

APPENDIX 'A'

GEOTECHNICAL REPORT



Quality Engineering | Valued Relationships

WSP Canada Group Ltd

19-C-09 Watt Street Pavement Renewal

Prepared for:

WSP Canada Group Ltd.
111-93 Lombard Ave.
Winnipeg, MB R3B
Attention: Kelly Groff, P. Eng.

Project Number:

0395 010 00 401

Date:

November 21, 2019
Final Report



Quality Engineering | Valued Relationships

November 21, 2019

Our File No. 0395 010 00

Kelly Groff, P.Eng.
WSP Canada Group Ltd.
111-93 Lombard Avenue
Winnipeg, Manitoba, R3B 3B1

**RE: Sub-Surface Investigation Report for
19-C-09 Watt Street Pavement Renewal**

TREK Geotechnical Inc. is pleased to submit our report for the sub-surface investigations for the 19-C-09 Watt Street Pavement Renewal.

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:

A handwritten signature in blue ink, appearing to read "Nelson John Ferreira", is written over the printed name below.

Nelson John Ferreira, Ph.D., P. Eng.
Geotechnical Engineer, Principal
Tel: 204.975.9433 ext. 103

cc: Angela Fidler-Kliewer C.Tech. (TREK Geotechnical)

Revision History

Revision No.	Author	Issue Date	Description
0	AFK	November 21, 2019	Final Report

Authorization Signatures

Prepared By:



Angela Fidler-Kliwer, C. Tech
Manager of Laboratory and Field Services



Reviewed By:

Nelson John Ferreira, Ph.D., P.Eng.
Geotechnical Engineer



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1.0 Introduction

This report summarizes the results of the road investigation completed for the 19-C-09 Watt Street Pavement Renewal project. The test holes were completed along Watt Street between Chalmers Ave and Munroe Ave. The information collected describes the pavement structure of the existing road as well as the soil stratigraphy beneath the pavement structure at the test hole locations.

2.0 Road Investigation and Laboratory Program

The investigation included coring of pavement followed by drilling of test holes at 9 locations. WSP selected the investigation locations as shown on Figure 01. The road investigation was conducted between September 24, 2019 and October 18, 2019. The pavement structure (asphalt and/or concrete) was cored by Harsimran Singh of TREK Geotechnical Inc. (TREK) using a portable coring press equipped with a hollow 150 mm diameter diamond core drill bit. Eight test holes were drilled to a depth of 2.1 m below road surface by Paddock Drilling Ltd. using a truck mounted drill rig equipped with 125 mm diameter solid stem augers. Due to overhead powerlines, one test hole was drilled using a 50 mm diameter hand auger to a depth of 2.1 m below the road surface. The sub-surface conditions were observed during drilling and visually classified by Bryan Hiebert of TREK. Other pertinent information such as groundwater and drilling conditions were also recorded during the drilling investigation. Disturbed (auger cuttings) samples and bulk 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.

Core and test hole locations noted on the summary tables and test hole logs are based on UTM coordinates obtained using a hand-held GPS and their location relative to the nearest address, and measured distance from the edge of pavement or other permanent features.

The laboratory testing program consisted of moisture content determination on all samples, as well as Atterberg limits, and grain size analysis (mechanical sieve and hydrometer methods) on select samples between 0.5 and 1.0 m below pavement. Laboratory testing results are included on the test hole logs in Appendix A, while the individual test results are included in Appendix B with a summary table. Photos of the asphalt and concrete pavement cores are included in Appendix C.

Three CBR's were completed on bulk samples of differing soil units and the results are shown in the table below.

Table 1. CBR Testing Summary

Sample Description	Test Hole	Depth (m)	SPMDD (kg/m ³)	Opt. Moisture (%)	Percent Proctor (%)	Moisture Content (%)	CBR Value at 2.54 mm	CBR Value at 5.08 mm
Silt and Sand	TH19-03	0.5-1.5	1895	12.9	96.2	15.2	6.0%	4.6%
Clay	TH19-04	0.3-1.5	1529	25.6	94.7	28.4	5.9%	4.4%
Clay	TH19-05	0.3-1.5	1498	26.7	94.5	30.5	4.5%	3.4%

* Testing completed on bulk samples

3.0 Closure

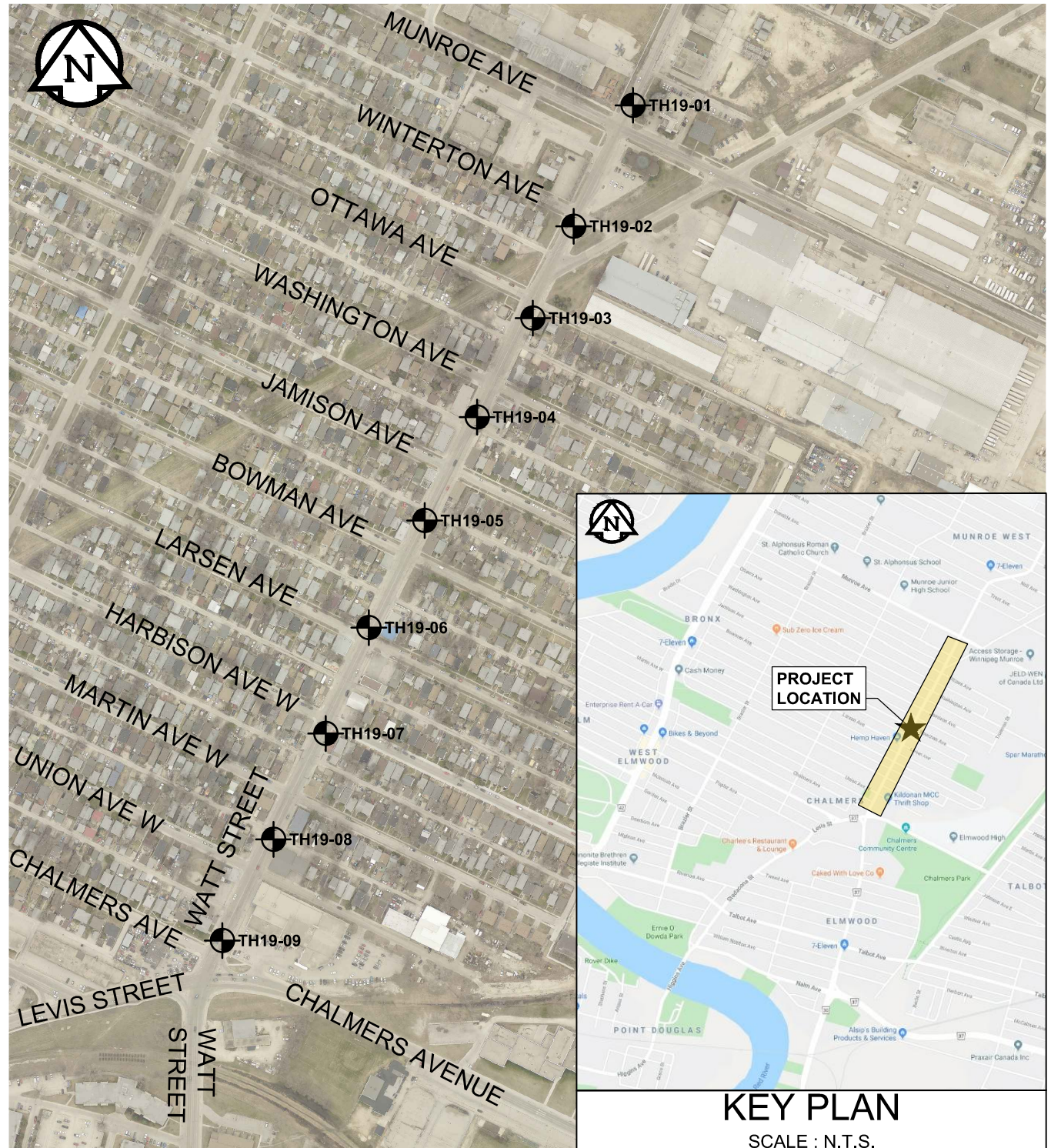
The information provided in this report is in accordance with current engineering principles and practices (Standard of Practice). The findings of this report were based on information provided (field investigation, laboratory testing, geometries). Soil conditions are natural deposits that can be highly variable across a site. If sub-surface 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 WSP Canada Group (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.

Figures

Z:\Projects\0395 WSP\0395 010 00 Pavement Renewals\3 Survey and Dwg\3.4 CAD\3.4.3 Working Folder\FIG 01_19-11-20_TH LOCATION_0_B_DW_0395-010-00.dwg, 11/20/2019 12:49:07 PM

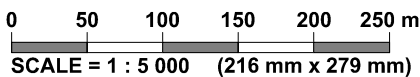


LEGEND:

TEST HOLE (TREK, NOVEMBER 2019)

NOTES:

1. AERIAL PHOTOGRAPH FROM CITY of WINNIPEG 2016
2. GPS COORDINATES FROM HAND HELD DEVICE



KEY PLAN
SCALE : N.T.S.

FIGURE 01
TEST HOLE LOCATION PLAN

Appendix A
Test Hole Logs

GENERAL NOTES

- 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.
- 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.
- 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 Classification	Symbols	Typical Names	Laboratory Classification Criteria		Particle Size			
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)	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 cases 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	ASTM Sieve sizes #10 to #4 #40 to #10 #200 to #40 < #200			
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW				
		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 borderline 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	mm 2.00 to 4.75 0.425 to 2.00 0.075 to 0.425 < 0.075		
			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 borderline 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)		Sils 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		Particle Size ASTM Sieve Sizes mm > 300 75 to 300 19 to 75 4.75 to 19 3 in. to 12 in. 3/4 in. to 3 in. #4 to 3/4 in.
						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								
Sils 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			

* 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

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)	▽ Water Level at Time of Drilling
PL - Plastic Limit (%)	▼ Water Level at End of Drilling
PI - Plasticity Index (%)	▽ Water Level After Drilling as Indicated on Test Hole Logs
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	

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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

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



Sub-Surface Log

Test Hole TH19-01

1 of 1

Client: WSP Group Canada Inc. Project Number: 0395-010-00
 Project Name: 19-C-09 Pavement Renewals - Watt Street Location: N-5531236, E-636561
 Contractor: Paddock Drilling Ltd. Ground Elevation: Top of Pavement
 Method: 125 mm Solid Stem Auger, CME55 Truck Mount Date Drilled: October 17, 2019

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)								
					16	17	18	19	20	21	0	50	100	150	200	250	
0.0 - 0.1		ASPHALT - 150 mm thick															
0.1 - 0.2		CONCRETE - 160 mm thick															
0.2 - 2.1		CLAY - silty, trace sand - grey - moist, firm - high plasticity - AASHTO: A-7-6(54) - stiff below 0.6 m - very stiff below 1.2 m - stiff below 1.5 m - firm below 1.8 m	<input checked="" type="checkbox"/>	G01 G02 G03 G04 G05 G06													

END OF TEST HOLE AT 2.1 m IN CLAY
 1) No seepage or sloughing observed.
 2) Test hole open to 2.1 m immediately after drilling.
 3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
 4) Test hole located in Northbound curb lane, 1.3 m North and 3.5 m West of fire hydrant near 505 Munroe Ave.

SUB-SURFACE LOG LOGS 2019-10-31_WATT STREET_0395-010-00_A_BMH.GPJ_TREK GEOTECHNICAL.GDT 11/20/19

Logged By: Bryan Hiebert Reviewed By: Angela Fidler-Kliewer Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH19-02

1 of 1

Client: WSP Group Canada Inc. Project Number: 0395-010-00
 Project Name: 19-C-09 Pavement Renewals - Watt Street Location: N-5531132, E-636510
 Contractor: TREK Geotechnical Ground Elevation: Top of Pavement
 Method: Hand Auger Date Drilled: October 18, 2019

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)					
					16	17	18	19	20	21	Test Type					
					Particle Size (%)											
					0	20	40	60	80	100						
					PL MC LL 20 40 60 80 100											
					0	20	40	60	80	100	0	50	100	150	200	250
											+ Pocket Pen. + Δ Torvane Δ ⊠ Qu ⊠ ○ Field Vane ○					
		ASPHALT - 150 mm thick														
		CONCRETE - 200 mm thick														
0.5		CLAY - silty, trace sand - dark grey - moist, firm to stiff - high plasticity - AASHTO: A-7-6		G50												
				G51												
1.0				G52												
1.5				G53												
2.0		SILT - trace clay, trace sand - light brown - moist to wet, soft - low plasticity - AASHTO: A-5		G54												
				G55												

END OF TEST HOLE AT 2.1 m IN SILT
 1) Seepage from silt layer observed between 1.8 to 2.1 m depth.
 2) No sloughing observed.
 3) Test hole open to 2.1 m immediately after drilling.
 4) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
 5) Test hole located in Northbound curb lane, 3.5 m South and 12 m East of fire hydrant near 496 Winterton Ave.

SUB-SURFACE LOG LOGS 2019-10-31_WATT STREET_0395-010-00_A_BMH.GPJ_TREK GEOTECHNICAL.GDT 11/20/19



Sub-Surface Log

Test Hole TH19-03

1 of 1

Client: WSP Group Canada Inc. Project Number: 0395-010-00
 Project Name: 19-C-09 Pavement Renewals - Watt Street Location: N-5531053, E-636475
 Contractor: Paddock Drilling Ltd. Ground Elevation: Top of Pavement
 Method: 125 mm Solid Stem Auger, CME55 Truck Mount Date Drilled: October 17, 2019

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)								
					16	17	18	19	20	21	0	50	100	150	200	250	
0.0 - 0.1		ASPHALT - 260 mm thick															
0.1 - 0.4		CONCRETE - 180 mm thick															
0.4 - 0.9		SAND AND GRAVEL - some silt, trace clay - light brown - moist, compact - well graded sand and gravel (<25 mm diam.) - sub-rounded to angular "pitrun" - AASHTO: A-1b(0)	<input checked="" type="checkbox"/>	G37													
0.9 - 1.5		TRANSITION: from SAND AND GRAVEL to CLAY AND SILT	<input checked="" type="checkbox"/>	G38													
1.5 - 2.1		CLAY - silty, trace sand, trace organics - mottled black and brown - moist, firm to stiff - intermediate to high plasticity - AASHTO: A-7-6	<input checked="" type="checkbox"/>	G39													
			<input checked="" type="checkbox"/>	G40													
			<input checked="" type="checkbox"/>	G41													
			<input checked="" type="checkbox"/>	G42													

END OF TEST HOLE AT 2.1 m IN CLAY
 1) No seepage observed.
 2) Sloughing from sand and gravel layer observed between 0.9 to 1.5 m depth.
 3) Test hole open to 1.2 m immediately after drilling.
 4) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
 5) Test hole located in Northbound curb lane, 8 m North and 14 m West of fire hydrant near 504 Ottawa Ave.

SUB-SURFACE LOG LOGS 2019-10-31_WATT STREET_0395-010-00_0_A_BMH.GPJ_TREK GEOTECHNICAL.GDT 11/20/19

Logged By: Bryan Hiebert Reviewed By: Angela Fidler-Kliewer Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH19-04

1 of 1

Client: WSP Group Canada Inc. Project Number: 0395-010-00
 Project Name: 19-C-09 Pavement Renewals - Watt Street Location: N-5530968, E-636427
 Contractor: Paddock Drilling Ltd. Ground Elevation: Top of Pavement
 Method: 125 mm Solid Stem Auger, CME55 Truck Mount Date Drilled: October 17, 2019

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)					
					16	17	18	19	20	21	Test Type					
					Particle Size (%)											
					0	20	40	60	80	100						
					PL MC LL											
					0	20	40	60	80	100	0	50	100	150	200	250
		ASPHALT - 75 mm thick														
		CONCRETE - 205 mm thick														
0.5		CLAY - silty, trace sand - grey - moist, stiff to very stiff - high plasticity - AASHTO: A-7-6		G43												
				G44												
1.0				G45												
				G46												
1.5		- brown below 1.3 m														
				G47												
2.0		SILT - trace to some clay, trace sand - light brown, moist to wet, soft - low to intermediate plasticity - AASHTO: A-5		G48												
				G49												

END OF TEST HOLE AT 2.1 m IN SILT

- 1) No seepage observed.
- 2) Sloughing from silt layer observed between 1.8 to 2.1 m depth.
- 3) Test hole open to 1.9 m immediately after drilling.
- 4) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
- 5) Test hole located Northbound median lane, 5 m South and 8 m West of 445 Watt St.

Logged By: Bryan Hiebert Reviewed By: Angela Fidler-Kliewer Project Engineer: Nelson Ferreira

SUB-SURFACE LOG LOGS 2019-10-31_WATT STREET_0395-010-00_A_BMH.GPJ_TREK GEOTECHNICAL.GDT 11/20/19



Sub-Surface Log

Test Hole TH19-05

1 of 1

Client: WSP Group Canada Inc. Project Number: 0395-010-00
 Project Name: 19-C-09 Pavement Renewals - Watt Street Location: N-5530879, E-636382
 Contractor: Paddock Drilling Ltd. Ground Elevation: Top of Pavement
 Method: 125 mm Solid Stem Auger, CME55 Truck Mount Date Drilled: October 17, 2019

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)									
					16	17	18	19	20	21	0	50	100	150	200	250		
0.00 - 0.05		ASPHALT - 50 mm thick																
0.05 - 0.10		CONCRETE - 180 mm thick																
0.10 - 1.60		CLAY - silty, trace sand, trace organics - mottled black and blue - moist, firm to stiff - high plasticity, strong chemical-like odour - AASHTO: A-7-6(60)	G07															
			G08															
			G09															
		- brown, no organics, stiff to very stiff below 1.2 m	G10															
			G11															
1.60 - 2.10		SILT - trace clay, trace sand - light brown - wet, soft - low plasticity - AASHTO: A-5	G12															

END OF TEST HOLE AT 2.1 m IN SILT

- 1) No seepage or sloughing observed.
- 2) Test hole open to 2.1 m immediately after drilling.
- 3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
- 4) Test hole located in Southbound median lane, 24 m North and 8 m West of fire hydrant near 501 Bowman Ave.

Logged By: Bryan Hiebert Reviewed By: Angela Fidler-Kliewer Project Engineer: Nelson Ferreira

SUB-SURFACE LOG LOGS 2019-10-31_WATT STREET_0395-010-00_A_BMH.GPJ_TREK GEOTECHNICAL.GDT 11/20/19



Sub-Surface Log

Test Hole TH19-06

1 of 1

Client: WSP Group Canada Inc. Project Number: 0395-010-00
 Project Name: 19-C-09 Pavement Renewals - Watt Street Location: N-5530787, E-636334
 Contractor: Paddock Drilling Ltd. Ground Elevation: Top of Pavement
 Method: 125 mm Solid Stem Auger, CME55 Truck Mount Date Drilled: October 17, 2019

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)					
					16	17	18	19	20	21	Test Type					
					Particle Size (%)											
					0	20	40	60	80	100						
					PL _____ MC _____ LL _____ 0 20 40 60 80 100											
					0	20	40	60	80	100	0	50	100	150	200	250
		ASPHALT - 70 mm thick														
		CONCRETE - 230 mm thick														
0.5		CLAY - silty, trace sand - grey - moist, stiff - high plasticity - AASHTO: A-7-6	<input checked="" type="checkbox"/>	G13												
			<input checked="" type="checkbox"/>	G14												
1.0		- very stiff below 0.9 m	<input checked="" type="checkbox"/>	G15												
1.5		SILT - trace clay, trace sand - light brown - moist to wet, soft - low plasticity - AASHTO: A-5	<input checked="" type="checkbox"/>	G16												
			<input checked="" type="checkbox"/>	G17												
2.0			<input checked="" type="checkbox"/>	G18												

END OF TEST HOLE AT 2.1 m IN SILT

- 1) No seepage or sloughing observed.
- 2) Test hole open to 2.1 m immediately after drilling.
- 3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
- 4) Test hole located in Southbound median lane, 4 m North and 8.3 m West of fire hydrant near the intersection of Larsen Ave and Watt St.

Logged By: Bryan Hiebert Reviewed By: Angela Fidler-Kliewer Project Engineer: Nelson Ferreira

SUB-SURFACE LOG LOGS 2019-10-31_WATT STREET_0395-010-00_A_BMH.GPJ_TREK GEOTECHNICAL.GDT 11/20/19



Sub-Surface Log

Test Hole TH19-07

1 of 1

Client: WSP Group Canada Inc. Project Number: 0395-010-00
 Project Name: 19-C-09 Pavement Renewals - Watt Street Location: N-5530696, E-636297
 Contractor: Paddock Drilling Ltd. Ground Elevation: Top of Pavement
 Method: 125 mm Solid Stem Auger, CME55 Truck Mount Date Drilled: October 17, 2019

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)								
					16	17	18	19	20	21	0	50	100	150	200	250	
0.0 - 0.1		ASPHALT - 150 mm thick															
0.1 - 0.4		CONCRETE - 350 mm thick															
0.4 - 1.1		CLAY - silty, trace sand - dark grey - moist, stiff - high plasticity - AASHTO: A-7-6(55)	<input checked="" type="checkbox"/>	G31													
1.1 - 1.4		SILT - trace clay, trace sand - light brown, moist to wet, soft - low plasticity - AASHTO: A-5	<input checked="" type="checkbox"/>	G32													
1.4 - 1.8		CLAY - silty - brown - moist, very stiff - high plasticity - AASHTO: A-7-6	<input checked="" type="checkbox"/>	G33													
1.8 - 2.1		- firm to stiff below 1.8 m	<input checked="" type="checkbox"/>	G34													
			<input checked="" type="checkbox"/>	G35													
			<input checked="" type="checkbox"/>	G36													

END OF TEST HOLE AT 2.1 m IN CLAY
 1) No seepage observed.
 2) Sloughing from silt layer observed between 1.1 to 1.4 m depth.
 3) Test hole open to 1.2 m immediately after drilling.
 4) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
 5) Test hole located in Southbound median lane, 6 m South and 8 m West of 430 Harbison Ave.

Logged By: Bryan Hiebert Reviewed By: Angela Fidler-Kliwer Project Engineer: Nelson Ferreira

SUB-SURFACE LOG LOGS 2019-10-31_WATT STREET_0395-010-00_A_BMH.GPJ_TREK GEOTECHNICAL.GDT 11/20/19



Sub-Surface Log

Test Hole TH19-08

1 of 1

Client: WSP Group Canada Inc. Project Number: 0395-010-00
 Project Name: 19-C-09 Pavement Renewals - Watt Street Location: N-5530605, E-636252
 Contractor: Paddock Drilling Ltd. Ground Elevation: Top of Pavement
 Method: 125 mm Solid Stem Auger, CME55 Truck Mount Date Drilled: October 17, 2019

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)								
					16	17	18	19	20	21	0	50	100	150	200	250	
0.0		ASPHALT - 110 mm thick															
0.1		CONCRETE - 490 mm thick (420 mm recovered)															
0.5																	
0.8		CLAY - silty, trace sand - brown - moist, stiff to very stiff - high plasticity - AASHTO: A-7-6(51)	<input checked="" type="checkbox"/>	G25													
1.0			<input checked="" type="checkbox"/>	G26													
1.5		SILT - trace clay, trace sand - light brown - moist to wet, soft - low plasticity - AASHTO: A-5	<input checked="" type="checkbox"/>	G27													
1.8			<input checked="" type="checkbox"/>	G28													
2.0			<input checked="" type="checkbox"/>	G29													
2.1			<input checked="" type="checkbox"/>	G30													

END OF TEST HOLE AT 2.1 m IN SILT
 1) No seepage observed.
 2) Sloughing from silt layer observed between 1.2 to 2.1 m depth.
 3) Test hole open to 1.8 m immediately after drilling.
 4) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
 5) Test hole located in Northbound median lane, 4 m North and 7.5 m West of 229 Watt St.

Logged By: Bryan Hiebert Reviewed By: Angela Fidler-Kliewer Project Engineer: Nelson Ferreira

SUB-SURFACE LOG LOGS 2019-10-31_WATT STREET_0395-010-00_A_BMH.GPJ_TREK GEOTECHNICAL.GDT 11/20/19



Sub-Surface Log

Test Hole TH19-09

1 of 1

Client: WSP Group Canada Inc. Project Number: 0395-010-00
 Project Name: 19-C-09 Pavement Renewals - Watt Street Location: N-5530518, E-636208
 Contractor: Paddock Drilling Ltd. Ground Elevation: Top of Pavement
 Method: 125 mm Solid Stem Auger, CME55 Truck Mount Date Drilled: October 17, 2019

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)								
					16	17	18	19	20	21	0	50	100	150	200	250	
0.00 - 0.09		ASPHALT - 90 mm thick															
0.09 - 0.30		CONCRETE - 210 mm thick															
0.30 - 0.90		CLAY - silty, trace sand, trace gravel (<20 mm diam.) - grey - moist, stiff - high plasticity - AASHTO: A-7-6	<input checked="" type="checkbox"/>	G19													
0.90 - 1.10	<input checked="" type="checkbox"/>	SILT - trace clay, trace sand - light brown - wet, soft - low plasticity - AASHTO: A-5	<input checked="" type="checkbox"/>	G21													
1.10 - 1.30	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	G20													
1.30 - 1.50	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	G22													
1.50 - 1.70	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	G23													
1.70 - 2.10	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	G24													

END OF TEST HOLE AT 2.1 m IN SILT
 1) No seepage observed.
 2) Sloughing from silt layer observed between 1.2 to 2.1 m depth.
 3) Test hole open to 1.6 m immediately after drilling.
 4) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
 5) Test hole located in Northbound median lane, 63 m South and 9.3 m East of fire hydrant near the intersector of Union Ave and Watt St.

SUB-SURFACE LOG LOGS 2019-10-31_WATT STREET_0395-010-00_A_BMH.GPJ_TREK GEOTECHNICAL.GDT 11/20/19

Logged By: Bryan Hiebert Reviewed By: Angela Fidler-Kliewer Project Engineer: Nelson Ferreira

Appendix B

Summary Table & Lab Testing Results



**Watt Street Pavement Renewals
Sub-Surface Investigation
Watt Street**

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)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index	
TH19-01	UTM : 5531236 N, 636561 E Located in Northbound, curb lane, 1.3 m North and 3.5 m West of fire hydrant near 505 Munroe Avenue	Asphalt	150	Concrete	160	Clay and Silt	0.3	0.5	28								
						Clay and Silt	0.6	0.8	32	60	32	9	0	18	72	54	
						Clay and Silt	0.9	1.1	34								
						Clay and Silt	1.2	1.4	35								
						Clay and Silt	1.5	1.7	30								
						Clay and Silt	2.0	2.1	38								
TH19-02	UTM : 5531132 N, 636510 E Located in Northbound, curb lane, 3.5 m South and 12 m East of fire hydrant near 496 Winterton Ave.	Asphalt	150	Concrete	200	Clay and Silt	0.5	0.6	33								
						Clay and Silt	0.8	0.9	32								
						Clay and Silt	1.1	1.2	33								
						Clay and Silt	1.4	1.5	33								
						Silt	1.7	1.8	24								
						Silt	2.0	2.1	29								
TH19-03	UTM : 5531053 N, 636475 E Located in Northbound, curb lane, 8.0 North and 14.0 m West of fire hydrant near 504 Ottawa Ave.	Asphalt	260	Concrete	180						%Fines	Sand	Gravel				
						Sand and Gravel (Fill)	0.5	0.6	7								
						Sand and Gravel (Fill)	0.8	0.9	8		23	38	39				
						Transition from Sand and Gravel to Clay and Silt	1.1	1.2	11								
						Transition from Sand and Gravel to Clay and Silt	1.4	1.5	22								
						Clay and Silt	1.7	1.8	24								
TH19-04	UTM : 5530968 N, 636427 E Located in Northbound, median lane, 5.0 m South and 8.0 m West of 445 Watt St.	Asphalt	75	Concrete	205	Clay and Silt	0.3	0.5	31								
						Clay and Silt	0.6	0.8	29								
						Clay and Silt	0.9	1.1	29								
						Clay and Silt	1.2	1.4	29								
						Clay and Silt	1.5	1.7	31								
						Silt	1.8	2.0	24								
				Silt	2.0	2.1	27										



**Watt Street Pavement Renewals
Sub-Surface Investigation
Watt Street**

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)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index	
TH19-05	UTM : 5531236 N, 636561 E Located in Northbound, curb lane, 1.3 m North and 3.5 m West of fire hydrant near 505 Munroe Avenue	Asphalt	50	Concrete	180	Clay and Silt	0.4	0.5	18								
						Clay and Silt	0.6	0.8	32	47	46	7	0	21	79	58	
						Clay and Silt	0.9	1.1	31								
						Clay and Silt	1.2	1.4	29								
						Clay and Silt	1.5	1.7	28								
						Silt	2.0	2.1	25								
TH19-06	UTM : 5530787 N, 636334 E Located in Southbound, median lane, 4.0 m North and 8.3 m West of fire hydrant near the intersection of Larsen Ave and Watt St.	Asphalt	70	Concrete	230	Clay and Silt	0.3	0.5	31								
						Clay and Silt	0.6	0.8	31								
						Clay and Silt	0.9	1.1	30								
						Silt	1.2	1.4	22								
						Silt	1.5	1.7	22								
						Silt	2.0	2.1	23								
TH19-07	UTM : 5530696 N, 636297 E Located in Southbound, median lane, 6.0 m South and 8.0 m West of 430 Harbison Ave.	Asphalt	150	Concrete	350	Clay and Silt	0.5	0.7	33	58	36	5	0	22	73	52	
						Clay and Silt	0.8	1.0	27								
						Silt	1.1	1.3	23								
						Clay	1.4	1.6	30								
						Clay	1.7	1.9	43								
						Clay	2.0	2.1	40								
TH19-08	UTM : 5530605 N, 636252 E Located in Northbound, median lane, 4.0 m North and 7.5 m West of 229 Watt St.	Asphalt	110	Concrete	470	Clay and Silt	0.6	0.8	30	69	26	5	0	21	70	48	
						Clay and Silt	0.9	1.1	30								
						Silt	1.2	1.4	23								
						Silt	1.5	1.7	24								
						Silt	1.8	2.0	24								
						Silt	2.0	2.1	24								



Project No. 0395-010-00
Client WSP Group Canada Ltd.
Project 19-C-09 Watt Street Pavement Renewals

Sample Date 17-Oct-19
Test Date 01-Nov-19
Technician SB

Test Hole	TH19-01	TH19-01	TH19-01	TH19-01	TH19-01	TH19-01
Depth (m)	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	2.0 - 2.1
Sample #	G01	G02	G03	G04	G05	G06
Tare ID	W47	AB96	AB62	H20	F32	E9
Mass of tare	8.6	6.7	6.6	8.5	8.3	8.6
Mass wet + tare	175.1	386.3	140.9	161.6	144.0	149.3
Mass dry + tare	138.3	293.6	107.0	121.8	112.8	110.7
Mass water	36.8	92.7	33.9	39.8	31.2	38.6
Mass dry soil	129.7	286.9	100.4	113.3	104.5	102.1
Moisture %	28.4%	32.3%	33.8%	35.1%	29.9%	37.8%

Test Hole	TH19-02	TH19-02	TH19-02	TH19-02	TH19-02	TH19-02
Depth (m)	0.5 - 0.6	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.7 - 1.8	2.0 - 2.1
Sample #	G50	G51	G52	G53	G54	G55
Tare ID	AA19	AB07	Z26	E52	N22	AC10
Mass of tare	6.8	6.8	8.5	8.5	8.5	6.6
Mass wet + tare	166.8	183.8	143.7	156.8	228.0	222.0
Mass dry + tare	127.4	140.6	110.3	120.2	185.0	174.0
Mass water	39.4	43.2	33.4	36.6	43.0	48.0
Mass dry soil	120.6	133.8	101.8	111.7	176.5	167.4
Moisture %	32.7%	32.3%	32.8%	32.8%	24.4%	28.7%

Test Hole	TH19-03	TH19-03	TH19-03	TH19-03	TH19-03	TH19-03
Depth (m)	0.5 - 0.6	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.7 - 1.8	2.0 - 2.1
Sample #	G37	G38	G39	G40	G41	G42
Tare ID	A32	J33	N32	D21	N59	P28
Mass of tare	9.1	367.9	8.3	8.6	8.5	8.6
Mass wet + tare	201.3	1073.3	173.8	192.2	176.6	182.2
Mass dry + tare	189.2	1020.0	157.1	159.4	143.8	138.3
Mass water	12.1	53.3	16.7	32.8	32.8	43.9
Mass dry soil	180.1	652.1	148.8	150.8	135.3	129.7
Moisture %	6.7%	8.2%	11.2%	21.8%	24.2%	33.8%



Project No. 0395-010-00
Client WSP Group Canada Ltd.
Project 19-C-09 Watt Street Pavement Renewals

Sample Date 17-Oct-19
Test Date 01-Nov-19
Technician SB

Test Hole	TH19-04	TH19-04	TH19-04	TH19-04	TH19-04	TH19-04
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 #	G43	G44	G45	G46	G47	G48
Tare ID	C2	F132	E41	AA01	E44	A30
Mass of tare	8.6	8.7	8.5	6.7	8.6	8.2
Mass wet + tare	150.1	150.2	167.7	175.9	178.7	184.3
Mass dry + tare	116.7	118.3	131.8	138.1	138.9	150.7
Mass water	33.4	31.9	35.9	37.8	39.8	33.6
Mass dry soil	108.1	109.6	123.3	131.4	130.3	142.5
Moisture %	30.9%	29.1%	29.1%	28.8%	30.5%	23.6%

Test Hole	TH19-04	TH19-05	TH19-05	TH19-05	TH19-05	TH19-05
Depth (m)	2.0 - 2.1	0.4 - 0.5	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7
Sample #	G49	G07	G08	G09	G10	G11
Tare ID	AA22	Z73	F1	Z09	C17	E138
Mass of tare	6.9	8.6	8.6	8.4	8.7	8.8
Mass wet + tare	151.5	216.0	347.8	173.4	174.1	168.6
Mass dry + tare	121.2	184.7	264.8	134.7	136.9	133.7
Mass water	30.3	31.3	83.0	38.7	37.2	34.9
Mass dry soil	114.3	176.1	256.2	126.3	128.2	124.9
Moisture %	26.5%	17.8%	32.4%	30.6%	29.0%	27.9%

Test Hole	TH19-05	TH19-06	TH19-06	TH19-06	TH19-06	TH19-06
Depth (m)	2.0 - 2.1	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7
Sample #	G12	G13	G14	G15	G16	G17
Tare ID	N42	E121	AB90	Z45	Z07	H53
Mass of tare	8.6	8.4	6.7	8.7	8.6	8.4
Mass wet + tare	203.6	152.1	190.2	165.6	187.6	252.7
Mass dry + tare	164.1	118.2	146.7	129.0	154.9	208.4
Mass water	39.5	33.9	43.5	36.6	32.7	44.3
Mass dry soil	155.5	109.8	140.0	120.3	146.3	200.0
Moisture %	25.4%	30.9%	31.1%	30.4%	22.4%	22.2%



Project No. 0395-010-00
Client WSP Group Canada Ltd.
Project 19-C-09 Watt Street Pavement Renewals

Sample Date 17-Oct-19
Test Date 01-Nov-19
Technician SB

Test Hole	TH19-06	TH19-07	TH19-07	TH19-07	TH19-07	TH19-07
Depth (m)	2.0 - 2.1	0.5 - 0.7	0.8 - 1.0	1.1 - 1.3	1.4 - 1.6	1.7 - 1.9
Sample #	G18	G31	G32	G33	G34	G35
Tare ID	F55	K20	H70	E85	AA15	K29
Mass of tare	8.6	8.4	8.8	8.6	6.7	8.2
Mass wet + tare	194.2	378.5	161.9	146.0	170.3	169.9
Mass dry + tare	159.2	287.2	129.6	120.0	132.6	121.1
Mass water	35.0	91.3	32.3	26.0	37.7	48.8
Mass dry soil	150.6	278.8	120.8	111.4	125.9	112.9
Moisture %	23.2%	32.7%	26.7%	23.3%	29.9%	43.2%

Test Hole	TH19-07	TH19-08	TH19-08	TH19-08	TH19-08	TH19-08
Depth (m)	2.0 - 2.1	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0
Sample #	G36	G25	G26	G27	G28	G29
Tare ID	C20	Z109	W76	W22	N92	W19
Mass of tare	8.4	8.5	8.5	8.4	8.5	8.7
Mass wet + tare	169.1	346.5	176.5	212.8	188.7	178.9
Mass dry + tare	123.4	268.2	137.4	174.1	154.2	145.6
Mass water	45.7	78.3	39.1	38.7	34.5	33.3
Mass dry soil	115.0	259.7	128.9	165.7	145.7	136.9
Moisture %	39.7%	30.2%	30.3%	23.4%	23.7%	24.3%

Test Hole	TH19-08	TH19-09	TH19-09	TH19-09	TH19-09	TH19-09
Depth (m)	2.0 - 2.1	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7
Sample #	G30	G19	G20	G21	G22	G23
Tare ID	AB71	W80	H56	H59	Z23	Z21
Mass of tare	6.7	8.7	8.7	8.7	8.5	9.2
Mass wet + tare	191.3	161.9	158.3	167.4	150.4	215.1
Mass dry + tare	155.9	124.9	122.6	135.1	120.5	176.2
Mass water	35.4	37.0	35.7	32.3	29.9	38.9
Mass dry soil	149.2	116.2	113.9	126.4	112.0	167.0
Moisture %	23.7%	31.8%	31.3%	25.6%	26.7%	23.3%



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Moisture Content Report ASTM D2216-10

Project No. 0395-010-00
Client WSP Group Canada Ltd.
Project 19-C-09 Watt Street Pavement Renewals

Sample Date 17-Oct-19
Test Date 01-Nov-19
Technician SB

Test Hole	TH19-09					
Depth (m)	2.0 - 2.1					
Sample #	G24					
Tare ID	E83					
Mass of tare	8.7					
Mass wet + tare	156.6					
Mass dry + tare	127.1					
Mass water	29.5					
Mass dry soil	118.4					
Moisture %	24.9%					



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Atterberg Limits
ASTM D4318-10e1

Project No. 0395-001-00
Client WSP Group Canada Ltd.
Project 19-C-09 Watt Street Pavement Renewals

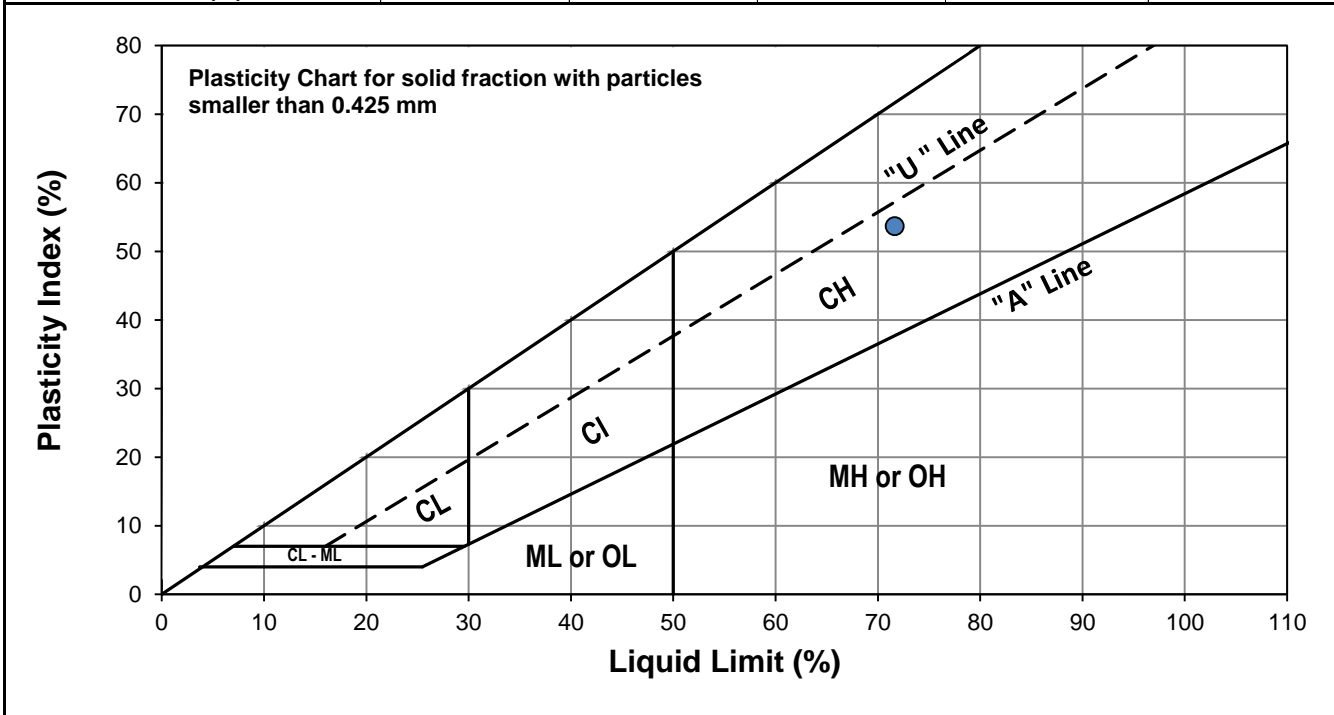


Test Hole TH19-01
Sample # G02
Depth (m) 0.6 - 0.8
Sample Date 17-Oct-19
Test Date 05-Nov-19
Technician SB

Liquid Limit	72
Plastic Limit	18
Plasticity Index	54

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	17	22	31
Mass Wet Soil + Tare (g)	22.069	21.141	21.039
Mass Dry Soil + Tare (g)	18.661	18.142	18.220
Mass Tare (g)	14.062	14.023	14.196
Mass Water (g)	3.408	2.999	2.819
Mass Dry Soil (g)	4.599	4.119	4.024
Moisture Content (%)	74.103	72.809	70.055



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.012	14.161			
Mass Wet Soil + Tare (g)	21.341	21.953			
Mass Dry Soil + Tare (g)	20.207	20.781			
Mass Water (g)	1.134	1.172			
Mass Dry Soil (g)	6.195	6.620			
Moisture Content (%)	18.305	17.704			



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Atterberg Limits
ASTM D4318-10e1

Project No. 0395-001-00
Client WSP Group Canada Ltd.
Project 19-C-09 Watt Street Pavement Renewals

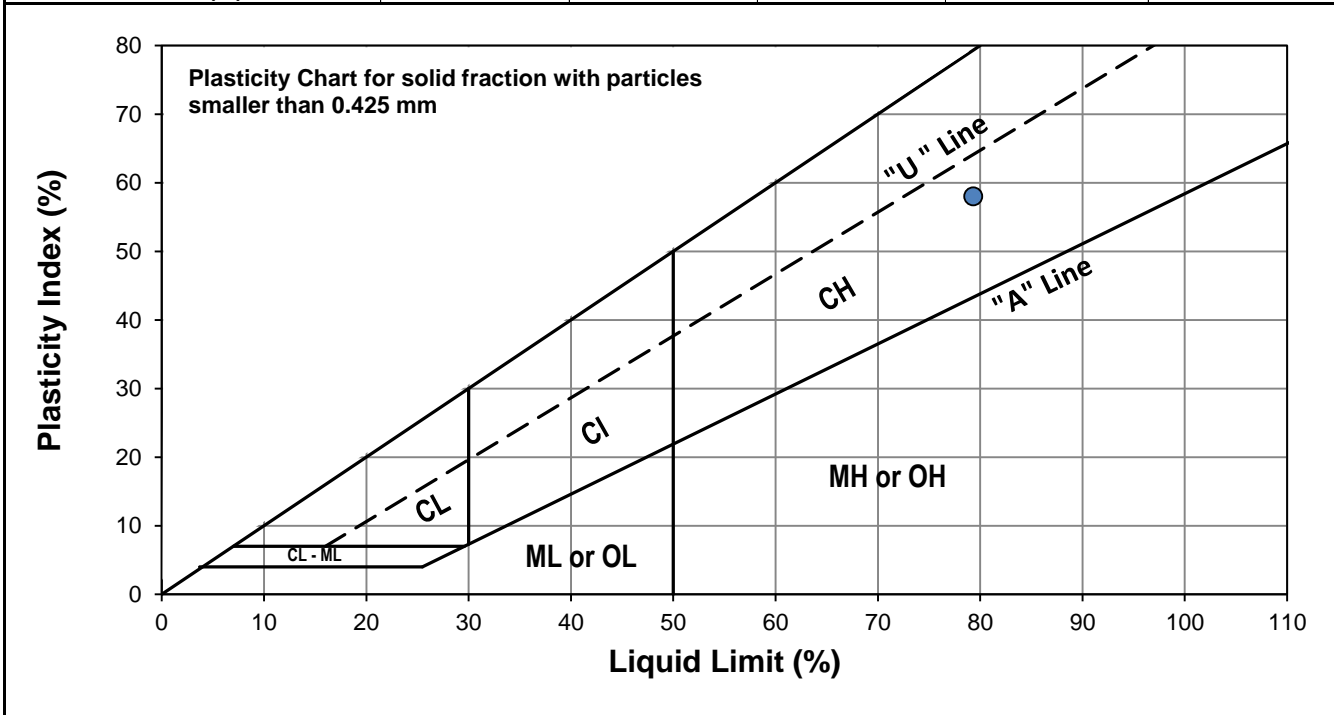


Test Hole TH19-05
Sample # G08
Depth (m) 0.6 - 0.8
Sample Date 18-Oct-19
Test Date 06-Nov-19
Technician SB

Liquid Limit	79
Plastic Limit	21
Plasticity Index	58

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	21	27	30
Mass Wet Soil + Tare (g)	20.710	20.762	21.005
Mass Dry Soil + Tare (g)	17.660	17.888	18.012
Mass Tare (g)	13.855	14.249	14.198
Mass Water (g)	3.050	2.874	2.993
Mass Dry Soil (g)	3.805	3.639	3.814
Moisture Content (%)	80.158	78.978	78.474



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.937	14.178			
Mass Wet Soil + Tare (g)	22.036	21.931			
Mass Dry Soil + Tare (g)	20.596	20.582			
Mass Water (g)	1.440	1.349			
Mass Dry Soil (g)	6.659	6.404			
Moisture Content (%)	21.625	21.065			



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Atterberg Limits
ASTM D4318-10e1

Project No. 0395-001-00
Client WSP Group Canada Ltd.
Project 19-C-09 Watt Street Pavement Renewals

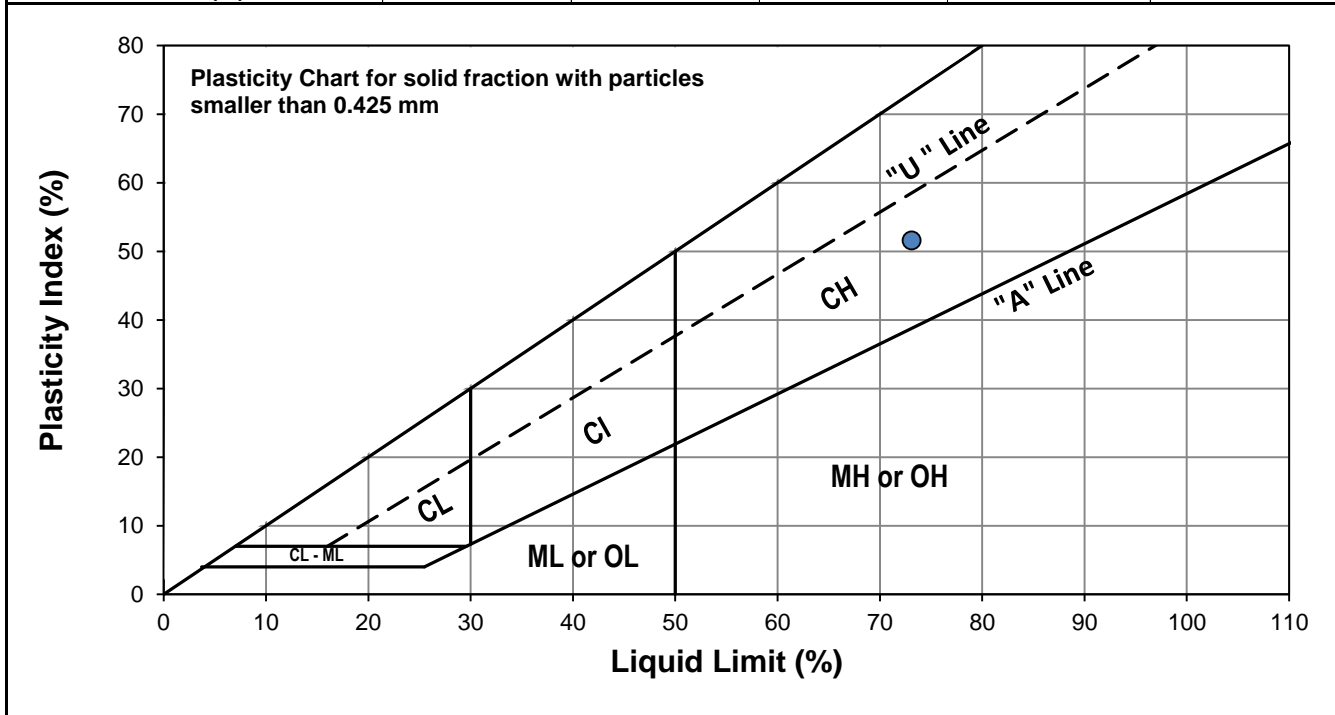


Test Hole TH19-07
Sample # G31
Depth (m) 0.5 - 0.7
Sample Date 17-Oct-19
Test Date 06-Nov-19
Technician SB/AD

Liquid Limit	73
Plastic Limit	22
Plasticity Index	52

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	19	22	28
Mass Wet Soil + Tare (g)	20.206	21.613	21.200
Mass Dry Soil + Tare (g)	17.581	18.383	18.283
Mass Tare (g)	14.110	14.037	14.234
Mass Water (g)	2.625	3.230	2.917
Mass Dry Soil (g)	3.471	4.346	4.049
Moisture Content (%)	75.627	74.321	72.042



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.011	14.153			
Mass Wet Soil + Tare (g)	21.117	21.496			
Mass Dry Soil + Tare (g)	19.881	20.171			
Mass Water (g)	1.236	1.325			
Mass Dry Soil (g)	5.870	6.018			
Moisture Content (%)	21.056	22.017			



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Atterberg Limits
ASTM D4318-10e1

Project No. 0395-001-00
Client WSP Group Canada Ltd.
Project 19-C-09 Watt Street Pavement Renewals

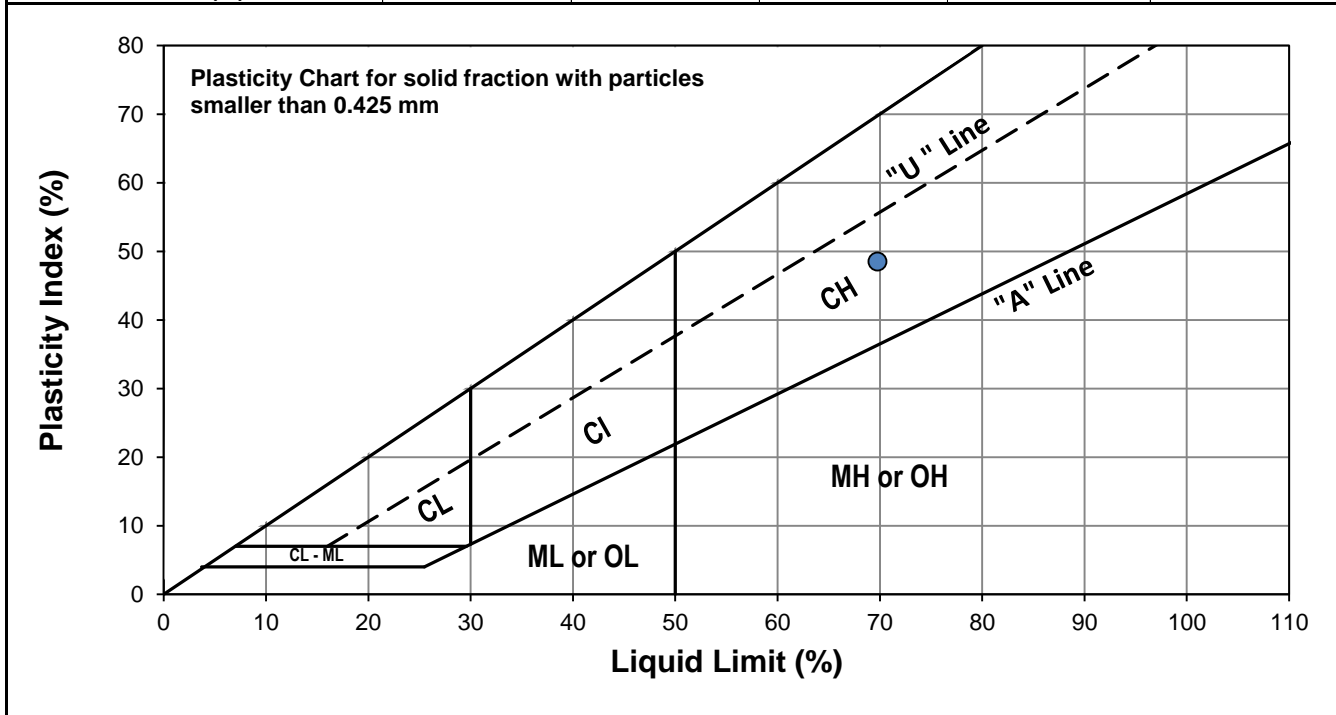


Test Hole TH19-08
Sample # G25
Depth (m) 0.6 - 0.8
Sample Date 17-Oct-19
Test Date 06-Nov-19
Technician SB

Liquid Limit	70
Plastic Limit	21
Plasticity Index	48

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	16	25	28
Mass Wet Soil + Tare (g)	20.283	21.887	21.422
Mass Dry Soil + Tare (g)	17.570	18.726	18.388
Mass Tare (g)	13.988	14.152	13.977
Mass Water (g)	2.713	3.161	3.034
Mass Dry Soil (g)	3.582	4.574	4.411
Moisture Content (%)	75.740	69.108	68.783



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.716	14.347			
Mass Wet Soil + Tare (g)	22.406	23.031			
Mass Dry Soil + Tare (g)	20.867	21.521			
Mass Water (g)	1.539	1.510			
Mass Dry Soil (g)	7.151	7.174			
Moisture Content (%)	21.521	21.048			



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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

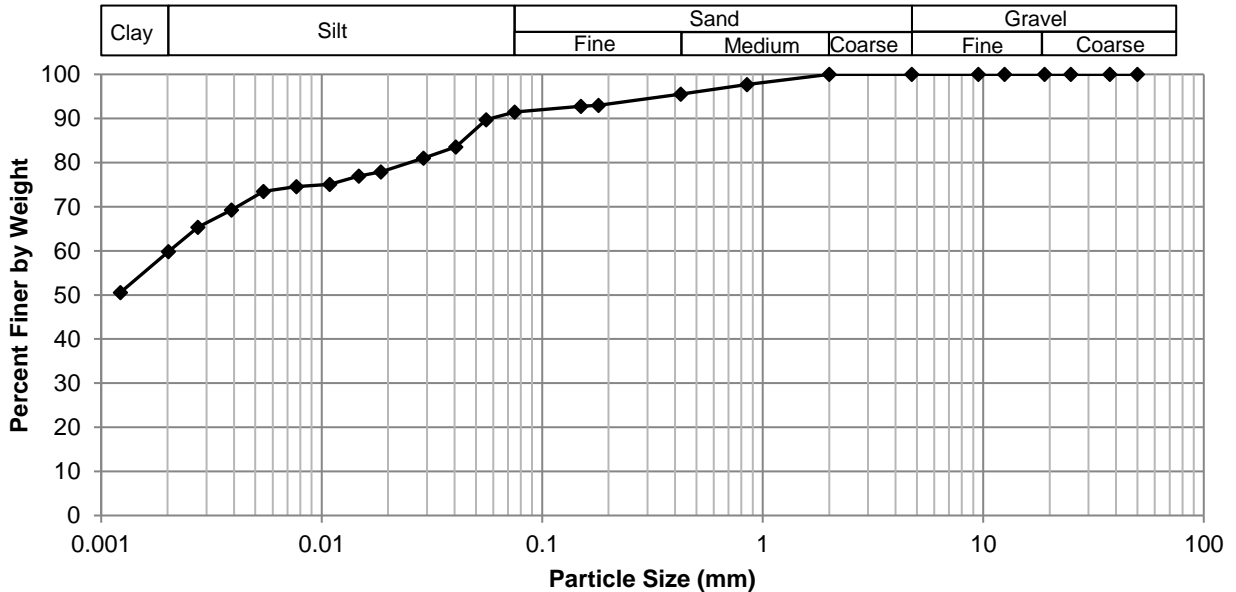
Project No. 0395-010-00-400
Client WSP Group Canada Ltd.
Project 19-C-09 Watt Street Pavement Renewals



Test Hole TH19-01
Sample # G02
Depth (m) 0.6 - 0.8
Sample Date 17-Oct-19
Test Date 5-Nov-19
Technician JSB

Gravel	0.0%
Sand	8.5%
Silt	31.9%
Clay	59.6%

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	100.00	0.0750	91.49
37.5	100.00	2.00	100.00	0.0557	89.71
25.0	100.00	0.850	97.72	0.0405	83.53
19.0	100.00	0.425	95.49	0.0290	81.03
12.5	100.00	0.180	93.01	0.0186	77.91
9.50	100.00	0.150	92.74	0.0148	76.97
4.75	100.00	0.075	91.49	0.0109	75.09
				0.0077	74.54
				0.0054	73.44
				0.0039	69.28
				0.0027	65.37
				0.0020	59.81
				0.0012	50.56



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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

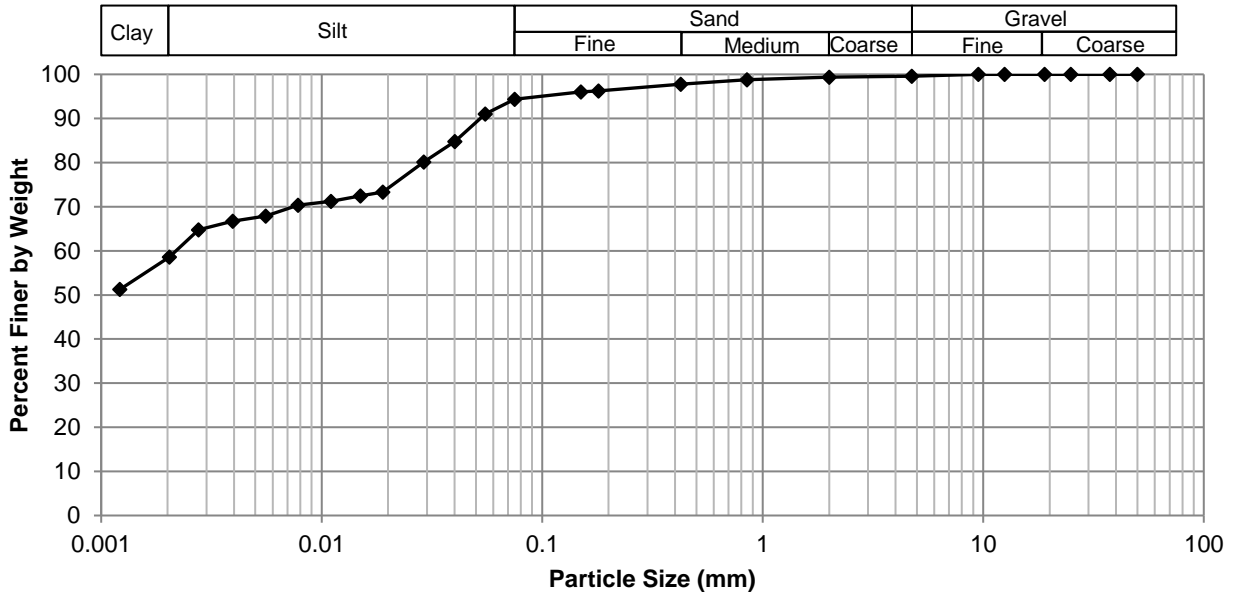
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Client WSP Group Canada Ltd.
Project 19-C-09 Watt Street Pavement Renewals



Test Hole TH19-07
Sample # G31
Depth (m) 0.5 - 0.7
Sample Date 17-Oct-19
Test Date 6-Nov-19
Technician JSB

Gravel	0.4%
Sand	5.2%
Silt	36.2%
Clay	58.2%

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	99.57	0.0750	94.38
37.5	100.00	2.00	99.40	0.0552	91.01
25.0	100.00	0.850	98.76	0.0402	84.80
19.0	100.00	0.425	97.80	0.0290	80.14
12.5	100.00	0.180	96.25	0.0189	73.30
9.50	100.00	0.150	96.05	0.0150	72.43
4.75	99.57	0.075	94.38	0.0110	71.19
				0.0078	70.32
				0.0056	67.90
				0.0039	66.72
				0.0028	64.73
				0.0020	58.58
				0.0012	51.24



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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

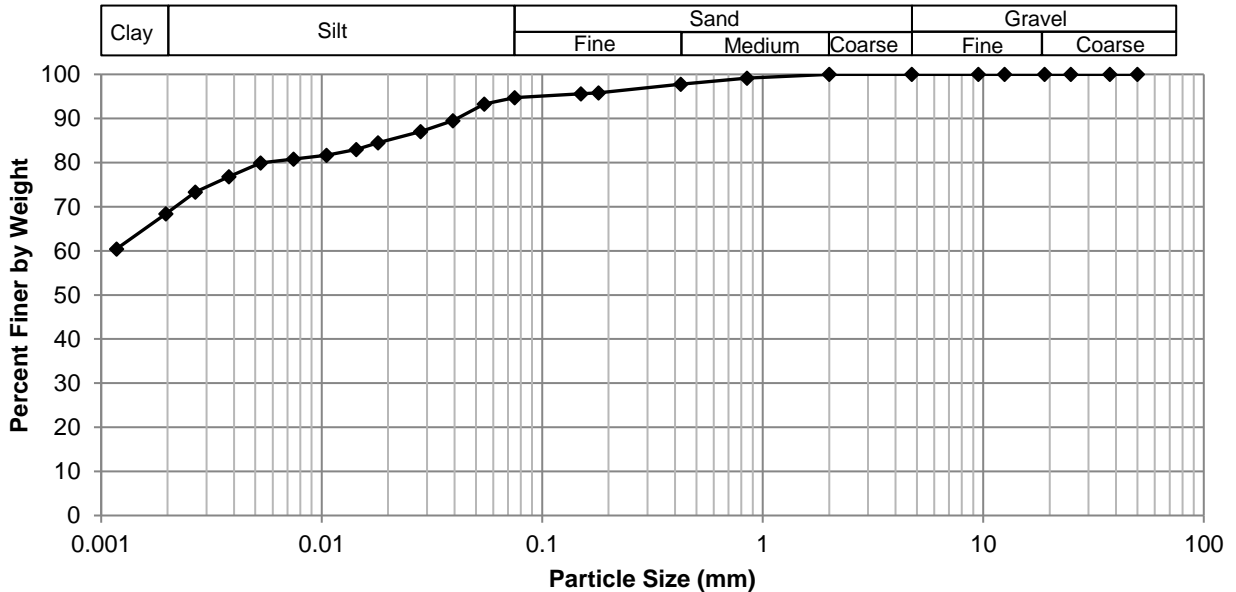
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Client WSP Group Canada Ltd.
Project 19-C-09 Watt Street Pavement Renewals



Test Hole TH19-08
Sample # G25
Depth (m) 0.6 - 0.8
Sample Date 17-Oct-19
Test Date 6-Nov-19
Technician JSB

Gravel	0.0%
Sand	5.3%
Silt	26.1%
Clay	68.6%

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	100.00	0.0750	94.71
37.5	100.00	2.00	100.00	0.0546	93.26
25.0	100.00	0.850	99.13	0.0393	89.50
19.0	100.00	0.425	97.78	0.0281	87.00
12.5	100.00	0.180	95.80	0.0180	84.50
9.50	100.00	0.150	95.59	0.0143	82.94
4.75	100.00	0.075	94.71	0.0105	81.69
				0.0075	80.82
				0.0053	79.94
				0.0038	76.82
				0.0027	73.31
				0.0020	68.38
				0.0012	60.43



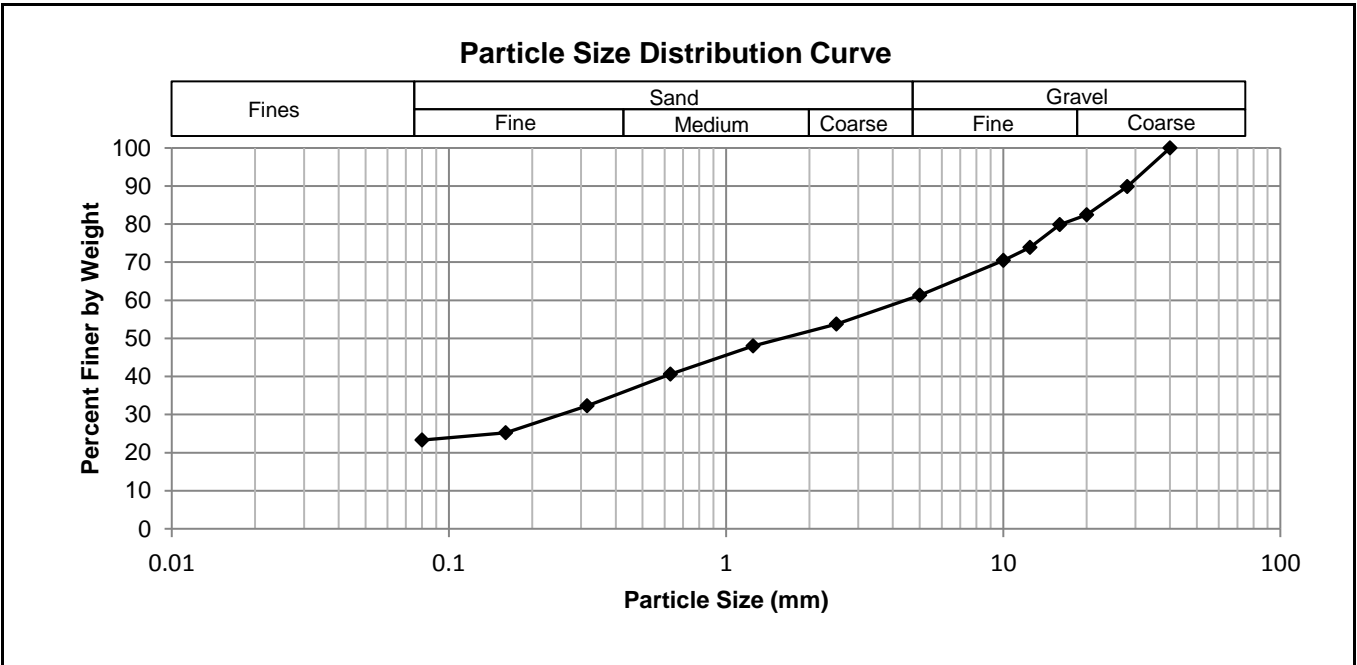
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Grain Size Analysis (Sieve Method)
ASTM C136-06

Project No. 0395-010-00-400
Client WSP Group Canada Ltd.
Project Watt Street Pavement Renewals

Test Hole TH19-03
Sample # G38
Depth 0.8 - 0.9
Date Sampled 17-Oct-19
Date Tested 3-Nov-19
Technician SB

Total Weight (g)	652.1
Gravel %	38.7
Sand %	38.0
Fines %	23.3



Sieve Opening (mm)	Percent Passing	Specification (Min-Max)
40.0	100	-
28.0	90	-
20.0	82	-
16.0	80	-
12.5	74	-
10.0	70	-
5.0	61	-
2.50	54	-
1.25	48	-
0.630	41	-
0.315	32	-
0.160	25	-
0.080	23	-



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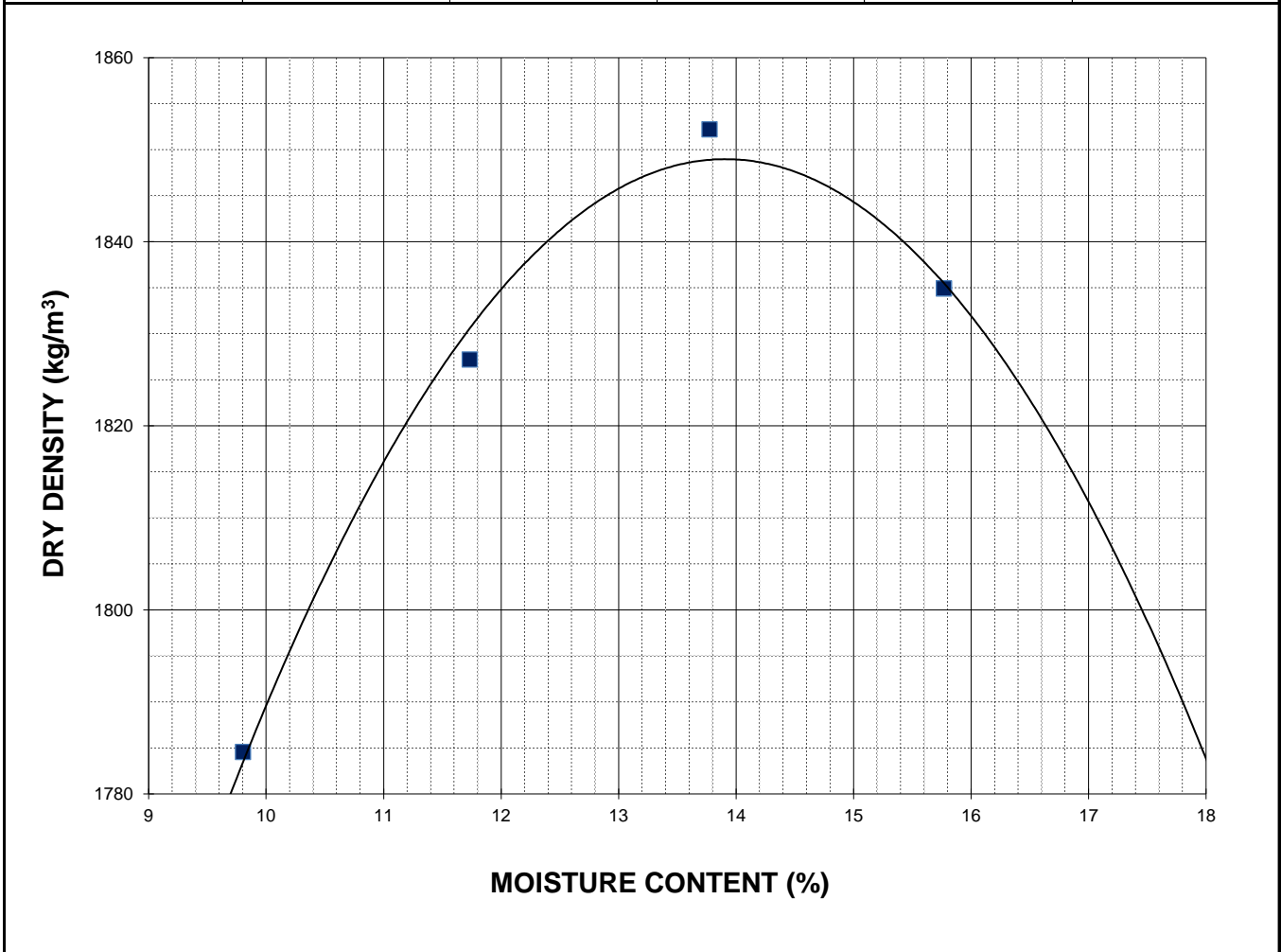
Standard Proctor Compaction Test
ASTM D698-12e2

Project No. 0395-010-00
Client WSP Group
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Sample #	Bulk 1		
Source	TH19-03	Corrected Max. Dry Density (kg/m³)	1895
Material	Silt and Sand	Corrected Optimum Moisture (%)	12.9
Sample Date	17-Oct-19	Oversize Material (%)	8
Test Date	05-Nov-19	Maximum Dry Density (kg/m³)	1849
Technician	BMH	Optimum Moisture (%)	13.9

Trial Number	1	2	3	4	
Wet Density (kg/m³)	1959	2042	2107	2124	
Dry Density (kg/m³)	1785	1827	1852	1835	
Moisture Content (%)	9.8	11.7	13.8	15.8	





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Standard Proctor Compaction Test

ASTM D698-12e2

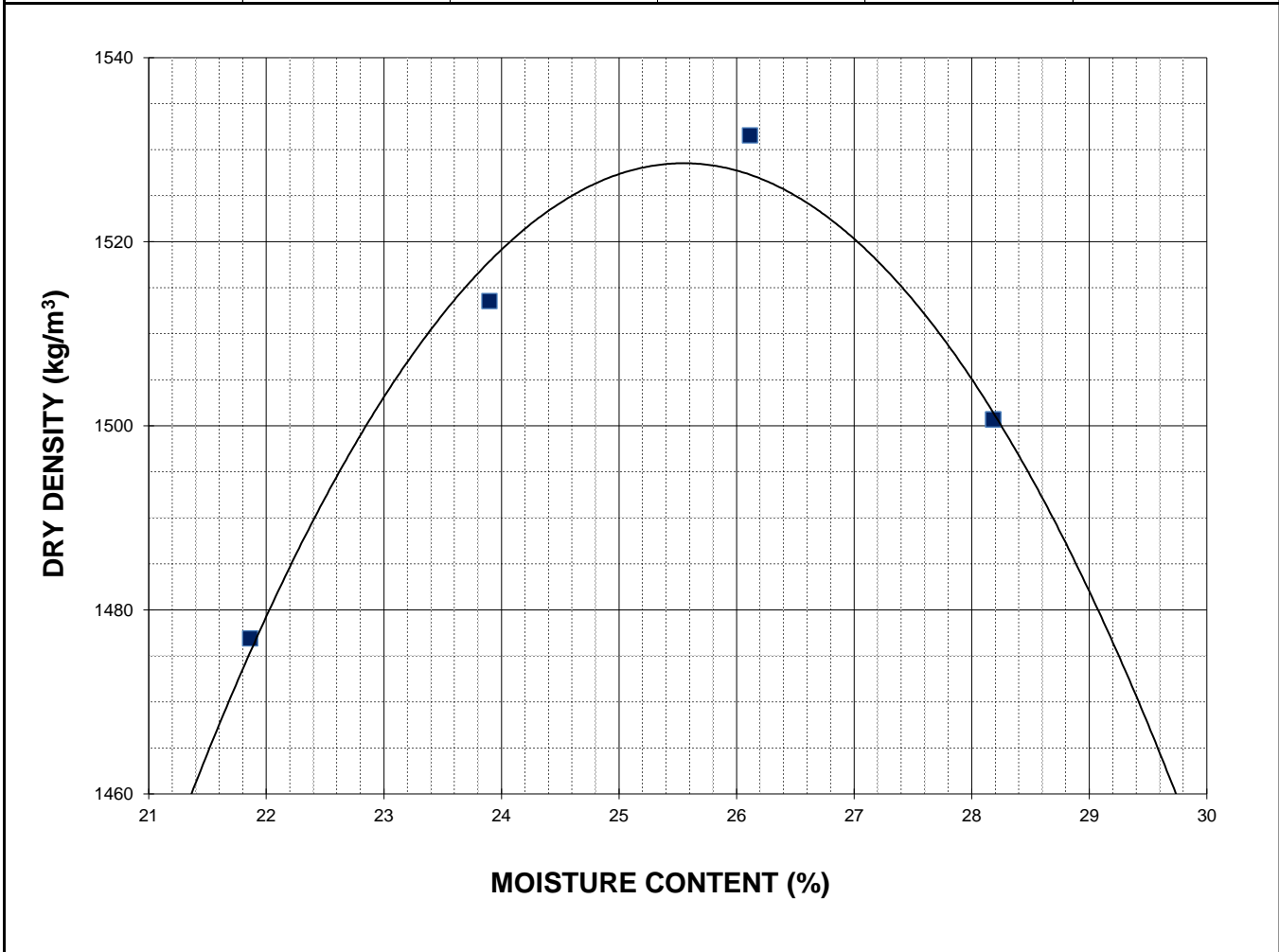
Project No. 0395-010-00
Client WSP Group
Project 19-C-09 Watt Street Pavement Renewals



Sample # Bulk 2
Source TH19-04
Material Clay
Sample Date 17-Oct-19
Test Date 05-Nov-19
Technician BMH

Maximum Dry Density (kg/m³)	1529
Optimum Moisture (%)	25.6

Trial Number	1	2	3	4	
Wet Density (kg/m ³)	1800	1875	1931	1924	
Dry Density (kg/m ³)	1477	1514	1532	1501	
Moisture Content (%)	21.9	23.9	26.1	28.2	





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Standard Proctor Compaction Test

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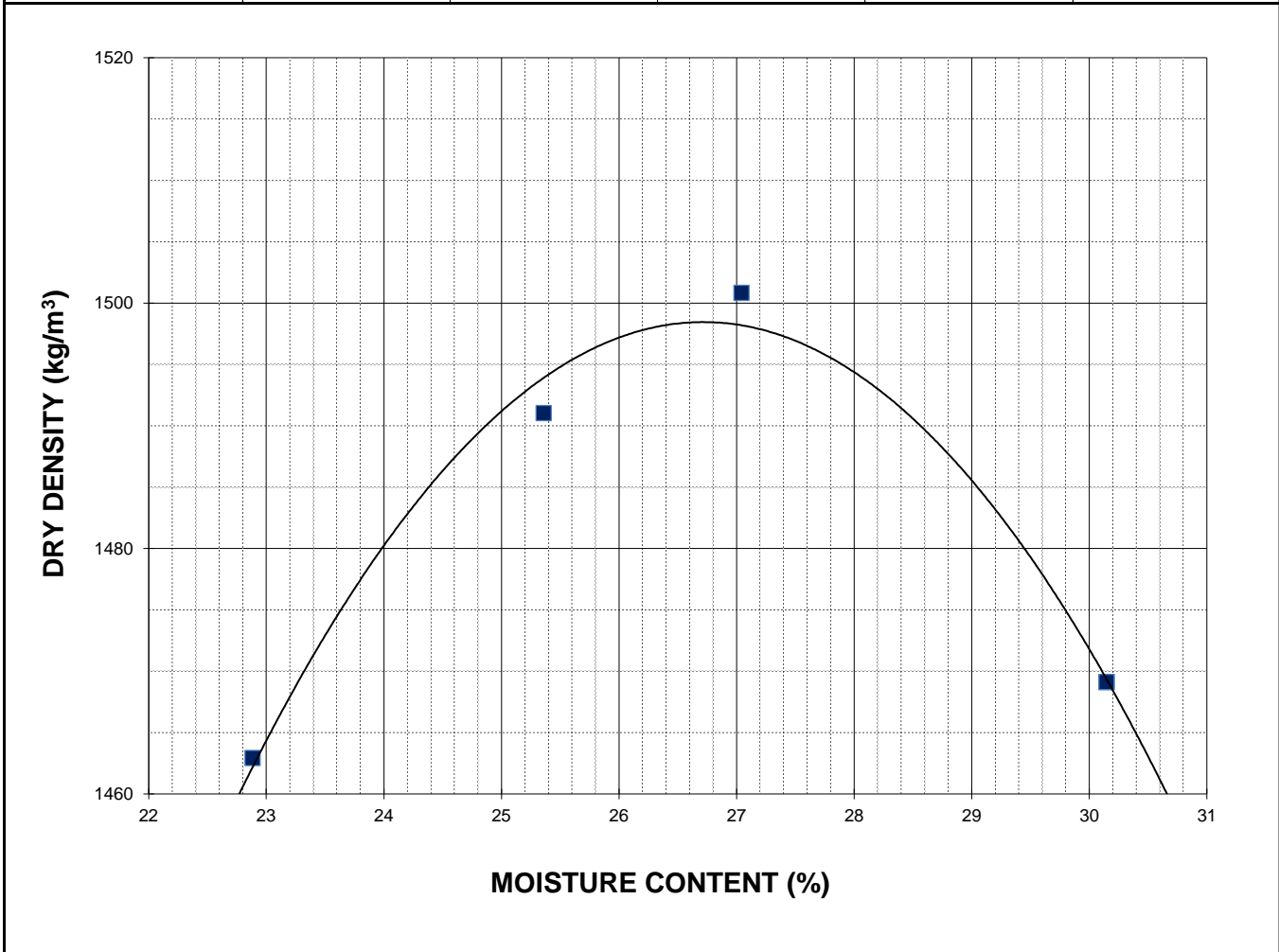
Project No. 0395-010-00
Client WSP Group
Project 19-C-09 Watt Street Pavement Renewals



Sample # Bulk 3
Source TH19-05
Material Clay Fill
Sample Date 17-Oct-19
Test Date 05-Nov-19
Technician BMH

Maximum Dry Density (kg/m³)	1498
Optimum Moisture (%)	26.7

Trial Number	1	2	3	4	
Wet Density (kg/m ³)	1798	1869	1907	1912	
Dry Density (kg/m ³)	1463	1491	1501	1469	
Moisture Content (%)	22.9	25.4	27.0	30.1	





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California Bearing Ratio Test Data Sheet
ASTM D1883-16

Project No.	0395-010-00	Source	TH19-03
Client	WSP Group	Material	Silt and Sand
Project	2019 Pavement Renewals - Watt	Sample Date	10/17/2019
Sample #	Bulk 1	Test Date	12/11/2019
		Technician	BMH

Proctor Results (ASTM D698)

Maximum Dry Density	1895 kg/m3
Optimum Moisture Content	12.9 %
Material Retained on 19 mm Sieve	0.0 %

CBR Sample Compaction

Dry Density	1822 kg/m3
Initial Moisture Content	15.2 %
Relative Density	96.2 % SPMDD

Soaking Results

Surcharge	4.54 kg
Swell	0.2 %
Moisture Content in top 25 mm	15.9 %
Immersion Period	96 h

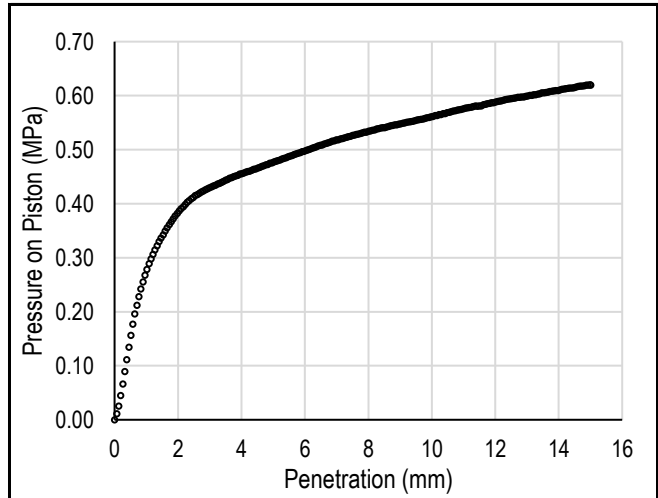
CBR Results

CBR at 2.54 mm	6.0 %
CBR at 5.08 mm	4.6 %
Zero Correction	0 mm

Test Data

Penetration (mm)	Measured Pressure (MPa)	Corrected Pressure (MPa)
0.64	0.20	0.20
1.27	0.31	0.31
1.91	0.38	0.38
2.54	0.41	0.41
3.18	0.43	0.43
3.81	0.45	0.45
4.45	0.46	0.46
5.08	0.48	0.48
7.62	0.53	0.53
10.16	0.56	0.56
12.70	0.60	0.60

Load/Penetration Curve



Comments:



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California Bearing Ratio Test Data Sheet
ASTM D1883-16

Project No.	0395-010-00	Source	TH19-04
Client	WSP Group	Material	Clay
Project	2019 Pavement Renewals - Watt	Sample Date	10/17/2019
Sample #	Bulk 2	Test Date	12/11/2019
		Technician	BMH

Proctor Results (ASTM D698)

Maximum Dry Density	1529 kg/m3
Optimum Moisture Content	25.6 %
Material Retained on 19 mm Sieve	0.0 %

CBR Sample Compaction

Dry Density	1447 kg/m3
Initial Moisture Content	28.4 %
Relative Density	94.7 % SPMDD

Soaking Results

Surcharge	4.54 kg
Swell	0.6 %
Moisture Content in top 25 mm	32.7 %
Immersion Period	96 h

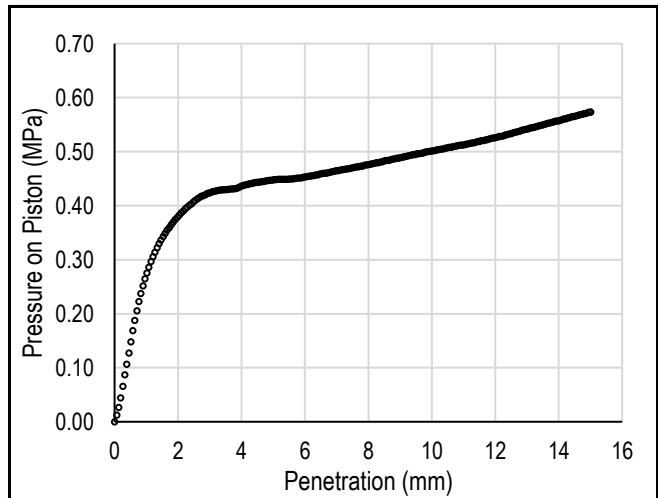
CBR Results

CBR at 2.54 mm	5.9 %
CBR at 5.08 mm	4.4 %
Zero Correction	0 mm

Test Data

Penetration (mm)	Measured Pressure (MPa)	Corrected Pressure (MPa)
0.64	0.19	0.19
1.27	0.31	0.31
1.91	0.37	0.37
2.54	0.41	0.41
3.18	0.43	0.43
3.81	0.43	0.43
4.45	0.44	0.44
5.08	0.45	0.45
7.62	0.47	0.47
10.16	0.50	0.50
12.70	0.54	0.54

Load/Penetration Curve



Comments:



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California Bearing Ratio Test Data Sheet
ASTM D1883-16

Project No.	0395-010-00	Source	TH19-05
Client	WSP Group	Material	Clay Fill
Project	2019 Pavement Renewals - Watt	Sample Date	10/17/2019
Sample #	Bulk 3	Test Date	12/11/2019
		Technician	BMH

Proctor Results (ASTM D698)

Maximum Dry Density	1498 kg/m3
Optimum Moisture Content	26.7 %
Material Retained on 19 mm Sieve	0.0 %

CBR Sample Compaction

Dry Density	1416 kg/m3
Initial Moisture Content	30.5 %
Relative Density	94.5 % SPMDD

Soaking Results

Surcharge	4.54 kg
Swell	0.5 %
Moisture Content in top 25 mm	33.6 %
Immersion Period	96 h

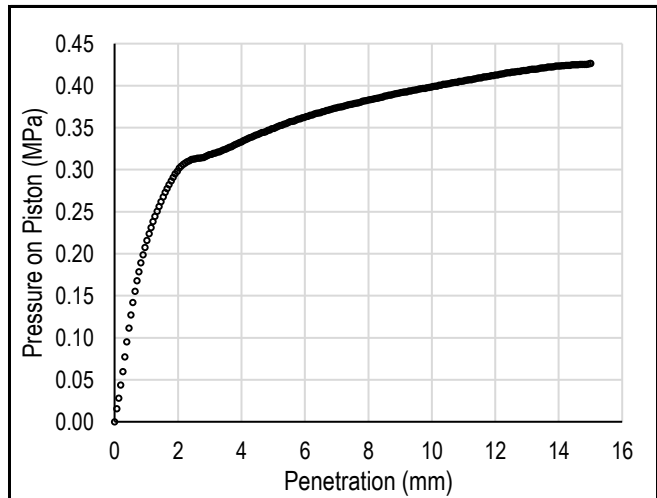
CBR Results

CBR at 2.54 mm	4.5 %
CBR at 5.08 mm	3.4 %
Zero Correction	0 mm

Test Data

Penetration (mm)	Measured Pressure (MPa)	Corrected Pressure (MPa)
0.64	0.16	0.16
1.27	0.24	0.24
1.91	0.30	0.30
2.54	0.31	0.31
3.18	0.32	0.32
3.81	0.33	0.33
4.45	0.34	0.34
5.08	0.35	0.35
7.62	0.38	0.38
10.16	0.40	0.40
12.70	0.42	0.42

Load/Penetration Curve



Comments:

Appendix C

Photographs of Pavement Core Samples



Photo 1: Pavement Core Sample at Test Hole TH19-01



Photo 2: Pavement Core Sample at Test Hole TH19-02



Photo 3: Pavement Core Sample at Test Hole TH19-03



Photo 4: Pavement Core Sample at Test Hole TH19-04



Photo 5: Pavement Core Sample at Test Hole TH19-05



Photo 6: Pavement Core Sample at Test Hole TH19-06



Photo 7: Pavement Core Sample at Test Hole TH19-07



Photo 8: Pavement Core Sample at Test Hole TH19-08



Wood

Photo 9: Pavement Core Sample at Test Hole TH19-09