



THURBER ENGINEERING LTD.



**FOUNDATION INVESTIGATION REPORT
NEW GARAGE BUILDING
MTO PATROL YARD – MARATHON SITE
TOWN OF MARATHON, ONTARIO
LAT. 48.764986, LONG. -86.355128
AGREEMENT NO. 6015-E-0023, ASSIGNMENT NO. 5
G.W.P. 6053-16-00**

GEOCRES No. 42D-48

Report to

Ministry of Transportation of Ontario

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1. INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the site of a proposed garage building located at an existing Ministry of Transportation Ontario (MTO) Patrol Yard in Northwestern Ontario. The patrol yard is located on Highway 17, approximately 2.1 km west of Peninsula Road, in the Town of Marathon, 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, approximately 2.1 km west of Peninsula Road, in the District of Thunder Bay, Ontario.

The site includes two sand domes, a salt shed, a 4 door garage and office, and a gravel stockpile. There is an asphalt access road to the site which provides access to the garage and sand domes. The remainder of the site has a gravel surface. The site terrain is generally flat. The site is bounded by Highway 17 to the south, a commercial property (motel) to the west, and forested land to the north and east. Photographs of the site are presented in Appendix C.

Quaternary mapping indicates that the site is located within an area generally characterized by glaciofluvial outwash deposits consisting of sand and gravel.

3. SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project was carried out between June 19 and 20, 2017, and consisted of drilling and sampling five boreholes (MAR-01 to MAR-05) within the footprint of the proposed garage building. All boreholes were terminated in overburden at a depth of 9.8 m (Elev. 289.7 to 288.0 m).

The approximate borehole locations are shown on the Borehole Locations and Soil Strata Drawing in Appendix D. 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 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 MAR-01 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 MAR-01 was abandoned in accordance with Reg. 903 upon completion of the field program.

4. LABORATORY TESTING

All recovered soil 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). 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 stratigraphy are presented on the Record of Borehole Sheets in Appendix A and the Borehole Locations and Soil Strata Drawing in Appendix D.

The stratigraphic boundaries shown on the borehole sheets and on the interpreted stratigraphic profile 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 fill layer overlying a deposit of native sand, which in turn overlies a deposit of native silt 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 2.1 m thick layer of brown sand fill with some gravel and trace to some silt was encountered from the ground surface in all of the boreholes between Elev. 299.5 and 297.8 m. A 125 mm thick layer of asphalt was encountered at 0.1 m depth in Borehole MAR-02. The base of the layer was encountered between Elev. 298.6 and 296.1 m.

The measured SPT 'N' values within the sand fill ranged from 3 to 28 blows per 0.3 m penetration suggesting a very loose to compact relative density. Natural moisture contents measured on samples of the sand fill ranged from 4 to 20%.

The results of grain size analyses conducted on selected samples of the sand fill 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 analyses are also summarized in the table below.

Soil Particle	%
Gravel	12 to 20
Sand	72 to 78
Silt + Clay	7 to 13

5.2 Sand

A 4.9 to 7.8 m thick deposit of brown to grey sand was encountered underlying the sand fill in all of the boreholes. The deposit generally contained trace amounts of silt however a tested sample indicated the presence of silty zones. The upper boundary of the deposit was encountered between Elev. 298.6 and 296.1 m in the boreholes and the base of the deposit was encountered between Elev. 292.7 and 289.5 m.

The measured SPT 'N' values within the sand ranged from 3 to 32 blows per 0.3 m penetration indicating a very loose to dense relative density. In general, the 'N' values ranged from 7 to 15 (loose to compact relative density). The natural moisture content measured on samples of the sand ranged from 2 to 23%.

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 analyses are also summarized in the table below.

Soil Particle	%
Gravel	0
Sand	71 to 95
Silt + Clay	5 to 29

5.3 Sand and Silt

A deposit of grey sand and silt was encountered underlying the sand deposit in all the boreholes. The sand and silt deposit contained trace amounts of clay. The boreholes were terminated within the sand and silt deposit between Elev. 289.7 and 288.0 m. The upper boundary of the deposit was encountered between Elev. 292.7 and 289.5 m in the boreholes.

The measured SPT 'N' values within the deposit ranged from 0 to 52 blows per 0.3 m penetration. In general, the SPT 'N' values within the deposit ranged between 20 and 50 blows per 0.3 m penetration, indicating a compact to dense relative density. The natural moisture content measured on samples of the sand and silt ranged from 14 to 21%.

The results of grain size analyses conducted on samples of the sand and silt 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	0
Sand	37 to 64
Silt	32 to 58
Clay	4 to 6

5.4 Groundwater Levels

Water levels were observed in the boreholes during and upon completion of drilling. A standpipe piezometer was installed in Borehole MAR-01 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	
MAR-01	June 19, 2016 June 20, 2017	6.0 6.0	293.5	In piezometer
MAR-02	June 20, 2017	7.8	291.0	In open borehole
MAR-03	June 20, 2017	7.0	290.8	In open borehole
MAR-04	June 20, 2017	5.1	293.1	In open borehole
MAR-05	June 20, 2017	9.8	289.6	In open borehole

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 Superior Survey 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.



Geoff Lay, P.Eng.
Geotechnical Engineer



Keli Shi, P.Eng.
Geotechnical Engineer



P.K. Chatterji, P.Eng.
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


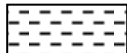



SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	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 (MPa) (psi)	Field Estimation of Hardness*	
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
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
<u>TERMS</u>		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Extremely Weak (Rock)			Indented by thumbnail
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			

RECORD OF BOREHOLE No MAR-01

1 OF 2

METRIC

GWP# 6053-16-00 LOCATION NE Building Corner, NAD 83-14 N 5 402 781.5 E 352 036.3 ORIGINATED BY SMP
 HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.19 - 2017.06.19 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												
299.5	GROUND SURFACE							20	40	60	80	100								
0.0	SAND , some gravel, trace silt Compact Brown Moist (FILL)		1	SS	15															
			2	SS	10															
298.2																				
1.3	SAND , trace silt Very Loose to Loose Brown to Grey Moist to Wet Compact		3	SS	4															
			4	SS	3															
			5	SS	9															
			6	SS	9															
			7	SS	10															
			8	SS	13															
			9	SS	28															
290.4																				
9.1	SAND and SILT , trace clay Compact Grey Wet		11	SS	28															
289.7																				
9.8	END OF BOREHOLE AT 9.8m.																			

Continued Next Page

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

RECORD OF BOREHOLE No MAR-01

2 OF 2

METRIC

GWP# 6053-16-00 LOCATION NE Building Corner, NAD 83-14 N 5 402 781.5 E 352 036.3 ORIGINATED BY SMP
 HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.19 - 2017.06.19 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
								20	40	60	80	100		20	40	60		GR SA SI CL
	Continued From Previous Page																	
	Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.06.19 6.0 293.5 2017.06.20 6.0 293.5																	

RECORD OF BOREHOLE No MAR-02

1 OF 2

METRIC

GWP# 6053-16-00 LOCATION Centre of Building, NAD 83-14 N 5 402 765.0 E 352 022.4 ORIGINATED BY SMP
 HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.20 - 2017.06.20 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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									WATER CONTENT (%)				GR
298.8	GROUND SURFACE							20	40	60	80	100									
0.0	SAND , some gravel, trace silt, 125mm thick asphalt layer at 0.1m Compact Brown Moist (FILL)		1	SS	28		298							○					15	78	7 (SI+CL)
297.6			2	SS	13									○							
1.2	SAND , trace silt Loose to Compact Brown Moist		3	SS	4		297							○							
			4	SS	7									○							
			5	SS	12		296							○					0	94	6 (SI+CL)
			6	SS	12									○							
			7	SS	12		295							○							
			8	SS	20		294							○							
							293														
292.7																					
6.1	SAND and SILT , trace clay Compact to Very Dense Brown to Grey Wet		9	SS	25		292							○					0	55	41 4
			10	SS	39		291							○							
							290														
289.0			11	SS	52									○							
9.8	END OF BOREHOLE AT 9.8m.																				

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

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

[illegible]

ONTMT4S MTO-18934.GPJ 2017TEMPLATE(MTO).GDT 17/8/3

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MAR-03

1 OF 2

METRIC

GWP# 6053-16-00 LOCATION SE Building Corner, NAD 83-14 N 5 402 743.0 E 352 019.6 ORIGINATED BY SMP
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2017.06.20 - 2017.06.20 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						
297.8	GROUND SURFACE							20 40 60 80 100	20 40 60					
0.0	SAND , some gravel, some silt Very Loose to Loose Brown Moist (FILL)		1	SS	5		297	○ UNCONFINED	+ FIELD VANE					15 72 13 (SI+CL)
			2	SS	3			● QUICK TRIAXIAL	× LAB VANE					
296.5								20 40 60 80 100	20 40 60					
1.3	SAND , trace silt Loose to Compact Brown to Grey Moist		3	SS	5		296							
			4	SS	10									
			5	SS	7		295							
			6	SS	12									
			7	SS	7		294							
			8	SS	5		293							
							292							
291.4			9	SS	20		291							0 95 5 (SI+CL)
6.4	SAND and SILT , trace clay Very Loose to Compact Grey Wet													0 64 32 4
							290							
	soil blow back through augers resulting in probable sample disturbance and erroneous N value		10	SS	0									
							289							
			11	SS	26									
288.0														
9.8	END OF BOREHOLE AT 9.8m.													

Continued Next Page

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

RECORD OF BOREHOLE No MAR-03

2 OF 2

METRIC

GWP# 6053-16-00 LOCATION SE Building Corner, NAD 83-14 N 5 402 743.0 E 352 019.6 ORIGINATED BY SMP
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2017.06.20 - 2017.06.20 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	WATER CONTENT (%)					
	Continued From Previous Page													
	WATER LEVEL AT 7.0m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.													




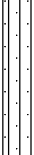
ONTMT4S MTO-18934.GPJ 2017TEMPLATE(MTO).GDT 17/8/9

RECORD OF BOREHOLE No MAR-04

1 OF 2

METRIC

GWP# 6053-16-00 LOCATION SW Building Corner, NAD 83-14 N 5 402 749.2 E 352 005.5 ORIGINATED BY SMP
 HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.20 - 2017.06.20 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											
								20 40 60 80 100											
298.2	GROUND SURFACE																		
0.0	SAND , some gravel Loose Brown (FILL)		1	SS	9		298												
			2	SS	7														
			3	SS	5														
			4	SS	8														
296.1	SAND , trace silt Loose Brown to Grey Moist Wet		5	SS	4		296												
2.1			6	SS	7														
			7	SS	7														
			8	SS	10														
			9	SS	9														
			10	SS	3														
289.5																			
8.7	SAND and SILT , trace clay Very Dense Grey Wet																		
			11	SS	45	289													
288.4																			
9.8	END OF BOREHOLE AT 9.8m.																		

Continued Next Page

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

METRIC

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

[illegible]

ONTMT4S MTO-18934.GPJ 2017TEMPLATE(MTO).GDT 17/8/3

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MAR-05

1 OF 2

METRIC

GWP# 6053-16-00 LOCATION NW Building Corner, NAD 83-14 N 5 402 786.9 E 352 024.1 ORIGINATED BY SMP
 HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.20 - 2017.06.20 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												
299.4	GROUND SURFACE							20	40	60	80	100								
0.0	SAND , some gravel, trace silt Compact Brown Moist (FILL)		1	SS	12		299													
298.6																				
0.8	SAND , silty to trace silt Loose to Compact Brown Moist		2	SS	5															
			3	SS	8		298													
			4	SS	6															
			5	SS	13		297													
			6	SS	15		296													
			7	SS	16															
			8	SS	15		295													
							294													
	Dense Wet		9	SS	32		293													
							292													
291.5			10	SS	40															
7.9	SAND and SILT , trace clay Dense Grey Wet						291													
			11	SS	40		290													
289.6																				
9.8	END OF BOREHOLE AT 9.8m.																			

Continued Next Page

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

RECORD OF BOREHOLE No MAR-05

2 OF 2

METRIC

GWP# 6053-16-00 LOCATION NW Building Corner, NAD 83-14 N 5 402 786.9 E 352 024.1 ORIGINATED BY SMP
HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2017.06.20 - 2017.06.20 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																
	WATER LEVEL AT 9.8m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																



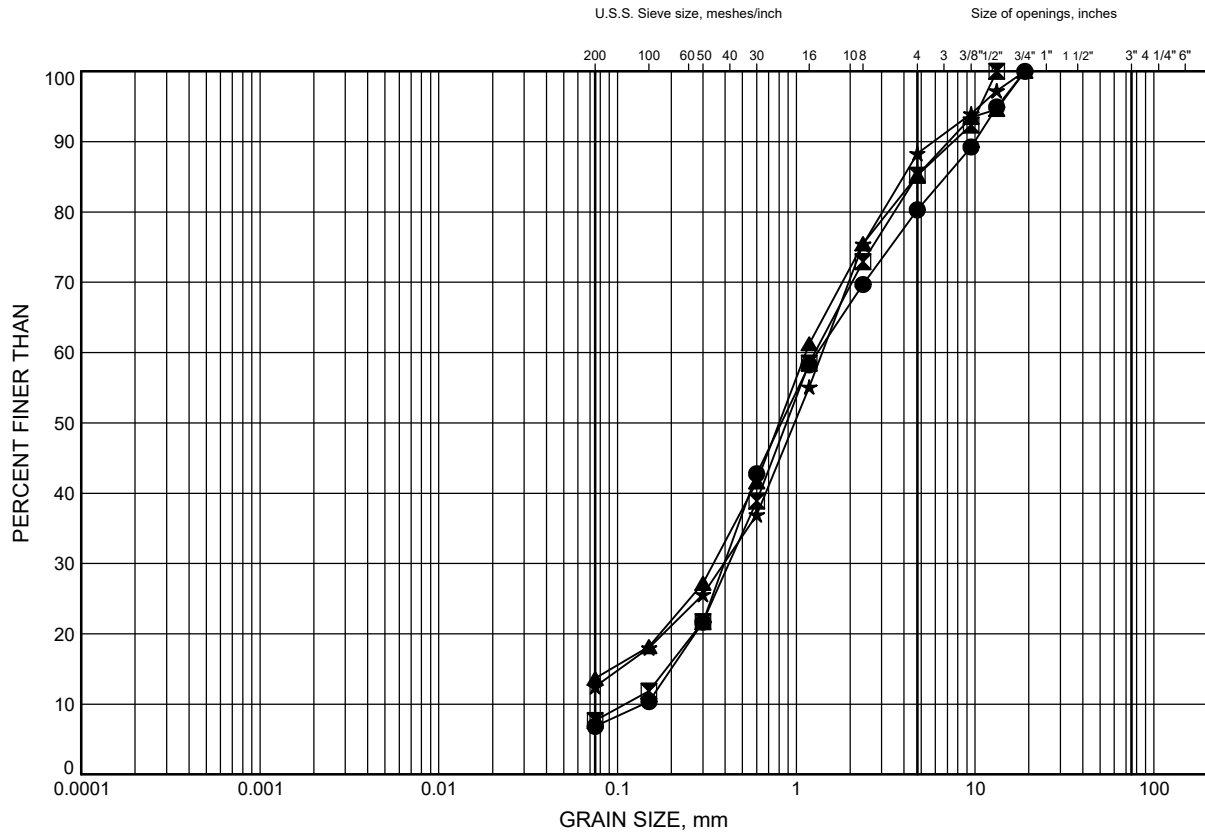
Appendix B

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)
●	MAR-01	0.9	298.6
■	MAR-02	0.1	298.7
▲	MAR-03	0.3	297.5
★	MAR-04	0.9	297.3

Date August 2017
GWP# 6053-16-00

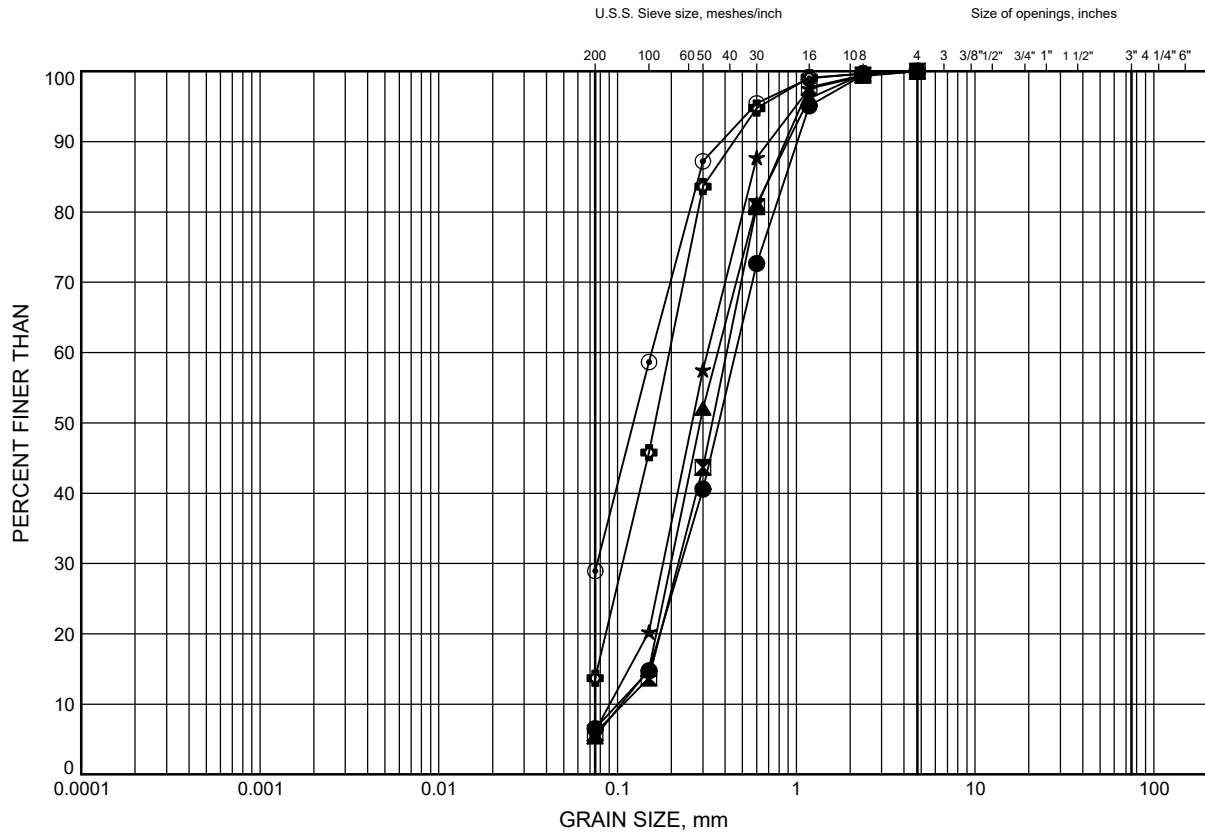


Prep'd AN
Chkd. GRL

GRAIN SIZE DISTRIBUTION

FIGURE B2

SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MAR-01	2.1	297.4
⊠	MAR-02	2.7	296.1
▲	MAR-03	6.2	291.6
★	MAR-04	2.7	295.5
⊙	MAR-05	4.4	295.0
⊕	MAR-05	7.8	291.6

Date August 2017

GWP# 6053-16-00



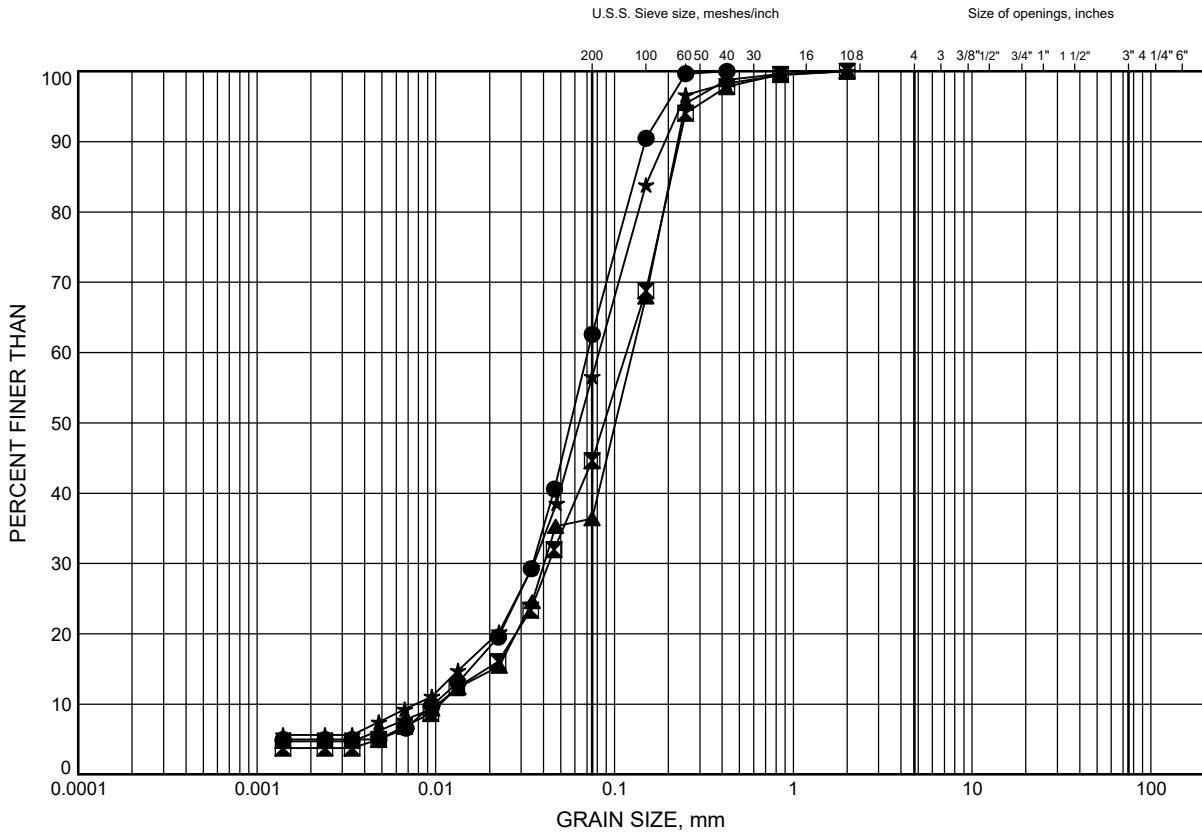
Prep'd AN

Chkd. GRL

GRAIN SIZE DISTRIBUTION

FIGURE B3

SAND & SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MAR-01	9.4	290.1
⊠	MAR-02	6.4	292.4
▲	MAR-03	6.6	291.2
★	MAR-05	8.1	291.3

Date August 2017

GWP# 6053-16-00



Prep'd AN

Chkd. GRL



Appendix C

Site Photographs



Photograph 1 – Panorama of site from site entrance, looking north



Photograph 2 – Existing salt shed and sand dome, looking north

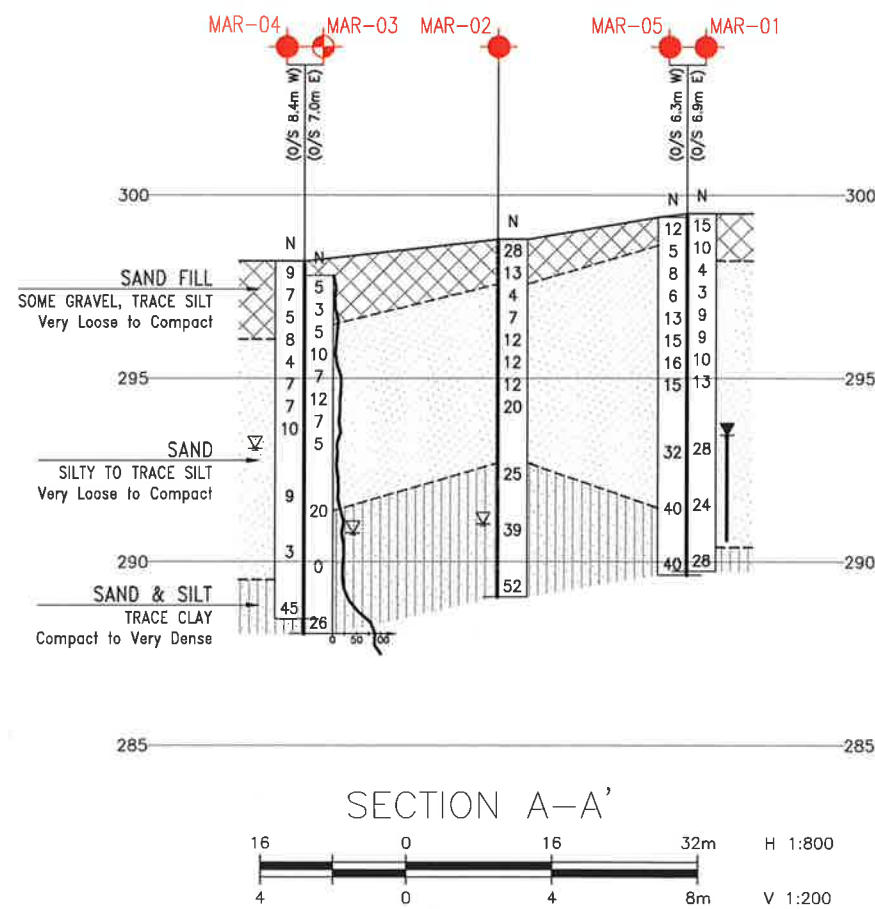
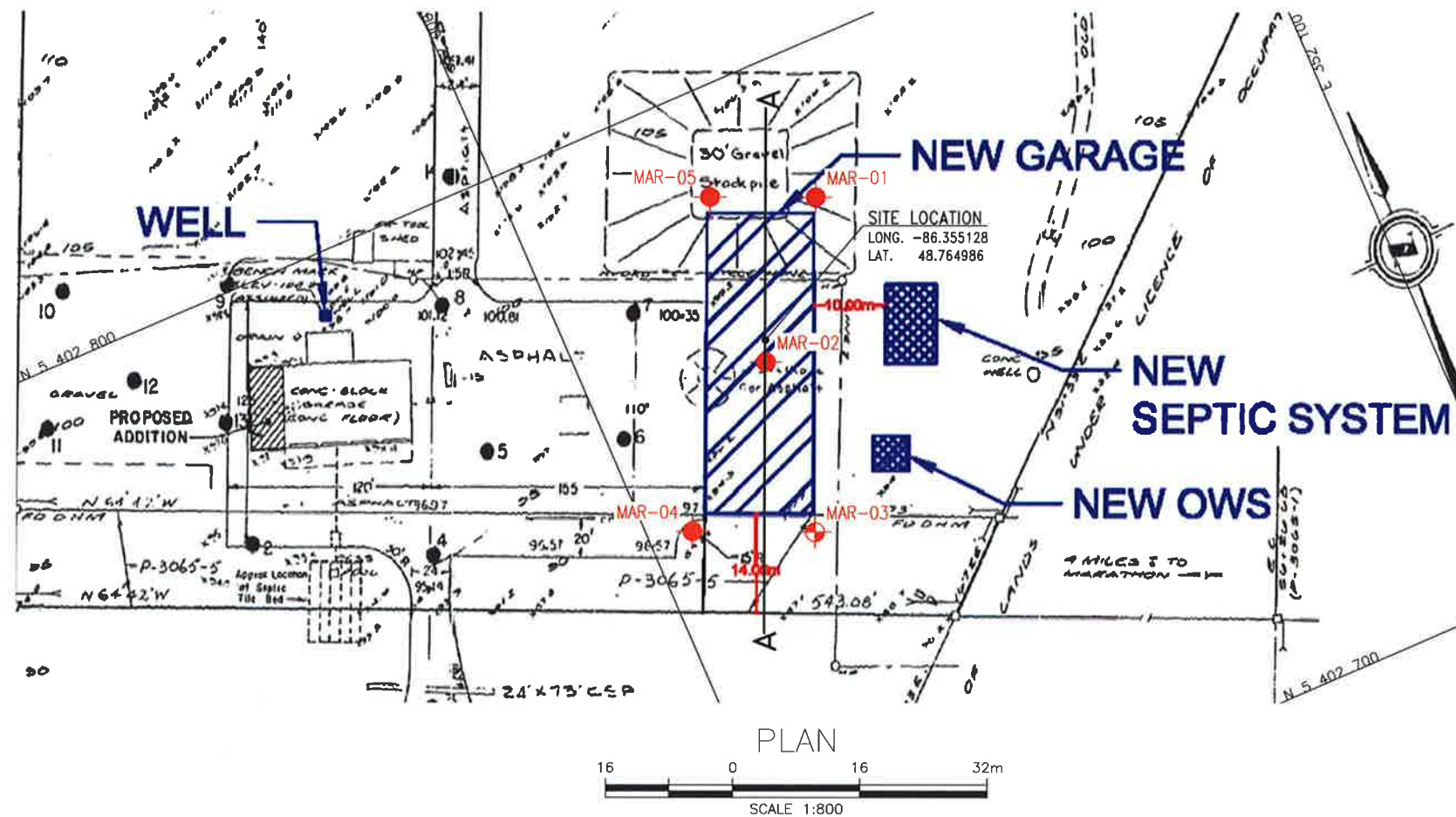


Photograph 3 – Proposed building location, looking east



Appendix D

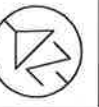
Borehole Locations and Soil Strata Drawing



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

CONT No
GWP No 6053-16-00

NEW GARAGE BUILDING
MTO PATROL YARD-MARATHON
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
MAR-01	299.5	5 402 781.5	352 036.3
MAR-02	298.8	5 402 765.0	352 022.4
MAR-03	297.8	5 402 743.0	352 019.6
MAR-04	298.2	5 402 749.2	352 005.5
MAR-05	299.4	5 402 786.9	352 024.1

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 14 coordinates.

GEOCRES No. 42D-48



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