APPENDIX ‘A’

GEOTECHNICAL REPORTS

Quality Engineering | Valued Relationships

Morrison Hershfield

St. James Street Rehabilitation
Sub-Surface Investigation

Prepared for:

Morrison Hershfield
Suite 1, 59 Scurfield Boulevard
Winnipeg, MB R3Y 1V2
Attention: Ron Bruce

Project Number:
0035-051-00

Date: October 4, 2017

October 4, 2017 Our File No. 0035-051-00

Ron Bruce, P.Eng.
Morrison Hershfield
Suite 1, 59 Scurfield Boulevard
Winnipeg, MB R3Y 1V2

RE: St. James Street Rehabilitation
Sub-Surface Investigation Report

TREK Geotechnical Inc. is pleased to submit our report for the sub-surface investigations for the St. James Street Rehabilitation project.

Please contact the undersigned if you have any questions. Thank you for the opportunity to serve you on this assignment.

Sincerely,

TREK Geotechnical Inc.
Per:

Brent Hay, P. Eng.
Geotechnical Engineer, Partner
Tel: 204.975.9433 ext. 105

cc: Paul Bevel, B.Sc.

Revision History

Revision No.	Author	Issue Date	Description
0	PB	October 4, 2017	Final Report

Authorization Signatures

Prepared By:

Paul Bevel, B.Sc.
Assistant Lab and Field Services Manager.

PROVINCE OF MANITOBA
Oct. 4/17
B.S.
HAY
Member
32339
REGISTERED PROFESSIONAL ENGINEER

APEGM
Certificate of Authorization
Trek Geotechnical Inc.
No. 4877 Date: 2017/10/4

Reviewed By:

Brent Hay, P.Eng.
Geotechnical Engineer

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1.0 Introduction

This report summarizes the results of the sub-surface investigation completed for St James Street. The information collected describes the pavement structure of the existing road as well as the soil stratigraphy beneath the pavement structure.

2.0 Sub-Surface Investigation and Laboratory Program

A total of five (5) test holes were drilled along St. James Street between Ellice Avenue and Sargent Avenue. The test holes were drilled at an 40 to 50 m spacing at the locations shown in Figure 01. The test holes were drilled to determine sub-surface conditions for the road reconstruction. The sub-surface investigation was conducted on September 8, 2017. The test holes were drilled to a depth of 2.1 m below road surface by Trek Geotechnical Inc. (Trek) using a 50 mm hand auger. The pavement structure (asphalt or concrete) was cored by Paul Bevel of Trek Geotechnical, using a portable coring press equipped with a hollow 150 mm diameter diamond core drill bit. The sub-surface conditions were observed during drilling and visually classified by Paul Bevel. Other pertinent information such as groundwater and drilling conditions were also recorded during the drilling. Disturbed (auger cuttings) samples retrieved during the sub-surface investigation were transported to TREK’s material testing laboratory for further testing. Core samples were also retrieved and logged at TREK’s material testing laboratory.

The laboratory testing program consisted of moisture content determination, Atterberg limits, and grain size analysis (mechanical sieve and hydrometer methods) on selected samples. Sub-surface information gathered for St James Street is includes; Appendix A - Test Hole Logs; Appendix B Laboratory Testing Summary and Lab Testing Results, and; Appendix C Photographs of Pavement Core Samples.

Test hole locations noted on the test hole logs and shown on Figure 01 are based on survey conducted by Morrison Hershfield and measured distances from the nearest address, edge of pavement or other permanent features.

3.0 Closure

The geotechnical information provided in this report is in accordance with current engineering principles and practices (Standard of Practice). The findings of this report were based on information provided (field investigation and laboratory testing). Soil conditions are natural deposits that can be highly variable across a site. If subsurface conditions are different than the conditions previously encountered on-site or those presented here, we should be notified to adjust our findings if necessary.

All information provided in this report is subject to our standard terms and conditions for engineering services, a copy of which is provided to each of our clients with the original scope of work, or a mutually executed standard engineering services agreement. If these conditions are not attached, and you are not already in possession of such terms and conditions, contact our office and you will be promptly provided with a copy.

This report has been prepared by TREK Geotechnical Inc. (the Consultant) for the exclusive use of Morrison Hershfield Ltd. (the Client) and their agents for the work product presented in the report. Any findings or recommendations provided in this report are not to be relied upon by any third parties, except as agreed to in writing by the Client and Consultant prior to use.

Figure 01

0 10 20 30 m
SCALE = 1 : 750 **(279 mm x 432 mm)**

LEGEND: ⊕ **TEST HOLE (TREK, 2017)**

NOTES: **1. AERIAL IMAGE FROM CITY OF WINNIPEG 2016.**

Figure 01
Test Hole Location Plan

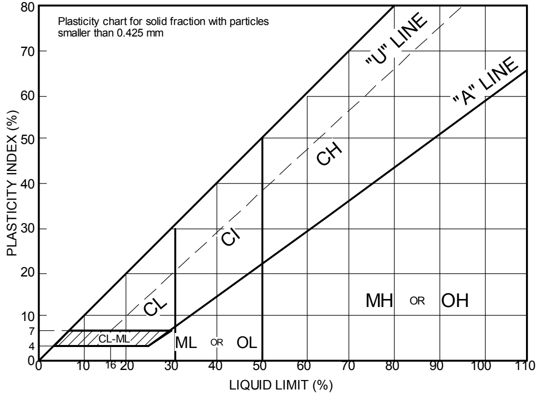
Appendix A

Test Hole Logs

EXPLANATION OF FIELD AND LABORATORY TESTING

GENERAL NOTES

1. Classifications are based on the United Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.
2. Descriptions on these test hole logs apply only at the specific test hole locations and at the time the test holes were drilled. Variability of soil and groundwater conditions may exist between test hole locations.
3. When the following classification terms are used in this report or test hole logs, the primary and secondary soil fractions may be visually estimated.

Major Divisions			USCS Classi-fication	Symbols	Typical Names	Laboratory Classification Criteria		
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than 4.75 mm)	Clean gravel (Little or no fines)	GW	▨	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain size curve, depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows: Less than 5 percent...... GW, GP, SW, SP More than 12 percent...... GM, GC, SM, SC 6 to 12 percent...... Borderline case4s requiring dual symbols*	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	▨	Poorly-graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravel with fines (Appreciable amount of fines)	GM	▨	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			GC	▨	Clayey gravels, gravel-sand-silt mixtures		Atterberg limits above "A" line or P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than 4.75 mm)	Clean sands (Little or no fines)	SW	▨	Well-graded sands, gravelly sands, little or no fines		$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	▨	Poorly-graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM	▥	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			SC	▨	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line or P.I. greater than 7	
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Silts and Clays (Liquid limit less than 50)		ML	▥	Inorganic silts and very fine sands, rock floor, silty or clayey fine sands or clayey silts with slight plasticity	Plasticity Chart 		
			CL	▨	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	▤	Organic silts and organic silty clays of low plasticity			
	Silts and Clays (Liquid limit greater than 50)		MH	▥	Inorganic silts, micaceous or distomaceous fine sandy or silty soils, organic 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	Von Post Classification Limit	Strong colour or odour, and often fibrous texture	

Material		Particle Size ASTM Sieve sizes	Particle Size mm
Sand	Coarse	#10 to #4	2.00 to 4.75
	Medium	#40 to #10	0.425 to 2.00
	Fine	#200 to #40	0.075 to 0.425
Silt or Clay		< #200	< 0.075

Material		Particle Size ASTM Sieve Sizes	Particle Size mm
Boulders		> 12 in.	> 300
Cobbles		3 in. to 12 in.	75 to 300
Gravel	Coarse	3/4 in. to 3 in.	19 to 75
	Fine	#4 to 3/4 in.	4.75 to 19

* Borderline classifications used for soils possessing characteristics of two groups are designated by combinations of groups symbols. For example; GW-GC, well-graded gravel-sand mixture with clay binder.

Other Symbol Types

■	Asphalt	▨	Bedrock (undifferentiated)	▨	Cobbles
▨	Concrete	⊞	Limestone Bedrock	■	Boulders and Cobbles
▩	Fill	☰	Cemented Shale	▨	Silt Till
		▨	Non-Cemented Shale	▨	Clay Till

TREK GEOTECHNICAL

EXPLANATION OF FIELD AND LABORATORY TESTING

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)
PL - Plastic Limit (%)
PI - Plasticity Index (%)
MC - Moisture Content (%)
SPT - Standard Penetration Test
RQD - Rock Quality Designation
Qu - Unconfined Compression
Su - Undrained Shear Strength
VW - Vibrating Wire Piezometer
SI - Slope Inclinometer

▽ Water Level at Time of Drilling

▼ Water Level at End of Drilling

⧨ Water Level After Drilling as Indicated on Test Hole Logs

FRACTION OF SECONDARY SOIL CONSTITUENTS ARE BASED ON THE FOLLOWING TERMINOLOGY

TERM	EXAMPLES	PERCENTAGE
and	and CLAY	35 to 50 percent
"y" or "ey"	clayey, silty	20 to 35 percent
some	some silt	10 to 20 percent
trace	trace gravel	1 to 10 percent

TERMS DESCRIBING CONSISTENCY OR COMPACTION CONDITION

The Standard Penetration Test blow count (N) of a non-cohesive soil can be related to compactness condition as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very loose	< 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	> 50

The Standard Penetration Test blow count (N) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very soft	< 2
Soft	2 to 4
Firm	4 to 8
Stiff	8 to 15
Very stiff	15 to 30
Hard	> 30

The undrained shear strength (Su) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	Undrained Shear Strength (kPa)
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH17-01

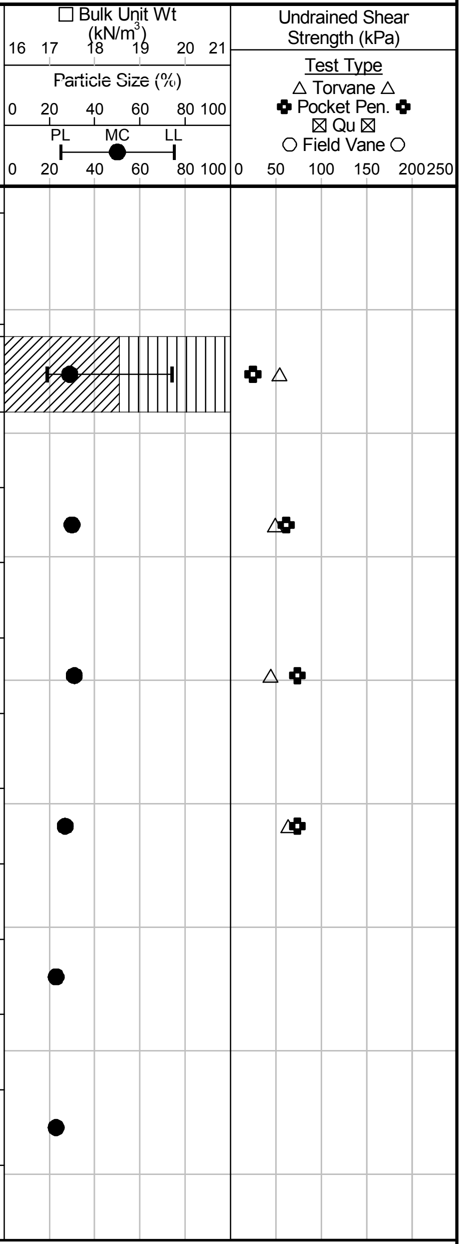
1 of 1

Client: Morrison Hershfield
Project Name: St. James Street - Subsurface Investigation
Contractor: TREK Geotechnical Inc.
Method: 50 mm Hand Auger
Project Number: 0035 051 00
Location: UTM N-5528637, E-629249
Ground Elevation: 233.80 m
Date Drilled: 8 September 2017 - 8 September 2017

Sample Type: ◢ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) ☒ Split Barrel (SB) ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◌ Cobbles ■ Boulders

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number
233.7		ASPHALT (56 mm THICK)	▮	C01
		CONCRETE (224 mm THICK)	▮	C02
233.5		CLAY AND SILT - trace fine sand - brown - moist, firm - high plasticity	◢	G03
	0.5		◢	G04
	1.0		◢	G05
		- trace sand laminations (1-3 mm thick), trace oxidation below 1.2 m	◢	G06
232.3	1.5	SILT AND SAND - clayey - light brown - moist, loose to compact - low to intermediate plasticity	◢	G07
232.0		SILT - trace to some clay, trace fine sand - light brown - wet, soft - no to low plasticity	◢	G08
	2.0			
231.7				



END OF TEST HOLE AT 2.1 m IN SILT
1) No sloughing or seepage observed.
2) Test hole backfilled with auger cuttings, bentonite, sand, and cold patch asphalt to surface.
3) Test hole located in the northbound lane, 180 m south of the intersection of St. James Street and Sargent Avenue, 0.3 m west of east curb. Accross from 1038 St. James Street.
4) UTM coordinates and elevation surveyed by Morrison Hershfield.

Logged By: Paul Bevel **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

Sub-Surface Log

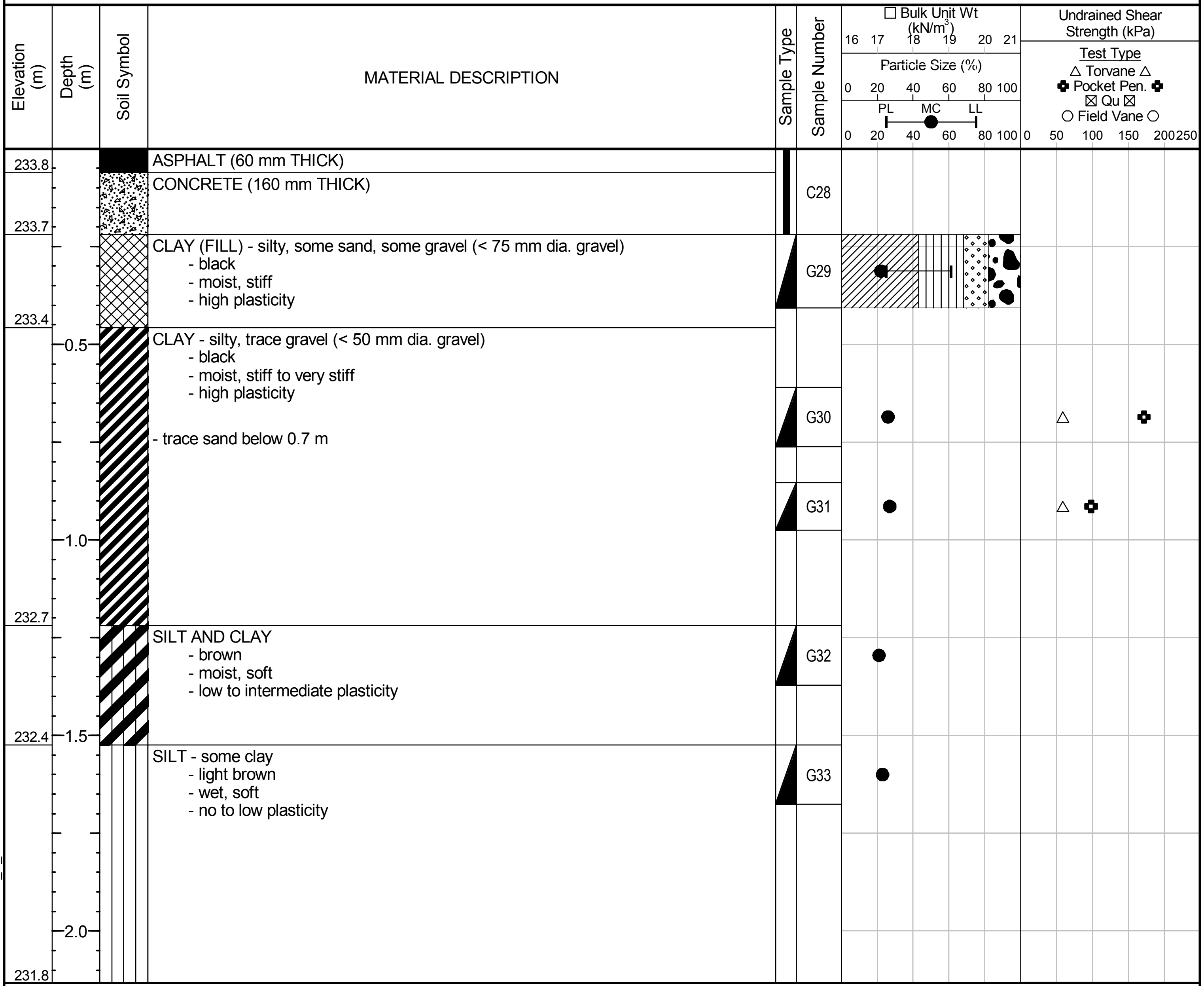
Test Hole TH17-02

1 of 1

Client: Morrison Hershfield
Project Number: 0035 051 00
Project Name: St. James Street - Subsurface Investigation
Location: UTM N-5528682, E-629242
Contractor: TREK Geotechnical Inc.
Ground Elevation: 233.90 m
Method: 50 mm Hand Auger
Date Drilled: 8 September 2017 - 8 September 2017

Sample Type: ◩ Grab (G) ◨ Shelby Tube (T) ☒ Split Spoon (SS) ☒ Split Barrel (SB) ◫ Core (C)

Particle Size Legend: ▥ Fines ▨ Clay ▥ Silt ⁘ Sand Gravel Cobbles Boulders



Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Number
233.8		ASPHALT (60 mm THICK)	
233.7		CONCRETE (160 mm THICK)	C28
233.4		CLAY (FILL) - silty, some sand, some gravel (< 75 mm dia. gravel) - black - moist, stiff - high plasticity	G29
232.7	0.5 1.0	CLAY - silty, trace gravel (< 50 mm dia. gravel) - black - moist, stiff to very stiff - high plasticity - trace sand below 0.7 m	G30 G31
232.4	1.5	SILT AND CLAY - brown - moist, soft - low to intermediate plasticity	G32
231.8	2.0	SILT - some clay - light brown - wet, soft - no to low plasticity	G33

END OF TEST HOLE AT 2.1 m IN SILT

Notes:

1) No sloughing or seepage observed.
2) Test hole backfilled with auger cuttings, bentonite, sand, and cold patch asphalt to surface.
3) Test hole located in the southbound lane, 130 m south of the intersection of St. James Street and Sargent Avenue, 5.5 m east of west curb. Accross from 1070 St. James Street.
4) UTM coordinates and elevation surveyed by Morrison Hershfield.

Logged By: Paul Bevel **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

Sub-Surface Log

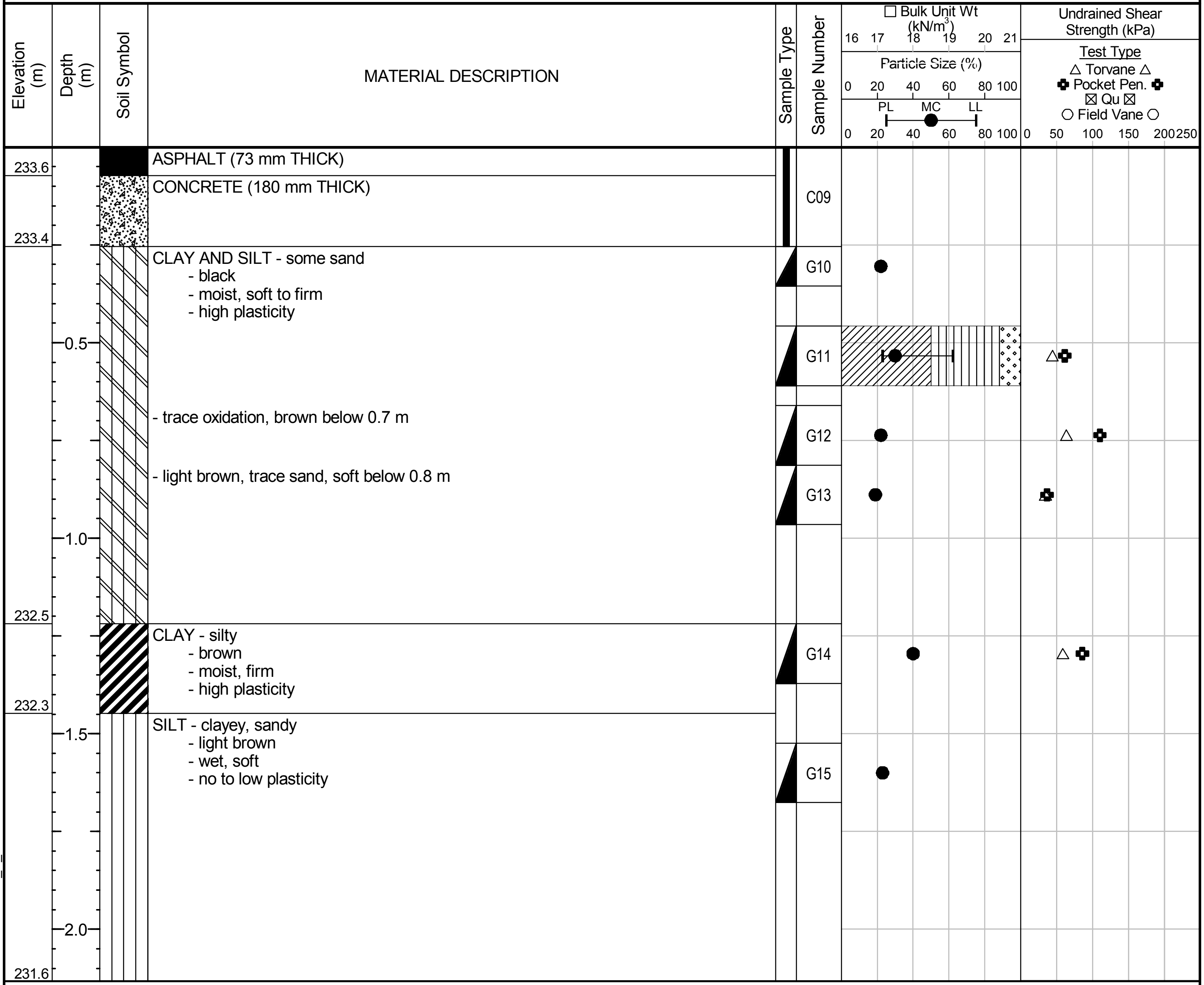
Test Hole TH17-03

1 of 1

Client: Morrison Hershfield
Project Number: 0035 051 00
Project Name: St. James Street - Subsurface Investigation
Location: UTM N-5528744, E-629247
Contractor: TREK Geotechnical Inc.
Ground Elevation: 233.70 m
Method: 50 mm Hand Auger
Date Drilled: 8 September 2017 - 8 September 2017

Sample Type: ◣ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) ☒ Split Barrel (SB) ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel Cobbles Boulders



ASPHALT (73 mm THICK)

CONCRETE (180 mm THICK)

CLAY AND SILT - some sand
- black
- moist, soft to firm
- high plasticity

- trace oxidation, brown below 0.7 m

- light brown, trace sand, soft below 0.8 m

CLAY - silty
- brown
- moist, firm
- high plasticity

SILT - clayey, sandy
- light brown
- wet, soft
- no to low plasticity

END OF TEST HOLE AT 2.1 m IN SILT
Notes:
1) No seepage observed.
2) Sloughing observed below 1.0 m.
3) Test hole backfilled with auger cuttings, bentonite, sand, and cold patch asphalt to surface.
4) Test hole located in the northbound lane, 70 m south of the intersection of St. James Street and Sargent Avenue, 5.5 m west of east curb. Accross from 1065 St. James Street.
5) UTM coordinates and elevation surveyed by Morrison Hershfield.

Logged By: Paul Bevel
Reviewed By: Nelson Ferreira
Project Engineer: Nelson Ferreira

Test Hole TH17-04

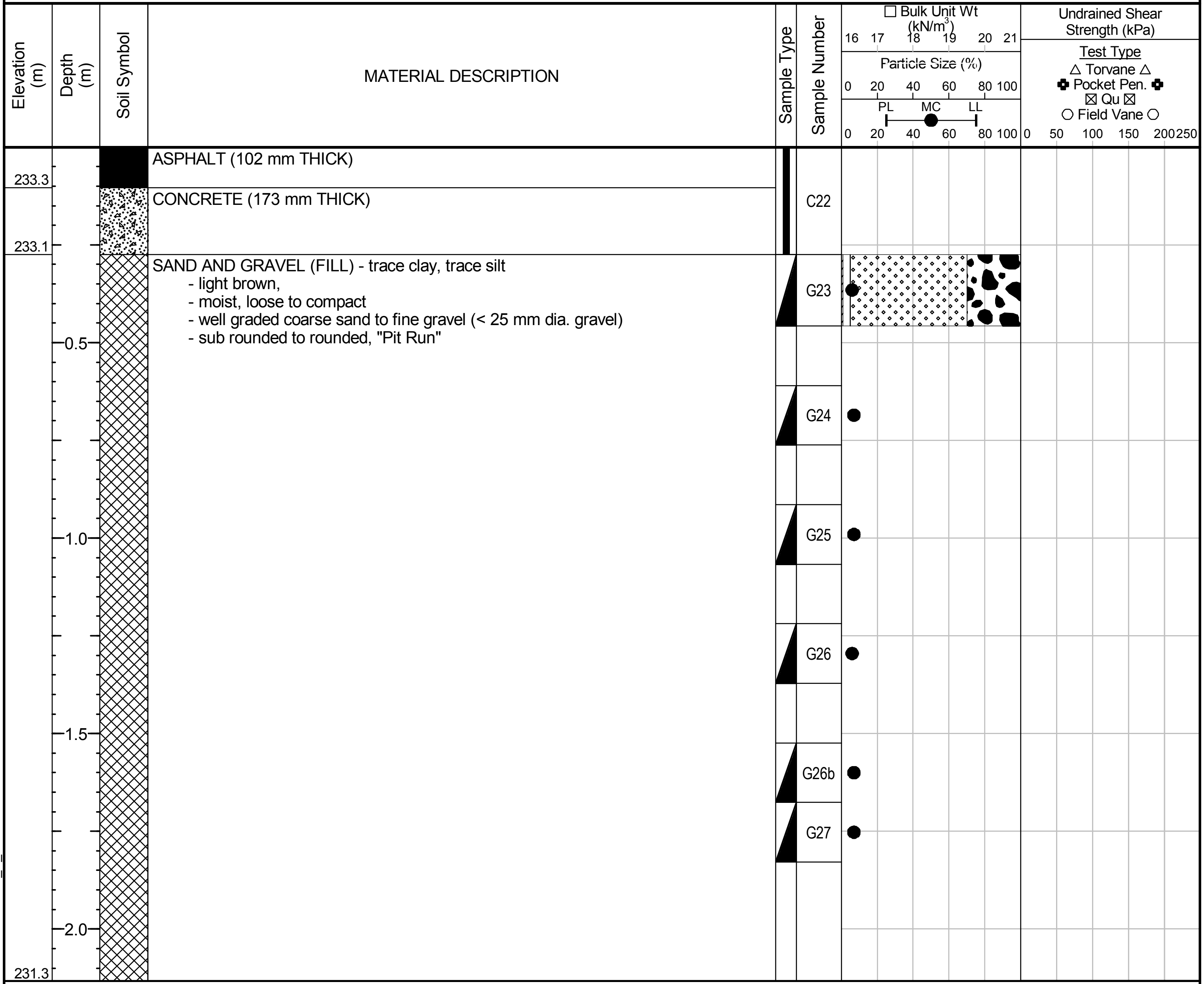
1 of 1

Sub-Surface Log

Client: Morrison Hershfield
Project Number: 0035 051 00
Project Name: St. James Street - Subsurface Investigation
Location: UTM N-5528794, E-629242
Contractor: TREK Geotechnical Inc.
Ground Elevation: 233.40 m
Method: 50 mm Hand Auger
Date Drilled: 8 September 2017 - 8 September 2017

Sample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) Split Barrel (SB) Core (C)

Particle Size Legend: Fines Clay Silt Sand Gravel Cobbles Boulders



ASPHALT (102 mm THICK)

CONCRETE (173 mm THICK)

SAND AND GRAVEL (FILL) - trace clay, trace silt
- light brown,
- moist, loose to compact
- well graded coarse sand to fine gravel (< 25 mm dia. gravel)
- sub rounded to rounded, "Pit Run"

END OF TEST HOLE AT 2.1 m IN SAND AND GRAVEL
Notes:
1) No seepage observed.
2) Sloughing observed below 1.0 m.
3) Test hole backfilled with auger cuttings, bentonite, sand, and cold patch asphalt to surface.
4) Test hole located in the southbound lane, 12 m south of the intersection of St. James Street and Sargent Avenue, 1.6 m east of west curb. Accross from 1108 St. James Street.
5) UTM coordinates and elevation surveyed by Morrison Hershfield.

Logged By: Paul Bevel **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH17-05

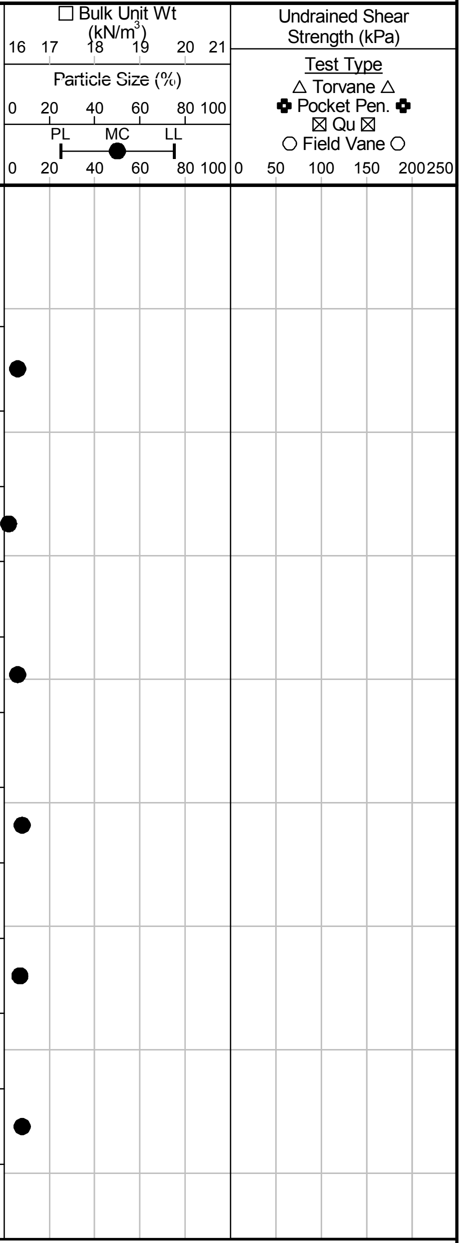
1 of 1

Client: Morrison Hershfield
Project Number: 0035 051 00
Project Name: St. James Street - Subsurface Investigation
Location: UTM N-5528852, E-629255
Contractor: TREK Geotechnical Inc.
Ground Elevation: 233.60 m
Method: 50 mm Hand Auger
Date Drilled: 8 September 2017 - 8 September 2017

Sample Type: ◪ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) ⧓ Split Barrel (SB) ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand Gravel Cobbles Boulders

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number
233.5		ASPHALT (63 mm THICK)	▮	
		CONCRETE (224 mm THICK)	▮	C16
233.3		SAND AND GRAVEL (FILL) - trace silt - light brown - moist, loose to compact - well graded coarse sand to fine gravel (< 20 mm dia. gravel) - carbonate (limestone), sub angular to angular, "20 mm crushed limestone"	◢	G17
233.1	0.5	SAND AND GRAVEL (FILL) - trace silt - light brown - moist, loose to compact - well graded coarse sand to fine gravel (< 50 mm dia. gravel) - carbonate (limestone), sub angular to angular, "50 mm crushed limestone"	◢	G18
232.8	1.0	SAND AND GRAVEL (FILL) - trace clay, trace silt - brown - moist, loose to compact - poorly graded, fine sand to fine gravel (< 20 mm dia. gravel) - rounded to sub-rounded, "Pit Run"	◢	G19
		-trace silt, trace clay below 1.2 m	◢	G20
	1.5		◢	G21
	2.0		◢	G21b
231.5				



END OF TEST HOLE AT 2.1 m IN SAND AND GRAVEL
1) No sloughing or seepage observed.
2) Test hole backfilled with auger cuttings, bentonite, sand, and cold patch asphalt to surface.
3) Test hole located in the northbound lane, 40 m north of the intersection of St. James Street and Sargent Avenue, 1.6 m west east curb. Accross from 1130 St. James Street.
4) UTM coordinates and elevation surveyed by Morrison Hershfield.

Logged By: Paul Bevel **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

Appendix B

Laboratory Testing Summary and Lab Testing Results

St James Street - Sargent Ave. to Ellice Ave.
Sub-Surface Investigation
Summary Table

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits		
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid	Plastic	Plasticity Index
TH17-01	U14 (5528637m N, 629249m E) 180 meters south of the intersection of St James St. and Sargent Ave., northbound lane, 0.3 meters west of east curb	Asphalt	56	Concrete	224				-							
						CLAY and SILT	0.3	0.5	29.4	0	0	49	51	74	19	55
						CLAY and SILT	0.6	0.8	30.0							
						CLAY and SILT	0.9	1.1	30.5							
						CLAY and SILT	1.2	1.4	26.8							
						SILT and SAND	1.5	1.7	22.6							
						SILT	1.8	2.0	22.8							
TH17-02	U14 (5528682m N, 629242m E) 130 meters south of the intersection of St. James St. and Sargent Ave., southbound lane, 5.5 meters east of west curb	Asphalt	60	Concrete	160											
						CLAY (FILL)	0.3	0.5	21.8	18	14	25	43	62	23	39
						CLAY	0.6	0.8	25.9							
						CLAY	0.8	0.9	26.6							
						SILT and CLAY	1.2	1.4	20.5							
						SILT	1.5	1.7	22.8							
TH17-03	U14 (5528744m N, 629247m E) 70 meters south of the intersection of St. James St. and Sargent Ave., northbound lane, 5.5 meters west of east curb	Asphalt	73	Concrete	180											
						CLAY and SILT	0.2	0.4	22.2							
						CLAY and SILT	0.5	0.6	29.6	0	12	38	50	61	25	36
						CLAY and SILT	0.6	0.8	21.5							
						CLAY and SILT	0.8	0.9	19.0							
						CLAY	1.2	1.4	40.2							
						SILT	1.5	1.7	23.0							
TH17-04	U14 (5528793m N, 629242m 12 meters south of the intersection of St. James St. and Sargent Ave., southbound lane, 1.6 meters east of west curb	Asphalt	102	Concrete	173											
						SAND and GRAVEL (FILL)	0.3	0.5	5.7	30	65	5				
						SAND and GRAVEL (FILL)	0.6	0.8	6.8							
						SAND and GRAVEL (FILL)	0.9	1.1	6.5							
						SAND and GRAVEL (FILL)	1.2	1.4	6.3							
						SAND and GRAVEL (FILL)	1.5	1.7	7.3							
						SAND and GRAVEL (FILL)	1.7	1.8	7.3							
TH17-05	U14 (5528852m N, 629255m E) 40 meters south of the intersection of St. James St. and Sargent Ave., northbound lane, 1.6 meters west of east curb	Asphalt	63	Concrete	224											
						20 mm LIMESTONE (FILL)	0.3	0.5	5.6							
						50 mm LIMESTONE (FILL)	0.6	0.8	1.5							
						SAND and GRAVEL (FILL)	0.9	1.1	6.0							
						SAND and GRAVEL (FILL)	1.2	1.4	7.6							
						SAND and GRAVEL (FILL)	1.5	1.7	6.5							
						SAND and GRAVEL (FILL)	1.8	2.0	8.2							

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Moisture Content Report
ASTM D2216-10

Project No.	0035-051-00
Client	Morrison Hershfield
Project	St James Street Reconstruction
Sample Date	08-Sep-17
Test Date	19-Sep-17
Technician	PB

Test Pit	TH17-01	TH17-01	TH17-01	TH17-01	TH17-01	TH17-01
Depth (m)	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0
Sample #	G03	G04	G05	G06	G07	G08
Tare ID	AB84	AC07	Z52	P06	W81	Z122
Mass of tare	6.8	6.7	8.4	8.6	9.4	8.5
Mass wet + tare	287.5	311.4	260.2	259.7	277.1	368.8
Mass dry + tare	223.8	241.0	201.4	206.6	227.8	301.8
Mass water	63.7	70.4	58.8	53.1	49.3	67.0
Mass dry soil	217.0	234.3	193.0	198.0	218.4	293.3
Moisture %	29.4%	30.0%	30.5%	26.8%	22.6%	22.8%

Test Pit	TH17-03	TH17-03	TH17-03	TH17-03	TH17-03	TH17-03
Depth (m)	0.2 - 0.4	0.5 - 0.6	0.6 - 0.8	0.8 - 0.9	1.2 - 1.4	1.5 - 1.7
Sample #	G10	G11	G12	G13	G14	G15
Tare ID	F53	E129	AA12	AB27	Z02	F19
Mass of tare	8.7	8.5	6.8	6.7	8.6	9.3
Mass wet + tare	233.6	249.1	269.7	269.1	227.0	378.8
Mass dry + tare	192.8	194.2	223.2	227.2	164.4	309.6
Mass water	40.8	54.9	46.5	41.9	62.6	69.2
Mass dry soil	184.1	185.7	216.4	220.5	155.8	300.3
Moisture %	22.2%	29.6%	21.5%	19.0%	40.2%	23.0%

Test Pit	TH17-05	TH17-05	TH17-05	TH17-05	TH17-05	TH17-05
Depth (m)	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0
Sample #	G17	G18	G19	G20	G21	G21b
Tare ID	A2	4	Nelson	H474	1	E72
Mass of tare	253.2	254.2	253.9	249.3	255.4	8.6
Mass wet + tare	5009.4	1568.0	2068.5	1202.8	1164.5	553.9
Mass dry + tare	4755.2	1548.4	1966.4	1135.6	1109.2	512.8
Mass water	254.2	19.6	102.1	67.2	55.3	41.1
Mass dry soil	4502.0	1294.2	1712.5	886.3	853.8	504.2
Moisture %	5.6%	1.5%	6.0%	7.6%	6.5%	8.2%

Moisture Content Report
ASTM D2216-10

Project No. 0035-051-00
Client Morrison Hershfield
Project St James Street Reconstruction

Sample Date 08-Sep-17
Test Date 19-Sep-17
Technician PB

Test Pit	TH17-04	TH17-04	TH17-04	TH17-04	TH17-04	TH17-04
Depth (m)	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	1.7 - 1.8
Sample #	G23	G24	G25	G26	G26b	G27
Tare ID	HA 1	43	K866	Chiron	H23	Z83
Mass of tare	376.9	370.0	530.4	365.0	8.6	8.4
Mass wet + tare	1650.5	1858.9	1764.0	1535.5	648.8	700.8
Mass dry + tare	1582.0	1763.6	1689.2	1466.4	605.0	653.8
Mass water	68.5	95.3	74.8	69.1	43.8	47.0
Mass dry soil	1205.1	1393.6	1158.8	1101.4	596.4	645.4
Moisture %	5.7%	6.8%	6.5%	6.3%	7.3%	7.3%

Test Pit	TH17-02	TH17-02	TH17-02	TH17-02	TH17-02	
Depth (m)	0.3 - 0.5	0.6 - 0.8	0.8 - 0.9	1.2 - 1.4	1.5 - 1.7	
Sample #	G29	G30	G31	G32	G33	
Tare ID	BIG	Z85	H53	21H	H20	
Mass of tare	32.0	8.4	8.6	8.4	8.4	
Mass wet + tare	593.9	309.1	399.9	384.1	322.8	
Mass dry + tare	493.4	247.2	317.6	320.2	264.4	
Mass water	100.5	61.9	82.3	63.9	58.4	
Mass dry soil	461.4	238.8	309.0	311.8	256.0	
Moisture %	21.8%	25.9%	26.6%	20.5%	22.8%	

Test Pit						
Depth (m)						
Sample #						
Tare ID						
Mass of tare						
Mass wet + tare						
Mass dry + tare						
Mass water						
Mass dry soil						
Moisture %						

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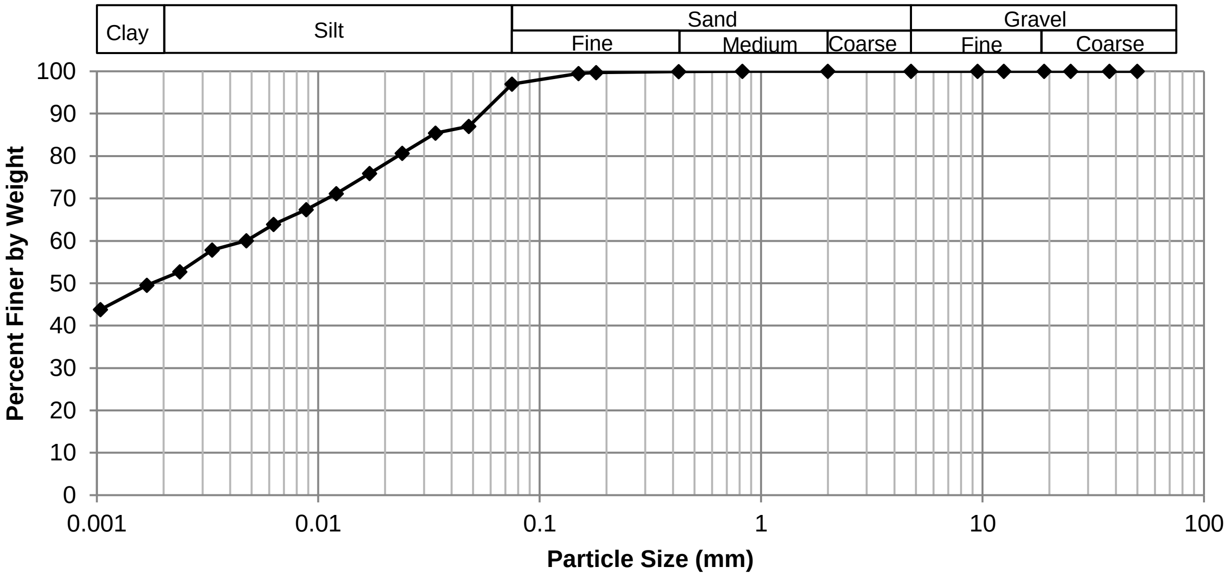
Grain Size Analysis (Hydrometer Method)
ASTM D422

Project No.	0035-051-00
Client	Morrison Hershfield
Project	St James Street Reconstruction
Test Hole	TH17-01
Sample #	G03
Depth (m)	0.3 - 0.5
Sample Date	8-Sep-17
Test Date	21-Sep-17
Technician	HS

Gravel	0.0%
Sand	0.1%
Silt	49.0%
Clay	50.9%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	96.98
37.5	100.00	2.00	100.00	0.0479	87.05
25.0	100.00	0.825	99.98	0.0338	85.46
19.0	100.00	0.425	99.90	0.0239	80.70
12.5	100.00	0.180	99.68	0.0171	75.94
9.50	100.00	0.150	99.45	0.0121	71.17
4.75	100.00	0.075	96.98	0.0088	67.36
				0.0063	63.87
				0.0047	60.06
				0.0033	57.83
				0.0024	52.68
				0.0017	49.51
				0.0010	43.79

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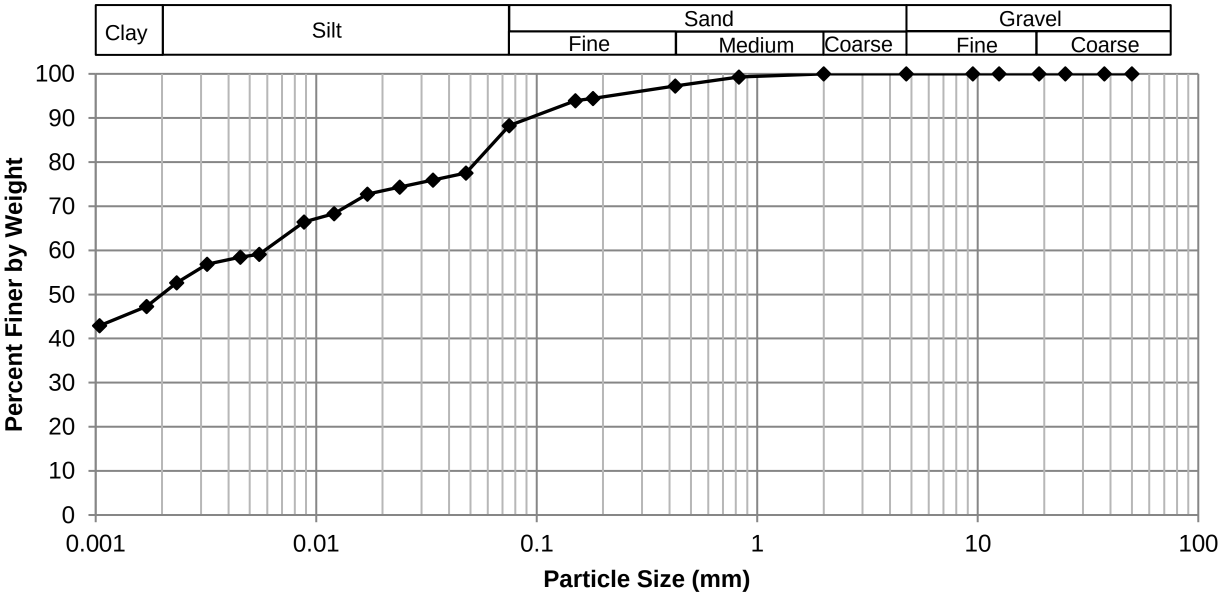
Grain Size Analysis (Hydrometer Method)
ASTM D422

Project No. 0035-051-00
Client Morrison Hershfield
Project St James Street Reconstruction

Test Hole TH17-03
Sample # G11
Depth (m) 0.5 - 0.6
Sample Date 8-Sep-17
Test Date 21-Sep-17
Technician HS

Gravel	0.0%
Sand	11.8%
Silt	38.4%
Clay	49.9%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	88.23
37.5	100.00	2.00	100.00	0.0479	77.52
25.0	100.00	0.825	99.31	0.0338	75.94
19.0	100.00	0.425	97.25	0.0239	74.35
12.5	100.00	0.180	94.41	0.0171	72.76
9.50	100.00	0.150	93.90	0.0121	68.31
4.75	100.00	0.075	88.23	0.0088	66.41
				0.0055	59.10
				0.0045	58.47
				0.0032	56.88
				0.0023	52.68
				0.0017	47.28
				0.0010	42.91

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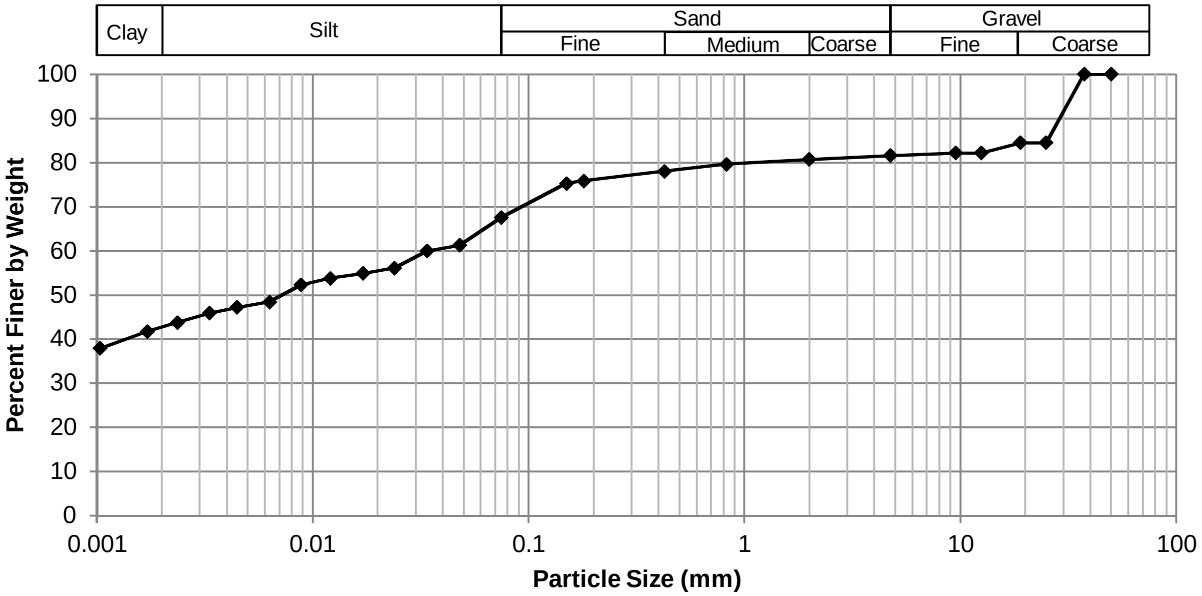
Grain Size Analysis (Hydrometer Method)
ASTM D422

Project No.	0035-051-00
Client	Morrison Hershfield
Project	St James Street Reconstruction
Test Hole	TH17-02
Sample #	G29
Depth (m)	0.3 - 0.5
Sample Date	8-Sep-17
Test Date	21-Sep-17
Technician	HS

Gravel	18.4%
Sand	13.9%
Silt	25.0%
Clay	42.6%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	81.56	0.0750	67.62
37.5	100.00	2.00	80.69	0.0479	61.27
25.0	84.50	0.825	79.60	0.0338	59.99
19.0	84.50	0.425	78.02	0.0239	56.15
12.5	82.16	0.180	75.88	0.0171	54.87
9.50	82.16	0.150	75.31	0.0121	53.84
4.75	81.56	0.075	67.62	0.0088	52.30
				0.0063	48.46
				0.0045	47.18
				0.0033	45.90
				0.0024	43.79
				0.0017	41.74
				0.0010	37.95

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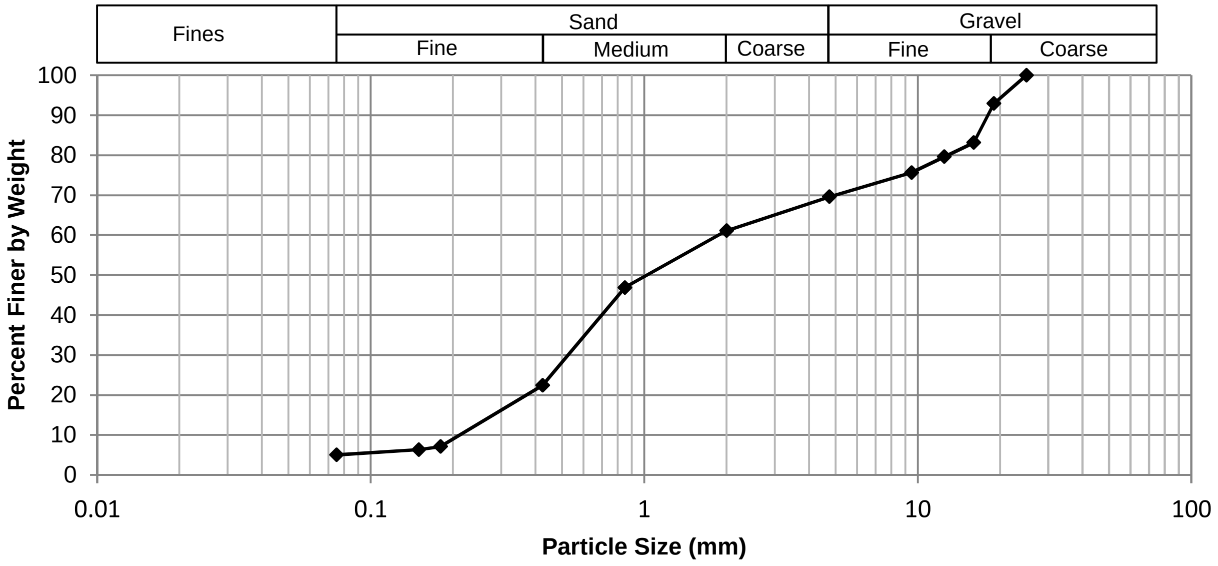
Grain Size Analysis (Sieve Method)
ASTM C136-14

Project No.	0035-051-00
Client	Morrison Hershfield
Project	St James Street Reconstruction
Sample #	G23
Source	TH17-04
Soil Desc.	Sand & Gravel
Date Sampled	8-Sep-17
Date Tested	22-Sep-17
Technician	DA/HS

Gravel %	30.4
Sand %	64.6
Fines %	5.0

Particle Size Distribution Curve



Sieve Number	Sieve Opening (mm)	Percent Passing	Specification (Min-Max)
6"	150		
5"	125		
4"	100		
3"	75.0		
2"	50.0		
1 1/2"	37.5		
1"	25.0	100	
3/4"	19.0	93	
5/8"	16.0	83	
1/2"	12.5	80	
3/8"	9.50	76	
no. 4	4.75	70	
no. 10	2.00	61	
no. 20	0.850	47	
no. 40	0.425	22	
no. 80	0.180	7	
no. 100	0.150	6	
no. 200	0.075	5	

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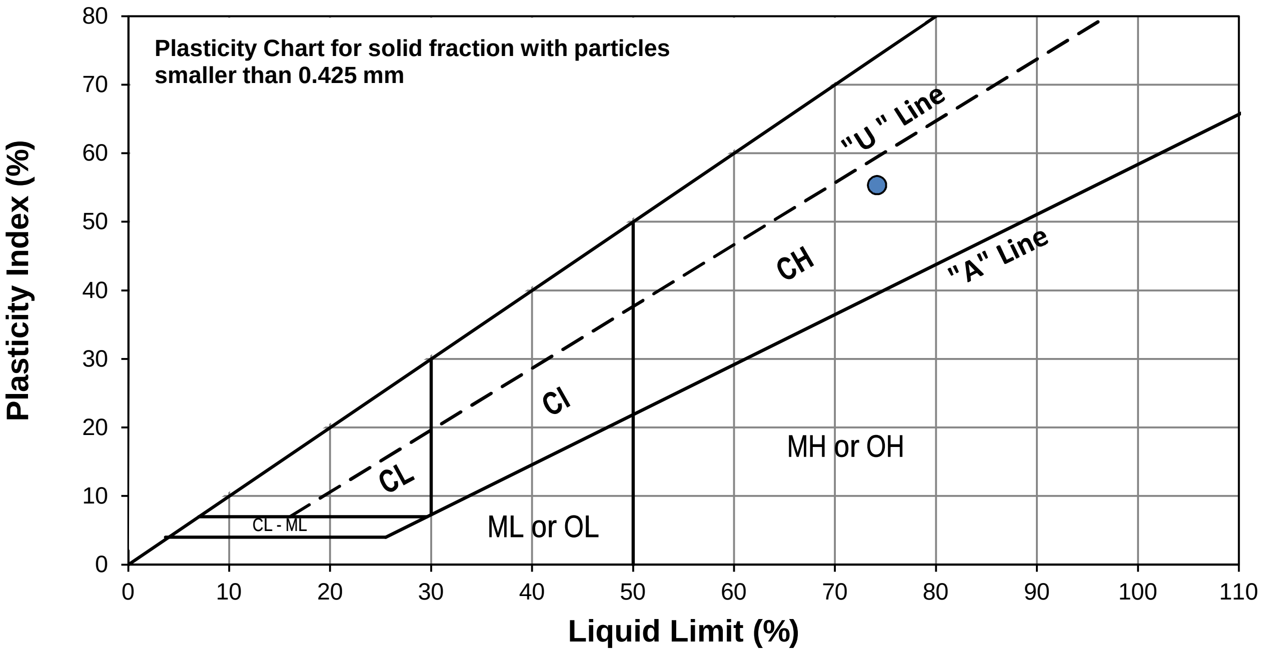
Atterberg Limits
ASTM D4318-10e1

Project No.	0035-051-00
Client	Morrison Hershfield
Project	St. James Street Reconstruction
Test Hole	TH17-01
Sample #	G03
Depth (m)	0.3 - 0.4
Sample Date	08-Sep-17
Test Date	21-Sep-17
Technician	DA

Liquid Limit	74
Plastic Limit	19
Plasticity Index	55

Liquid Limit

Trial #	1	2	3	4	5
Number of Blows (N)	20	25	31		
Mass Wet Soil + Tare (g)	21.765	23.724	22.966		
Mass Dry Soil + Tare (g)	18.485	19.662	19.380		
Mass Tare (g)	14.130	14.204	14.453		
Mass Water (g)	3.280	4.062	3.586		
Mass Dry Soil (g)	4.355	5.458	4.927		
Moisture Content (%)	75.316	74.423	72.783		



Plastic Limit

Trial #	1	2	3	4	5
Mass Wet Soil + Tare (g)	20.577	20.040			
Mass Dry Soil + Tare (g)	19.559	19.165			
Mass Tare (g)	14.251	14.418			
Mass Water (g)	1.018	0.875			
Mass Dry Soil (g)	5.308	4.747			
Moisture Content (%)	19.179	18.433			

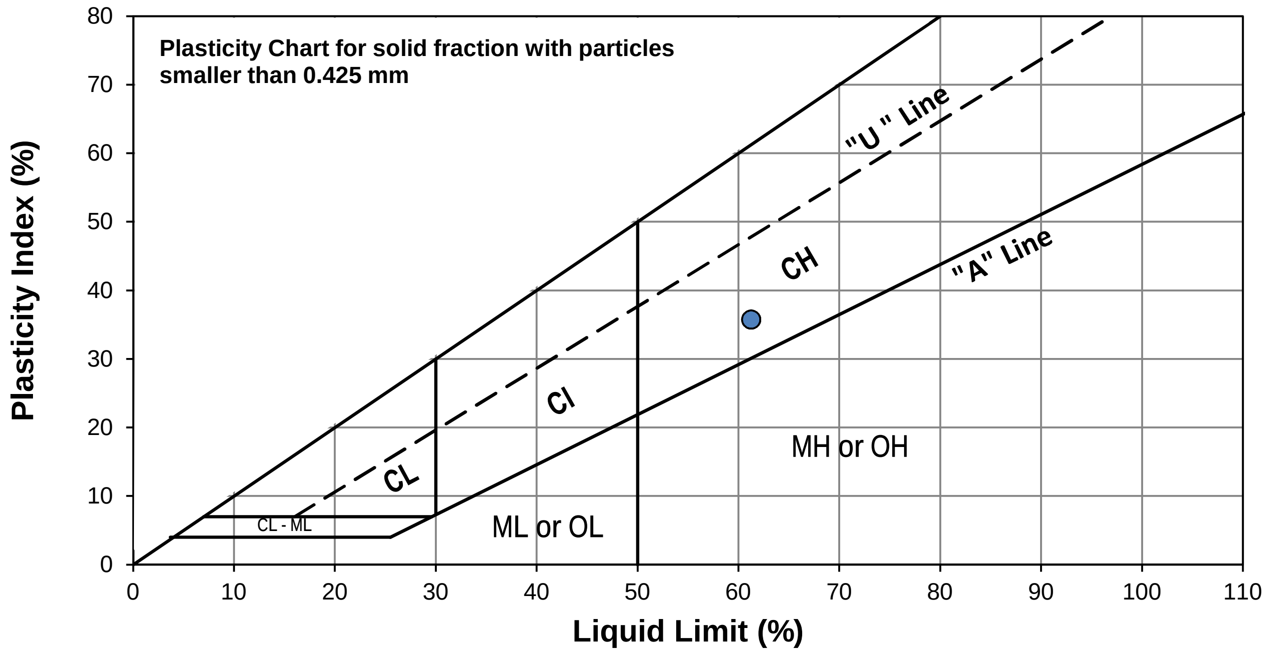
Atterberg Limits
ASTM D4318-10e1

Project No.	0035-051-00
Client	Morrison Hershfield
Project	St. James Street Reconstruction
Test Hole	TH17-03
Sample #	G11
Depth (m)	0.5 - 0.6
Sample Date	08-Sep-17
Test Date	21-Sep-17
Technician	DA

Liquid Limit	61
Plastic Limit	25
Plasticity Index	36

Liquid Limit

Trial #	1	2	3	4	5
Number of Blows (N)	19	26	31		
Mass Wet Soil + Tare (g)	22.585	22.927	21.297		
Mass Dry Soil + Tare (g)	19.334	19.566	18.602		
Mass Tare (g)	14.275	14.004	14.050		
Mass Water (g)	3.251	3.361	2.695		
Mass Dry Soil (g)	5.059	5.562	4.552		
Moisture Content (%)	64.262	60.428	59.205		



Plastic Limit

Trial #	1	2	3	4	5
Mass Wet Soil + Tare (g)	20.249	22.890			
Mass Dry Soil + Tare (g)	19.032	21.151			
Mass Tare (g)	14.322	14.210			
Mass Water (g)	1.217	1.739			
Mass Dry Soil (g)	4.710	6.941			
Moisture Content (%)	25.839	25.054			

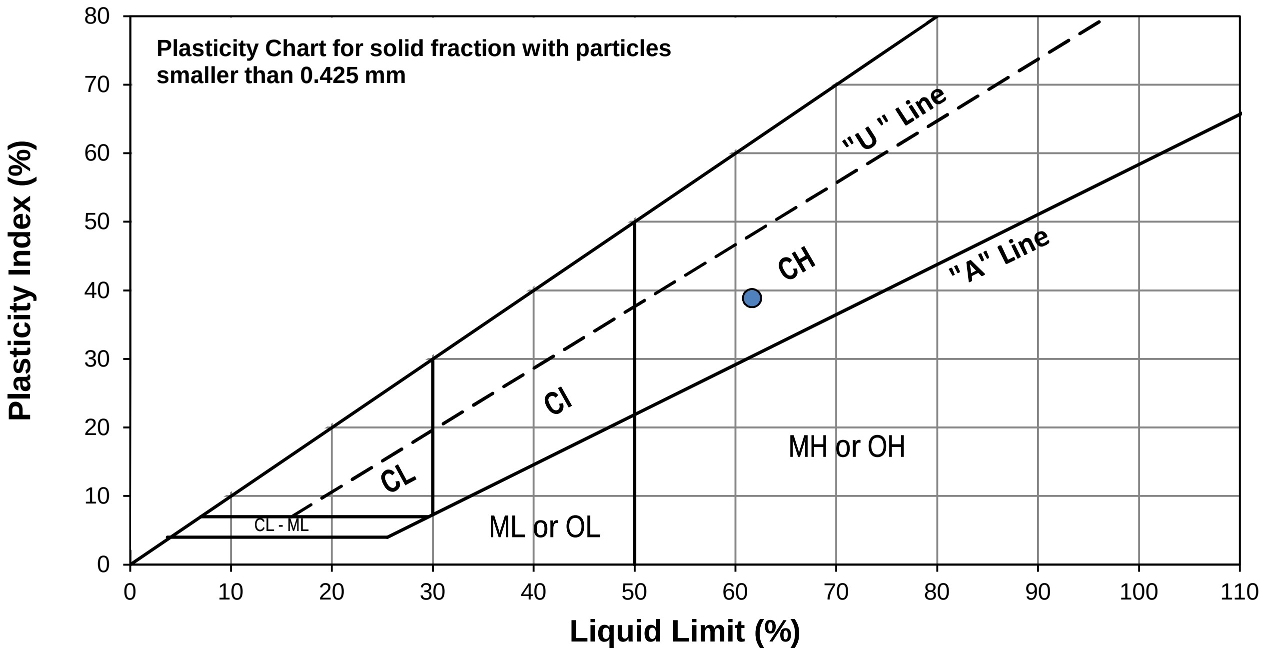
Atterberg Limits
ASTM D4318-10e1

Project No.	0035-051-00
Client	Morrison Hershfield
Project	St. James Street Reconstruction
Test Hole	TH17-02
Sample #	G29
Depth (m)	0.3 - 0.4
Sample Date	08-Sep-17
Test Date	21-Sep-17
Technician	DA

Liquid Limit	62
Plastic Limit	23
Plasticity Index	39

Liquid Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Number of Blows (N)	17	25	31		
Mass Wet Soil + Tare (g)	22.191	21.670	21.112		
Mass Dry Soil + Tare (g)	19.116	18.721	18.594		
Mass Tare (g)	14.281	13.918	14.448		
Mass Water (g)	3.075	2.949	2.518		
Mass Dry Soil (g)	4.835	4.803	4.146		
Moisture Content (%)	63.599	61.399	60.733		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Wet Soil + Tare (g)	20.224	20.570			
Mass Dry Soil + Tare (g)	19.105	19.389			
Mass Tare (g)	14.221	14.150			
Mass Water (g)	1.119	1.181			
Mass Dry Soil (g)	4.884	5.239			
Moisture Content (%)	22.912	22.542			

Appendix C

Photographs of Pavement Core Samples

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Project 0035-051-00
Location St. James St
Hole No. TH17-01 Sample No. C1
Depth 0 - 1'
Technician PB Date Sept 8/17

Photo 1: Pavement Core Sample at Test Hole TH17-01

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Project 0035-051-00
Location St. James St
Hole No. TH17-02 Sample No. C28
Depth 0-10"
Technician PB Date Sept 8/17

Photo 2: Pavement Core Sample at Test Hole TH17-02

Photo 3: Pavement Core Sample at Test Hole TH17-03

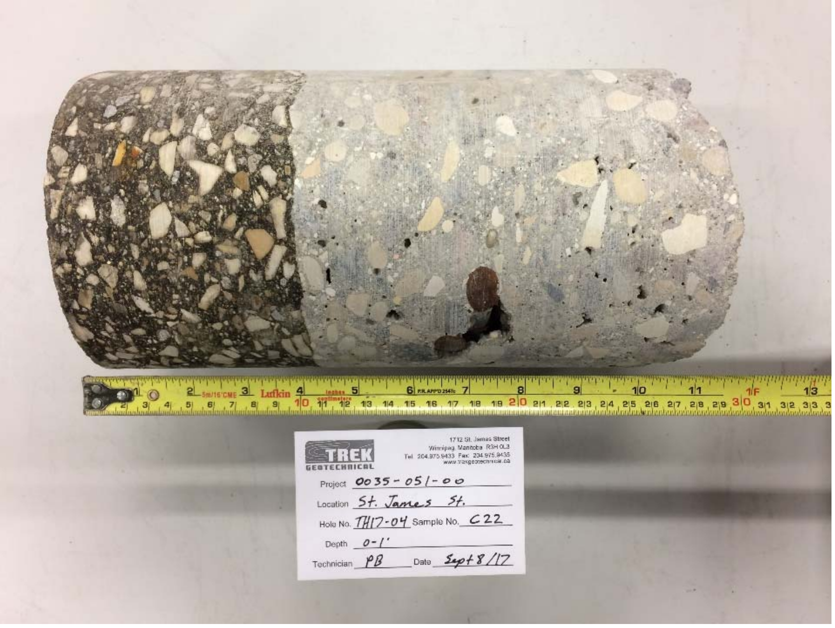

Photo 4: Pavement Core Sample at Test Hole TH17-04

TREK GEOTECHNICAL

Project 0035-051-00

Location St. James St

Hole No. TH17-05 Sample No. C16

Depth 0-11"

Technician PB Date Sept 8 /17

Photo 5: Pavement Core Sample at Test Hole TH17-05

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April 23, 2019 Our File No. 0035-078-00

Beth Phillips, P.Eng., C.I.M
Morrison Hershfield Ltd.
59 Scurfield Boulevard, Unit #1
Winnipeg, Manitoba
R3Y 1V2

RE: The Brick Retaining Wall
Addendum #2 - Geotechnical Recommendations

Introduction

This report provides an updated addendum to the recommendations provided on January 11, 2019 by TREK Geotechnical Inc. (TREK) to Morrison Hershfield Ltd. for the proposed retaining wall at The Brick in Winnipeg, Manitoba.

TREK understands as part of the St. James Street renewal between Ellice Ave. and Sargent Ave., the parking lot access at The Brick will be reconstructed. The reconstruction will result in grade changes and a retaining wall is required to support the existing concrete sidewalk along an approximate 10 m by 10 m portion (20 m length) of the south west corner of the building. The height of the retaining wall is currently not established however will be less than 1 m. The wall will be supported by Cast-in-Place Concrete (CIPC) friction piles, reinforced with steel H-piles. The H-piles will extend above grade and be used to support concrete lagging. A draft drawing provided by Morrison Hershfield showing the rough layout of the wall is attached for reference. Design and construction recommendations for the proposed wall are provided below.

TREK has provided geotechnical design recommendations based on typical Winnipeg soil conditions. These recommendations are being provided with the understanding that TREK will be retained to observe pile installation and subgrade conditions in order to confirm that the soil conditions are consistent with the recommendations provided in this letter. As no investigation has been performed there is a risk that soil conditions will vary from the assumptions used to prepare this letter.

Cast-in-Place-Concrete Friction Pile Construction Recommendations

The following recommendations apply to the design and construction of CIPC friction piles.

1. Based on review of existing information, the sub-surface stratigraphy is expected to consist of approximately 10 m of high plasticity clay overlying silt till. In this regard, the design of CIPC friction piles should be no deeper than 8 m to avoid penetration into the underlying silt till. Additionally, piles should be embedded a minimum of 8 m below grade to resist frost jacking. Based on the depth to till and frost jacking requirements, piles should be designed to 8 m depth. In the event the silt till is encountered at shallower depths, the pile design may have to be re-evaluated by the structural engineer.
2. The piles should have a minimum shaft diameter of 406 mm.
3. Piles require steel reinforcement designed by a qualified structural engineer for the anticipated axial (compression and tension), lateral and bending loads induced from the structure. Piles subject to frost jacking forces should be reinforced for their entire length.

4. Temporary steel casings (sleeves) should be available and used if sloughing of the pile hole occurs and/or to control groundwater seepage. Care should be taken in removing sleeves to prevent sloughing (necking) of the shaft walls and a reduction in the cross-sectional area of the pile. The piling contractor should be prepared to sleeve the full shaft length if required.
5. Concrete should be placed in one continuous operation immediately after the completion of drilling the pile hole to avoid construction problems such as sloughing or caving and groundwater seepage. Concrete should be poured under dry conditions. If groundwater is encountered, it should be controlled and removed. If water cannot be controlled and removed, the concrete should be placed using tremie methods.
6. Concrete placed by free-fall methods should be directed through the middle of the pile shaft and steel reinforcing cage to prevent striking of the drilled shaft walls to protect against soil contamination of the concrete.

Lateral Earth Pressures and Shear Strengths

The magnitude of lateral earth pressures from retained soil acting against retaining walls will depend on the retained material type, method of placement, compaction of the backfill and the magnitude of rotation of the walls. The earth pressure coefficients and unit weights provided in Table 01 can be used to calculate lateral earth pressures of the backfill acting on retaining walls. The values for the clay can be used to calculate the resistance provided by the piles. Any surcharge loading should be added to the calculated lateral earth pressure.

Table 01. Lateral Earth Pressure Coefficients for Retaining Wall Design

Design Parameter	Granular Backfill	Clay
Active Earth Pressure Coefficient (K_a)	0.3	0.5
Passive Earth Pressure Coefficient (K_p)	3.7	2.0
At-Rest Earth Pressure Coefficient (K_o)	0.4	0.7
Estimated Effective Unit Weight, γ' (kN/m³)	22	18

An active pressure coefficient (K_a) should be used to calculate lateral loads from soils against walls which are free to rotate away from the retained soil. A passive earth pressure coefficient (K_p) should be used if the wall is free to translate horizontally towards the retained soil. An at-rest earth pressure coefficient (K_o) should be used if the walls rotates away from the retained soil less than the magnitude required to initiate the minimum active and maximum passive earth pressures.

An active earth pressure coefficient (K_a) should be used to calculate lateral loads against retaining walls which are free to translate horizontally away from the retained soil by more than 1.0% of the wall height. A passive earth pressure coefficient (K_p) should be used if the wall is free to translate horizontally towards the resisting soil by more than 2% of the wall height. An at-rest earth pressure coefficient (K_o) should be used if the walls undergo less than 2% movement of the wall height towards the retained soil and less than 1.0% of the wall height away from the retained soil.

Alternative methods of determining lateral pile capacity can be considered for design such as Broms method. To determine lateral pile capacity using Brom's method in cohesive soils, an estimate of soil shear strength is required.

Based on typical values for the upper 7 m of Winnipeg clays, an undrained shear strength of 40 kPa is appropriate for use, however needs to be confirmed during construction.

It should be noted that some settlement upslope of the wall is typically observed for construction of a cantilevered wall. The degree of settlement is largely a function of workmanship and is difficult to predict.

Site Drainage

Drainage adjacent to the wall and exterior sidewalks should promote run-off away from the structures. A minimum gradient of about 2% should be used for the entire site and maintained throughout the life of the structure. A free draining granular material and perforated sub-drain should be incorporated into the wall design to prevent hydrostatic pressures from developing on the retained soil side of the wall. The City of Winnipeg Standard Construction Specification CW2030 Type 3 Material is appropriate for use as a free draining backfill. A minimum 0.3 m width of material should be placed behind the wall and hand tamped in maximum 0.3 m lifts. A non-woven geotextile separator such as a Titan TE-4 should be installed between the free draining granular, the sub-grade and surrounding fill.

Observation Requirements

In accordance with Section *4.2.2.3 Field Review* of the NBCC (2010), the designer or other suitably qualified person shall carry out a field review on:

1. on an as-required basis for the observation of subgrade preparation and in excavating, dewatering and other related works.

In consideration of the above and relative to this particular project, the above recommendations are contingent on TREK, as the geotechnical engineer of record, being retained to review the prepared subgrade and pile installation prior to wall placement.

Closure

The geotechnical information provided in this report is in accordance with current engineering principles and practices (Standard of Practice). The findings of this report were based on information provided (field investigation and laboratory testing). Soil conditions are natural deposits that can be highly variable across a site. If subsurface conditions are different than the conditions previously encountered on-site or those presented here, we should be notified to adjust our findings if necessary.

All information provided in this report is subject to our standard terms and conditions for engineering services, a copy of which is provided to each of our clients with the original scope of work or standard engineering services agreement. If these conditions are not attached, and you are not already in possession of such terms and conditions, contact our office and you will be promptly provided with a copy.

This report has been prepared by TREK Geotechnical Inc. (the Consultant) for the exclusive use of Morrison Hershfield Ltd. (the Client) and their agents for the work product presented in the report. Any findings or recommendations provided in this report are not to be used or relied upon by any third parties, except as agreed to in writing by the Client and Consultant prior to use.

Kind Regards,

TREK Geotechnical Inc.

Per:

PROVINCE OF MANITOBA
B.S.
HAY
Member
32339
REGISTERED PROFESSIONAL ENGINEER
Apr 23/19

Brent Hay, P.Eng.
Geotechnical Engineer

Reviewed By:

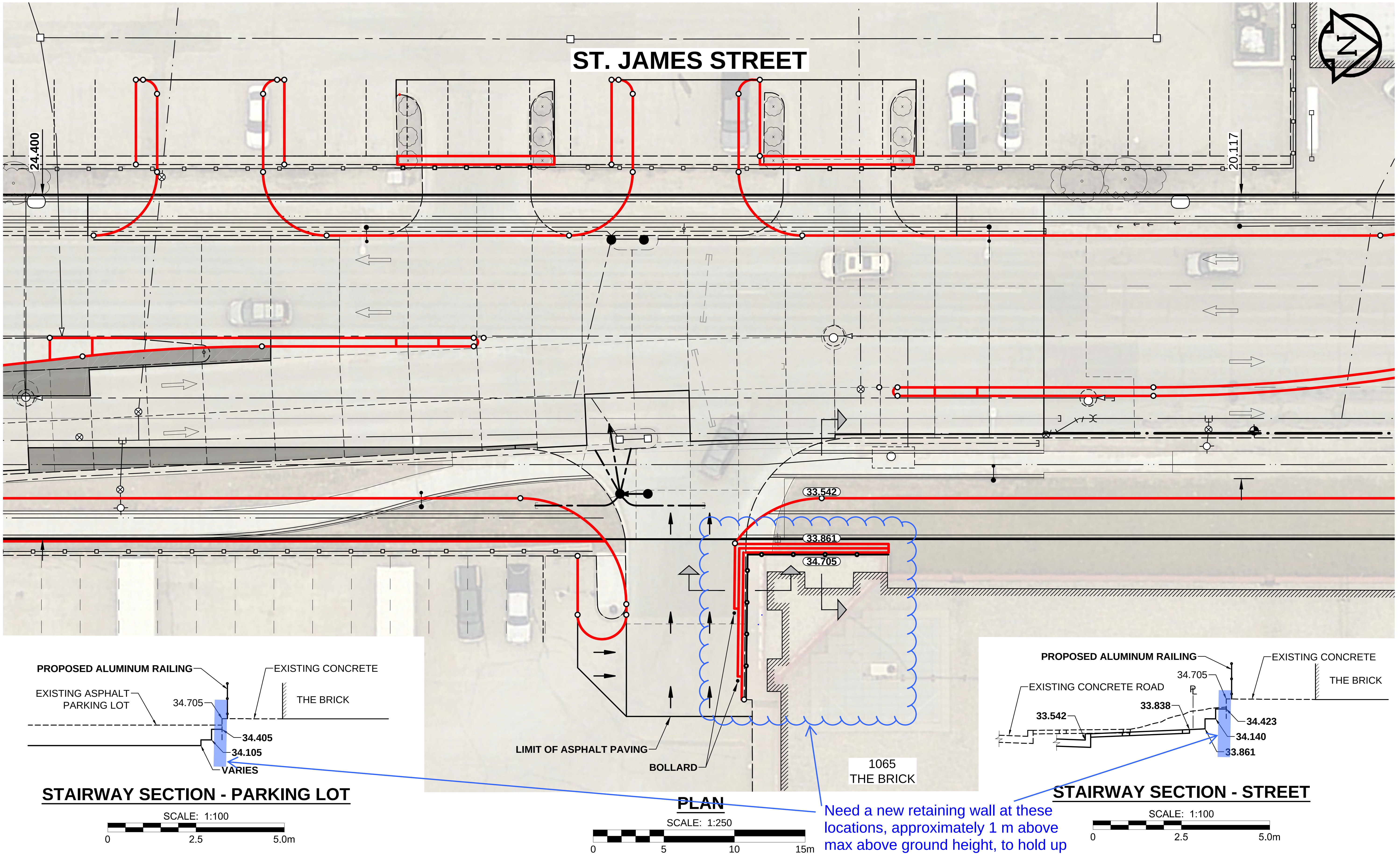
Kent Bannister, M.Sc., P.Eng.
Senior Geotechnical Engineer

Attachment

ENGINEERS
GEOSCIENTISTS
MANITOBA
KWB
Certificate of Authorization
TREK GEOTECHNICAL INC.
No. 4877 Date: Aug 23, 2019

Existing Information

\\WIN01FP\Data1\shared\Proj\W170041\4 Design\1 Drawings\08 Sketches\The Brick\W170041 - The Brick Design.dwg   Last Saved: 2/20/2018 3:24 PM by dlane   Plotted: 2/20/2018 3:30 PM by Dave Lane



STAIRWAY SECTION - PARKING LOT

SCALE: 1:100

PLAN

SCALE: 1:250

STAIRWAY SECTION - STREET

SCALE: 1:100

Need a new retaining wall at these locations, approximately 1 m above max above ground height, to hold up the "sidewalk" around the entrance tower

MORRISON HERSHFIELD

St. James Street Reconstruction
The BRICK - Parking Lot Design

Figure 01

February 21, 2018
VERSION 1.0