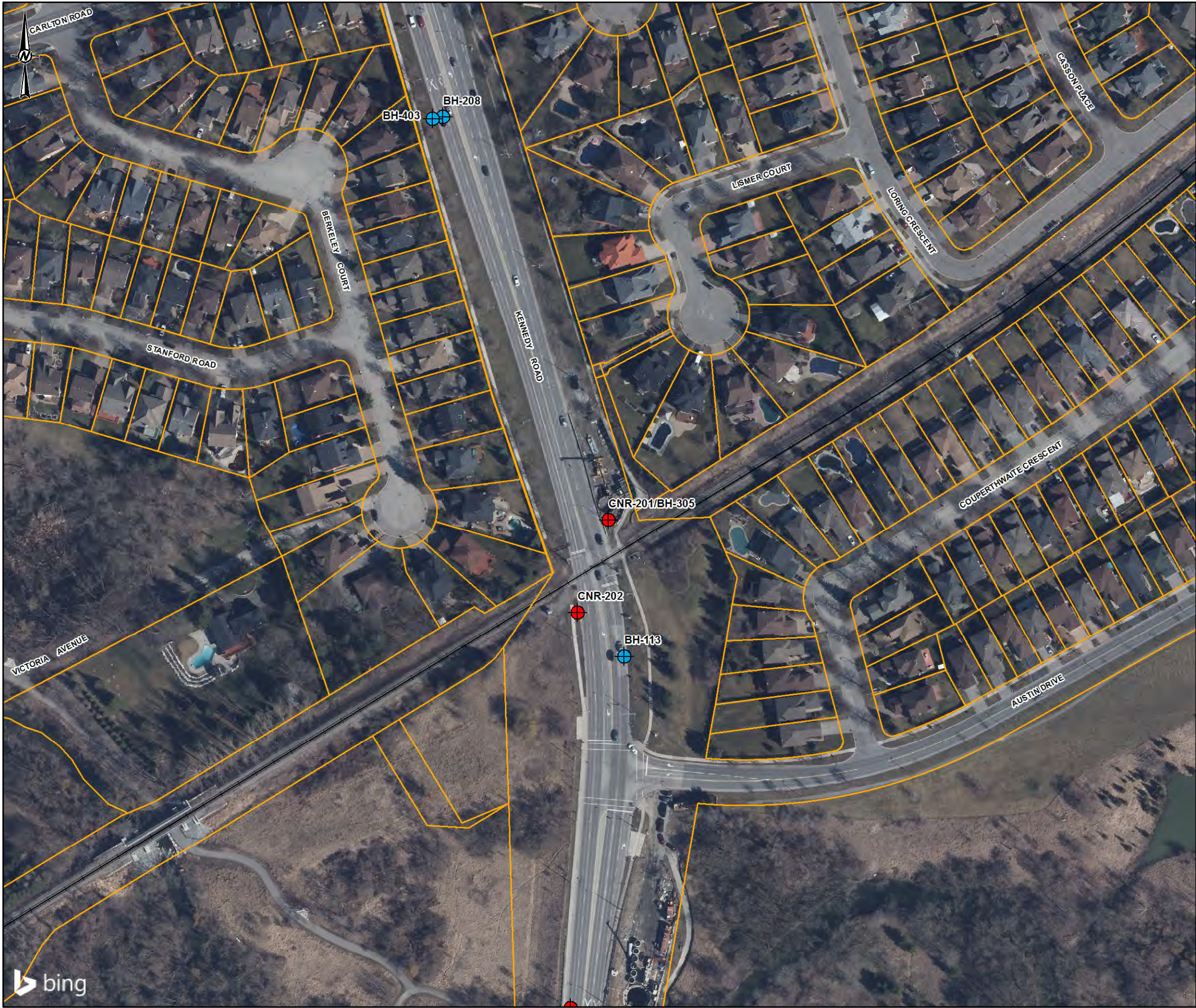




LEGEND

- Foundation Borehole
- Pavement Borehole
- Environmental Borehole
- Property Boundary

0 25 50 75 100
1:1,700 Meters

REFERENCE(S)

1. BASE DATA: MNRF LIO, OBTAINED 2016
2. IMAGERY PROVIDED BY THE REGION OF YORK, 2017
3. PARCELS PROVIDED BY THE REGION OF YORK (MARCH 2017)
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

HDR CORPORATION

PROJECT

KENNEDY ROAD (Y.R. 67)
STEELES AVENUE (Y.R. 95) TO MAJOR MACKENZIE DRIVE (Y.R. 25), CITY OF MARKHAM, REGION OF YORK

TITLE

BOREHOLE LOCATION PLAN

CONSULTANT	YYYY-MM-DD	2018-09-13
	DESIGNED	MM
	PREPARED	MM
	REVIEWED	GG
	APPROVED	SJ

PROJECT NO. 1664178	CONTROL 0001	REV. 0	FIGURE 2-20
------------------------	-----------------	-----------	-----------------------



LEGEND

- Foundation Borehole
- Pavement Borehole
- Environmental Borehole
- Property Boundary

0 25 50 75 100
1:1,700 Meters

REFERENCE(S)

1. BASE DATA: MNRF LIO, OBTAINED 2016
2. IMAGERY PROVIDED BY THE REGION OF YORK, 2017
3. PARCELS PROVIDED BY THE REGION OF YORK (MARCH 2017)
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
HDR CORPORATION

PROJECT
KENNEDY ROAD (Y.R. 67)
STEELES AVENUE (Y.R. 95) TO MAJOR MACKENZIE DRIVE (Y.R. 25), CITY OF MARKHAM, REGION OF YORK

TITLE
BOREHOLE LOCATION PLAN

CONSULTANT	YYYY-MM-DD	2018-09-13
	DESIGNED	MM
	PREPARED	MM
	REVIEWED	GG
	APPROVED	SJ

PROJECT NO. 1664178	CONTROL 0001	REV. 0	FIGURE 2-21
------------------------	-----------------	-----------	----------------



LEGEND

- Foundation Borehole
- Pavement Borehole
- Environmental Borehole
- Property Boundary

0 25 50 75 100
1:1,700 Meters

REFERENCE(S)

1. BASE DATA: MNRF LIO, OBTAINED 2016
2. IMAGERY PROVIDED BY THE REGION OF YORK, 2017
3. PARCELS PROVIDED BY THE REGION OF YORK (MARCH 2017)
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

HDR CORPORATION

PROJECT

KENNEDY ROAD (Y.R. 67)
STEELES AVENUE (Y.R. 95) TO MAJOR MACKENZIE DRIVE (Y.R. 25), CITY OF MARKHAM, REGION OF YORK

TITLE

BOREHOLE LOCATION PLAN

CONSULTANT	YYYY-MM-DD	2018-09-13
	DESIGNED	MM
	PREPARED	MM
	REVIEWED	GG
	APPROVED	SJ

PROJECT NO.	CONTROL	REV.	FIGURE
1664178	0001	0	2-22



LEGEND

- Foundation Borehole
- Pavement Borehole
- Environmental Borehole
- Property Boundary

0 25 50 75 100
1:1,700 Meters

REFERENCE(S)

1. BASE DATA: MNRF LIO, OBTAINED 2016
2. IMAGERY PROVIDED BY THE REGION OF YORK, 2017
3. PARCELS PROVIDED BY THE REGION OF YORK (MARCH 2017)
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

HDR CORPORATION

PROJECT

KENNEDY ROAD (Y.R. 67)
STEELES AVENUE (Y.R. 95) TO MAJOR MACKENZIE DRIVE (Y.R. 25), CITY OF MARKHAM, REGION OF YORK

TITLE

BOREHOLE LOCATION PLAN

CONSULTANT	YYYY-MM-DD	2018-09-13
	DESIGNED	MM
	PREPARED	MM
	REVIEWED	GG
	APPROVED	SJ

PROJECT NO. 1664178	CONTROL 0001	REV. 0	FIGURE 2-23
------------------------	-----------------	-----------	-----------------------



LEGEND

- Foundation Borehole
- Pavement Borehole
- Environmental Borehole
- Property Boundary

0 25 50 75 100
1:1,700 Meters

REFERENCE(S)

1. BASE DATA: MNRF LIO, OBTAINED 2016
2. IMAGERY PROVIDED BY THE REGION OF YORK, 2017
3. PARCELS PROVIDED BY THE REGION OF YORK (MARCH 2017)
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

HDR CORPORATION

PROJECT

KENNEDY ROAD (Y.R. 67)
STEELES AVENUE (Y.R. 95) TO MAJOR MACKENZIE DRIVE (Y.R. 25), CITY OF MARKHAM, REGION OF YORK

TITLE

BOREHOLE LOCATION PLAN

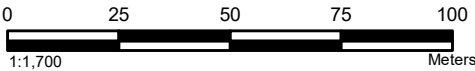
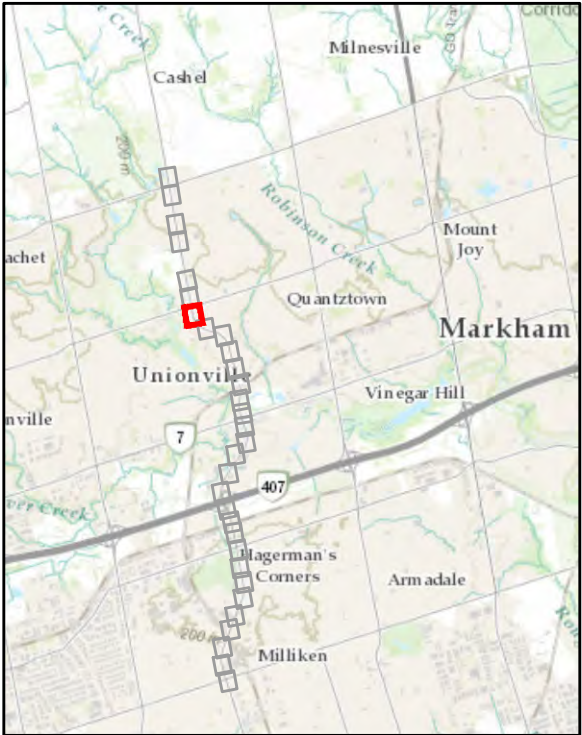
CONSULTANT	YYYY-MM-DD	2018-09-13
	DESIGNED	MM
	PREPARED	MM
	REVIEWED	GG
	APPROVED	SJ

PROJECT NO. 1664178	CONTROL 0001	REV. 0	FIGURE 2-24
------------------------	-----------------	-----------	-----------------------



LEGEND

- Foundation Borehole
- Pavement Borehole
- Environmental Borehole
- Property Boundary



REFERENCE(S)
1. BASE DATA: MNRF LIO, OBTAINED 2016
2. IMAGERY PROVIDED BY THE REGION OF YORK, 2017
3. PARCELS PROVIDED BY THE REGION OF YORK (MARCH 2017)
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
HDR CORPORATION

PROJECT
KENNEDY ROAD (Y.R. 67)
STEELES AVENUE (Y.R. 95) TO MAJOR MACKENZIE DRIVE (Y.R. 25), CITY OF MARKHAM, REGION OF YORK

TITLE
BOREHOLE LOCATION PLAN

CONSULTANT	YYYY-MM-DD	2018-09-13
	DESIGNED	MM
	PREPARED	MM
	REVIEWED	GG
	APPROVED	SJ



PROJECT NO. 1664178	CONTROL 0001	REV. 0	FIGURE 2-25
------------------------	-----------------	-----------	----------------



LEGEND

- Foundation Borehole
- Pavement Borehole
- Environmental Borehole
- Property Boundary

0 25 50 75 100
1:1,700 Meters

REFERENCE(S)

1. BASE DATA: MNRF LIO, OBTAINED 2016
2. IMAGERY PROVIDED BY THE REGION OF YORK, 2017
3. PARCELS PROVIDED BY THE REGION OF YORK (MARCH 2017)
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

HDR CORPORATION

PROJECT

KENNEDY ROAD (Y.R. 67)
STEELES AVENUE (Y.R. 95) TO MAJOR MACKENZIE DRIVE (Y.R. 25), CITY OF MARKHAM, REGION OF YORK

TITLE

BOREHOLE LOCATION PLAN

CONSULTANT	YYYY-MM-DD	2018-09-13
	DESIGNED	MM
	PREPARED	MM
	REVIEWED	GG
	APPROVED	SJ

PROJECT NO. 1664178	CONTROL 0001	REV. 0	FIGURE 2-26
------------------------	-----------------	-----------	-----------------------



LEGEND

- Foundation Borehole
- Pavement Borehole
- Environmental Borehole
- Property Boundary

0 25 50 75 100
1:1,700 Meters

REFERENCE(S)

1. BASE DATA: MNRF LIO, OBTAINED 2016
2. IMAGERY PROVIDED BY THE REGION OF YORK, 2017
3. PARCELS PROVIDED BY THE REGION OF YORK (MARCH 2017)
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

HDR CORPORATION

PROJECT

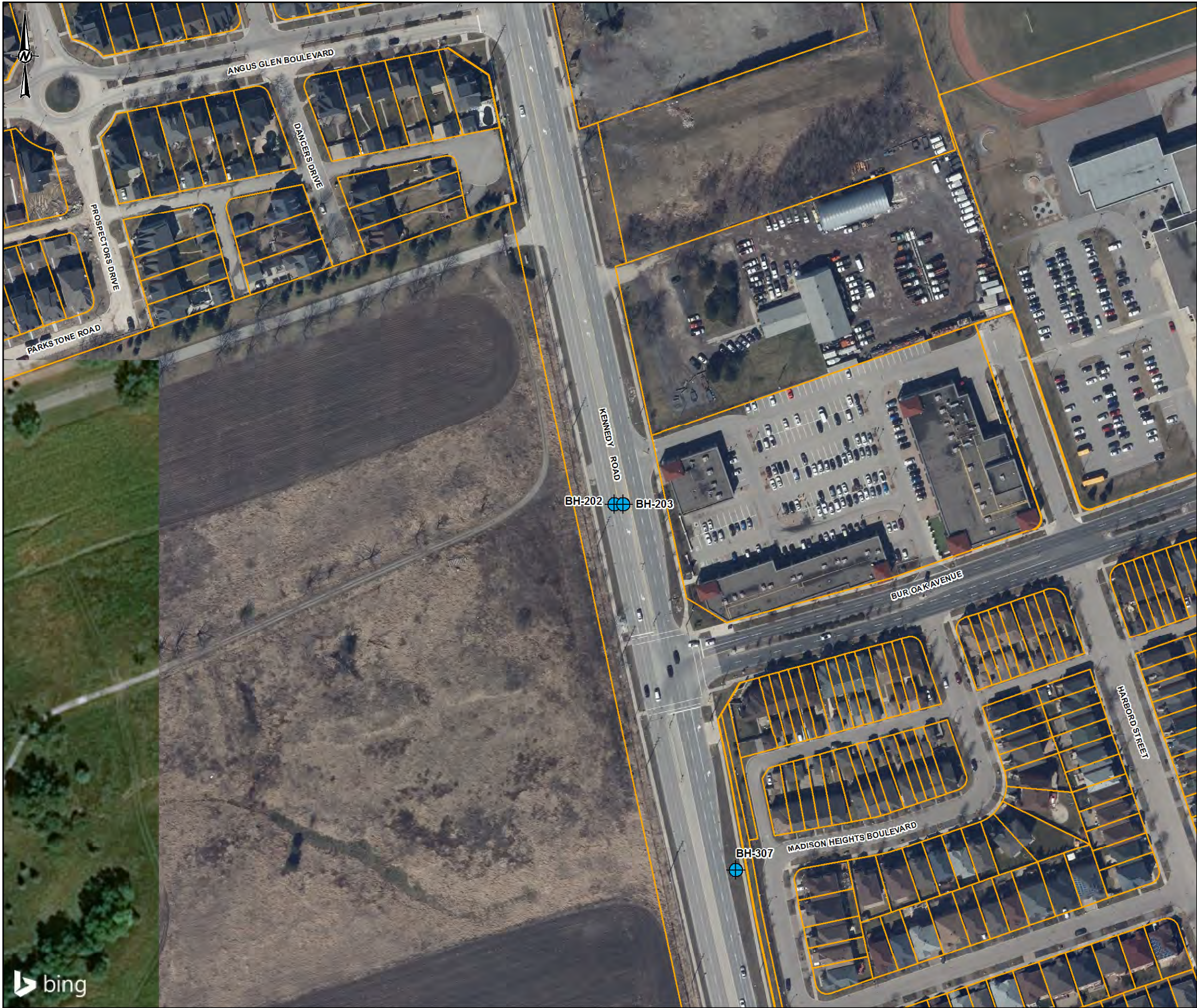
KENNEDY ROAD (Y.R. 67)
STEELES AVENUE (Y.R. 95) TO MAJOR MACKENZIE DRIVE (Y.R. 25), CITY OF MARKHAM, REGION OF YORK

TITLE

BOREHOLE LOCATION PLAN

CONSULTANT	YYYY-MM-DD	2018-09-13
	DESIGNED	MM
	PREPARED	MM
	REVIEWED	GG
	APPROVED	SJ

PROJECT NO.	CONTROL	REV.	FIGURE
1664178	0001	0	2-27



LEGEND

- Foundation Borehole
- Pavement Borehole
- Environmental Borehole
- Property Boundary

0 25 50 75 100
1:1,700 Meters

REFERENCE(S)

1. BASE DATA: MNRF LIO, OBTAINED 2016
2. IMAGERY PROVIDED BY THE REGION OF YORK, 2017
3. PARCELS PROVIDED BY THE REGION OF YORK (MARCH 2017)
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

HDR CORPORATION

PROJECT

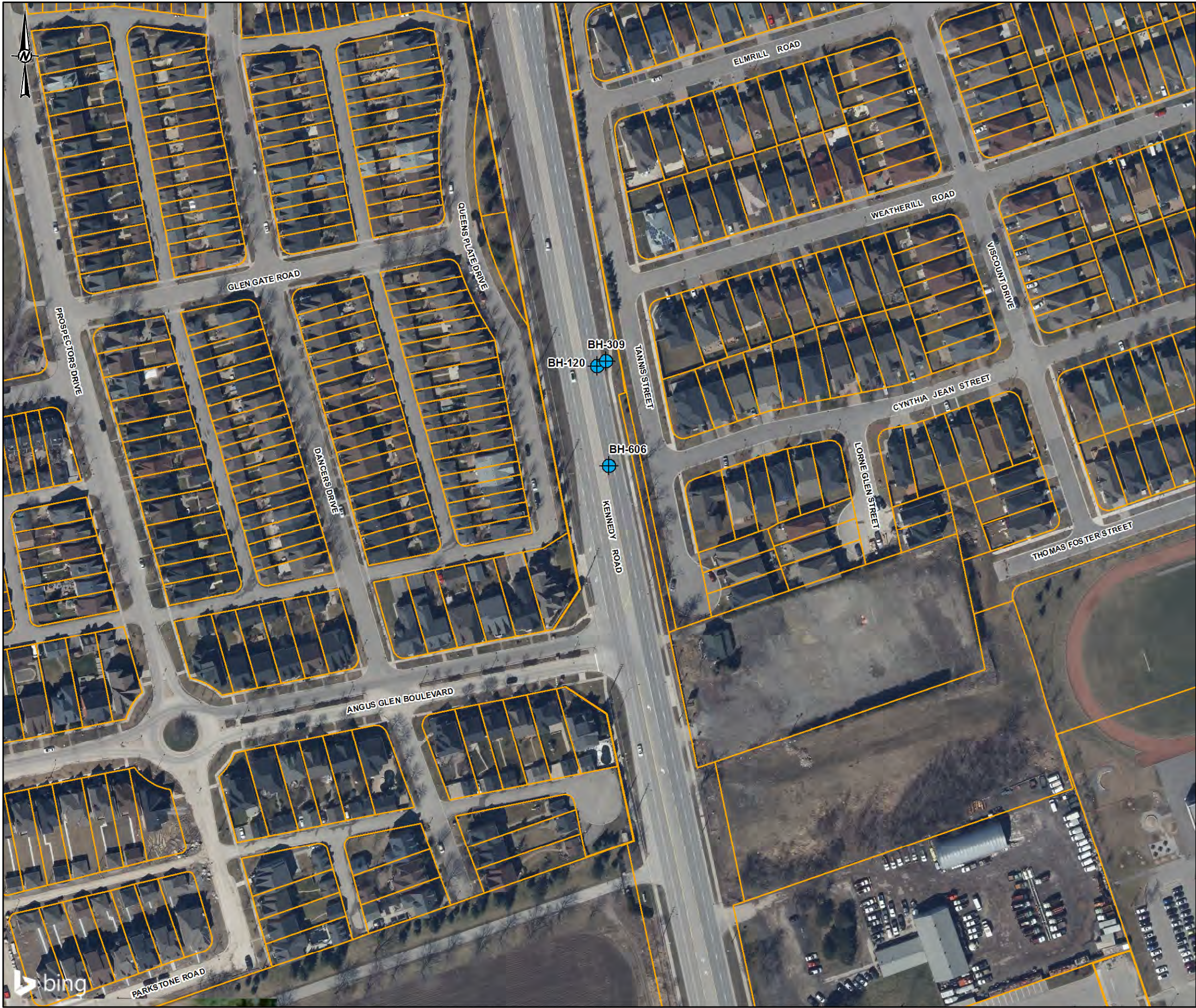
KENNEDY ROAD (Y.R. 67)
STEELES AVENUE (Y.R. 95) TO MAJOR MACKENZIE DRIVE (Y.R. 25), CITY OF MARKHAM, REGION OF YORK

TITLE

BOREHOLE LOCATION PLAN

CONSULTANT	YYYY-MM-DD	2018-09-13
	DESIGNED	MM
	PREPARED	MM
	REVIEWED	GG
	APPROVED	SJ

PROJECT NO. 1664178	CONTROL 0001	REV. 0	FIGURE 2-28
------------------------	-----------------	-----------	-----------------------



LEGEND

- Foundation Borehole
- Pavement Borehole
- Environmental Borehole
- Property Boundary

0 25 50 75 100
1:1,700 Meters

REFERENCE(S)

1. BASE DATA: MNRF LIO, OBTAINED 2016
2. IMAGERY PROVIDED BY THE REGION OF YORK, 2017
3. PARCELS PROVIDED BY THE REGION OF YORK (MARCH 2017)
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

HDR CORPORATION

PROJECT

KENNEDY ROAD (Y.R. 67)
STEELES AVENUE (Y.R. 95) TO MAJOR MACKENZIE DRIVE (Y.R. 25), CITY OF MARKHAM, REGION OF YORK

TITLE

BOREHOLE LOCATION PLAN

CONSULTANT	YYYY-MM-DD	2018-09-13
	DESIGNED	MM
	PREPARED	MM
	REVIEWED	GG
	APPROVED	SJ

PROJECT NO. 1664178	CONTROL 0001	REV. 0	FIGURE 2-29
------------------------	-----------------	-----------	-----------------------



LEGEND

- Foundation Borehole
- Pavement Borehole
- Environmental Borehole
- Property Boundary

0 25 50 75 100
1:1,700 Meters

REFERENCE(S)

1. BASE DATA: MNRF LIO, OBTAINED 2016
2. IMAGERY PROVIDED BY THE REGION OF YORK, 2017
3. PARCELS PROVIDED BY THE REGION OF YORK (MARCH 2017)
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
HDR CORPORATION

PROJECT
KENNEDY ROAD (Y.R. 67)
STEELES AVENUE (Y.R. 95) TO MAJOR MACKENZIE DRIVE (Y.R. 25), CITY OF MARKHAM, REGION OF YORK

TITLE
BOREHOLE LOCATION PLAN

CONSULTANT	YYYY-MM-DD	2018-09-13
	DESIGNED	MM
	PREPARED	MM
	REVIEWED	GG
	APPROVED	SJ

PROJECT NO. 1664178	CONTROL 0001	REV. 0	FIGURE 2-30
------------------------	-----------------	-----------	-----------------------

S:\Clients\Region of York\Kennedy_Road\99_PROJ\1664178_HDR\00_PROD\0005_Geotechnical_Workset\1664178-0005-EG-001.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 28mm



LEGEND

- Foundation Borehole
- Pavement Borehole
- Environmental Borehole
- Property Boundary

0 25 50 75 100
1:1,700 Meters

REFERENCE(S)

1. BASE DATA: MNRF LIO, OBTAINED 2016
2. IMAGERY PROVIDED BY THE REGION OF YORK, 2017
3. PARCELS PROVIDED BY THE REGION OF YORK (MARCH 2017)
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

HDR CORPORATION

PROJECT

KENNEDY ROAD (Y.R. 67)
STEELES AVENUE (Y.R. 95) TO MAJOR MACKENZIE DRIVE (Y.R. 25), CITY OF MARKHAM, REGION OF YORK

TITLE

BOREHOLE LOCATION PLAN

CONSULTANT	YYYY-MM-DD	2018-09-13
DESIGNED	MM	
PREPARED	MM	
REVIEWED	GG	
APPROVED	SJ	

PROJECT NO.
1664178

CONTROL
0001

REV.
0

FIGURE
2-31



Photo 1 – Severe longitudinal alligator cracking in southbound lane 1, south of 16th Avenue.



Photo 2 – Severe longitudinal cracking in southbound lane 2, south of 16th Avenue.

CLIENT

HDR Corporation

CONSULTANT



YYYY-MM-DD 2018-11-08

TAKEN BY GBG

CHECKED BY JGR

PROJECT

**Regional Municipality of York – Kennedy Road
Environmental Assessment (EA)**

TITLE

Site Photographs

PROJECT No. 1664178

FIGURE

3-1



Photo 3 – Severe transverse cracking across all lanes and machine patched pothole in southbound lane 2, south of 16th Avenue.



Photo 4 – Severe alligator cracking in the right wheel path and transverse cracking in southbound lane 2, north of Carlton Road.

CLIENT

HDR Corporation

CONSULTANT



YYYY-MM-DD 2018-11-08

TAKEN BY GBG

CHECKED BY JGR

PROJECT

**Regional Municipality of York – Kennedy Road
Environmental Assessment (EA)**

TITLE

Site Photographs

PROJECT No. 1664178

FIGURE

3-2



Photo 5 – Severe alligator and longitudinal joint cracking and potholes in southbound lane 2, north of Carlton Road.



Photo 6 – Moderate severity transverse and longitudinal cracking in southbound lane 2, north of Highway 7.

CLIENT

HDR Corporation

CONSULTANT



YYYY-MM-DD 2018-11-08

TAKEN BY GBG

CHECKED BY JGR

PROJECT

**Regional Municipality of York – Kennedy Road
Environmental Assessment (EA)**

TITLE

Site Photographs

PROJECT No. 1664178

FIGURE

3-3



Photo 7 – Severe longitudinal joint cracking between southbound lanes 1 and 2, north of Carlton Road.



Photo 8 – Severe longitudinal and transverse cracking in southbound lane 1, south of Highglen Avenue.

CLIENT

HDR Corporation

CONSULTANT



YYYY-MM-DD 2018-11-08

TAKEN BY GBG

CHECKED BY JGR

PROJECT

**Regional Municipality of York – Kennedy Road
Environmental Assessment (EA)**

TITLE

Site Photographs

PROJECT No. 1664178

FIGURE

3-4



Photo 9 – Severe longitudinal joint cracking between lanes 1 and the left-turning-lane, south of Highglen Avenue.



Photo 10 – Severe transverse cracking in northbound lane 1, south of Highglen Avenue.

CLIENT

HDR Corporation

CONSULTANT



YYYY-MM-DD 2018-11-08

TAKEN BY GBG

CHECKED BY JGR

PROJECT

**Regional Municipality of York – Kennedy Road
Environmental Assessment (EA)**

TITLE

Site Photographs

PROJECT No. 1664178

FIGURE

3-5



Photo 11 – Severe longitudinal and transverse cracking in the shared left-turning-lane, south of 14th Avenue.



Photo 12 – Severe longitudinal cracking along northbound lane 1, north of Helen Avenue.

CLIENT

HDR Corporation

CONSULTANT



YYYY-MM-DD 2018-11-08

TAKEN BY GBG

CHECKED BY JGR

PROJECT

**Regional Municipality of York – Kennedy Road
Environmental Assessment (EA)**

TITLE

Site Photographs

PROJECT No. 1664178

FIGURE

3-6



Photo 13 – Severe transverse cracking across northbound lanes 1 and 2, north of Castan Avenue.



Photo 14 – Moderate severity longitudinal and alligator cracking along northbound lane 2, south of Highway 7.

CLIENT

HDR Corporation

CONSULTANT



YYYY-MM-DD 2018-11-08

TAKEN BY GBG

CHECKED BY JGR

PROJECT

**Regional Municipality of York – Kennedy Road
Environmental Assessment (EA)**

TITLE

Site Photographs

PROJECT No. 1664178

FIGURE

3-7



Photo 15 – Severe transverse cracking and raveling in northbound right-turning-lane, south of Highway 7.



Photo 16 – Severe transverse alligator cracking in northbound right-turning-lane, south of Highway 7.

CLIENT

HDR Corporation

CONSULTANT



YYYY-MM-DD 2018-11-08

TAKEN BY GBG

CHECKED BY JGR

PROJECT

**Regional Municipality of York – Kennedy Road
Environmental Assessment (EA)**

TITLE

Site Photographs

PROJECT No. 1664178

FIGURE

3-8

APPENDIX A

Pavement Condition Surveys

FLEXIBLE PAVEMENT CONDITION EVALUATION FORM (MUNICIPALITIES)

Road No. (Street) Kennedy Road **Location From** Steeles Avenue **To** 300m north of Denison Street
Section Length 1.5 (KM) **Survey Date** November, 2018 **Traffic Direction** B B: Both Directions, N: North Bound
S: South Bound, E: East Bound, W: West Bound
Contract No. P-16-167 **Work Project No.** 1664178 **Class** A F: Freeway, C: Connecting Link, A: Major Arterial
M: Minor Arterial, R: Residential
Pavement Condition Rating (PCR) 75 **Riding Condition Rating (RCR)** 7.5 **Evaluated by** GBG

Riding Condition Rating (At Posted Speed)			Severity of Distress			Density of Distress % Extent of Occurrence		
			Slight	Moderate	Severe	Intermittent	Frequent	Extensive
10 Excellent Smooth and Pleasant	8 Good Comfortable	6 Fair Uncomfortable	4 Poor Very Rough and Bumpy	2 Very Poor Dangerous at Posted Speed				

Pavement Distress Manifestation		1	2	3	< 20	20-50	> 50
		1	2	3	1	2	3
Surface Defects	Ravelling	1	X			X	
	Flushing	2					
	Potholes	3					
	Pavement Edge Breaks	4					
	Manholes and Catchbasins	5	X			X	
Surface Deformation	Rippling and Shoving	6					
	Wheel Track Rutting	7	X			X	
	Distortion	8					
	Utility Trenches	9					
Cracking	Longitudinal	10	X	X			X
	Transverse	11	X	X		X	
	Pavement Edge	12					
	Map	13	X	X		X	
	Alligator	14					

Distress Comments (Items not covered above) Localized severe map cracking at the CN Rail pavement change. Severe longitudinal and transverse cracking at intersections.

Recommendation by Evaluator

Shoulder Distress Manifestation		Severity of Distress						Density of Distress % Extent of Occurrence					
Dominant Type	one	Right			Left			Right			Left		
		Sli	Mod	Sev	Sli	Mod	Sev	<20	20-50	>50	<20	20-50	>50
Paved Full													
Paved Partial													
Surface Treated													
Primed													

Curb and Gutter

Maintenance Treatment							
Pavement	Extent of Occurrence %			Shoulder	Extent of Occurrence %		
	<20	20-50	>50		<20	20-50	>50
	1	2	3		1	2	3
Manual Patching				Manual patching			
Machine Patching				Manual Spray Patching			
Manual Spray patching				Manual Chip Seal			
Manual Chip Seal				Crack Rout and Seal			
Machine Chip Seal							
Fog Seal							
Surface Treatment							
Manual Burn & Seal							
Crack Rout and Seal	X						

Road No. (Street)	Kennedy Road	Location From	300m north of Denison Street	To	14th Avenue
Section Length	0.8 (KM)	Survey Date	November, 2018	Traffic Direction	B: Both Directions, N: North Bound S: South Bound, E: East Bound, W: West Bound
Contract No.	P-16-167	Work Project No.	1664178	Class	A: Freeway, C: Connecting Link, A: Major Arterial M: Minor Arterial, R: Residential
Pavement Condition Rating (PCR)	65	Riding Condition Rating (RCR)	6	Evaluated by	GBG

Riding Condition Rating (At Posted Speed)					Severity of Distress			Density of Distress % Extent of Occurrence			
10	8	6	4	2	0	Slight	Moderate	Severe	Intermittent	Frequent	Extensive
Excellent	Good	Fair	Poor	Very Poor							
Smooth and Pleasant	Comfortable	Uncomfortable	Very Rough and Bumpy	Dangerous at Posted Speed							
Pavement Distress Manifestation						1	2	3	< 20	20-50	> 50
Surface Defects	Ravelling				1	X				X	
	Flushing				2						
	Potholes				3		X		X		
	Pavement Edge Breaks				4						
	Manholes and Catchbasins				5		X		X		
Surface Deformation	Rippling and Shoving				6						
	Wheel Track Rutting				7	X			X		
	Distortion				8						
	Utility Trenches				9	X			X		
Cracking	Longitudinal				10		X	X		X	
	Transverse				11		X	X		X	
	Pavement Edge				12		X	X	X		
	Map				13		X			X	
	Alligator				14		X		X		

Distress Comments (Items not covered above)	All lanes appear to be oxidized. Localized machine patching at various locations within this section. Localized pavement change in NB L1, SB L1 and LTL south of 14th Avenue
---	---

Recommendation by Evaluator

[illegible]

Maintenance Treatment							
Pavement	Extent of Occurrence %			Shoulder	Extent of Occurrence %		
	<20	20-50	>50		<20	20-50	>50
	1	2	3		1	2	3
Manual Patching				Manual patching			
Machine Patching	X			Manual Spray Patching			
Manual Spray patching				Manual Chip Seal			
Manual Chip Seal				Crack Rout and Seal			
Machine Chip Seal							
Fog Seal							
Surface Treatment							
Manual Burn & Seal							
Crack Rout and Seal	X						

FLEXIBLE PAVEMENT CONDITION EVALUATION FORM (MUNICIPALITIES)

Road No. (Street) Kennedy Road **Location From** 14th Avenue **To** Highway 7
Section Length 2.5 (KM) **Survey Date** November, 2018 **Traffic Direction** B B: Both Directions, N: North Bound
S: South Bound, E: East Bound, W: West Bound
Contract No. P-16-167 **Work Project No.** 1664178 **Class** A F: Freeway, C: Connecting Link, A: Major Arterial
M: Minor Arterial, R: Residential
Pavement Condition Rating (PCR) 75 **Riding Condition Rating (RCR)** 7.5 **Evaluated by** GBG

Riding Condition Rating (At Posted Speed)			Severity of Distress			Density of Distress % Extent of Occurrence					
10	8	6	4	2	0	Slight	Moderate	Severe	Intermittent	Frequent	Extensive
Excellent	Good	Fair	Poor	Very Poor							
Smooth and Pleasant	Comfortable	Uncomfortable	Very Rough and Bumpy	Dangerous at Posted Speed							

Pavement Distress Manifestation		1	2	3	< 20	20-50	> 50
					1	2	3
Surface Defects	Ravelling	1	X			X	
	Flushing	2					
	Potholes	3					
	Pavement Edge Breaks	4					
	Manholes and Catchbasins	5	X	X		X	
Surface Deformation	Rippling and Shoving	6					
	Wheel Track Rutting	7					
	Distortion	8					
	Utility Trenches	9	X			X	
Cracking	Longitudinal	10	X	X		X	
	Transverse	11	X	X		X	
	Pavement Edge	12	X			X	
	Map	13	X			X	
	Alligator	14					

Distress Comments (Items not covered above) Severe map cracking at intersections. Localized machine patching at various sections. Pavement appears to be microsurfaced at Highway 407 and Highway 7.

Recommendation by Evaluator

Shoulder Distress Manifestation		Severity of Distress						Density of Distress % Extent of Occurrence								
Dominant Type	one	Distress	Right			Left			Right			Left				
			Sli	Mod	Sev	Sli	Mod	Sev	<20	20-50	>50	<20	20-50	>50		
			1	2	3	1	2	3	1	2	3	1	2	3		
Paved Full		Pavement Edge														
		Paved Shoulder Separation														
Paved Partial		Cracking														
		Breakup and Potholes														
Surface Treated		Distortion														
		Pavement Edge Curb Separation														
Primed																

Maintenance Treatment							
Pavement	Extent of Occurrence %			Shoulder	Extent of Occurrence %		
	<20	20-50	>50		<20	20-50	>50
	1	2	3		1	2	3
Manual Patching				Manual patching			
Machine Patching	X			Manual Spray Patching			
Manual Spray patching				Manual Chip Seal			
Manual Chip Seal				Crack Rout and Seal			
Machine Chip Seal							
Fog Seal							
Surface Treatment	X						
Manual Burn & Seal							
Crack Rout and Seal	X						

FLEXIBLE PAVEMENT CONDITION EVALUATION FORM (MUNICIPALITIES)

Road No. (Street) Kennedy Road **Location From** Highway 7 **To** Major Mackenzie Drive
Section Length 4.5 (KM) **Survey Date** November, 2018 **Traffic Direction** B B: Both Directions, N: North Bound
S: South Bound, E: East Bound, W: West Bound
Contract No. P-16-167 **Work Project No.** 1664178 **Class** A F: Freeway, C: Connecting Link, A: Major Arterial
M: Minor Arterial, R: Residential
Pavement Condition Rating (PCR) 70 **Riding Condition Rating (RCR)** 7 **Evaluated by** GBG

Riding Condition Rating (At Posted Speed)			Severity of Distress			Density of Distress % Extent of Occurrence					
10	8	6	4	2	0	Slight	Moderate	Severe	Intermittent	Frequent	Extensive
Excellent	Good	Fair	Poor	Very Poor							
Smooth and Pleasant	Comfortable	Uncomfortable	Very Rough and Bumpy	Dangerous at Posted Speed							

Pavement Distress Manifestation		1	2	3	< 20	20-50	> 50
		1	2	3	1	2	3
Surface Defects	Ravelling	1	X			X	
	Flushing	2					
	Potholes	3			X	X	
	Pavement Edge Breaks	4					
	Manholes and Catchbasins	5		X		X	
Surface Deformation	Rippling and Shoving	6					
	Wheel Track Rutting	7	X				X
	Distortion	8					
	Utility Trenches	9	X			X	
Cracking	Longitudinal	10	X	X	X		X
	Transverse	11	X	X		X	
	Pavement Edge	12		X		X	
	Map	13		X	X	X	
	Alligator	14		X	X	X	

Distress Comments (Items not covered above) Pavement generally in fair condition with pavement distress areas at Highway 7 and most intersections. Pavement appears to be microsurfaced north of 16th Avenue, reflected cracks have been sealed.

Recommendation by Evaluator

Shoulder Distress Manifestation			Severity of Distress						Density of Distress % Extent of Occurrence								
Dominant Type	one	Distress	Right			Left			Right			Left					
			Sli	Mod	Sev	Sli	Mod	Sev	<20	20-50	>50	<20	20-50	>50			
			1	2	3	1	2	3	1	2	3	1	2	3			
Paved Full		Pavement Edge															
		Paved Shoulder Separation															
Paved Partial		Cracking															
		Breakup and Potholes															
Surface Treated		Distortion															
		Pavement Edge Curb Separation															
Primed																	

Maintenance Treatment											
Pavement			Extent of Occurrence %			Shoulder			Extent of Occurrence %		
			<20	20-50	>50				<20	20-50	>50
			1	2	3				1	2	3
Manual Patching						Manual patching					
Machine Patching	X					Manual Spray Patching					
Manual Spray patching						Manual Chip Seal					
Manual Chip Seal						Crack Rout and Seal					
Machine Chip Seal											
Fog Seal											
Surface Treatment	X										
Manual Burn & Seal											
Crack Rout and Seal	X										

APPENDIX B

Record of Borehole Logs

Borehole No.	Lane	BOREHOLE LOG				LABORATORY TESTING				Sieves (%)				
		Depth (mm/m)	Description	Sample Depth (mm/m)	Frost Susceptibility	Water Content (%)	Gradation	4.75 mm	75 um	5 um				
Northbound														
South of Steeles Avenue														
		11.7 m Rt of C/L, Datum = 0												
BH ENV1	NB BLVD	0	- 130	Drk Br Si Tpsl										
		130	- 650	Br Si Sa & Gr, Moist										
			- 650	NFP Utility Conflict										
Steeles Avenue to Denison Street														
		2.7 m Rt of C/L, Datum = 0												
BH 101	NB L1	0	- 140	Asph										
		140	- 400	Br Cr Gran										
		400	- 830	Br Sa Tr Gr Tr Si, Moist										
		830	- 1.50	Br Cl Si Tr Sa Tr Gr, Moist										
		9.0 m Rt of C/L, Datum = 0												
BH 102	NB L2	0	- 175	Asph										
		175	- 450	Br Cr Gran, Moist	1	175	- 450	4.6	Unacceptable Granular A (material too fine on most sieves)					
		450	- 840	Br Sa & Gr Tr Si, Moist										
		840	- 1.50	Br Cl Si Tr Sa Tr Gr, Moist										
		13.8 m Rt of C/L, Datum = +200 mm												
BH ENV2	NB BLVD	0	- 170	Drk Br Si Tpsl										
		170	- 800	Br Cl Si Tr Sa Tr Gr, Moist										
			- 800	NFP Utility Conflict										
		13.2 m Rt of C/L, Datum = +200 mm												
BH 301	NB BLVD	0	- 130	Drk Br Si Tpsl										
		130	- 1.50	Br Cl Si and Sa Tr Gr, Moist	1	400	- 700	LSFH (34.6)	14.2	ML - Clayey Silt	96	55.1	21	
Denison Street to 14th Avenue														
		3.8 m Rt of C/L, Datum = 0												
BH 103	NB L1	0	- 100	Asph										
		100	- 450	Br Cr Gran										
		450	- 770	Br Sa & Gr Tr Si, Moist										
		770	- 1.50	Br Cl Si Tr Sa Tr Gr, Moist										
		4.4 m Rt of C/L, Datum = 0												
BH 104	NB L1	0	- 340	Asph										
		340	- 600	Br Cr Gran										
		600	- 810	Br Sa W Gr Tr Si, Moist										
		810	- 1.50	Br Cl Si and Sa Tr Gr, Moist										
		2.3 m Rt of C/L, Datum = 0												
BH 105	NB LTL	0	- 350	Asph										
		350	- 690	Br Si Cl Tr Sa Tr Gr, Moist										
		690	- 1.50	Br Cl Si and Sa Tr Gr, Dry	2	1.0	- 1.30	LSFH (36.0)	9.9	ML-CL - Clayey Silt	95.3	54	18	
		4.9 m Rt of C/L, Datum = 0												
BH 601/ENV3	NB L1	0	- 340	Asph										
		340	- 760	Br Cr Gran	1	340	- 640	2.3	Unacceptable Granular A (material too fine on most sieves)					
		760	- 1.50	Br Si Cl Tr Sa Tr Gr, Moist										
		2.4 m Rt of C/L, Datum = 0												
BH 106	NB LTL	0	- 350	Asph										
		350	- 750	Br Cr Gran										
		750	- 1.50	Br Si Cl Tr Sa Tr Gr, Moist										
		10.0 m Rt of C/L, Datum = +200 mm												
BH 302	NB BLVD	0	- 110	Drk Br Si Tpsl										
		110	- 1.50	Br Cl Si Tr Sa Tr Gr, Moist										
		21.8 m Rt of C/L, Datum = +300 mm												
BH ENV4	NB BLVD	0	- 200	Drk Br Si Tpsl										
		200	- 710	Dr Cl Si Tr Sa, Moist										
		710	- 1.20	Br Sa Si Tr Gr, Moist										
		1.20	- 1.50	Br Si Cl Tr Sa, Moist										
14th Avenue to Highway 407														
		10.1 m Rt of C/L, Datum = 0												
BH ETR1	NB L3	0	- 150	Asph										
		150	- 340	Br Cr Gran										
		340	- 1.35	Br Sa and Gr Tr Si, Moist										
		1.35	- 1.50	Br Si and Sa W Gr, Moist										
		10.6 m Rt of C/L, Datum = +300 mm												
BH 303	NB BLVD	0	- 180	Drk Br Si Tpsl										
		180	- 560	Drk Br Si Cl, Moist										
		560	- 660	Br Si Cl Tr Sa, Moist										
		660	- 1.50	Li Br Si Cl W Sa Tr Gr, Moist										
Highway 407 to Highway 7														
		5.8 m Rt of C/L, Datum = 0												
BH 107	NB L2	0	- 150	Asph										
		150	- 340	Br Cr Gran, Moist	1	150	- 340	7.0	Unacceptable Granular A (material too fine on most sieves)					
		340	- 690	Br Sa Tr Gr Tr Si, Dry	2	350	- 650	2.9	Acceptable Granular B, Type I					
		690	- 1.50	Br Cl Si Sa Tr Gr, Dry	3	1.1	- 1.4	LSFH (28.9)	6.9	SM - Silty Sand	92.1	50.9	22	
		8.2 m Rt of C/L, Datum = 0												
BH 108/ENV5	NB L2	0	- 320	Asph										
		320	- 710	Br Sa Tr Gr Tr Si, Moist										
		710	- 1.50	Br Si Sa, Moist										
		0.9 m Rt of C/L, Datum = 0												
BH 109	NB LTL	0	- 130	Asph										
		130	- 360	Br Cr Gran										
		360	- 740	Br Sa Tr Gr Tr Si, Moist										
		740	- 1.50	Br Si Cl Tr Sa, Moist										
		2.4 m Rt of C/L, Datum = 0												
BH ENV8	NB LTL	0	- 110	Asph										
		110	- 310	Br Cr Gran										
		310	- 860	Br Sa Tr Gr Tr Si, Moist										
		860	- 1.50	Br Si Cl Tr Sa, Moist										
		4.7 m Rt of C/L, Datum = 0												
BH 110	NB L1	0	- 130	Asph										
		130	- 360	Br Cr Gran										
		360	- 750	Br Sa Tr Gr Tr Si, Moist										
		750	- 1.50	Br Si Cl Tr Sa Tr Gr, Moist										
		2.0 m Rt of C/L, Datum = 0												
BH 111	NB LTL	0	- 100	Asph										
		100	- 400	Br Cr Gran										
		400	- 760	Br Sa Tr Gr Tr Si, Moist	2	400	- 700	3.4	Generally Acceptable Granular B, Type I (9.8% passing the 0.075 mm sieve)					
		760	- 1.50	Br Si Cl Tr Sa Tr Gr, Moist										
		7.6 m Rt of C/L, Datum = 0												
BH 603	NB L2	0	- 120	Asph										
		120	- 310	Br Cr Gran										
		310	- 820	Br Sa Tr Gr Tr Si, Moist										
		820	- 1.50	Br Si Cl Tr Sa Tr Gr, Moist										
		11.1 m Rt of C/L, Datum = 0												
BH 604	NB RTL	0	- 170	Asph										
		170	- 380	Br Cr Gran										
		380	- 820	Br Sa Tr Gr Tr Si, Moist										
		820	- 1.50	Br Si Cl Tr Sa Tr Gr, Moist										
		9.6 m Rt of C/L, Datum = +200 mm												
BH 304	NB BLVD	0	- 30	Drk Br Si Tpsl										
		30	- 550	Br Sa & Gr Tr Si, Moist										
			- 550	NFP Utility Conflict										

Borehole No.	Lane	BOREHOLE LOG					LABORATORY TESTING					Sieves (%)		
		Depth (mm/m)	Description	Sample Depth (mm/m)	Frost Susceptibility	Water Content (%)	Gradation	4.75 mm	75 mm	5 mm				
Highway 7 to 16th Avenue														
BH 112	NB L2	0 - 100	Asph											
		100 - 440	Br Cr Gran	1	140	-	440							
		440 - 930	Br Sa W Gr Tr Si, Moist	2	630	-	930							
		930 - 1.50	Br Si Cl Tr Sa Tr Gr OXI STN, Moist	3	1	-	1.3							
5.5 m Rt of C/L, Datum = 0														
BH 113	NB L2	0 - 130	Asph											
		130 - 310	Br Cr Gran											
		310 - 600	Br Sa W Gr Tr Si, Moist											
		600 - 1.50	Gry Si Cl Tr Sa, Moist											
2.5 m Rt of C/L, Datum = 0														
BH 114	NB L1	0 - 120	Asph											
		120 - 270	Br Cr Gran	1	120	-	270							
		270 - 650	Br Sa Tr Si Tr Gr, Moist	2	300	-	600							
		650 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist											
4.9 m Rt of C/L, Datum = 0														
BH 115	NB L2	0 - 130	Asph											
		130 - 290	Br Cr Gran											
		290 - 760	Br Sa Tr Si Tr Gr, Moist											
		760 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist											
3.5 m Rt of C/L, Datum = 0														
BH 116	NB L1	0 - 130	Asph											
		130 - 290	Br Cr Gran											
		290 - 870	Br Sa Tr Si Tr Gr Occ Cob, Moist											
		870 - 1.50	Br Si Cl W Sa Tr Gr, Moist											
2.2 Rt of C/L, Datum = 0														
BH 117	NB LTL	0 - 130	Asph											
		130 - 310	Br Cr Gran											
		310 - 700	Br Sa Tr Si Tr Gr Occ Cob, Moist											
		700 - 1.50	Br Si Cl W Sa Tr Gr, Moist	3	1.1	-	1.4	LSFH (18.6)	22.2	C1 - Silty Clay	99.5	86.6	68	
8.7 m Rt of C/L, Datum = +200 mm														
BH ENV10	NB BLVD	0 - 210	Drk Br Si Tpsl											
		210 - 500	Br Si Cl Tr Sa OXI STN, Moist											
		500 - 710	Br Si Sa Tr Gr OXI STN, Moist											
		710 - 1.50	Gry Si Cl Tr Sa OXI STN, Moist											
8.4 m Rt of C/L, Datum = +200														
BH ENV11	NB BLVD	0 - 200	Drk Br Si Tpsl											
		200 - 540	Br Si Cl Tr Sa, Moist											
		540 - 720	Br Si Sa Tr Gr, Moist											
		720 - 1.50	Gry Si Cl Tr Sa, Moist											
10.1 m Rt of C/L, Datum = +200 mm														
BH 305	NB BLVD	0 - 160	Drk Br Si Tpsl											
		160 - 1.30	Br Si Sa & Gr, Moist											
		1.30 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist											
9.8 m Rt of C/L, Datum = +200 mm														
BH 306	NB BLVD	0 - 110	Dr Br Si Tpsl											
		110 - 1.50	Br Sa Cl Si Tr Gr, Moist	1	400	-	700	LSFH (27.8)	16.4	ML - Clayey Silt	96.6	71.8	44	
10.4 m Rt of C/L, Datum = +200 mm														
BH 308	NB BLVD	0 - 130	Drk Br Si Tpsl											
		130 - 1.50	Br Si Cl Tr Sa Tr Gr OXI STN, Moist											
16th Avenue to Major Mackenzie Drive														
3.7 m Rt of C/L, Datum = 0														
BH 118	NB L1	0 - 160	Asph											
		160 - 330	Br Cr Gr W RAP											
		330 - 860	Br Sa Tr Si Tr Gr, Moist											
		860 - 1.50	Br Si Sa Tr Gr, Moist											
0.9 m Rt of C/L, Datum = 0														
BH 119	NB LTL	0 - 190	Asph											
		190 - 340	Br Cr Gran W RAP											
		340 - 770	Br Sa Tr Si Tr Gr, Moist											
		770 - 1.50	Br Si Sa Tr Gr, Moist											
2.4 m Rt of C/L, Datum = 0														
BH 606	NB L1	0 - 160	Asph											
		160 - 350	Br Cr Gran W RAP											
		350 - 900	Br Sa Tr Si Tr Gr, Moist											
		900 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist											
5.8 m Rt of C/L, Datum = 0														
BH 120	NB L2	0 - 160	Asph											
		160 - 400	Br Cr Gran	1	160	-	400							
		400 - 1.10	Br Sa W Gr Tr Si, Dry	2	500	-	800							
		1.10 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist											
			Borehole Caved at 1.1											
9.8 m Rt of C/L, Datum = 0														
BH 121	NB L2	0 - 170	Asph											
		170 - 360	Br Cr Gr W RAP											
		360 - 820	Br Sa Tr Gr Tr Si, Moist											
		880 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist											
13 m Rt of C/L, Datum = 0														
BH 122	NB RTL	0 - 160	Asph											
		160 - 460	Br Cr Gr W RAP											
		460 - 910	Br Sa Tr Gr Tr Si, Moist											
		910 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist											
9.4 m Rt of C/L, Datum = +200 mm														
BH 307	NB BLVD	0 - 90	Drk Br Si Tpsl											
		90 - 1.20	Br Si Sa & Gr, Moist											
		1.20 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist											
9.2 m Rt of C/L, Datum = +200 mm														
BH 309	NB BLVD	0 - 100	Drk Br Sa Tpsl											
		100 - 1.20	Br Sa W Si W Gr, Moist to Wet											
		1.20 - 1.50	Br Si Cl W Sa Tr Gr, Moist											
			Wet @ 910											
North of Major Mackenzie Drive														
3.7 m Rt of C/L, Datum = 0														
BH 123	NB L2	0 - 150	Asph											
		150 - 470	Br Cr Gran w RAP											
		470 - 900	Br Sa W Gr Tr Si, Moist											
		900 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist											

Borehole No.	Lane	BOREHOLE LOG			LABORATORY TESTING			Sieves (%)			
		Depth (mm/m)	Description	Sample Depth (mm/m)	Frost Susceptibility	Water Content (%)	Gradation	4.75 mm	75 um	5 um	
Southbound											
Major Mackenzie Drive to 16th Avenue											
BH 201	SB L2	5.3 m Lt of C/L, Datum = 0									
		0 - 140	Asph								
		140 - 490	Br Cr Gran W RAP	1	140	-	440	2.3	Generally Acceptable Granular A (75.2% passing the 9.5 mm sieve) (58.4% passing the 4.75 mm sieve) (10.2% passing the 0.075 mm sieve)		
		490 - 810	Br Sa W Gr Tr Si, Moist	2	490	-	790				
		810 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist								
BH 202	SB L1	6.2 m Lt of C/L, Datum = 0									
		0 - 180	Asph								
		180 - 460	Br Cr Gran w RAP								
		460 - 910	Br Sa W Gr Tr Si, Moist								
		910 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist								
BH 203	SB LTL	3.2 m Lt of C/L, Datum = 0									
		0 - 170	Asph								
		170 - 450	Br Cr Gran w RAP								
		450 - 900	Br Sa W Gr Tr Si, Moist								
		900 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist								
BH 204	SB L2	7.9 Lt of C/L, Datum = 0									
		0 - 160	Asph								
		160 - 920	Br Sa Tr Gr, Dry	1B	600	-	900	3	Acceptable Granular B, Type I		
		920 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist								
BH 401	SB BLVD	11.4 m Lt of C/L, Datum = +200 mm									
		0 - 130	Drk Br Si Tpsl								
		130 - 480	Br Si Cl Tr Sa Tr Gr, Moist								
		480 - 850	Br Si Sa Tr Gr, Moist								
		850 - 1.5	Br Sa Si Cl Tr Gr, Moist	2	1.1	-	1.40	LSFH (27.0)	21.4	CL - Silty Clay	98.8
16th Avenue to Highway 7											
BH 205	SB L1	5.0 m Lt of C/L, Datum = 0									
		0 - 90	Asph								
		90 - 260	Br Cr Gran w RAP								
		260 - 770	Br Sa Tr Gr Tr Si, Moist								
		770 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist								
BH 206	SB LTL	2.2 m Lt of C/L, Datum = 0									
		0 - 100	Asph								
		100 - 260	Br Cr Gran w RAP								
		260 - 750	Br Sa Tr Gr Tr Si, Moist								
		750 - 1.50	Br Si Cl Tr Sa, Moist								
BH 207	SB L2	5.9 m Lt of C/L, Datum = 0									
		0 - 120	Asph								
		120 - 510	Br Cr Gran	1	200	-	500	1.8	Marginally Unacceptable Granular A (58.8% passing the 4.75 mm sieve) (45.1% passing the 1.18 mm sieve) (27.8% passing the 0.3 mm sieve) (11.1% passing the 0.075 mm sieve)		
		510 - 890	Br Sa Tr Gr Tr Si, Moist	2	510	-	810	6.4	Generally Acceptable Granular B, Type I (12.1% passing the 0.075 mm sieve)		
		890 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist								
BH 208	SB L2	8.3 m Lt of C/L, Datum = 0									
		0 - 110	Asph								
		110 - 310	Br Cr Gran								
		310 - 780	Br Sa W Gr Tr Si, Moist								
		780 - 1.50	Br Si Cl Tr Sa Tr Gr								
BH 210/RR2	SB L2	5.54 m Lt of C/L, Datum = 0									
		0 - 125	Asph								
		125 - 710	Br Cr Gran								
		710 - 1.22	Br Sa W Gr, Moist								
		1.22 - 1.41	Gr Si Cl Tr Sa, Moist								
BH 209	SB L1	2.6 m Lt of C/L, Datum = 0									
		0 - 105	Asph								
		105 - 400	Br Cr Gran								
		400 - 730	Br Sa W Gr Tr Si, Moist								
		730 - 1.50	Br Cl Si W Sa Tr Gr, Moist								
BH 605	SB L2	5.9 m Lt of C/L, Datum = 0									
		0 - 130	Asph								
		130 - 270	Br Cr Gran								
		270 - 680	Br Sa W Gr Tr Si, Moist	2	330	-	630	4.5	Marginally Unacceptable Granular B, Type I (13.9% passing the 0.075 mm sieve)		
		680 - 1.50	Blk-Grv Cl Si W Sa, Moist to Wet	3	1	-	1.3	MSFH (47.7)	20.8	ML - Clayey Silt	99.7
BH 402	SB BLVD	10.5 m Lt of C/L, Datum = +200 mm									
		0 - 170	Drk Br Si Tpsl								
		170 - 520	Br Si Cl Tr Sa Tr Gr, Moist								
		520 - 900	Br Si Sa Tr Gr, Moist								
		900 - 1.50	Br Si Cl Tr Sa, Moist								
BH 403	SB BLVD	12.2 Lt C/L, Datum = +200 mm									
		0 - 130	Drk Br Si Tpsl								
		130 - 1.50	Br Si Cl Tr Sa, Moist								

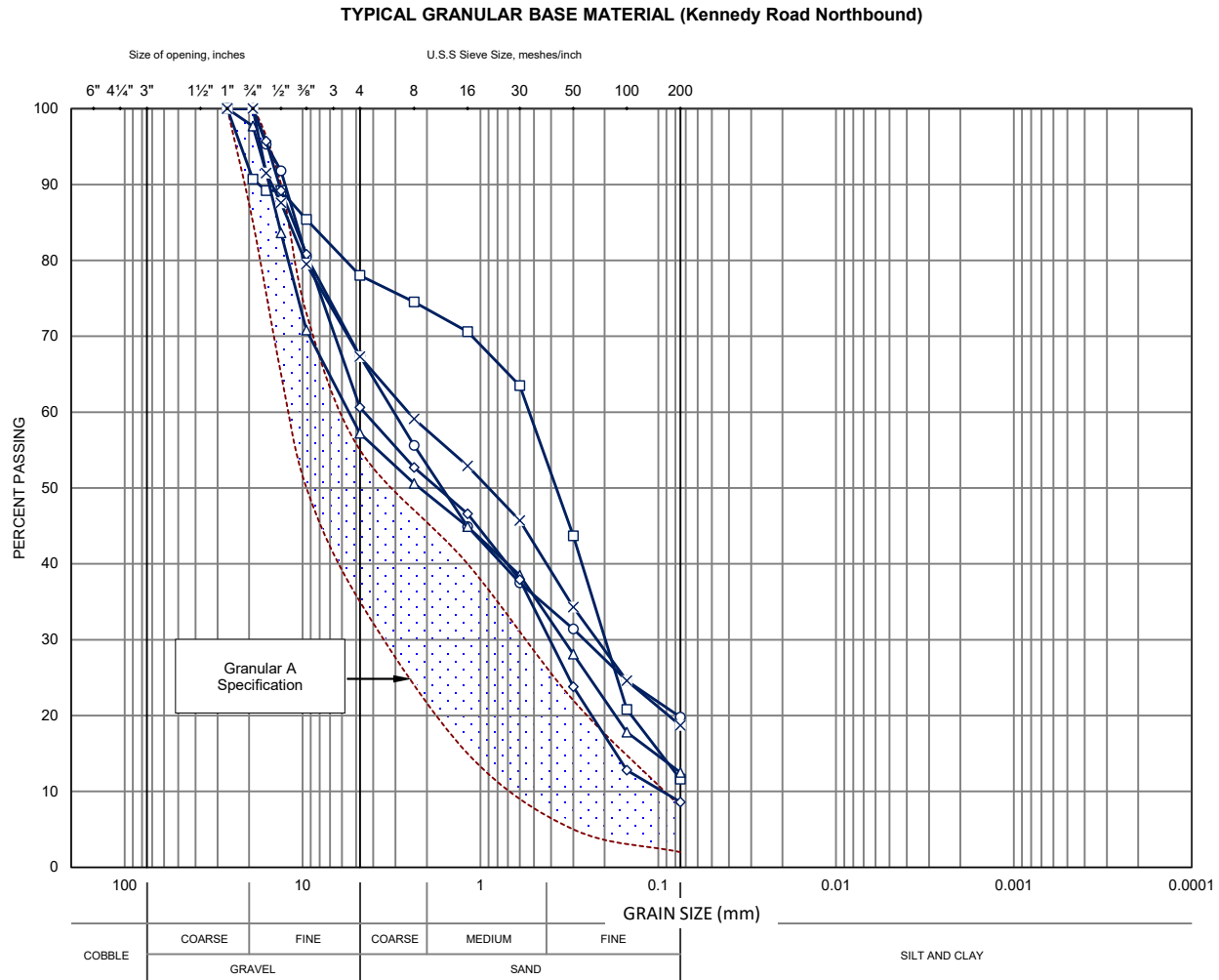
Borehole No.	Lane	BOREHOLE LOG				LABORATORY TESTING				Sieves (%)		
		Depth (mm/m)	Description	Sample Depth (mm/m)	Frost Susceptibility	Water Content (%)	Gradation	4.75 mm	75 um	5 um		
Highway 7 to Highway 407												
BH 211	SB L2	8.6 Lt of C/L, Datum = 0										
		0 - 110	Asph									
		110 - 310	Br Cr Gran									
		- 310	NFP Utility Conflict									
BH 212	SB RTL	13.5 m Lt of C/L, Datum = 0										
		0 - 80	Asph									
		80 - 260	Br Cr Gran									
		260 - 780	Br Sa W Gr Tr Si, Moist									
		780 - 1.50	Br Cl Si W Sa Tr Gr, Moist									
3.8 m Lt of C/L, Datum = 0												
BH 213	SB L1	0 - 110										
		110 - 340	Br Cr Gran	1	110	- 340		1.5	Generally Acceptable Granular A (40.8% passing the 1.18 mm sieve) (24.6% passing the 0.3 mm sieve) (9.8% passing the 0.075 mm sieve)			
		340 - 960	Br Sa Tr Gr Tr Si, Dry	2	370	- 670		3	Generally Acceptable Granular B, Type I (65.8% passing the 0.3 mm sieve) (12.7% passing the 0.075 mm sieve)			
		960 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist									
		8.45 m Lt of C/L, Datum = 0										
BH ENV6	SB L2	0 - 160	Asph									
		160 - 320	Br Cr Gran									
		320 - 670	Br Sa Tr Gr Tr Si, Moist									
		670 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist									
9.9 m Lt of C/L, Datum = 0												
BH 214	SB L2	0 - 160	Asph									
		160 - 570	Br Cr Gran									
		570 - 790	Br Sa Tr Gr Tr Si, Moist									
		790 - 1.50	Blk Sa Si Cl Tr Gr, Wet	3	1.20	- 1.50	LSFH (22.7)	25.4	CL - Silty Clay	99	67.7	46
8.4 m Lt of C/L, Datum = 0												
BH 215/ETR2	SB L2	0 - 155	Asph									
		155 - 594	Br Cr Gran									
		594 - 871	Br Sa W Gr W Si, Dry									
		871 - 1.30	Br Si Cl W Sa, Moist									
BH ENV9/404	SB BLVD	18.6 Lt of C/L, Datum = +500 mm										
		0 - 150	Drk Br Si Tpsl									
		150 - 440	Br Si Cl Tr Sa, Moist									
		440 - 1.1	Br Si Sa Tr Gr, Wet									
20.4 m Lt of C/L, Datum = +400 mm												
BH 405	SB BLVD	0 - 180	Drk Br Si Tpsl									
		180 - 1.50	Br Si Cl Tr Sa Tr Gr, Moist									
14.2m Lt of C/L, Datum = +200 mm												
BH ENV7	SB BLVD	0 - 180	Drk Br Si Tpsl									
		180 - 540	Br Si Cl Tr Sa, Moist									
		540 - 1.50	Drk Br Si Cl Tr Sa, Moist									
15.8 m Lt of C/L, Datum = +200 mm												
BH 406	SB BLVD	0 - 130	Drk Br Si Tpsl									
		130 - 550	Br Si Cl Tr Sa, Moist									
		550 - 1.15	Br Sa W Gr Tr Si, Moist									
		1.15 - 1.50	Bl Cl Si and Sa Tr Gr, Moist	2	1.15	- 1.45	LSFH (23.5)	13.1	SM - Silty Sand	96.2	51.5	29
Highway 407 to 14th Avenue												
BH 602	SB L1	2.6 m Lt of C/L, Datum = 0										
		0 - 130	Asph									
		130 - 490	Br Cr Gran									
		490 - 1.5	Br Sa W Gr Tr Si, Moist									
7.26 m Lt of C/L, Datum = 0												
BH 216	SB L2	0 - 345	Asph									
		345 - 730	Br Cr Gran									
		730 - 1.20	Blk Si Cl W Sa, Moist									
3.7 m Lt of C/L, Datum = 0												
BH 217	SB L1	0 - 330	Asph									
		330 - 600	Br Cr Gran									
		600 - 1.5	Br Si Cl Tr Sa Tr Gr, Moist									
14.4 m Lt of C/L, Datum = +200 mm												
BH 407	SB BLVD	0 - 130	Drk Br Si Tpsl									
		130 - 1.2	Br Si Cl Tr Sa, Moist									
		1.2 - 1.50	Bl Cl Si and Sa Tr Gr, Moist									
14th Avenue to Denison Street												
BH 218	SB L2	5.7 m Lt of C/L, Datum = 0										
		0 - 90	Asph									
		90 - 310	Br Cr Gran									
		310 - 600	Br Sa W Gr Tr Si, Moist									
8.8 m Lt of C/L, Datum = 0												
BH 219	SB L2	0 - 100	Asph									
		100 - 390	Br Cr Gran W RAP									
		390 - 750	Br Sa W Gr Tr Si, Moist									
		750 - 1.50	Br Cl Si W Sa Tr Gr, Moist									
11.7 m Lt of C/L, Datum = +200 mm												
BH 408	SB BLVD	0 - 150	Drk Br Si Tpsl									
		150 - 650	Br Cl Si Tr Sa Tr Gr, Moist									
		- 650	NFP Utility Conflict									
Denison Street to Steeles Avenue												
BH 220	SB L2	4.2 Lt of C/L, Datum = 0										
		0 - 130	Asph									
		130 - 630	Br Cr Gran									
		630 - 1.08	Br Sa W Gr Tr Si, Moist									
		1.08 - 1.50	Br Cl Si Tr Sa Tr Gr, Moist									
6.2 Lt of C/L, Datum = 0												
BH 221	SB L2	0 - 140	Asph									
		140 - 470	Br Cr Gran									
		470 - 1	Br Sa W Gr Tr Si, Moist									
		1 - 1.50	Br Cl Si Tr Sa, Moist									
9.8 Lt of C/L, Datum = 0												
BH 222	SB L2	0 - 170	Asph									
		170 - 510	Br Cr Gran, Moist	1	170	- 470		4.3	Unacceptable Granular A (material too fine on most sieves)			
		510 - 880	Br Sa W Gr Tr Si, Moist	2	510	- 810		4.7	Unacceptable Granular B, Type I (31.8% passing the 0.075 mm sieve)			
		880 - 1.50	Br Si Sa W Cl Tr Gr, Moist	3	900	- 1.20	LSFH (36.3)	11.4	SM - Silty Sand	97	52.3	16
5.7 m Lt of C/L, Datum = 0												
BH 223	SB L2	0 - 150	Asph									
		150 - 510	Br Cr Gran									
		510 - 820	Br Sa W Gr Tr Si, Moist									
		820 - 1.5	Br Si Sa W Cl Tr Gr, Moist									
		15 m Lt of C/L, Datum = +200 mm										
BH 409	SB BLVD	0 - 130	Drk Br Si Tpsl									
		130 - 650	Br Si Sa & Gr, Moist									
		- 650	NFP Utility Conflict									

APPENDIX C

Grain Size Distribution Curves

GRAIN SIZE DISTRIBUTION CHART

FIGURE - C1



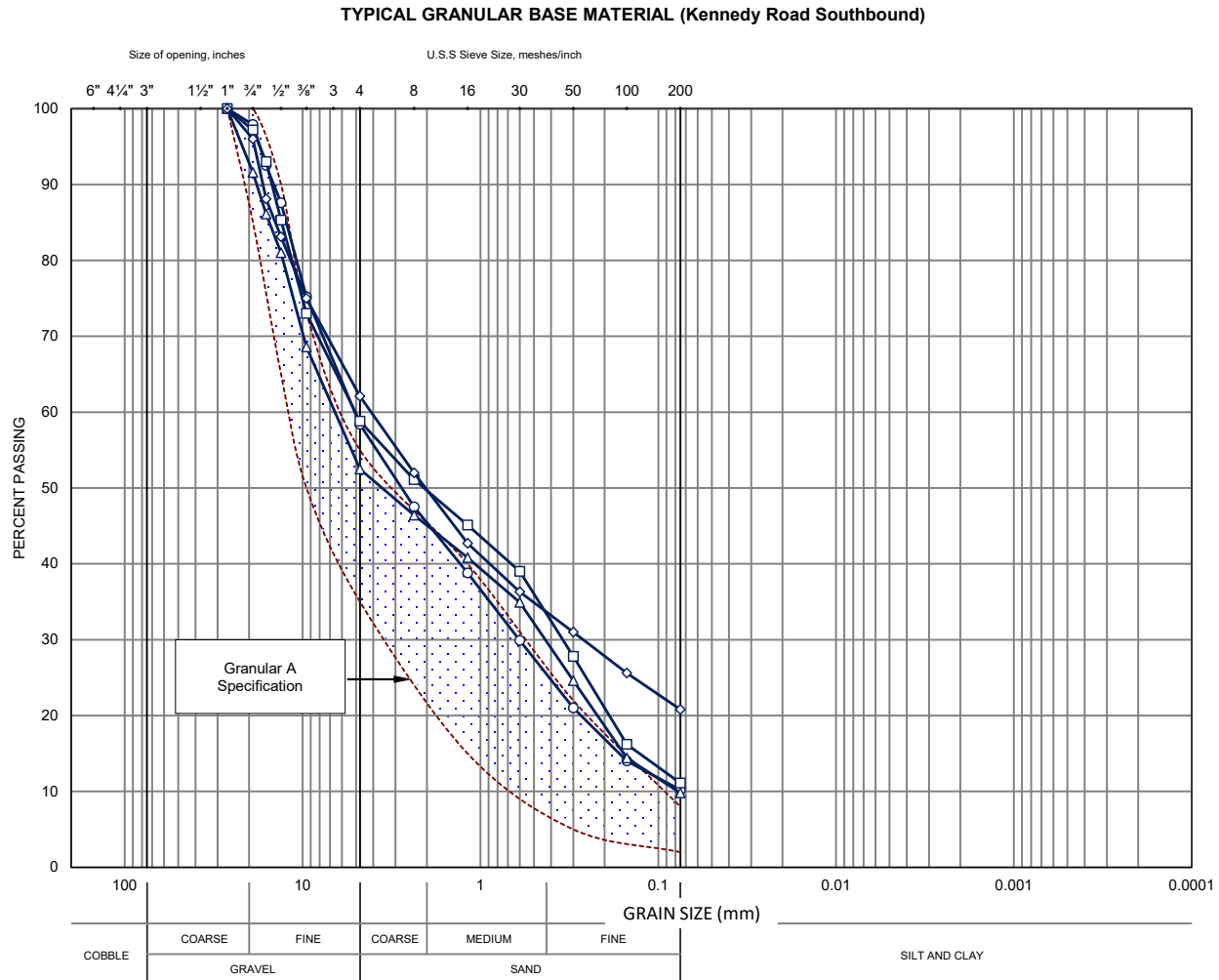
SYMBOL	HIGHWAY / ROAD	BOREHOLE LOCATION	STATION	OFFSET	SAMPLE	DEPTH (mm)
○	Kennedy Road	NB L2	-	9.0 m Rt of C/L	1	175 - 450
□	Kennedy Road	NB L2	-	5.8 m of Rt C/L	1	150 - 340
△	Kennedy Road	NB L1	-	2.5 m of Rt C/L	1	120 - 270
◇	Kennedy Road	NB L2	-	5.8 m of Rt C/L	1	160 - 400
x	Kennedy Road	NB L1	-	4.9 m of Rt C/L	1	340 - 640

Date: February, 2019
Project: 1664178

Inputted: JGR
Checked: GBG

GRAIN SIZE DISTRIBUTION CHART

FIGURE - C2



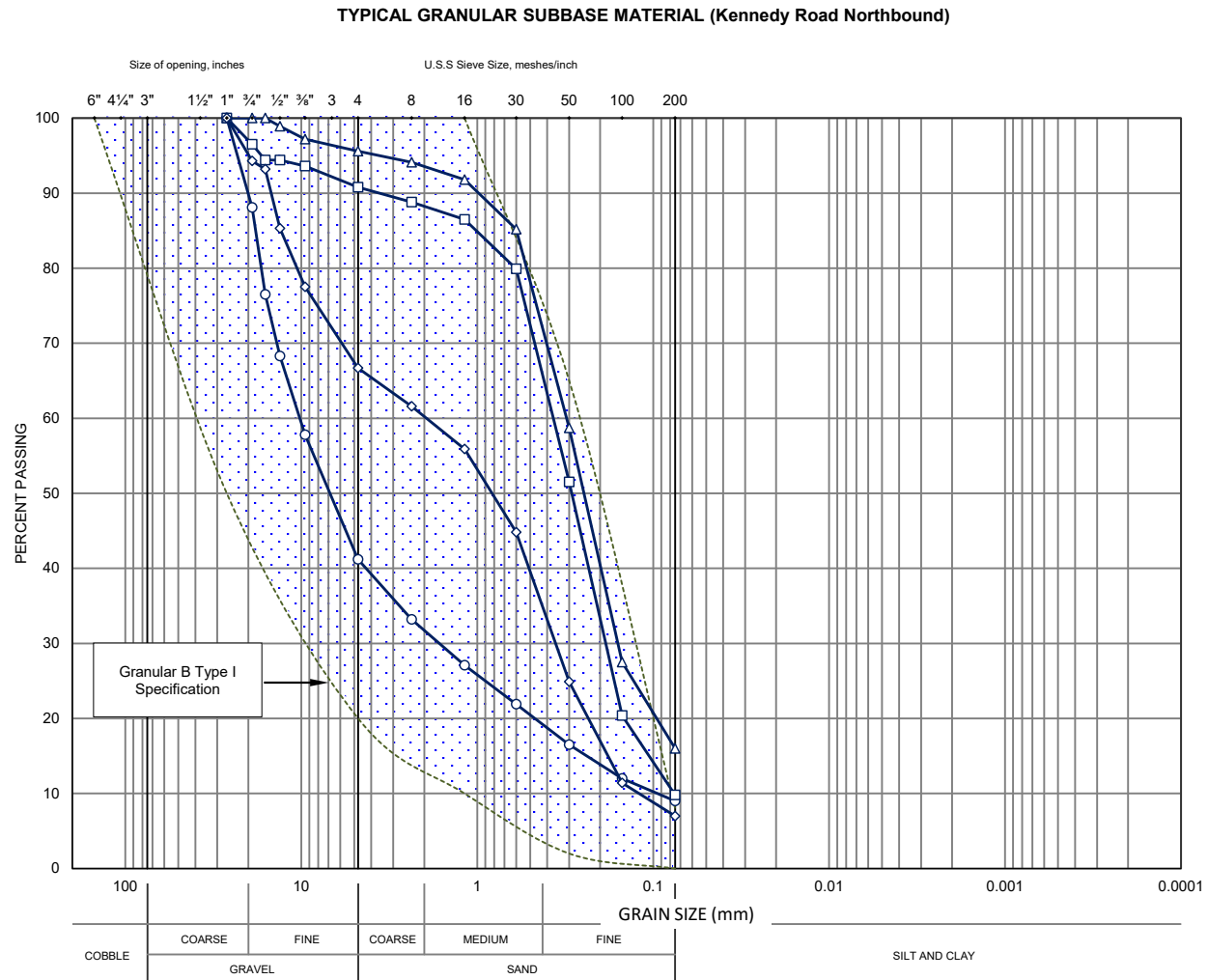
SYMBOL	HIGHWAY / ROAD	BOREHOLE LOCATION	STATION	OFFSET	SAMPLE	DEPTH (mm)
○	Kennedy Road	SB L2	-	5.3 m Lt C/L	1	140 - 440
□	Kennedy Road	SB L2	-	5.9 m Lt C/L	1	200 - 500
△	Kennedy Road	SB L1	-	3.8 m Lt C/L	1	110 - 340
◇	Kennedy Road	SB L2	-	9.8 m Lt C/L	1	170 - 470

Date: February, 2019
Project: 1664178

Inputted: JGR
Checked: GBG

GRAIN SIZE DISTRIBUTION CHART

FIGURE - C3

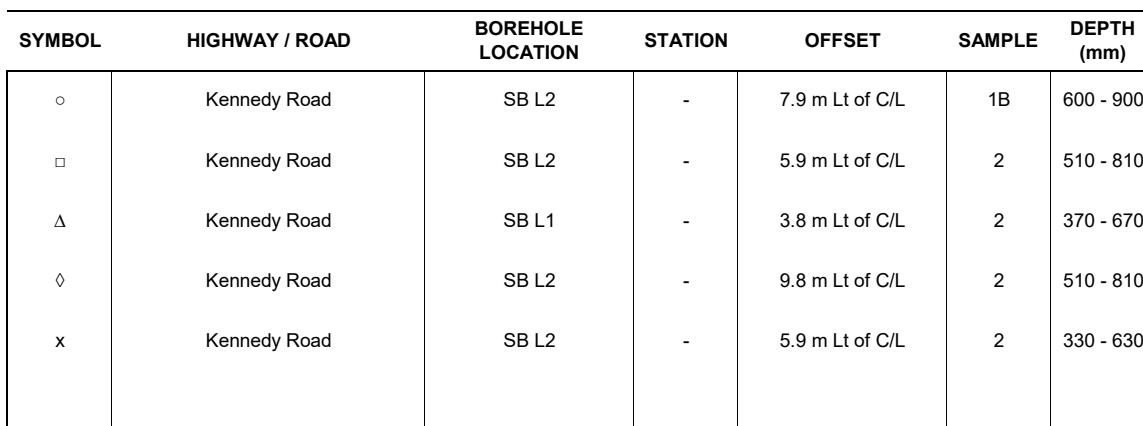


SYMBOL	HIGHWAY / ROAD	BOREHOLE LOCATION	STATION	OFFSET	SAMPLE	DEPTH (mm)
○	Kennedy Road	NB L2	-	5.8 m Rt of C/L	2	350 - 650
□	Kennedy Road	NB LTL	-	2.0 m Rt of C/L	2	400 - 700
△	Kennedy Road	NB L1	-	2.5 m Rt of C/L	2	300 - 600
◇	Kennedy Road	NB L2	-	5.8 m Rt of C/L	2	500 - 800

Date: February, 2019
Project: 1664178

Inputted: JGR
Checked: GBG

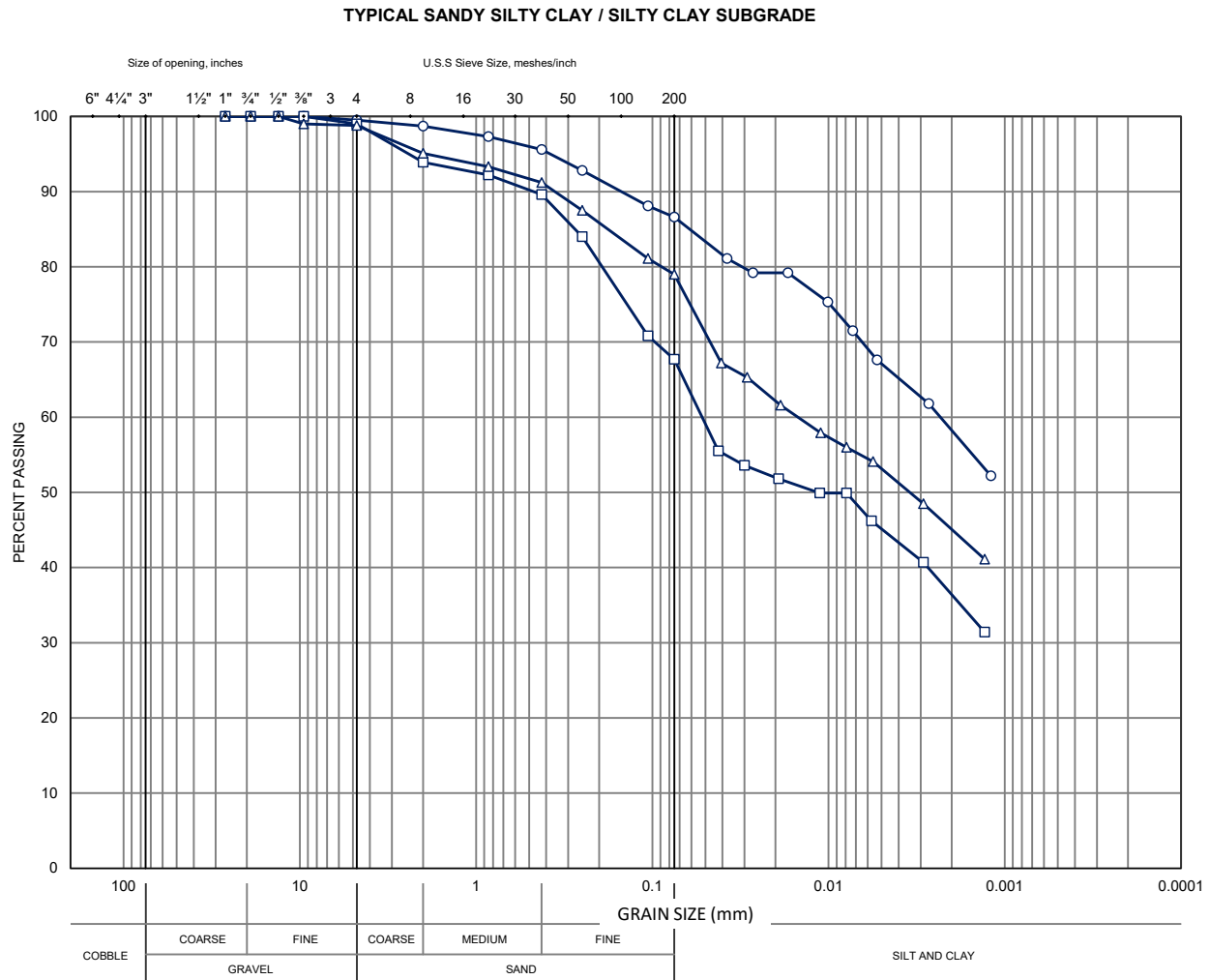
FIGURE - C4



Inputted:	JGR
Checked:	GBG

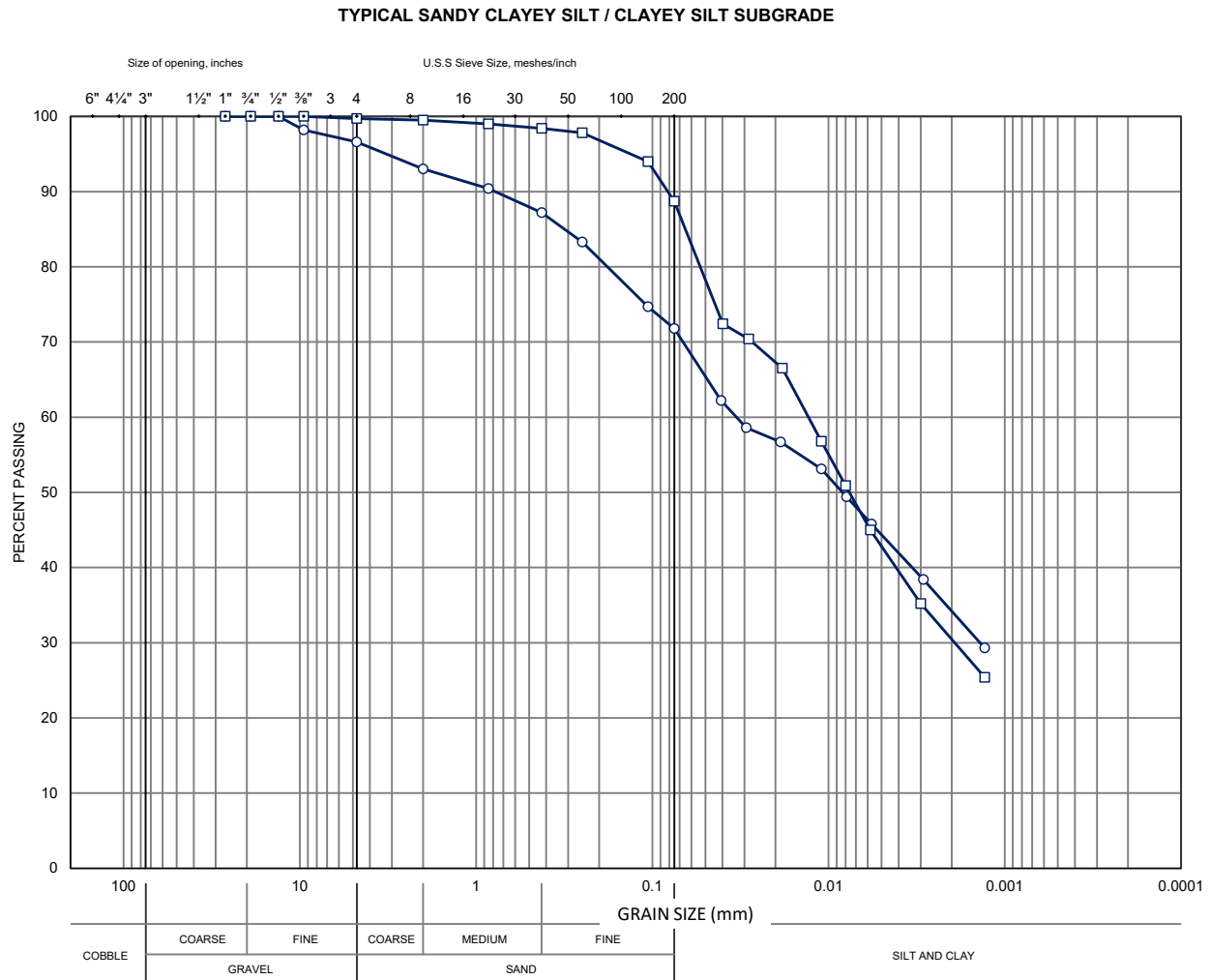
GRAIN SIZE DISTRIBUTION CHART

FIGURE - C5



GRAIN SIZE DISTRIBUTION CHART

FIGURE - C6



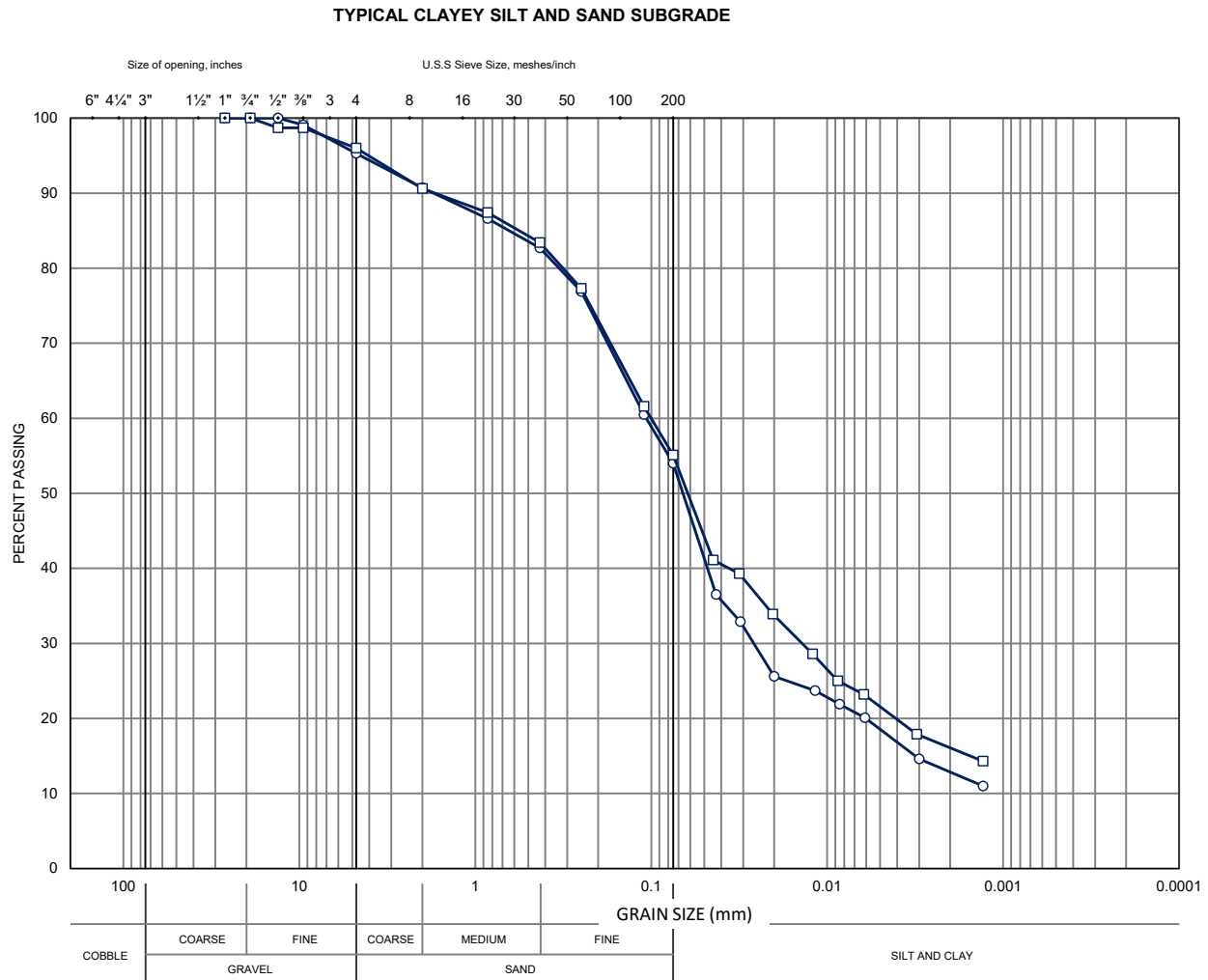
SYMBOL	HIGHWAY / ROAD	BOREHOLE LOCATION	STATION	OFFSET	SAMPLE	DEPTH (mm)
○	Kennedy Road	NB BLVD	-	9.8 m Rt of C/L	1	400 - 700
□	Kennedy Road	SB L2	-	5.9 m Lt of C/L	3	1.0 - 1.3

Date: February, 2019
Project: 1664178

Inputted: JGR
Checked: GBG

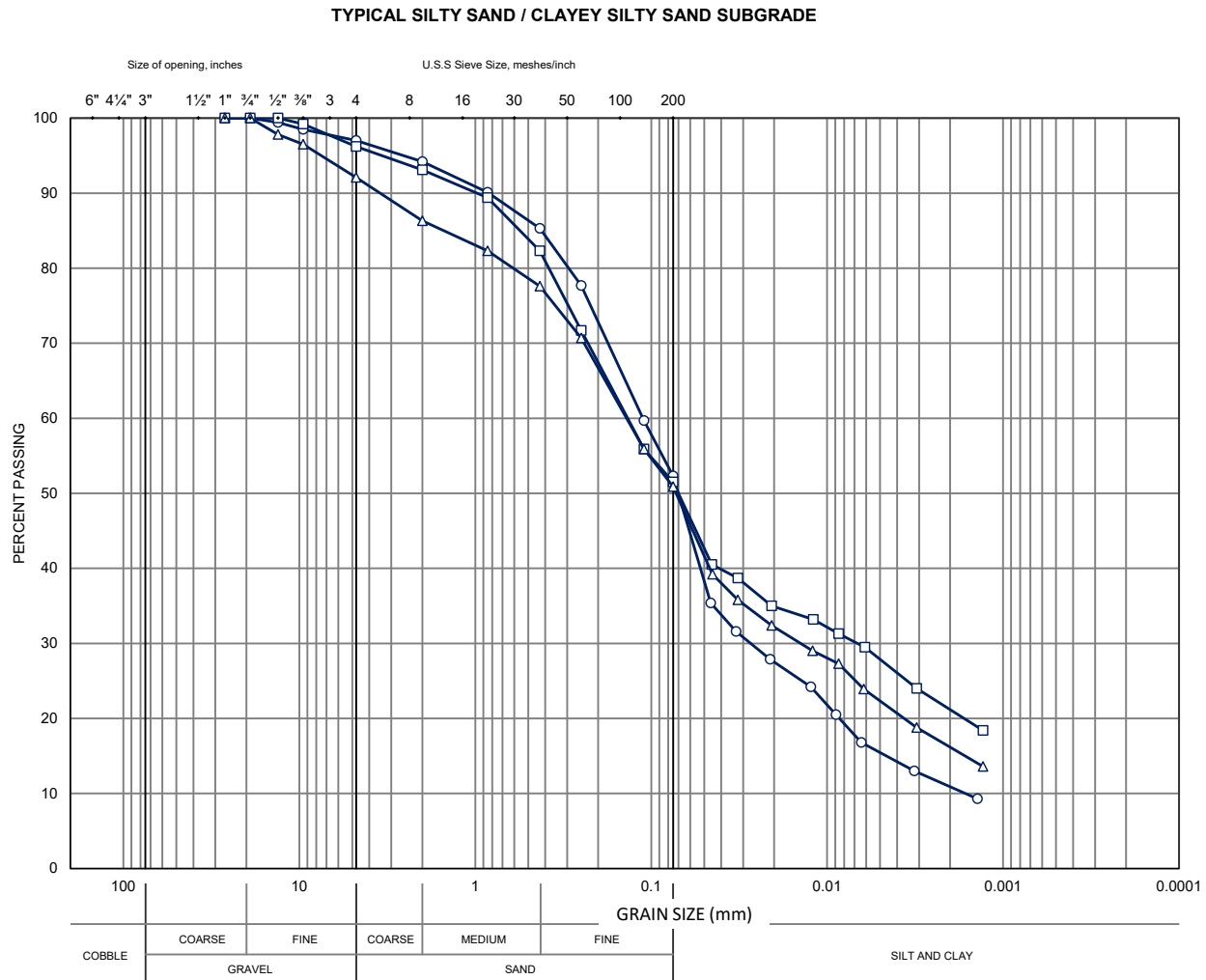
GRAIN SIZE DISTRIBUTION CHART

FIGURE - C7



GRAIN SIZE DISTRIBUTION CHART

FIGURE - C8



SYMBOL	HIGHWAY / ROAD	BOREHOLE LOCATION	STATION	OFFSET	SAMPLE	DEPTH (mm)
○	Kennedy Road	SB L2	-	9.8 m Lt of C/L	3	900 - 1.2
□	Kennedy Road	SB BLVD	-	15.8 m Lt of C/L	2	1.15 - 1.45
△	Kennedy Road	NB L2	-	5.8 m Rt of C/L	3	1.1 - 1.4

Date: February, 2019
Project: 1664178

Inputted: JGR
Checked: GBG

APPENDIX D

Environmental Test Results

CLIENT NAME: GOLDER ASSOCIATES LTD
#1, 215 SHIELDS COURT
MARKHAM, ON L3R 8V2
(905) 475-5591

ATTENTION TO: Gordon Goode

PROJECT: 1664178(5000)

AGAT WORK ORDER: 18T412418

SOIL ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

TRACE ORGANICS REVIEWED BY: Oksana Gushyla, Trace Organics Lab Supervisor

DATE REPORTED: Nov 29, 2018

PAGES (INCLUDING COVER): 8

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.



Certificate of Analysis

AGAT WORK ORDER: 18T412418

PROJECT: 1664178(5000)

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: GOLDER ASSOCIATES LTD

ATTENTION TO: Gordon Goode

SAMPLING SITE:

SAMPLED BY: Gordon Goode

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2018-11-22

DATE REPORTED: 2018-11-29

Parameter	Unit	SAMPLE DESCRIPTION:		ENV10 SA2	ENV4 SA1	ENV1 SA1	ENV5 SA1	ENV3 SA2
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		2018-11-19	2018-11-19	2018-11-19	2018-11-19	2018-11-18
		G / S	RDL	9729233	9729241	9729242	9729243	9729244
Antimony	µg/g	1.3	0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1	3	2	3	2	2
Barium	µg/g	220	2	141	39	42	19	26
Beryllium	µg/g	2.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Boron	µg/g	36	5	9	<5	6	<5	<5
Boron (Hot Water Soluble)	µg/g	NA	0.10	<0.10	0.45	0.47	0.20	<0.10
Cadmium	µg/g	1.2	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g	70	2	26	16	14	10	12
Cobalt	µg/g	21	0.5	8.9	5.2	4.1	3.5	5.1
Copper	µg/g	92	1	18	12	11	6	9
Lead	µg/g	120	1	9	14	33	4	5
Molybdenum	µg/g	2	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel	µg/g	82	1	18	11	9	7	10
Selenium	µg/g	1.5	0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Silver	µg/g	0.5	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Uranium	µg/g	2.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vanadium	µg/g	86	1	36	24	23	17	20
Zinc	µg/g	290	5	51	49	45	17	28
Chromium VI	µg/g	0.66	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Electrical Conductivity	mS/cm	0.57	0.005	0.537	0.803	0.461	1.23	1.22
Sodium Adsorption Ratio	NA	2.4	NA	5.28	5.03	8.20	13.2	4.25
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.66	7.56	8.01	7.97	7.77

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use

Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9729233-9729244 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

Divine Basily



Certificate of Analysis

AGAT WORK ORDER: 18T412418

PROJECT: 1664178(5000)

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: GOLDER ASSOCIATES LTD

ATTENTION TO: Gordon Goode

SAMPLING SITE:

SAMPLED BY: Gordon Goode

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2018-11-22

DATE REPORTED: 2018-11-29

		SAMPLE DESCRIPTION:		ENV10 SA2	ENV4 SA1	ENV1 SA1	ENV5 SA1	ENV3 SA2
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		2018-11-19	2018-11-19	2018-11-19	2018-11-19	2018-11-18
Parameter	Unit	G / S	RDL	9729233	9729241	9729242	9729243	9729244
Benzene	µg/g	0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Toluene	µg/g	0.2	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	µg/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Xylene Mixture	µg/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
F1 (C6 to C10)	µg/g	25	5	<5	<5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	25	5	<5	<5	<5	<5	<5
F2 (C10 to C16)	µg/g	10	10	<10	<10	<10	<10	<10
F3 (C16 to C34)	µg/g	240	50	<50	<50	92	<50	<50
F4 (C34 to C50)	µg/g	120	50	<50	<50	130	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g	120	50	NA	NA	NA	NA	NA
Moisture Content	%		0.1	19.4	12.6	13.1	14.7	12.3
Surrogate	Unit	Acceptable Limits						
Terphenyl	%	60-140		85	82	82	78	62

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use

Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9729233-9729244 Results are based on sample dry weight.

The C6-C10 fraction is calculated using Toluene response factor.

The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.

Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.

The chromatogram has returned to baseline by the retention time of nC50.

Total C6 - C50 results are corrected for BTEX contributions.

This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.

nC6 and nC10 response factors are within 30% of Toluene response factor.

nC10, nC16 and nC34 response factors are within 10% of their average.

C50 response factor is within 70% of nC10 + nC16 + nC34 average.

Linearity is within 15%.

Extraction and holding times were met for this sample.

Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.

Quality Control Data is available upon request.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



Guideline Violation

AGAT WORK ORDER: 18T412418

PROJECT: 1664178(5000)

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: GOLDER ASSOCIATES LTD

ATTENTION TO: Gordon Goode

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
9729233	ENV10 SA2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	NA	2.4	5.28
9729241	ENV4 SA1	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	mS/cm	0.57	0.803
9729241	ENV4 SA1	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	NA	2.4	5.03
9729242	ENV1 SA1	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	NA	2.4	8.20
9729242	ENV1 SA1	ON T1 S RPI/ICC	O. Reg. 153(511) - PHCs F1 - F4 (Soil)	F4 (C34 to C50)	µg/g	120	130
9729243	ENV5 SA1	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	mS/cm	0.57	1.23
9729243	ENV5 SA1	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	NA	2.4	13.2
9729244	ENV3 SA2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	mS/cm	0.57	1.22
9729244	ENV3 SA2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	NA	2.4	4.25



Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD

PROJECT: 1664178(5000)

SAMPLING SITE:

AGAT WORK ORDER: 18T412418

ATTENTION TO: Gordon Goode

SAMPLED BY: Gordon Goode

Soil Analysis															
RPT Date: Nov 29, 2018			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	9729233	9729233	<0.8	<0.8	NA	< 0.8	126%	70%	130%	95%	80%	120%	90%	70%	130%
Arsenic	9729233	9729233	3	3	NA	< 1	104%	70%	130%	101%	80%	120%	97%	70%	130%
Barium	9729233	9729233	141	120	15.9%	< 2	99%	70%	130%	102%	80%	120%	95%	70%	130%
Beryllium	9729233	9729233	<0.5	<0.5	NA	< 0.5	85%	70%	130%	96%	80%	120%	81%	70%	130%
Boron	9729233	9729233	9	9	NA	< 5	100%	70%	130%	100%	80%	120%	103%	70%	130%
Boron (Hot Water Soluble)	9729233	9729233	<0.10	0.10	NA	< 0.10	107%	60%	140%	102%	70%	130%	100%	60%	140%
Cadmium	9729233	9729233	<0.5	<0.5	NA	< 0.5	121%	70%	130%	100%	80%	120%	91%	70%	130%
Chromium	9729233	9729233	26	25	3.9%	< 2	89%	70%	130%	102%	80%	120%	95%	70%	130%
Cobalt	9729233	9729233	8.9	9.3	4.1%	< 0.5	101%	70%	130%	102%	80%	120%	94%	70%	130%
Copper	9729233	9729233	18	17	5.2%	< 1	85%	70%	130%	100%	80%	120%	90%	70%	130%
Lead	9729233	9729233	9	9	7.4%	< 1	112%	70%	130%	103%	80%	120%	100%	70%	130%
Molybdenum	9729233	9729233	<0.5	<0.5	NA	< 0.5	107%	70%	130%	104%	80%	120%	93%	70%	130%
Nickel	9729233	9729233	18	20	9.2%	< 1	95%	70%	130%	97%	80%	120%	89%	70%	130%
Selenium	9729233	9729233	<0.4	<0.4	NA	< 0.4	95%	70%	130%	102%	80%	120%	97%	70%	130%
Silver	9729233	9729233	<0.2	<0.2	NA	< 0.2	120%	70%	130%	106%	80%	120%	97%	70%	130%
Thallium	9729233	9729233	<0.4	<0.4	NA	< 0.4	73%	70%	130%	107%	80%	120%	104%	70%	130%
Uranium	9729233	9729233	<0.5	<0.5	NA	< 0.5	85%	70%	130%	91%	80%	120%	91%	70%	130%
Vanadium	9729233	9729233	36	38	5.4%	< 1	100%	70%	130%	99%	80%	120%	90%	70%	130%
Zinc	9729233	9729233	51	50	2.8%	< 5	105%	70%	130%	104%	80%	120%	101%	70%	130%
Chromium VI	9731846		<0.2	<0.2	NA	< 0.2	82%	70%	130%	106%	80%	120%	115%	70%	130%
Cyanide	9729233	9729233	<0.040	<0.040	NA	< 0.040	103%	70%	130%	98%	80%	120%	105%	70%	130%
Mercury	9729233	9729233	<0.10	<0.10	NA	< 0.10	98%	70%	130%	100%	80%	120%	100%	70%	130%
Electrical Conductivity	9729233	9729233	0.537	0.526	2.1%	< 0.005	95%	90%	110%						
Sodium Adsorption Ratio	9729233	9729233	5.28	5.43	2.8%	NA									
pH, 2:1 CaCl2 Extraction	9724402		7.18	7.23	0.7%	NA	99%	80%	120%						

Comments: NA signifies Not Applicable.

Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:

Divine Basily



Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD

PROJECT: 1664178(5000)

SAMPLING SITE:

AGAT WORK ORDER: 18T412418

ATTENTION TO: Gordon Goode

SAMPLED BY: Gordon Goode

Trace Organics Analysis

RPT Date: Nov 29, 2018

RPT Date: Nov 29, 2018			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE			MATRIX SPIKE			
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

Benzene	9733534		< 0.02	< 0.02	NA	< 0.02	112%	60%	130%	102%	60%	130%	109%	60%	130%
Toluene	9733534		< 0.05	< 0.05	NA	< 0.05	101%	60%	130%	94%	60%	130%	100%	60%	130%
Ethylbenzene	9733534		< 0.05	< 0.05	NA	< 0.05	85%	60%	130%	86%	60%	130%	82%	60%	130%
Xylene Mixture	9733534		< 0.05	< 0.05	NA	< 0.05	80%	60%	130%	83%	60%	130%	85%	60%	130%
F1 (C6 to C10)	9733534		< 5	< 5	NA	< 5	84%	60%	130%	91%	85%	115%	79%	70%	130%
F2 (C10 to C16)	9724834		< 10	< 10	NA	< 10	80%	60%	130%	92%	80%	120%	84%	70%	130%
F3 (C16 to C34)	9724834		< 50	< 50	NA	< 50	98%	60%	130%	108%	80%	120%	89%	70%	130%
F4 (C34 to C50)	9724834		< 50	< 50	NA	< 50	86%	60%	130%	102%	80%	120%	108%	70%	130%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD

AGAT WORK ORDER: 18T412418

PROJECT: 1664178(5000)

ATTENTION TO: Gordon Goode

SAMPLING SITE:

SAMPLED BY: Gordon Goode

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Barium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	EPA SW 846 6010C; MSA, Part 3, Ch.21	ICP/OES
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Selenium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Silver	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Thallium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Uranium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium VI	INOR-93-6029	SM 3500 B; MSA Part 3, Ch. 25	SPECTROPHOTOMETER
Cyanide	INOR-93-6052	MOE CN-3015 & E 3009 A; SM 4500 CN	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Electrical Conductivity	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010C	ICP/OES
pH, 2:1 CaCl ₂ Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Trace Organics Analysis			
Benzene	VOL-91-5009	EPA SW-846 5035 & 8260D	P & T GC/MS
Toluene	VOL-91-5009	EPA SW-846 5035 & 8260D	P & T GC/MS
Ethylbenzene	VOL-91-5009	EPA SW-846 5035 & 8260D	P & T GC/MS
Xylene Mixture	VOL-91-5009	EPA SW-846 5035 & 8260D	P & T GC/MS
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	BALANCE
Moisture Content	VOL-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009		GC/FID



AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: Golder Associates
Contact: Gordon Goode / Steven Jangdat
Address: 215 Shields Court Unit #1
Markham, Ontario L3R 8V2
Phone: 647 454 6049 Fax: _____
Reports to be sent to: ggoode@golder.com
1. Email: sjangdat@golder.com
2. Email: _____

Project Information:

Project: 1664178 (5000)
Site Location: Kennedy Road
Sampled By: Gordon Goode
AGAT Quote #: _____ PO: _____

Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company: _____
Contact: _____
Address: _____
Email: _____

Regulatory Requirements:

☐ No Regulatory Requirement

(Please check all applicable boxes)

☒ Regulation 153/04

☐ Sewer Use

☐ Regulation 558

Table: Indicate One

☒ Ind/Com

☐ Res/Park

☐ Agriculture

☐ Sanitary

☐ CCME

☐ Storm

☐ Prov. Water Quality Objectives (PWQO)

☐ Other

Soil Texture (Check One)

☐ Coarse

☒ Fine

Region

Indicate One

☐ MISA

Indicate One

Is this submission for a
Record of Site Condition?

☐ Yes

☐ No

Report Guideline on
Certificate of Analysis

☐ Yes

☐ No

Sample Matrix Legend

B Biota
GW Ground Water
O Oil
P Paint
S Soil
SD Sediment
SW Surface Water

Field Filtered - Metals, Hg, CrVI

O. Reg 153

Metals and Inorganics

☐ All Metals ☐ 153 Metals (excl. Hydrides)

☐ Hydride Metals ☐ 153 Metals (incl. Hydrides)

ORPs: ☐ B-HWS ☐ Cl⁻ ☐ CN

☐ Cr⁶⁺ ☐ EC ☐ FOC ☐ Hg

☐ pH ☐ SAR

Full Metals Scan

Regulation/Custom Metals

Nutrients: ☐ TP ☐ NH₃ ☐ TKN
☐ NO₃ ☐ NO₂ ☐ NO₃+NO₂

Volatiles: ☐ VOC ☒ BTEX ☐ THM

PHCs F1 - F4

ABNs

PAHs

PCBs: ☐ Total ☐ Aroclors

Organochlorine Pesticides

TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs

Sewer Use

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Y / N	Metals and Inorganics	ORPs	Nutrients	Volatiles	PHCs F1 - F4	ABNs	PAHs	PCBs	Organochlorine Pesticides	TCLP	Sewer Use
ENV10 SA 2	Nov 19/18	2:32pm	3	S			☒			☒	☒						
ENV4 SA 1	Nov 19/18	6:02pm	3	S			☒			☒	☒						
ENV1 SA 1	Nov 19/18	5:10pm	3	S	limited sample		☒			☒	☒						
ENV5 SA 1	Nov 19/18	11:19am	3	S			☒			☒	☒						
ENV3 SA 2	Nov 18/18	4:10pm	3	S			☒			☒	☒						

Samples Relinquished By (Print Name and Sign):

Samples Relinquished By (Print Name and Sign):

Samples Relinquished By (Print Name and Sign):

Date: Nov 21/18

Time: 1:30pm

Date: _____

Time: _____

Date: Nov 22

Time: 4:15

Samples Received By (Print Name and Sign):

Samples Received By (Print Name and Sign):

Samples Received By (Print Name and Sign):

Date: Nov 22/18

Time: 1:22pm

Date: _____

Time: _____

Date: _____

Time: _____

Page 1 of 1

Nº: **T 081133**

APPENDIX E

ESALs & AASHTO Pavement Designs

Table E1
EQUIVALENT SINGLE AXLE LOAD CALCULATION
Kennedy Road - Section 1: Steeles Avenue to 300 m north of Denison Street
Markham, Ontario
20 Year Design

1) Traffic Analysis

Traffic Data Year	2015	2024	2041
Design Year	2024		
Traffic Analysis Period	9	17	
Average Annual Daily Traffic (AADT)	39,148	46,840	61,371
Average Rate of Increase in Traffic (%)	2.01	1.60	
Truck Fraction of Total Traffic (%)	1.76	1.76	1.76
Average Rate of Increase in Truck Fraction (%)	0.00	0.00	
Number of Lanes in One Direction	2	2	3
Directional Factor	0.5	0.5	0.5
Lane Distribution Factor	0.8	0.8	0.6
Daily Truck Volume	330	330	324

2) Daily ESALs Analysis

Road Classification	Urban Minor Arterial		
Traffic Analysis Base Year	2024	2024	2041
Breakdown of Truck Proportions (%)	Class 1	65	
	Class 2	5	
	Class 3	20	
	Class 4	10	
Daily Truck Volumes for 4 Classes	Class 1	214	211
	Class 2	16	16
	Class 3	66	65
	Class 4	33	32
Truck Factors for 4 Classes of Truck	Class 1	0.5	
	Class 2	2.3	
	Class 3	1.6	
	Class 4	5.5	
Weighted Average Truck Factor		1.310	
Daily ESALs per Truck Class	Class 1	107	105
	Class 2	38	37
	Class 3	106	104
	Class 4	181	178
Total Daily ESALs in Design Lane	432	432	424

3) Total ESALs for Base Year

Base Year	2024	2024	2041
Number of Days of Truck Traffic	365	365	365
Total ESALs for Base Year	157,672	157,672	154,939

4) Cumulative ESALs for the Design Period

Design Period (Years)	20	
Span of Design Periods	<u>2024 to 2024</u>	<u>2024 to 2044</u>
Average Rate of Increase in Truck Volume (%)		-0.10
Years of Design Periods	0	20
Growth Factor	0.00	23.36
ESALs for the Design Periods	0	3,683,000
Cumulative ESALs for the Design Period	3,682,833	

Note: The ESAL calculations are based on the guidelines "Procedures for Estimating Traffic Loads for Pavement Design" by Jerry Hajek, 1995, and on MTO's "Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions", March 19, 2008.

Table E2
EQUIVALENT SINGLE AXLE LOAD CALCULATION

Kennedy Road - Section 2: 300 m north of Denison Street to 14th Avenue
Markham, Ontario
20 Year Design

1) Traffic Analysis

Traffic Data Year	2015	2024	2041
Design Year	2024		
Traffic Analysis Period	9	17	
Average Annual Daily Traffic (AADT)	43,913	50,912	64,131
Average Rate of Increase in Traffic (%)	1.66	1.37	
Truck Fraction of Total Traffic (%)	7.47	7.47	7.47
Average Rate of Increase in Truck Fraction (%)	0.00	0.00	
Number of Lanes in One Direction	2	2	3
Directional Factor	0.5	0.5	0.5
Lane Distribution Factor	0.8	0.8	0.6
Daily Truck Volume	1,521	1,521	1,437

2) Daily ESALs Analysis

Road Classification	Urban Minor Arterial		
Traffic Analysis Base Year	2024	2024	2041
Breakdown of Truck Proportions (%)	Class 1	65	
	Class 2	5	
	Class 3	20	
	Class 4	10	
Daily Truck Volumes for 4 Classes	Class 1	989	934
	Class 2	76	72
	Class 3	304	287
	Class 4	152	144
Truck Factors for 4 Classes of Truck	Class 1	0.5	
	Class 2	2.3	
	Class 3	1.6	
	Class 4	5.5	
Weighted Average Truck Factor		1.310	
Daily ESALs per Truck Class	Class 1	494	467
	Class 2	175	165
	Class 3	487	460
	Class 4	837	790
Total Daily ESALs in Design Lane	1,993	1,993	1,883

3) Total ESALs for Base Year

Base Year	2024	2024	2041
Number of Days of Truck Traffic	365	365	365
Total ESALs for Base Year	727,386	727,386	687,186

4) Cumulative ESALs for the Design Period

Design Period (Years)	20	
Span of Design Periods	<u>2024 to 2024</u>	<u>2024 to 2044</u>
Average Rate of Increase in Truck Volume (%)		-0.33
Years of Design Periods	0	20
Growth Factor	0.00	22.82
ESALs for the Design Periods	0	16,601,000
Cumulative ESALs for the Design Period		16,601,453

Note: The ESAL calculations are based on the guidelines "Procedures for Estimating Traffic Loads for Pavement Design" by Jerry Hajek, 1995, and on MTO's "Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions", March 19, 2008.

Table E3
EQUIVALENT SINGLE AXLE LOAD CALCULATION

Kennedy Road - Section 3: 14th Avenue to Highway 407

Markham, Ontario

20 Year Design

1) Traffic Analysis

Traffic Data Year	2015	2023	2041
Design Year	2023		
Traffic Analysis Period	8	18	
Average Annual Daily Traffic (AADT)	42,943	49,612	64,616
Average Rate of Increase in Traffic (%)	1.82	1.48	
Truck Fraction of Total Traffic (%)	7.45	7.45	7.45
Average Rate of Increase in Truck Fraction (%)	0.00	0.00	
Number of Lanes in One Direction	2	2	3
Directional Factor	0.5	0.5	0.5
Lane Distribution Factor	0.8	0.8	0.6
Daily Truck Volume	1,478	1,478	1,444

2) Daily ESALs Analysis

Road Classification	Urban Minor Arterial		
Traffic Analysis Base Year	2023	2023	2041
Breakdown of Truck Proportions (%)	Class 1	65	
	Class 2	5	
	Class 3	20	
	Class 4	10	
Daily Truck Volumes for 4 Classes	Class 1	961	939
	Class 2	74	72
	Class 3	296	289
	Class 4	148	144
Truck Factors for 4 Classes of Truck	Class 1	0.5	
	Class 2	2.3	
	Class 3	1.6	
	Class 4	5.5	
Weighted Average Truck Factor		1.310	
Daily ESALs per Truck Class	Class 1	480	469
	Class 2	170	166
	Class 3	473	462
	Class 4	813	794
Total Daily ESALs in Design Lane	1,937	1,937	1,892

3) Total ESALs for Base Year

Base Year	2023	2023	2041
Number of Days of Truck Traffic	365	365	365
Total ESALs for Base Year	706,915	706,915	690,529

4) Cumulative ESALs for the Design Period

Design Period (Years)	20	
Span of Design Periods	<u>2023 to 2023</u>	<u>2023 to 2043</u>
Average Rate of Increase in Truck Volume (%)		-0.13
Years of Design Periods	0	20
Growth Factor	0.00	23.08
ESALs for the Design Periods	0	16,312,000
Cumulative ESALs for the Design Period		16,312,335

Note: The ESAL calculations are based on the guidelines "Procedures for Estimating Traffic Loads for Pavement Design" by Jerry Hajek, 1995, and on MTO's "Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions", March 19, 2008.

Table E4
EQUIVALENT SINGLE AXLE LOAD CALCULATION

Kennedy Road - Section 4: Highway 407 to Highway 7
Markham, Ontario
20 Year Design

1) Traffic Analysis

Traffic Data Year	2015	2024	2041
Design Year	2024		
Traffic Analysis Period	9	17	
Average Annual Daily Traffic (AADT)	43,971	56,493	80,145
Average Rate of Increase in Traffic (%)	2.82	2.08	
Truck Fraction of Total Traffic (%)	6.83	6.83	6.83
Average Rate of Increase in Truck Fraction (%)	0.00	0.00	
Number of Lanes in One Direction	2	2	3
Directional Factor	0.5	0.5	0.5
Lane Distribution Factor	0.8	0.8	0.6
Daily Truck Volume	1,543	1,543	1,642

2) Daily ESALs Analysis

Road Classification	Urban Minor Arterial		
Traffic Analysis Base Year	2024	2024	2041
Breakdown of Truck Proportions (%)	Class 1	65	
	Class 2	5	
	Class 3	20	
	Class 4	10	
Daily Truck Volumes for 4 Classes	Class 1	1,003	1,067
	Class 2	77	82
	Class 3	309	328
	Class 4	154	164
Truck Factors for 4 Classes of Truck	Class 1	0.5	
	Class 2	2.3	
	Class 3	1.6	
	Class 4	5.5	
Weighted Average Truck Factor		1.310	
Daily ESALs per Truck Class	Class 1	502	534
	Class 2	177	189
	Class 3	494	525
	Class 4	849	903
Total Daily ESALs in Design Lane	2,022	2,022	2,151

3) Total ESALs for Base Year

Base Year	2024	2024	2041
Number of Days of Truck Traffic	365	365	365
Total ESALs for Base Year	737,971	737,971	785,204

4) Cumulative ESALs for the Design Period

Design Period (Years)	20	
Span of Design Periods	2024 to 2024	2024 to 2044
Average Rate of Increase in Truck Volume (%)		0.37
Years of Design Periods	0	20
Growth Factor	0.00	24.49
ESALs for the Design Periods	0	18,072,000
Cumulative ESALs for the Design Period		18,071,569

Note: The ESAL calculations are based on the guidelines "Procedures for Estimating Traffic Loads for Pavement Design" by Jerry Hajek, 1995, and on MTO's "Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions", March 19, 2008.

Table E5
EQUIVALENT SINGLE AXLE LOAD CALCULATION

Kennedy Road - Section 5: Highway 7 to 16th Avenue
Markham, Ontario
20 Year Design

1) Traffic Analysis

Traffic Data Year	2015	2028	2041
Design Year	2028		
Traffic Analysis Period	13	13	
Average Annual Daily Traffic (AADT)	32,438	46,571	60,705
Average Rate of Increase in Traffic (%)	2.82	2.06	
Truck Fraction of Total Traffic (%)	5.23	5.23	5.23
Average Rate of Increase in Truck Fraction (%)	0.00	0.00	
Number of Lanes in One Direction	2	2	3
Directional Factor	0.5	0.5	0.5
Lane Distribution Factor	0.8	0.8	0.6
Daily Truck Volume	974	974	952

2) Daily ESALs Analysis

Road Classification	Urban Minor Arterial		
Traffic Analysis Base Year	2028	2028	2041
Breakdown of Truck Proportions (%)	Class 1	65	
	Class 2	5	
	Class 3	20	
	Class 4	10	
Daily Truck Volumes for 4 Classes	Class 1	633	619
	Class 2	49	48
	Class 3	195	190
	Class 4	97	95
Truck Factors for 4 Classes of Truck	Class 1	0.5	
	Class 2	2.3	
	Class 3	1.6	
	Class 4	5.5	
Weighted Average Truck Factor		1.310	
Daily ESALs per Truck Class	Class 1	317	310
	Class 2	112	110
	Class 3	312	305
	Class 4	536	524
Total Daily ESALs in Design Lane	1,276	1,276	1,248

3) Total ESALs for Base Year

Base Year	2028	2028	2041
Number of Days of Truck Traffic	365	365	365
Total ESALs for Base Year	465,845	465,845	455,419

4) Cumulative ESALs for the Design Period

Design Period (Years)	20	
Span of Design Periods	<u>2028 to 2028</u>	<u>2028 to 2048</u>
Average Rate of Increase in Truck Volume (%)		-0.17
Years of Design Periods	0	20
Growth Factor	0.00	24.44
ESALs for the Design Periods	0	11,386,000
Cumulative ESALs for the Design Period		11,386,404

Note: The ESAL calculations are based on the guidelines "Procedures for Estimating Traffic Loads for Pavement Design" by Jerry Hajek, 1995, and on MTO's "Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions", March 19, 2008.

Table E6
EQUIVALENT SINGLE AXLE LOAD CALCULATION
Kennedy Road - Section 6: 16th Avenue to Major Mackenzie Drive
Markham, Ontario
20 Year Design

1) Traffic Analysis

Traffic Data Year	2015	2028	2041
Design Year	2028		
Traffic Analysis Period	13	13	
Average Annual Daily Traffic (AADT)	25,096	38,515	51,933
Average Rate of Increase in Traffic (%)	3.35	2.33	
Truck Fraction of Total Traffic (%)	3.73	3.73	3.73
Average Rate of Increase in Truck Fraction (%)	0.00	0.00	
Number of Lanes in One Direction	2	2	3
Directional Factor	0.5	0.5	0.5
Lane Distribution Factor	0.8	0.8	0.6
Daily Truck Volume	575	575	581

2) Daily ESALs Analysis

Road Classification	Urban Minor Arterial		
Traffic Analysis Base Year	2028	2028	2041
Breakdown of Truck Proportions (%)	Class 1	65	
	Class 2	5	
	Class 3	20	
	Class 4	10	
Daily Truck Volumes for 4 Classes	Class 1	374	378
	Class 2	29	29
	Class 3	115	116
	Class 4	57	58
Truck Factors for 4 Classes of Truck	Class 1	0.5	
	Class 2	2.3	
	Class 3	1.6	
	Class 4	5.5	
Weighted Average Truck Factor		1.310	
Daily ESALs per Truck Class	Class 1	187	189
	Class 2	66	67
	Class 3	184	186
	Class 4	316	320
Total Daily ESALs in Design Lane	753	753	761

3) Total ESALs for Base Year

Base Year	2028	2028	2041
Number of Days of Truck Traffic	365	365	365
Total ESALs for Base Year	274,766	274,766	277,867

4) Cumulative ESALs for the Design Period

Design Period (Years)	20	
Span of Design Periods	<u>2028 to 2028</u>	<u>2028 to 2048</u>
Average Rate of Increase in Truck Volume (%)		0.09
Years of Design Periods	0	20
Growth Factor	0.00	25.10
ESALs for the Design Periods	0	6,897,000
Cumulative ESALs for the Design Period		6,897,107

Note: The ESAL calculations are based on the guidelines "Procedures for Estimating Traffic Loads for Pavement Design" by Jerry Hajek, 1995, and on MTO's "Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions", March 19, 2008.

Table E7
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 1: Steeles Avenue to 300 m north of Denison Street
Markham, Ontario
20 Year Design - Rehabilitation - Northbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	3,700,000
Initial Serviceability	4.4
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	128

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	160	160	67
2	Existing Hot Mix Asphalt	0.28	1.00	40	40	11
3	Existing Granular Base	0.12	0.90	295	295	32
4	Existing Granular Subbase	0.08	0.90	380	380	27
Total	-	-	-	875	875	137

Layered Thickness Design

Thickness precision		Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Actual		Elastic Modulus <u>(kPa)</u>	Calculated Thickness <u>(mm)</u>	Calculated <u>SN (mm)</u>
<u>Layer</u>	<u>Material Description</u>			Spec Thickness <u>(Di) (mm)</u>	Min Thickness <u>(Di) (mm)</u>			
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	56	23
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	2,250,000	159	44
3	Existing Granular Base	0.12	0.90	-	-	180,000	183	20
4	Existing Granular Subbase	0.08	0.90	-	-	90,000	559	40
Total	-	-	-	-	-	-	957	127

Table E8
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 1: Steeles Avenue to 300 m north of Denison Street
Markham, Ontario
20 Year Design - Widening - Northbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	3,700,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	126

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	140	140	59
2	New Granular A Base	0.14	1.00	150	150	21
3	New Granular B, Type I	0.09	1.00	585	585	53
Total	-	-	-	875	875	133

Layered Thickness Design

Thickness precision		Actual						
		Struct Coef.	Drain Coef.	Spec Thickness	Min Thickness	Elastic Modulus	Calculated Thickness	Calculated
Layer	Material Description	(Ai)	(Mi)	(Di) (mm)	(Di) (mm)	(kPa)	(mm)	SN (mm)
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	142	60
2	New Granular A Base	0.14	1.00	-	-	250,000	89	12
3	New Granular B,Type I	0.09	1.00	-	-	150,000	599	54
Total	-	-	-	-	-	-	830	126

Table E9
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 1: Steeles Avenue to 300 m north of Denison Street
Markham, Ontario
20 Year Design - Rehabilitation - Southbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	3,700,000
Initial Serviceability	4.4
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	128

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	160	160	67
2	Existing Hot Mix Asphalt	0.28	1.00	40	40	11
3	Existing Granular Base	0.12	0.90	365	365	39
4	Existing Granular Subbase	0.08	0.90	405	405	29
Total	-	-	-	970	970	146

Layered Thickness Design

Thickness precision		Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Actual		Elastic Modulus <u>(kPa)</u>	Calculated Thickness <u>(mm)</u>	Calculated <u>SN (mm)</u>
<u>Layer</u>	<u>Material Description</u>			Spec Thickness <u>(Di) (mm)</u>	Min Thickness <u>(Di) (mm)</u>			
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	56	23
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	2,250,000	159	44
3	Existing Granular Base	0.12	0.90	-	-	180,000	183	20
4	Existing Granular Subbase	0.08	0.90	-	-	90,000	559	40
Total	-	-	-	-	-	-	957	127

Table E10
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 1: Steeles Avenue to 300 m north of Denison Street
Markham, Ontario
20 Year Design - Widening - Southbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	3,700,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	126

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	140	140	59
2	New Granular A Base	0.14	1.00	150	150	21
3	New Granular B, Type I	0.09	1.00	680	680	61
Total	-	-	-	970	970	141

Layered Thickness Design

Thickness precision			Actual					
Layer	Material Description	Struct	Drain	Spec	Min	Elastic	Calculated	Calculated
		Coef.	Coef.	Thickness	Thickness	Modulus	Thickness	
		(Ai)	(Mi)	(Di) (mm)	(Di) (mm)	(kPa)	(mm)	SN (mm)
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	142	60
2	New Granular A Base	0.14	1.00	-	-	250,000	89	12
3	New Granular B,Type I	0.09	1.00	-	-	150,000	599	54
Total	-	-	-	-	-	-	830	126

Table E11
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 2: 300 m north of Denison Street to 14th Avenue
Markham, Ontario
20 Year Design - Rehabilitation - Northbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	16,700,000
Initial Serviceability	4.4
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	156

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	210	210	88
2	Existing Hot Mix Asphalt	0.28	1.00	255	255	71
3	Existing Granular Base	0.12	0.90	430	430	46
Total	-	-	-	895	895	205

Layered Thickness Design

Thickness precision		Actual						
		Struct	Drain	Spec	Min	Elastic	Calculated	
		Coef.	Coef.	Thickness	Thickness	Modulus	Thickness	Calculated
<u>Layer</u>	<u>Material Description</u>	<u>(Ai)</u>	<u>(Mi)</u>	<u>(Di) (mm)</u>	<u>(Di) (mm)</u>	<u>(kPa)</u>	<u>(mm)</u>	<u>SN (mm)</u>
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	76	32
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	2,250,000	194	54
3	Existing Granular Base	0.12	0.90	-	-	180,000	650	70
Total	-	-	-	-	-	-	920	156

Table E12
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 2: 300 m north of Denison Street to 14th Avenue
Markham, Ontario
20 Year Design - Widening - Northbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	16,700,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	154

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	210	210	88
2	New Granular A Base	0.14	1.00	150	150	21
3	New Granular B, Type I	0.09	1.00	535	535	48
Total	-	-	-	895	895	157

Layered Thickness Design

Thickness precision			Actual					
Layer	Material Description	Struct	Drain	Spec	Min	Elastic	Calculated	Calculated
		Coef.	Coef.	Thickness	Thickness	Modulus	Thickness	
		(Ai)	(Mi)	(Di) (mm)	(Di) (mm)	(kPa)	(mm)	SN (mm)
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	181	76
2	New Granular A Base	0.14	1.00	-	-	250,000	109	15
3	New Granular B,Type I	0.09	1.00	-	-	150,000	699	63
Total	-	-	-	-	-	-	989	154

Table E13
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 2: 300 m north of Denison Street to 14th Avenue
Markham, Ontario
20 Year Design - Rehabilitation - Southbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	16,700,000
Initial Serviceability	4.4
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	156

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	280	280	118
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	-
3	Existing Granular Base	0.12	0.90	150	150	16
4	Existing Granular Subbase	0.08	0.90	290	290	21
Total	-	-	-	720	720	155

Layered Thickness Design

Thickness precision		Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Actual		Elastic Modulus <u>(kPa)</u>	Calculated Thickness <u>(mm)</u>	Calculated <u>SN (mm)</u>
<u>Layer</u>	<u>Material Description</u>			Spec Thickness <u>(Di) (mm)</u>	Min Thickness <u>(Di) (mm)</u>			
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	76	32
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	2,250,000	194	54
3	Existing Granular Base	0.12	0.90	-	-	180,000	222	24
4	Existing Granular Subbase	0.08	0.90	-	-	90,000	642	46
Total	-	-	-	-	-	-	1134	156

Table E14
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 2: 300 m north of Denison Street to 14th Avenue
 Markham, Ontario
 20 Year Design - Widening - Southbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	16,700,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	154

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	230	230	97
2	New Granular A Base	0.14	1.00	150	150	21
3	New Granular B, Type I	0.09	1.00	450	450	41
Total	-	-	-	830	830	159

Layered Thickness Design

Thickness precision		Actual					Calculated	
<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Spec Thickness <u>(Di) (mm)</u>	Min Thickness <u>(Di) (mm)</u>	Elastic Modulus <u>(kPa)</u>	Thickness <u>(mm)</u>	Calculated <u>SN (mm)</u>
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	181	76
2	New Granular A Base	0.14	1.00	-	-	250,000	109	15
3	New Granular B, Type I	0.09	1.00	-	-	150,000	699	63
Total	-	-	-	-	-	-	989	154

Table E15
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 3: 14th Avenue to Highway 407
Markham, Ontario
20 Year Design - Rehabilitation - Northbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	16,400,000
Initial Serviceability	4.4
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	35,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	149

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di) (mm)	Required	Calculated SN (mm)
					Thickness (mm)	
1	New Hot Mix Asphalt	0.42	1.00	205	205	86
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	-
3	Existing Granular Base	0.12	0.90	135	135	15
4	Existing Granular Subbase	0.08	0.90	1010	1010	73
Total	-	-	-	1350	1350	174

Layered Thickness Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Actual		Elastic Modulus (kPa)	Calculated Thickness (mm)	Calculated SN (mm)
				Spec Thickness (Di) (mm)	Min Thickness (Di) (mm)			
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	76	32
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	2,250,000	193	54
3	Existing Granular Base	0.12	0.90	-	-	180,000	222	24
4	Existing Granular Subbase	0.08	0.90	-	-	90,000	542	39
Total	-	-	-	-	-	-	1033	149

Table E16
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 3: 14th Avenue to Highway 407
Markham, Ontario
20 Year Design - Widening - Northbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	16,400,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	35,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	147

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	180	180	76
2	New Granular A Base	0.14	1.00	150	150	21
3	New Granular B, Type I	0.09	1.00	1020	1020	92
Total	-	-	-	1350	1350	189

Layered Thickness Design

Thickness precision			Actual					
Layer	Material Description	Struct	Drain	Spec	Min	Elastic	Calculated	Calculated
		Coef.	Coef.	Thickness	Thickness	Modulus	Thickness	
		(Ai)	(Mi)	(Di) (mm)	(Di) (mm)	(kPa)	(mm)	SN (mm)
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	180	76
2	New Granular A Base	0.14	1.00	-	-	250,000	109	15
3	New Granular B,Type I	0.09	1.00	-	-	150,000	620	56
Total	-	-	-	-	-	-	909	147

Table E17
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 3: 14th Avenue to Highway 407
Markham, Ontario
20 Year Design - Rehabilitation - Southbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	16,400,000
Initial Serviceability	4.4
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	35,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	149

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	140	140	59
2	Existing Hot Mix Asphalt	0.28	1.00	200	200	56
3	Existing Granular Base	0.12	0.90	330	330	36
Total	-	-	-	670	670	151

Layered Thickness Design

Thickness precision			Actual					
Layer	Material Description	Struct	Drain	Spec	Min	Elastic	Calculated	Calculated
		Coef.	Coef.	Thickness	Thickness	Modulus	Thickness	
		(Ai)	(Mi)	(Di) (mm)	(Di) (mm)	(kPa)	(mm)	SN (mm)
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	76	32
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	2,250,000	193	54
3	Existing Granular Base	0.12	0.90	-	-	180,000	583	63
Total	-	-	-	-	-	-	852	149

Table E18
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 3: 14th Avenue to Highway 407
Markham, Ontario
20 Year Design - Widening - Southbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	16,400,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	35,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	147

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	240	240	101
2	New Granular A Base	0.14	1.00	150	150	21
3	New Granular B, Type I	0.09	1.00	450	450	41
Total	-	-	-	840	840	163

Layered Thickness Design

Thickness precision		Actual					
<u>Layer</u>	<u>Material Description</u>	Struct Coef.	Drain Coef.	Spec Thickness	Min Thickness	Elastic Modulus	Calculated Thickness
		<u>(Ai)</u>	<u>(Mi)</u>	<u>(Di) (mm)</u>	<u>(Di) (mm)</u>	<u>(kPa)</u>	<u>SN (mm)</u>
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	180
2	New Granular A Base	0.14	1.00	-	-	250,000	109
3	New Granular B, Type I	0.09	1.00	-	-	150,000	620
Total	-	-	-	-	-	-	909
-	-	-	-	-	-	-	147

Table E19
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 4: Highway 407 to Highway 7
Markham, Ontario
20 Year Design - Rehabilitation - Northbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	18,100,000
Initial Serviceability	4.4
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	158

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	240	240	101
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	-
3	Existing Granular Base	0.12	0.90	220	220	24
4	Existing Granular Subbase	0.08	0.90	425	425	31
Total	-	-	-	885	885	156

Layered Thickness Design

Thickness precision		Actual						
		Struct	Drain	Spec	Min	Elastic	Calculated	
		Coef.	Coef.	Thickness	Thickness	Modulus	Thickness	Calculated
<u>Layer</u>	<u>Material Description</u>	<u>(Ai)</u>	<u>(Mi)</u>	<u>(Di) (mm)</u>	<u>(Di) (mm)</u>	<u>(kPa)</u>	<u>(mm)</u>	<u>SN (mm)</u>
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	77	32
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	2,250,000	196	55
3	Existing Granular Base	0.12	0.90	-	-	180,000	224	24
4	Existing Granuar Subbase	0.08	0.90	-	-	90,000	646	47
Total	-	-	-	-	-	-	1143	158

Table E20
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 4: Highway 407 to Highway 7
Markham, Ontario
20 Year Design - Widening - Northbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	18,100,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	156

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	210	210	88
2	New Granular A Base	0.14	1.00	150	150	21
3	New Granular B, Type I	0.09	1.00	525	525	47
Total	-	-	-	885	885	156

Layered Thickness Design

Thickness precision			Actual					
Layer	Material Description	Struct	Drain	Spec	Min	Elastic	Calculated	Calculated
		Coef.	Coef.	Thickness	Thickness	Modulus	Thickness	
		(Ai)	(Mi)	(Di) (mm)	(Di) (mm)	(kPa)	(mm)	SN (mm)
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	183	77
2	New Granular A Base	0.14	1.00	-	-	250,000	110	15
3	New Granular B,Type I	0.09	1.00	-	-	150,000	704	63
Total	-	-	-	-	-	-	997	155

Table E21
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 4: Highway 407 to Highway 7
Markham, Ontario
20 Year Design - Rehabilitation - Southbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	18,100,000
Initial Serviceability	4.4
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	158

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	240	240	101
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	-
3	Existing Granular Base	0.12	0.90	270	270	29
4	Existing Granular Subbase	0.08	0.90	395	395	28
Total	-	-	-	905	905	158

Layered Thickness Design

Thickness precision		Actual						
		Struct	Drain	Spec	Min	Elastic	Calculated	
		Coef.	Coef.	Thickness	Thickness	Modulus	Thickness	Calculated
<u>Layer</u>	<u>Material Description</u>	<u>(Ai)</u>	<u>(Mi)</u>	<u>(Di) (mm)</u>	<u>(Di) (mm)</u>	<u>(kPa)</u>	<u>(mm)</u>	<u>SN (mm)</u>
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	77	32
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	2,250,000	196	55
3	Existing Granular Base	0.12	0.90	-	-	180,000	224	24
4	Existing Granuar Subbase	0.08	0.90	-	-	90,000	646	47
Total	-	-	-	-	-	-	1143	158

Table E22
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 4: Highway 407 to Highway 7
Markham, Ontario
20 Year Design - Widening - Southbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	18,100,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	156

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. (Ai)	Drain Coef. (Mi)	Required		Calculated SN (mm)
				Thickness (Di) (mm)	Thickness (mm)	
1	New Hot Mix Asphalt	0.42	1.00	210	210	88
2	New Granular A Base	0.14	1.00	150	150	21
3	New Granular B, Type I	0.09	1.00	545	545	49
Total	-	-	-	905	905	158

Layered Thickness Design

Thickness precision			Actual				Calculated	
Layer	Material Description	Struct	Drain	Spec	Min	Elastic	Calculated	Calculated
		Coef.	Coef.	Thickness	Thickness	Modulus	Thickness	
		(Ai)	(Mi)	(Di) (mm)	(Di) (mm)	(kPa)	(mm)	SN (mm)
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	183	77
2	New Granular A Base	0.14	1.00	-	-	250,000	110	15
3	New Granular B,Type I	0.09	1.00	-	-	150,000	704	63
Total	-	-	-	-	-	-	997	155

Table E23
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 5: Highway 7 to 16th Avenue
Markham, Ontario
20 Year Design - Rehabilitation - Northbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	11,400,000
Initial Serviceability	4.4
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	149

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	230	230	97
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	-
3	Existing Granular Base	0.12	0.90	195	195	21
4	Existing Granular Subbase	0.08	0.90	435	435	31
Total	-	-	-	860	860	149

Layered Thickness Design

Thickness precision		Actual						
		Struct Coef.	Drain Coef.	Spec Thickness	Min Thickness	Elastic Modulus	Calculated Thickness	Calculated SN
Layer	Material Description	(Ai)	(Mi)	(Di) (mm)	(Di) (mm)	(kPa)	(mm)	SN (mm)
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	71	30
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	2,250,000	184	51
3	Existing Granular Base	0.12	0.90	-	-	180,000	213	23
4	Existing Granuar Subbase	0.08	0.90	-	-	90,000	621	45
Total	-	-	-	-	-	-	1088	149

Table E24
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 5: Highway 7 to 16th Avenue
Markham, Ontario
20 Year Design - Widening - Northbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	11,400,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	147

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. (Ai)	Drain Coef. (Mi)	Required		Calculated SN (mm)
				Thickness (Di) (mm)	Thickness (mm)	
1	New Hot Mix Asphalt	0.42	1.00	190	190	80
2	New Granular A Base	0.14	1.00	150	150	21
3	New Granular B, Type I	0.09	1.00	520	520	47
Total	-	-	-	860	860	148

Layered Thickness Design

Thickness precision			Actual				Calculated	
Layer	Material Description	Struct	Drain	Spec	Min	Elastic	Calculated	Calculated
		Coef.	Coef.	Thickness	Thickness	Modulus	Thickness	
		(Ai)	(Mi)	(Di) (mm)	(Di) (mm)	(kPa)	(mm)	SN (mm)
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	170	71
2	New Granular A Base	0.14	1.00	-	-	250,000	104	15
3	New Granular B,Type I	0.09	1.00	-	-	150,000	673	61
Total	-	-	-	-	-	-	947	147

Table E25
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 5: Highway 7 to 16th Avenue
Markham, Ontario
20 Year Design - Rehabilitation - Southbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	11,400,000
Initial Serviceability	4.4
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	149

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	215	215	90
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	-
3	Existing Granular Base	0.12	0.90	275	275	30
4	Existing Granular Subbase	0.08	0.90	445	445	32
Total	-	-	-	935	935	152

Layered Thickness Design

Thickness precision		Actual					Calculated	
		Struct Coef.	Drain Coef.	Spec Thickness	Min Thickness	Elastic Modulus	Thickness	Calculated
<u>Layer</u>	<u>Material Description</u>	<u>(Ai)</u>	<u>(Mi)</u>	<u>(Di) (mm)</u>	<u>(Di) (mm)</u>	<u>(kPa)</u>	<u>(mm)</u>	<u>SN (mm)</u>
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	71	30
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	2,250,000	184	51
3	Existing Granular Base	0.12	0.90	-	-	180,000	213	23
4	Existing Granuar Subbase	0.08	0.90	-	-	90,000	621	45
Total	-	-	-	-	-	-	1088	149

Table E26
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 5: Highway 7 to 16th Avenue
Markham, Ontario
20 Year Design - Widening - Southbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	11,400,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	147

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	170	170	71
2	New Granular A Base	0.14	1.00	150	150	21
3	New Granular B, Type I	0.09	1.00	615	615	55
Total	-	-	-	935	935	147

Layered Thickness Design

Thickness precision		Actual					
<u>Layer</u>	<u>Material Description</u>	Struct Coef.	Drain Coef.	Spec Thickness	Min Thickness	Elastic Modulus	Calculated Thickness
		<u>(Ai)</u>	<u>(Mi)</u>	<u>(Di) (mm)</u>	<u>(Di) (mm)</u>	<u>(kPa)</u>	<u>SN (mm)</u>
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	170
2	New Granular A Base	0.14	1.00	-	-	250,000	104
3	New Granular B, Type I	0.09	1.00	-	-	150,000	673
Total	-	-	-	-	-	-	947
-	-	-	-	-	-	-	147

Table E27
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 6: 16th Avenue to Major Mackenzie Drive
Markham, Ontario
20 Year Design - Rehabilitation - Northbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	6,900,000
Initial Serviceability	4.4
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	27,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	144

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	170	170	71
2	Existing Hot Mix Asphalt	0.28	1.00	50	50	14
3	Existing Granular Base	0.12	0.90	205	205	22
4	Existing Granular Subbase	0.08	0.90	520	520	37
Total	-	-	-	945	945	144

Layered Thickness Design

Thickness precision		Actual						
		Struct	Drain	Spec	Min	Elastic	Calculated	
		Coef.	Coef.	Thickness	Thickness	Modulus	Thickness	Calculated
<u>Layer</u>	<u>Material Description</u>	<u>(Ai)</u>	<u>(Mi)</u>	<u>(Di) (mm)</u>	<u>(Di) (mm)</u>	<u>(kPa)</u>	<u>(mm)</u>	<u>SN (mm)</u>
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	64	27
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	2,250,000	172	48
3	Existing Granular Base	0.12	0.90	-	-	180,000	200	22
4	Existing Granuar Subbase	0.08	0.90	-	-	90,000	658	47
Total	-	-	-	-	-	-	1093	144

Table E28
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 6: 16th Avenue to Major Mackenzie Drive
 Markham, Ontario
 20 Year Design - Widening - Northbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	6,900,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	27,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	142

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	170	170	71
2	New Granular A Base	0.14	1.00	150	150	21
3	New Granular B, Type I	0.09	1.00	625	625	56
Total	-	-	-	945	945	148

Layered Thickness Design

Thickness precision			Actual					
Layer	Material Description	Struct	Drain	Spec	Min	Elastic	Calculated	Calculated
		Coef.	Coef.	Thickness	Thickness	Modulus	Thickness	
		(Ai)	(Mi)	(Di) (mm)	(Di) (mm)	(kPa)	(mm)	SN (mm)
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	157	66
2	New Granular A Base	0.14	1.00	-	-	250,000	97	14
3	New Granular B,Type I	0.09	1.00	-	-	150,000	691	62
Total	-	-	-	-	-	-	945	142

Table E29
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 6: 16th Avenue to Major Mackenzie Drive
 Markham, Ontario
 20 Year Design - Rehabilitation - Southbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	6,900,000
Initial Serviceability	4.4
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	27,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	144

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Required		Calculated <u>SN (mm)</u>
				Thickness <u>(Di) (mm)</u>	Thickness <u>(mm)</u>	
1	New Hot Mix Asphalt	0.42	1.00	145	145	61
2	Existing Hot Mix Asphalt	0.28	1.00	75	75	21
3	Existing Granular Base	0.12	0.90	305	305	33
4	Existing Granular Subbase	0.08	0.90	495	495	36
Total	-	-	-	1020	1020	151

Layered Thickness Design

Thickness precision		Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Actual		Elastic Modulus <u>(kPa)</u>	Calculated Thickness <u>(mm)</u>	Calculated <u>SN (mm)</u>
<u>Layer</u>	<u>Material Description</u>			Spec Thickness <u>(Di) (mm)</u>	Min Thickness <u>(Di) (mm)</u>			
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	64	27
2	Existing Hot Mix Asphalt	0.28	1.00	-	-	2,250,000	172	48
3	Existing Granular Base	0.12	0.90	-	-	180,000	200	22
4	Existing Granular Subbase	0.08	0.90	-	-	90,000	658	47
Total	-	-	-	-	-	-	1093	144

Table E30
PAVEMENT DESIGN AND ANALYSIS - FLEXIBLE STRUCTURAL DESIGN MODULE

Kennedy Road - Section 6: 16th Avenue to Major Mackenzie Drive
Markham, Ontario
20 Year Design - Widening - Southbound Lanes

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	6,900,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level (%)	90
Overall Standard Deviation	0.47
Roadbed Soil Resilient Modulus	27,000 kPa
Stage Construction	1.0
Calculated Design Structural Number	142

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. (Ai)	Drain Coef. (Mi)	Required		Calculated SN (mm)
				Thickness (Di) (mm)	Thickness (mm)	
1	New Hot Mix Asphalt	0.42	1.00	170	170	71
2	New Granular A Base	0.14	1.00	150	150	21
3	New Granular B, Type I	0.09	1.00	700	700	63
Total	-	-	-	1020	1020	155

Layered Thickness Design

Thickness precision			Actual					
Layer	Material Description	Struct	Drain	Spec	Min	Elastic	Calculated	
		Coef.	Coef.	Thickness	Thickness	Modulus	Thickness	Calculated
		(Ai)	(Mi)	(Di) (mm)	(Di) (mm)	(kPa)	(mm)	SN (mm)
1	New Hot Mix Asphalt	0.42	1.00	-	-	2,750,000	157	66
2	New Granular A Base	0.14	1.00	-	-	250,000	97	14
3	New Granular B,Type I	0.09	1.00	-	-	150,000	691	62
Total	-	-	-	-	-	-	945	142

APPENDIX F

Life Cycle Cost Analysis

Table F-1
LIFE CYCLE ANALYSIS FOR 50 YEARS
(per lane per kilometer)
KENNEDY ROAD

From 16th Avenue to Major Mackenzie Drive, Section 6 Southbound

SUMMARY OF LIFE CYCLE COST ANALYSIS						
OPTIONS	DESCRIPTION	INITIAL COST		LCC		COST RANKING
OPTION A	Mill at least one lift (min. 50 mm) and Overlay with HMA	\$179,216		\$307,817		1
OPTION B	Full Depth Asphalt Removal and Pave new HMA	\$218,127		\$334,841		2
OPTION C	Full Depth Reconstruction	\$339,500		\$441,407		3

OPTION A Mill at least one lift (min. 50 mm) and Overlay with HMA						
Structure	Thickness (mm)	Item		Quantity	Unit	Price
Milling Existing Asphalt	90	90 mm	Milling	3750	sq.m	\$6.60
New Hot Mix Asphalt	145	40 mm	SP 12.5 FC2	378	t	\$136.00
		50 mm	SP 19.0	459	t	\$101.00
		55 mm	SP 19.0	505	t	\$101.00
Tack Coat		3 lift	Tack Coat	11,250	sq.m	\$0.50
Total						\$179,216

OPTION B Full Depth Asphalt Removal and Pave new HMA						
Structure	Thickness (mm)	Item		Quantity	Unit	Price
Milling Existing Asphalt	165	165 mm	Milling	11250	sq.m	\$3.60
New Hot Mix Asphalt	180	40 mm	SP 12.5 FC2	378	t	\$136.00
		50 mm	SP 19.0	459	t	\$101.00
		90 mm	SP 25.0	827	t	\$92.00
Tack Coat		2 lift	Tack Coat	7,500	sq.m	\$0.50
Total						\$218,127

OPTION C Full Depth Reconstruction						
Structure	Thickness (mm)	Item		Quantity	Unit	Price
Excavation	870	870 mm	Excavation/Removal	3263	cu.m	\$18.00
New Hot Mix Asphalt	170	40 mm	SP 12.5 FC2	378	t	\$136.00
		50 mm	SP 19.0	459	t	\$101.00
		80 mm	SP 25.0	735	t	\$92.00
New Granular A	150	150 mm	Granular A	1350	t	\$24.00
New Granular B, Type I	550	550 mm	Granular B Type I	4950	t	\$16.00
Tack Coat		2 lifts	Tack Coat	7,500	sq.m	\$0.50
Total						\$339,500

Designed: GBG
Checked: SYJ

Table F-2
50 YEARS LIFE CYCLE COST ANALYSIS
 (Per Lane per kilometer)
 KENNEDY ROAD

From 16th Avenue to Major Mackenzie Drive, Section 6 Southbound
OPTION A - Mill at least one lift (min. 50 mm) and Overlay with HMA

Scheduled Maint/Rehab Year	Maintenance/Rehabilitation Treatment	Quantities	Pay Item Price (\$)	Cost	Yearly Total Cost	Discount (5%)	Present Worth Maint/Rehab \$
0	Initial Construction Cost			\$179,216	\$179,216	1.00	\$179,216
3	Rout and Seal cracks	70 m	\$14.00	\$980	\$980	0.86	\$847
9	Rout and Seal cracks	120 m	\$14.00	\$1,680	\$4,680	0.64	\$3,017
	Mill 40 mm and 40 mm Patch	300 sq.m	\$10.00	\$3,000			
14	Rout and Seal cracks	170 m	\$14.00	\$2,380	\$11,755	0.51	\$5,937
	Mill 40 mm and 40 mm Patch	938 sq.m	\$10.00	\$9,375			
18	Mill 100 mm asphalt pavement	3,750 sq.m	\$6.60	\$24,750	\$138,210	0.42	\$57,429
	Resurface SP 12.5 FC2 - 50 mm	473 t	\$136.00	\$64,260			
	Resurface SP 19.0 - 50 mm	450 t	\$101.00	\$45,450			
	Tack Coat - 2 layers	7,500 sq.m	\$0.50	\$3,750			
21	Rout and Seal cracks	70 m	\$14.00	\$980	\$980	0.36	\$352
26	Rout and Seal cracks	250 m	\$14.00	\$3,500	\$8,000	0.28	\$2,250
	Mill 40 mm and 40 mm Patch	450 sq.m	\$10.00	\$4,500			
30	Mill 100 mm asphalt pavement	3,750 sq.m	\$6.60	\$24,750	\$138,210	0.23	\$31,979
	Resurface SP 12.5 FC2 - 50 mm	473 t	\$136.00	\$64,260			
	Resurface SP 19.0 - 50 mm	450 t	\$101.00	\$45,450			
	Tack Coat - 2 layers	7,500 sq.m	\$0.50	\$3,750			
33	Rout and Seal cracks	70 m	\$14.00	\$980	\$980	0.20	\$196
37	Rout and Seal cracks	250 m	\$14.00	\$3,500	\$8,000	0.16	\$1,315
	Mill 40 mm and 40 mm Patch	450 sq.m	\$10.00	\$4,500			
40	Mill 100 mm asphalt pavement	3,750 sq.m	\$6.60	\$24,750	\$138,210	0.14	\$19,632
	Resurface SP 12.5 FC2 - 50 mm	473 t	\$136.00	\$64,260			
	Resurface SP 19.0 - 50 mm	450 t	\$101.00	\$45,450			
	Tack Coat - 2 layers	7,500 sq.m	\$0.50	\$3,750			
43	Rout and Seal cracks	70 m	\$14.00	\$980	\$980	0.12	\$120
46	Rout and Seal cracks	250 m	\$14.00	\$3,500	\$8,000	0.11	\$848
	Mill 40 mm and 40 mm Patch	450 sq.m	\$10.00	\$4,500			
48	Mill 100 mm asphalt pavement	3,750 sq.m	\$6.60	\$24,750	\$138,210	0.10	\$13,288
	Resurface SP 12.5 FC2 - 50 mm	473 t	\$136.00	\$64,260			
	Resurface SP 19.0 - 50 mm	450 t	\$101.00	\$45,450			
	Tack Coat - 2 layers	7,500 sq.m	\$0.50	\$3,750			
50	Salvage Value			-\$98,721	-\$98,721	0.09	-\$8,609
TOTAL							\$307,817

Calculated:
Reviewed:

SYJ
GBG

COST ASSUMPTIONS:

Table F-3
50 YEARS LIFE CYCLE COST ANALYSIS

(Per Lane per kilometer)

KENNEDY ROAD

From 16th Avenue to Major Mackenzie Drive, Section 6 Southbound

OPTION B - Full Depth Asphalt Removal and Pave new HMA

Scheduled Maint/Rehab Year	Maintenance/Rehabilitation Treatment	Quantities	Pay Item Price (\$)	Cost	Yearly Total Cost	Discount (5%)	Present Worth Maint/Rehab \$
0	Initial Construction Cost			\$218,127	\$218,127	1.00	\$218,127
3	Rout and Seal cracks	80 m	\$14.00	\$1,120	\$1,120	0.86	\$967
10	Rout and Seal cracks	130 m	\$14.00	\$1,820	\$5,195	0.61	\$3,189
	Mill (40 mm) and Patch 40-mm Patch	338 m	\$10.00	\$3,375			
15	Rout and Seal cracks	170 m	\$14.00	\$2,380	\$12,130	0.48	\$5,835
	Mill (40 mm) and Patch 40-mm Patch	975 m	\$10.00	\$9,750			
19	Mill 100 mm Asphalt Pavement	3,750 sq.m	\$6.60	\$24,750	\$138,210	0.40	\$54,694
	Resurface SP 12.5 FC2 - 50 mm	473 t	\$136.00	\$64,260			
	Resurface SP 19.0 - 50 mm	450 t	\$101.00	\$45,450			
	Tack Coat - 2 layers	7,500 sq.m	\$0.50	\$3,750			
22	Rout and Seal cracks	80 m	\$14.00	\$1,120	\$1,120	0.34	\$383
27	Rout and Seal cracks	250 m	\$14.00	\$3,500	\$8,375	0.27	\$2,243
	Mill (40 mm) and Patch 40-mm Patch	488 m	\$10.00	\$4,875			
31	Mill 100 mm Asphalt Pavement	3,750 sq.m	\$6.60	\$24,750	\$138,210	0.22	\$30,456
	Resurface SP 12.5 FC2 - 50 mm	473 t	\$136.00	\$64,260			
	SP 19.0 - 50 mm	450 t	\$101.00	\$45,450			
	Tack Coat - 2 layers	7,500 sq.m	\$0.50	\$3,750			
34	Rout and Seal cracks	80 m	\$14.00	\$1,120	\$1,120	0.19	\$213
38	Rout and Seal cracks	250 m	\$14.00	\$3,500	\$8,375	0.16	\$1,312
	Mill (40 mm) and Patch 40-mm Patch	488 m	\$10.00	\$4,875			
41	Rout and Seal cracks	250 m	\$14.00	\$3,500	\$8,375	0.14	\$1,133
	Mill (40 mm) and Patch 40-mm Patch	488 m	\$10.00	\$4,875			
42	Mill 100 mm Asphalt Pavement	3,750 sq.m	\$6.60	\$24,750	\$138,210	0.13	\$17,807
	Resurface SP 12.5 FC2 - 50 mm	473 t	\$136.00	\$64,260			
	Resurface SP 19.0 - 50 mm	450 t	\$101.00	\$45,450			
	Tack Coat - 2 layers	7,500 sq.m	\$0.50	\$3,750			
45	Rout and Seal cracks	80 m	\$14.00	\$1,120	\$1,120	0.11	\$125
49	Rout and Seal cracks	250 m	\$14.00	\$3,500	\$8,375	0.09	\$767
	Mill (40 mm) and Patch 40-mm Patch	488 m	\$10.00	\$4,875			
50	Salvage Value			-\$27,642	-\$27,642	0.09	-\$2,410
TOTAL							\$334,841

Calculated:

GBG

Reviewed:

SYJ

Table F-4
50 YEARS LIFE CYCLE COST ANALYSIS
 (Per Lane per kilometer)

KENNEDY ROAD
 From 16th Avenue to Major Mackenzie Drive, Section 6 Southbound

OPTION C - Full Depth Reconstruction

Scheduled Maint/Rehab Year	Maintenance/Rehabilitation Treatment	Quantities	Pay Item Price (\$)	Cost	Yearly Total Cost	Discount (5%)	Present Worth Maint/Rehab \$
0	Initial Construction Cost			\$339,500	\$339,500	1.00	\$339,500
3	Rout and Seal cracks	60 m	\$14.00	\$840	\$840	0.86	\$726
10	Rout and Seal cracks	100 m	\$14.00	\$1,400	\$3,275	0.61	\$2,011
	Mill 40 mm and 40 mm Patch	188 sq.m	\$10.00	\$1,875			
16	Rout and Seal cracks	150 m	\$14.00	\$2,100	\$9,600	0.46	\$4,398
	Mill 40 mm and 40 mm Patch	750 sq.m	\$10.00	\$7,500			
20	Mill 100 mm asphalt pavement	3,750 sq.m	\$6.60	\$24,750	\$138,210	0.38	\$52,090
	Resurface SP 12.5 FC2 - 50 mm	473 t	\$136.00	\$64,260			
	Resurface SP 19.0 - 50 mm	450 t	\$101.00	\$45,450			
	Tack Coat - 2 layers	7,500 sq.m	\$0.50	\$3,750			
23	Rout and Seal cracks	60 m	\$14.00	\$840	\$840	0.33	\$273
29	Rout and Seal cracks	220 m	\$14.00	\$3,080	\$6,830	0.24	\$1,659
	Mill 40 mm and 40 mm Patch	375 sq.m	\$10.00	\$3,750			
33	Mill 100 mm asphalt pavement	3,750 sq.m	\$6.60	\$24,750	\$138,210	0.20	\$27,624
	Resurface SP 12.5 FC2 - 50 mm	473 t	\$136.00	\$64,260			
	Resurface SP 19.0 - 50 mm	450 t	\$101.00	\$45,450			
	Tack Coat - 2 layers	7,500 sq.m	\$0.50	\$3,750			
36	Rout and Seal cracks	60 m	\$14.00	\$840	\$840	0.17	\$145
40	Rout and Seal cracks	220 m	\$14.00	\$3,080	\$6,830	0.14	\$970
	Mill 40 mm and 40 mm Patch	375 sq.m	\$10.00	\$3,750			
44	Mill 100 mm asphalt pavement	3,750 sq.m	\$6.60	\$24,750	\$138,210	0.12	\$16,151
	Resurface SP 12.5 FC2 - 50 mm	473 t	\$136.00	\$64,260			
	Resurface SP 19.0 - 50 mm	450 t	\$101.00	\$45,450			
	Tack Coat - 2 layers	7,500 sq.m	\$0.50	\$3,750			
47	Rout and Seal cracks	60 m	\$14.00	\$840	\$840	0.10	\$85
50	Rout and Seal cracks	220 m	\$14.00	\$3,080	\$6,830	0.09	\$596
	Mill 40 mm and 40 mm Patch	375 sq.m	\$10.00	\$3,750			
50	Salvage Value			-\$55,284	-\$55,284	0.09	-\$4,821
TOTAL							\$441,407

Calculated: _____ GBG
 Reviewed: _____ SYJ

COST ASSUMPTIONS:



golder.com



golder.com