

# 17 Indacom Dr – Stormwater Management Report February 2026

Submitted by:

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Project # 25-5395A

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## 1. Introduction

Greer Galloway, a division of Jp2g has been retained by The Little Frozen Yogurt Company as part of a design team to provide engineering services to support the development of a proposed mini-golf course requiring expansion of the parking lot to add an additional 22 parking stalls and storage features of the Little Frozen Yogurt Company property located at the municipal address 17 Indacom Dr, Douro-Dummer, Ontario. This report has been prepared in consideration of Stormwater Management (SWM) to support the engineering design submission.

### 1.1 Scope of Report

This SWM Report addresses the stormwater management treatment provided to ensure no negative impact to downstream infrastructure.

### 1.2 Design Criteria

The design criteria for the stormwater management system are based on the requirements of the Ministry of the Environment, Conservation and Parks, (MECP). The key design criteria are listed below:

- Enhanced (Level 1) treatment for Water Quality as defined by the MOE shall be achieved – 80% Total Suspended Solids (T.S.S) removal efficiency shall be achieved.
- Water quantity controls shall be in accordance with the 2003 MOE SWMPD Manual. Storm runoff management criteria require that all storm events up to and including the 100-year storm will be controlled to predevelopment levels.
- Sediment erosion and transference are to be mitigated during and after the construction of the proposed development and stormwater management measures.

### 1.3 Standards and Guidelines

The following standards and guidelines were consulted in the preparation of the SWMD:

- Stormwater Management Planning and Design Manual - Ministry of the Environment, 2003; and
- MTO Drainage Management Manual – Ministry of Transportation, 1997;

## 2. Pre-Development Conditions

The development site is located in Douro-Dummer, Ontario, at 17 Indacom Drive. The property has an area of approximately 0.9 ha. The site comprises of an existing parking lot, building, sidewalk, outbuilding, walkway, storm pond and landscaped areas, that was developed through site plan approval. Part of that original approval process included providing a stormwater management design and report (*Stormwater Management Report* prepared by Greer Galloway Group, dated March 2019), resulting in the development of a stormwater management wet pond, which was oversized to store additional water for fire flows.

The stormwater management pond is intended to be removed as part of the site redevelopment, with fire flow storage provided through an underground cistern. Since the storm pond was an integral part of the previous development stormwater management system, we are controlling the post-development (previous development combined with new proposed development) peak flows to pre-development (undeveloped/open land) rates.

The *Stormwater Management Report* (March 2019), identifies that the undeveloped site primarily consists of grass overlaying silty sandy soils. Based on the Agmaps, the property is primarily consistent of Colborne Sandy Loam and Cramahe Gravel Sandy Loam.

A review of the undeveloped topographic survey (2019) illustrates that there are two natural storm outlets from the site. The natural drainage divide roughly splits through the centre of the site, with the north section of the property generally sheet

slope to the northwest towards the existing CR 4 roadside ditch while the southern portion of the site generally sloping to the southwest towards the existing HWY 28 roadside ditch. Ultimately, both site outlets drain towards the intersection of HWY 28 and CR4.

. To properly illustrate the site conditions and calculate the predevelopment conditions, we have separated the drainage area into 4 parcels. The Airport Method was used to calculate the time of concentration ( $T_c$ ) as follows:

$$T_c = \frac{3.26 \times (1.1 - C) \times \sqrt{L}}{\sqrt[3]{S}}$$

## 2.1 Area 101

The drainage area for Area 101 is 0.29 ha and comprises of areas that are located on Northern part of the site and sheet flows to the west. Based on the existing land use and soils, a composite runoff coefficient of 0.30 was selected. Runoff will sheet flow over the area at 6.7% and concentrate at the Western limits of the drainage boundary (approximately 85 metres).

Intensity-Duration-Frequency curves were used to determine the 1 in 5-year and 1 in 100-year rainfall intensities for the watershed. Based on a time of concentration of 9 minutes, the 5-year peak intensity will be 111 mm/hr and the 100-year peak intensity is 184 mm/hr. This results in peak flow rates of 27 litres/second and 45 litres/second for the 5-year and 100-year storms, respectively. Refer to Appendix 'A' for predevelopment stormwater calculations.

## 2.2 Area 102

The drainage area for Area 102 is 0.33 ha and comprises of areas that are located on Central portion of the site . Based on the existing land use and soils, a composite runoff coefficient of 0.30 was selected. Runoff will sheet flow over the area at 5.2% and concentrate at the Western limits of the drainage boundary (approximately 101 metres).

Intensity-Duration-Frequency curves were used to determine the 1 in 5-year and 1 in 100-year rainfall intensities for the watershed. Based on a time of concentration of 10 minutes, the 5-year peak intensity will be 98 mm/hr and the 100-year peak intensity is 164 mm/hr. This results in peak flow rates of 27 litres/second and 41 litres/second for the 5-year and 100-year storms, respectively. Refer to Appendix 'A' for predevelopment stormwater calculations.

## 2.3 Area 103

The drainage area for Area 103 is 0.20 ha and comprises of areas that are located on Southern portion of the site. Based on the existing land use and soils, a composite runoff coefficient of 0.30 was selected. Runoff will sheet flow over the area at 2.6% and concentrate at the Southern limits of the drainage boundary (approximately 126 metres).

Intensity-Duration-Frequency curves were used to determine the 1 in 5-year and 1 in 100-year rainfall intensities for the watershed. Based on a time of concentration of 14 minutes, the 5-year peak intensity will be 78 mm/hr and the 100-year peak intensity is 129 mm/hr. This results in peak flow rates of 13 litres/second and 22 litres/second for the 5-year and 100-year storms, respectively. Refer to Appendix 'A' for predevelopment stormwater calculations.

## 2.4 External Area 104

The drainage area for Area 101 is 0.08 ha and comprises of areas comprises of west end of the property. Based on the existing land use and soils, a composite runoff coefficient of 0.30 was selected. Runoff will sheet flow over the area at 3.2% and concentrate at the Northern limits of the drainage boundary (approximately 102 metres).

Intensity-Duration-Frequency curves were used to determine the 1 in 5-year and 1 in 100-year rainfall intensities for the watershed. Based on a time of concentration of 12 minutes, the 5-year peak intensity will be 88 mm/hr and the 100-year peak intensity is 146 mm/hr. This results in peak flow rates of 21 litres/second and 35 litres/second for the 5-year and 100-year storms, respectively. Refer to Appendix 'A' for predevelopment stormwater calculations.

### 3. Post Development

An increase in the impervious area is expected to occur due to the proposed development concept. The proposed site plan showing the development of land can be referenced in Appendix 'B'. Refer to Storm Drainage Plan, drawing SPD-1 for reference to the post development drainage areas. Further description is summarized below:

#### 3.1 Area 201

The post development drainage area is 0.29 ha and is comprised of golf course and landscape areas. This increases imperviousness by 22%. An enhanced grass swale with ponding check dams has been designed to treat additional storm flows that are expected to be generated from the increase in imperviousness. Refer to appendix 'A' for post development stormwater calculations.

#### 3.2 Area 202

The post development drainage area is 0.33 ha and is comprised of gravel parking lot, buildings, sidewalk connecting building to the parking lot and landscaped areas. This increases imperviousness by 69%. An enhanced grass swale with ponding check dams has been designed to treat additional storm flows that are expected to be generated from the increase in imperviousness. Refer to appendix 'A' for post development stormwater calculations.

#### 3.3 Area 203

The post development drainage area is 0.20 ha and is comprised of building, parking lot and landscaped areas. This increases imperviousness by 34%. An enhanced grass swale with ponding check dams has been designed to treat additional storm flows that are expected to be generated from the increase in imperviousness. Refer to appendix 'A' for post development stormwater calculations.

#### 3.4 External Area 204

The post development drainage area is 0.08 ha. This areas remain undisturbed and therefore comprised unimproved areas. Imperviousness will remain the same at 0% and so will composite runoff coefficient of 0.24. Since the area remains unchanged with no development proposed, no quantity and quality control is required for this area.

### 4. Quantity Control

A water quantity assessment was performed, and the best possible option was established. For this site, enhanced grass swales were selected to provide control measures for both water quantity and water quality.

The water quantity objective is to preserve the hydrologic function of the adjacent watercourses and wetlands and minimize impacts to flooding that may occur as a result of the development. Therefore, an assessment of the development and its impacts has been performed to demonstrate that the proposed changes will not result in negative impacts to downstream flooding. To minimize the impact of development, an enhanced grass swales will be constructed to collect and attenuate stormwater runoff. The stormwater runoff will be stored in the enhanced swale and will outlet via rip rap check dam. Following which, the runoff will sheet flow and ultimately outlet to Highway 28.

#### 4.1 Area 201

The contributing area for Area 201 is 0.29 hectares with a composite runoff coefficient of 0.29 for 5-year storm event and 0.36 for 100-year storm event. To control post development runoff to predevelopment levels, 5-year storm outflows must be limited to 27 litres/second and 100-year storm outflows must be limited to 45 litres/second. Using the Modified Rational Method, the 5-year peak storage volume of -2 cubic metres was calculated to occur at a time of concentration of 10 minutes at post

development outflows of 27 litres/second. The 100-year peak storage volume of 2 cubic metres was calculated to occur at a time of concentration of 10 minutes to control post development outflows of 49 litres/second down to 45 litres/second.

Enhanced Swale will be constructed as a 2.3m wide x 0.3m deep ditch section, with 3H:1V side slopes and a longitudinal slope of 2.0% along the length of need. At a depth of 0.3 metres, each ponding section will be 15 metres long with a storage volume of 5.9 cubic metres. 1 check dams will need to be constructed to provide the necessary ponding storage. Therefore, a total ponding length of 15 metres will provide a storage volume of **5.9 cubic metres**, exceeding the quantity control requirement of **2.4 cubic metres**.

#### 4.2 Area 202

The contributing area for Area 202 is 0.33 hectares with a composite runoff coefficient of 0.49 for 5-year storm event and 0.61 for 100-year storm event. To control post development runoff to predevelopment levels, 5-year storm outflows must be limited to 27 litres/second and 100-year storm outflows must be limited to 45 litres/second. Using the Modified Rational Method, the 5-year peak storage volume of 10 cubic metres was calculated to occur at a time of concentration of 10 minutes to control post development outflows of 44 litres/second to 27 litres/second. The 100-year peak storage volume of 28 cubic metres was calculated to occur at a time of concentration of 10 minutes to control post development outflows of 92 litres/second down to 45 litres/second.

Two Enhanced Swales will be constructed as a 2.9m wide x 0.4m deep ditch section, with 3H:1V side slopes and a longitudinal slope of 1.5% along the length of need. At a depth of 0.4 metres, each ponding section will be 26.7 metres long with a storage volume of 15.1 cubic metres. 2 check dams will need to be constructed to provide the necessary ponding storage. Therefore, a total ponding length of 53.4 metres will provide a storage volume of **30.2 cubic metres**, exceeding the quantity control requirement of **27.8 cubic metres**.

#### 4.3 Area 203

The contributing area for Area 203 is 0.20 hectares with a composite runoff coefficient of 0.36 for 5-year storm event and 0.44 for 100-year storm event. To control post development runoff to predevelopment levels, 5-year storm outflows must be limited to 13 litres/second and 100-year storm outflows must be limited to 22 litres/second. Using the Modified Rational Method, the 5-year peak storage volume of 3 cubic metres was calculated to occur at a time of concentration of 12 minutes to control post development outflows of 17 litres/second to 13 litres/second. The 100-year peak storage volume of 10 cubic metres was calculated to occur at a time of concentration of 11 minutes to control post development outflows of 37 litres/second down to 22 litres/second.

Enhanced Swale will be constructed as a 2.3m wide x 0.3m deep ditch section, with 3H:1V side slopes and a longitudinal slope of 1.0% along the length of need. At a depth of 0.3 metres, each ponding section will be 30 metres long with a storage volume of 11.9 cubic metres. 1 check dams will need to be constructed to provide the necessary ponding storage. Therefore, a total ponding length of 30 metres will provide a storage volume of **11.9 cubic metres**, exceeding the quantity control requirement of **10.4 cubic metres**.

Should the blockage occur within the Enhanced Swale, the storm runoff will attenuate and overflow towards the west onto Highway 28. Therefore, elevating the risk of flooding.

### 5. Quality Control

The development project of Little Building Company will result in a minimal increase in impervious surfaces that will require quality control treatment in accordance with the Ministry of Environment (MOE) – Stormwater Management Planning and Design Manual 2003. To achieve the water quality objectives, stormwater management best management practices (BMPs) have been selected for this project. The Toronto and Region Conservation Authority (TRCA) in partnership with the Credit Valley Conservation Authority (CVC), released a document in 2010 called the 'Low Impact Development Stormwater

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Management Planning and Design Guide' (herein referred to as the Design Guide). This document provides design guidance for enhanced grass swales and vegetated filter strips which have been selected as BMPs for this project.

### 5.1 Area 201

The drainage area of the Area 201 is 0.29 ha. Using the Rational Method per the MOE design manual, the required flow is calculated to be 0.004 m<sup>3</sup>/s.

Using the flow rate of 0.004 m<sup>3</sup>/s, manning's coefficient of 0.05 from LID Design Guide, P. 4-145, side slope of 3H:1V and ditch slope of 2.0%, the calculated velocity is 0.204 m/s at a flow of 0.008 m<sup>3</sup>/s. A flow depth of 2 cm will occur for the quality storm. Thus, meeting the quality control requirements.

A drainage swale has been designed with 15 m length and at a slope of 2.0% will provide further quality control to the proposed development.

### 5.2 Area 202

The drainage area of the Area 202 is 0.33 ha. Using the Rational Method per the MOE design manual, the required flow is calculated to be 0.012 m<sup>3</sup>/s.

Using the flow rate of 0.012 m<sup>3</sup>/s, manning's coefficient of 0.05 from LID Design Guide, P. 4-145, side slope of 3H:1V and ditch slope of 1.5%, the calculated velocity is 0.229 m/s at a flow of 0.014 m<sup>3</sup>/s. A flow depth of 3 cm will occur for the quality storm. Thus, meeting the quality control requirements.

A drainage swale has been designed with 53.4 m length and at a slope of 1.5% will provide further quality control to the proposed development.

### 5.3 Area 203

The drainage area of the Area 203 is 0.20 ha. Using the Rational Method per the MOE design manual, the required flow is calculated to be 0.004 m<sup>3</sup>/s.

Using the flow rate of 0.004 m<sup>3</sup>/s, manning's coefficient of 0.05 from LID Design Guide, P. 4-145, side slope of 3H:1V and ditch slope of 1.0%, the calculated velocity is 0.144 m/s at a flow of 0.006 m<sup>3</sup>/s. A flow depth of 2 cm will occur for the quality storm. Thus, meeting the quality control requirements.

A drainage swale has been designed with 30 m length and at a slope of 1.0% will provide further quality control to the proposed development.

Check dams for Enhanced Swale should be constructed of Rip-rap stone underlain with a non-woven geotextile filter fabric as per OPSD 219.210.

Therefore, with the combination of Enhanced Swale and drainage swale, quality control requirements are adequately met.

## 6. Maintenance

As per the MOE Stormwater Management Planning and Design Manual, for the first two years of operation, the stormwater management system shall be inspected after every significant storm to ensure proper functionality. Subsequently, the system should be inspected annually in order to identify potential maintenance issues. Potential maintenance and inspection activities for the stormwater management system include:

- Obstruction Removal – Trash and debris should be cleaned from the swales, check dams and the outlet structures.

- Swales – Swales would be inspected regularly for signs of erosion. Any areas where erosion has occurred should be infilled and vegetated immediately. A grass height of 100mm to 150mm should be maintained.
- Vegetation – The first year after planting, irrigation may be required to establish the vegetation if insufficient rainfall occurs. Decomposed mulch may need to be periodically renewed.

## 7. Erosion Control

During construction, a combination of light duty filter cloth, straw bale check dams, and other common measures will be applied to contain construction related suspended solids and other materials within the disturbed areas. All disturbed areas are to be bordered by light duty filter cloth, and straw bales or rip rap check dams are to be used where flows are concentrated. Vegetated surfaces will be established as rapidly as possible, and the physical barriers noted above will be continuously maintained until the vegetative cover is suitably established.

## 8. Conclusions

Based on the investigations and analysis conducted as part of this study, it is concluded that it is possible to provide the necessary stormwater management measures to mitigate any adverse effects of the proposed development relating to stormwater quality. It can also be concluded that:

1. The undeveloped site conditions were considered as 'existing conditions' due to storm pond being removed as a part of redevelopment. The existing site were broken into four drainage areas – Area 101, Area 102, Area 103 and External Area 104. The proposed development will add additional flows to the outlet. Therefore, 4 Enhanced swales with rock check dams would be constructed. This will help in controlling the stormwater outflow. No negative impacts are expected as a result.
2. The Area 101 outlet historically accepted flows from the 5-year storm of approximately 27 l/s. 100-year flows to the Area 101 outlet was 45 l/s. Post development outflows for the 5-year storm are expected to decrease to 23 l/s at the outlet. 100-year flows increase to 49 l/s at the outlet.
3. The Area 102 outlet historically accepted flows from the 5-year storm of approximately 27 l/s. 100-year flows to the Area 102 outlet was 45 l/s. Post development outflows for the 5-year storm are expected to increase to 44 l/s at the outlet. 100-year flows increase to 92 l/s at the outlet.
4. The Area 103 outlet historically accepted flows from the 5-year storm of approximately 13 l/s. 100-year flows to the Area 103 outlet was 22 l/s. Post development outflows for the 5-year storm are expected to increase to 17 l/s at the outlet. 100-year flows increase to 37 l/s at the outlet.
5. For External Area 204, no quantity control and quality control has been considered as no development is being proposed within the drainage area and it is expected to remain improvised .
6. Enhanced swales with rip rap check dams have been designed to provide the necessary quantity controls to reduce peak post development contributing area to the allowable release rates for storm events 1 in 5 year event and 1 in 100 year event.
7. The calculated quality flow for all the Enhanced Swales are below 5 m/s velocity. Thus, meeting quality control requirements for the design of the enhanced grass swales BMP.
8. Maintenance of the stormwater management systems should be carried out with the recommendation of this report.
9. Erosion and sedimentation control measures should be carried out in accordance with the recommendations of this report.

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Respectfully Written by,

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Respectfully submitted by,



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# Appendix A

## Stormwater Management Calculations

# 17 Indacom Drive

## Appendix 'A' - Stormwater Management Calculations

### Pre Development Site Land-use

#### Area 101

Drainage Area: 0.29 ha

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A
Asphalt	0.00	0.95	0.00	98	0
Concrete Sidwalk	0.00	0.95	0.00	98	0
Gravel	0.00	0.60	0.00	89	0
Roofs	0.00	0.95	0.00	98	0
Unimproved Areas	0.29	0.30	0.09	74	21
<b>Total</b>	<b>0.29</b>		<b>0.09</b>		<b>21</b>

Composite CN Value: 74  
 Composite Runoff Coefficient: 0.30  
 % Imperviousness: 0%

Watershed Length: 85 m  
 Elevation - Top: 99.18 m  
 Elevation - Bottom: 93.50 m  
 Watershed Slope: 6.7%

Time of Concentration,  $T_c$  = 13 minutes (calculated using the Airport Method for  $C < 0.4$ )  
 Watershed Time to Peak,  $T_p$  = 9 minutes ( $2/3$  of  $T_c$ )

Rainfall Intensity,  $I$  (From MTO Website - IDF Curve Lookup)  
 $I = A$

2-Year Intensity	83 mm/hr
5-Year Intensity	111 mm/hr
10-Year Intensity	129 mm/hr
25-Year Intensity	151 mm/hr
50-Year Intensity	168 mm/hr
100-Year Intensity	184 mm/hr

Peak Flow, Q (From MOE Drainage Manual)  
 Q=2.78 AIR

2-Year Flow, Q	20 l/s
5-Year Flow, Q	27 l/s
10-Year Flow, Q	31 l/s
25-Year Flow, Q	36 l/s
50-Year Flow, Q	41 l/s
100-Year Flow, Q	45 l/s

#### Area 102

Drainage Area: 0.33 ha

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A
Asphalt	0.00	0.95	0.00	98	0
Concrete Sidwalk	0.00	0.95	0.00	98	0
Gravel	0.00	0.60	0.00	89	0
Roofs	0.00	0.95	0.00	98	0
Unimproved Areas	0.33	0.30	0.10	74	24
<b>Total</b>	<b>0.33</b>		<b>0.10</b>		<b>24</b>

Composite CN Value: 74  
 Composite Runoff Coefficient: 0.30  
 % Imperviousness: 0%

Watershed Length: 101 m  
 Elevation - Top: 98.75 m  
 Elevation - Bottom: 93.50 m  
 Watershed Slope: 5.2%

Time of Concentration,  $T_c$  = 15 minutes (calculated using the Airport Method for  $C < 0.4$ )  
 Watershed Time to Peak,  $T_p$  = 10 minutes ( $2/3$  of  $T_c$ )

Rainfall Intensity,  $I$  (From MTO Website - IDF Curve Lookup)  
 $I = A$

2-Year Intensity	74 mm/hr
5-Year Intensity	98 mm/hr
10-Year Intensity	114 mm/hr
25-Year Intensity	134 mm/hr
50-Year Intensity	149 mm/hr
100-Year Intensity	164 mm/hr

Peak Flow, Q (From MOE Drainage Manual)  
 Q=2.78 AIR

2-Year Flow, Q	20 l/s
5-Year Flow, Q	27 l/s
10-Year Flow, Q	32 l/s
25-Year Flow, Q	37 l/s
50-Year Flow, Q	41 l/s



# 17 Indacom Drive

## Appendix 'A' - Stormwater Management Calculations

### Post Development Site Land-use

#### Area 201

##### Post-Development Peak Flows

Drainage Area: 0.29 ha

(MTO Design Chart 1.07)

Land Use	Area (Ha)	Runoff Coefficient - 5 Year	Runoff Coefficient - 100 Year	C x A - 5 Year	C x A - 100 Year	SCS Curve Number	CN x A
Asphalt	0.00	0.90	1.00	0.00	0.00	98	0
Gravel	0.06	0.60	0.75	0.04	0.05	89	6
Concrete Sidewalk	0.00	0.90	1.00	0.00	0.00	98	0
Roofs	0.00	0.90	1.00	0.00	0.00	98	0
Landscape Areas	0.23	0.20	0.25	0.05	0.06	74	17
<b>Total</b>	<b>0.29</b>			<b>0.08</b>	<b>0.11</b>		<b>23</b>

Composite CN Value: 77      Watershed Length: 85 m  
 Composite Runoff Coefficient - 5 Year: 0.29      Watershed Δ Elevation: 5.68 m  
 Composite Runoff Coefficient - 100 Year: 0.36      Watershed Slope (%): 6.7%  
 % Imperviousness: 22%

Time of Concentration - 5 Year<sup>(1)</sup>: 13 minutes  
 Watershed Time to Peak - 5 Year, T<sub>p</sub> = 10 minutes (2/3 of T<sub>c</sub>)      Limited to 10 mins minimum

Time of Concentration - 100 Year<sup>(1)</sup>: 12 minutes  
 Watershed Time to Peak - 100 Year, T<sub>p</sub> = 8 minutes (2/3 of T<sub>c</sub>)

#### Area 202

##### Post-Development Peak Flows

Drainage Area: 0.33 ha

(MTO Design Chart 1.07)

Land Use	Area (Ha)	Runoff Coefficient - 5 Year	Runoff Coefficient - 100 Year	C x A - 5 Year	C x A - 100 Year	SCS Curve Number	CN x A
Asphalt	0.00	0.90	1.00	0.00	0.00	98	0
Gravel	0.21	0.60	0.75	0.13	0.16	89	19
Concrete Sidewalk	0.01	0.90	1.00	0.00	0.01	98	0
Roofs	0.01	0.90	1.00	0.01	0.01	98	1
Landscape Areas	0.10	0.20	0.25	0.02	0.03	74	7
<b>Total</b>	<b>0.33</b>			<b>0.16</b>	<b>0.20</b>		<b>28</b>

# 17 Indacom Drive

## Appendix 'A' - Stormwater Management Calculations

### Post Development Site Land-use

Composite CN Value:	85	Watershed Length:	101 m
Composite Runoff Coefficient - 5 Year:	0.49	Watershed $\Delta$ Elevation:	5.25 m
Composite Runoff Coefficient - 100 Year:	0.61	Watershed Slope (%):	5.2%
% Imperviousness:	69%		
Time of Concentration - 5 Year <sup>(1)</sup> :	12	minutes	
Watershed Time to Peak - 5 Year, $T_p$ =	10	minutes (2/3 of $T_c$ )	Limited to 10 mins minimum
Time of Concentration - 100 Year <sup>(1)</sup> :	9	minutes	
Watershed Time to Peak - 100 Year, $T_p$ =	6	minutes (2/3 of $T_c$ )	

### Area 203

#### Post-Development Peak Flows

Drainage Area: 0.20 ha

(MTO Design Chart 1.07)

Land Use	Area (Ha)	Runoff Coefficient - 5 Year	Runoff Coefficient - 100 Year	C x A - 5 Year	C x A - 100 Year	SCS Curve Number	CN x A
Asphalt	0.00	0.90	1.00	0.00	0.00	98	0
Gravel	0.05	0.60	0.75	0.03	0.04	89	4
Concrete Sidewalk	0.00	0.90	1.00	0.00	0.00	98	0
Roofs	0.02	0.90	1.00	0.02	0.02	98	2
Landscape Areas	0.13	0.20	0.25	0.03	0.03	74	10
<b>Total</b>	<b>0.20</b>			<b>0.07</b>	<b>0.09</b>		<b>16</b>

Composite CN Value:	80	Watershed Length:	126 m
Composite Runoff Coefficient - 5 Year:	0.36	Watershed $\Delta$ Elevation:	3.28 m
Composite Runoff Coefficient - 100 Year:	0.44	Watershed Slope (%):	2.6%
% Imperviousness:	34%		
Time of Concentration - 5 Year <sup>(1)</sup> :	20	minutes	
Watershed Time to Peak - 5 Year, $T_p$ =	13	minutes (2/3 of $T_c$ )	
Time of Concentration - 100 Year <sup>(1)</sup> :	18	minutes	
Watershed Time to Peak - 100 Year, $T_p$ =	12	minutes (2/3 of $T_c$ )	

### External Area 204

#### Post-Development Peak Flows

# 17 Indacom Drive

## Appendix 'A' - Stormwater Management Calculations

### Post Development Site Land-use

Drainage Area: 0.08 ha

(MTO Design Chart 1.07)

Land Use	Area (Ha)	Runoff Coefficient - 5 Year	Runoff Coefficient - 100 Year	C x A - 5 Year	C x A - 100 Year	SCS Curve Number	CN x A
Asphalt	0.00	0.90	1.00	0.00	0.00	98	0
Gravel	0.00	0.60	0.75	0.00	0.00	89	0
Concrete Sidewalk	0.00	0.90	1.00	0.00	0.00	98	0
Roofs	0.00	0.90	1.00	0.00	0.00	98	0
Unimproved Area	0.08	0.30	0.30	0.02	0.02	74	6
Total	0.08			0.02	0.02		6

Composite CN Value:	74	Watershed Length:	102 m
Composite Runoff Coefficient - 5 Year:	0.30	Watershed $\Delta$ Elevation:	3.28 m
Composite Runoff Coefficient - 100 Year:	0.30	Watershed Slope (%):	3.2%
% Imperviousness:	0%		
Time of Concentration - 5 Year <sup>(1)</sup> :	18	minutes	
Watershed Time to Peak - 5 Year, T <sub>P</sub> =	12	minutes (2/3 of T <sub>c</sub> )	
Time of Concentration - 100 Year <sup>(1)</sup> :	18	minutes	
Watershed Time to Peak - 100 Year, T <sub>P</sub> =	12	minutes (2/3 of T <sub>c</sub> )	

# 17 Indacom Drive

## Appendix 'A' - Stormwater Management Calculations

### Quantity Control - Area 201

#### Modified Rational Method - 5 - Year

Time	Intensity	Inflows	Outflows	Storage
10	99	23	27	-2
11	93	22	27	-3
12	87	21	27	-5
13	83	19	27	-6

#### Modified Rational Method - 100 - Year

Time	Intensity	Inflows	Outflows	Storage
10	165	49	45	2
11	155	45	45	1
12	146	43	45	-1
13	138	40	45	-3

### Quantity Control

#### Detention Storage Calculations

Required Storage Volume 2.4 m<sup>3</sup>  
 Ditch Grade 0.0200 m/m  
 Side Slopes of 3:1

Depth (m)	Length (m)	Area (m <sup>2</sup> )	Avg Area (m <sup>2</sup> )	Δ Volume (m <sup>3</sup> )	Total Volume (m <sup>3</sup> )	No. of Check Dams
0	0.0	0.00	0.00	0.0	0.0	0.0
0.1	5.0	0.23	0.12	0.6	0.6	4.1
0.2	10.0	0.52	0.38	1.9	2.5	1.0
0.3	15.0	0.87	0.70	3.5	5.9	0.4
0.4	20.0	1.28	1.08	5.4	11.3	0.2
0.5	25.0	1.75	1.52	7.6	18.9	0.1

### Quantity Control - Area 202

#### Modified Rational Method - 5 - Year

Time	Intensity	Inflows	Outflows	Storage
10	99	44	27	10
11	93	42	27	9
12	87	39	27	9
13	83	37	27	8

#### Modified Rational Method - 100 - Year

Time	Intensity	Inflows	Outflows	Storage
10	165	92	45	28
11	155	86	45	27
12	146	81	45	25
13	138	76	45	24

### Quantity Control

#### Detention Storage Calculations

Required Storage Volume 27.8 m<sup>3</sup>  
 Ditch Grade 0.0150 m/m  
 Side Slopes of 3:1

Depth (m)	Length (m)	Area (m <sup>2</sup> )	Avg Area (m <sup>2</sup> )	Δ Volume (m <sup>3</sup> )	Total Volume (m <sup>3</sup> )	No. of Check Dams
0	0.0	0.00	0.00	0.0	0.0	0.0
0.1	6.7	0.23	0.12	0.8	0.8	36.2
0.2	13.3	0.52	0.38	2.5	3.3	8.5
0.3	20.0	0.87	0.70	4.6	7.9	3.5
0.4	26.7	1.28	1.08	7.2	15.1	1.8
0.5	33.3	1.75	1.52	10.1	25.2	1.1

### Quantity Control - Area 203

#### Modified Rational Method - 5 - Year

Time	Intensity	Inflows	Outflows	Storage
12	87	17	13	3
13	83	16	13	3
14	79	16	13	2
15	75	15	13	2

#### Modified Rational Method - 100 - Year

Time	Intensity	Inflows	Outflows	Storage
11	155	37	22	10
12	146	35	22	10
13	138	33	22	9
14	131	32	22	8

# 17 Indacom Drive

## Appendix 'A' - Stormwater Management Calculations

### Quantity Control

#### **Detention Storage Calculations**

Required Storage Volume 10.4 m<sup>3</sup>

Ditch Grade 0.0100 m/m

Side Slopes of 3:1

Depth (m)	Length (m)	Area (m <sup>2</sup> )	Avg Area (m <sup>2</sup> )	Δ Volume (m <sup>3</sup> )	Total Volume (m <sup>3</sup> )	No. of Check Dams
0	0.0	0.00	0.00	0.0	0.0	0.0
0.1	10.0	0.23	0.12	1.2	1.2	9.1
0.2	20.0	0.52	0.38	3.8	4.9	2.1
0.3	30.0	0.87	0.70	7.0	11.9	0.9
0.4	40.0	1.28	1.08	10.8	22.6	0.5
0.5	50.0	1.75	1.52	15.2	37.8	0.3

# 17 Indacom Drive

## Appendix 'A' - Stormwater Management Calculations

### Area 201

Drainage Area = 0.29 ha

**Quality Storm - 25 mm, 4 Hour Chicago Storm Equivalent**

Rational Formula,  $Q = 0.00278 \cdot C \cdot i \cdot A$

C = 0.29

A = 0.29 ha

$i = 43 \cdot C + 5.9$

18.2 mm/hr

Flow 0.004 m<sup>3</sup>/s

### Enhanced Grass Swale Design (Trapezoidal-Ditch Section)

Inflow = 0.004 m<sup>3</sup>/s

Manning's n = 0.05 (LID Design Guide, P. 4-145)

Ditch Slope = 0.02 m/m

Side Slopes = 3:1

Flow Depth (m)	Area (m <sup>2</sup> )	Perimeter (m)	Flow m <sup>3</sup> /s	Velocity (m/s)
0	0.000	2.000	0.000	0.000
0.02	0.041	2.126	0.008	0.204
0.03	0.063	2.190	0.017	0.265
0.04	0.085	2.253	0.027	0.318
0.05	0.108	2.316	0.039	0.365
0.06	0.131	2.379	0.053	0.409
0.07	0.155	2.443	0.070	0.449
0.08	0.179	2.506	0.087	0.487
0.09	0.204	2.569	0.107	0.523
0.1	0.230	2.632	0.128	0.557

### Area 202

Drainage Area = 0.33 ha

**Quality Storm - 25 mm, 4 Hour Chicago Storm Equivalent**

Rational Formula,  $Q = 0.00278 \cdot C \cdot i \cdot A$

C = 0.49

A = 0.33 ha

$i = 43 \cdot C + 5.9$

27.0 mm/hr

Flow 0.012 m<sup>3</sup>/s

### Enhanced Grass Swale Design (Trapezoidal-Ditch Section)

Inflow = 0.012 m<sup>3</sup>/s

Manning's n = 0.05 (LID Design Guide, P. 4-145)

Ditch Slope = 0.015 m/m

Side Slopes = 3:1

Flow Depth (m)	Area (m <sup>2</sup> )	Perimeter (m)	Flow m <sup>3</sup> /s	Velocity (m/s)
0	0.000	2.000	0.000	0.000
0.02	0.041	2.126	0.007	0.177
0.03	0.063	2.190	0.014	0.229
0.04	0.085	2.253	0.023	0.275

# 17 Indacom Drive

## Appendix 'A' - Stormwater Management Calculations

0.05	0.108	2.316	0.034	0.316
0.06	0.131	2.379	0.046	0.354
0.07	0.155	2.443	0.060	0.389
0.08	0.179	2.506	0.076	0.422
0.09	0.204	2.569	0.093	0.453
0.1	0.230	2.632	0.111	0.482

### Area 203

Drainage Area = 0.20 ha

#### Quality Storm - 25 mm, 4 Hour Chicago Storm Equivalent

Rational Formula,  $Q = 0.00278 * C * i * A$

C = 0.36

A = 0.20 ha

$i = 43 * C + 5.9$

21.5 mm/hr

Flow 0.004 m<sup>3</sup>/s

#### Enhanced Grass Swale Design (Trapezoidal-Ditch Section)

Inflow = 0.004 m<sup>3</sup>/s

Manning's n = 0.05 (LID Design Guide, P. 4-145)

Ditch Slope = 0.01 m/m

Side Slopes = 3:1

Flow Depth (m)	Area (m <sup>2</sup> )	Perimeter (m)	Flow m <sup>3</sup> /s	Velocity (m/s)
0	0.000	2.000	0.000	0.000
0.02	0.041	2.126	0.006	0.144
0.03	0.063	2.190	0.012	0.187
0.04	0.085	2.253	0.019	0.225
0.05	0.108	2.316	0.028	0.258
0.06	0.131	2.379	0.038	0.289
0.07	0.155	2.443	0.049	0.318
0.08	0.179	2.506	0.062	0.345
0.09	0.204	2.569	0.076	0.370
0.1	0.230	2.632	0.091	0.394

# Appendix B

## Detail Design Drawing



