# 106 MAIN STREET

# TOWN OF NEWMARKET

# STORMWATER MANAGEMENT REPORT

**Prepared for:**

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**BCI Project No. 16-08**

**September, 2016**

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## 1. INTRODUCTION

The site is located on the west side of Main Street in Newmarket, Ontario.

It is proposed renovate the existing commercial building to provide a residential unit above the ground floor commercial unit.

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.

The Report has used the following documentation in its preparation:

1. Site Plan prepared by Groundswell Urban Planners.
2. Town of Newmarket Design Criteria.
3. Stormwater Management Planning and Design Manual by the Ministry of Environment, dated March 2003.

## 2. EXISTING SITE CONDITIONS

The site is currently occupied by a single building, driveway and parking at the rear and measures 0.0651 ha. The driveway and parking area are surfaced with well compacted gravel.

The site drains to the west apart from a small area (28$m^2$) at the front which drains to Main Street where it is directed to a 300 mm diameter storm sewer in Main Street.

The rear of the site is crossed by a 6.0m wide storm sewer easement containing a 250mm diameter storm sewer.

The site drains to a parking area at the west and north side and runoff is collected in catchbasins in the parking area.

This Report deals with the 0.0623 ha. area that drains to the west with the front portion draining as at present.

## 3. HYDROLOGY

The Town of Newmarket require that pre-development run-off conditions be maintained for the 2-100 year storm events with additional runoff retained on site and discharged at pre-development rates.

Rainfall Distributions and Flows

Rainfall intensities have been based on the Town of Newmarket IDF curves defined by the following equation and values:

$$I = \frac{A}{(T+B)^C} \text{ mm/m}$$

| Storm | A | B | C |
|---|---|---|---|
| 2 year | 648 | 4 | 0.784 |
| 5 year | 930 | 4 | 0.798 |
| 10 year | 1021 | 3 | 0.787 |
| 25 year | 1100 | 2 | 0.776 |
| 50 year | 1488 | 3 | 0.803 |
| 100 year | 1770 | 4 | 0.820 |

and T = duration (min.)

Assuming a duration of 10 minutes for this size of site, the following are the rainfall intensities used in the calculation of the Pre-Development flows.

| | |
|---|---|
| 2 Year Storm | 81.85 mm/hr |
| 5 Year Storm | 113.21 mm/hr |
| 10 Year Storm | 135.63 mm/hr |
| 25 Year Storm | 159.94 mm/hr |
| 50 Year Storm | 189.72 mm/hr |
| 100 Year Storm | 203.31 mm/hr |

Calculation of the Impermeability Factors has been based on the following impermeability factors:

| | 2–10 Year | 25 Year | 50 Year | 100 Year |
|---|---|---|---|---|
| Buildings | 0.90 | 1.00 | 1.00 | 1.00 |
| Paving | 0.90 | 1.00 | 1.00 | 1.00 |
| Gravel | 0.80 | 0.88 | 0.96 | 1.00 |
| Grass/Landscape | 0.30 | 0.33 | 0.36 | 0.38 |

The impermeability factors for the lower figures have been increased for the 25, 50 and 100 year storms by 10%, 20% and 25% respectively as recommended by MTO Design Chart 1.07.

The 2 - 10 year Pre-Development characteristics for the site are as follows:

| | | |
|---|---|---|
| Buildings | 132 sq.m. @ 0.90 | = 118.8 |
| Gravel | 262 sq.m. @ 0.80 | = 209.6 |
| Concrete | 21 sq.m. @ 0.90 | = 18.9 |
| Pavers | 15 sq.m. @ 0.70 | = 10.5 |
| Grass/Landscape | 193 sq.m. @ 0.30 | = 57.9 |
| | TOTAL | 415.7 |

The 2 - 10 year Pre-Development Impermeability Factor $= \frac{415.7}{623.0} = 0.67$

The 25 year, 50 year and 100 year Pre-Development Impermeability Factors increase to 0.79, 0.80 and 0.80 respectively.

The 2 - 10 year Post-Development characteristics for the site are as follows:

| | | |
|---|---|---|
| Building | 124 sq.m. @ 0.90 | = 111.6 |
| Paving | 349 sq.m. @ 0.90 | = 314.1 |
| Grass/Landscape | 150 sq.m. @ 0.30 | = 45.0 |
| | TOTAL | 470.7 |

The 2 - 10 year Post-Development Impermeability Factor $= \frac{470.7}{623.0} = 0.76$

The 25 year, 50 year and 100 year Post-Development Impermeability Factors increase to 0.84, 0.85 and 0.85 respectively.

Discharges have been calculated using the formula $Q = \frac{Api}{0.36}$

where Q = discharge (l/sec)
A = area (ha)
p = impermeability factor
i = rainfall intensity (mm/hr)

Retention volumes have been calculated based on the equation.

$V = (\text{Post-Development Flow} - \text{Pre-Development Flow}) \times \frac{T \times 60}{1000}$ cu.m.

Discharge from the site will be controlled to Pre-Development values using a “V”-notch weir in the curb for the parking area.

Post-Development flows were calculated for the site for various times of concentration and the maximum retention volume for each storm was found. Details are shown in Appendix l.

Table 1 shows details of the retention volumes for each storm.

**TABLE 1**

| STORM | PRE-DEVELOPMENT FLOW (l/sec.) | RETENTION VOLUME (cu.m.) |
|---|---|---|
| 2 Year | 9.49 | 1.73 |
| 5 Year | 13.13 | 2.43 |
| 10 Year | 15.73 | 3.19 |
| 25 Year | 21.82 | 4.32 |
| 50 Year | 26.21 | 4.72 |
| 100 Year | 28.15 | 4.60 |

Runoff from the parking area and house will sheet flow to the west side of the parking lot where it will be collected by a new catchbasin connecting to the existing storm sewer running through the site.

The major storm overflow from the site will continue to be to the west to the existing parking lot.

## 4. CONVEYANCE

It is proposed to sheet drain flows from the parking area to the northwest corner of the new parking area.

Prior to leaving the parking area, the curb will have a "V"-notch weir to restrict the flows to the allowable values.

On-site storage is surface storage on the proposed parking area.

The 100 year retention volume will result in a depth of the ponded water at the 'V' notch of 0.246m.

The size of the 'v' notch is calculated using the formula:

$$Q = Cd \frac{8}{15} \sqrt{2g} \, Tan \frac{\propto}{2} H^{5/2}$$

where, Q = discharge (c.m.s.)
Cd = 0.60
H = head (m)
$\propto$ = angle of the notch

For the 100 year storm

$$0.02815 = 0.60 \times \frac{8}{15} \sqrt{2g} \times Tan \frac{\propto}{2} \times 0.246^{5/2}$$

$$Tan \frac{\propto}{2} = 0.6616$$

$$\propto = 67^0$$

This calculation was carried out for all storm events with the 10 year storm requiring the lowest weir angle of $53.5^0$. This has been used to design the control weir outlet.

Outlet discharges for the various storms are shown in Table 2 along with the retention volumes.

**TABLE 2**

| STORM | PRE-DEVELOPMENT FLOW (l/sec.) | RETENTION VOLUME (cu.m) | DISCHARGE (l/sec) |
|---|---|---|---|
| 2 Year | 9.49 | 1.73 | 9.46 |
| 5 Year | 13.13 | 2.43 | 12.56 |
| 10 Year | 15.73 | 3.19 | 15.73 |
| 25 Year | 21.82 | 4.32 | 20.30 |
| 50 Year | 26.21 | 4.72 | 21.83 |
| 100 Year | 28.15 | 4.60 | 21.37 |

The stage-storage-discharge calculations are shown in Appendix II.

The major storm overflow from the site will be to the west as at present.

## 5. QUALITY CONTROL

The Town of Newmarket and Lake Simcoe Region Conservation Authority require that all parking and access areas be provided with a facility to prevent fuel spills and sediment from entering the storm sewer system. It is proposed to provide a filter bed to deal with the quality control of the run-off from the parking area.

Table 3.2 in the MOE Stormwater Management Planning and Design Manual requires a filter medium volume of 37 cu.m./ha. for a site with a 76% impermeability factor. This will result in a filter bed volume of 2.31 cu.m.

The area of the filter bed is calculated by the equation:

$$A = \frac{1000Vd}{k(h+d)t}$$

Where
- $A$ = surface area of the filter($m^2$)
- $V$ = volume to be infiltrated ($m^3$)
- $d$ = depth of the controlling filter medium(m)
- $k$ = coefficient of permeability of the controlling filter medium
- $h$ = operating head of water on the filter(m)
- $t$ = Retention time (hr)

It is assumed that sand has a percolation rate of 45 mm/hr.
Therefore, for infiltration,

$$A = \frac{1000 \times 2.31 \times 0.25}{45 \times (0.10+0.25) \times 24}$$
$$= 1.74 \text{ m}^2$$

It is proposed to provide a 2.0m x 2.0 m filter bed giving an area of 4.0 $m^2$ and a depth of 0.25m.

## 6. SEDIMENTATION AND EROSION CONTROL

Sedimentation and erosion controls should be provided during construction using the following techniques depending on site development phasing and seasonal considerations:

1) Minimizing the amount of disturbance to the site
2) Grading and vegetating disturbed areas as soon as possible after disturbance
3) Protection of catchbasins during construction
4) Place a Silt Fence around the construction area

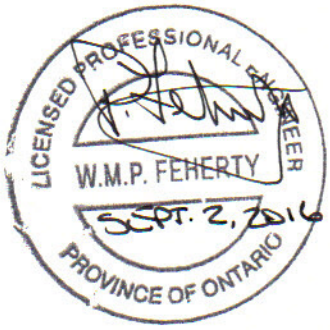
All sedimentation and erosion control measured should be carried out in accordance with current Town of Newmarket and Ministry of Natural Resources guidelines.

## 7. SUMMARY

This Report has presented stormwater management details for the development and is to be used as the basis for the detailed project design.

The key points are:

1. Discharges from the site will be controlled to the Pre-Development flows.
2. Excess run-off will be retained on site and discharged at the Pre-Development flows.
3. A filter bed will be installed to provide quality control.
4. Sedimentation and erosion controls will be provided during construction.

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# APPENDIX I
# RETENTION VOLUME CALCULATIONS

**106 MAIN STREET**
**NEWMARKET**
**RAINFALL AND RETENTION VOLUME CALCULATIONS**
**September, 2016**

Rainfall, $I = \frac{A}{(T+B)^C}$ mm./hr.

2 YEAR STORM

| T | A | B | T+B | C | $(T+B)^C$ | I | PRE Q | POST Q | POST-PRE | RET. VOL. |
|---|---|---|---|---|---|---|---|---|---|---|
| min | | | | | | mm/hr | l/sec | l/sec | l/sec | cu m |
| 2 | 648 | 4 | 6 | 0.784 | 4.07 | 159.04 | 9.49 | 20.91 | 11.42 | 1.37 |
| 3 | 648 | 4 | 7 | 0.784 | 4.60 | 140.93 | 9.49 | 18.53 | 9.04 | 1.63 |
| 4 | 648 | 4 | 8 | 0.784 | 5.11 | 126.93 | 9.49 | 16.69 | 7.20 | 1.73 |
| 5 | 648 | 4 | 9 | 0.784 | 5.60 | 115.73 | 9.49 | 15.22 | 5.73 | 1.72 |
| 6 | 648 | 4 | 10 | 0.784 | 6.08 | 106.56 | 9.49 | 14.01 | 4.52 | 1.63 |
| 7 | 648 | 4 | 11 | 0.784 | 6.55 | 98.88 | 9.49 | 13.00 | 3.51 | 1.48 |
| 8 | 648 | 4 | 12 | 0.784 | 7.02 | 92.36 | 9.49 | 12.15 | 2.66 | 1.27 |
| 9 | 648 | 4 | 13 | 0.784 | 7.47 | 86.74 | 9.49 | 11.41 | 1.92 | 1.04 |
| 10 | 648 | 4 | 14 | 0.784 | 7.92 | 81.85 | 9.49 | 10.76 | 1.27 | 0.76 |

5 YEAR STORM

| T | A | B | T+B | C | $(T+B)^C$ | I | PRE Q | POST Q | POST-PRE | RET. VOL. |
|---|---|---|---|---|---|---|---|---|---|---|
| min | | | | | | mm/hr | l/sec | l/sec | l/sec | cu m |
| 2 | 930 | 4 | 6 | 0.798 | 4.18 | 222.60 | 13.13 | 29.27 | 16.14 | 1.94 |
| 3 | 930 | 4 | 7 | 0.798 | 4.72 | 196.83 | 13.13 | 25.88 | 12.75 | 2.30 |
| 4 | 930 | 4 | 8 | 0.798 | 5.26 | 176.94 | 13.13 | 23.27 | 10.14 | 2.43 |
| 5 | 930 | 4 | 9 | 0.798 | 5.77 | 161.06 | 13.13 | 21.18 | 8.05 | 2.41 |
| 6 | 930 | 4 | 10 | 0.798 | 6.28 | 148.08 | 13.13 | 19.47 | 6.34 | 2.28 |
| 7 | 930 | 4 | 11 | 0.798 | 6.78 | 137.23 | 13.13 | 18.05 | 4.92 | 2.06 |
| 8 | 930 | 4 | 12 | 0.798 | 7.26 | 128.03 | 13.13 | 16.84 | 3.71 | 1.78 |
| 9 | 930 | 4 | 13 | 0.798 | 7.74 | 120.10 | 13.13 | 15.79 | 2.66 | 1.44 |
| 10 | 930 | 4 | 14 | 0.798 | 8.22 | 113.21 | 13.13 | 14.89 | 1.76 | 1.05 |

10 YEAR STORM

| T | A | B | T+B | C | $(T+B)^C$ | I | PRE Q | POST Q | POST-PRE | RET. VOL. |
|---|---|---|---|---|---|---|---|---|---|---|
| min | | | | | | mm/hr | l/sec | l/sec | l/sec | cu m |
| 2 | 1021 | 3 | 5 | 0.787 | 3.55 | 287.70 | 15.73 | 37.83 | 22.10 | 2.65 |
| 3 | 1021 | 3 | 6 | 0.787 | 4.10 | 249.24 | 15.73 | 32.78 | 17.05 | 3.07 |
| 4 | 1021 | 3 | 7 | 0.787 | 4.62 | 220.77 | 15.73 | 29.03 | 13.30 | 3.19 |
| 5 | 1021 | 3 | 8 | 0.787 | 5.14 | 198.74 | 15.73 | 26.13 | 10.40 | 3.12 |
| 6 | 1021 | 3 | 9 | 0.787 | 5.64 | 181.15 | 15.73 | 23.82 | 8.09 | 2.91 |
| 7 | 1021 | 3 | 10 | 0.787 | 6.12 | 166.73 | 15.73 | 21.93 | 6.20 | 2.60 |
| 8 | 1021 | 3 | 11 | 0.787 | 6.60 | 154.69 | 15.73 | 20.34 | 4.61 | 2.21 |
| 9 | 1021 | 3 | 12 | 0.787 | 7.07 | 144.45 | 15.73 | 18.99 | 3.26 | 1.76 |
| 10 | 1021 | 3 | 13 | 0.787 | 7.53 | 135.63 | 15.73 | 17.84 | 2.11 | 1.26 |

25 YEAR STORM

| T | A | B | T+B | C | $(T+B)^C$ | I | PRE Q | POST Q | POST-PRE | RET. VOL. |
|---|---|---|---|---|---|---|---|---|---|---|
| min | | | | | | mm/hr | l/sec | l/sec | l/sec | cu m |
| 2 | 1100 | 2 | 4 | 0.776 | 2.93 | 375.14 | 21.87 | 54.55 | 32.68 | 3.92 |
| 3 | 1100 | 2 | 5 | 0.776 | 3.49 | 315.49 | 21.87 | 45.87 | 24.00 | 4.32 |
| 4 | 1100 | 2 | 6 | 0.776 | 4.02 | 273.87 | 21.87 | 39.82 | 17.95 | 4.31 |
| 5 | 1100 | 2 | 7 | 0.776 | 4.53 | 242.99 | 21.87 | 35.33 | 13.46 | 4.04 |
| 6 | 1100 | 2 | 8 | 0.776 | 5.02 | 219.08 | 21.87 | 31.85 | 9.98 | 3.59 |
| 7 | 1100 | 2 | 9 | 0.776 | 5.50 | 199.94 | 21.87 | 29.07 | 7.20 | 3.02 |
| 8 | 1100 | 2 | 10 | 0.776 | 5.97 | 184.24 | 21.87 | 26.79 | 4.92 | 2.36 |
| 9 | 1100 | 2 | 11 | 0.776 | 6.43 | 171.11 | 21.87 | 24.88 | 3.01 | 1.62 |
| 10 | 1100 | 2 | 12 | 0.776 | 6.88 | 159.94 | 21.87 | 23.25 | 1.38 | 0.83 |

50 YEAR STORM

| T | A | B | T+B | C | $(T+B)^C$ | I | PRE Q | POST Q | POST-PRE | RET. VOL. |
|---|---|---|---|---|---|---|---|---|---|---|
| min | | | | | | mm/hr | l/sec | l/sec | l/sec | cu m |
| 2 | 1488 | 3 | 5 | 0.803 | 3.64 | 408.63 | 26.21 | 60.11 | 33.90 | 4.07 |
| 3 | 1488 | 3 | 6 | 0.803 | 4.22 | 352.98 | 26.21 | 51.92 | 25.71 | 4.63 |
| 4 | 1488 | 3 | 7 | 0.803 | 4.77 | 311.88 | 26.21 | 45.88 | 19.67 | 4.72 |
| 5 | 1488 | 3 | 8 | 0.803 | 5.31 | 280.17 | 26.21 | 41.21 | 15.00 | 4.50 |
| 6 | 1488 | 3 | 9 | 0.803 | 5.84 | 254.89 | 26.21 | 37.49 | 11.28 | 4.06 |
| 7 | 1488 | 3 | 10 | 0.803 | 6.35 | 234.21 | 26.21 | 34.45 | 8.24 | 3.46 |
| 8 | 1488 | 3 | 11 | 0.803 | 6.86 | 216.95 | 26.21 | 31.91 | 5.70 | 2.74 |
| 9 | 1488 | 3 | 12 | 0.803 | 7.35 | 202.31 | 26.21 | 29.76 | 3.55 | 1.92 |
| 10 | 1488 | 3 | 13 | 0.803 | 7.84 | 189.72 | 26.21 | 27.91 | 1.70 | 1.02 |

100 YEAR STORM

| T | A | B | T+B | C | $(T+B)^C$ | I | PRE Q | POST Q | POST-PRE | RET. VOL. |
|---|---|---|---|---|---|---|---|---|---|---|
| min | | | | | | mm/hr | l/sec | l/sec | l/sec | cu m |
| 2 | 1770 | 4 | 6 | 0.820 | 4.35 | 407.28 | 28.15 | 59.91 | 31.76 | 3.81 |
| 3 | 1770 | 4 | 7 | 0.820 | 4.93 | 358.92 | 28.15 | 52.80 | 24.65 | 4.44 |
| 4 | 1770 | 4 | 8 | 0.820 | 5.50 | 321.69 | 28.15 | 47.32 | 19.17 | 4.60 |
| 5 | 1770 | 4 | 9 | 0.820 | 6.06 | 292.08 | 28.15 | 42.96 | 14.81 | 4.44 |
| 6 | 1770 | 4 | 10 | 0.820 | 6.61 | 267.90 | 28.15 | 39.41 | 11.26 | 4.05 |
| 7 | 1770 | 4 | 11 | 0.820 | 7.14 | 247.76 | 28.15 | 36.45 | 8.30 | 3.48 |
| 8 | 1770 | 4 | 12 | 0.820 | 7.67 | 230.70 | 28.15 | 33.94 | 5.79 | 2.78 |
| 9 | 1770 | 4 | 13 | 0.820 | 8.19 | 216.04 | 28.15 | 31.78 | 3.63 | 1.96 |
| 10 | 1770 | 4 | 14 | 0.820 | 8.71 | 203.31 | 28.15 | 29.91 | 1.76 | 1.05 |

# APPENDIX II
# STAGE-STORAGE-DISCHARGE DETAILS

**106 MAIN STREET**
**NEWMARKET**
**STAGE-STORAGE-DISCHARGE CALCULATIONS**
**September, 2016**

| STORM | DEPTH m. | VOLUME cu.m. | HEAD m. | DISCHARGE l/sec. |
|---|---|---|---|---|
| | 0.100 | 0.31 | 0.100 | 2.26 |
| | 0.125 | 0.61 | 0.125 | 3.95 |
| | 0.150 | 1.04 | 0.150 | 6.18 |
| | 0.175 | 1.67 | 0.175 | 9.17 |
| 2-YEAR | 0.177 | 1.73 | 0.177 | 9.46 |
| 5-YEAR | 0.199 | 2.43 | 0.199 | 12.56 |
| | 0.200 | 2.47 | 0.200 | 12.74 |
| 10-YEAR | 0.217 | 3.19 | 0.217 | 15.73 |
| 25-YEAR | 0.241 | 4.32 | 0.241 | 20.30 |
| 50-YEAR | 0.248 | 4.72 | 0.248 | 21.83 |
| 100-YEAR | 0.246 | 4.60 | 0.246 | 21.37 |
| | 0.250 | 4.86 | 0.250 | 22.36 |