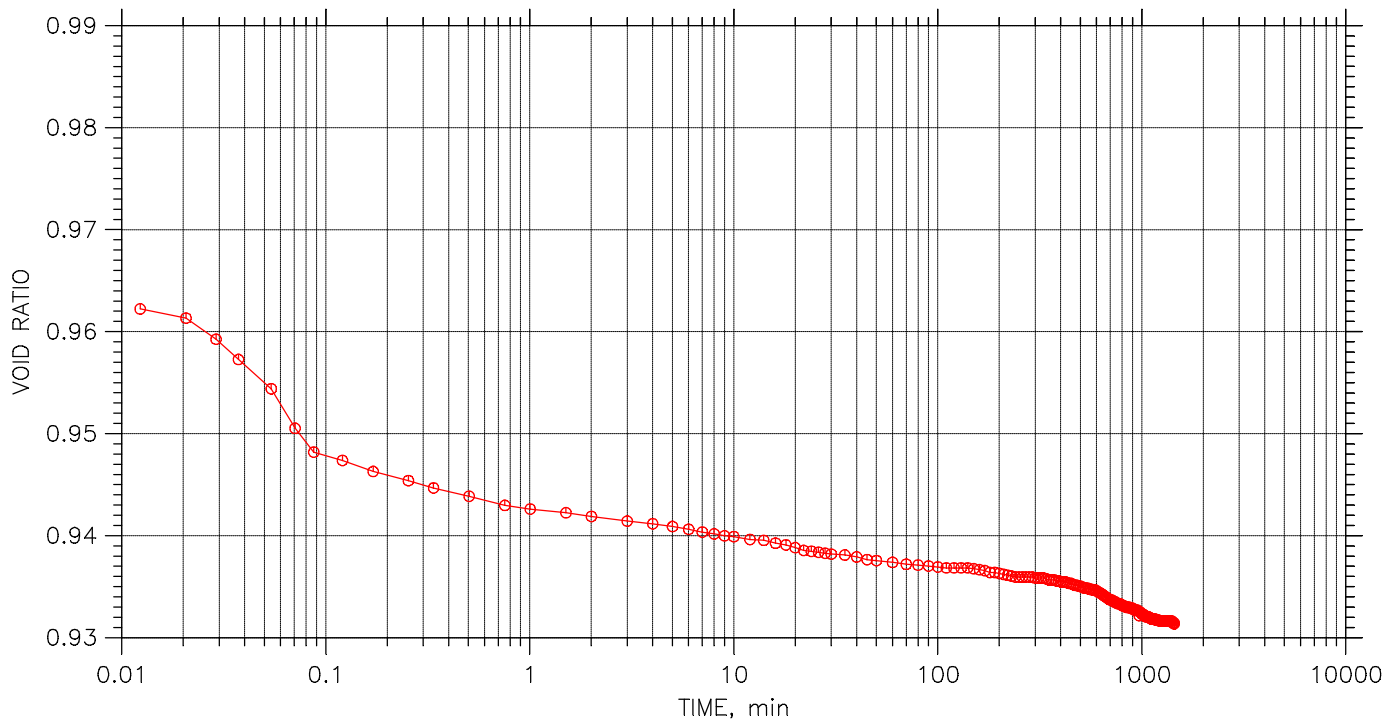
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	Boring No.: ST6	Tested By: FV	Checked By: TF
	Sample No.: 17-469	Test Date: June 23,17	Depth: 8 - 10 ft
	Test No.: 3	Sample Type: TW	Elevation:
	Description: Clay, light grey		
	Remarks:		


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 6 of 12

Stress: 400. kPa



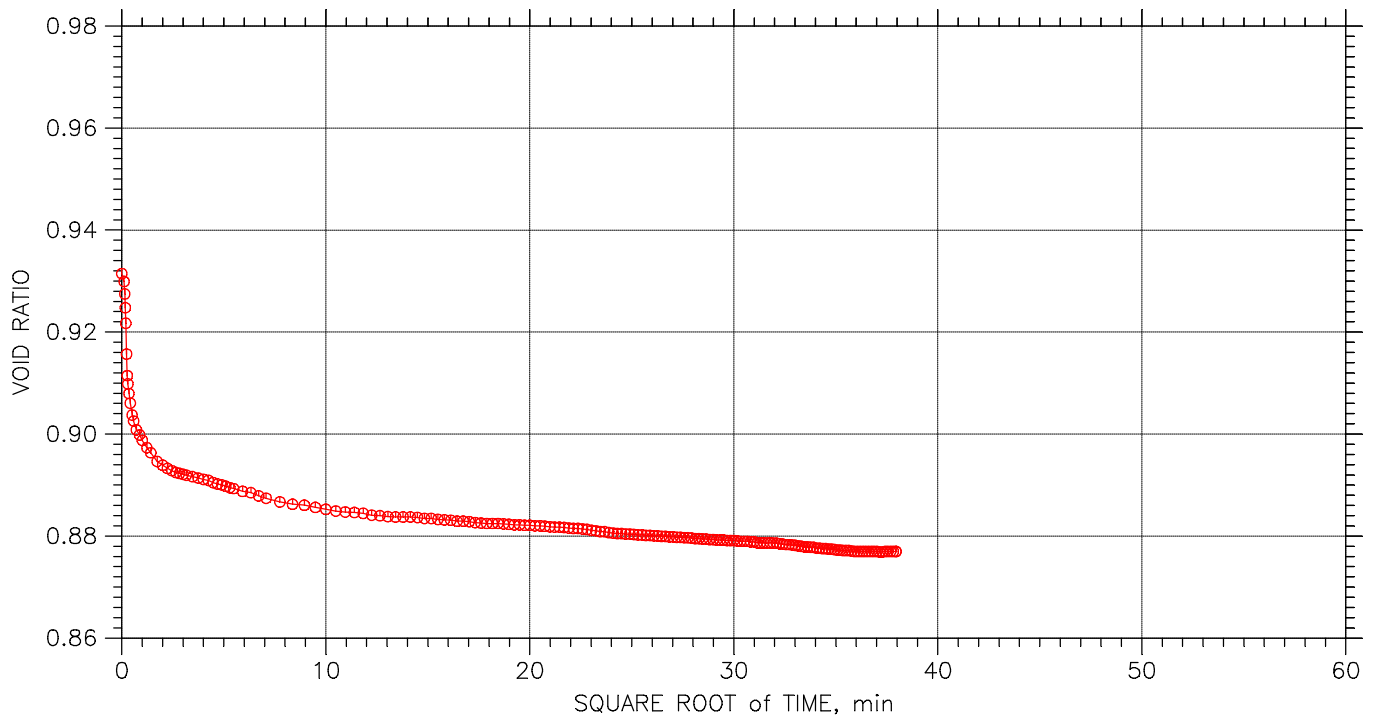
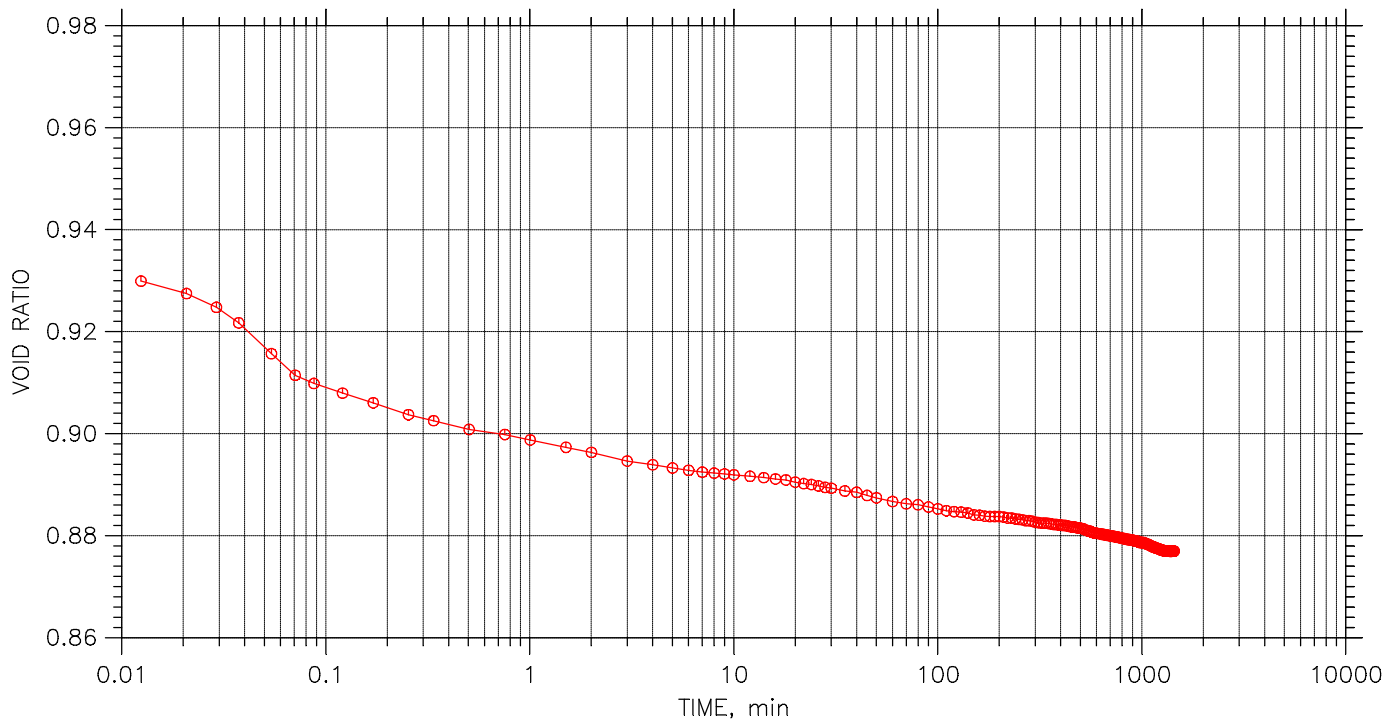
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	Boring No.: ST6	Tested By: FV	Checked By: TF
	Sample No.: 17-469	Test Date: June 23,17	Depth: 8 - 10 ft
	Test No.: 3	Sample Type: TW	Elevation:
	Description: Clay, light grey		
	Remarks:		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 7 of 12

Stress: 800. kPa



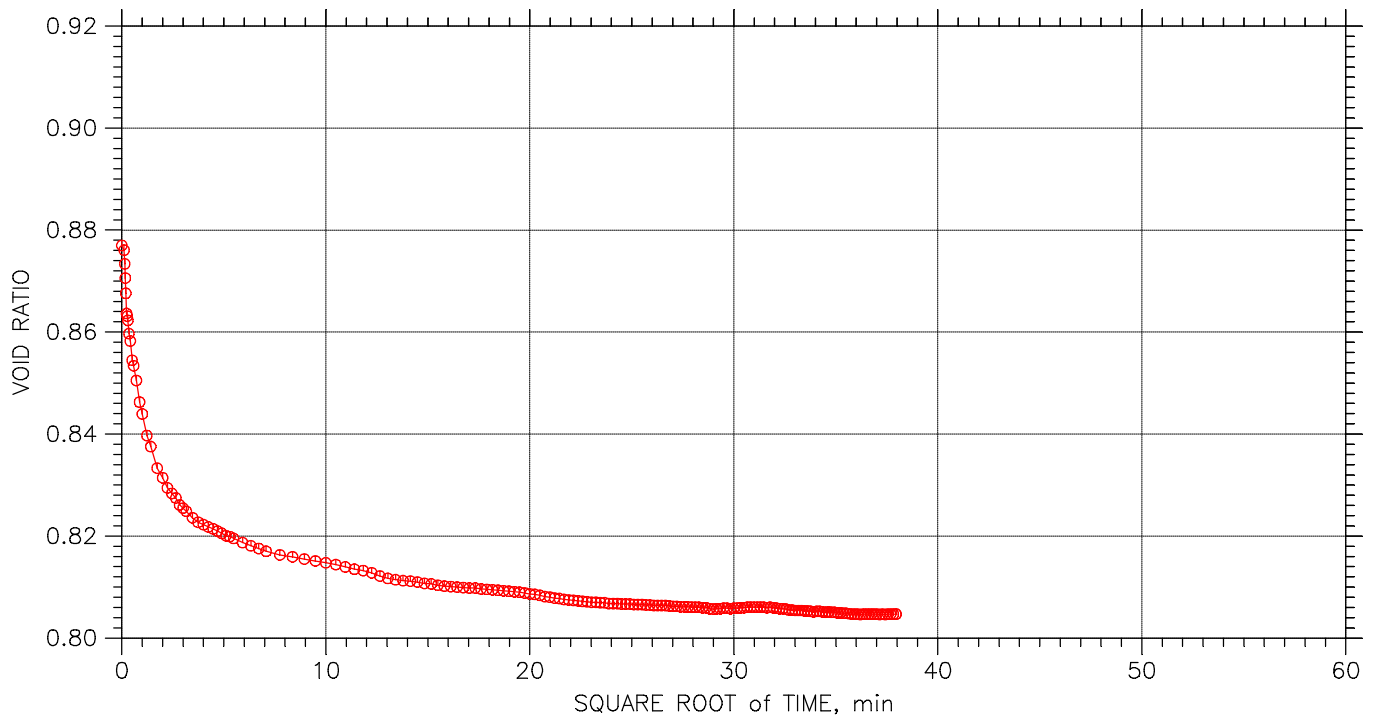
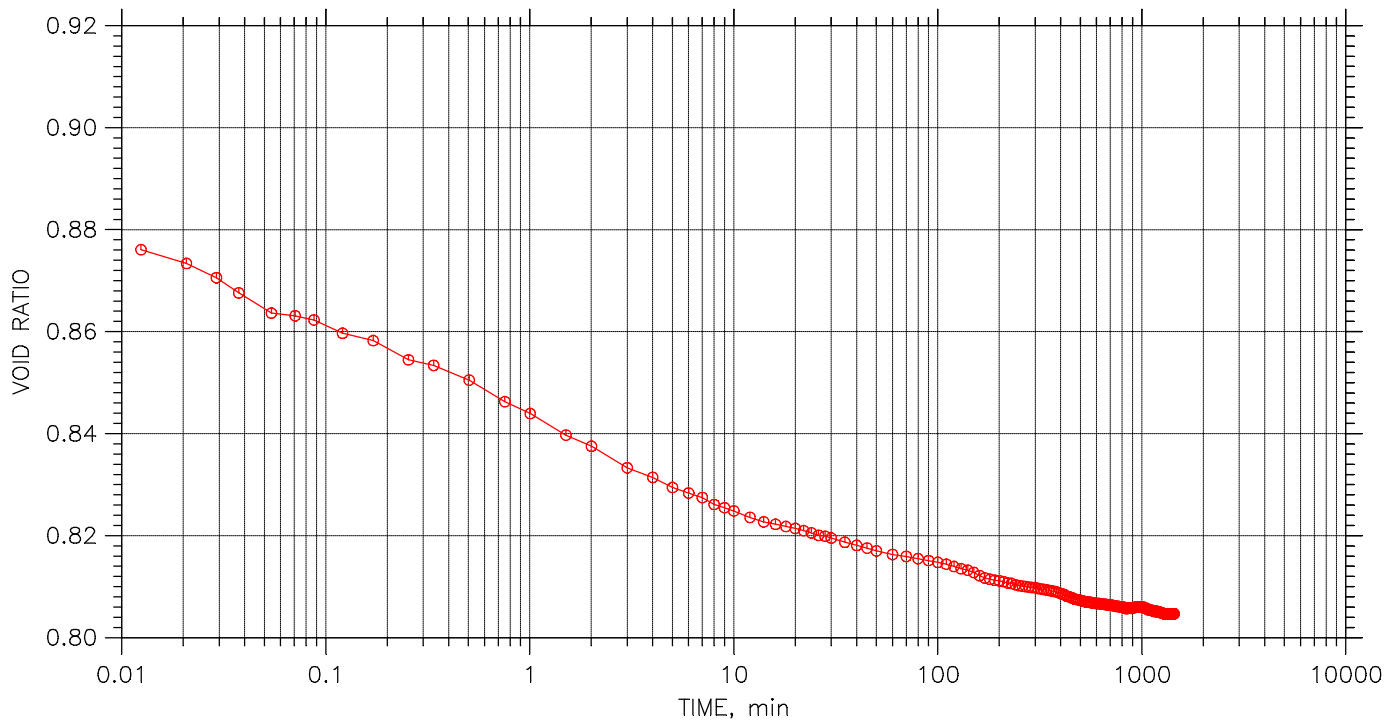
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Boring No.: ST6	Tested By: FV	Checked By: TF
Sample No.: 17-469	Test Date: June 23,17	Depth: 8 - 10 ft
Test No.: 3	Sample Type: TW	Elevation:
Description: Clay, light grey		
Remarks:		


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 8 of 12

Stress: 1500. kPa



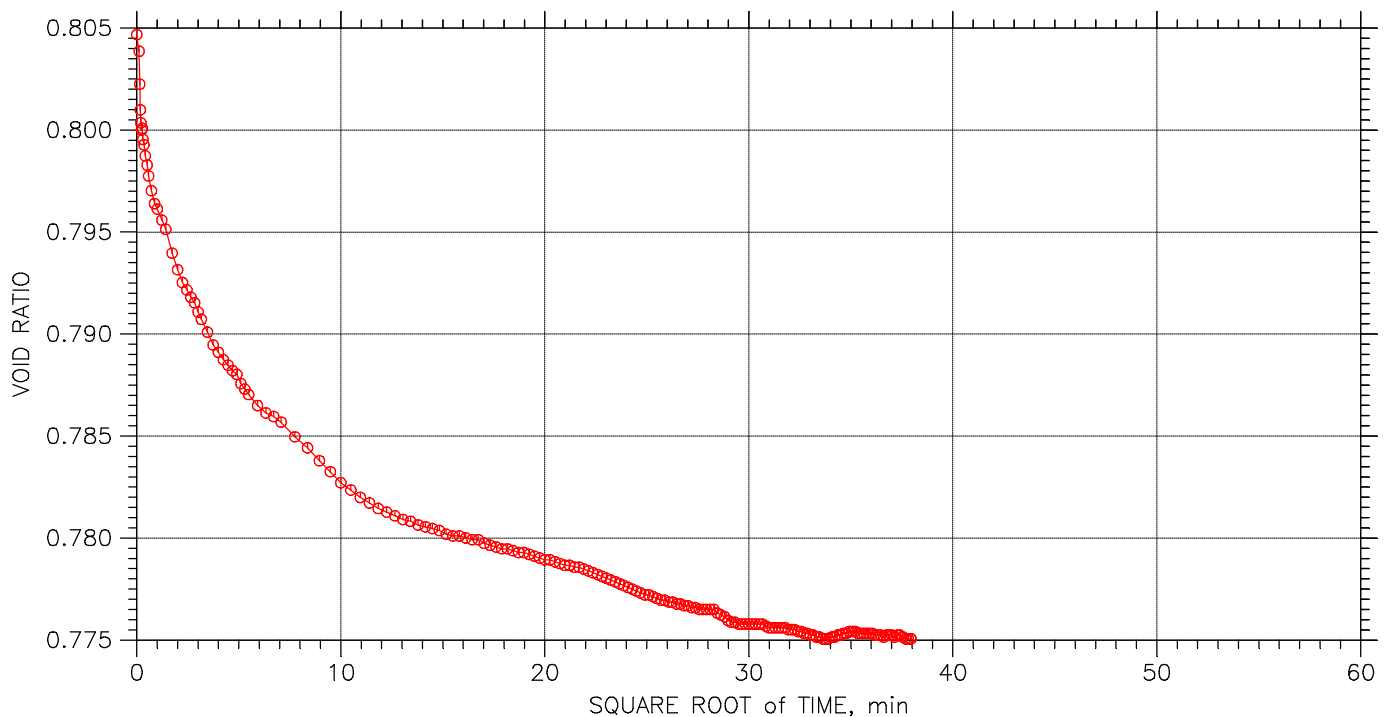
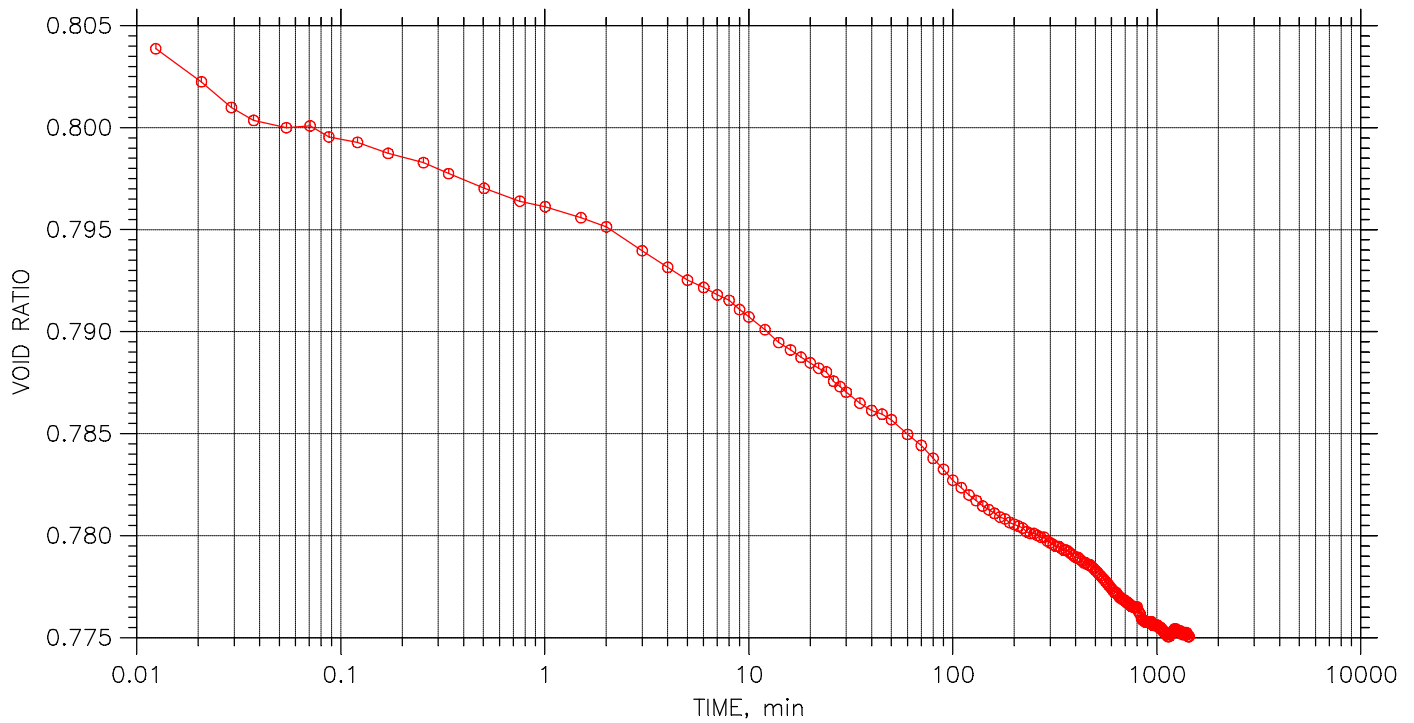
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	Boring No.: ST6	Tested By: FV	Checked By: TF
	Sample No.: 17-469	Test Date: June 23,17	Depth: 8 - 10 ft
	Test No.: 3	Sample Type: TW	Elevation:
	Description: Clay, light grey		
	Remarks:		


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 9 of 12

Stress: 2000. kPa



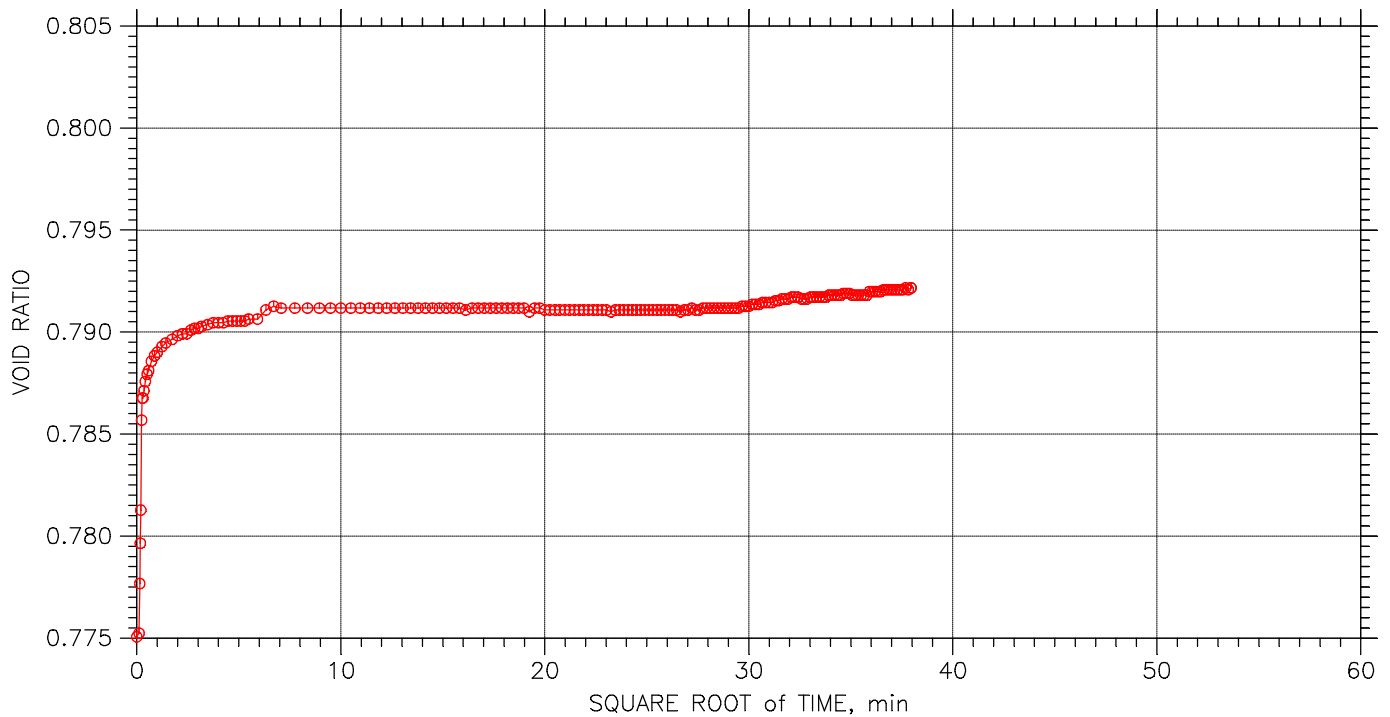
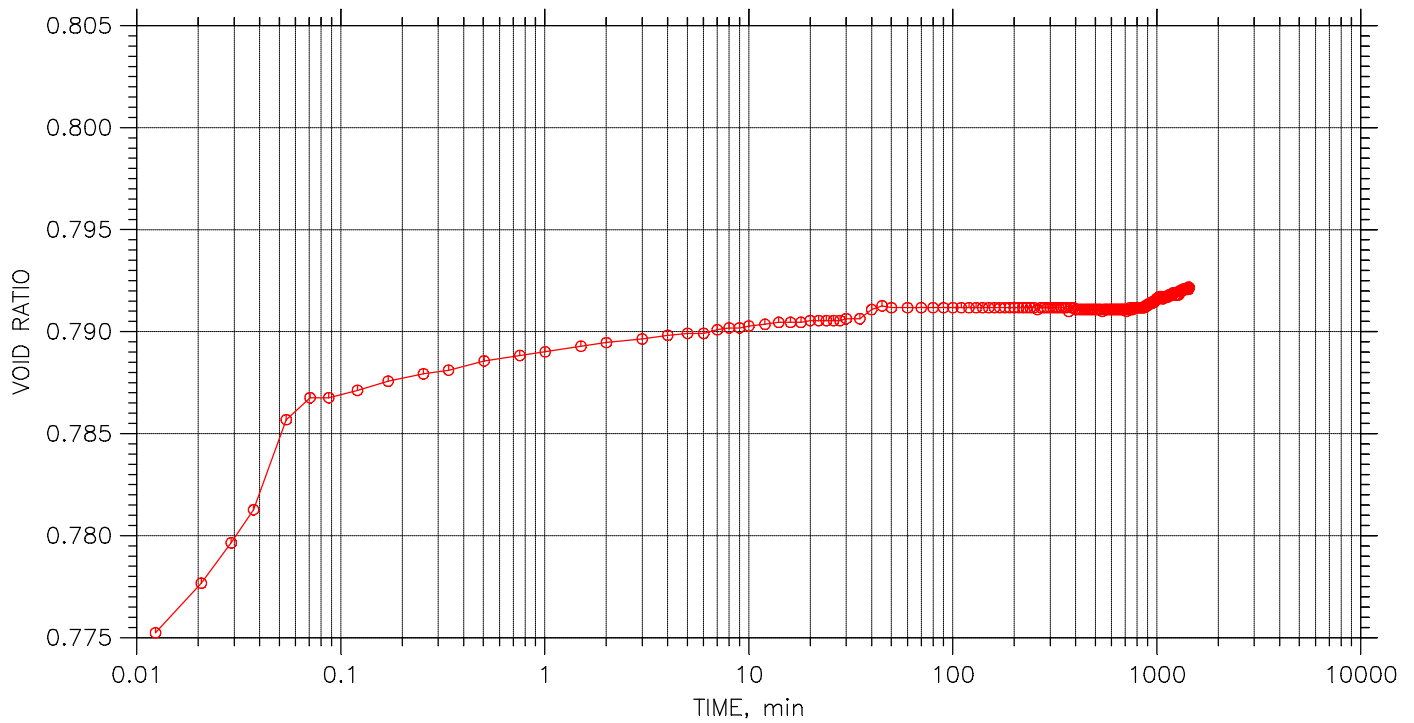
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	Boring No.: ST6	Tested By: FV	Checked By: TF
	Sample No.: 17-469	Test Date: June 23,17	Depth: 8 - 10 ft
	Test No.: 3	Sample Type: TW	Elevation:
	Description: Clay, light grey		
	Remarks:		


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 10 of 12

Stress: 750. kPa



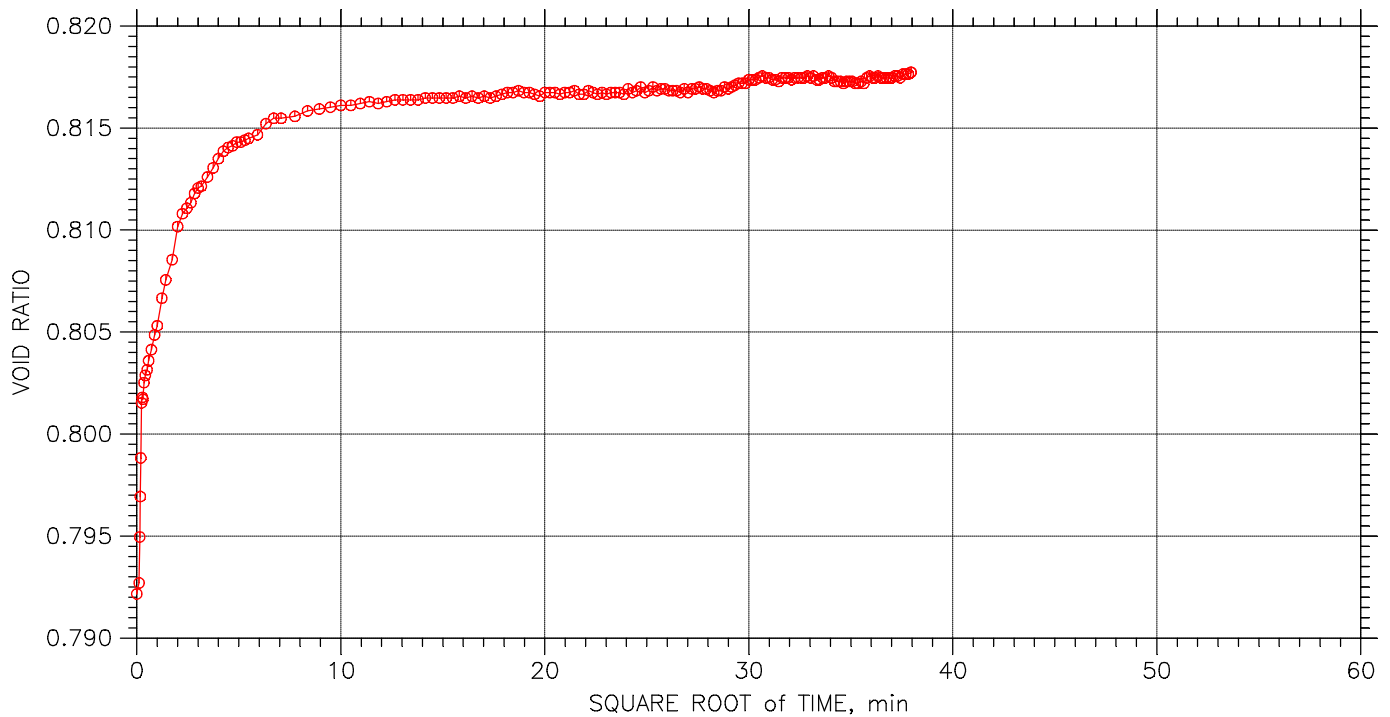
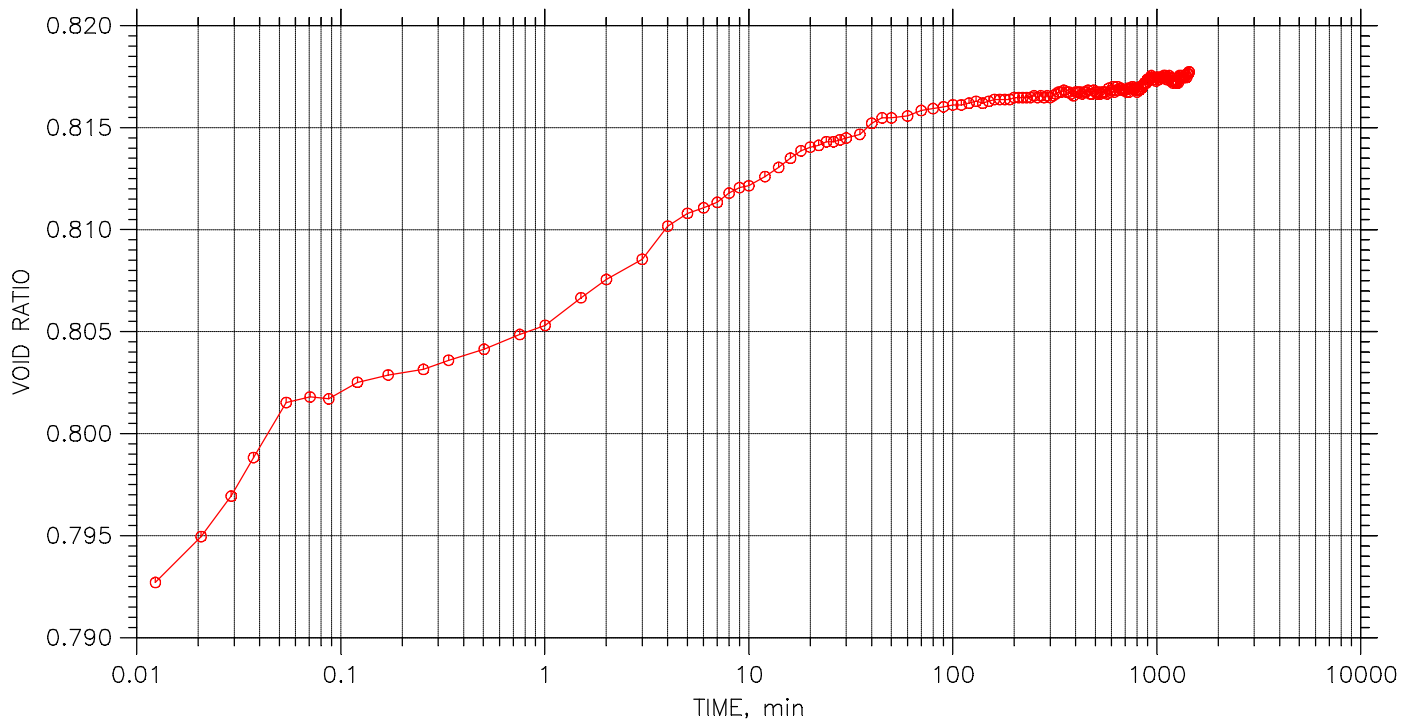
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	Boring No.: ST6	Tested By: FV	Checked By: TF
	Sample No.: 17-469	Test Date: June 23,17	Depth: 8 - 10 ft
	Test No.: 3	Sample Type: TW	Elevation:
	Description: Clay, light grey		
	Remarks:		


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 11 of 12

Stress: 200. kPa



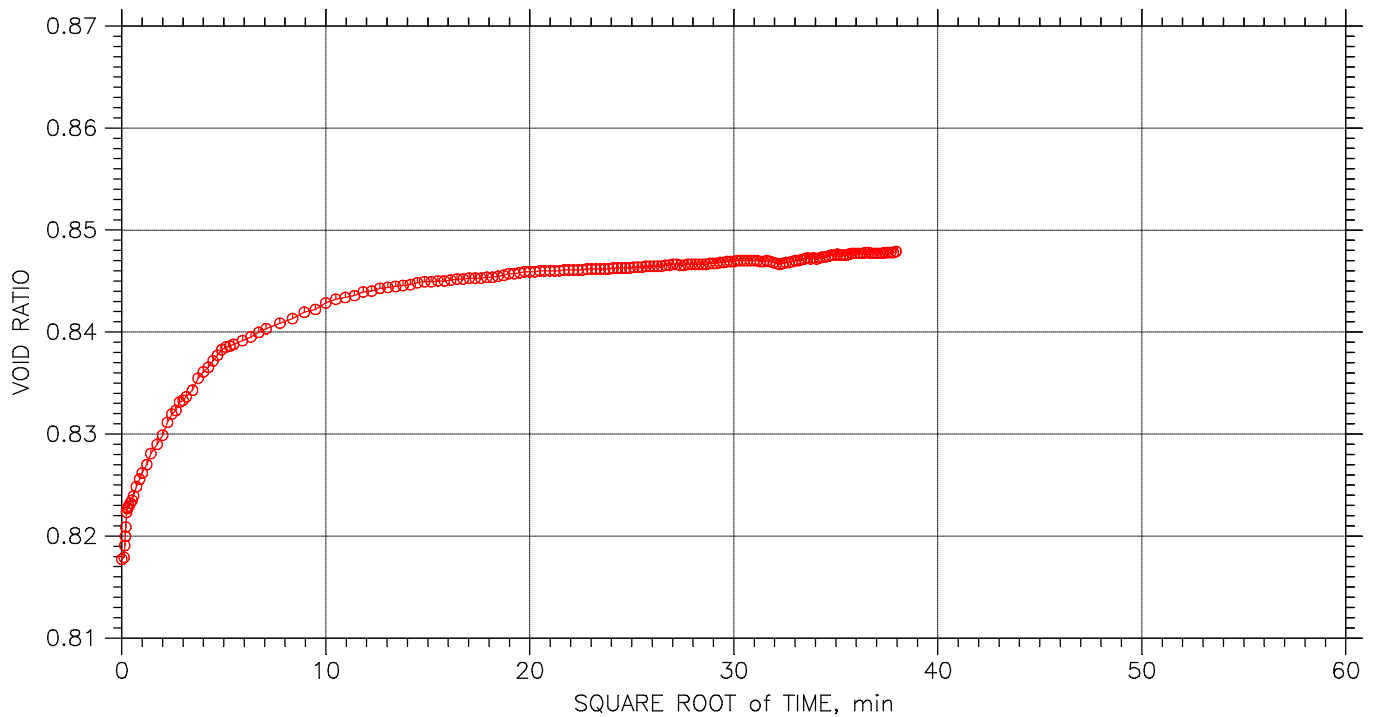
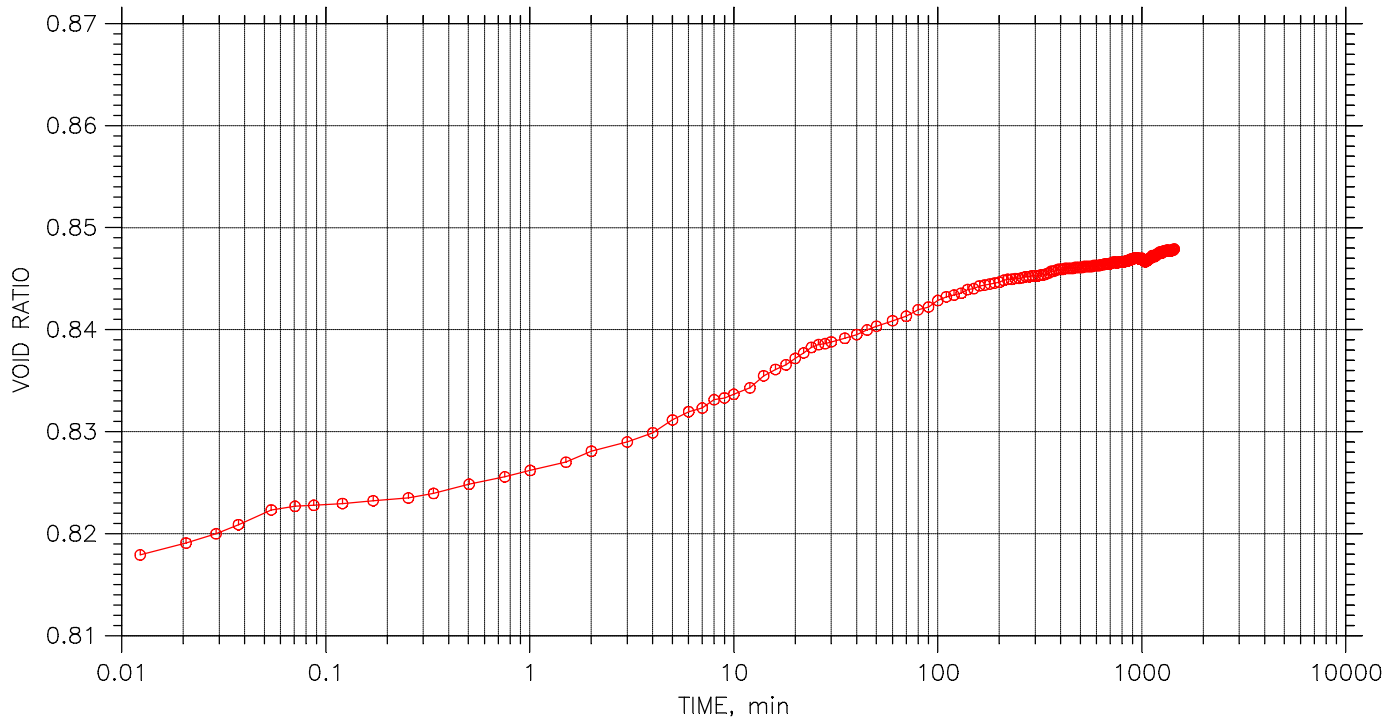
	Project: MTO Patrol Yard	Location: Dryden ON	Project No.: 17-252
	Boring No.: ST6	Tested By: FV	Checked By: TF
	Sample No.: 17-469	Test Date: June 23,17	Depth: 8 - 10 ft
	Test No.: 3	Sample Type: TW	Elevation:
	Description: Clay, light grey		
	Remarks:		


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 12 of 12

Stress: 50. kPa



	Project: MTO Patrol Yard	Location: Dryden ON	Project No.: 17-252
	Boring No.: ST6	Tested By: FV	Checked By: TF
	Sample No.: 17-469	Test Date: June 23,17	Depth: 8 - 10 ft
	Test No.: 3	Sample Type: TW	Elevation:
	Description: Clay, light grey		
	Remarks:		

BOREHOLE: **DRY-01**
CORE RUN #1: 28'10" – 33'10"
CORE RUN #2: 33'10" – 36'2"
CORE RUN #3: 36'2" – 38'11"



BOREHOLE: **DRY-04**
CORE RUN #1: 32'0" – 34'0"
CORE RUN #2: 34'0" – 39'0"
CORE RUN #3: 39'0" – 42'4"





Appendix C

Site Photographs



Photograph 1 – Proposed building location, looking east



Photograph 2 – Proposed building location showing drill rig at Borehole DRY-01 location, looking east



Appendix D

List of Special Provisions and OPSS Documents

1. List of Special Provisions and OPSS Documents Referenced in this Report

- OPSS.PROV 501 – Construction Specification for Compacting
- OPSS.PROV 1010 – Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material
- OPSS 902 – Construction Specification for Excavating and Backfilling – Structures



Appendix E

Slope Stability Analysis Results

FIGURE E1

Title: MTO Dryden Site
Comments: Stockpile Not Backfilled Against Footing - ESA
Location: Salt / Sand Storage Building
Last Edited By; Geoff Lay
Last Solved Date: 7/25/2017

Gravelly Sand Fill	21 kN/m ³	0 kPa	34 °
Silty Clay	17 kN/m ³	0 kPa	28 °
Sandy Silt	18 kN/m ³	0 kPa	30 °
Salt / Sand Stockpile	16 kN/m ³	0 kPa	32 °
Concrete Footing	25 kN/m ³	15,000 kPa	0 °

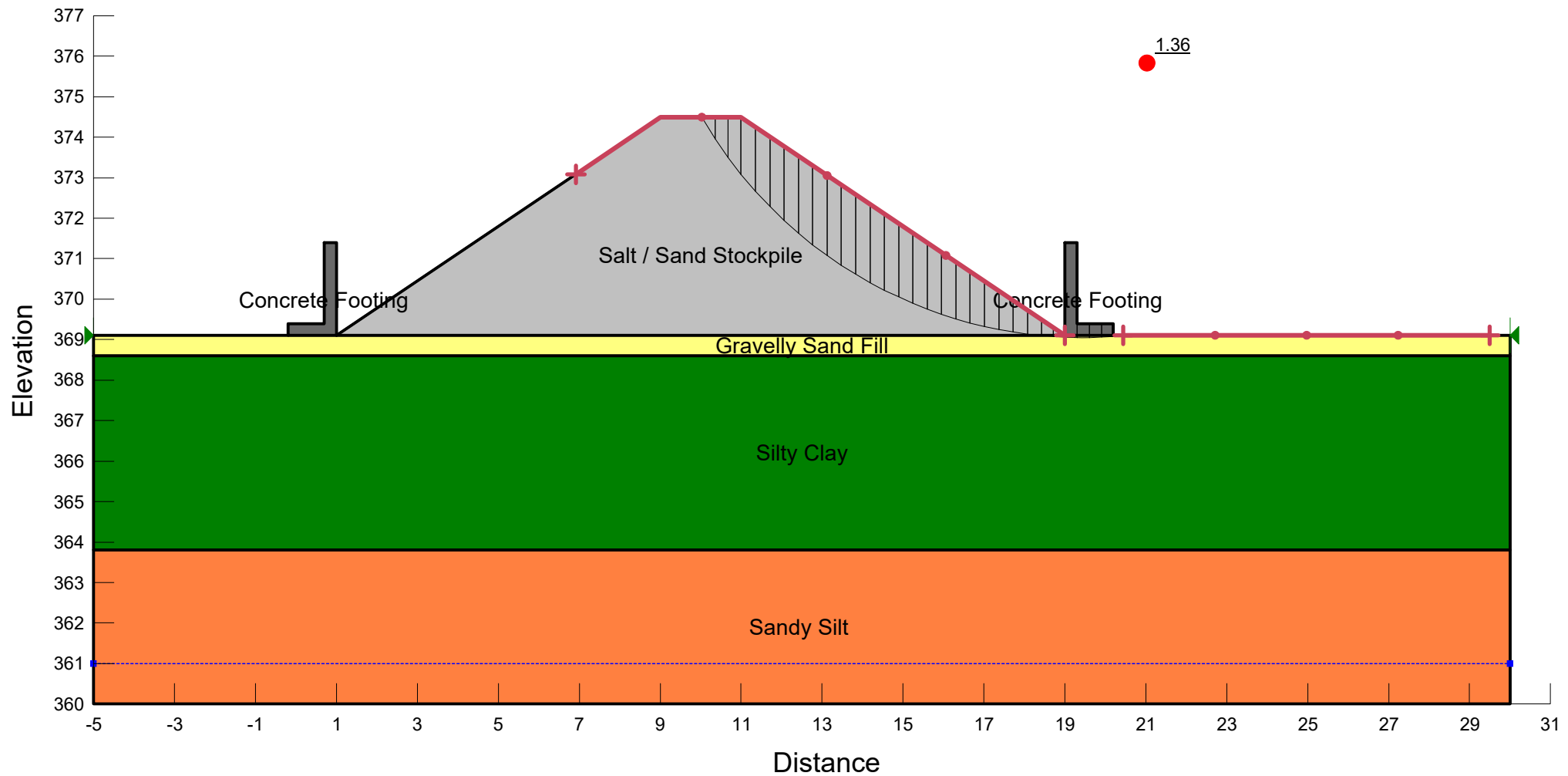


FIGURE E2

Title: MTO Dryden Site
Comments: Footings at Ground Surface - ESA
Location: Salt / Sand Storage Building
Last Edited By; Geoff Lay
Last Solved Date: 7/25/2017

Gravelly Sand Fill	21 kN/m ³	0 kPa	34 °
Silty Clay	17 kN/m ³	0 kPa	28 °
Sandy Silt	18 kN/m ³	0 kPa	30 °
Salt / Sand Stockpile	16 kN/m ³	0 kPa	32 °
Concrete Footing	25 kN/m ³	15,000 kPa	0 °

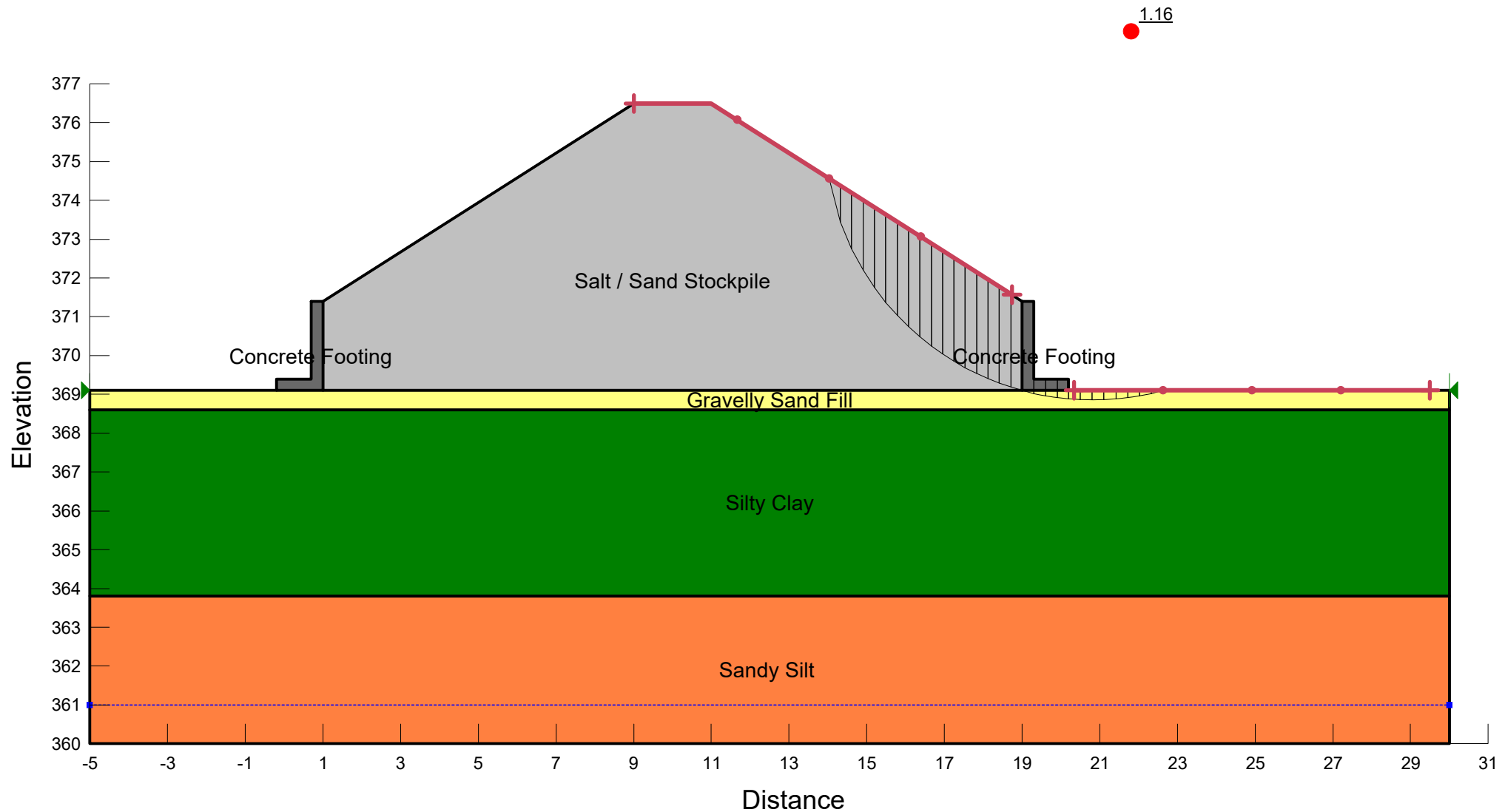


FIGURE E3

Title: MTO Dryden Site
Comments: Footings Buried 0.5 m - TSA
Location: Salt / Sand Storage Building
Last Edited By; Geoff Lay
Last Solved Date: 7/25/2017

Gravelly Sand Fill	21 kN/m ³	0 kPa	34 °
Silty Clay	17 kN/m ³	75 kPa	28 °
Sandy Silt	18 kN/m ³	0 kPa	30 °
Salt / Sand Stockpile	16 kN/m ³	0 kPa	32 °
Concrete Footing	25 kN/m ³	15,000 kPa	0 °

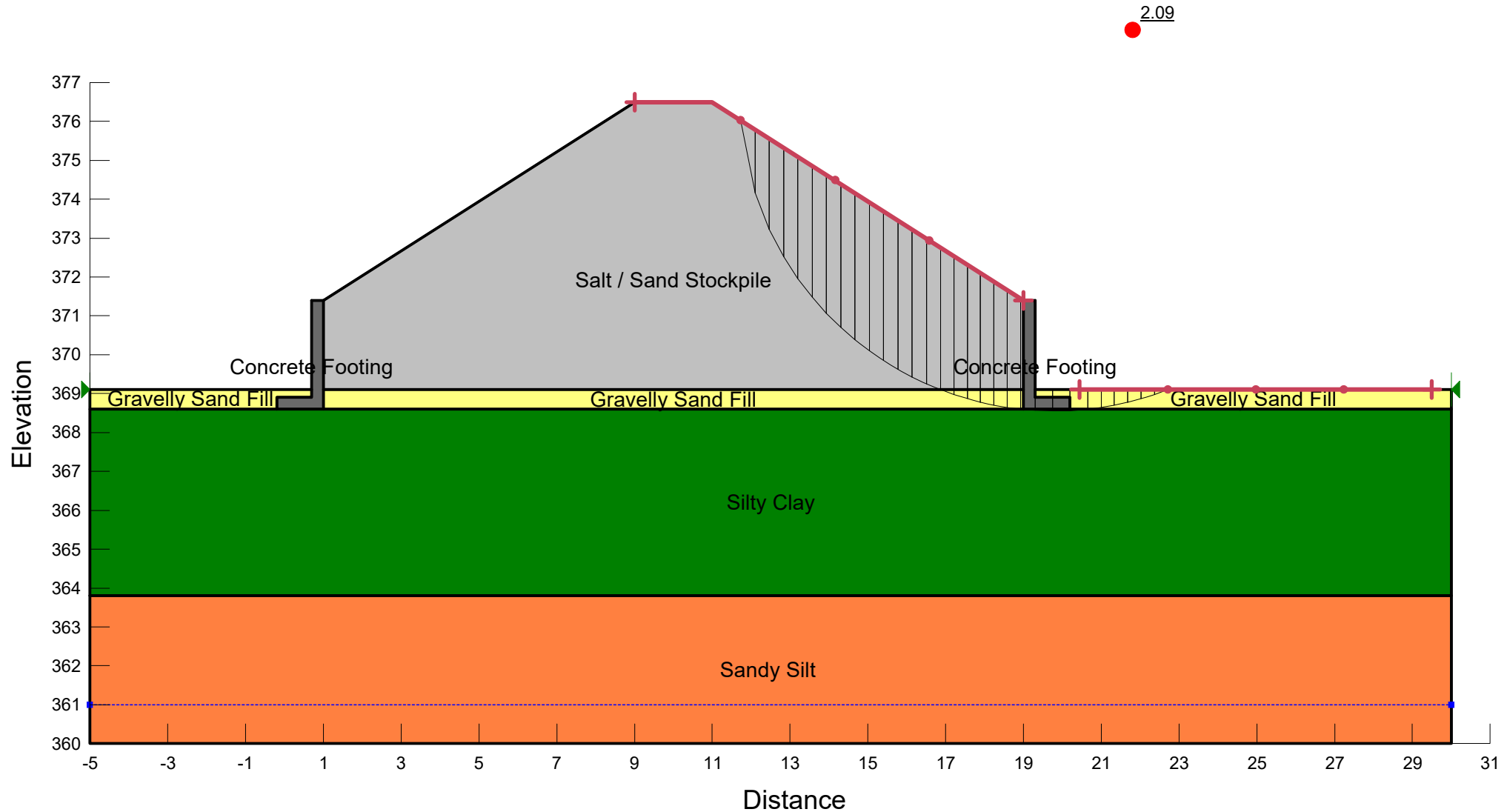
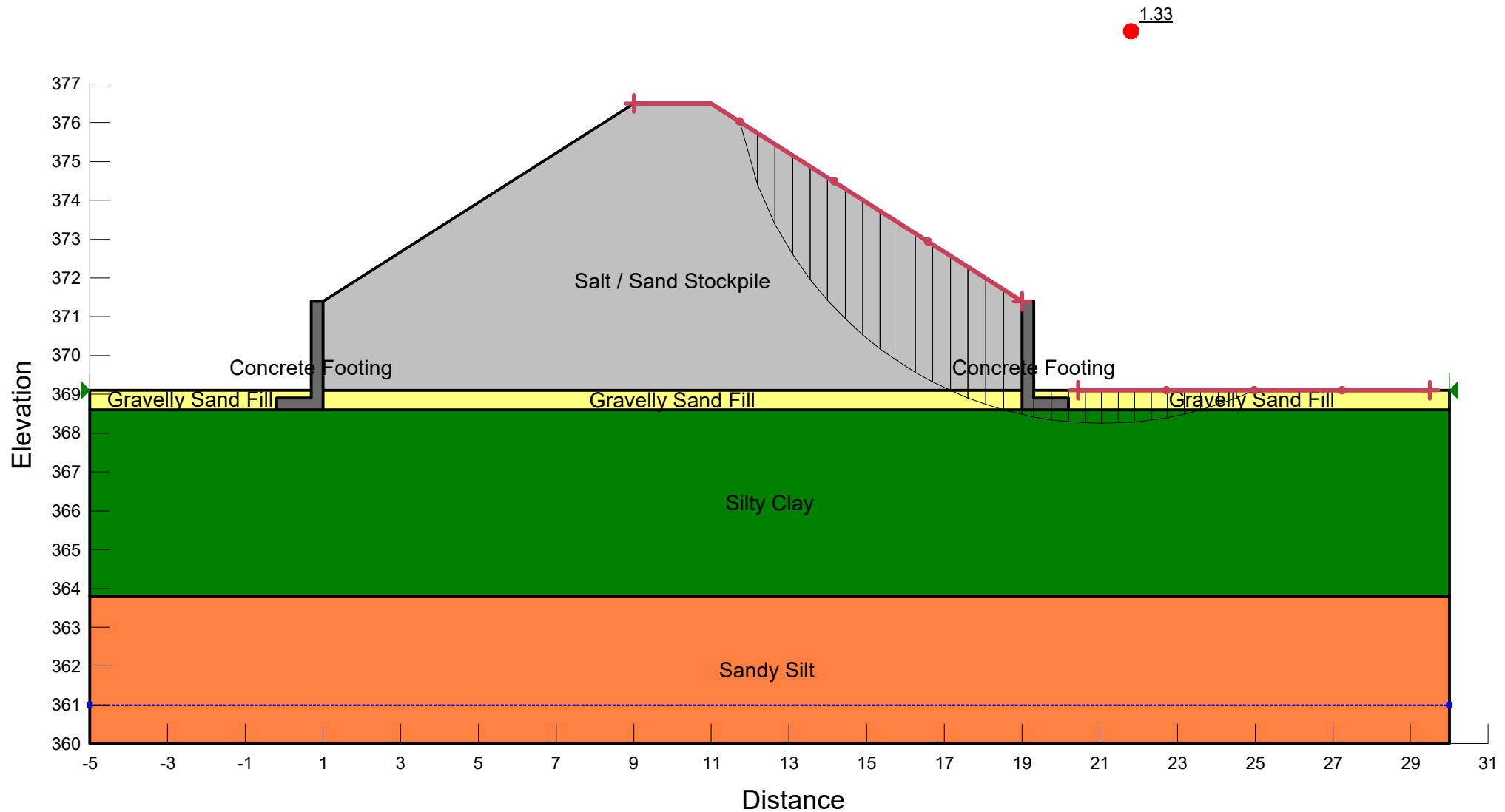


FIGURE E4

Title: MTO Dryden Site
Comments: Footings Buried 0.5 m - ESA
Location: Salt / Sand Storage Building
Last Edited By; Geoff Lay
Last Solved Date: 7/25/2017

Gravelly Sand Fill	21 kN/m ³	0 kPa	34 °
Silty Clay	17 kN/m ³	0 kPa	28 °
Sandy Silt	18 kN/m ³	0 kPa	30 °
Salt / Sand Stockpile	16 kN/m ³	0 kPa	32 °
Concrete Footing	25 kN/m ³	15,000 kPa	0 °

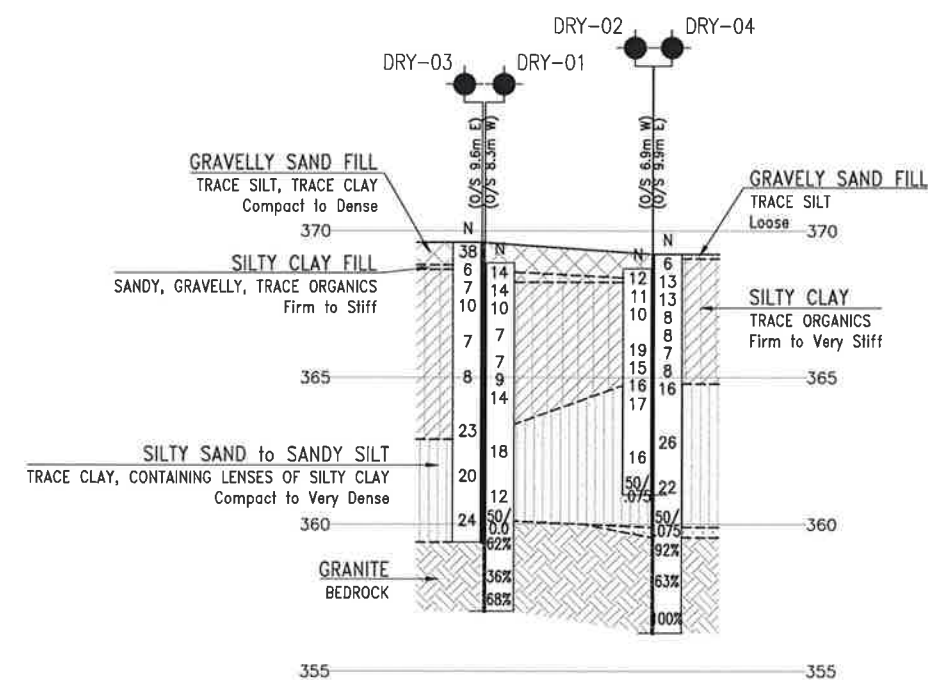




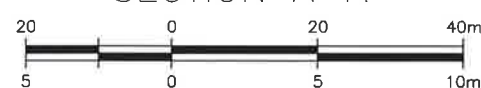
Appendix F

Borehole Locations and Soil Strata Drawing

PLAN



SECTION A-A'



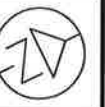
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V 1:250

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

CONT No	(
GWP No 6054-16-00)

NEW SALT/SAND STORAGE BUILDING
MTO PATROL YARD—DRYDEN
HIGHWAY 11/17
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET








THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
DRY-01	368.9	5 517 214.7	315 581.7
DRY-02	368.7	5 517 237.6	315 583.9
DRY-03	369.2	5 517 213.7	315 599.6
DRY-04	369.6	5 517 237.1	315 600.7

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Borehole locations are shown in MTM NAD-83 Zone 16 coordinates.

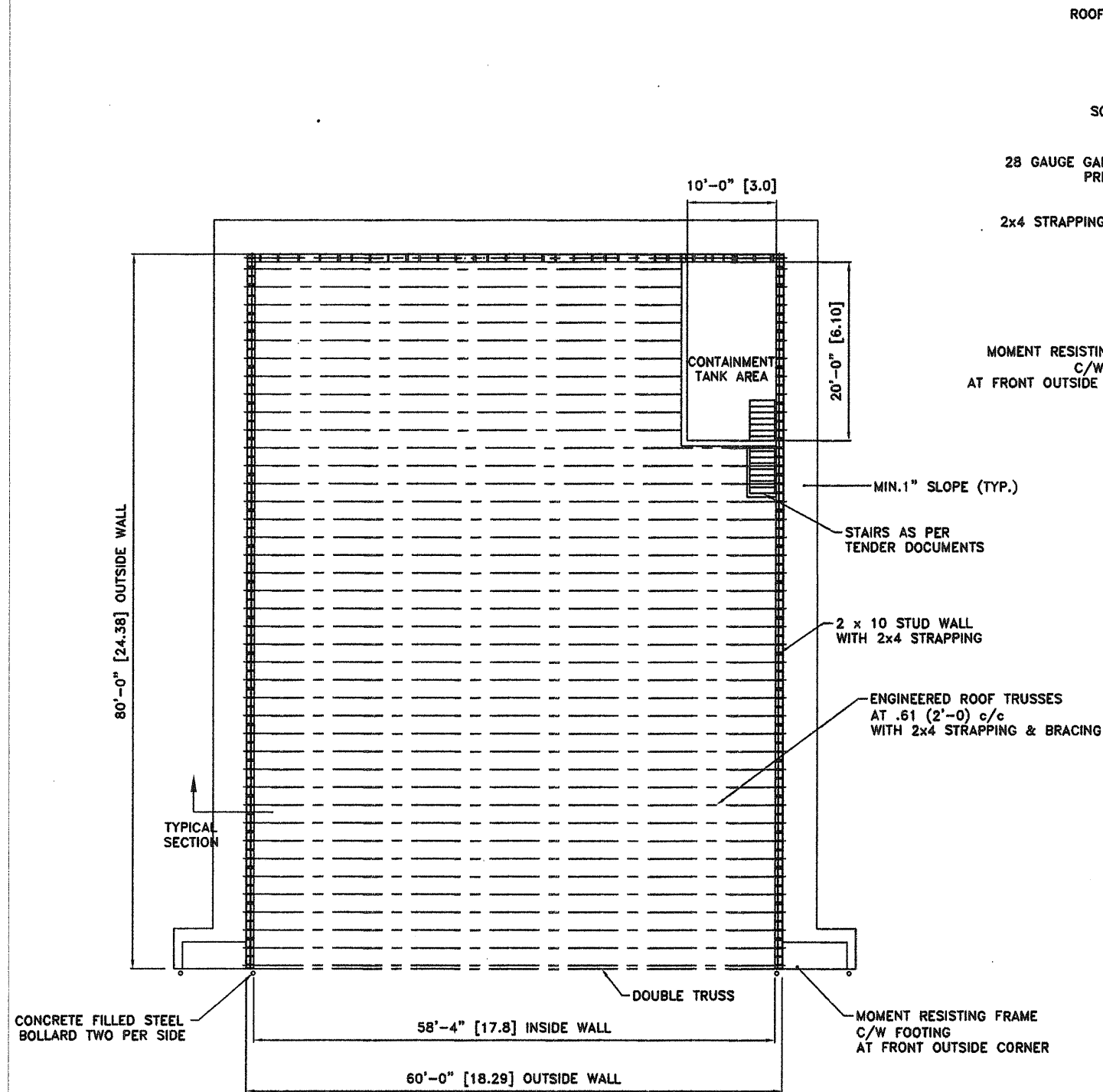
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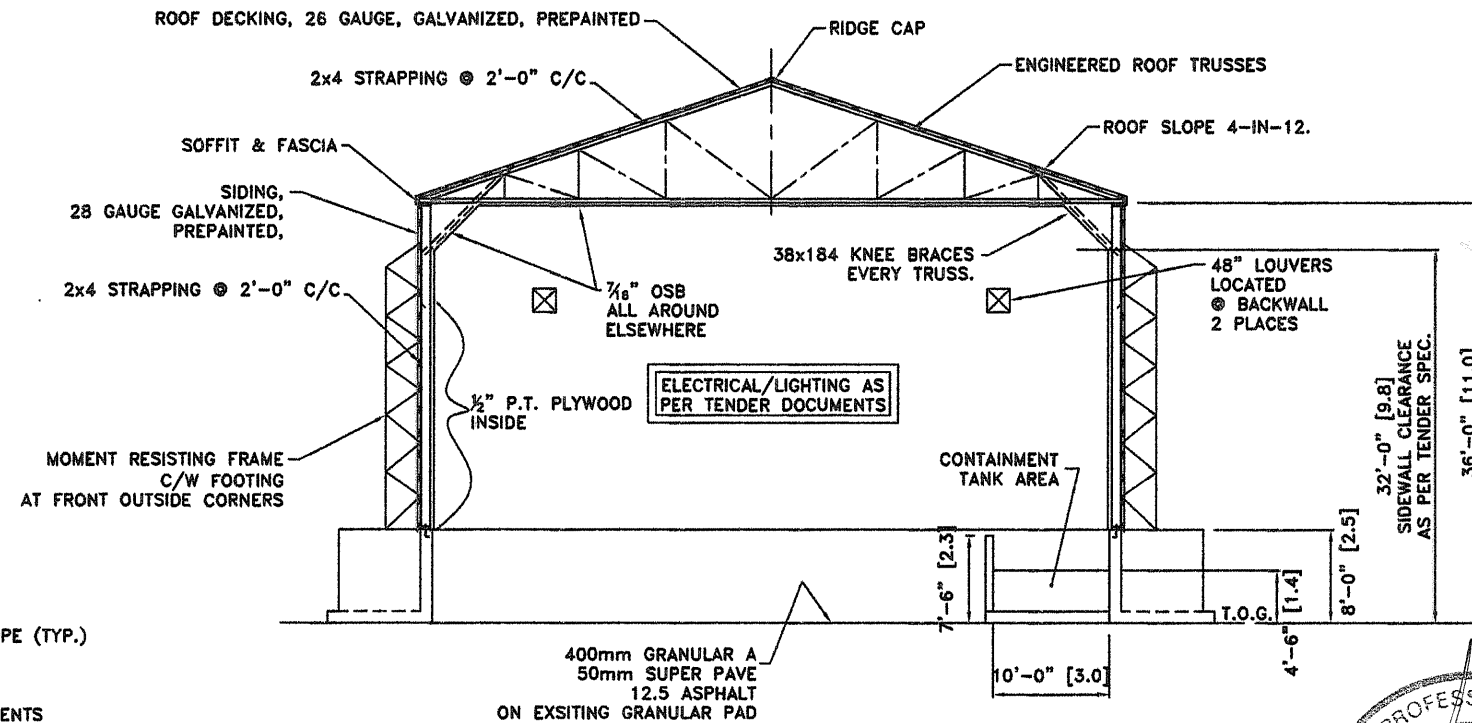


Appendix G

Typical General Arrangement Drawing



PLAN VIEW - FRONT OPEN



TYPICAL SECTION - FRONT OPEN

NOTES:

GENERAL:

- 1) ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE ONTARIO BUILDING CODE AND LATEST REVISIONS (OBC 2012).
- 2) SCOPE OF WORK AS PER CONTRACT DOCUMENTS.

FOUNDATION:

- 1) FOUNDATION HAS BEEN DESIGNED FOR A MINIMUM PERMISSIBLE BEARING PRESSURE OF 200 KPa (4000 PSI).
- 2) FOUNDATION TO BE FOUNDED ON GRADE AS PERMITTED BY OBC 2006 4.2.4.4.(2)(b).
- 3) CONCRETE TO CONFORM TO CSA A23.1-04 AND CSA A23.3-04 AND SHALL HAVE A MINIMUM STRENGTH AT 28 DAYS OF 30 MPA AND SHALL CONTAIN 4% TO 7% ENTRAINE AIR.
- 4) STEEL REINFORCEMENT TO CONFORM TO CSA A23.3-04 AND CSA A23.1-04. EPOXY COATED REBAR TO BE USED IN ALL AREAS NOT COVERED BY A MINIMUM OF 500mm OF SOIL.
- 5) EXPOSED INTERIOR CONCRETE FOUNDATION TO BE COATED WITH SEALER AS PER TENDER SPECIFICATIONS.

LUMBER:

- 1) ALL LUMBER SHALL CONFORM TO THE REQUIREMENTS OF THE STANDARD GRADING RULES OF THE NATIONAL LUMBER GRADES AUTHORITY, AND TO CAN/CSA-086-1 M89, "ENGINEERING DESIGN IN WOOD". ALL LUMBER SHALL BE DRY NO. 2 SPRUCE (SPF) OR BETTER.
- 2) ALL LUMBER IN CONTACT WITH THE CONCRETE SHALL MEET THE REQUIREMENTS OF CAN/CSA 080.0, CAN/CSA 080.2 FOR WOOD PRESERVATION.
- 3) NAILING OF WOODEN STRUCTURE TO BE DONE IN ACCORDANCE WITH GOOD PRACTICE AND THE REQUIREMENTS OF THE ONTARIO BUILDING CODE.
- 4) ORIENTATED STRAND BOARD (OSB) TO BE 7/8" OSB TYPE 2 OR BETTER.

ROOF TRUSSES:

- 1) ROOF TRUSSES TO BE DESIGNED BY ROOF MANUFACTURER.
- 2) LATERAL BRACING INSTALLED AS RECOMMENDED BY ROOF TRUSS MANUFACTURER.
- 3) INSTALLATION AS PER BCSI-BI-GUIDE FOR HANDLING, INSTALLING, RESTRAINING AND BRACING OF TRUSSES.
- 4) ROOF TRUSSES TO BE WOOD.
- 5) ROOF TRUSS UPLIFT ANCHORS TO BE INSTALLED AS PER TRUSS MANUFACTURER RECOMMENDATIONS.

SIDING/ROOFING:

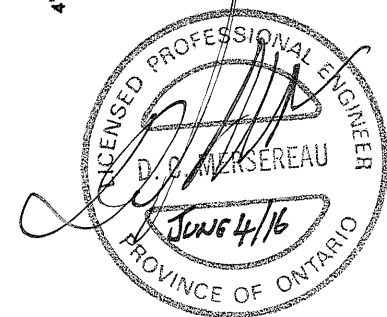
- 1) ROOFING TO BE 26 GA VICWEST OR EQUIVALENT. TRIM TO BE WHITE.
- 2) SIDING TO BE 26 GA VICWEST OR EQUIVALENT. TRIM TO BE WHITE.
- 3) ROOF TRUSSES AND INTERIOR WALLS TO BE COVERED WITH 12mm OSB AND 1/2" P.T. PLYWOOD AS NOTED.

ELECTRICAL:

- 1) ELECTRICAL TO BE AS SPECIFIED IN TENDER DOCUMENT.

LOADS:

- 1) FOUNDATION IS DESIGNED TO WITHSTAND DEAD AND LIVE LOADS IMPOSED UPON IT BY THE SUPERSTRUCTURE AS WELL AS LOADS FROM LOADING EQUIPMENT.
- 2) ENVIRONMENTAL LOADS DEFINED IN O.B.C. FOR RED LAKE $S_s=2.4$ kPa, $S_r=0.3$ kPa, q (q_0)=0.28 kPa.
- 3) FOUNDATION LOADS DUE TO PILED SAND/SALT.



MINISTRY OF TRANSPORTATION ONTARIO
RED LAKE PATROL YARD
60 x 80 SAND/SALT STORAGE STRUCTURE
RED LAKE, ONTARIO
GENERAL ARRANGEMENT & NOTES
FOR CONSTRUCTION

REV	DATE REVISED (mm-dd-yy)

Attention:
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DESIGNED: D.M.	SCALE: NTS
DRAWN: RM	DATE: (mm-dd-yy) 05-13-16
PROJECT ENG: D.J.	DRAWING NO: L01
CONTRACT NO: 122-716	(1 OF 1)