1649 St Clair Ave W
Toronto, ON Canada M6N 1H7

Proposed Stacked Townhouses
6645-6665 McLeod Rd

Stormwater Management Report

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1.0 Project Location

This report examines the impacts the proposed development will have on the run-off and sedimentation from the site and measures to mitigate those impacts for the proposed residential buildings development in which located at 6645-6665 McLeod Road, Niagara Falls, Ontario. The Report has used the following documentation in its preparation:

1. Site Plan prepared by MXL Engineering & Assciates.
2. The current City of Niagara Falls City Standards
3. The current Niagara Region Stormwater Management Guidelines
4. Stormwater Management Planning and Design Manual by the Ministry of the Environment, dated March 2003.

2.0 Scope of Report

The purpose of this report is to study stormwater management design criteria typically provided in such plans are to:

1. Preserve groundwater and base flow characteristics
2. Prevent undesirable and costly geometric change in the watercourse
3. Prevent any increase in flood risk potential
4. Protect water quality for human uses.
5. Calculate and describe the control measures taken for proposed development to control rain and storm water run-off on the entire property.
6. Identify all issues that require facilities, for the City of Niagara Falls approvals, including impacts of drainage to the Streets.

3.0 Methodology

In order to successfully complete the storm water management study for this site, the following specific tasks were undertaken:

1. Calculate the allowable runoff rates using rational method.
2. Determine the percent impervious of the site post-development value = 0.8.
3. Calculate post development runoff hydrographs.
4. Pre-development of existing site C value = 0.2.
5. Post-development C value = 0.8.

4.0 Existing Site Surface Conditions

The site consists of 4220.12 square meters including road widening parcel area and 66.28 meters fronting on McLeod Road. 42 stacked townhouse units are to be constructed at this location with site services and 46 parking spaces.

New proposed storm water management facilities (SWM) have to be implemented to satisfy the criteria outlined by City of Niagara Falls and control measures have to be incorporated in the design for quality and quantity of the storm water leaving the subject site.

We have considered in calculations the development areas covering proposed buildings, landscaped and parking areas.

5.0 Quantity Control

The site allows for a pre-development maximum runoff coefficient of 0.2 and a time of concentration of 10 minutes. The City of Niagara Falls requires that post-development run-off shall match the pre-development runoff for the 100-year storm events based on a post-development time of concentration of 10 minutes. Any excess runoff will be discharged at pre-development rates so there is no impact on the existing stormwater management regime.

6.0 Post Development Conditions

The design of storm sewers computed in accordance with jurisdiction of the City of Niagara Falls. The extent of the proposed development consists of new buildings, driveways, parking as shown on Architectural plans, landscaped areas and site grading.

Proposed Building

The following are the criteria of post development conditions:

Used Description	Area (square meters)	Percentage
Total Building Roof Area	1059.67	25.11
Paved/Concrete Surfaces	2162.89	51.25
Landscaped, Grass, etc.	997.56	23.64
Total Area	4220.12	100

The post-development site storm discharge was designed to achieve all vegetated surfaces below the cut off elevation shall be drained to the road at equal runoff flows as existing conditions.

7.0 Rainfall Intensity Duration – Frequency Curve Equation

An IDF (Intensity Duration Frequency) curve is a statistical of the expected rainfall intensity for a given duration and storm frequency.

The intensity duration frequency equations and data are used for calculating required storm water storage capacity to limit the peak flow. Equation of IDF curve is:

$$I = \frac{A}{(B+t)^C}$$

Or

$$I = AT^C$$

Where,

I is rainfall intensity in mm/hr
T is time in hours (use 10 minutes for time of concentration)
A, *B* and *C* are shown as below:

Return Period (years)	*A*	*B*	*C*
2	521.97	5.28	0.7590
5	719.50	6.34	0.7687
10	870.09	6.81	0.7738
25	1020.69	7.29	0.7790
50	1142.00	7.50	0.7800
100	1264.57	7.72	0.7814

Method of calculation:

Using Rational Method;

$$Q = \frac{AIC}{360}$$

Where,

Q = Runoff Volume, in m^3/sec
A = Area contributing to runoff, in Ha
I = Rainfall intensity in mm/hr
C = Runoff Coefficient, dimensionless

Time of Concentration (T.C.) = 10 minutes

Refer to appendices for the computer printout calculations.

It is proposed to design for domestic water, fire services, sanitary and storm services in order to meet the current standards. Following is a brief description of each service.

Discharge is calculated using Rational Method Formula:

$$Q = 0.00278CIA$$

Where,

Q = Runoff Volume, in m^3/sec
A = Area contributing to runoff, in Ha
I = Rainfall intensity in mm/hr
C = Runoff Coefficient, dimensionless

Time of Concentration (T.C.) = 10 min. pre-development and 10 for post development. Refer to appendices for the computer printout calculations.

8.0 Proposed Services to the Buildings

9.1 Water Service

New 150mm diameter PVC watermain supply line is proposed. New incoming water service lines and water meters to be located in each townhouse prior to design and recommendation from mechanical consultant engineer in accordance with the jurisdiction of the City of Niagara Falls.

New water services to the buildings are 100mm diameter soft copper type ‘k’ serving domestic water line complete with City water meter installed in basement mechanical room. Only one water line service is connected to the proposed watermain. City water meter remote control shall be located outside the building in location to suit site construction and City approvals.

9.2 Sanitary Service

A new 150 diameter PVC sanitary sewer is proposed. Road cuts of new services shall be carried out in accordance with City requirements and reinstatements are required as per City of Niagara Falls.

9.3 Storm Service

New storm service required and grading resulting in storm water run-off from the site.

The proposed building will have a flat roof complete with flow-controlled roof drains connected to rainwater leaders which will discharge at grade.

The existing buildings have rainwater leader lines discharged onto grade with landscaped areas and existing driveway areas.

9.0 Erosion and Sedimentation Control

In order to minimize the effects of erosion during the grading of the site, sediment control fencing shall be installed around stockpiles on site prior to stripping topsoil and around catch basin during construction phase.

The erosion and sediment control shall be designed, constructed and maintained on site in accordance with the City of Niagara Falls requirements. The sediment fence shall be maintained until all construction is complete. Use of catch basin silt sacks and a sediment control mat at the entrance to be implemented. Any sediment that is tracked onto the roadway during the course of construction shall be cleaned by the contractor.

10.0 Storm Water Quantity Control

The proposed buildings will have a flat roof area of 1059.67m^2 complete with roof drains that will be piped through rainwater leaders and discharged to exterior landscaped areas.

The discharge of storm water will be achieved by ground infiltration, evaporation, landscaped areas. The allowable overall storm water volume is retained on site and discharged to natural pathways and the overland runoff for post development events is directed toward the streets.

Low Impact Development: An Alternative Site Design Strategy

Low Impact Development (LID) is an alternative site design strategy that uses natural and engineered infiltration and storage techniques to control storm water where it is generated. LID reintroduces the hydrologic and environmental functions that are altered with conventional storm water management. LID helps to maintain the water balance on a site and reduces the detrimental effects that traditional end-of-pipe systems have on waterways and the groundwater supply. LID devices provide temporary retention areas; increase infiltration through landscaped areas and control the release of storm water into adjacent waterways.

Some examples of LID technologies include:

- **Engineered systems** that filter storm water from parking lots and impervious surfaces, such as bioretention cells, filter strips, and tree box filters;
- **Engineered systems** that retain (or store) storm water and slowly infiltrate water, such as sub-surface collection facilities under landscape lots, bioretention cells, and infiltration trenches;
- **Modifications to infrastructure** to decrease the amount of impervious surfaces such as curbless, gutterless, and reduced width streets;
- **Low-tech vegetated areas** that filter, direct, and retain storm water such as rain gardens and bio-swales;
- **Innovative materials** that help break up (disconnect) impervious surfaces or are made of recycled material such as porous concrete, permeable pavers, or site furnishings made of recycled waste;
- **Water collection systems** such as subsurface collection facilities, cisterns, or rain barrels; and
- **Native or site-appropriate vegetation.** Subsurface retention facilities are typically constructed below landscape or parking lots (either permeable or impervious) and can be built to any depth to retain, filter, infiltrate, and alter the runoff volume and timing. This practice is well suited to dense urban areas. Subsurface facilities can provide a considerable amount of runoff storage.

  Approximate landscape area near (adjusting) rainwater leaders = 1000m^2,
  300mm top soil,
  300mm buried crushed stones below top soil,
  Assumed percolation rate 40 minutes per inch of percolation.

The porous landscape area shown on landscape drawings shall be used for storm retention and allow infiltration gallery below it for storm water retention. The water is filtered through the stone aggregate and infiltrates into the ground at assumed maximum percolation time 24 hours.

Table 1: Pre and Post Development Flows

	Event	**Runoff (m^3/s)**
Pre-Development (before construction)	5 years	0.0197
	100 years	0.0314
Post- Development (after construction)	5 years	0.0789
	100 years	0.1256

The pre-development and post-development release rate generated from areas are not the same quantities and flow requirements for post development will be controlled with installation roof-controlled drains. There will be no external drainage flowing towards the site and proposed water storage ponding does not occur in the parking area for 5 or 100-year storm events.

The proposed storm water management system for this site development will maintain the pre-development (existing) surface and ground water divides for all design storms up to and including the 100-year event of post development. The water quantity and surface runoff are controlled throughout the site by ground infiltration, evaporation, landscaped areas and new storm pipe flow system.

The proposed storm water management plan will incorporate LID practices to promote infiltration where feasible. Water quantity controls for the property will be provided via a combination of underground storm sewer and storm structures.

11.0 Weeping Drain Tiles

Weeping tile to be installed at the footing/foundation perimeter to a sump pump in the basement of each townhouse and discharge to exterior. The design to be included by the mechanical engineering base building permit application drawings.

12.0 Conclusion and Recommendations

1) In Conclusion, the site development will be provided with a complete storm drain system, site grading and existing sidewalks surface elevations.
2) Post development flow release rate is calculated, and stormwater runoff is discharged as shown on drawings to match existing site condition.
3) The new proposed SWM facilities designed to control the release rate as indicated through the report and plans.
4) The site will be fully developed as detailed on site servicing plans and Architectural drawings.
5) The site grading to be undertaken according to the proposed elevations, details and erosion control measures.
6) Upon completion of construction, the site shall be confirmed to the design criteria specified to meet the City of Niagara Falls Standards and requirements.
7) Existing eternal flow path is out of our scope of this report and site development.
8) Overland storm route water runoff into City's streets shall occur after the 100-years storm event is adequate.
9) Site inspection during construction is required by a professional engineer.

I have included storm water management design calculations for this development. The existing and proposed conditions presented indicate the post development conditions will be improved, this will meet the City of Niagara Falls requirements and the proposed development can safely be carried out. This report is issued for site plan approval and building permit.

It is recommended that:

i. The site grading is undertaken according to the proposed elevations, details and erosion control measures.
ii. The storm water management system shall be installed as detailed on engineering drawings.
iii. The storm water management faculties to be inspected by certified professional engineer during construction.

Yours truly,

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Appendices

Sanitary Drainage System

Item Number	Description	Fixture Type	Quantity	Drainage Fixture Unit	Total Per Fixture
1	All Buildings	Lav	68	1 ½	102
2		KS	42	1 ½	63
3		W.C.	64	4	256
4		Bath	58	1 ½	87
5		Laundry	42	2	84
6		F.D.	42	3	126
	Sub Total				718

Required total drainage fixture unit Hydraulic Load (DFU) = 718 DFU

Use sanitary main service line = 200mm (8”) Dia.

Cold Water Demand per Fixture Load Calculation

Item Number	Description	Fixture Type	Quantity	Cold Water Demand		Remarks
				Load Values	Total	
1	All Buildings	Lav	68	¾	51	
2		KS	42	1 ½	63	
3		W.C.	64	3	192	
4		D.W.	24	1.4	33.6	
5		Bath	58	1	58	
6		Laundry	42	1	42	
	Sub Total				439.6	

Total load values, in cold water supply Fixture Units = 439.6

Use 4” (100mm) DIA. Domestic cold watermain supply pipe for the development. (Not including fire line)

Rainfall Intensities for a 4-hour Design Storm

T.C. (min): 10

Time (min.)	I (mm/hr)					
	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
10	65.90	84.02	98.00	110.83	122.49	133.78
20	44.97	58.21	68.29	77.67	86.10	94.31
30	34.92	45.45	53.43	60.90	67.60	74.13
40	28.89	37.71	44.37	50.61	56.21	61.69
50	24.83	32.45	38.19	4359	48.43	53.17
60	21.89	28.62	33.69	38.45	42.74	46.93
70	19.64	25.69	30.24	34.52	38.37	42.14
80	17.87	23.37	27.51	31.40	34.91	38.34
90	16.43	21.48	25.28	28.85	32.08	35.23
100	15.23	19.91	23.43	26.74	29.73	32.65
110	14.22	18.58	21.86	24.94	27.74	30.46
120	13.35	17.44	20.52	23.40	26.02	28.58
130	12.59	16.45	19.35	22.06	24.54	26.95
140	11.93	15.58	18.32	20.89	23.23	25.51
150	11.34	14.81	17.41	19.85	22.07	24.24
160	10.81	14.12	16.60	18.92	21.03	23.10
170	10.34	13.50	15.87	18.08	20.10	22.08
180	9.92	12.94	15.20	17.32	19.26	21.16
190	9.53	12.43	14.60	16.63	18.50	20.31
200	9.17	11.96	14.05	16.01	17.80	19.55
210	8.85	11.53	13.55	15.43	17.16	18.84
220	8.55	11.14	13.08	14.90	16.57	18.19
230	8.27	10.78	12.65	14.41	16.02	17.59
240	8.01	10.44	12.26	13.95	15.51	17.03

Pre-Development of Existing Land Before Construction

Pre-Construction C: 0.2

Roof (ha):	0.0457
Paved (ha):	0.0491
Grass (ha):	0.3272
Total Area (ha):	0.4220

5 Year Storm
Q = 0.00278(0.2)84.02(0.4220) = 0.0197m^3/s

100 Year Storm
Q = 0.00278(0.2)133.78(0.4220) = 0.0314m^3/s

Post-Development of Proposed Buildings

Post-Construction C: 0.8

Roof (ha):	0.1060
Paved (ha):	0.2163
Grass (ha):	0.0997
Total Area (ha):	0.4220

5 Year Storm
Q = 0.00278(0.8)84.02(0.4220) = 0.0789m^3/s

100 Year Storm
Q =0.00278(0.8)133.78(0.4220) = 0.1256m^3/s