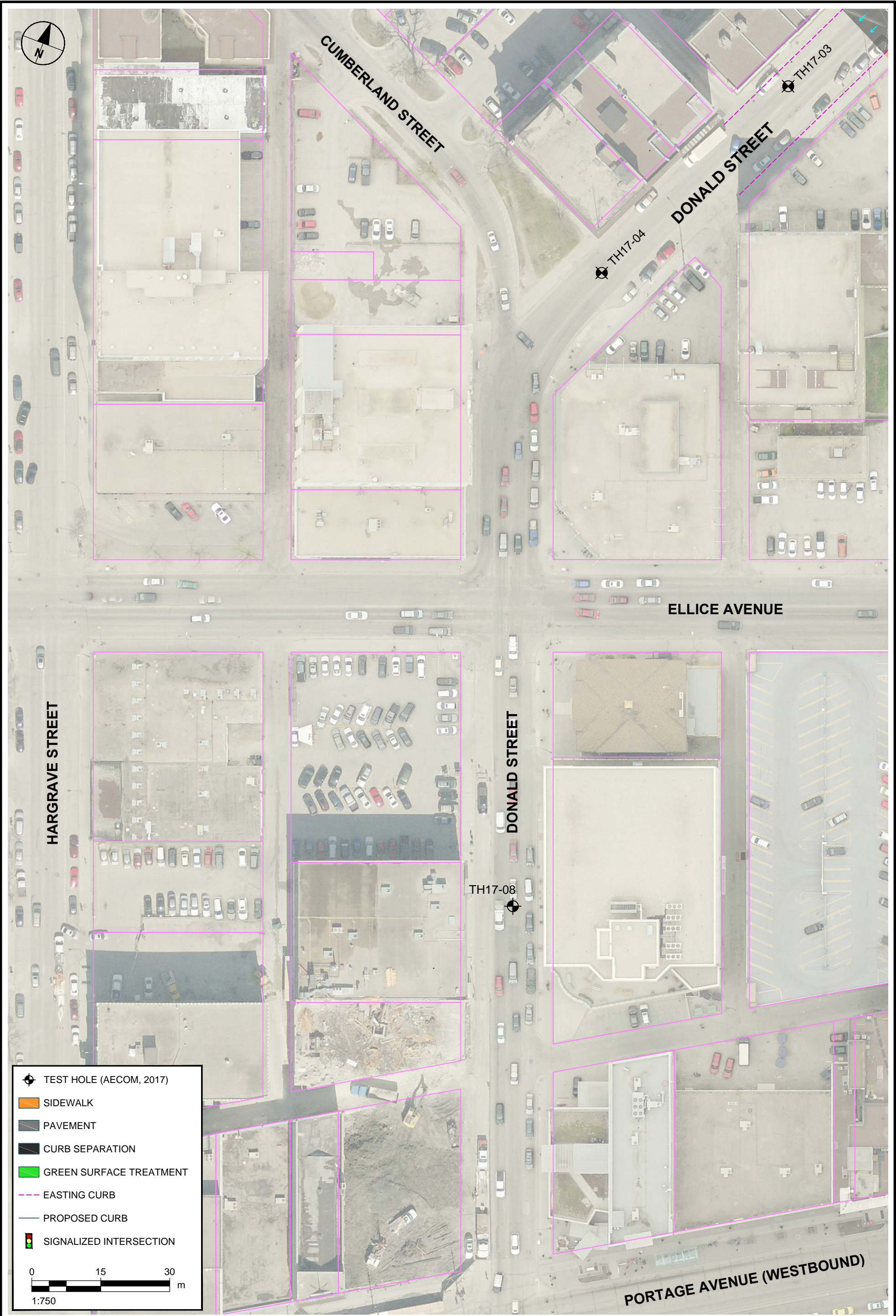


APPENDIX 'A'

GEOTECHNICAL REPORT

Appendix A

Test Hole and Pavement Core Location Plans



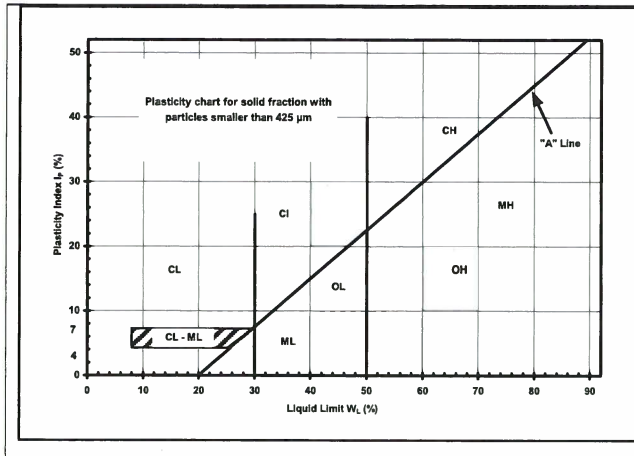
EXPLANATION OF FIELD & LABORATORY TEST DATA

Description				UMA Log Symbols	USCS Classification	Laboratory Classification Criteria			
						Fines (%)	Grading	Plasticity	Notes
COARSE GRAINED SOILS	GRAVELS (More than 50% of coarse fraction of gravel size)	CLEAN GRAVELS (Little or no fines)	Well graded gravels, sandy gravels, with little or no fines		GW	0-5	$C_u > 4$ $1 < C_c < 3$		Dual symbols if 5-12% fines. Dual symbols if above "A" line and $4 < W_p < 7$ $C_u = \frac{D_{60}}{D_{10}}$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
			Poorly graded gravels, sandy gravels, with little or no fines		GP	0-5	Not satisfying GW requirements		
		DIRTY GRAVELS (With some fines)	Silty gravels, silty sandy gravels		GM	> 12		Atterberg limits below "A" line or $W_p < 4$	
			Clayey gravels, clayey sandy gravels		GC	> 12		Atterberg limits above "A" line or $W_p < 7$	
	SANDS (More than 50% of coarse fraction of sand size)	CLEAN SANDS (Little or no fines)	Well graded sands, gravelly sands, with little or no fines		SW	0-5	$C_u > 6$ $1 < C_c < 3$		
			Poorly graded sands, gravelly sands, with little or no fines		SP	0-5	Not satisfying SW requirements		
		DIRTY SANDS (With some fines)	Silty sands, sand-silt mixtures		SM	> 12		Atterberg limits below "A" line or $W_p < 4$	
			Clayey sands, sand-clay mixtures		SC	> 12		Atterberg limits above "A" line or $W_p < 7$	
FINE GRAINED SOILS	SILTS (Below 'A' line negligible organic content)	$W_L < 50$	Inorganic silts, silty or clayey fine sands, with slight plasticity		ML				
		$W_L > 50$	Inorganic silts of high plasticity		MH				
	CLAYS (Above 'A' line negligible organic content)	$W_L < 30$	Inorganic clays, silty clays, sandy clays of low plasticity, lean clays		CL			Classification is Based upon Plasticity Chart	
		$30 < W_L < 50$	Inorganic clays and silty clays of medium plasticity		CI				
		$W_L > 50$	Inorganic clays of high plasticity, fat clays		CH				
	ORGANIC SILTS & CLAYS (Below 'A' line)	$W_L < 50$	Organic silts and organic silty clays of low plasticity		OL				
		$W_L > 50$	Organic clays of high plasticity		OH				
	HIGHLY ORGANIC SOILS		Peat and other highly organic soils			Pt	Von Post Classification Limit		Strong colour or odour, and often fibrous texture
	Asphalt			Till				AECOM	
	Concrete			Bedrock (Undifferentiated)					
	Fill			Bedrock (Limestone)					

When the above classification terms are used in this report or test hole logs, the designated fractions may be visually estimated and not measured.

NOT USED TO CLASSIFY SUBGRADE. REFER TO CITY OF WINNIPEG SPECIFICATIONS FOR GEOTECHNICAL INVESTIGATION REQUIREMENTS FOR PUBLIC WORKS PROJECTS (SEPTEMBER, 2015)

NOT USED TO CLASSIFY SUBGRADE. REFER TO CITY OF WINNIPEG SPECIFICATIONS FOR GEOTECHNICAL INVESTIGATION REQUIREMENTS FOR PUBLIC WORKS PROJECTS (SEPTEMBER, 2015)



FRACTION		SEIVE SIZE (mm)		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
		Passing	Retained	Percent	Identifier
Gravel	Coarse	76	19	35-50	and
	Fine	19	4.75		
Sand	Coarse	4.75	2.00	20-35	"y" or "ey" *
	Medium	2.00	0.425		
	Fine	0.425	0.075		
Silt (non-plastic) or Clay (plastic)		< 0.075 mm		10-20	some
				1-10	trace
* for example: gravelly, sandy clayey, silty					
Definition of Oversize Material					
COBBLES: 76mm to 300mm diameter					
BOULDERS: >300mm diameter					

LEGEND OF SYMBOLS

Laboratory and field tests are identified as follows:

- q_u - undrained shear strength (kPa) derived from unconfined compression testing.
- T_v - undrained shear strength (kPa) measured using a torvane
- p_p - undrained shear strength (kPa) measured using a pocket penetrometer.
- L_v - undrained shear strength (kPa) measured using a lab vane.
- F_v - undrained shear strength (kPa) measured using a field vane.
- γ - bulk unit weight (kN/m^3).
- SPT - Standard Penetration Test. Recorded as number of blows (N) from a 63.5 kg hammer dropped 0.76 m (free fall) which is required to drive a 51 mm O.D. Raymond type sampler 0.30 m into the soil.
- DPPT - Drive Point Pentrometer Test. Recorded as number of blows from a 63.5 kg hammer dropped 0.76 m (free fall) which is required to drive a 50 mm drive point 0.30 m into the soil.
- w - moisture content (W_L , W_P)

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

S_u (kPa)	CONSISTENCY
<12	very soft
12 – 25	soft
25 – 50	medium or firm
50 – 100	stiff
100 – 200	very stiff
200	hard

The resistance (N) of a non-cohesive soil can be related to compactness condition as follows

N – BLOWS/0.30 m	COMPACTNESS
0 - 4	very loose
4 - 10	loose
10 - 30	compact
30 - 50	dense
50	very dense

F2. SEWER TELEVISION GUIDELINES FOR PUBLIC WORKS PROJECTS (JANUARY 2009)

- F2.1 The Consultant is required to assess the extent of Closed Circuit Television (CCTV) inspection for all combined, wastewater, land drainage and storm relief sewers to confirm any sewer repairs required in the right-of-way within the limits of the street renewal.
- F2.2 The criteria provided are general guidelines and are not intended to replace sound municipal engineering judgement specific to the individual Project scope and/or location.
- F2.3 The available sewer televising information is contained within the City of Winnipeg's Sewer Management System (SMS) application.
- F2.4 Confirm televising requirements with Project Manager.
- F2.5 CCTV inspection general guidelines:
- (a) Confirm CCTV requirements with Water & Waste Department for sewers 1050 mm and larger in diameter;
 - (b) Televising if no previous CCTV inspections have been completed;
 - (c) Re-televising sewers in Categories A/B/C/X with a Structural Performance Grade (SPG) of 3 or higher that have not been televised in the previous 5 years;
 - (d) Sewers located more than two metres from the curb line (i.e. not located under pavement) do not need to be re-televised if previous CCTV inspection data exist. If a sewer repair or renewal requiring excavation is noted, contact the WWD;
 - (e) On all street reconstructions, regardless of location of the sewer (within the right-of-way);
 - (f) If the street exhibits obvious distress at/along the underground plant;
 - (g) Of all CB leads to be reused, as part of a street reconstruction or major rehabilitation.
- F2.6 For any uncertain situations and/or locations, contact the Project Manager.
- F2.7 The Consultant is required to coordinate the sewer-televising contract and communicate the results to the Water & Waste Department. Any repairs or other activities deemed necessary from these inspections must be coordinated with the Water & Waste Department.

F3. GEOTECHNICAL INVESTIGATION REQUIREMENTS FOR PUBLIC WORKS PROJECTS (OCTOBER 2008)

- F3.1 Fieldwork
- (a) Clear all underground services at each test-hole location.
 - (b) As this street project is greater than 500 metres, test holes may be taken every 100 m. More or fewer test-holes may be required depending upon Site conditions – confirm with the Project Manager.
 - (c) Record location of test-hole (offset from curb, distance from cross street and house number).
 - (d) Drill 150 mm-diameter cores in pavement.
 - (e) Drill 125 mm-diameter test-holes into fill materials and subgrade.
 - (f) If a service trench backfilled with granular materials is encountered, another hole shall be drilled to define the existing sub-surface conditions.
 - (g) Test-holes shall be drilled to depth of 2 m \pm 150 mm below surface of the pavement.
 - (h) Recover pavement core sample and representative samples of soil (fill materials, pavement structure materials and subgrade).
 - (i) Measure and record pavement section exposed in the test-hole (thickness of concrete or asphalt and different types of pavement structure materials).

- (j) Pavement structure materials to be identified as crushed limestone or granular fill and the maximum aggregate size of the material (20 mm, 50 mm or 150 mm).
- (k) Log soil profile for the subgrade.
- (l) Representative samples of soil must be obtained at the following depths below the bottom of the pavement structure materials – 0.1 m, 0.4 m, 0.7 m, 1.0 m, 1.3 m, 1.6 m, etc. Ensure a sample is obtained from each soil type encountered in the test-hole.
- (m) Make note of any water seepage into the test-hole.
- (n) Backfill test-hole with native materials and additional granular fill, if required. Patch pavement surface with hot mix asphalt or high strength durable concrete mix.
- (o) Return core sample from the pavement and soil samples to the laboratory.


F3.2 Lab Work

- (a) Test all soil samples for moisture content.
- (b) Photograph core samples recovered from the pavement surface.
- (c) Conduct tests for plasticity index and hydrometer analysis on selected soil samples which are between 0.5 m and 1 m below top of pavement (this is the sub-grade on which the pavement and sub-base will be built). The selection will be based upon visual classification and moisture content test results, with a minimum of one sample of each soil type per street to be tested.
- (d) Prepare test-hole logs and classify subgrade (based on hydrometer) as follows:
 - < 30% silt - classify as clay
 - 30% - 50% silt - classify as silty clay
 - 50% - 70% silt - classify as clayey silt
 - > 70% silt - classify as silt
- (e) For any uncertain situations and/or locations, or clarification of these requirements, contact the Project Manager.

LOG OF TEST HOLE BOREHOLE LOGS TC REV1.GPJ UMA WINN.GDT 4/27/17

PROJECT: Downtown Pavement Renewals - 17-B-02				CLIENT: City of Winnipeg				TESTHOLE NO: TH17-03					
LOCATION: 14U - 0633298 m E, 5528745 m N, Donald Street, 5.49 m S of N curb								PROJECT NO.: 60540686					
CONTRACTOR: Maple Leaf Drilling Ltd.				METHOD: Truck-mounted CME 55, 125 mm SSA				ELEVATION (m): N/A					
SAMPLE TYPE		<input checked="" type="checkbox"/> GRAB		<input type="checkbox"/> SHELBY TUBE		<input checked="" type="checkbox"/> SPLIT SPOON		<input type="checkbox"/> BULK		<input checked="" type="checkbox"/> NO RECOVERY		<input type="checkbox"/> CORE	

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS * Becker * ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) ■ Total Unit Wt ■ (kN/m³) Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH + Torvane + X QU/2 X □ Lab Vane □ △ Pocket Pen. △ ● Field Vane ● (kPa) 50 100 150 200	COMMENTS	DEPTH
0		ASPHALT - 83 mm							
		CONCRETE - 476 mm							
		SAND and GRAVEL FILL - 102 mm							
		CLAY - some silt, some sand - dark brown, frozen to 1.1 m - high plasticity - (G2): LL = 66.7%, PL = 17.9%		G2				(G2): Gravel: 0.0%, Sand: 16.4%, Silt: 21.4%, Clay: 62.3%	
1		- firm, dry to moist below 1.1 m		G3					
				G4					
		SILT - clayey, some sand to sandy - light brown, soft, moist - low to intermediate plasticity		G5					
				G6					
2		END OF TEST HOLE AT 1.98 m IN SILT							
		Notes: 1. No seepage observed during drilling. 2. Test hole open to 1.6 m upon removal of auger. 3. Test hole backfilled with drill cuttings and bentonite and patched with asphalt upon completion.							
3									




LOGGED BY: Tessa Christi
 REVIEWED BY: Alex Hill
 PROJECT ENGINEER: Kevin Rae

COMPLETION DEPTH: 1.98 m
 COMPLETION DATE: 3/27/17
 Page 1 of 1

LOG OF TEST HOLE BOREHOLE LOGS TC REV1.GPJ UMA WINN.GDT 4/27/17

PROJECT: Downtown Pavement Renewals - 17-B-02				CLIENT: City of Winnipeg				TESTHOLE NO: TH17-04					
LOCATION: 14U - 0633276 m E, 5528716 m N, Donald Street, 5.46 m S of N curb								PROJECT NO.: 60540686					
CONTRACTOR: Maple Leaf Drilling Ltd.				METHOD: Truck-mounted CME 55, 125 mm SSA				ELEVATION (m): N/A					
SAMPLE TYPE		<input checked="" type="checkbox"/> GRAB		<input type="checkbox"/> SHELBY TUBE		<input checked="" type="checkbox"/> SPLIT SPOON		<input type="checkbox"/> BULK		<input checked="" type="checkbox"/> NO RECOVERY		<input type="checkbox"/> CORE	

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS * Becker * ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) ■ Total Unit Wt (kN/m³) Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH + Torvane + X QU/2 X □ Lab Vane □ △ Pocket Pen. △ ● Field Vane ● (kPa) 50 100 150 200	COMMENTS	DEPTH
0		ASPHALT - 210 mm							
		CONCRETE - 114 mm							
		WOOD - streetcar tie - 152 mm							
		SAND and GRAVEL FILL - 57 mm							
		CLAY - trace to some silt - dark brown, frozen to 0.9 m		G2					
		- firm, dry to moist, high plasticity below 0.9 m		G3					
		SILT - clayey, some sand - light brown, firm, dry to moist - low plasticity - (G4): LL = 26.2%, PL = 15.4%		G4				(G4): Gravel: 0.0%, Sand: 19.2%, Silt: 61.0%, Clay: 19.9%	
				G5					
				G6					
2		END OF TEST HOLE AT 1.98 m IN SILT							
		Notes: 1. No seepage observed during drilling. 2. Wooden streetcar tie encountered 0.3 m below ground surface. 3. Test hole open to 1.7 m upon removal of auger. 4. Test hole backfilled with drill cuttings and bentonite and patched with asphalt upon completion.							

PROJECT: Downtown Pavement Renewals - 17-B-02				CLIENT: City of Winnipeg				TESTHOLE NO: TH17-08			
LOCATION: 14U - 0633295 m E, 5528533 m N, Donald Street, 4.42 m W of E curb								PROJECT NO.: 60540686			
CONTRACTOR: Maple Leaf Drilling Ltd.				METHOD: Truck-mounted CME 55, 125 mm SSA				ELEVATION (m): N/A			
SAMPLE TYPE <input checked="" type="checkbox"/> GRAB <input type="checkbox"/> SHELBY TUBE <input checked="" type="checkbox"/> SPLIT SPOON <input type="checkbox"/> BULK <input checked="" type="checkbox"/> NO RECOVERY <input type="checkbox"/> CORE											
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS * Becker * ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) ■ Total Unit Wt (kN/m³) Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH + Torvane + X QU/2 X □ Lab Vane □ △ Pocket Pen. △ ● Field Vane ● (kPa) 50 100 150 200	COMMENTS	DEPTH		
0		ASPHALT - 51 mm CONCRETE - 305 mm									
		SAND and GRAVEL FILL - 102 mm									
		CLAY - silty, some sand, some organics - dark grey to black, firm, dry to moist - high plasticity - silt laminations < 5 mm thick - (G1): LL = 73.1%, PL = 19.1%		G1				(G1): Gravel: 0.0%, Sand: 15.8%, Silt: 30.1%, Clay: 54.1%			
1		SILT - clayey, some sand to sandy - light brown, soft to firm, moist - low to intermediate plasticity		G2							
		CLAY - trace to some silt - brown, firm to stiff, dry to moist - high plasticity - (G4): LL = 65.4%, PL = 20.5%		G3							
				G4							
2				G5							
				G6							
		END OF TEST HOLE AT 2.30 m IN CLAY									
		Notes: 1. No seepage observed during drilling. 2. Test hole open to 2.2 m upon removal of auger. 3. Test hole backfilled with drill cuttings and bentonite and patched with asphalt upon completion.									
3											
					LOGGED BY: Tessa Christi		COMPLETION DEPTH: 2.29 m				
					REVIEWED BY: Alex Hill		COMPLETION DATE: 3/30/17				
					PROJECT ENGINEER: Kevin Rae		Page 1 of 1				

City of Winnipeg

Downtown Pavement Renewals, Protected Bike Lanes & Streetscaping 17-B-02 – Garry Street/Donald Street/Notre Dame Avenue

Geotechnical Investigation

Table 01- Summary of Laboratory Soil Testing

Test Hole No.	Test Hole Location	Pavement Structure		Subgrade Description *	Sample Depth (m)	Moisture Content (%)	Hydrometer Analysis				Atterberg Limits		
		Type	Thickness (mm)				Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid Limit	Plastic Limit	Plasticity Index
TH17-01	Garry Street 14U – 0633476 m E, 5528692 m N 5.2 m E of W curb	Asphalt	254	CLAYEY SANDY SILT	0.6	21.9							
				CLAYEY SANDY SILT	0.9	23.2	0.1	24.5	49.1	26.3	32.3	13.5	18.8
		Concrete	330	CLAYEY SANDY SILT	1.2	29.1							
				CLAYEY SANDY SILT	1.5	21.4							
				CLAYEY SANDY SILT	1.8	21.5							
TH17-02	Garry Street 14U – 0633489 m E, 5528581 m N 5.3 m E of W curb	Asphalt	165	CLAY	0.6	27.1							
				CLAY	0.9	29.7							
		Concrete	324	CLAY	1.2	28.3							
				CLAY	1.5	27.7							
				CLAY	1.8	27.8							
TH17-03	Donald Street 14U – 0633298 m E, 5528745 m N 5.5 m E of W curb	Asphalt	83	CLAY	0.7	29.5	0.0	16.4	21.4	62.3	66.7	17.9	48.8
				CLAY	0.9	29.4							
		Concrete	476	CLAY	1.2	33.8							
				CLAYEY SANDY SILT	1.5	28.5							
				CLAYEY SANDY SILT	1.8	23.1							
TH17-04	Donald Street 14U – 0633276 m E, 5528716 m N 5.5 m E of W curb	Asphalt	210	CLAY	0.6	33.7							
				CLAY	0.9	30.6							
		Concrete	114	CLAY	1.2	22.7	0.0	19.2	61.0	20.0	26.2	15.4	10.8
				CLAYEY SILT	1.5	20.5							
				CLAYEY SILT	1.8	21.5							
TH17-05	Notre Dame Avenue 14U – 0633572 m E, 5528686 m N	Asphalt	89	--	--	--							
				--	--	--							
				--	--	--							
		Concrete	191	--	--	--							
				--	--	--							
				--	--	--							
TH17-06	Notre Dame Avenue 14U – 0633493 m E, 5528680 m N 5.0 m W of E curb	Asphalt	203	CLAY	0.9	33.5							
				CLAY	1.2	29.6							
		Concrete	406	CLAY	1.5	29.2	0.1	4.8	25.7	69.4	70.8	19.9	50.9
				CLAY	1.8	27.6							

* Note – Subgrade Description based on City of Winnipeg Specifications for Geotechnical Investigation Requirements for Public Works Projects (September 2015)

Test Hole No.	Test Hole Location	Pavement Structure		Subgrade Description *	Sample Depth (m)	Moisture Content (%)	Hydrometer Analysis				Atterberg Limits		
		Type	Thickness (mm)				Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid Limit	Plastic Limit	Plasticity Index
TH17-07	Notre Dame Avenue 14U - 0633421 m E, 5528728 m N 5.0 m W of E curb	Asphalt	114	SILTY SANDY CLAY	0.8	27.6	7.3	23.5	34.1	35.1	42.9	19.9	22.9
				SILTY SANDY CLAY	1.1	29.7							
				CLAYEY SILT	1.2	25.5							
		Concrete	470	SILTY SANDY CLAY	1.4	22.3							
				SILTY SANDY CLAY	1.7	21.3							
				CLAY	2.0	30.7							
				CLAY	2.1	41.3							
TH17-08	Donald Street 14U – 0633295 m E, 5528533 m N 4.42 m W of E curb	Asphalt	51	CLAY	0.8	31.5	0.0	15.8	30.1	54.1	73.1	19.1	54.0
				CLAYEY SILT	1.1	29.5							
				CLAY	1.4	18.3							
		Concrete	305	CLAY	1.7	30.6					65.4	20.5	44.9
				CLAY	2.0	32.9							
				CLAY	2.1	43.0							

* Note – Subgrade Description based on City of Winnipeg Specifications for Geotechnical Investigation Requirements for Public Works Projects (September 2015)



Photograph 3: Test Hole TH17-03 - Donald Street



Photograph 4: Test Hole TH17-04 - Donald Street



Photograph 7: Test Hole TH17-07 – Notre Dame Avenue



Photograph 8: Test Hole TH17-08 – Donald Street