

F

Appendix F Drainage and Stormwater Management



TECHNICAL MEMORANDUM

TO : Walter Neubauer, PMP Manager, Town of Lincoln
COPY TO : David Hiett, P.Eng., Director, CIMA+
PREPARED BY : Yuan Yuan, Water Resources, CIMA+
REVIEWED BY : Madhav Baral, M.A. Sc. P.Eng., Senior Manager, Water Resources, CIMA+
DATE : April 11, 2025
SUBJECT : B001659-Greenlane Reconstruction – Stormwater Management Design

1. Introduction

The Town of Lincoln has retained CIMA+ to complete a Schedule C Municipal Class Environmental Assessment (MCEA) of Greenlane Road between the west urban boundary limit, i.e. Konkle Creek Trail and Bartlett Road. This roadway is in poor condition, and due to the combination of new constructions such as the new West Niagara Secondary School on King Street and the future Go Station on Ontario Street, as well as due to the predicted increased vehicle volumes resulting from development growth in the area, this corridor has a high priority for reconstruction. In addition, the Town's Active Transportation Strategy identified Greenlane as a key east/west active transportation link and is also part of the Region of Niagara Cycling Network. Therefore, the proposed work includes the active transportation infrastructure to improve safety and connectivity for pedestrians and cyclists in the area. **Figure 1** shows the location map of the study area.



Figure 1: Location Map of Project Site

Under existing condition, Greenlane from Konkle Creek Trail to Bartlett Road is an urban local collector roadway. The entire study area is within the jurisdiction of the Niagara Peninsula Conservation Authority (NPCA).

2. Review of Background Information

Following documents were reviewed as a part of the study:

- Niagara Region Stormwater Management Guidelines by WSP, 2022
- NPCA Stormwater Management Guidelines, NPCA, March 2010
- Town of Lincoln Municipal Design & Quality Standards (2023)
- As-built drawings from Konkle Creek Trail to Ontario Street, prepared by V&S Engineering Group Ltd, 2002.
- As-built drawings from Ontario Street to Carriage Road, prepared by Denco Engineering Ltd, September 1989.
- As-built drawings from Garden Gate Terrace to Bartlett Road, prepared by J.David Pounder Limited, October 1994.
- Niagara Catholic District School Board Elemental School Preliminary Plan, prepared by Sedas Architects Inc., June 2023.
- NHDGI Utopia West Residential Development Preliminary Servicing Plan, prepared by Lanhack Consultants Inc, September 2021.
- Greenlane & Ontario Street Site Servicing Plan, prepared by S.Llewellyn & Associates Limited, July 2023.
- Functional Servicing Report, Greenlane & Ontario Street, prepared by S.Llewellyn & Associates Limited, October 2021.

3. Design Standard and Guidelines

The Niagara Region Stormwater Management Guidelines (2022), Town of Lincoln Municipal Design & Quality Standards (2023), the Niagara Peninsula Conservation Authority (NPCA)'s Stormwater Management (SWM) Guidelines (2010), Ministry of the Environment, Conservation and Parks (MECP) and the Ontario Ministry of Transportation (MTO) Highway Drainage Design Standards (2008) were reviewed for the necessary design requirements.

Appendix B of the Niagara Region Stormwater Management Guidelines provides the applicable IDF parameter, which is shown in **Table 1** below. The analysis was completed using the Rational Method based on the Town of Lincoln guidelines including rainfall data found below.

Table 1: Town of Lincoln - IDF Curve

Return Period Frequency	A	B	C
5-Year	1039.20	7	0.8210

- Minor system shall be designed to convey a 5-year design storm.
- The velocity in storm sewers shall be generally limited to a minimum of 0.75 m/s and a maximum of 4.5 m/sec.
- The time of concentration can be 10 minutes for overland flow and pipe flow time.

4. Existing and Proposed Conditions Drainage

4.1 Existing Conditions Drainage

The Greenlane from Konkle Creek Trail to Bartlett Road is an urban two-lane collector road. The study area is bounded by medium density residential developments to the south and commercial developments to the north. Roadway runoff is conveyed by the combination of existing storm sewers and roadway ditch. The drainage pattern is separated into three outlet areas. Followings are the discussion on existing drainage condition and pattern.

- Road runoff from Catchment 100 (drainage area 0.60 ha) drains easterly towards the road low point via the roadside ditches along Greenlane and discharge to Konkle Creek near an existing box culvert west of Konkle Creek Trail. This catchment falls outside of the current study limit.
- Runoff from Catchment 110 (drainage area 0.64 ha) and minor runoff from 120 (drainage area 0.13 ha) drains westerly through existing storm sewers along Greenlane and discharge to Konkle Creek on the north side of the Greenlane. The total area draining through storm sewers to Konkle Creek at this outlet is 0.77 ha, out of that, 0.59 ha is impervious area.
- Runoff from Catchment 130 (drainage area 0.17 ha) drains overland in east direction and get captured by catch basin near the intersection of Greenlane and Ontario Street. The catch basins are connected to Ontario Street storm sewer system which conveys the flow further to the north direction along Ontario Street.
- Runoff from Catchments 140 (drainage area 0.16 ha) and 150 (drainage area 1.71 ha) is conveyed by existing storm sewers and ditches along Greenlane easterly and then crosses the Canadian National Railway (CNR) line to discharge to the existing SWM pond located north-east of the study area. The total area draining through storm sewers to this outlet is 1.87 ha, out of that, 0.87 ha is impervious area.
- Similarly, runoff from Catchment 160 (drainage area 0.28 ha) is conveyed by ditches and storm sewers on Greenlane and discharge to the westside ditch of Bartlett Road via an existing culvert under CNR tracks.

- There are significant amounts of external drainage areas which drain directly to existing storm sewers located within Greenlane ROW and conveyed runoff into outlets, which are as follows:
 - Catchments 170 (drainage area 0.20 ha) ,190 (drainage area 1.05 ha), 200 (drainage area 4.11 ha) and 210 (drainage area 1.84 ha) are existing residential area which located on the south of Greenland.
 - Catchment 180 (drainage area 2.22 ha) is currently a grass field and is proposed to develop an elementary school in the future.
 - Catchment 101 (drainage area 1.25 ha) ,102 (drainage area 0.17 ha) are defined based on the Functional Servicing Report prepared by S. Llewellyn & Associates Limited. These two Catchments currently consists of grassed fields. According to pervious FSR, storm runoff from these catchments is directed easterly and are captured by an existing ditch inlet within the reed area and conveyed to the Greenlane municipal storm sewer.

The existing conditions drainage mosaic sheet is included in **Appendix A**.

4.2 Storm Sewers Under Existing Conditions

The existing conditions storm sewer capacity assessment was completed using the Rational Method. The time of concentration and runoff coefficients were set based on the Town of Lincoln guidelines. Calculation details for the existing conditions storm sewer capacity assessment can be found in the **Appendix B**. According to the analysis:

- The existing 300 mm storm sewer on Greenlane from MH 27A to 26A has around 169% usage. This is due to the relatively flat slopes of the existing storm sewer.
- All remaining storm sewers along Greenlane Road are under 100% of utilization.

4.3 Proposed Conditions Drainage

There is no significant change in the drainage pattern and the existing outlet are maintained under proposed conditions for the most of study area. There will be some minor modifications in sewershed catchments and increase in impervious area due to the proposed multi-use path and associated lane adjustments. The existing storm sewers will continue to function with some minor adjustment of catch basin locations as the curb lines shift slightly from Cedarbrook Ave to 40 m east of Carriage Road. Followings are the discussion on proposed drainage condition and pattern.

- Catchment 100 falls outside of the current study limit. There will be some changes in impervious coverage due to urbanization of Greenlane.
- There is no change in drainage pattern for Catchment 110 and 120. The drainage area for Catchments 110 and 120 will slightly change due to the adjustment of profile, but the total drainage area (0.77 ha) from Catchments 110 and 120 remain unchanged under

total drainage area (0.77 ha) from Catchments 110 and 120 remain unchanged under proposed conditions. The total impervious coverage has shown a minor increase from 0.59 ha to 0.61 ha and can be considered a negligible increase.

- There is no change in the drainage area and drainage pattern for Catchment 130, runoff from this catchment will be connected to the storm sewers along Ontario Street as in existing condition. However, due to the introduction of landscape area, the impervious coverage of this catchment has decreased from 91% under existing condition to 89% under proposed condition. As such, there will be no impact to the Ontario Street storm sewer system.
- Catchments 140 and 150 are redefined as Catchments 140, 150A and 150B under proposed conditions. Due to the urbanization of Greenlane, a sidewalk will be provided on the north side of Greenlane up to Carriage Road, and the north ditch along Greenlane from Garden Gate to Bartlett will be maintained. Runoff from Catchments 140, 150A and 150B will be conveyed by proposed storm sewers to the existing SWM pond located north-east of the study area as in existing condition. There is no change in the total drainage area at this outlet, but due to the additions of the parking bay and multi-use path on the north side of Greenlane, the total impervious area has increased from 0.87 ha to 1.22 ha, which makes an increase of 19% compared to the existing condition.
- Similarly, Catchment 160 has been redefined as Catchment 160A and 160B. Runoff from Catchment 160A and 160B will be captured by proposed catch basin and ditch inlet to There is no change in the drainage pattern, total drainage area and discharge point at this outlet but the impervious area has increased from 0.11 ha to 0.16 ha, which makes an increase of about 18%.
- The four external Catchments (170, 190, 200 and 210) will not be impacted by proposed road reconstruction.
- It is proposed to construct an elementary school within Catchment 180 (drainage area 2.22 ha). The current storm sewer on Greenlane includes the 5-year pre-development level flow from this catchment. There is not much information available currently, however, a peak flow control measure is required to place for Catchments 180 to control the flow to the minor storm 5-year runoff equivalent to the pre-development condition.
- According to the Functional Servicing Report prepared by S. Llewellyn & Associates Limited, there is no change on drainage pattern and drainage area for external Catchment 102. Catchment 201 (drainage area 1.15 ha), 202 (drainage area 0.07 ha) and 203 (drainage area 0.03 ha) are defined based on the FSR. Runoff from Catchment 201 will be controlled before discharging to existing storm sewer on Greenlane. Uncontrolled runoff from Catchment 202 will drain overland southerly to Greenlane ROW

and get captured by storm sewer. Runoff from Catchment 203 drains overland in the north direction to a watercourse and this outfall falls outside of the study limit.

4.4 Storm Sewers Under Proposed Conditions

A Rational Method analysis was completed in order to assess the storm sewer capacity for proposed condition. The results of the storm sewer assessments under proposed conditions show that:

- The existing 300 mm concrete storm sewer on Greenlane from MH 27A to 26A will be replaced by with a 450 mm diameter concrete pipe with 69% pipe usage. Under existing conditions, it has 169% usage. Similarly, the 750 mm storm sewer on Greenlane from MH 19A to 18A will be replaced by with an 825 mm diameter concrete pipe with 80% pipe usage. This storm sewer has 87% usage under existing condition.
- All remaining storm sewer along Greenlane Road are under 100% of utilization.

Proposed conditions Storm Sewer Capacity Assessment calculation details can be found in the **Appendix B**

5. Stormwater Management Strategy

As discussed above, the proposed improvement of Greenlane includes the introduction of active transportation. Under the proposed conditions, no notable increase in impervious area is expected in Greenlane from Konkle Creek Trail to Ontario Street. From Ontario Street to Bartlett Road, there will be additions of parking bay and an MUP at the north end, therefore, the increase in impervious area is significant within this segment.

- The percentage of imperviousness from Catchment 110 and 120 which increased from 77% to 79%, which is negligible.
- The percentage of imperviousness in Catchment 130 decreased from 91% to 89% due to introduction of landscape area.
- The percentage of imperviousness from Catchment 140 and 150 increased from 47% to 65%.
- The percentage of imperviousness from Catchment 160 increased from 39% to 57%.

5.1 Quantity and Quality Control

Under existing conditions, existing SWM Pond which located north-east of the study area provides the quantity and quality control for roadway Catchments 140 and 150. The SWM Pond will continue to provide quantity and quality control for Catchments 140, 150A and 150B under proposed condition. No information on the existing SWM Pond was available in the current study. Therefore, it is recommended for further investigation regarding quantity and quality control capacity of the existing SWM Pond during the detailed design stage.

Within Greenlane roadway Catchment 150B, an OGS unit (OGS #1) can be proposed at St 1+232, just before the runoff is conveyed by an existing 1350 mm diameter pipe northerly across the CNR tracks to the outlet. The sizing calculation of proposed OGS unit will be explored in the detail design stage. It is expected that the treatment train approach (combination of OGS and SWM facility) will provide Level 1 of runoff quality treatment.

To offset the increase of imperviousness within Catchment 160A and 160B, pervious pavement along the multiuse path can be considered during the detailed design stage.

5.2 Proposed LID – Infiltration Gallery

Due to the linear nature of the project and the constraints of various utilities, there are limited areas within the ROW that can be considered as potential areas for infiltration galleries to provide LID measure such as infiltration. Therefore, infiltration volume will be provided to the maximum extent possible and infiltration galleries are proposed along Greenlane wherever practical. These infiltration galleries will provide a measure of water balance and erosion control.

Table 2 below outlines the locations where infiltration galleries can potentially be provided.

Table 2: Location and Length of Potential Infiltration Galleries

Infiltration Gallery ID	Station		Location	Length (m)
	From	To		
IG #1	0+250	0+290	Landscape area on the north side of Greenlane	40

The infiltration gallery location provided in **Table 2** are only intended to identify the potential location. Any constraints related to utility line need be further investigated during the detailed design phase.

6. Conclusion

This memo provides details of drainage and storm sewer capacity assessments under existing and proposed conditions as well as stormwater management analysis for the proposed Greenlane reconstruction. The followings are the finding of this memo:

- Greenlane from Ontario Street to Bartlett Road, the existing SWM pond located to the north-east of study area will continue to provide quantity and quality control for Catchments 140, 150A and 150B. Further investigation regarding quantity and quality control capacity of the existing SWM Pond is recommended during the detailed design stage.
- The combination of OGS proposed at Catchment 150B near the outlet and existing SWM pond will maintain the treatment train approach and help to provide Level 1 runoff quality control. The sizing calculation of proposed OGS unit will be explored in the detail design stage.
- The existing undersized 300 mm concrete storm sewer on Greenlane from MH 27A to 26A is recommended for replacement with a 450 mm diameter concrete pipe and the existing undersized 750 mm storm sewer from MH 19A to 18A is recommended for replacement with an 825 mm diameter concrete pipe.
- As the increase in imperviousness from Konkle Creek Trail to Ontario Street is negligible, an infiltration gallery can be proposed as a LID measure which will provide the infiltration and water balance requirement for Catchment 110.
- Beside the proposed infiltration galleries, pervious pavement along the multiuse path within Catchments 140, 150A and 160A can be explored during the detailed design stage.



TECHNICAL MEMORANDUM

APPENDIX A

Existing and Proposed Conditions Drainage Plans



1	ISSUED FOR 60% REVIEW	2025-04-09	M.B.	
No.	REVISION	DATE	By	

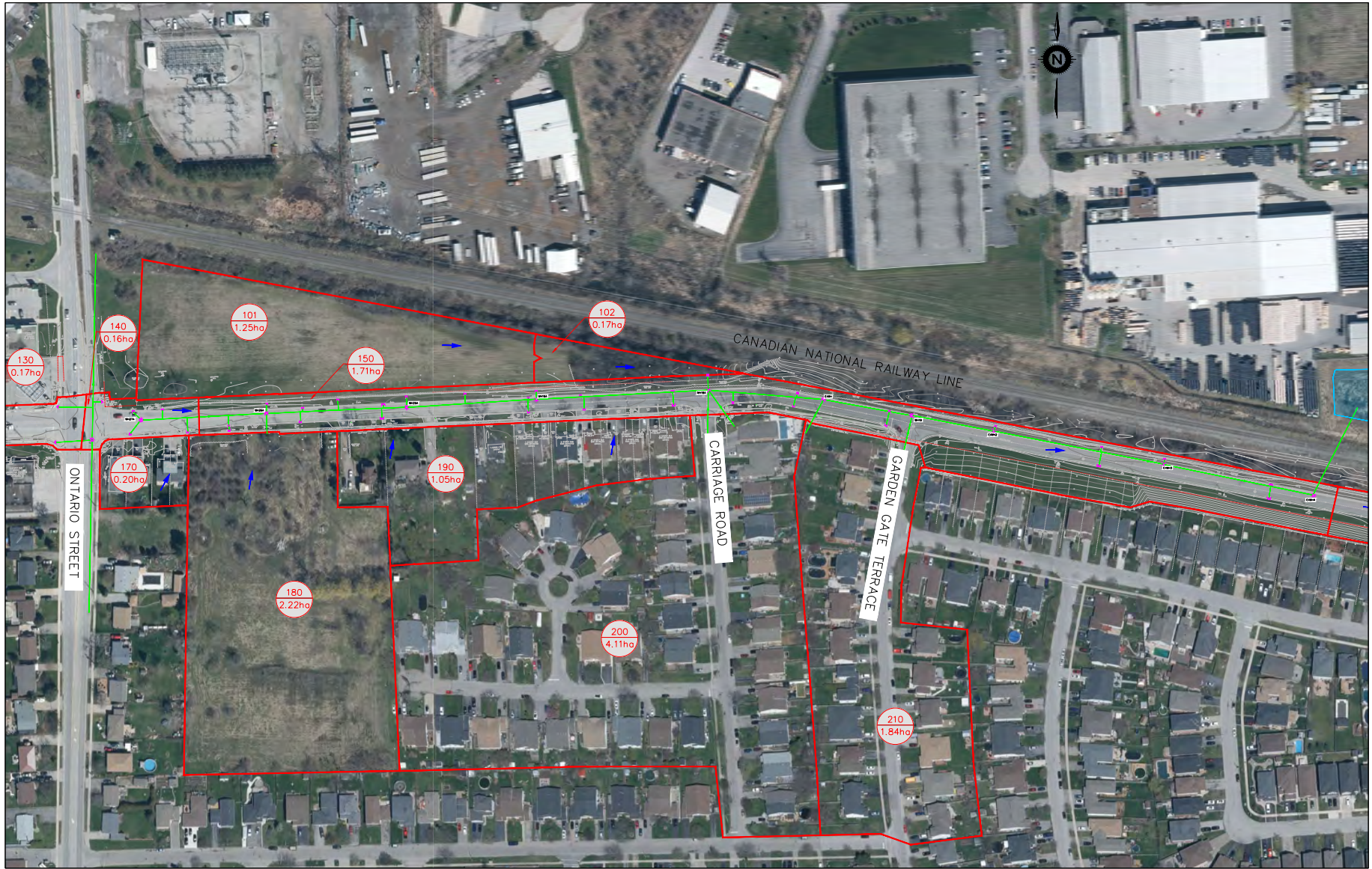
**EXISTING CONDITION
DRAINAGE MOSAICS**

DRAFTING	Y.Y
DESIGN	Y.Y
CHECKED BY	M.B.
APPROVED BY	M.B.



TOWN OF LINCOLN
GREENLANE ROAD
ENVIRONMENTAL ASSESSMENT
PROPERTY IMPACT PLAN
4998 GREENLANE ROAD
PIN: 460970126

CONSULTANT FILE No.	8001695
DATE	2025-04-09
SCALE	1:1000
DWG No.	
	EXHIBIT 1



1	ISSUED FOR 60% REVIEW	2025-04-09	M.B.		
No.	REVISION	DATE	By		

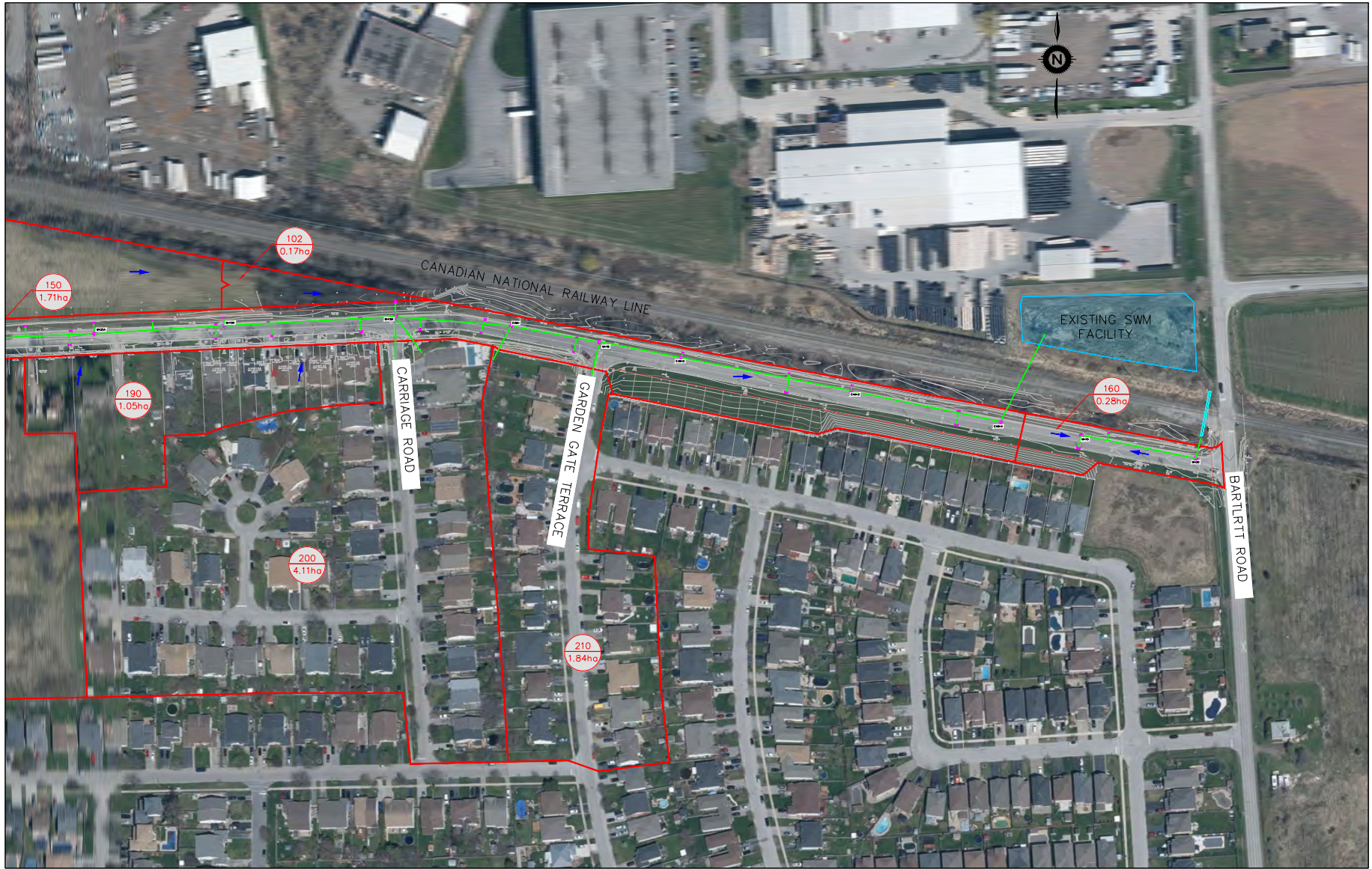
EXISTING CONDITION
DRAINAGE MOSAICS

DRAFTING	Y.Y
DESIGN	Y.Y
CHECKED BY	M.B.
APPROVED BY	M.B.



TOWN OF LINCOLN
GREENLANE ROAD
ENVIRONMENTAL ASSESSMENT
PROPERTY IMPACT PLAN
4998 GREENLANE ROAD
PIN: 460970126

CONSULTANT FILE No.	8001695
DATE	2025-04-09
SCALE	1:1000
DWG No.	EXHIBIT 2



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No.	REVISION	DATE	By	

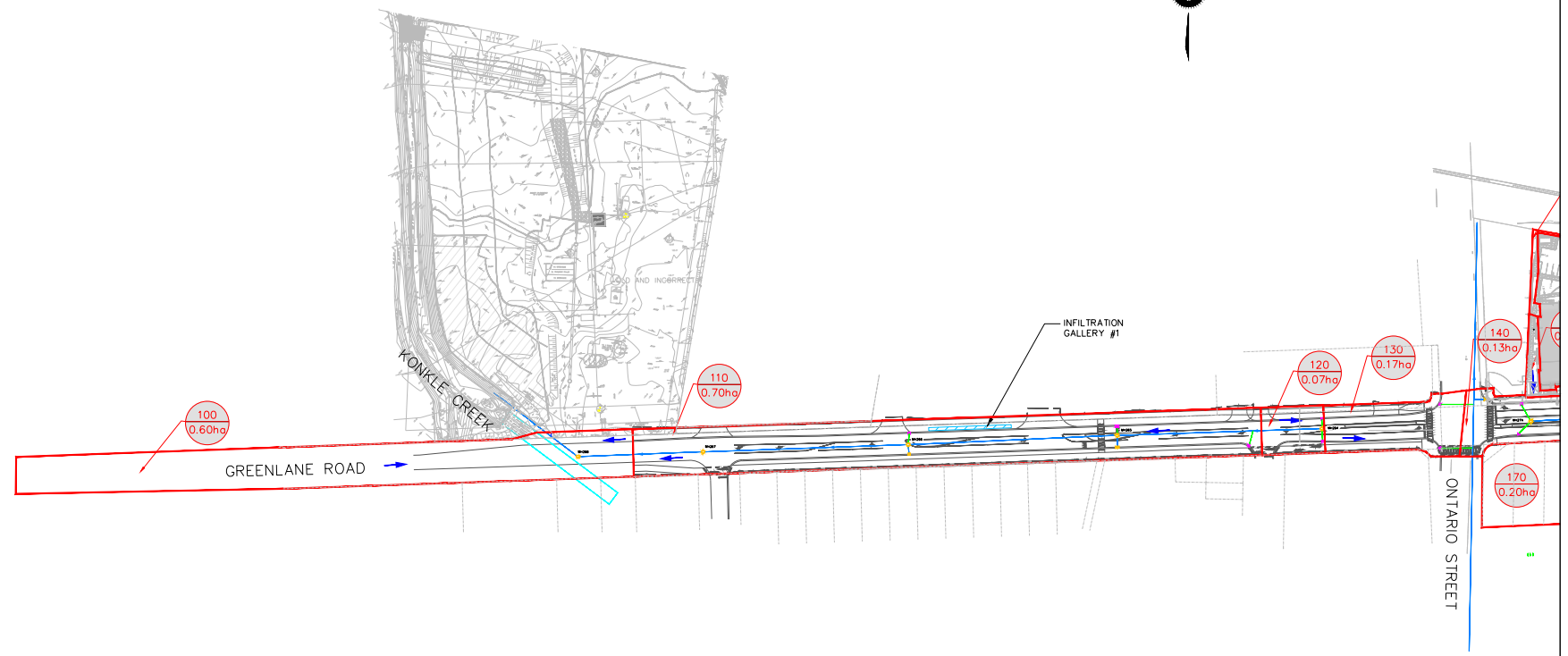
EXISTING CONDITION
DRAINAGE MOSAICS

DRAFTING	Y.Y
DESIGN	Y.Y
CHECKED BY	M.B.
APPROVED BY	M.B.



TOWN OF LINCOLN
GREENLANE ROAD
ENVIRONMENTAL ASSESSMENT
PROPERTY IMPACT PLAN
4998 GREENLANE ROAD
PIN: 460970126

CONSULTANT FILE No.	8001695
DATE	2025-04-09
SCALE	1:1000
DWG No.	EXHIBIT 3



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No.	REVISION	DATE	By

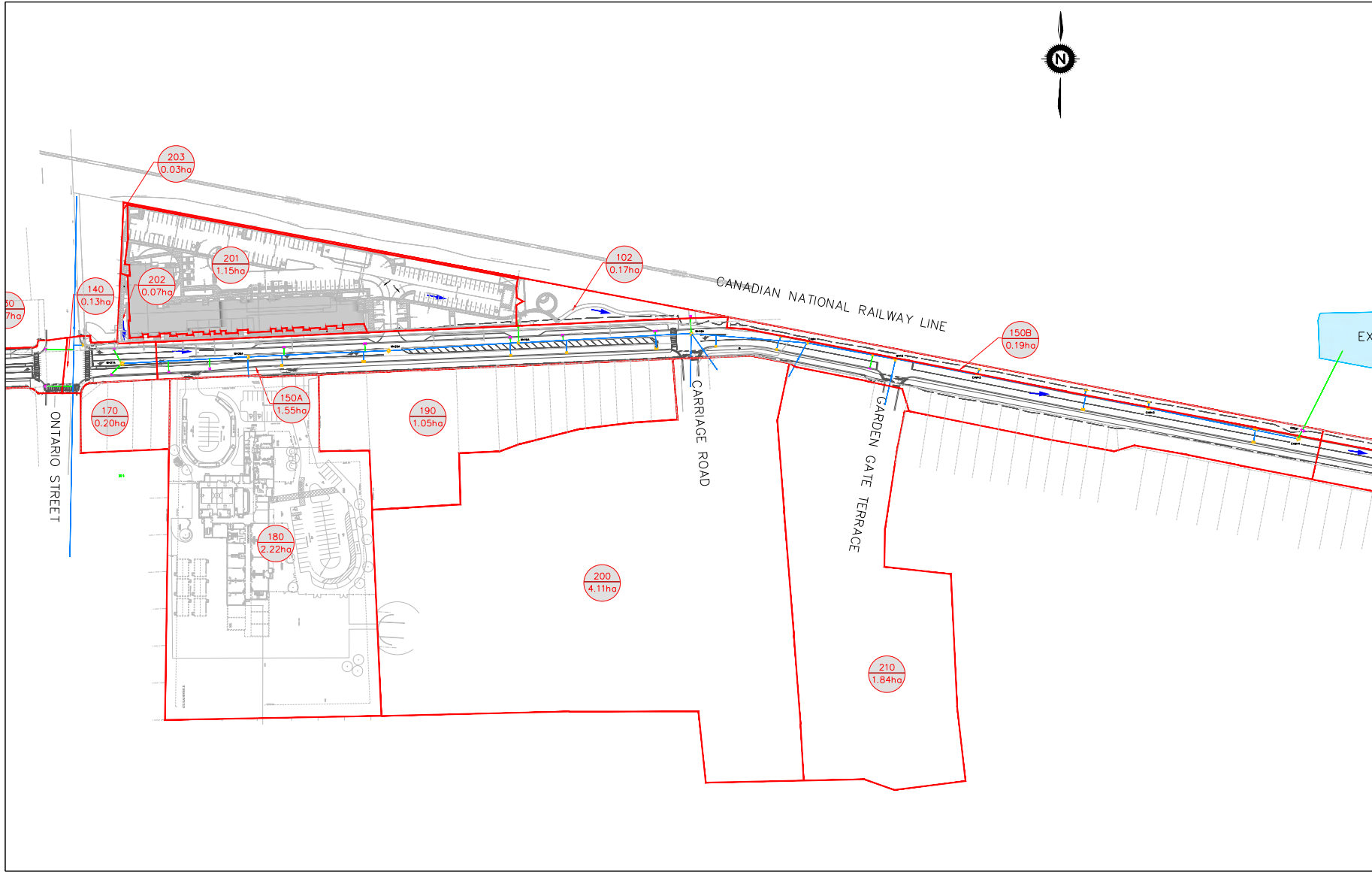
**PROPOSED CONDITION
DRAINAGE MOSAICS**

DRAFTING	Y.Y
DESIGN	Y.Y
CHECKED BY	M.B.
APPROVED BY	M.B.



**TOWN OF LINCOLN
GREENLANE ROAD
ENVIRONMENTAL ASSESSMENT
PROPERTY IMPACT PLAN
4998 GREENLANE ROAD
PIN: 460970126**

CONSULTANT FILE No.	B001695
DATE	2025-04-09
SCALE	1:1000
DWG No.	EXHIBIT 4



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No.	REVISION	DATE	By	

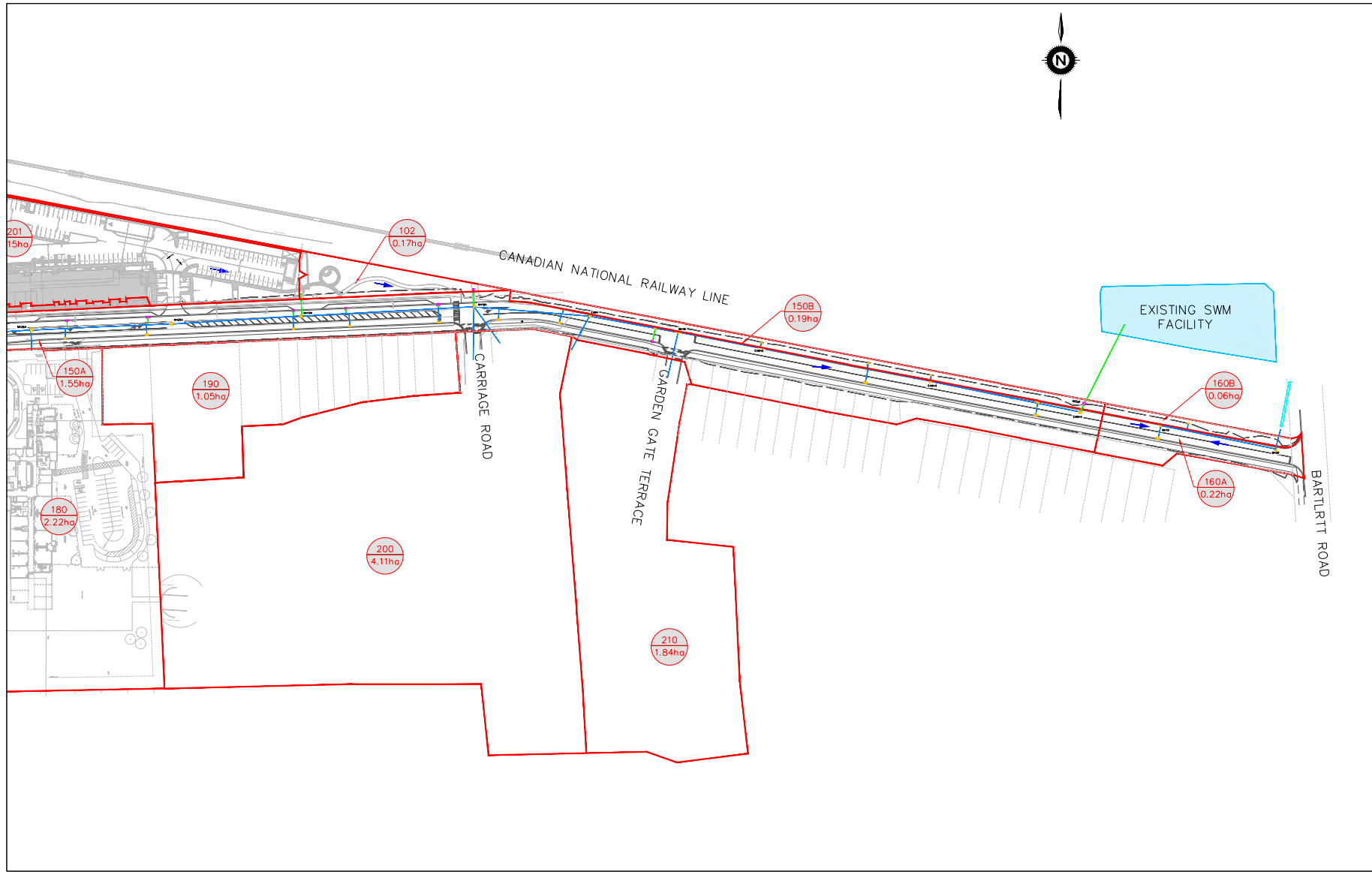
**PROPOSED CONDITIONS
DRAINAGE MOSAIC**

DRAFTING	Y.Y
DESIGN	Y.Y
CHECKED BY	M.B.
APPROVED BY	M.B.



**TOWN OF LINCOLN
GREENLANE ROAD
ENVIRONMENTAL ASSESSMENT
PROPERTY IMPACT PLAN
4998 GREENLANE ROAD
PIN: 460970126**

CONSULTANT FILE No.	8001695
DATE	2025-04-09
SCALE	1:1000
DWG No.	EXHIBIT 5



1	ISSUED FOR 60% REVIEW	2025-04-09	M.B.		
No.	REVISION	DATE	By		

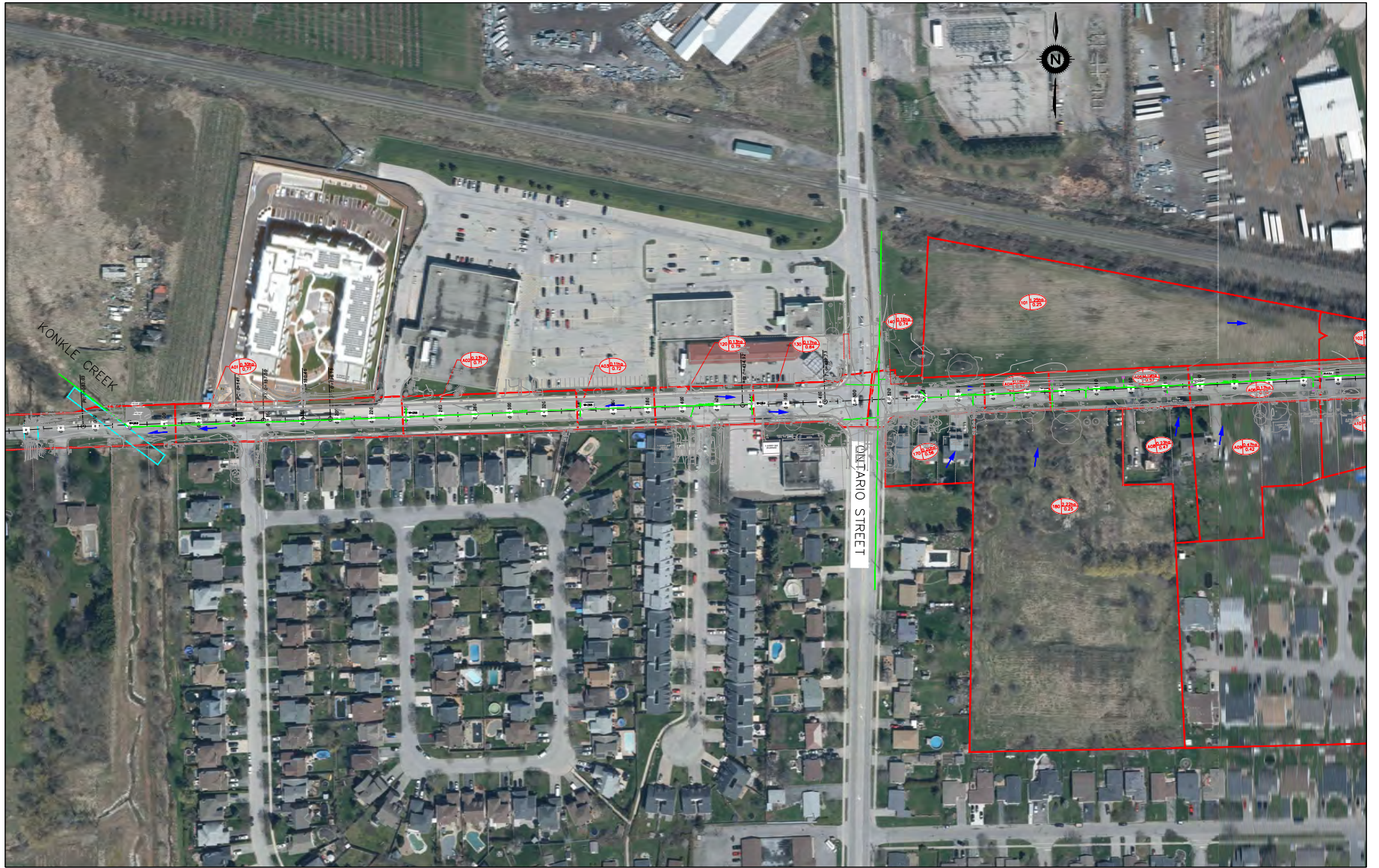
PROPOSED CONDITIONS DRAINAGE MOSAIC

DRAFTING	Y.Y.
DESIGN	Y.Y.
CHECKED BY	M.B.
APPROVED BY	M.B.



TOWN OF LINCOLN
GREENLANE ROAD
ENVIRONMENTAL ASSESSMENT
PROPERTY IMPACT PLAN
4998 GREENLANE ROAD
PIN: 460970126

CONSULTANT FILE No.	8001695
DATE	2025-04-09
SCALE	1:1000
DWG No.	EXHIBIT 6



1	ISSUED FOR 60% REVIEW	2025-04-09	M.B.
No.	REVISION	DATE	By

EXISTING SEWERSHED MOSAICS

DRAFTING	Y.Y.
DESIGN	Y.Y.
CHECKED BY	M.B.
APPROVED BY	M.B.



TOWN OF LINCOLN
GREENLANE ROAD
 ENVIRONMENTAL ASSESSMENT
 PROPERTY IMPACT PLAN
 4998 GREENLANE ROAD
 PIN: 460970126

CONSULTANT FILE No.	8001695
DATE	2025-04-09
SCALE	1:1000
DWG No.	EXHIBIT 7



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No.	REVISION	DATE	By

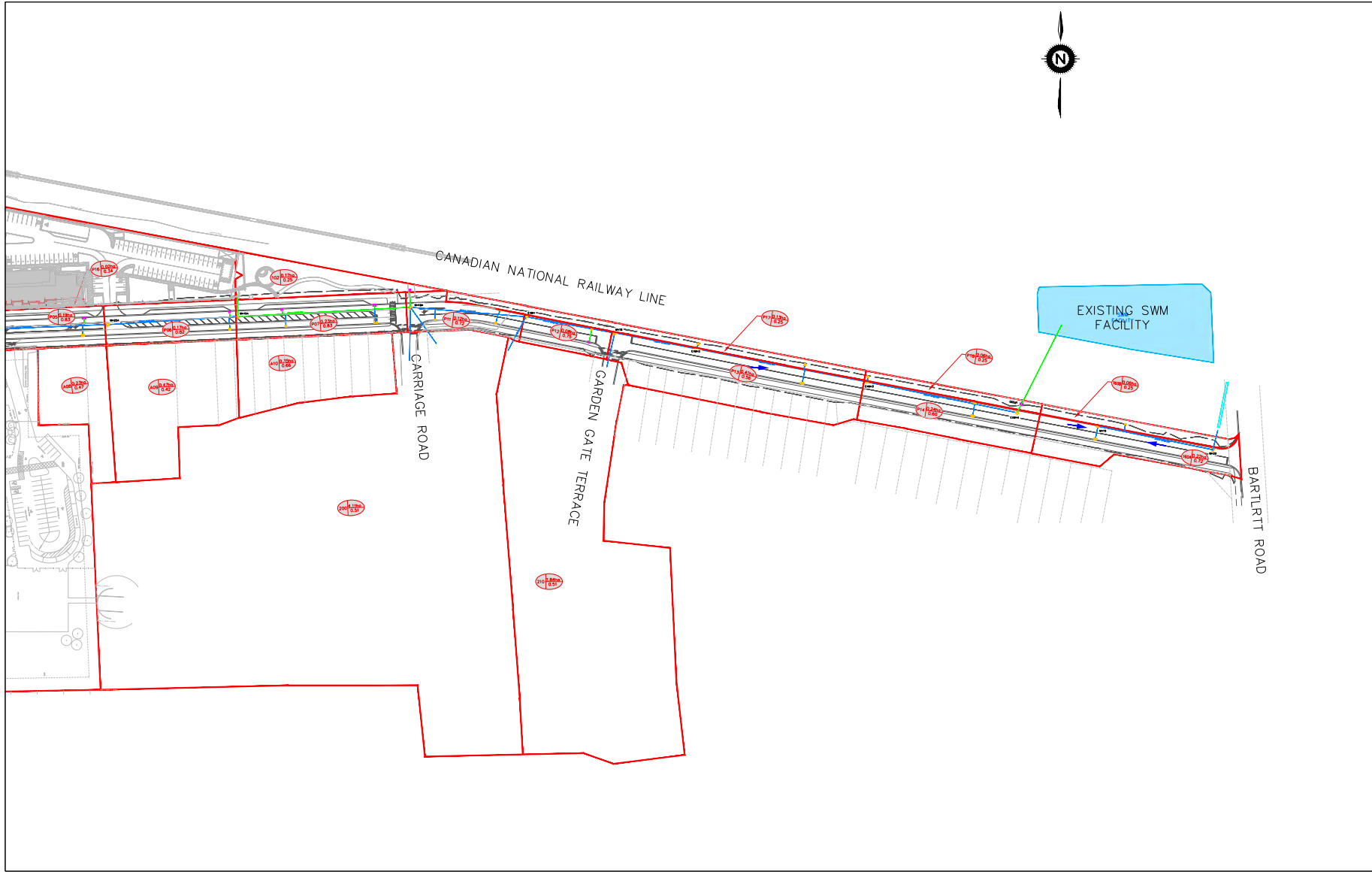
EXISTING SEWERSHED MOSAICS

DRAFTING	Y.Y.
DESIGN	Y.Y.
CHECKED BY	M.B.
APPROVED BY	M.B.



**TOWN OF LINCOLN
GREENLANE ROAD
ENVIRONMENTAL ASSESSMENT
PROPERTY IMPACT PLAN
4998 GREENLANE ROAD
PIN: 460970126**

CONSULTANT FILE No.	8001695
DATE	2025-04-09
SCALE	1:1000
DWG No.	EXHIBIT 8



1	ISSUED FOR 60% REVIEW	2025-04-09	M.B.
No.	REVISION	DATE	By

**PROPOSED SEWERSHED
MOSAICS**

DRAFTING	Y.Y
DESIGN	Y.Y
CHECKED BY	M.B.
APPROVED BY	M.B.



**TOWN OF LINCOLN
GREENLANE ROAD
ENVIRONMENTAL ASSESSMENT
PROPERTY IMPACT PLAN
4998 GREENLANE ROAD
PIN: 460970126**

CONSULTANT FILE No. 8001695
DATE 2025-04-09
SCALE 1:1000
DWG No. EXHIBIT 10

APPENIDX B

Storm Sewer Capacity Assessment Detail

				Town of Lincoln STORM SEWER DESIGN SHEET Existing Condition																											
Project Name				Greenlane EA				Project # B001695				Town of Lincoln IDF Data		Storm		A	B	C	Town's Criteria:				Manning's n		Calculated By: YY Checked By: MB						
Design Storm				5-Year				Rainfall Intensity: $I = A/(B+T)^C$				5-year		1039.2	7.00	0.82	$V_{min} = 0.75$ m/s				0.013 for Concrete										
Initial Time of Concentration				10 min				T= Time of Concentration in min								$V_{max} = 4.50$ m/s				0.024 for CSP											
LOCATION				RUNOFF DATA												PIPE DATA												TIME AND USAGE		COMMENTS	
From		TO		Catchment ID	Area A	Runoff Coeff. C	AC	Accum. AC	Time of Conc. T	Rainfall Intensity I	Runoff $Q_{ac} = 2.78ACI$	External Flow Rate	Nominal Pipe Dia.	Actual Pipe Dia.	Pipe Length	Pipe Type	Manning's n	U/S Invert Elev.	D/S Invert Elev.	Fall	Pipe Slope	Flow Velocity V_{full}	Pipe Capacity Q_{full}	Flow Time	Pipe Usage Q_{ac} / Q_{full}						
MH/ CB	Station	MH / CB	Station																												
No.		No.																													
Greenlane, Draining from East to West																															
MH264		MH265		120	0.13	0.79	0.103	0.103	10.00	101.51	29.0		375	0.375	99.2	PVC	0.013	88.37	87.99	0.38	0.38	0.98	109	1.68	27%						
MH265		MH266		A03	0.11	0.72	0.079	0.182	11.68	93.95	47.5		525	0.525	101.4	PVC	0.013	87.88	87.72	0.15	0.15	0.77	167	2.19	28%						
MH266		MH267		A02	0.23	0.71	0.163	0.345	13.87	85.78	82.3		525	0.525	99.4	PVC	0.013	87.73	87.51	0.22	0.22	0.94	204	1.76	40%						
MH267		MH268		A01	0.30	0.77	0.231	0.576	15.63	80.26	128.6		525	0.525	60.5	PVC	0.013	87.51	87.30	0.21	0.34	1.17	252	0.87	51%						
MH268		OUTLET #1	Konkle Creek																												
Greenlane, Draining from West to East																															
MH27A		MH26A		140, 170, A04	0.44	0.63	0.277	0.277	10.00	101.5	78.2		300	0.300	71.0	CONC	0.013	87.68	87.51	0.16	0.23	0.66	46	1.81	169%						
Catchment 180		MH26A		180	2.22	0.25	0.555	0.555	10.00	101.5	156.6		600	0.600	12.0	CONC	0.013		87.21		0.20	0.97	275	0.21	57%						
MH26A		MH25A		A05, A08	0.42	0.52	0.218	0.496	11.81	93.4	128.7	156.6	675	0.675	81.0	CONC	0.013	87.14	86.98	0.16	0.20	1.05	376	1.28	76%						
MH25A		MH19A		A06, A09	0.64	0.46	0.294	0.790	13.09	88.5	194.4	156.6	750	0.750	75.0	CONC	0.013	86.90	86.75	0.15	0.20	1.13	498	1.11	70%						
MH19A		MH18A		A07, A10	0.58	0.65	0.377	1.167	14.20	84.7	274.7	156.6	750	0.750	100.0	CONC	0.013	86.75	86.55	0.20	0.20	1.13	498	1.48	87%						
Catchement 101,102		MH18A		101,102	1.42	0.25	0.355	0.355				37.0														5-year Event Flow is obtained from Table 2.2 in Funtional Servicing Report					
Carriage Road		MH18A		200	4.11	0.51	2.096	2.096	12.92	89.1	519.3																				
MH18A		EX.MH		A11	0.14	0.61	0.085	1.252	15.68	80.1	278.9	713.0	1,350	1.350	65.0	CONC	0.013	86.50			0.10	1.18	1,688	0.92	59%						
EX.MH		MH18		A12	0.11	0.62	0.068	1.321	16.60	77.5	284.7	713.0	1,350	1.350	50.6	CONC	0.013				0.10	1.18	1,688	0.72	59%	Assumed Slope					
Garden Gate Terrace		MH18		210	1.84	0.51	0.938	0.938	13.14	88.3	230.4		600	0.600	67.9	CONC	0.013				0.40	1.37	388	0.82	59%						
MH18		EXMH2						2.259	17.32	75.7	475.1	943.4	1,350	1.350	46.8	CONC	0.013				0.30	2.04	2,923	0.38	49%	Assumed Slope					
EXMH2		EXMH3		A13	0.49	0.46	0.225	2.484	17.70	74.7	515.9	943.4	1,350	1.350	98.8	CONC	0.013				0.30	2.04	2,923	0.81	50%	Assumed Slope					
EXMH3		EXMH4		A14	0.30	0.47	0.141	2.625	18.51	72.7	530.9	943.4	1,350	1.350	86.8	CONC	0.013				0.30	2.04	2,923	0.71	50%	Assumed Slope					
EXMH4		OUTLET #2	SWM Pond					2.625	19.22	71.1	519.1	943.4	1,350	1.350	45.6	CONC	0.013				0.30	2.04	2,923	0.37	50%	Assumed Slope					
Greenlane, Draining from West to East																															
MH19		MH20		160	0.28	0.52	0.146	0.146	10.00	101.5	41.1		375	0.375	67.5	CONC	0.013	88.60	88.40	0.20	0.30	1	96	1.30	43%						
MH20		OUTLET #3	Ditch																												

				Town of Lincoln STORM SEWER DESIGN SHEET Proposed Condition																												
Project Name				Greenlane EA				Project # B001695				Town of Lincoln IDF Data				Storm		A	B	C	Town's Criteria:				Manning's n				Calculated By: YY			
Design Storm				5-Year				Rainfall Intensity: $I = A/(B+T)^C$ T= Time of Concentration in min				5-year				1039.2	7.00	0.82	V _{min} = 0.75 m/s				0.013 for Concrete				Checked By: MB					
Initial Time of Concentration				10 min												V _{max} = 4.50 m/s				0.024 for CSP												
LOCATION				RUNOFF DATA										PIPE DATA												TIME AND USAGE		COMMENTS				
From		TO		Catchment ID	Area A	Runoff Coeff. C	AC	Accum. AC	Time of Conc. T	Rainfall Intensity I	Runoff Q _{ac} = 2.78ACI	External Flow Rate	Nominal Pipe Dia.	Actual Pipe Dia.	Pipe Length	Pipe Type	Manning's n	U/S Invert Elev.	D/S Invert Elev.	Fall	Pipe Slope	Flow Velocity V _{full}	Pipe Capacity Q _{full}	Flow Time	Pipe Usage Q _{ac} / Q _{full}							
MH/ CB	Station	MH / CB	Station																													
No.		No.																									(ha)					
Greenlane, Draining from East to West																																
MH264		MH265		120	0.07	0.81	0.057	0.057	10.00	101.51	16.0		375	0.375	99.2	PVC	0.013	88.37	87.99	0.38	0.38	0.98	109	1.68	15%							
MH265		MH266		P03	0.17	0.75	0.128	0.184	11.68	93.95	48.1		525	0.525	101.4	PVC	0.013	87.88	87.72	0.15	0.15	0.77	167	2.19	29%							
MH266		MH267		P02	0.23	0.76	0.175	0.359	13.87	85.78	85.6		525	0.525	99.4	PVC	0.013	87.73	87.51	0.22	0.22	0.94	204	1.76	42%							
MH267		MH268		P01	0.30	0.77	0.231	0.590	15.63	80.26	131.6		525	0.525	60.5	PVC	0.013	87.51	87.30	0.21	0.34	1.17	252	0.87	52%							
MH268		OUTLET #1	Konkle Creek																													
Greenlane, Draining from West to East																																
MH27A		MH26A		140, 170, P04, P15	0.49	0.68	0.333	0.333	10.00	101.5	94.0		450	0.450	71.0	CONC	0.013	87.68	87.51	0.16	0.23	0.86	137	1.38	69%							
Catchment 180		MH26A		180	2.22						156.6		600	0.600	12.0	CONC	0.013		87.21		0.20	0.97	275	0.21	57%	Assumed the flow will be controlled as Existing Level						
MH26A		MH25A		P05, P16, A08	0.44	0.62	0.273	0.606	11.38	95.2	160.4	156.6	675	0.675	81.0	CONC	0.013	87.14	86.98	0.16	0.20	1.05	376	1.28	84%							
Catchment 201		MH19A		201	1.15	0.78						28.0														5-year Event Flow is obtained from Table 2.5 in Funtional Servicing Report						
MH25A		MH19A		P06, A09	0.64	0.52	0.333	0.939	12.66	90.1	235.1	184.6	750	0.750	75.0	CONC	0.013	86.90	86.75	0.15	0.20	1.13	498	1.11	84%							
MH19A		MH18A		P07, A10	0.58	0.73	0.423	1.362	13.77	86.1	326.1	184.6	825	0.825	100.0	CONC	0.013	86.75	86.55	0.20	0.20	1.20	642	1.39	80%							
Catchment 102		MH18A		102	0.17	0.25						6.0														5-year Event Flow is obtained from Table 2.2 in Funtional Servicing Report						
Carriage Road		MH18A		200	4.11	0.51	2.096	2.096	12.92	89.1	519.3																					
MH18A		EX.MH		P11	0.12	0.75	0.090	1.452	15.16	81.7	329.7	710.0	1,350	1.350	65.0	CONC	0.013	86.50			0.10	1.18	1,688	0.92	62%							
EX.MH		MH18		P12	0.08	0.75	0.060	1.512	16.08	79.0	332.0	710.0	1,350	1.350	50.6	CONC	0.013				0.10	1.18	1,688	0.72	62%	Assumed Slope						
Garden Gate Terrace		MH18		210	1.84	0.51	0.938	0.938	13.14	88.3	230.4		600	0.600	67.9	CONC	0.013				0.40	1.37	388	0.82	59%							
MH18		EXMH2						1.512	16.80	77.0	323.7	940.4	1,350	1.350	46.8	CONC	0.013				0.30	2.04	2,923	0.38	43%	Assumed Slope						
EXMH2		EXMH3		P13, P17	0.54	0.48	0.259	1.771	17.18	76.0	374.3	940.4	1,350	1.350	98.8	CONC	0.013				0.30	2.04	2,923	0.81	45%	Assumed Slope						
EXMH3		EXMH4		P14, P18	0.30	0.53	0.159	1.930	17.99	74.0	397.0	940.4	1,350	1.350	86.8	CONC	0.013				0.30	2.04	2,923	0.71	46%	Assumed Slope						
EXMH4		OUTLET #2	SWM Pond					1.930	18.70	72.3	388.0	940.4	1,350	1.350	45.6	CONC	0.013				0.30	2.04	2,923	0.37	45%	Assumed Slope						
Greenlane, Draining from West to East																																
MH19		MH20		160A, 160B	0.28	0.62	0.174	0.174	10.00	101.5	49.0		375	0.375	67.5	CONC	0.013	88.60	88.40	0.20	0.30	1	96	1.30	51%							
MH20		OUTLET #3	Ditch																													