



LAND SURVEYORS and ENGINEERS

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Miduss Output	

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August 30, 2020
21201-13

Dunnink Homes
4988 Jones Base Line
Guelph, Ontario
N0B 2J0

Attention: John Dunnink

Dear Sir:

Re: Stormwater Management Report
Hyland Road and Glenburnie Drive Extensions
City of Guelph, Ontario

1.0 Introduction

Van Harten Surveying Inc. is pleased to submit this report regarding the proposed residential development located in the northeast section of Guelph. This work was authorized by Mr. John Dunnink of Dunnink Homes.

The project involves the proposed construction of six (6) fully serviced single family homes as an extension of Hyland Road and an additional three (3) fully serviced single family homes in order to protect the existing woodlot on the property off Glenburnie Drive. These three (3) lots will be serviced by the existing cul-de-sac and infrastructure from Glenburnie Drive. The purpose of the stormwater management report is to evaluate the general surface drainage characteristics and the impact of the development along with the stormwater management criteria. The wetlands, east of the proposed development, are also presently owned by the applicant.

2.0 Site Location and Existing Conditions

The subject lands are located near Eramosa Road and Victoria Road in the northeast section of Guelph. The northern part of this development will be an eastern extension of Hyland Road and the southern part will be an eastern residential extension fronting on the cul-de-sac off Glenburnie Drive. The proposed Hyland Road extension is abutting existing residential developments and surface drainage is generally directed to an existing 450 mm diameter culvert in the southeast corner that conveys water to a protected wetland to the south. The proposed Glenburnie Drive extension is abutting existing residential

developments to the north, west and south with overland surface flow towards protected wetlands to the east. The existing building on the Hyland Road development will be demolished including the asphalt driveway. There are no private wells on either property.

3.0 Proposed Development

The subject lands are located at the eastern limit of a fully serviced and established residential subdivision in the northeast section of Guelph. The Hyland Road extension covers 1.065 ha and includes the development of six (6) lots under a Draft Plan of Subdivision Development with the provision that the City of Guelph will not accept the responsibility of a Communal Pumping Station. The proposed houses on the Hyland Road development will be constructed without basements and will be no more than 1.20 m below grade and weepers will be pumped to the surface.

The existing cul-de-sac at the east limit of Glenburnie Drive is to remain to accommodate three (3) new single family residences on 0.674 ha of land in accordance with the City of standards.

4.0 Design Criteria

The design criteria is to model the development for the minor and major storm systems conveyance using MIDUSS Version 2.25 for the pre and post development with the City of Guelph Intensity-Duration Frequency Parameters for the 2, 5, and 100-years return period storms flows.

The City of Guelph's current IDF parameters are presented in the Table 1 as follows:

Table 1. City of Guelph Intensity-Duration Frequency Parameters					
Parameter	IDF Parameters for Specified Return				Periods
	2	5	25	50	
a	743	1593	3158	3886	4688
b	6	11	15	16	17
c	0.7989	0.8789	0.9355	0.9495	0.9624

Pertinent pre and post development pervious and impervious parameters are presented in Table 2 as follows:

	Hyland Road		Road Glenburnie	
	pre-dev.	post dev.	pre-dev.	post dev.
Area	1.065	1.065	0.674	0.674
Pervious (%)	97.2	76.4	100	89.3
Imperious (%)	2.80	23.60	0.00	10.70
td (min)	10	10	10	10

Referring to the attached Drainage Catchment Areas Plan, the post development drainage areas are divided into three (3) distinct areas as follows:

Catchment Area 1

- The eastbound lane of Hyland Road drain in sheet flow directly into the wetland as it presently exists. The drainage will cross the proposed rip-rap protecting the slope for erosion.

Catchment Area 2

- Hyland Road Development - the lot grading is split drainage to the front and balance to approximately the midpoint of the rear lot area with an outlet into the wetlands. The rear of the lots are drained generally into a north/east direction via vegetated swales to the eastern boundary line of the development to a cross-culvert or storm sewer system on Hyland Road into the wetlands.

Catchment Area 3

- The Glenburnie Drive development drainage is directed to the wetlands via vegetated swales, east of the proposed development.

The calculated run-off coefficients as calculated by MIDUSS are as follows:

MIDUSS RUNOFF COEFFICIENT CALCULATIONS						
	Hyland Road			Glenburnie Drive		
	Pre Development			Pre Development		
	Pervious	Impervious	Combined	Pervious	Impervious	Combined
2 yrs	0.058	0.934	0.083	0.058	0.000	0.058
5 Yrs	0.234	0.951	0.254	0.233	0.000	0.233
100 yrs	0.513	0.964	0.526	0.510	0.000	0.510
	Post Development			Post Development		
2 yrs	0.058	0.934	0.253	0.058	0.937	0.152
5 yrs	0.234	0.951	0.393	0.233	0.953	0.310
100 yrs	0.513	0.964	0.613	0.510	0.970	0.559

Summary of the peak flow rates are illustrated below.

	Peak Flow Rate (m ³ /sec)			
Storm Event	Hyland Road		Glenburie Drive	
	Pre-Dev.	Post-Dev.	Pre-Dev.	Post-Dev.
	Flow	Fow	Flow	Flow
2 yrs	0.008	0.055	0.007	0.017
5 yrs	0.061	0.089	0.049	0.054
100 yrs	0.294	0.294	0.218	0.215

The infill development is adjacent to the existing wetlands and generally sufficient storage facilities are not available within the proposed development. It is noted that, based on the calculations presented in the above table, post-development flow rates from the site are only slightly higher than existing conditions, and no increase in flow is anticipated for major storms including the 100-year event.

Prior to construction, a heavy duty silt fence will be installed along the boundary to protect the existing wetlands as well as straw bales at the inlet of the culvert to prevent silt entering



LAND SURVEYORS and ENGINEERS

the culvert/wetlands during construction. In addition, mud slabs will be provided as per City of Guelph standards and specifications at the entrances to the project (start of Hyland Road construction and the entrance to Glenburnie Drive).

5.0 Water Quality Treatment

The objective of water quality as noted in the City of Guelph Stormwater Management Master Plan is to improve sediment, surface water, groundwater quality, minimize pollutants loadings to groundwater and surface water. The development requires fill. The emphasis is to obtain select fill, if available, with favorable infiltration rates such as reclaimed granular material from Hyland Road re-construction.

The Hyland Road development lot drainage will be conveyed to the proposed catchbasin located on Hyland Road via vegetated swales, and french drains as illustrated on grading plans. Along the eastern rear property lines, perforated pipe with sock will be installed in the French drain and subsurface connection to the above noted catchbasin will be provided. A cross-culvert/storm sewer will be installed spanning Hyland Road with an outlet into the wetlands designed with adequately capacity as per City's requirements. The outlet will be protected with 150mm rip-rap configured in a V-figure to promote diverging flow. The roof drainage will be discharged in soak away pits and vegetated swales are illustrated on the preliminary grading plan

6.0 Water Balance

The water level in the wetlands is controlled by an outlet at a fixed elevation in a south-east location of the wetlands. The development is located adjacent/near the wetland and is classified as infill development. The wetlands may be classified as a natural storm water management pond as there is a controlled outlet in a south-east location of the wetlands. The implementation of infiltration trenches is ineffective due to the very low infiltration rate of the native soils. It may be concluded that any water imbalance from the theoretical calculations is of short duration and any intervention is of very little benefit.

The water balance is reviewed based on the results of pre and post development run-off volumes into the wetlands as illustrated on the next page.

WATER BALANCE							
Runoff Volume (cm)							
Storm Event	Hyland Road to Wetland			Glenburnie Drive to Wetlands			Net
	Pre-Dev. Volume	Post Dev. Volume	Incr/Decr.	Pre-Dev. Volume	Post Dev. Volume	Incr/Decr.	Incr./Decr.
2 yrs	29.17	93.45	64.28	12.97	33.97	21	85.28
5 Yrs	126.46	200.84	74.38	73.47	70.47	97.74	172.12
100 yrs	495.06	583.38	88.32	303.85	333.23	29.38	117.7

The Miduss model shows a net runoff volume increase of 64.28, 74.38, 88.32 cubic meters for the Hyland Road development and 80.95, 167.12, and 111.75 cubic meters increase in runoff volume for the Glenburnie Drive development directed towards the wetlands for the 2-, 5-, and 100-year return period storm event respective.

7.0 Conclusions

Dunhill Homes, the applicant, is applying for the infill development located north of Hyland Road and east of Glenburnie Drive. This report has been prepared to support the application for draft approval of the proposed development.

The above concludes that the infill development is feasible as follows:

- Storm drainage will be provided via vegetated swales, curb & gutter, and catchbasin/ditch-inlet to the wetlands
- Water quality control will be provided through the use of French drains, vegetated swales, soak away pits, and catch basins/ditch inlet.
- Any engineering concerns may be addressed during the engineering design approval process.

Respectfully submitted,





MIDUSS OUTPUT

2 YEAR PRE AND POST DEVELOPMENT

Hyland Road: 2-Year Storm - Existing Conditions

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"                                           20-mar-18 SWM calcs"
"          Output filename:                   2-yr ex Hyland.out"
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"          Company                            "
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"          180.000 Max. Storm length"
"          1500.000 Max. Hydrograph"
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"          1 1=rainfall; 2=hydrograph"
"          1 1=rain; 2=imperv; 3=perv"
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"          Maximum intensity                  109.400 mm/hr"
"          Duration                          170.000 minutes"
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"          6 002hyd Hydrograph extension used in this file"
" 33      CATCHMENT 201"
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"          1 Equal length"
"          2 Horton equation"
"          201 Hyland Road Pre-Development"
"          2.800 % Impervious"
"          1.065 Total Area"
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"          1.036 Pervious Area"
"          100.000 Pervious length"
"          4.000 Pervious slope"
"          0.030 Impervious Area"
"          100.000 Impervious length"
"          4.000 Impervious slope"
"          0.250 Pervious Manning 'n'"
"          75.000 Pervious Max.infiltration"
"          12.500 Pervious Min.infiltration"
"          0.250 Pervious Lag constant (hours)"
"          5.000 Pervious Depression storage"
"          0.015 Impervious Manning 'n'"
"          0.000 Impervious Max.infiltration"
"          0.000 Impervious Min.infiltration"
"          0.050 Impervious Lag constant (hours)"
"          1.500 Impervious Depression storage"
"          0.008 0.000 0.000 0.000 c.m/sec"
"          Catchment 201 Pervious Impervious Total Area "
"          Surface Area 1.036 0.030 1.065 hectare"
"          Time of concentration 44.433 3.580 31.504 minutes"
"          Time to Centroid 108.225 84.569 100.738 minutes"
"          Rainfall depth 33.124 33.124 33.124 mm"
"          Rainfall volume 343.02 9.88 352.90 c.m"
"          Rainfall losses 31.199 2.177 30.386 mm"
"          Runoff depth 1.925 30.947 2.738 mm"

```

"	Runoff volume	19.94	9.23	29.17	c.m"
"	Runoff coefficient	0.058	0.934	0.083	"
"	Maximum flow	0.008	0.006	0.008	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				
"		0.008	0.008	0.000	0.000"
" 38	START/RE-START TOTALS 201"				
"	3 Runoff Totals on EXIT"				
"	Total Catchment area			1.065	hectare"
"	Total Impervious area			0.030	hectare"
"	Total % impervious			2.800"	
" 19	EXIT"				

Hyland Road: 2-Year Storm - Proposed Conditions

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"          180.000 Max. Storm length"
"          1500.000 Max. Hydrograph"
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"          1  1=rainfall; 2=hydrograph"
"          1  1=rain; 2=imperv; 3=perv"
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"          1.065  Total Area"
"          100.000  Flow length"
"          4.000  Overland Slope"
"          0.814  Pervious Area"
"          100.000  Pervious length"
"          4.000  Pervious slope"
"          0.251  Impervious Area"
"          100.000  Impervious length"
"          4.000  Impervious slope"
"          0.250  Pervious Manning 'n'"
"          75.000  Pervious Max.infiltration"
"          12.500  Pervious Min.infiltration"
"          0.250  Pervious Lag constant (hours)"
"          5.000  Pervious Depression storage"
"          0.015  Impervious Manning 'n'"
"          0.000  Impervious Max.infiltration"
"          0.000  Impervious Min.infiltration"
"          0.050  Impervious Lag constant (hours)"
"          1.500  Impervious Depression storage"
"          0.055  0.000  0.000  0.000 c.m/sec"
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"          Surface Area      0.814      0.251      1.065      hectare"
"          Time of concentration  44.433      3.580      10.429      minutes"
"          Time to Centroid    108.225      84.569      88.535      minutes"
"          Rainfall depth     33.124      33.124      33.124      mm"
"          Rainfall volume    269.52      83.25      352.77      c.m"
"          Rainfall losses    31.199      2.177      24.350      mm"
"          Runoff depth       1.925      30.947      8.774      mm"

```

"	Runoff volume	15.67	77.78	93.45	c.m"
"	Runoff coefficient	0.058	0.934	0.265	"
"	Maximum flow	0.006	0.054	0.055	c.m/sec"
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"	4 Add Runoff "				
"		0.055	0.055	0.000	0.000"
" 38	START/RE-START TOTALS 202"				
"	3 Runoff Totals on EXIT"				
"	Total Catchment area			1.065	hectare"
"	Total Impervious area			0.251	hectare"
"	Total % impervious			23.600"	
" 19	EXIT"				

Glenburnie Drive: 2-Year Storm - Existing Conditions

```

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"          Company                            "
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"          Guelph, ON 2 year storm"
"          New storm defined"
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"          Maximum intensity                 109.400 mm/hr"
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"          101 Glenburnie Pre-Development"
"          0.000 % Impervious"
"          0.674 Total Area"
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"          10.000 Overland Slope"
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"          86.500 Pervious length"
"          10.000 Pervious slope"
"          0.000 Impervious Area"
"          86.500 Impervious length"
"          10.000 Impervious slope"
"          0.250 Pervious Manning 'n'"
"          75.000 Pervious Max.infiltration"
"          12.500 Pervious Min.infiltration"
"          0.250 Pervious Lag constant (hours)"
"          5.000 Pervious Depression storage"
"          0.015 Impervious Manning 'n'"
"          0.000 Impervious Max.infiltration"
"          0.000 Impervious Min.infiltration"
"          0.050 Impervious Lag constant (hours)"
"          1.500 Impervious Depression storage"
"          0.007 0.000 0.000 0.000 c.m/sec"
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"          Rainfall depth 33.124 33.124 33.124 mm"
"          Rainfall volume 223.22 0.00 223.22 c.m"
"          Rainfall losses 31.198 33.124 31.198 mm"
"          Runoff depth 1.926 0.000 1.926 mm"

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"	Maximum flow	0.007	0.000	0.007	c.m/sec"
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"	4 Add Runoff "				
"		0.007	0.007	0.000	0.000"
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"	3 Runoff Totals on EXIT"				
"	Total Catchment area			0.674	hectare"
"	Total Impervious area			0.000	hectare"
"	Total % impervious			0.000"	
" 19	EXIT"				

Glenburnie Drive: 2-Year Storm - Proposed Conditions

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"           Company                            "
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"           1500.000 Max. Hydrograph"
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"           1 1=rainfall; 2=hydrograph"
"           1 1=rain; 2=imperv; 3=perv"
"           guelph2.stm"
"           Guelph, ON 2 year storm"
"           New storm defined"
"           Total depth                        33.124 mm"
"           Maximum intensity                  109.400 mm/hr"
"           Duration                          170.000 minutes"
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"           10.000 Overland Slope"
"           0.602 Pervious Area"
"           86.500 Pervious length"
"           10.000 Pervious slope"
"           0.072 Impervious Area"
"           86.500 Impervious length"
"           10.000 Impervious slope"
"           0.250 Pervious Manning 'n'"
"           75.000 Pervious Max.infiltration"
"           12.500 Pervious Min.infiltration"
"           0.250 Pervious Lag constant (hours)"
"           5.000 Pervious Depression storage"
"           0.015 Impervious Manning 'n'"
"           0.000 Impervious Max.infiltration"
"           0.000 Impervious Min.infiltration"
"           0.050 Impervious Lag constant (hours)"
"           1.500 Impervious Depression storage"
"           0.017 0.000 0.000 0.000 c.m/sec"
"           Catchment 102 Pervious Impervious Total Area "
"           Surface Area 0.602 0.072 0.674 hectare"
"           Time of concentration 30.941 2.493 12.200 minutes"
"           Time to Centroid 97.700 82.917 87.961 minutes"
"           Rainfall depth 33.124 33.124 33.124 mm"
"           Rainfall volume 199.37 23.89 223.26 c.m"
"           Rainfall losses 31.198 2.092 28.084 mm"
"           Runoff depth 1.926 31.032 5.040 mm"

```


"	Runoff volume	11.59	22.38	33.97	c.m"
"	Runoff coefficient	0.058	0.937	0.152	"
"	Maximum flow	0.006	0.017	0.017	c.m/sec"
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"	4 Add Runoff "				
"		0.017	0.017	0.000	0.000"
" 38	START/RE-START TOTALS 102"				
"	3 Runoff Totals on EXIT"				
"	Total Catchment area			0.674	hectare"
"	Total Impervious area			0.072	hectare"
"	Total % impervious			10.700"	
" 19	EXIT"				



MIDUSS OUTPUT

5 YEAR PRE AND POST DEVELOPMENT

Hyland Avenue: 5-Year Storm - Existing Conditions

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"          MIDUSS Output ----->"
"          MIDUSS version                      Version 2.25 rev. 465"
"          MIDUSS created                      Tuesday, February 05, 2008"
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"                                           20-mar-18 SWM calcs"
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"          Company                            "
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"          5.000 Time Step"
"          180.000 Max. Storm length"
"          1500.000 Max. Hydrograph"
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"          1 1=read/open; 2=write/save"
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"          guelph5.stm"
"          Guelph, ON 5 year storm"
"          New storm defined"
"          Total depth                        46.810 mm"
"          Maximum intensity                  139.290 mm/hr"
"          Duration                          170.000 minutes"
"          0.000 0.000 0.000 0.000 c.m/sec"
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" 33      CATCHMENT 201"
"          1 Triangular SCS"
"          1 Equal length"
"          2 Horton equation"
"          201 Hyland Road Pre-Development"
"          2.800 % Impervious"
"          1.065 Total Area"
"          100.000 Flow length"
"          4.000 Overland Slope"
"          1.035 Pervious Area"
"          100.000 Pervious length"
"          4.000 Pervious slope"
"          0.030 Impervious Area"
"          100.000 Impervious length"
"          4.000 Impervious slope"
"          0.250 Pervious Manning 'n'"
"          75.000 Pervious Max.infiltration"
"          12.500 Pervious Min.infiltration"
"          0.250 Pervious Lag constant (hours)"
"          5.000 Pervious Depression storage"
"          0.015 Impervious Manning 'n'"
"          0.000 Impervious Max.infiltration"
"          0.000 Impervious Min.infiltration"
"          0.050 Impervious Lag constant (hours)"
"          1.500 Impervious Depression storage"
"          0.061 0.000 0.000 0.000 c.m/sec"
"          Catchment 201 Pervious Impervious Total Area "
"          Surface Area 1.035 0.030 1.065 hectare"
"          Time of concentration 23.736 3.250 21.586 minutes"
"          Time to Centroid 96.030 83.522 94.717 minutes"
"          Rainfall depth 46.810 46.810 46.810 mm"
"          Rainfall volume 484.57 13.96 498.53 c.m"
"          Rainfall losses 35.876 2.299 34.936 mm"
"          Runoff depth 10.934 44.511 11.874 mm"

```

"	Runoff volume	113.19	13.27	126.46	c.m"
"	Runoff coefficient	0.234	0.951	0.254	"
"	Maximum flow	0.058	0.009	0.061	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				
"		0.061	0.061	0.000	0.000"
" 38	START/RE-START TOTALS 201"				
"	3 Runoff Totals on EXIT"				
"	Total Catchment area			1.065	hectare"
"	Total Impervious area			0.030	hectare"
"	Total % impervious			2.800"	
" 19	EXIT"				

Hyland Road: 5-Year Storm - Proposed Conditions

```

"          MIDUSS Output ----->"
"          MIDUSS version                      Version 2.25 rev. 465"
"          MIDUSS created                      Tuesday, February 05, 2008"
"          10  Units used:                      ie METRIC"
"          Job folder:                         Q:\13-212\21203-13 (Dunnink - Hyland)\
"                                               20-jul-31 swm calcs"
"          Output filename:                    5-yr design.out"
"          Licensee name:                      Mike.Vaughan"
"          Company                             "
"          Date & Time last used:              7/31/2020 at 3:01:05 PM"
" 31      TIME PARAMETERS"
"          5.000  Time Step"
"          180.000  Max. Storm length"
"          1500.000  Max. Hydrograph"
" 47      FILEI_O Read/Open guelph5.stm"
"          1  1=read/open; 2=write/save"
"          1  1=rainfall; 2=hydrograph"
"          1  1=rain; 2=imperv; 3=perv"
"          guelph5.stm"
"          Guelph, ON 5 year storm"
"          New storm defined"
"          Total depth                          46.810    mm"
"          Maximum intensity                     139.290    mm/hr"
"          Duration                             170.000    minutes"
"          0.000    0.000    0.000    0.000 c.m/sec"
"          6  005hyd  Hydrograph extension used in this file"
" 33      CATCHMENT 202"
"          1  Triangular SCS"
"          1  Equal length"
"          2  Horton equation"
"          202  Hyland Road Post-Development"
"          23.600  % Impervious"
"          1.065  Total Area"
"          100.000  Flow length"
"          4.000  Overland Slope"
"          0.814  Pervious Area"
"          100.000  Pervious length"
"          4.000  Pervious slope"
"          0.251  Impervious Area"
"          100.000  Impervious length"
"          4.000  Impervious slope"
"          0.250  Pervious Manning 'n'"
"          75.000  Pervious Max.infiltration"
"          12.500  Pervious Min.infiltration"
"          0.250  Pervious Lag constant (hours)"
"          5.000  Pervious Depression storage"
"          0.015  Impervious Manning 'n'"
"          0.000  Impervious Max.infiltration"
"          0.000  Impervious Min.infiltration"
"          0.050  Impervious Lag constant (hours)"
"          1.500  Impervious Depression storage"
"          0.089    0.000    0.000    0.000 c.m/sec"
"          Catchment 202      Pervious  Impervious Total Area "
"          Surface Area      0.814    0.251    1.065    hectare"
"          Time of concentration  23.736    3.250    12.325    minutes"
"          Time to Centroid    96.030    83.522    89.063    minutes"
"          Rainfall depth     46.810    46.810    46.810    mm"
"          Rainfall volume    380.87    117.65    498.53    c.m"
"          Rainfall losses    35.876    2.299    27.952    mm"
"          Runoff depth       10.934    44.511    18.858    mm"

```

"	Runoff volume	88.97	111.87	200.84	c.m"
"	Runoff coefficient	0.234	0.951	0.403	"
"	Maximum flow	0.046	0.073	0.089	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				
"		0.089	0.089	0.000	0.000"
" 38	START/RE-START TOTALS 202"				
"	3 Runoff Totals on EXIT"				
"	Total Catchment area			1.065	hectare"
"	Total Impervious area			0.251	hectare"
"	Total % impervious			23.600"	
" 19	EXIT"				

Glenburnie Drive: 5-Year Storm - Existing Conditions

```

"          MIDUSS Output ----->"
"          MIDUSS version                      Version 2.25 rev. 465"
"          MIDUSS created                      Tuesday, February 05, 2008"
"          10 Units used:                      ie METRIC"
"          Job folder:                        Q:\13-212\21203-13 (Dunnink - Hyland)\
"                                           20-mar-18 SWM calcs"
"          Output filename:                   5-yr ex Glenburnie.out"
"          Licensee name:                     Mike.Vaughan"
"          Company                            "
"          Date & Time last used:            3/18/2020 at 2:35:35 PM"
" 31      TIME PARAMETERS"
"          5.000 Time Step"
"          180.000 Max. Storm length"
"          1500.000 Max. Hydrograph"
" 47      FILEI_0 Read/Open guelph5.stm"
"          1 1=read/open; 2=write/save"
"          1 1=rainfall; 2=hydrograph"
"          1 1=rain; 2=imperv; 3=perv"
"          guelph5.stm"
"          Guelph, ON 5 year storm"
"          New storm defined"
"          Total depth                        46.810 mm"
"          Maximum intensity                  139.290 mm/hr"
"          Duration                          170.000 minutes"
"          0.000 0.000 0.000 0.000 c.m/sec"
"          6 005hyd Hydrograph extension used in this file"
" 33      CATCHMENT 101"
"          1 Triangular SCS"
"          1 Equal length"
"          2 Horton equation"
"          101 Glenburnie Pre-Development"
"          0.000 % Impervious"
"          0.674 Total Area"
"          86.500 Flow length"
"          10.000 Overland Slope"
"          0.674 Pervious Area"
"          86.500 Pervious length"
"          10.000 Pervious slope"
"          0.000 Impervious Area"
"          86.500 Impervious length"
"          10.000 Impervious slope"
"          0.250 Pervious Manning 'n'"
"          75.000 Pervious Max.infiltration"
"          12.500 Pervious Min.infiltration"
"          0.250 Pervious Lag constant (hours)"
"          5.000 Pervious Depression storage"
"          0.015 Impervious Manning 'n'"
"          0.000 Impervious Max.infiltration"
"          0.000 Impervious Min.infiltration"
"          0.050 Impervious Lag constant (hours)"
"          1.500 Impervious Depression storage"
"          0.049 0.000 0.000 0.000 c.m/sec"
"          Catchment 101 Pervious Impervious Total Area "
"          Surface Area 0.674 0.000 0.674 hectare"
"          Time of concentration 16.529 2.263 16.529 minutes"
"          Time to Centroid 89.389 82.032 89.389 minutes"
"          Rainfall depth 46.810 46.810 46.810 mm"
"          Rainfall volume 315.50 0.00 315.50 c.m"
"          Rainfall losses 35.916 2.210 35.916 mm"
"          Runoff depth 10.894 44.600 10.894 mm"

```


"	Runoff volume	73.43	0.00	73.43	c.m"
"	Runoff coefficient	0.233	0.000	0.233	"
"	Maximum flow	0.049	0.000	0.049	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				
"	0.049 0.049 0.000 0.000"				
" 38	START/RE-START TOTALS 101"				
"	3 Runoff Totals on EXIT"				
"	Total Catchment area		0.674	hectare"	
"	Total Impervious area		0.000	hectare"	
"	Total % impervious		0.000"		
" 19	EXIT"				

Glenburnie Drive: 5-Year Storm - Proposed Conditions

```

"          MIDUSS Output ----->"
"          MIDUSS version                      Version 2.25 rev. 465"
"          MIDUSS created                      Tuesday, February 05, 2008"
"          10  Units used:                      ie METRIC"
"          Job folder:                          Q:\13-212\21203-13 (Dunnink - Hyland)\
"                                               20-mar-18 SWM calcs"
"          Output filename:                    5-yr pr Glenburnie.out"
"          Licensee name:                      Mike.Vaughan"
"          Company                             "
"          Date & Time last used:              3/18/2020 at 2:44:20 PM"
31  TIME PARAMETERS"
"          5.000  Time Step"
"          180.000  Max. Storm length"
"          1500.000  Max. Hydrograph"
47  FILEI_O Read/Open guelph5.stm"
"          1  1=read/open; 2=write/save"
"          1  1=rainfall; 2=hydrograph"
"          1  1=rain; 2=imperv; 3=perv"
"          guelph5.stm"
"          Guelph, ON 5 year storm"
"          New storm defined"
"          Total depth                          46.810    mm"
"          Maximum intensity                    139.290    mm/hr"
"          Duration                            170.000    minutes"
"          0.000    0.000    0.000    0.000 c.m/sec"
"          6  005hyd  Hydrograph extension used in this file"
33  CATCHMENT 102"
"          1  Triangular SCS"
"          1  Equal length"
"          2  Horton equation"
"          102  Glenburnie Post-Development"
"          10.700  % Impervious"
"          0.674  Total Area"
"          86.500  Flow length"
"          10.000  Overland Slope"
"          0.602  Pervious Area"
"          86.500  Pervious length"
"          10.000  Pervious slope"
"          0.072  Impervious Area"
"          86.500  Impervious length"
"          10.000  Impervious slope"
"          0.250  Pervious Manning 'n'"
"          75.000  Pervious Max.infiltration"
"          12.500  Pervious Min.infiltration"
"          0.250  Pervious Lag constant (hours)"
"          5.000  Pervious Depression storage"
"          0.015  Impervious Manning 'n'"
"          0.000  Impervious Max.infiltration"
"          0.000  Impervious Min.infiltration"
"          0.050  Impervious Lag constant (hours)"
"          1.500  Impervious Depression storage"
"          0.054    0.000    0.000    0.000 c.m/sec"
"          Catchment 102          Pervious  Impervious Total Area  "
"          Surface Area          0.602    0.072    0.674    hectare"
"          Time of concentration  16.529    2.263    11.834    minutes"
"          Time to Centroid      89.389    82.032    86.968    minutes"
"          Rainfall depth        46.810    46.810    46.810    mm"
"          Rainfall volume        281.74    33.76    315.50    c.m"
"          Rainfall losses        35.916    2.210    32.309    mm"
"          Runoff depth           10.894    44.600    14.501    mm"

```

"	Runoff volume	65.57	32.16	97.74	c.m"
"	Runoff coefficient	0.233	0.953	0.310	"
"	Maximum flow	0.044	0.023	0.054	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				
"	0.054 0.054 0.000 0.000"				
" 38	START/RE-START TOTALS 102"				
"	3 Runoff Totals on EXIT"				
"	Total Catchment area		0.674	hectare"	
"	Total Impervious area		0.072	hectare"	
"	Total % impervious		10.700"		
" 19	EXIT"				

MIDUSS OUTPUT

100 YEAR PRE AND POST DEVELOPMENT

Hyland Road: 100-Year Storm - Existing Conditions

```

"          MIDUSS Output ----->"
"          MIDUSS version                      Version 2.25 rev. 465"
"          MIDUSS created                      Tuesday, February 05, 2008"
"          10 Units used:                      ie METRIC"
"          Job folder:                        Q:\13-212\21203-13 (Dunnink - Hyland)\
"                                           20-mar-18 SWM calcs"
"          Output filename:                   100-yr ex Hyland.out"
"          Licensee name:                     Mike.Vaughan"
"          Company                            "
"          Date & Time last used:            3/18/2020 at 2:52:00 PM"
" 31      TIME PARAMETERS"
"          5.000 Time Step"
"          360.000 Max. Storm length"
"          3000.000 Max. Hydrograph"
" 47      FILEI_O Read/Open guelph100.stm"
"          1 1=read/open; 2=write/save"
"          1 1=rainfall; 2=hydrograph"
"          1 1=rain; 2=imperv; 3=perv"
"          guelph100.stm"
"          Guelph, ON 100 year storm"
"          New storm defined"
"          Total depth                        88.431 mm"
"          Maximum intensity                  239.350 mm/hr"
"          Duration                          210.000 minutes"
"          0.000 0.000 0.000 0.000 c.m/sec"
"          6 100hyd Hydrograph extension used in this file"
" 33      CATCHMENT 201"
"          1 Triangular SCS"
"          1 Equal length"
"          2 Horton equation"
"          201 Hyland Road Pre-Development"
"          2.800 % Impervious"
"          1.065 Total Area"
"          100.000 Flow length"
"          4.000 Overland Slope"
"          1.035 Pervious Area"
"          100.000 Pervious length"
"          4.000 Pervious slope"
"          0.030 Impervious Area"
"          100.000 Impervious length"
"          4.000 Impervious slope"
"          0.250 Pervious Manning 'n'"
"          75.000 Pervious Max.infiltration"
"          12.500 Pervious Min.infiltration"
"          0.250 Pervious Lag constant (hours)"
"          5.000 Pervious Depression storage"
"          0.015 Impervious Manning 'n'"
"          0.000 Impervious Max.infiltration"
"          0.000 Impervious Min.infiltration"
"          0.050 Impervious Lag constant (hours)"
"          1.500 Impervious Depression storage"
"          0.294 0.000 0.000 0.000 c.m/sec"
"          Catchment 201 Pervious Impervious Total Area "
"          Surface Area 1.035 0.030 1.065 hectare"
"          Time of concentration 14.749 2.617 14.126 minutes"
"          Time to Centroid 106.704 96.912 106.201 minutes"
"          Rainfall depth 88.431 88.431 88.431 mm"
"          Rainfall volume 915.42 26.37 941.79 c.m"
"          Rainfall losses 43.062 3.195 41.946 mm"
"          Runoff depth 45.369 85.236 46.485 mm"

```

"	Runoff volume	469.65	25.42	495.06	c.m"
"	Runoff coefficient	0.513	0.964	0.526	"
"	Maximum flow	0.285	0.016	0.294	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				
"		0.294	0.294	0.000	0.000"
" 38	START/RE-START TOTALS 201"				
"	3 Runoff Totals on EXIT"				
"	Total Catchment area			1.065	hectare"
"	Total Impervious area			0.030	hectare"
"	Total % impervious			2.800"	
" 19	EXIT"				

Hyland Road: 100-Year Storm - Proposed Conditions

```

"          MIDUSS Output ----->"
"          MIDUSS version                      Version 2.25 rev. 465"
"          MIDUSS created                      Tuesday, February 05, 2008"
"          10  Units used:                      ie METRIC"
"          Job folder:                          Q:\13-212\21203-13 (Dunnink - Hyland)\
"                                               20-jul-31 swm calcs"
"          Output filename:                    100-yr design.out"
"          Licensee name:                      Mike.Vaughan"
"          Company
"          Date & Time last used:              7/31/2020 at 3:06:48 PM"
" 31      TIME PARAMETERS"
"          5.000  Time Step"
"          360.000  Max. Storm length"
"          3000.000  Max. Hydrograph"
" 47      FILEI_O Read/Open guelph100.stm"
"          1  1=read/open; 2=write/save"
"          1  1=rainfall; 2=hydrograph"
"          1  1=rain; 2=imperv; 3=perv"
"          guelph100.stm"
"          Guelph, ON 100 year storm"
"          New storm defined"
"          Total depth                          88.431    mm"
"          Maximum intensity                    239.350    mm/hr"
"          Duration                            210.000    minutes"
"          0.000    0.000    0.000    0.000 c.m/sec"
" 6 100hyd Hydrograph extension used in this file"
" 33      CATCHMENT 202"
"          1  Triangular SCS"
"          1  Equal length"
"          2  Horton equation"
"          202  Hyland Road Post-Development"
"          23.600  % Impervious"
"          1.065  Total Area"
"          100.000  Flow length"
"          4.000  Overland Slope"
"          0.814  Pervious Area"
"          100.000  Pervious length"
"          4.000  Pervious slope"
"          0.251  Impervious Area"
"          100.000  Impervious length"
"          4.000  Impervious slope"
"          0.250  Pervious Manning 'n'"
"          75.000  Pervious Max.infiltration"
"          12.500  Pervious Min.infiltration"
"          0.250  Pervious Lag constant (hours)"
"          5.000  Pervious Depression storage"
"          0.015  Impervious Manning 'n'"
"          0.000  Impervious Max.infiltration"
"          0.000  Impervious Min.infiltration"
"          0.050  Impervious Lag constant (hours)"
"          1.500  Impervious Depression storage"
"          0.294    0.000    0.000    0.000 c.m/sec"
"          Catchment 202      Pervious  Impervious Total Area "
"          Surface Area      0.814    0.251    1.065    hectare"
"          Time of concentration  14.749    2.617    10.294    minutes"
"          Time to Centroid    106.704    96.912    103.108    minutes"
"          Rainfall depth      88.431    88.431    88.431    mm"
"          Rainfall volume     719.53    222.26    941.79    c.m"
"          Rainfall losses     43.062    3.195    33.654    mm"
"          Runoff depth        45.369    85.236    54.777    mm"

```


"	Runoff volume	369.15	214.23	583.38	c.m"
"	Runoff coefficient	0.513	0.964	0.619	"
"	Maximum flow	0.224	0.137	0.294	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				
"		0.294	0.294	0.000	0.000"
" 38	START/RE-START TOTALS 202"				
"	3 Runoff Totals on EXIT"				
"	Total Catchment area			1.065	hectare"
"	Total Impervious area			0.251	hectare"
"	Total % impervious			23.600"	
" 19	EXIT"				

Glenburnie Drive: 100-Year Storm - Existing Conditions

```

"          MIDUSS Output ----->"
"          MIDUSS version                      Version 2.25 rev. 465"
"          MIDUSS created                      Tuesday, February 05, 2008"
"          10 Units used:                      ie METRIC"
"          Job folder:                        Q:\13-212\21203-13 (Dunnink - Hyland)\
"                                           20-mar-18 SWM calcs"
"          Output filename:                   100-yr ex Glenburnie.out"
"          Licensee name:                     Mike.Vaughan"
"          Company                            "
"          Date & Time last used:            3/18/2020 at 2:36:42 PM"
" 31      TIME PARAMETERS"
"          5.000 Time Step"
"          180.000 Max. Storm length"
"          1500.000 Max. Hydrograph"
" 31      TIME PARAMETERS"
"          5.000 Time Step"
"          360.000 Max. Storm length"
"          3000.000 Max. Hydrograph"
" 47      FILEI_O Read/Open guelph100.stm"
"          1 1=read/open; 2=write/save"
"          1 1=rainfall; 2=hydrograph"
"          1 1=rain; 2=imperv; 3=perv"
"          guelph100.stm"
"          Guelph, ON 100 year storm"
"          New storm defined"
"          Total depth                        88.431 mm"
"          Maximum intensity                  239.350 mm/hr"
"          Duration                          210.000 minutes"
"          0.000 0.000 0.000 0.000 c.m/sec"
"          6 100hyd Hydrograph extension used in this file"
" 33      CATCHMENT 101"
"          1 Triangular SCS"
"          1 Equal length"
"          2 Horton equation"
"          101 Glenburnie Pre-Development"
"          0.000 % Impervious"
"          0.674 Total Area"
"          86.500 Flow length"
"          10.000 Overland Slope"
"          0.674 Pervious Area"
"          86.500 Pervious length"
"          10.000 Pervious slope"
"          0.000 Impervious Area"
"          86.500 Impervious length"
"          10.000 Impervious slope"
"          0.250 Pervious Manning 'n'"
"          75.000 Pervious Max.infiltration"
"          12.500 Pervious Min.infiltration"
"          0.250 Pervious Lag constant (hours)"
"          5.000 Pervious Depression storage"
"          0.015 Impervious Manning 'n'"
"          0.000 Impervious Max.infiltration"
"          0.000 Impervious Min.infiltration"
"          0.050 Impervious Lag constant (hours)"
"          1.500 Impervious Depression storage"
"          0.218 0.000 0.000 0.000 c.m/sec"
"          Catchment 101 Pervious Impervious Total Area "
"          Surface Area 0.674 0.000 0.674 hectare"
"          Time of concentration 10.270 1.822 10.270 minutes"
"          Time to Centroid 101.764 95.707 101.764 minutes"

```

"	Rainfall depth	88.431	88.431	88.431	mm"
"	Rainfall volume	596.02	0.00	596.02	c.m"
"	Rainfall losses	43.349	2.615	43.349	mm"
"	Runoff depth	45.082	85.816	45.082	mm"
"	Runoff volume	303.85	0.00	303.85	c.m"
"	Runoff coefficient	0.510	0.000	0.510	"
"	Maximum flow	0.218	0.000	0.218	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				
"		0.218	0.218	0.000	0.000"
" 38	START/RE-START TOTALS 101"				
"	3 Runoff Totals on EXIT"				
"	Total Catchment area			0.674	hectare"
"	Total Impervious area			0.000	hectare"
"	Total % impervious			0.000"	
" 19	EXIT"				

Glenburnie Drive: 100-Year Storm - Proposed Conditions

```

"          MIDUSS Output ----->"
"          MIDUSS version                      Version 2.25 rev. 465"
"          MIDUSS created                      Tuesday, February 05, 2008"
"          10 Units used:                      ie METRIC"
"          Job folder:                        Q:\13-212\21203-13 (Dunnink - Hyland)\
"                                           20-mar-18 SWM calcs"
"          Output filename:                   100-yr pr Glenburnie.out"
"          Licensee name:                     Mike.Vaughan"
"          Company                            "
"          Date & Time last used:            3/18/2020 at 2:45:13 PM"
31          TIME PARAMETERS"
"          5.000 Time Step"
"          360.000 Max. Storm length"
"          3000.000 Max. Hydrograph"
47          FILEI_O Read/Open guelph100.stm"
"          1 1=read/open; 2=write/save"
"          1 1=rainfall; 2=hydrograph"
"          1 1=rain; 2=imperv; 3=perv"
"          guelph100.stm"
"          Guelph, ON 100 year storm"
"          New storm defined"
"          Total depth                        88.431 mm"
"          Maximum intensity                  239.350 mm/hr"
"          Duration                          210.000 minutes"
"          0.000 0.000 0.000 0.000 c.m/sec"
"          6 100hyd Hydrograph extension used in this file"
33          CATCHMENT 102"
"          1 Triangular SCS"
"          1 Equal length"
"          2 Horton equation"
"          102 Glenburnie Post-Development"
"          10.700 % Impervious"
"          0.674 Total Area"
"          86.500 Flow length"
"          10.000 Overland Slope"
"          0.602 Pervious Area"
"          86.500 Pervious length"
"          10.000 Pervious slope"
"          0.072 Impervious Area"
"          86.500 Impervious length"
"          10.000 Impervious slope"
"          0.250 Pervious Manning 'n'"
"          75.000 Pervious Max.infiltration"
"          12.500 Pervious Min.infiltration"
"          0.250 Pervious Lag constant (hours)"
"          5.000 Pervious Depression storage"
"          0.015 Impervious Manning 'n'"
"          0.000 Impervious Max.infiltration"
"          0.000 Impervious Min.infiltration"
"          0.050 Impervious Lag constant (hours)"
"          1.500 Impervious Depression storage"
"          0.215 0.000 0.000 0.000 c.m/sec"
"          Catchment 102 Pervious Impervious Total Area "
"          Surface Area 0.602 0.072 0.674 hectare"
"          Time of concentration 10.270 1.822 8.701 minutes"
"          Time to Centroid 101.764 95.707 100.639 minutes"
"          Rainfall depth 88.431 88.431 88.431 mm"
"          Rainfall volume 532.25 63.77 596.02 c.m"
"          Rainfall losses 43.349 2.615 38.990 mm"
"          Runoff depth 45.082 85.816 49.441 mm"

```

"	Runoff volume	271.34	61.89	333.23	c.m"
"	Runoff coefficient	0.510	0.970	0.559	"
"	Maximum flow	0.195	0.041	0.215	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				
"		0.215	0.215	0.000	0.000"
" 38	START/RE-START TOTALS 102"				
"	3 Runoff Totals on EXIT"				
"	Total Catchment area			0.674	hectare"
"	Total Impervious area			0.072	hectare"
"	Total % impervious			10.700"	
" 19	EXIT"				