



**THURBER** ENGINEERING LTD.



**FOUNDATION INVESTIGATION AND DESIGN REPORT  
NEW SALT/SAND STORAGE BUILDING  
MTO PATROL YARD – DAWSON SITE  
TOWNSHIP OF MCINTYRE, ONTARIO  
LAT. 48.488618, LONG. -89.372937  
AGREEMENT NO. 6015-E-0023, ASSIGNMENT NO. 5  
G.W.P. 6055-16-00**

**GEOCRES No. 52A-232**

**Report to**

**Ministry of Transportation of Ontario**

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Date: August 10, 2017  
File: 18934

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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 Mapleward Road, approximately 150 m south of Dawson Road, in the Township of McIntyre, 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 Mapleward Road, approximately 150 m south of Dawson Road, in the Township of McIntyre, Ontario.

The site includes an existing sand dome, salt shed, 5 door garage and office, and gravel stockpile. There is an asphalt access road to the site which extends to the existing sand dome and garage and office. The remainder of the site has a gravel surface. The site terrain is generally flat and the area surrounding the site is wooded. Photographs of the site are presented in Appendix C.

Quaternary mapping indicates that the site is located within an area generally characterized by sand to silty sand till overlying granite bedrock.

### **3. SITE INVESTIGATION AND FIELD TESTING**

The site investigation and field testing for this project was carried out between June 14 and 17, 2017, and consisted of drilling and sampling four boreholes (DAW-01A/B to DAW-04) at the corners of the proposed salt and sand storage building. It is noted that while advancing Borehole DAW-1A, refusal was encountered at 2.9 m. The borehole was moved 1 m and advanced again as DAW-1B. For simplicity, these boreholes are collectively referred to as Borehole DAW-01A/1B. All boreholes were terminated in overburden at depths of 9.1 m to 15.8 m (Elev. 328.3 to 321.4 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, and N casing with tricone, were used to advance the boreholes through the overburden. Samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with the Standard Penetration Test (SPT).

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 DAW-1A 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-01A 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 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 sand layer overlying, in succession, deposits of silty clay, silty sand till, silt and sand till, and sand.

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

##### **5.1 Sand Fill**

A 0.8 to 1.3 m thick layer of brown sand fill with some gravel was encountered in all boreholes from the ground surface between Elev. 337.4 and 336.7 m. The base of the sand fill was encountered between Elev. 336.1 and 335.5 m.

The measured SPT 'N' values within the sand fill ranged from 20 to 33 blows per 0.3 m penetration suggesting a compact to dense relative density. Natural moisture contents measured on samples of the sand fill ranged from 6 to 16%.

The results of grain size analyses conducted on selected samples of the silty clay are 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	13 to 15
Sand	74 to 75
Silt + Clay	11 to 12

## 5.2 Silty Clay

A 0.4 to 0.9 m thick deposit of brown silty clay was encountered underlying the sand fill in boreholes DAW-1A/B, DAW-2, and DAW-4. The upper boundary of the deposit was encountered between Elev. 336.1 and 335.9 m in the boreholes. The base of the deposit was encountered between Elev. 335.5 and 335.2 m. Trace organics were observed within silty clay samples recovered from Boreholes DAW-01A and DAW-04.

The measured SPT 'N' values within the silty clay ranged from 6 to 15 blows per 0.3 m penetration indicating a firm to very stiff consistency. The natural moisture content measured on samples of the silty clay ranged from 16 to 35%.

The results of grain size analyses conducted on selected samples silty clay are provided on the Record of Borehole sheets in Appendix B1, 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 to 2
Sand	3 to 20
Silt	64 to 77
Clay	14 to 20

Atterberg limits testing was carried out on one sample of the silty clay and measured a plastic limit of 22%, a liquid limit of 32%, and a corresponding plasticity index of 10%. This result, which is plotted on Figure B7 of Appendix B, indicate that the deposit consists of low plasticity silty clay.

## 5.3 Silty Sand Till

A 0.7 to 2.8 m thick deposit of silty sand till was encountered underlying the silty clay deposit in Boreholes DAW-1A/B, DAW-2, and DAW-4, and below the sand fill in DAW-3. The silty sand till contained trace to some gravel and clay. The till deposit was also noted to contain cobbles and/or boulders. The upper boundary of the deposit was encountered between Elev. 335.5 and 335.2 m in the boreholes. The base of the deposit was encountered between Elev. 334.5 and 332.6 m.

The measured SPT 'N' values within the silty sand till ranged from 37 blows per 0.3 m penetration to 50 blows per 0.025 m of penetration, indicating a dense to very dense relative density. Auger refusal was encountered in this layer at 2.9 m depth in Borehole DAW-1A. The natural moisture content measured on samples of the silty sand till ranged from 13 to 23%.

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

Soil Particle	%
Gravel	10
Sand	55 to 60
Silt	20 to 26
Clay	9 to 10

#### 5.4 Silt Till

A 1.0 m thick discontinuous grey silt till layer was encountered underlying the silty sand till in Borehole DAW-02. The silt till was described as containing some clay and gravel and cobbles and/or boulders. The upper boundary of the deposit was encountered at Elev. 334.0 m. The base of the deposit was encountered at Elev. 333.0 m.

The measured SPT 'N' values within the silt till ranged from 50 blows per 0.125 m of penetration to 50 blows per 0.075 m of penetration, indicating a very dense relative density. A natural moisture content of 15% was measured on a sample of the silt till.

The result of a grain size analysis conducted on a sample of the silt till is provided on the Record of Borehole sheets in Appendix A, and illustrated in Figure B4 of Appendix B. The results of the grain size analysis are also summarized in the table below.

Soil Particle	%
Gravel	0
Sand	7
Silt	78
Clay	15



## 5.5 Sand and Silt Till

A 2.3 to 3.2 m thick deposit of sand and silt till was encountered underlying the silty sand till in Boreholes DAW-1A/B, DAW-03, and DAW-04, and below the silt till layer in DAW-02. The sand and silt till deposit ranged from being gravelly to having trace gravel and contained trace clay. The till deposit was also noted to contain cobbles and/or boulders. The upper boundary of the deposit was encountered between Elev. 334.5 to 332.6 m. The base of the deposit was encountered between Elev. 331.6 and 330.0 m.

The measured SPT 'N' values within the sand and silt till ranged from 50 blows per 0.15 m of penetration to 50 blows per 0.05 m of penetration, indicating a very dense relative density. The natural moisture content measured on samples of sand and silt till ranged from 6 to 17%.

The results of grain size analyses conducted on samples of the sand and silt till 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	5 to 71
Sand	25 to 43
Silt	29 to 45
Clay	7
Silt + Clay	4

## 5.6 Sand

A deposit of sand, which contained some silt and trace clay, was encountered underlying the silt and sand till deposit in all of the boreholes. The exact thickness of the sand is unknown as the boreholes were terminated within the sand deposit between Elev. 328.3 and 321.4 m. The upper boundary of the deposit was encountered between Elev. 331.6 to 330.0 m.

The measured SPT 'N' values within the sand ranged from 50 blows per 0.15 m of penetration to 100 blows per 0.05 m of penetration, indicating a very dense relative density. The natural moisture content measured on samples of the sand ranged from 3 to 26%.

The results of grain size analyses conducted on samples of the sand 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	0
Sand	79 to 85
Silt + Clay	15 to 21

## 5.7 Water Levels

Water levels were observed in the boreholes during and upon completion of drilling. A standpipe piezometer was installed in Borehole DAW-1 to monitor the groundwater level at the site. The following table summarizes the water levels measured in the open boreholes and piezometer.

**Table 5.1 – Water Level Measurements**

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
DAW-1	June 14, 2017	1.7	335.7	In piezometer
	June 15, 2017	1.4	336.0	
	June 16, 2017	1.2	336.2	
	June 17, 2017	1.2	336.2	
DAW-2	June 14, 2017	1.0	335.7	In open borehole
DAW-3	June 15, 2017	1.0	335.8	In open borehole
DAW-4	June 15, 2017	2.0	335.2	In open borehole

Based on the above measurements, the groundwater table is expected to be at about Elev. 336 m. However, it is noted that the above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

## 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.

Thurber Engineering Ltd.



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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 pavement will be approximately at the existing ground surface.

Any 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. The final subgrade surface should be uniformly compacted to 98% 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 sand till
- Strip footings placed near the surface on existing sand fill

While both foundation options are considered feasible, supporting the structure on strip footings founded below the frost depth on the very dense silty sand till will mitigate the risk of frost movement of the footings.

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

### **10.1 Strip Footings Founded Below the Frost Depth on Silty Sand Till**

The highest permitted founding elevations for footings founded below the frost depth on the very dense silty sand till are given in Table 10.1 below. Frost depth at this site is 2.2 m.

**Table 10.1 – Highest Permitted Founding Elevations**

Location	Borehole	Min. Depth (m)	Highest Elevation (m)
SW Building Corner	DAW-1A/B	2.2	335.2
NE Building Corner	DAW-2	2.2	334.5
NW Building Corner	DAW-3	2.2	334.6
SW Building Corner	DAW-4	2.2	335.0

Spread footings founded on the very dense silty sand till 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 = 450 kPa

Factored Geotechnical Resistance at SLS = 300 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 founded on the very dense silty sand till may be computed using an ultimate friction coefficient of 0.5.

The footing subgrade should be inspected by a geotechnical engineer following excavation, in accordance with OPSS 902 (*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 granular 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% Standard Proctor Maximum Dry Density (SPMDD).

## **10.2 Strip Footings on Existing Sand Fill**

Consideration could be given to supporting the building on spread footings founded at the ground surface on the sand fill. 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.

Spread 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
Factored 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 sand fill may be computed using an ultimate friction coefficient of 0.45.

## **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. To achieve a satisfactory factor of safety against slope instability, the foundation footing must be embedded a minimum 0.5 m below the finished grade as shown on Figures E2 and E3.

## **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 estimated from correlations with the SPT “N” values, index testing, and engineering judgement.

The analyses indicate that the placement of the stockpile will result in about 10 mm of immediate settlement in the sand fill. The ground will subsequently experience an additional 20 mm settlement associated with consolidation of the underlying cohesive silty clay. These settlements were estimated under the full height of sand/salt stockpile and are expected to occur relatively quickly following placement of the stockpile. It is estimated that less than 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.

### 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)
- $\gamma$  = 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 sand fill above the water level and native silty clay may be classed as Type 3 soil. The 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. Excavation into the silty sand till deposit will likely encounter cobbles and boulders. The contractor's excavation equipment must be able to dislodge and remove these obstructions. An NSSP to alert the contractor of this requirement has been included in Appendix D.

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**

Based on groundwater measurements in open boreholes and piezometer, excavations for construction of footings founded on the very dense silty sand till are anticipated to extend below the groundwater table. Therefore, groundwater seepage into the open excavations is expected over the course of construction. It is anticipated that groundwater control measures such as perimeter ditches and filtered sump pumping will be adequate for the control of groundwater prior to concrete placement.

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.

The foundation excavations will extend through permeable soils to a maximum depth of 1.3 m below the groundwater table (assuming that the spread footings founded on silty sand till option is adopted). Appropriate groundwater control measures should be implemented to allow footing construction in the dry.

## 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.

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## **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 <sup>(1)</sup> 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

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



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

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

### 5. LEGEND FOR RECORDS OF BOREHOLES


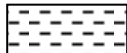



SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core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

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

 Water Level  
 Shear Strength Determination by Pocket Penetrometer

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

## EXPLANATION OF ROCK LOGGING TERMS

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

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

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



# 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 <sub>L</sub> < 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 <sub>L</sub> < 30%).
		CI	Inorganic clays of medium plasticity, silty clays. (30% < W <sub>L</sub> < 50%).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS W <sub>L</sub> > 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 DAW-01A/B 1 OF 2 METRIC

GWP# 6055-16-00 LOCATION SW Building Corner, NAD 83-15 N 5 372 415.2 E 351 119.1 ORIGINATED BY SMP  
HWY Mapleward Rd BOREHOLE TYPE Hollow Stem Augers/N Casing with Tricone COMPILED BY AN  
DATUM Geodetic DATE 2017.06.14 - 2017.06.17 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
337.4	GROUND SURFACE							20 40 60 80 100						
0.0	<b>SAND</b> , some gravel, some silt Compact to Dense Brown Moist (FILL)		1	SS	23		337							13 75 12 (SI+CL)
			2	SS	32									
336.1														
1.3	Silty <b>CLAY</b> , trace sand, organics Stiff Brown Wet		3	SS	15		336							0 3 77 20
335.2			4	SS	15									
2.2	Silty <b>SAND</b> , containing cobbles or boulders Very Dense Grey Wet (TILL)		5	SS	50/ 0.125		335							
334.5	Auger refusal at 2.9m, switch to casing		6	SS	50/ 0.100									
2.9	<b>SAND</b> and <b>SILT</b> , gravelly, trace clay, containing cobbles or boulders Very Dense Brown to Grey Wet (TILL)		1	GS			334							71 25 4 (SI+CL)
			7	SS	50/ 0.050									
			8	SS	50/ 0.125		333							62 34 4 (SI+CL)
							332							
331.3			9	SS	50/ 0.075		331							
6.1	<b>SAND</b> , some silt Very Dense Grey Wet						330							
			10	SS	50/ 0.150									
			2	GS			329							
328.3			11	SS	50/ 0.125									
9.1	END OF BOREHOLE AT 9.1m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.													

Continued Next Page

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

## 2 OF 2

ORIGINATED BY SMP

HWY	Mapleward Rd	BOREHOLE TYPE	Hollow Stem Augers/N Casing with Tricone	COMPILED BY	AN
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DATUM	Geodetic	DATE	2017.06.14 - 2017.06.17	CHECKED BY	GRL
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WATER LEVEL READINGS		
DATE	DEPTH(m)	ELEV.(m)
2017.06.14	1.7	335.7
2017.06.15	1.4	336.0
2017.06.16	1.2	336.2
2017.06.17	1.2	336.2

# RECORD OF BOREHOLE No DAW-02

1 OF 2

METRIC

GWP# 6055-16-00 LOCATION NE Building Corner, , NAD 83-15 N 5 372 433.7 E 351 140.5 ORIGINATED BY SMP  
 HWY Mapleward Rd BOREHOLE TYPE Hollow Stem Augers/N Casing with Tricone COMPILED BY AN  
 DATUM Geodetic DATE 2017.06.14 - 2017.06.14 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)							
336.7	GROUND SURFACE							20 40 60 80 100								GR SA SI CL			
0.0	<b>SAND</b> , some gravel, some silt Compact Brown Moist (FILL)		1	SS	20	▽	336									2 20 64 14			
335.9																			
0.8	Silty <b>CLAY</b> , sandy, trace gravel Firm Brown Moist		2	SS	6														
335.5									335										10 55 26 9
1.2	Silty <b>SAND</b> , some gravel, trace clay, occasional cobbles Dense to Very Dense Brown Wet (TILL)		3	SS	37														
			4	SS	50/ 0.075														
			5	SS	50/ 0.125				334										0 7 78 15
334.0																			
2.7	<b>SILT</b> , some clay, some gravel, containing cobbles and boulders Very Dense Grey Moist (TILL)		6	SS	50/ 0.125														
333.0			7	SS	50/ 0.075				333										
3.7	<b>SAND</b> and <b>SILT</b> , trace clay, containing cobbles and boulders Very Dense Grey Wet (TILL)		8	SS	50/ 0.125														
							332												
			9	SS	50/ 0.050														
330.0								331											
6.7	<b>SAND</b> , some silt Very Dense Grey Wet		10	SS	50/ 0.125		330												
			1	GS				329											
			11	SS	50/ 0.125		328												
326.9																			
9.8	END OF BOREHOLE AT 9.8m.							327											

Continued Next Page

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

## METRIC

[illegible]

# RECORD OF BOREHOLE No DAW-03

1 OF 2

METRIC

GWP# 6055-16-00 LOCATION NW Building Corner, NAD 83-15 N 5 372 435.7 E 351 126.1 ORIGINATED BY SMP  
 HWY Mapleward Rd BOREHOLE TYPE Hollow Stem Augers/N Casing with Tricone COMPILED BY AN  
 DATUM Geodetic DATE 2017.06.15 - 2017.06.15 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
336.8	GROUND SURFACE																
0.0	<b>SAND</b> , some gravel, some silt Compact Brown Moist (FILL)		1	SS	24		336										
335.5			2	SS	24												
1.3	Silty <b>SAND</b> , some gravel, some clay, containing cobbles Very Dense Brown Moist (TILL)		3	SS	50/ 0.100			335									
			4	SS	50/ 0.125												
			5	SS	50/ 0.075												
333.9			6	SS	50/ 0.075			334									
2.9	<b>SAND</b> and <b>SILT</b> , gravelly, trace clay, containing cobbles and boulders Very Dense Grey Wet (TILL)				0.075												
			1	GS													
331.6								332									
5.2	<b>SAND</b> , some silt, trace clay, oxidation stains Very Dense Grey Wet		7	SS	50/ 0.100												
						330											
			8	SS	50/ 0.125												
	becoming silty at 8.5m																
						328											
						327											

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No DAW-03

2 OF 2

METRIC

GWP# 6055-16-00 LOCATION NW Building Corner, NAD 83-15 N 5 372 435.7 E 351 126.1 ORIGINATED BY SMP  
 HWY Mapleward Rd BOREHOLE TYPE Hollow Stem Augers/N Casing with Tricone COMPILED BY AN  
 DATUM Geodetic DATE 2017.06.15 - 2017.06.15 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)						
						20	40	60	80	100	20	40	60				
	Continued From Previous Page		9	SS	50/ 0.100												
326.5 10.3	END OF BOREHOLE AT 10.3m. WATER LEVEL AT 1.0m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

## METRIC

[illegible]

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



# RECORD OF BOREHOLE No DAW-04

2 OF 2

METRIC

GWP# 6055-16-00 LOCATION SE Building Corner, NAD 83-15 N 5 372 410.5 E 351 135.5 ORIGINATED BY SMP  
 HWY Mapleward Rd BOREHOLE TYPE Hollow Stem Augers/N Casing with Tricone COMPILED BY AN  
 DATUM Geodetic DATE 2017.06.15 - 2017.06.16 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			
								○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE												
	Continued From Previous Page							20	40	60	80	100								
	becoming silty at 11.0m						327													
		12	SS	50/ 0.150																
							326													
		3	GS																	
		13	SS	25/ 0.025			325													
		4	GS				324													
		14	SS	50/ 0.125																
						323														
						322														
321.4																				
15.8	END OF BOREHOLE AT 15.8m. WATER LEVEL AT 2.0m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																			

ONTMT4S MTO-18934.GPJ 2017TEMPLATE(MTO).GDT 17/8/9



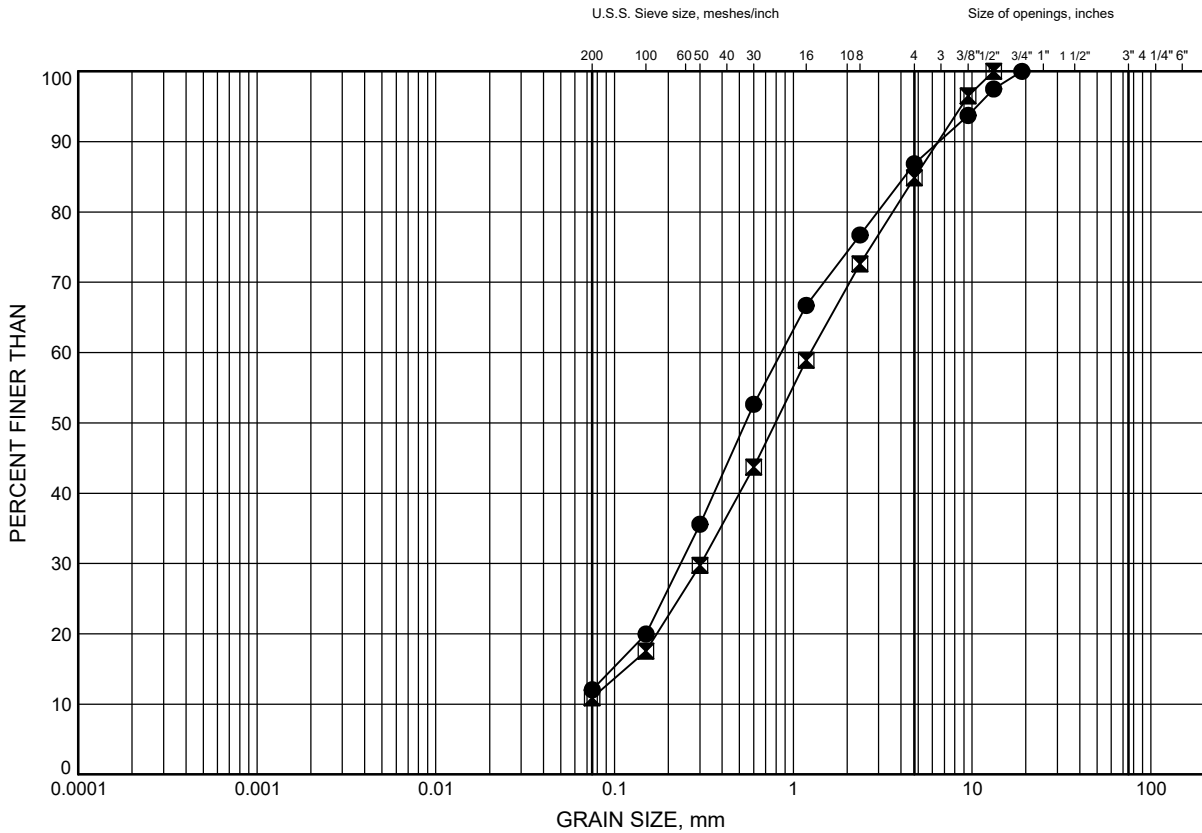
## **Appendix B**

### **Laboratory Test Results**

# GRAIN SIZE DISTRIBUTION

FIGURE B1

## SAND FILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DAW-01A/B	0.3	337.1
⊠	DAW-04	0.9	336.3

Date August 2017  
GWP# 6055-16-00

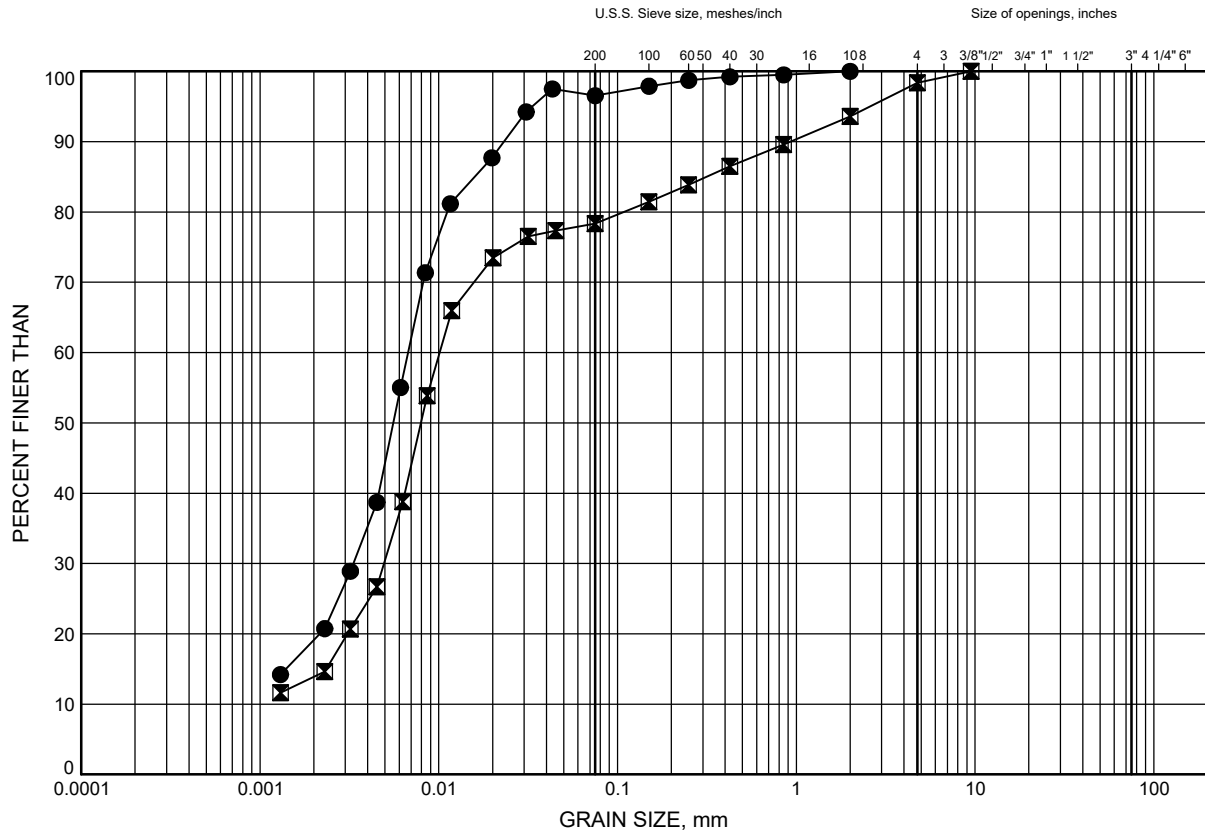


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Chkd. GRL

# GRAIN SIZE DISTRIBUTION

FIGURE B2

## Silty CLAY



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DAW-01A/B	1.5	335.9
⊠	DAW-02	1.0	335.7

Date August 2017

GWP# 6055-16-00



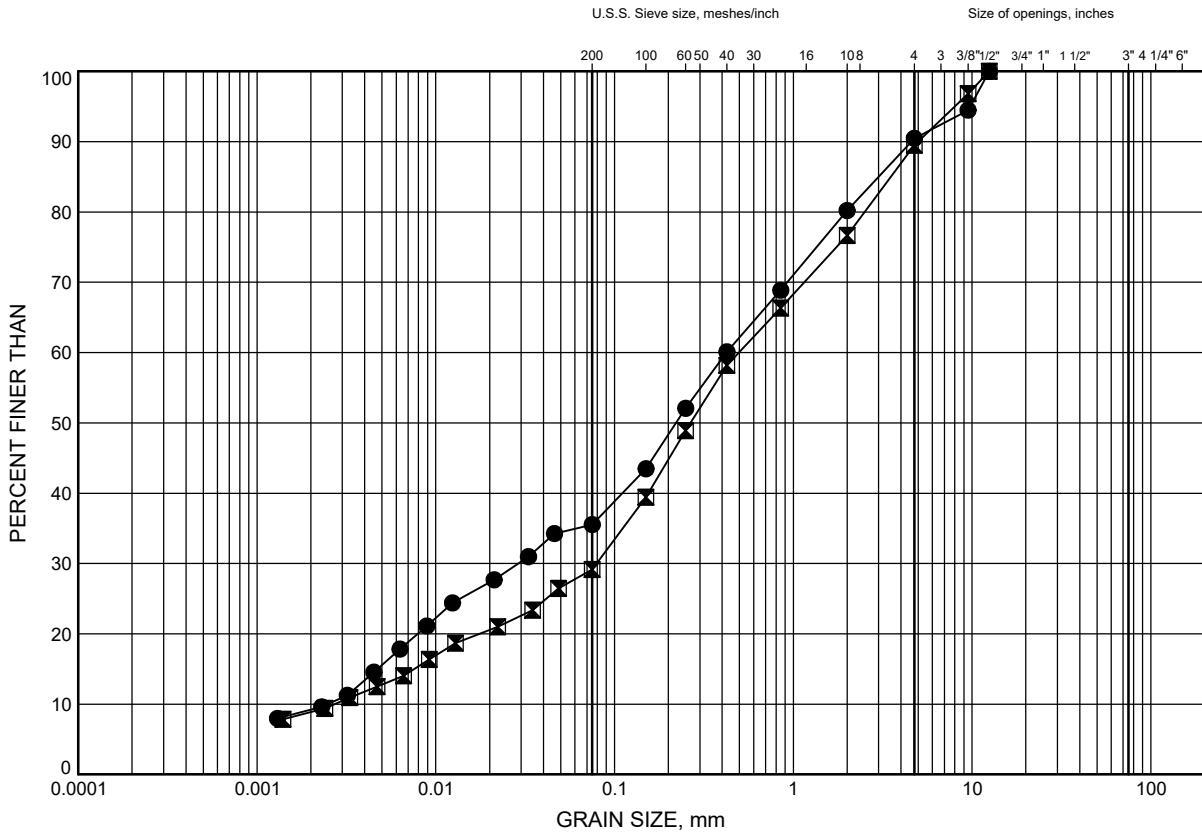
Prep'd AN

Chkd. GRL

# GRAIN SIZE DISTRIBUTION

FIGURE B3

## Silty SAND TILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DAW-02	2.1	334.6
◻	DAW-03	2.1	334.7

Date August 2017  
GWP# 6055-16-00

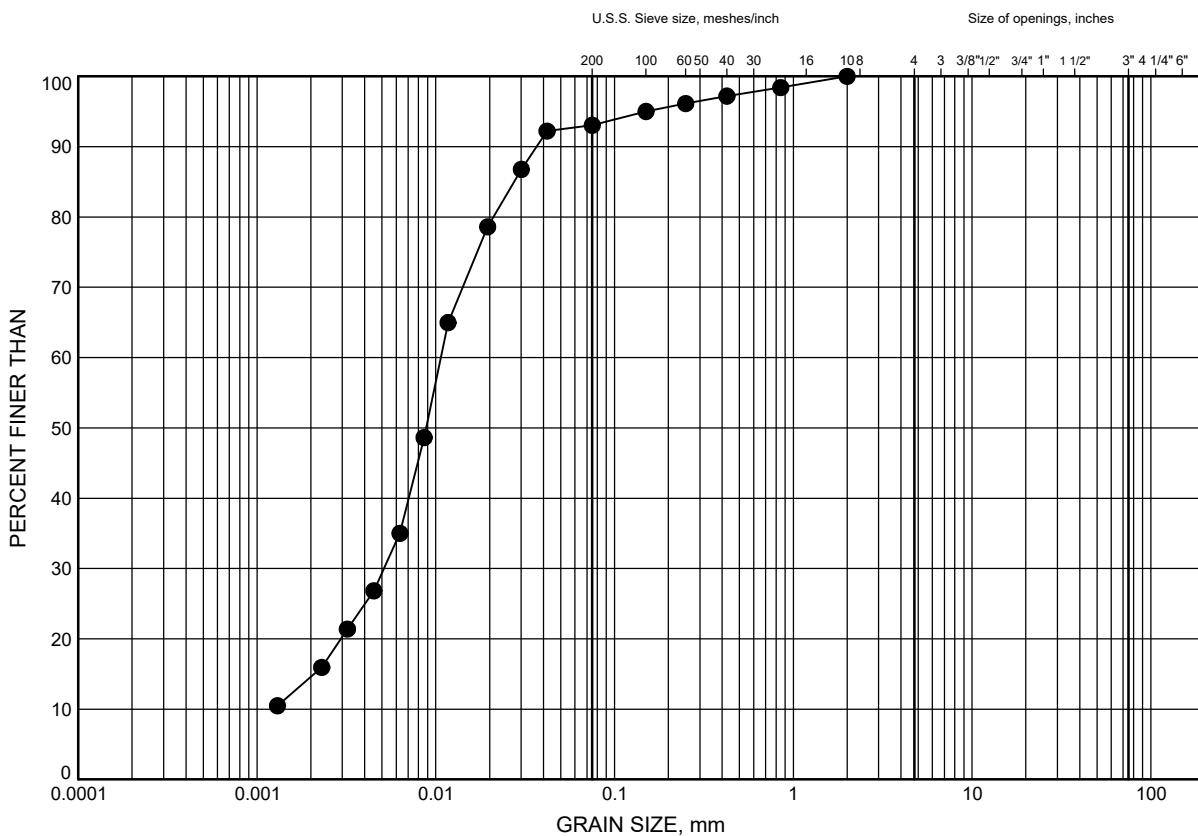


Prep'd AN  
Chkd. GRL

# GRAIN SIZE DISTRIBUTION

FIGURE B4

## SILT TILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DAW-02	3.1	333.6

Date August 2017

GWP# 6055-16-00



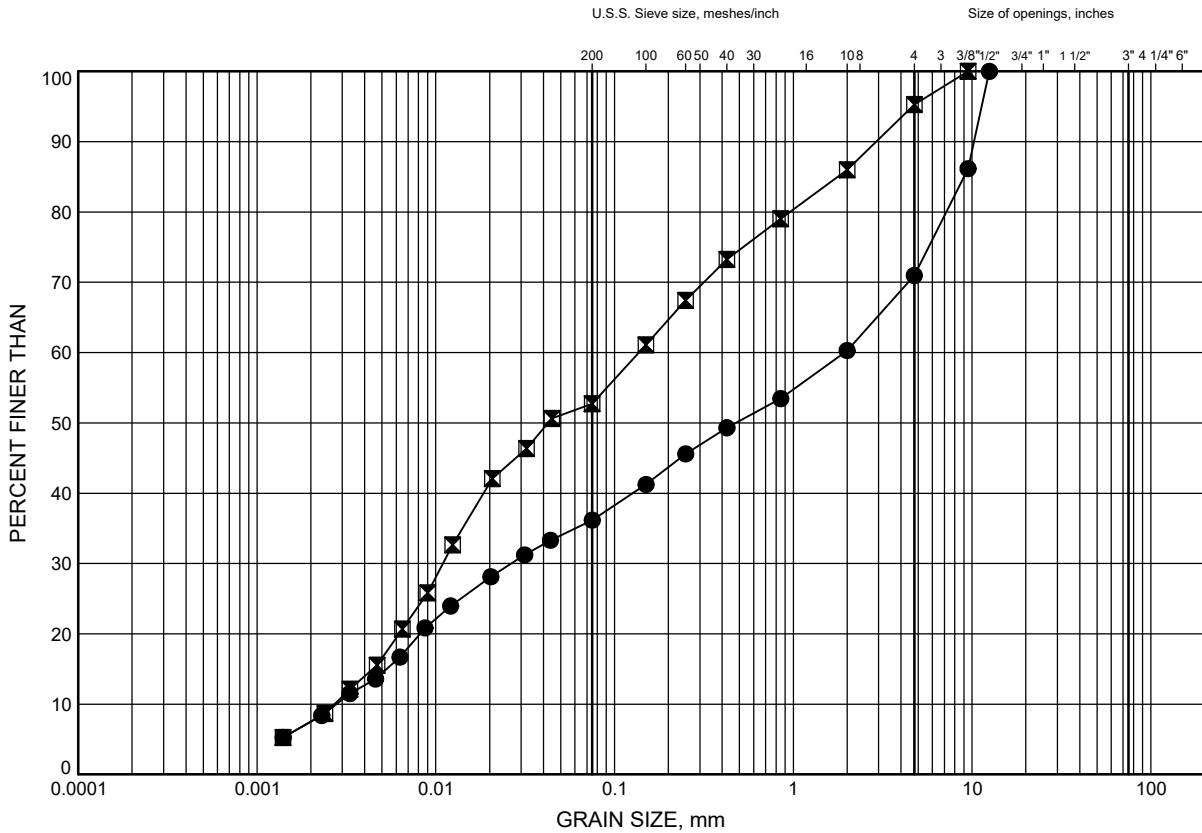
Prep'd AN

Chkd. GRL

# GRAIN SIZE DISTRIBUTION

FIGURE B5

## SAND & SILT TILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DAW-03	4.9	331.9
◻	DAW-04	6.1	331.1

Date August 2017  
GWP# 6055-16-00

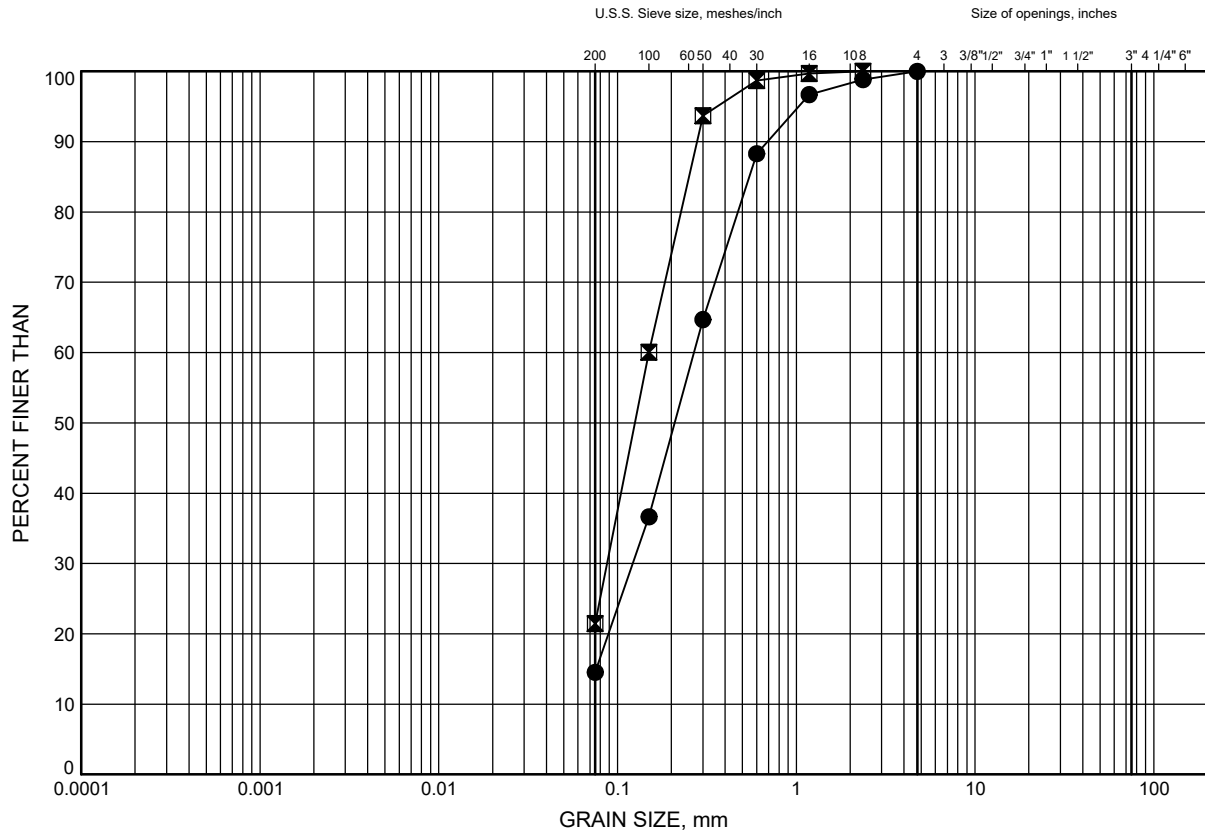


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# GRAIN SIZE DISTRIBUTION

FIGURE B6

## SAND



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DAW-03	6.1	330.7
⊠	DAW-04	8.2	329.0

Date August 2017  
GWP# 6055-16-00



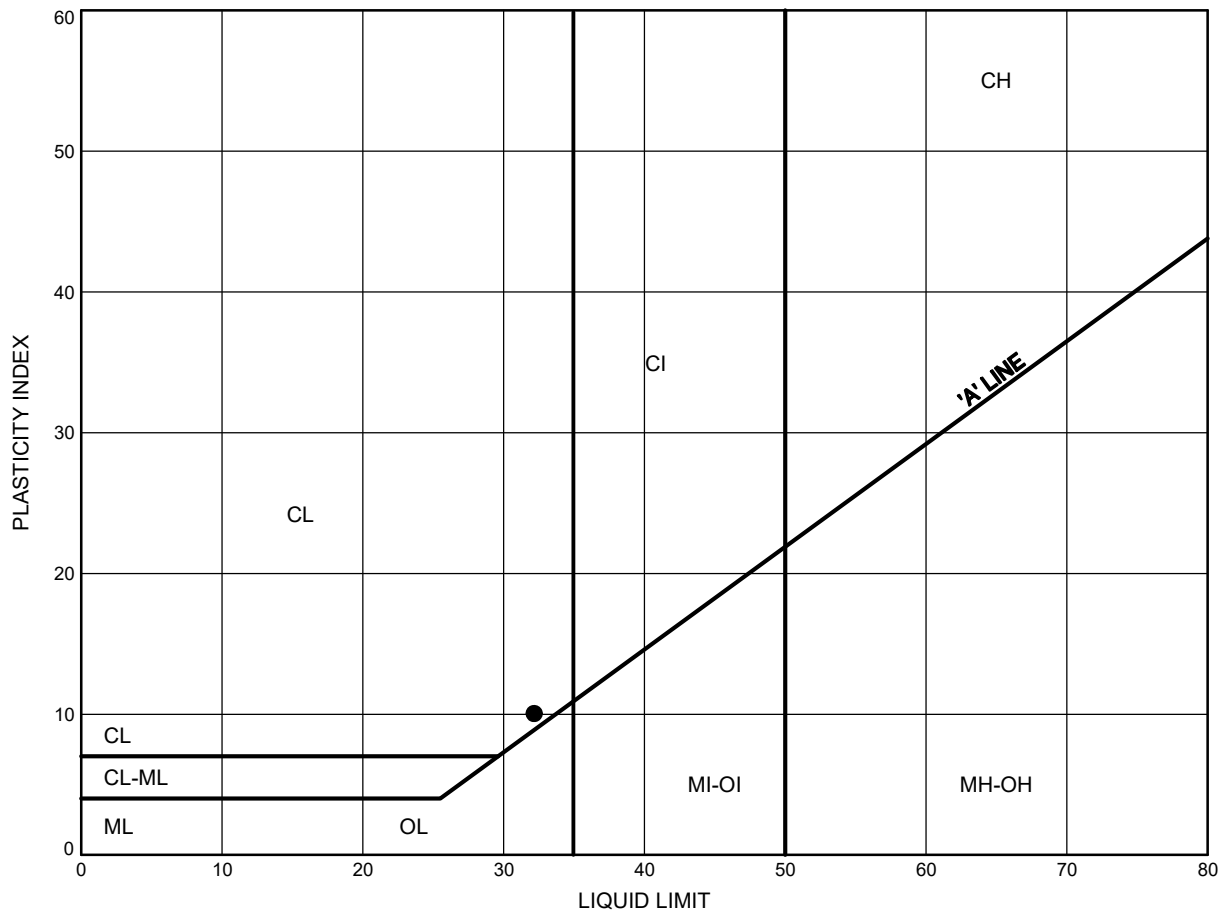
Prep'd AN  
Chkd. GRL



# ATTERBERG LIMITS TEST RESULTS

FIGURE B7

Silty CLAY



## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DAW-01A/B	1.5	335.9

Date August 2017

GWP# 6055-16-00



Prep'd AN

Chkd. GRL



## Appendix C

### Site Photographs



**Photograph 1 – Existing salt shed, sand dome, garage and office, looking west from site entrance**



**Photograph 2 – Proposed building area showing borehole locations, looking northeast**



## **Appendix D**

### **List of Special Provisions and Suggested Text for NSSP**



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

- OPSS.PROV 501
- OPSS.PROV 1010
- OPSS 902

## **2. Suggested Text for NSSP on “Obstructions in Silty Sand Till”**

Cobbles and boulders are present within the silty sand till deposit. The presence of these cobbles and boulders will make excavation through the till deposit difficult. Excavation through this till material may first be tried using bulk excavation techniques.



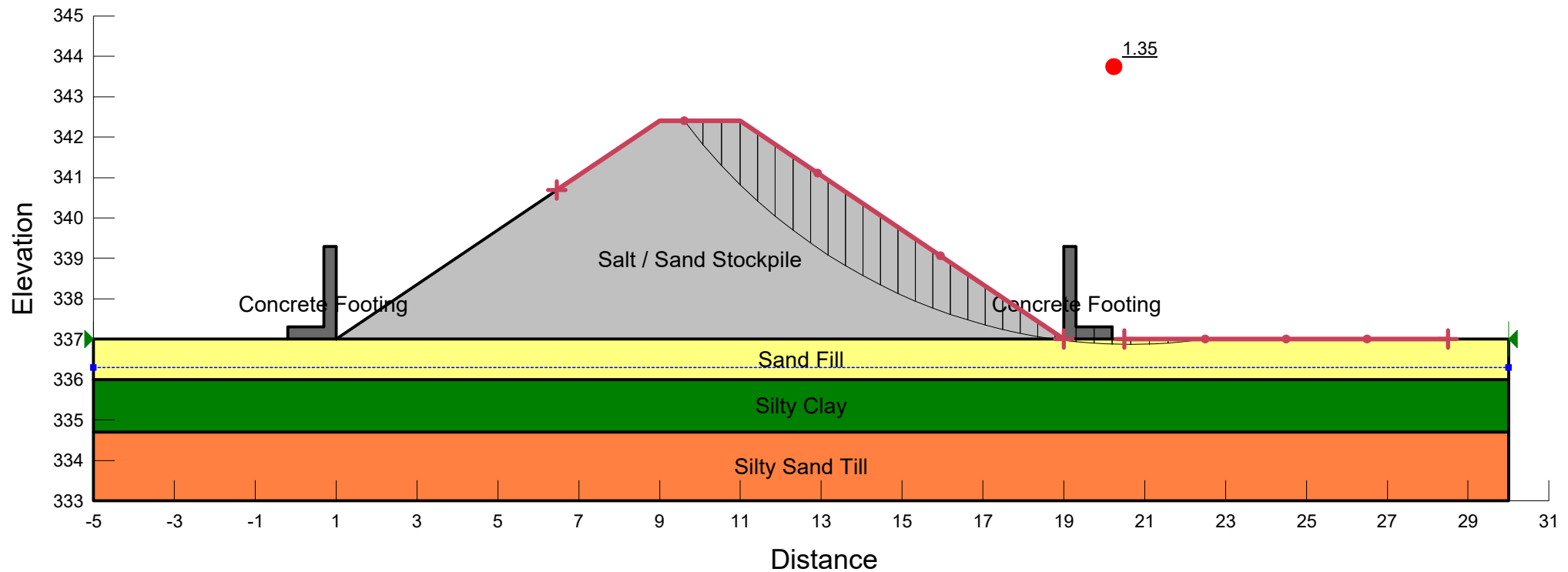
## **Appendix E**

### **Slope Stability Analysis Results**

# FIGURE E1

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

Sand Fill	21 kN/m <sup>3</sup>	0 kPa	34 °
Silty Clay	17 kN/m <sup>3</sup>	0 kPa	28 °
Silty Sand Till	18 kN/m <sup>3</sup>	0 kPa	36 °
Salt / Sand Stockpile	16 kN/m <sup>3</sup>	0 kPa	32 °
Concrete Footing	25 kN/m <sup>3</sup>	15,000 kPa	0 °

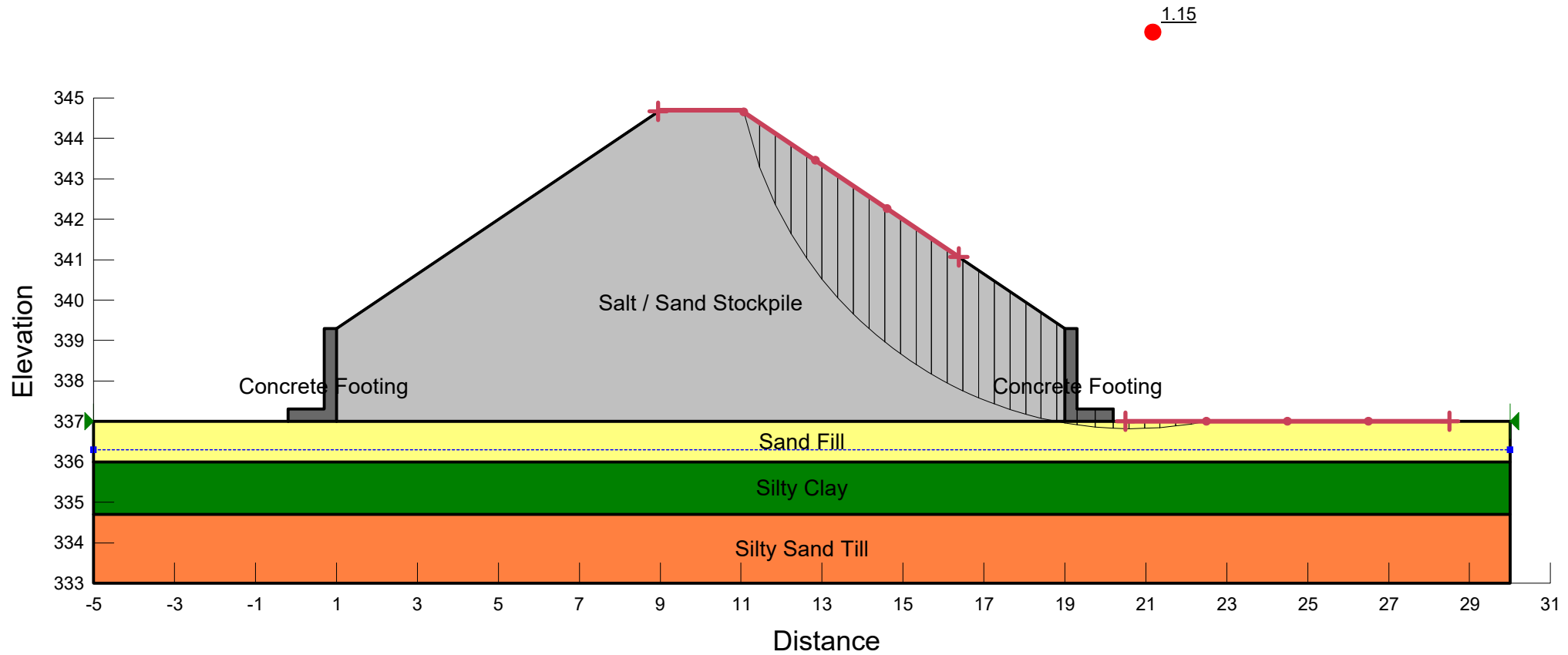




# FIGURE E2

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

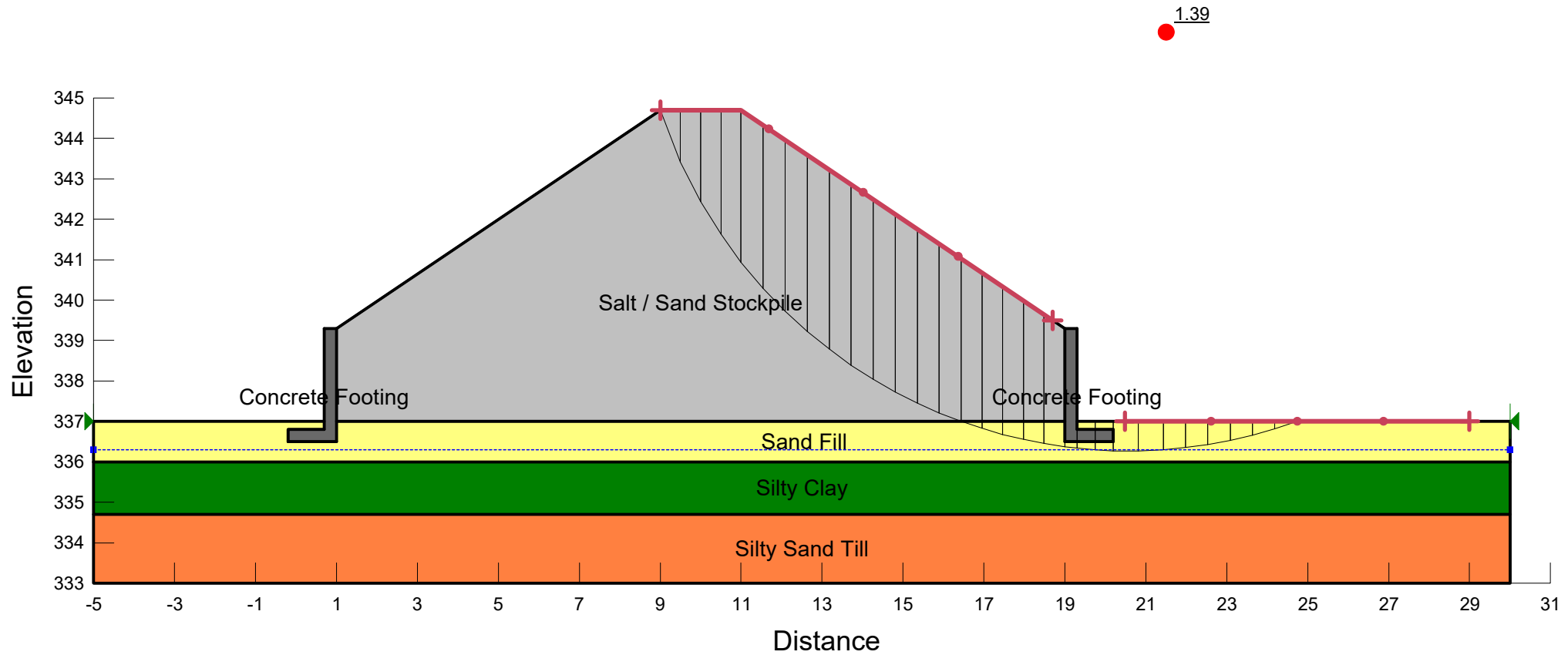
Sand Fill	21 kN/m <sup>3</sup>	0 kPa	34 °
Silty Clay	17 kN/m <sup>3</sup>	0 kPa	28 °
Silty Sand Till	18 kN/m <sup>3</sup>	0 kPa	36 °
Salt / Sand Stockpile	16 kN/m <sup>3</sup>	0 kPa	32 °
Concrete Footing	25 kN/m <sup>3</sup>	15,000 kPa	0 °



# FIGURE E3

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

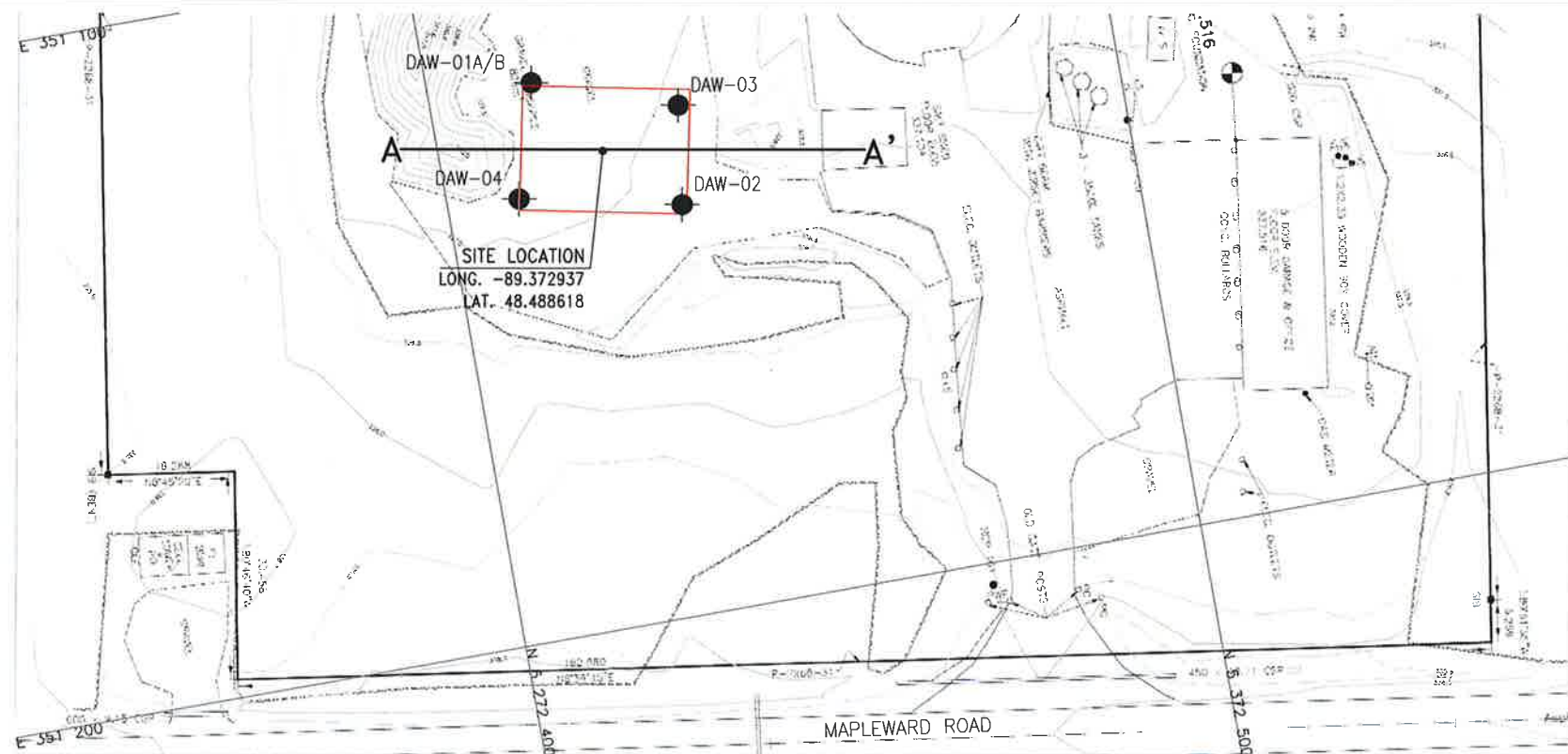
Sand Fill	21 kN/m <sup>3</sup>	0 kPa	34 °
Silty Clay	17 kN/m <sup>3</sup>	0 kPa	28 °
Silty Sand Till	18 kN/m <sup>3</sup>	0 kPa	36 °
Salt / Sand Stockpile	16 kN/m <sup>3</sup>	0 kPa	32 °
Concrete Footing	25 kN/m <sup>3</sup>	15,000 kPa	0 °



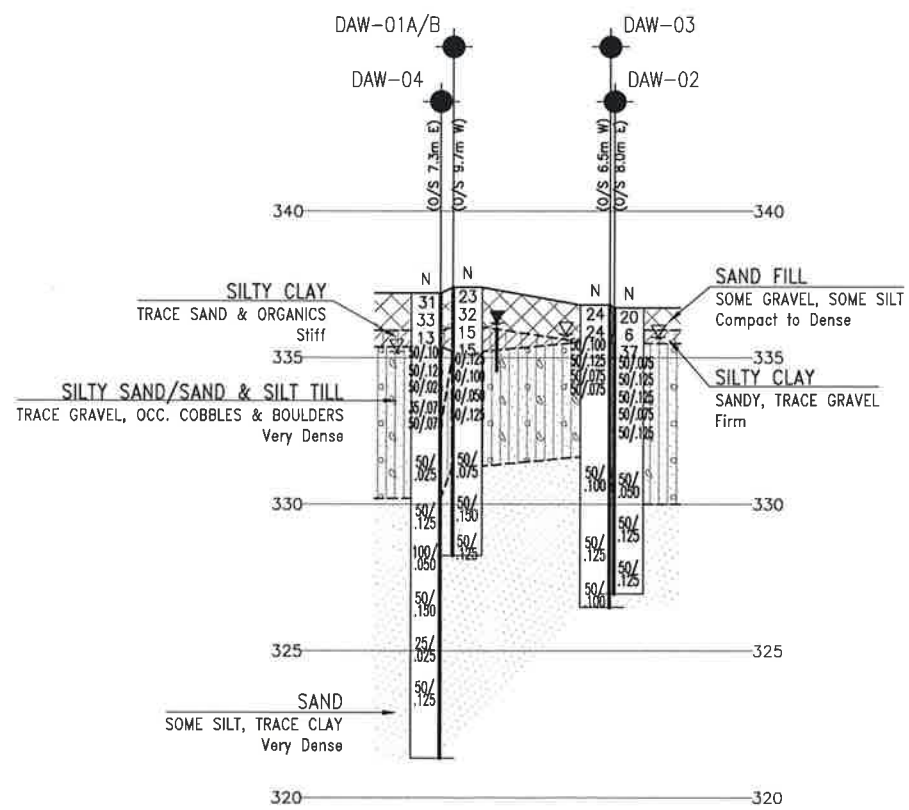


## **Appendix F**

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



PLAN



SECTION A-A'



H 1:1000

V 1:250

## METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
GWP No 6055-16-00

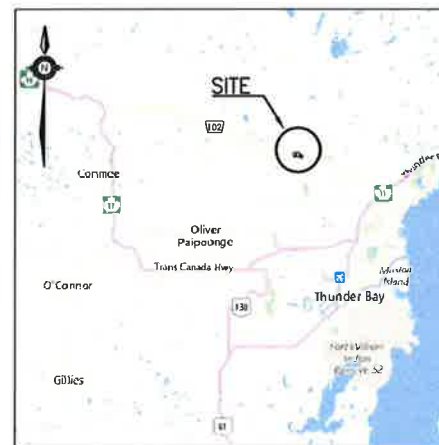
NEW SALT/SAND STORAGE BUILDING  
MTO PATROL YARD-DAWSON  
HIGHWAY 102  
BOREHOLE LOCATIONS AND SOIL STRATA



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
DAW-01A/B	337.4	5 372 415.2	351 119.1
DAW-02	336.7	5 372 433.7	351 140.5
DAW-03	336.8	5 372 435.7	351 126.1
DAW-04	337.2	5 372 410.5	351 135.5

## -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.
- Borehole locations are shown in MTM NAD-83 Zone 15 coordinates.

GEOCRES No. 52A-232

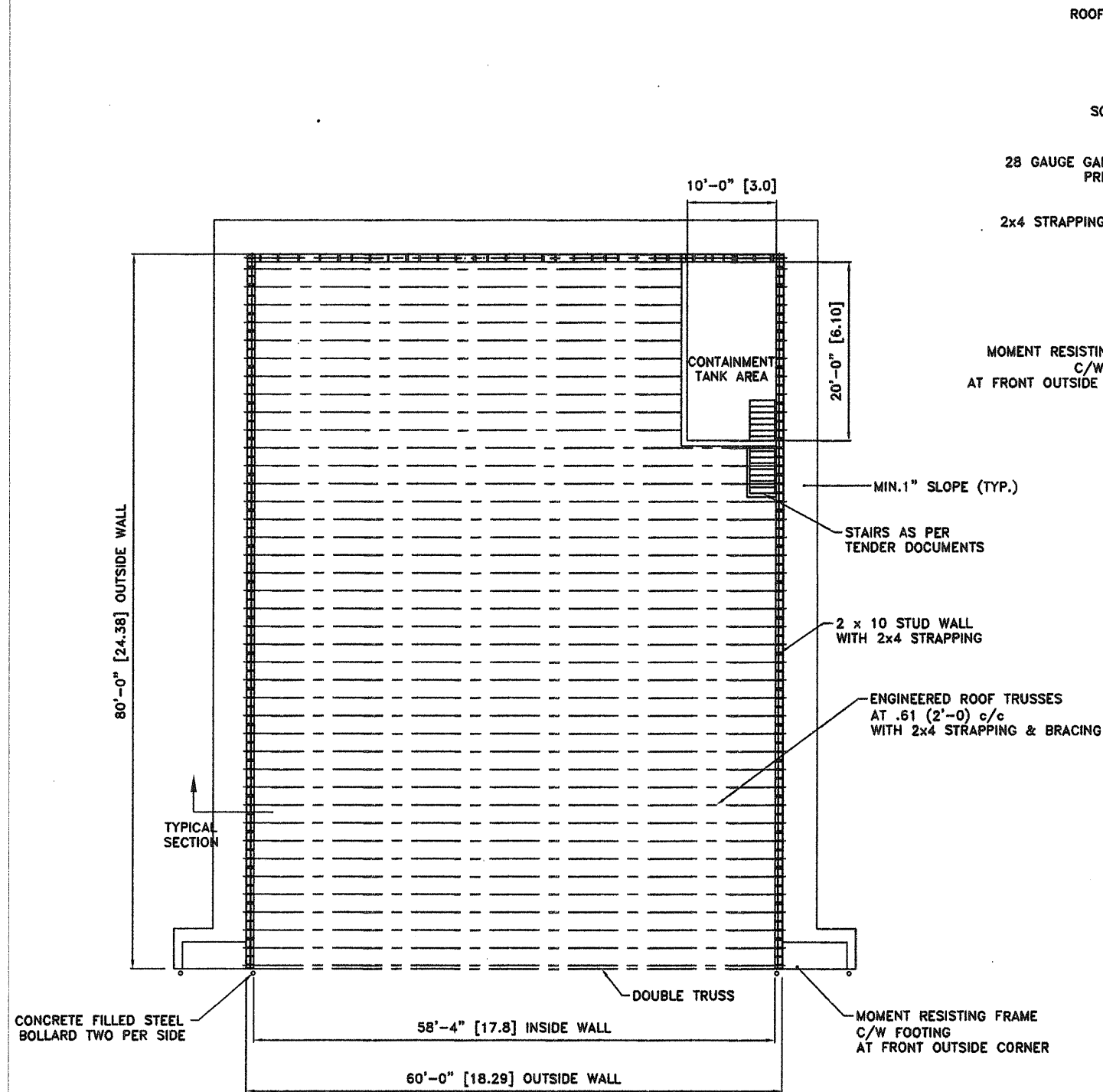


REVISIONS	DATE	BY	DESCRIPTION
DESIGN	GRL	CHK KS	CODE
DRAWN	AN	CHK GRL	SITE
			LOAD
			STRUCT
			DWG 1
			DATE AUG 2017

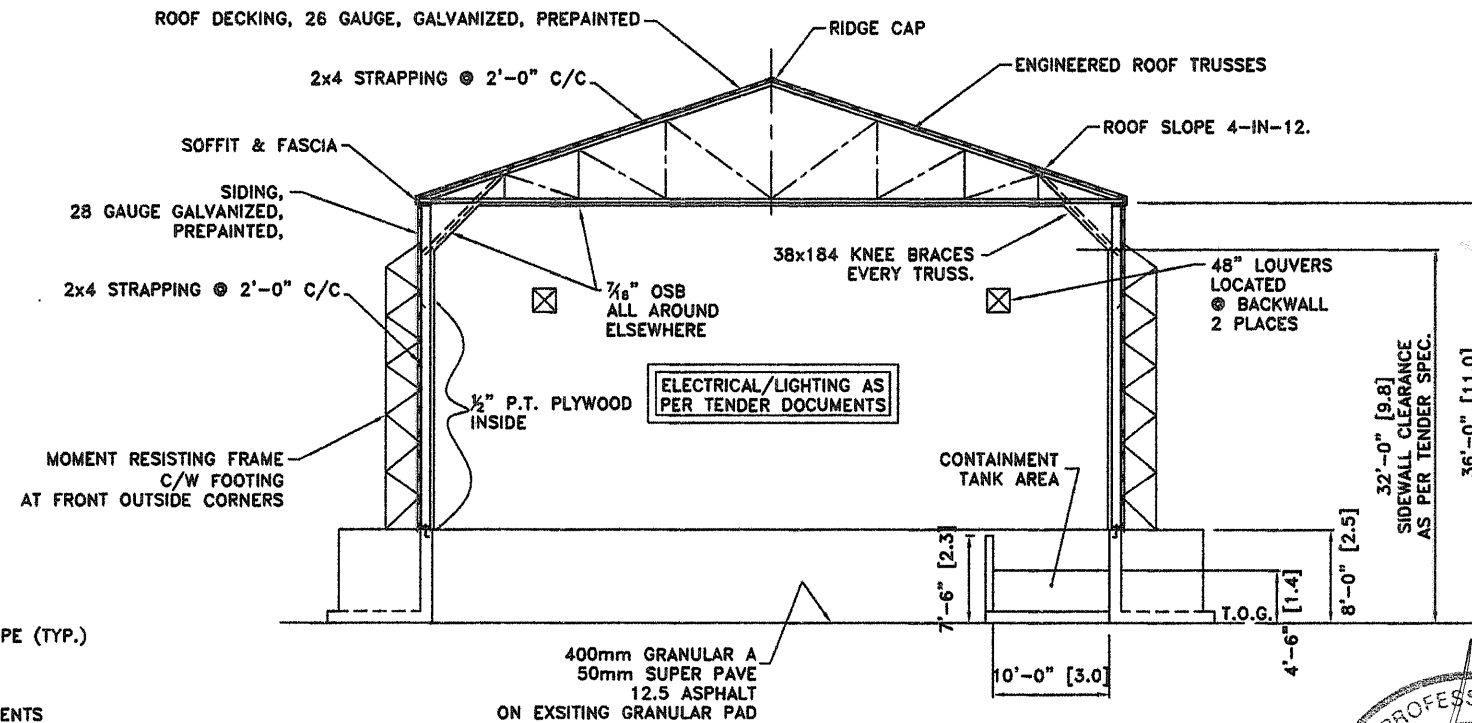


## Appendix G

### 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% ENTRAINED 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:

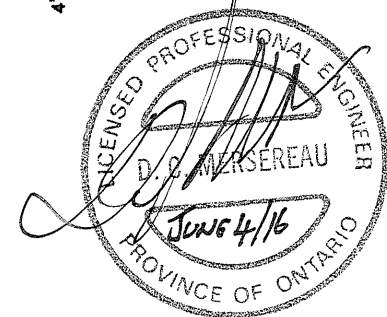
- 1) ROOFING TO BE 26 GA VICWEST OR EQUIVALENT. TRIM TO BE WHITE.
- 2) SIDING TO BE 26 GA VICWEST OR EQUIVALENT. TRIM TO BE WHITE.
- 3) ROOF TRUSSES AND INTERIOR WALLS TO BE COVERED WITH 12mm OSB AND 1/2" P.T. PLYWOOD AS NOTED.

##### 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 )