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Appendix C
Stormwater Drainage Review Memo

***If technical reports are required in an alternative format for accessibility needs, please contact:**

Maged Elmadhoon, M.Eng., P.Eng.
Manager, Transportation Planning Public Works, Niagara Region
Phone: 905-980-6000 ext. 3583
Email: Maged.Elmadhoon@niagararegion.ca

R.J. Burnside & Associates Limited 6990 Creditview Road, Unit 2 Mississauga ON L5N 8R9 CANADA
telephone (905) 821-1800 **fax** (519) 941-8120 **web** www.rjburnside.com

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Technical Memorandum

Stormwater Drainage Review

Date: March 11, 2022 **Project No.:** 300051307.0000

Project Name: Municipal Class EA - Regional Road 43 (Bridge Street) and Adjacent Roads Stormwater Drainage Review

Client Name: Niagara Region

Submitted To: Ahmad Ishtiaq, P.Eng.

Submitted By: Harold Faulkner, P.Eng.

Reviewed By: Ahmad Ishtiaq, P.Eng.

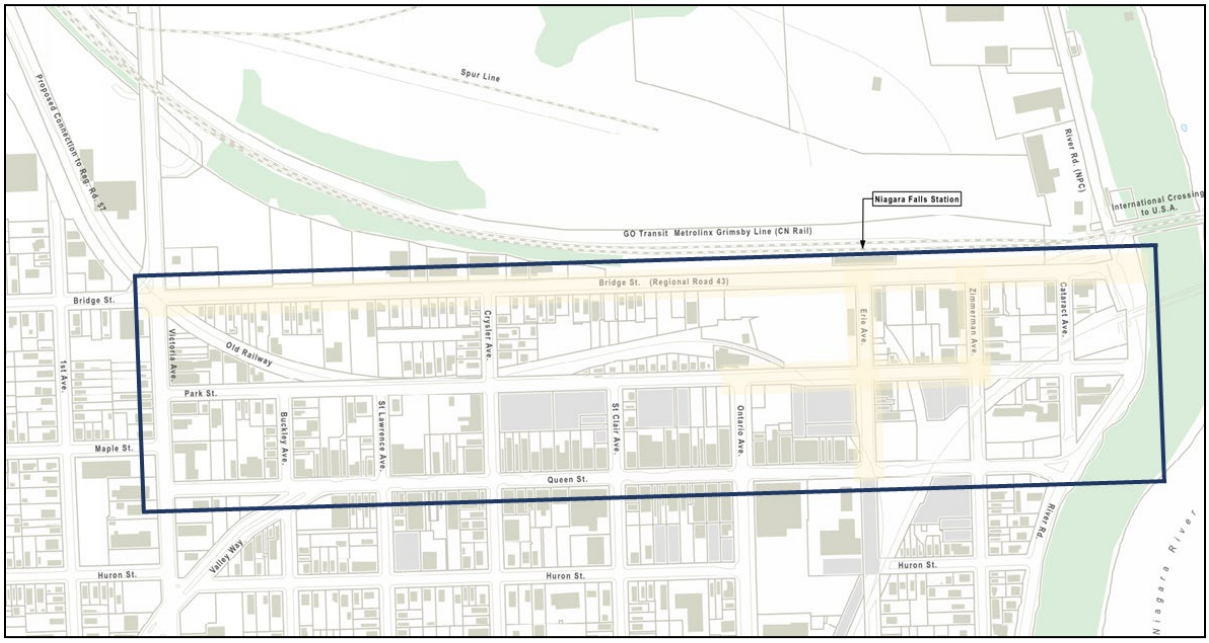
1.1 Background

R.J. Burnside & Associates Limited (Burnside) has been retained by Niagara Region (Region) to provide storm drainage design services in support of the Municipal Class Environmental Assessment (MCEA) Studies for the proposed improvements to Regional Road 43 (Bridge Street). The purpose of this memorandum is to provide a review of existing drainage conditions and summarize the constraints and stormwater management requirements resulting from the proposed improvements to Bridge Street. This memorandum also provides information on potential Low Impact Development (LID) design methodologies to be considered for detailed design that are being considered for these two road improvement projects. The Study Area is illustrated on Figure 1.

1.2 Study Area

The study area is bounded by Regional Road 43 (Bridge Street) in the north, River Road in the east, Queen Street in the south, and Victoria Avenue in the west. This review focuses on the drainage directly related to Bridge Street. The study area and project limits are shown in Figure 1.

Figure 1: Study Area



It is noted that the Victoria Avenue and Bridge Street intersection has been planned and designed through another MCEA for the extension of Regional Road 57 (Thorold Stone Road). The design of the Victoria Avenue and Bridge Street intersection as a roundabout is underway, hence analysis of the intersection is beyond the scope of this study.

1.3 Site Context

Land use within the study area consists primarily of residential with some commercial and parking uses. There are also transit facilities within the area, including stations for VIA Rail, Niagara Falls Transit, and GO Transit.

The existing road consists of an urbanized 18.3 m right-of-way (ROW) cross-section with two lanes and sidewalk on one or both sides of the road. An existing storm sewer system conveys minor runoff from west to east, with major flow going overland within the ROW. The north side of the road consists of commercial properties, as well as the VIA Rail Station. The south side of the road includes older, residential homes and some commercial properties, as well as the Niagara Falls Transit Station.

In the proposed condition, the existing drainage pattern and pavement width will be generally maintained, with a two-lane urbanized cross-section with sidewalk and bike lanes within the 18.3 m ROW. The existing storm sewers will also be retained where feasible. Where necessary, existing catch basin leads will be extended to accommodate adjustments to the roadway.

As part of the overall improvements to the area, bus laybys will be constructed on the north side of Bridge Street, east and west of the existing VIA Rail Station. These areas currently drain north, away from Bridge Street to the existing rail line. Runoff from these areas will be captured on-site, and any required stormwater management controls will be assessed during the detailed design of the station lands development.

2.0 Storm Drainage Considerations

2.1 Design Criteria

The relevant stormwater management design criteria documents are listed below:

- Niagara Region Complete Streets Design Guidelines, Niagara Region, June 2017;
- NPCA Stormwater Management Guidelines, Niagara Peninsula Conservation Authority, March 2010; and
- Stormwater Management Planning and Design Manual, Ontario Ministry of Environment, March 2003.

2.2 Topography and Drainage

Along Bridge Street the ground elevations range from 182 masl at Victoria Street down to 171 masl at River Road. Over the study area road length of 1 km, this results in a gentle slope of 1% from Victoria Avenue to River Road and the Niagara River in the east.

The Study Area is located in the Niagara River watershed within the jurisdiction of the Niagara Peninsula Conservation Authority (NPCA). The road is located outside of NPCA regulated area. This segment of Bridge Street does not include any watercourse crossings or culverts.

Bridge Street between Victoria Avenue and River Road consists of approximately 1.8 ha of ROW area, with approximately 6.6 ha of directly contributing external area, which includes existing commercial and residential runoff (See enclosed “Storm Drainage Area Plan – Downtown” prepared for the City of Niagara Falls). Most of the area directly north of Bridge Street drains north to the existing rail line, which ultimately discharges to the existing Bridge Street sewer east of Zimmerman Avenue. Contributing drainage areas will be confirmed as part of the design stage.

2.3 Conveyance

Conveyance of ROW runoff and external areas draining to the ROW is currently via existing storm sewers. The existing sewers appear to have been sized for the 1:5-year storm runoff, and will be assessed in detail during the design stage. It is anticipated the existing storm sewers will be maintained to provide conveyance of the improved road runoff. Runoff from storms exceeding the existing storm sewer capacity storm will be conveyed overland within the ROW to the east, as in the existing condition.

2.4 Stormwater Management Controls

Road improvements are not expected to result in a significant increased impervious area within the ROW, thereby resulting in a similar rate of storm runoff as in the existing condition. Peak flow analysis will be completed during the design stage to confirm post-improvement rates to not significantly exceed existing rates.

Similarly, road improvements are not expected to have a negative impact on existing stormwater runoff quality. Quality controls are not proposed as overall travelled impervious areas are not to be increased from the existing condition.

As a best management practice, low impact development (LID) measures are further discussed in Section 3.0.

3.0 Low Impact Development Measures

3.1 Benefits and Application of LID

Low Impact Development Best Management Practices (LID BMPs) can provide stormwater management benefits, including erosion control, quality control, temperature mitigation and water balance. Typically LID features are infiltration-based and include infiltration trenches, bioswales, vegetated swales, etc. located within the boulevards. These measures are to be implemented where it is determined they will be functional and will achieve the desired goal or protection. Implementation of LID features is highly dependent on soil type and groundwater levels.

Location-specific percolation rates and high groundwater elevations should be determined to complete a more detailed design of proposed LID infiltration measures. This information will also determine where functional infiltration-based LID measures are achievable. The geotechnical and borehole investigations shall be the guidance towards specific LID designs and locations during the detailed design process.

3.2 LID Design Options

LID uses cost-effective construction and building methods to store, filter and infiltrate rainwater and snow melt to the ground. LIDs mimic nature while cleaning and cooling surface water and evapotranspiration to manage localized flood risks while reducing stress to municipal stormwater infrastructure. Some of the more prevalent designs include:

1. **Box Trench Design** – This is a variable depth linear design to capture surface water quantity to hold, filter and infiltrate through a below ground perforated pipe system that is connected lineally. Pavement runoff may be collected through a series of catch basin inlets along the sides of the roadway and redirected into these units. They are also open to the sky to collect any precipitation and adjacent surface runoff. Each section shall have a small Hickenbottom structure to manage the water levels. These structures shall be planted with wet tolerant plant material and species pre-selected by the NPCA.

2. **Vegetated / Bio Swale Design** – This is a linear or meander application of water collection and conveyance from paved surfaces to larger bioretention and rain gardens. The effectiveness of this design is dependent on the size of the rain event and flow rates. This design will capture lower rates and flow volumes, allowing surface water (and contaminants) to filter through plant material and absorption media before infiltrating into the local subgrades.

3. **Bioretention and Rain Garden Design** – This is a stormwater infiltration practice that collects and treats runoff from paved surfaces utilizing the natural properties of vegetation and soil to trap and filter contaminants. This design requires a large surface area to be effective.

4. **Underground Storage Tanks** – Retains stormwater during peak flows and discharges it to the municipal storm sewer system.

5. **Infiltration Trenches and Soakaways** – Below ground clear stone infrastructure designed to capture precipitation and surface water for a timed release to the surrounding soils and / or into municipal stormwater management systems.

6. **Permeable Pavement** – A porous urban surface that infiltrates precipitation and surface water, storing it in its granular base while slowly allowing water to infiltrate into the subsoil below. This option is dependent on the local subsoil material.

7. **Above-Ground Rainwater Harvesting Tanks** – A gravity fed system that collects precipitation from upper level impervious surfaces such as building roofs and directed into rain barrels and storage tanks for reuse.

3.3 Applicability of LID for the Project

The study area includes highly urbanized roadway environments. These roads have constrained rights of way with limited opportunity for LID features; hence, it is not suitable to implement trenches, swales or rain gardens.

Permeable pavers may be feasible for the parking stalls on Zimmerman Avenue, the parking stalls north of Bridge Street east of the GO station and on the east boulevard of Erie Avenue.

As the detailed design process progresses, permeable pavement features may be considered.

R.J. Burnside & Associates Limited

Harold Faulkner, P.Eng.
Water Resources Engineer
HF:sm

Enclosure(s) Bridge St STM Sheet
STM Drainage Areas Downtown

The City of Niagara Falls Canada

STORM SEWER DESIGN

COMPUTATION SHEET 85-CA-69

REVISED ☐☐☐ ☐☐☐

PROJECT LOCATION: BRIDGE ST.

REF. PLAN NO.:

☐ PRELIMINARY ☒ FINAL

DATE: MAR 3/97
DESIGN: RC
CHECK:
FILE NO.: 97-153-96
SHEET 1 OF 1

E-3

STREET	MANHOLE FROM	MANHOLE TO	AREA	DRAINAGE AREAS A (HECTARES)	RUNOFF COEFFICIENT R	A R	Σ A R	TIME OF CONCENTRATION T (MINUTES)	RAINFALL INTENSITY I (mm/HR)	FLOW IN PIPE Q (l/s)	PIPE SIZE (mm)	SLOPE % S	n	PIPE CAPACITY (l/s)	FLOW VELOCITY (m/s)	PIPE LENGTH (m)	TIME IN PIPE (MIN.)	FALL IN METRES	INVERT ELEVATION UP STREAM	INVERT ELEVATION DOWN STREAM
BRIDGE ST	S10	S9	A	3.16	0.80	2.53	2.53	10	88.69	623.8	675	0.54	.013	644.7	1.75	369	3.51		178.00	176.01
" "	S9	S8	B	3.29	0.85	2.80	5.33	13.51	75.97	1125.7	825	0.86	.013	1390.3	2.52	371	2.45		175.90	172.71
" "	S8	S7	C	0.90	0.85	0.77	6.10	15.96	69.35	1176.0	825	0.64	.013	1199.4	2.17	148	1.14		172.16	171.213
RAIL LANDS			E	31.79	0.76	24.16	24.16	10	88.69	5956.8	1350	1.50	.013	6825.7	4.62	50.22	0.18		170.300	169.547
BRIDGE ST.	S7	S6	D	0.42	0.85	0.36	30.62	17.10	66.72	5679.4	1500	0.60	.013	5715.9	3.13	140.5	0.75		166.643	165.8
" "	S6	S5					30.62				1650	0.75	.013	8239.8	3.74	17.0	0.08		165.765	165.637
CATARACT	S5	S4	F	0.67	0.85	0.57	31.19	17.93	64.94	5630.8	1650	0.75	.013	8239.8	3.74	88.97			165.617	164.949

LAND USE :	RUNOFF COEFFICIENT		
INDUSTRIAL : WAREHOUSE, PRESTIGE, HEAVY.	0.75	0.65	0.75
COMMERCIAL : DOWNTOWN, SUBURBAN, TOURIST.	0.85	0.75	0.75

LAND USE :	RUNOFF COEFFICIENT		
OTHER : HIGHWAY PAVEMENT, SODDED SLOPE, PARK	0.95	0.30	0.20
RESIDENTIAL SUBDIVISION, ROWHOUSING, APARTMENT.	0.40	0.50	0.60

$Q = K A i R$ $\quad K = 2.78$

$i = \frac{2667}{T + 20}$

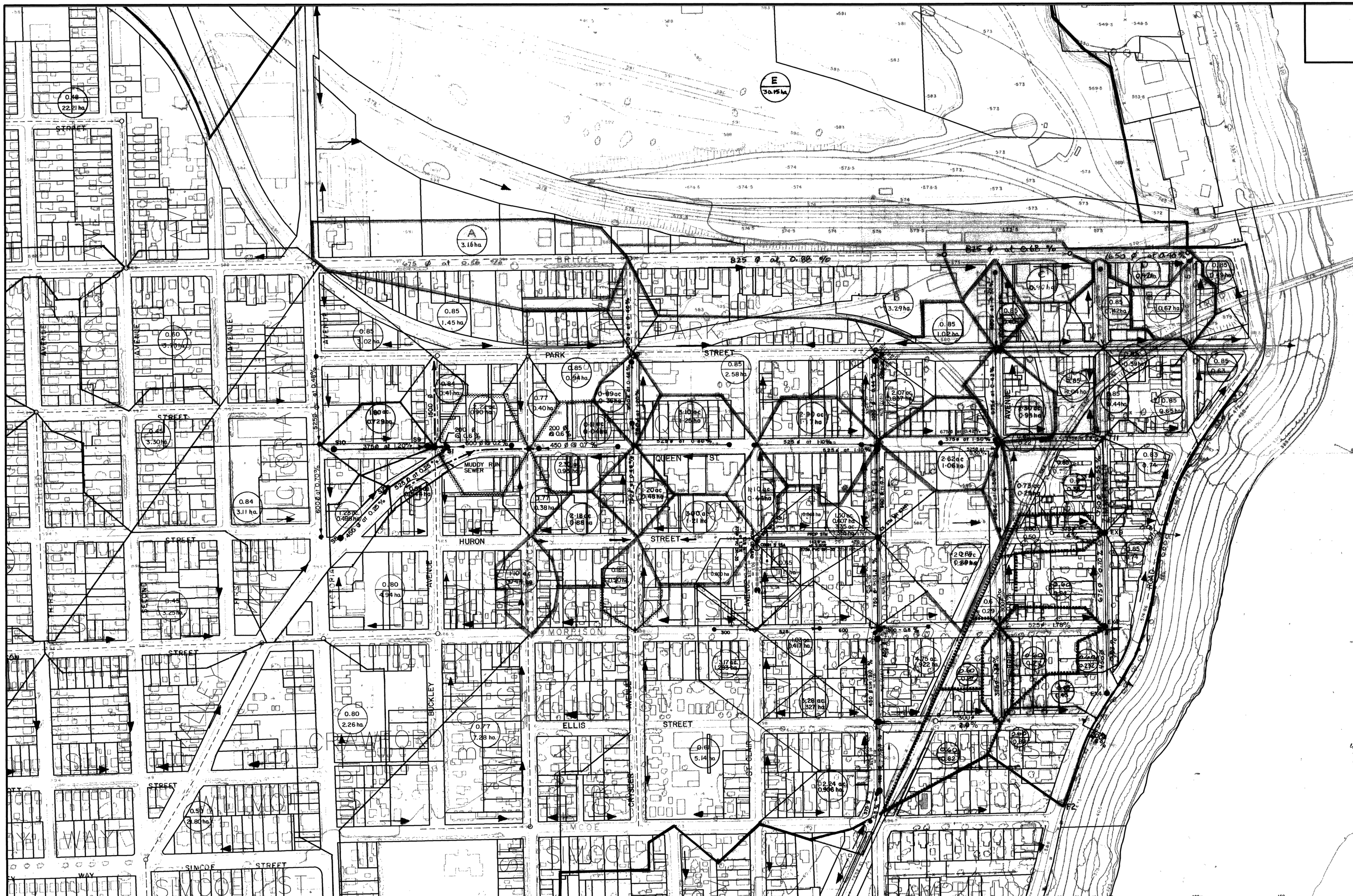
X-ing Under Muddy Run

5 YR. DESIGN

5YR $\quad i = \frac{603.021}{(T + 4.544)^{0.716}}$

2YR $\quad i = \frac{506.908}{(T + 5.238)^{0.743}}$

85-CA-69



8	ADDED HURON ST DRAINAGE AREA (REV. TO METRIC)	04/06/01	B.D.
7	ADDED MORRISON/HURON/ERIE/ELLIS DRAINAGE AREA	99/04/07	T.K.
6	ADDED ZIMMERMAN AVE. DRAINAGE AREA	98/08/20	B.D.
5	ADDED BRIDGE STREET DRAINAGE AREA	97/06/18	B.D.
4	ADDED PARK ST. DRAINAGE AREA	95/01/31	N.H.
3	ADDED VALLEYWAY OUTLET DRAINAGE AREA	94/10/28	N.H.
2	ADDED VALLEYWAY STM MH'S S7,S8	90/07/26	B.D.
1	STORM DRAINAGE AREAS BY DELCAN	87/06/22	B.D.
	REVISION	DATE	INIT.

CNP YY/MM/DD
N.F. HYDRO YY/MM/DD
ONTARIO HYDRO YY/MM/DD
GAS YY/MM/DD
BELL YY/MM/DD
CATV YY/MM/DD

NOTES:

(A) — DRAINAGE AREA (in ACRES & HECTARES)

EXIST SEWER
FUTURE SEWER
PROP SEWER

LEGEND

LS	LIGHT STANDARD
TL	TRAFFIC LIGHT
S	SIGN
B	BELL POLE
H	HYDRO POLE
HYD.	HYDRANT
	GUY AND ANCHOR
	MANHOLE EXISTING
	MANHOLE PROPOSED
	CATCHBASIN EXISTING
	CATCHBASIN PROPOSED
S.I.B.	STANDARD IRON BAR

UNDERGROUND UTILITIES

—H—	HYDRO CABLES
—o—W—	WATERMAINS
—o—G—	GASMAINS
—B—	BELL CABLES
	CAP OR PLUG
300 SAN.	SANITARY SEWER
300 STM.	STORM SEWER
300 COMB.	COMBINED SEWER

DRAFTING	B.E.S.
DESIGN	B.E.S.
CHECKED BY	?
PROJ. SUPVR.	B.D.

LICENSED PROFESSIONAL ENGINEER
D.E. SMITH
Jun 8/05
PROVINCE OF ONTARIO

The City of
Niagara Falls
Canada

BENCH MARK DATUM
G.B.M. No. 3551
ON POST OFFICE — NORTH WALL OF BLDG. ALONG QUEEN STREET
ELEV. 179.972

STORM DRAINAGE AREA

DOWNTOWN

FIELD NOTES	
DATE	APRIL 1984
SCALE HOR.	1:2000
VER.	
DWG No.	
MUN. REF. No.	85-CA-69
REV.	8