



Walton Avenue Subdivision Design

Stormwater Management Report

Project Location:

Walton Avenue
Listowel, ON

Prepared for:

Riverview Properties Creekside Ltd.
520 Riverview Drive
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Prepared by:

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MTE File No.: 60410_001





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1.0 INTRODUCTION

MTE Consultants Inc. (MTE) was retained by Riverview Properties Creekside Ltd. to complete the stormwater management design for the Walton Avenue Subdivision to be constructed along Walton Avenue in the Town of Listowel in the Municipality of North Perth. This report will utilize the proposed stormwater management (SWM) Block for the development, which was established by the proposed Draft Plan of Subdivision.

The site is located along Walton Avenue just south of Rhine Street and will connect to Perkin Crescent and Pleasant View Drive. The property is bounded to the north by residential and active agricultural lands, to the south by west by Walton Ave and an existing residential subdivision, to the south by residential lands, and to the east by the Middle Maitland River. For the exact location of the site, refer to Figure 1.0.

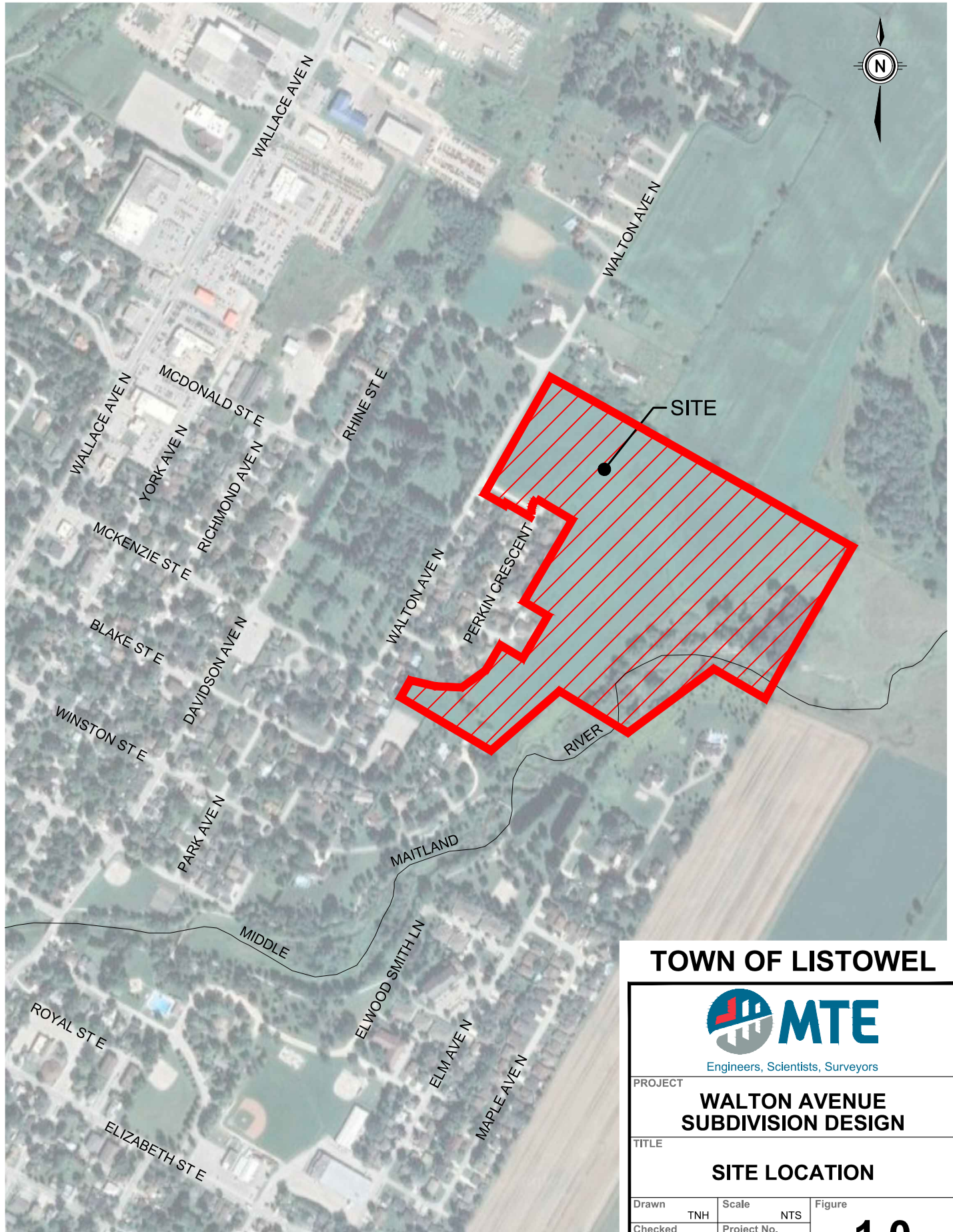
The 13.29ha site is proposed to be developed into a residential subdivision complete with municipal roadways, open space blocks, and a stormwater management block. The southeastern 4.28ha of the site (Block 11) is existing floodplain area and will not be developed. A total of 7 residential blocks are proposed along with two medium density blocks (Block 8 with 1.84ha and Block 9 with 1.09ha). The residential blocks are estimated to produce a total of 80 single-family lots. The exact quantity of single-family lots will be determined during detailed design, and the final design of the medium density blocks will most likely be determined during the site plan approval (SPA) process.

This report addresses the stormwater management requirements as recommended by the Municipality of North Perth, and the Ministry of the Environment, Conservation, and Parks (MECP) Stormwater Management Planning and Design Manual (March 2003) and proposes a design which meets these requirements.

2.0 CRITERIA

The stormwater management design criteria for the subject site, as provided by the Municipality of North Perth are as follows:

- Attenuation of the post-development peak flows for the 5-year through 100-year storm events to their corresponding pre-development (existing) peak flows; and
- Implementation of water quality controls to provide 'Enhanced' quality control as per the MECP SWM Planning and Design Manual (2003) (80% total suspended solid removal).



TOWN OF LISTOWEL



Engineers, Scientists, Surveyors

PROJECT

WALTON AVENUE SUBDIVISION DESIGN

TITLE

SITE LOCATION

Drawn	TNH	Scale	NTS	Figure
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Date	2025-03-03	Rev No.	0	

1.0

3.0 METHODOLOGY

In order to successfully complete the stormwater management design for this site, the following specific tasks were undertaken:

- Delineate drainage areas for pre- and post-development conditions;
- Determine the sub-catchment parameters;
- Determine the allowable stormwater runoff for the development through the use of the hydrologic program Visual OTTHYMO (VO);
- Calculate post-development runoff hydrographs using VO;
- Design the proposed SWM Facility to attain the required volume for quantity control;
- Perform an iterative procedure of varying the stage-storage-discharge relationship of the storage area until sufficient storage and quantity controls were provided;
- Include appropriate quality control measures in the development; and
- Incorporate appropriate erosion and sediment control measures in the design.

4.0 STORMWATER MANAGEMENT

The allowable/pre-development and post-development stormwater drainage and peak flow rates were determined by using the single event hydrologic modeling program VO. This program allows the user to analyze the impact on new and existing systems using accepted rainfall data to represent design storms of various durations and aid in the design of the stormwater management facilities.

As per the recommendations of the Municipality of North Perth the City of Stratford IDF curve parameters were used to create the rainfall data for each storm event. A Chicago Storm Distribution model (with a storm length of 6-hours and a time to peak ratio 'r' of 0.40) was used for determining peak flow rates for the 5-year through 100-year storm events. These flows were used to calculate the storage requirements to meet the targets of Stormwater Management.

4.1 Allowable/Pre-Development Conditions

The subject lands consist of mostly active agricultural row crop, with some floodplain and river lands located along the southeastern limits of the site where the Middle Maitland River flows through the site. The external contributing lands consist of residential lands.

The existing topography indicates that the 13.29ha site generally conveys flows to the southeast from Walton Avenue towards the Middle Maitland River. The existing lands exhibit medium to high sloping ranging in elevation from 391.74m at the northwest corner of the site to approximately 378.90m adjacent to the Middle Maitland River at the southeast corner of the site. Overland slopes are generally in the range of 1.5% to 12.0% with an average of approximately 3.25%. The banks of the floodplain area exhibit higher sloping in the range of 10% to 20% slopes.

The adjacent existing development conveys minor and major stormwater flows uncontrolled to the rear-yards of the lots along Pleasant View Drive through an easement. An existing 450mm diameter storm sewer discharges to grade within the subject lands and conveys flows across the site through a shallow swale to the Middle Maitland River.

4.1.1 Soils

A geotechnical investigation is currently under way and is being completed by MTE Consultants Inc. The preliminary borehole logs show a mixture of silt till and sand throughout the development.

The preliminary boreholes also revealed the presence of saturated soil conditions within the subject lands at depths as low as 3.0m below ground surface.

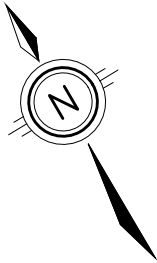
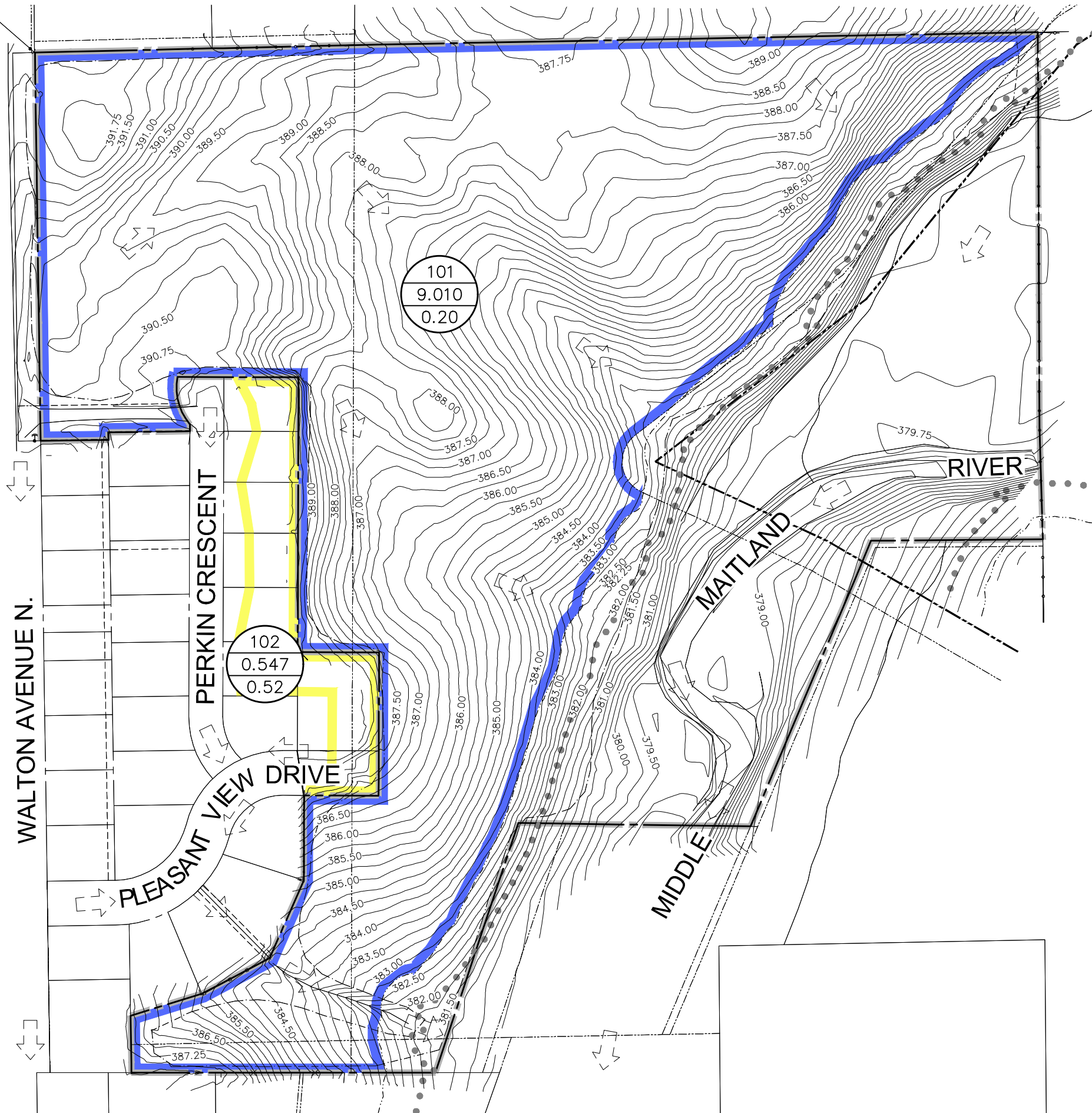
4.1.2 Hydrologic Modeling

The pre-development catchments were determined from the topographic survey and can be found on Figure 2.0. Table 4.1 provides the VO parameters used in the hydrologic modeling and a brief description for each catchment is below. Detailed calculations for various catchment parameters can be found in Appendix A. The southeastern 4.28ha within the floodplain limits has not been included within the stormwater management calculations as this land will remain unchanged.

- Catchment 101 – Consists of the subject lands outside of the floodplain limits that is proposed to be developed. These lands are primarily active agricultural lands conveying flows from west to east at an average slope of 3.25%.
- Catchment 102 – Consists of the external lands that contribute flows to the subject lands. These lands are existing residential lands.

Table 4.1 – Pre-Development Catchment Parameters

Catchment ID	Area (ha)	CN	Percent Impervious	Initial Abstraction (mm)	Flow Length	Manning's 'n'	Overland Slope
			TIMP XIMP	Pervious Impervious	Pervious Impervious	Pervious Impervious	Pervious Impervious
101 (Nash Hyd.)	9.010	81.7	Initial Abstraction =7.00mm		Time to Peak = 0.20 hours (Refer to Appendix A for Calculations)		
102 (Std. Hyd.)	0.547	85.0	45.0% 10.0%	5.00 1.50	25.0 61.0	0.25 0.013	2.00% 2.00%




LEGEND

- CATCHMENT 101
- CATCHMENT 102
- 101
0.685
0.25 SUB-CATCHMENT NUMBER
AREA (ha.)
RUNOFF COEFFICIENT
- Ex. OVERLAND FLOW ROUTE (MAJOR STORM)

CATCHMENT AREA CHARACTERISTICS			
CATCHMENT No.	AREA	'C'	% IMP
101	9.010ha	0.20	0.40%
102	0.547ha	0.52	45.0%
TOTAL	9.557ha	0.22	2.95%





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WALTON AVENUE SUBDIVISION DESIGN

TITLE
PRE-DEVELOPMENT CATCHMENT AREAS

Drawn	MRB	Scale	1:2,000	Figure 2.0
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Date	2025-03-03	Rev No.	0	

4.1.3 Pre-Development Modeling Results

The subject site under pre-development conditions discharges to the Middle Maitland River. Table 4.2 below shows a summary of the pre-development flows for the subject area. Refer to Appendix A for the detailed pre-development VO modeling input and output files.

Table 4.2 – Summary of Pre-Development Flows

Storm Event	Total Pre-Development Flows (m³/s)
5-year	0.666
10-year	0.923
25-year	1.257
50-year	1.521
100-year	1.790

4.2 Post-Development Conditions

The post-development conditions were broken down into four different catchment areas illustrated on Figure 3.0 below and described in the following list.

- Catchment 201 consists of the development lands that will continue to convey flows uncontrolled to the Middle Maitland River. These lands are located primarily within the rear-yards of the development or along the banks of the floodplain area.
- Catchment 202 consists of the external lands that convey flows to the proposed development. This catchment is the same as Catchment 102 from the pre-development conditions.
- Catchment 203 consists of the development lands that will convey both minor and major flows to the proposed stormwater management facility. Minor flows will be conveyed via the proposed storm sewer system and major flows will be conveyed overland through the proposed rights-of-way to the stormwater management facility.
- Catchment 204 consists of the medium density blocks that will convey only minor flows to the stormwater management facility with major flows being conveyed uncontrolled to the Middle Maitland River.

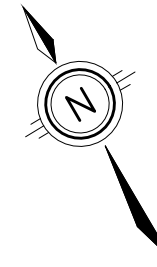
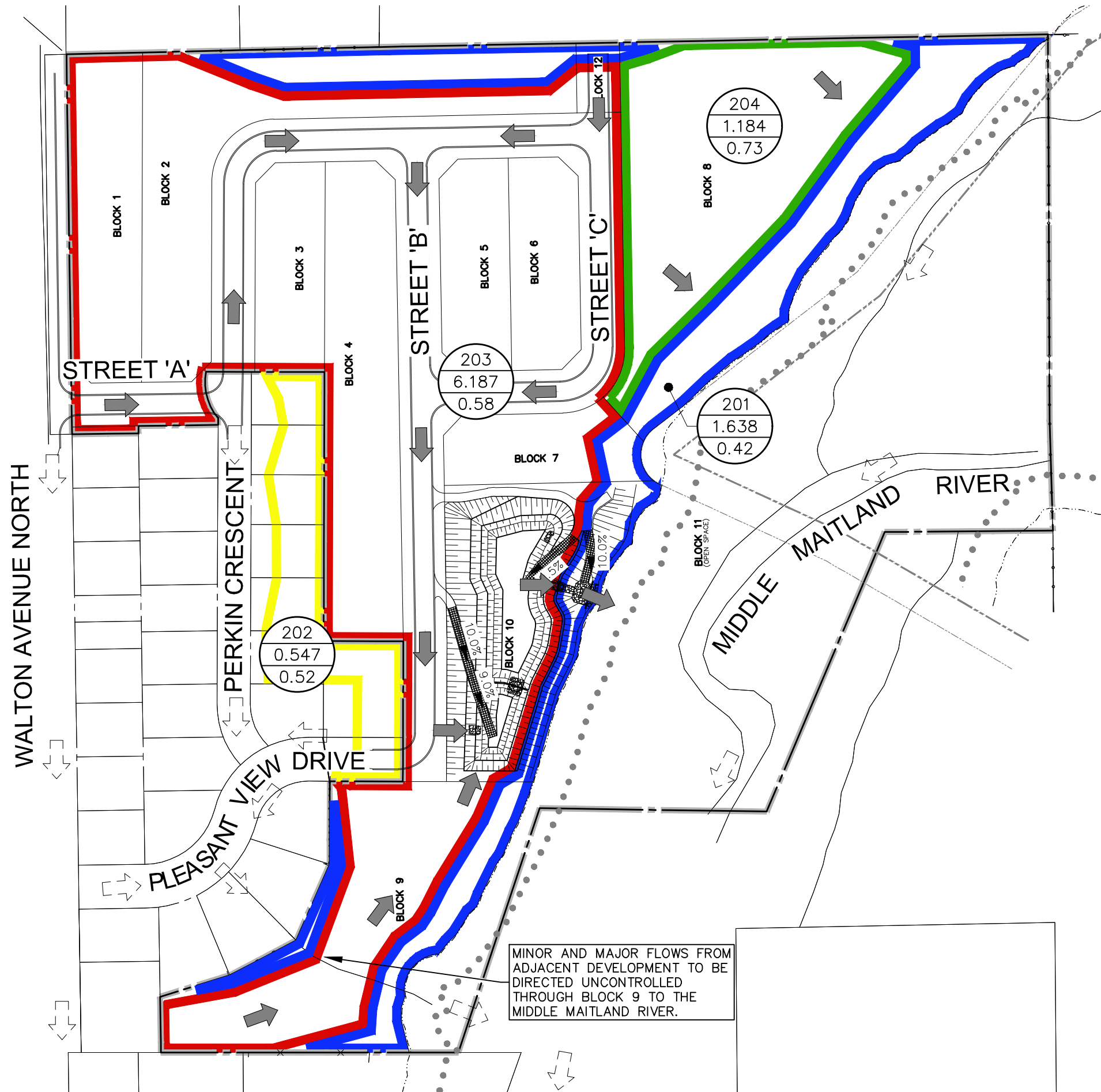
It is noted that the existing development along Pleasant View Drive and Perkin Crescent direct both minor and major flows uncontrolled to the ground surface on the west side of Block 9. These existing flows will be routed through the proposed medium density block and will continue to be conveyed uncontrolled to the Middle Maitland River. As these flows will not be increased or directed to the proposed SWM Facility, they have been excluded from the modeling.

4.2.1 Hydrologic Modeling

The table below (Table 4.3) summarizes the modeling parameters that were used for the post-development conditions and Appendix B contains the pertinent catchment calculations and the detailed VO modeling input and output files.

Table 4.3 – Post-Development Modeling Input

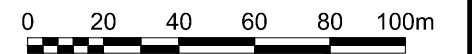
Catchment ID	Area (ha)	CN	Percent Impervious	Initial Abstraction (mm)	Flow Length (m)	Manning's 'n'	Overland Slope
			TIMP XIMP	Pervious Impervious	Pervious Impervious	Pervious Impervious	Pervious Impervious
201 (Std. Hyd.)	1.638	81.4	31.7% 10.0%	5.00 1.50	15.0 104.5	0.25 0.013	2.00% 2.00%
202 (Std. Hyd.)	0.547	85.0	45.0% 10.0%	5.00 1.50	25.0 60.4	0.25 0.013	2.00% 2.00%
203 (Std. Hyd.)	6.187	88.4	54.0% 45.0%	5.00 1.50	40.0 203.1	0.25 0.013	2.00% 2.00%
204 (Std. Hyd.)	1.184	92.0	75.0% 60.0%	5.00 1.50	40.0 88.86	0.25 0.013	2.00% 2.00%



LEGEND

- CATCHMENT 201
- CATCHMENT 202
- CATCHMENT 203
- CATCHMENT 204
- Ex. OVERLAND FLOW ROUTE (MAJOR STORM)
- OVERLAND FLOW ROUTE (MAJOR STORM)
- 201
0.685
20.0 SUB-CATCHMENT NUMBER
AREA (ha.)
RUNOFF COEFFICIENT

CATCHMENT AREA CHARACTERISTICS			
CATCHMENT No.	AREA	'C'	% IMP
201	1.638ha	0.42	31.7%
202	0.547ha	0.52	45.0%
203	2.535ha	0.53	56.1%
204	6.187ha	0.58	54.0%
TOTAL	9.557ha	0.57	52.3%



PROJECT
**WALTON AVENUE
SUBDIVISION DESIGN**

TITLE
**POST-DEVELOPMENT
CATCHMENT PLAN**

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MINOR AND MAJOR FLOWS FROM ADJACENT DEVELOPMENT TO BE DIRECTED UNCONTROLLED THROUGH BLOCK 9 TO THE MIDDLE MAITLAND RIVER.

4.2.2 Stormwater Management – Quantity Control

Stormwater quantity controls will be provided through the construction of a wet pond and its associated outlet control devices. This proposed SWM Facility is proposed to be located within Block 10 located at the intersection of the extension of Pleasant View Drive and Street 'B'. The facility will discharge to the bank of the Middle Maitland River at an elevation above the river's floodplain water surface elevation.

The proposed wet pond will be controlled by a single on-line orifice located on the face of the outlet headwall and an overflow weir for emergencies. The on-line orifice will convey flows through a storm sewer and will discharge into a plunge pool and flow spreader. The flow spreader will be designed to reduce the potential for any erosion of the bank of the Middle Maitland River. The SMWF has also been designed to include a maintenance access road for the bottom of the forebay, for the bottom of the main pond near the outlet, and for the plunge pool outlet as per the Municipalities recommendations.

Minor flows will be conveyed to the SWMF through the storm sewer system. An 825mm diameter storm sewer will discharge flows into the western corner of the proposed facility through a headwall structure constructed in accordance with OPSD 804.04. This headwall will be constructed with chute blocks to reduce the outgoing velocity of the flows and potential for erosion within the facility. Major flows will generally follow the proposed rights-of-way and rear-yard easements and will be directed to the SWM Facility through an inlet weir.

The 825mm diameter inlet is proposed to have an invert elevation of 385.060m and will be located near the southwest end of the proposed wet pond where a sediment forebay has been included. The pond is designed with a permanent ponding elevation of 383.70m. Flows from the forebay will be directed to the northeast end of the wet pond where a 250mm diameter on-line orifice will be installed on the face of the outlet headwall at an invert elevation of 383.700m. Flows from the orifice will be conveyed to a plunge pool and flow spreader through a 375mm diameter pipe. A 1.50m wide and 0.50m deep concrete overflow weir is to be installed within the vicinity at an elevation of 385.00m, which will also convey flows to the flow spreader.

Flows from the weir and the on-line orifice will discharge into a 1.0m deep plunge pool. The pool is proposed to reduce outflow velocities and erosion potential from the SWMF discharge. Flows from the pool will be conveyed over a 10.0m wide flow spreader that will safely discharge flows down the existing embankment of the Middle Maitland River using existing drainage patterns.

A 4.0m wide access/maintenance road has been incorporated into the design of the SWM facility to ensure sufficient access to the bottom of the wet pond, forebay, and the proposed plunge pool and flow spreader. The access road will have an asphalt surface around the exterior of the facility and have a maximum longitudinal grade of 8%, maximum cross-fall of 3% and a minimum centerline radius of curvature not less than 12m. The 4.0m access roads to the bottom of the pond and plunge pool will be constructed of cable concrete and have a maximum longitudinal grade of 10%, a maximum cross-fall of 3%, and a minimum centerline radius of curvature not less than 12m.

Due to the potential for a presence of shallow ground water levels within the vicinity of the SWM Facility, a clay liner may have to be included in the design.

If required, the clay liner shall be constructed with the following characteristics:

- Installed all around the SWM Facility in order to create a continuous liner up to an elevation that is a minimum of 0.30m above the seasonal high ground water level.
- Constructed with an imported clay material with the specified hydraulic conductivity to create a minimum 300mm thick compacted liner or constructed with a geosynthetic clay liner.
- Constructed with an inorganic soil that has a maximum saturated hydraulic conductivity of 1×10^{-8} m/s. The following are recommended ranges that will provide the required level of protection;

Particle Size Analysis

Fines: $\geq 50\%$
 Clay Content: $\geq 20\%$
 Sand Content: $\leq 45\%$
 Gravel Content: $\leq 50\%$

Atterberg Limits

Plasticity Index (PI): $11\% \leq PI \leq 30\%$
 Liquid Limit (LL): $30\% \leq LL \leq 60\%$

These characteristics are provided only as a guideline and a geotechnical engineer may provide an alternative design that is equivalent. The soil will need to be tested in a laboratory as per ASTM procedure.

The SWM facility has been designed in accordance with the MECP Stormwater Management Planning and Design Manual (March 2003), a summary of which can be found in Table 4.4 below.

Table 4.4 – Summary of Proposed SWM Facility Design

Design Element	Design Objective	Minimum/Preferred Criteria	Proposed Design
Drainage Area	Volumetric turnover	-Minimum: 5 ha -Preferred: >10 ha	9.557 ha
Treatment Volume	Provision of appropriate Level of protection (see Section 3.3.1.1)	-As per Table 3.2 of the MECP 2003 SWM Manual (Refer to Table 4.5)	7,558.3 m ³ Total Volume 1,722.8 m ³ Permanent Pool
Active Storage Detention Time	Suspended Solids Settling	-24 hours (12 hours if in conflict with minimum orifice size)	12.3 hours (Refer to Appendix D)
Forebay	Pre-treatment	-Minimum Depth: 1.0m -Maximum Area: 33% of the total permanent pool -Preferred Depth: 1.5m -Preferred Area: 20%	Depth – 1.00m Area – 644m ² (22.2% of permanent pool)
Length-to-width Ratio	Maximize flow path and minimize short-circuiting potential	-Minimum: 3:1 (Overall) -Minimum: 2:1 (Forebay) -Preferred: 4:1 to 5:1	Overall – 3.1 : 1 Forebay – 2.7 : 1

Design Element	Design Objective	Minimum/Preferred Criteria	Proposed Design
Permanent Pool Depth	Minimize re-suspension, avoid anoxic conditions	-Maximum Depth: 3.0m -Preferred Max: 2.5m -Mean Depth: 1.0 – 2.0m	Max Depth – 1.2m Mean Depth – 1.2m
Active Storage Depth	Storage/Flow Control	-Quality & Erosion Control: - 1.5m (Maximum) - 1.0m (Preferred) -Total including Quantity Control: 2.0m	25mm – 0.37m 5-year – 0.89m 100-year – 1.52m
Side Slopes	Safety	-Maximum: 5:1 for 3.0m around permanent pool with 3:1 elsewhere -Preferred: 7:1 near normal water level, use of 0.3m steps, 4:1 elsewhere	4:1 with 3.0m wide 5:1 bench at water surface. 3:1 within permanent ponding areas
Inlet	Avoid clogging/freezing	-Minimum: 450 mm -Preferred Slope >1.0%	825mm at 0.51% slope
Outlet	Avoid clogging/freezing	-Minimum: 450mm outlet pipe -Minimum: 150mm outlet for reverse sloped pipe -Minimum: 75mm orifice -Preferred: 100mm orifice	250mm On-line Orifice 375mm pipe at 0.50%
Maintenance Access	Access for backhoes or bobcats	-Provided to approval of - Municipality	4.0m wide access to bottom of forebay, main pond, and flow spreader
Sediment Drying Area	Sediment Removal	(Preferrable – only used when it imposes no additional land requirement) -Provided above maximum water level with drainage returning to pond	None provided
Buffer	Safety	-Minimum 7.5m beyond maximum water quality control water level -Minimum 3.0m beyond maximum water level	4.5m wide buffer from nearest PL to max. water level

4.2.3 Stormwater Management – Quality Control

Stormwater quality control for the subject lands will be provided by directing drainage through the wet pond facility, which has been designed in accordance with the MECP 2003 SWM Manual’s Table 3.2. A portion of this table is shown below (Table 4.5) and summarizes the required storage volumes per hectare required to meet an ‘Enhanced’ level of protection. An ‘Enhanced’ level of protection is defined by the MECP SWM Manual as an 80% long-term removal of suspended solids. A column has been added to the table illustrating the site-specific level of imperviousness (52.3%) that has been linearly interpolated from the adjacent published values.

Table 4.5 – Summary of Treatment Volume Requirements for ‘Enhanced’ Protection Levels

SWM Facility Type	Storage Volume for Impervious Level (m ³ /ha)				
	35%	52.3% (Interpolated)	55%	70%	85%
Infiltration	25	29.3	30	35	40
Wetlands	80	101.6	105	120	140
Hybrid Wet Pond/Wetlands	110	144.5	150	175	195
Wet Pond	140	183.1	190	225	250

The volume per hectare required for the proposed wet pond facility was calculated to be 183.1m³ for an ‘Enhanced’ level of protection. The post-development conditions contribute a total of 9.557ha of drainage, which results in a minimum facility size calculated at 1,750m³. Out of this total required volume, a minimum of 382.3m³ is required to be active storage volume. The remainder of the total required storage volume (1,367.9m³) is the minimum requirement for total permanent pool volume.

As per the minimum requirements of Table 4.4 above, the forebay must be sized to take up a maximum of 33% of the total area associated with the permanent pool. The permanent pool takes up a total area of 1,989m² with 356m² located within the forebay. This results in the forebay using 22.2% of the total permanent pool area, and fits within the requirements.

The forebays must also be sized to ensure sediment settling occurs given the calculated flow rate and sediment loading. To facilitate the design of the forebays, the 25mm storm event was modeled within the VO hydrologic model and the resulting flows were input into a calculation spreadsheet (found in Appendix E). As a result of these calculations, the forebay was designed with a length of 29.0m, which met the settling requirements and is greater than the minimum 2:1 length to width ratio.

Anticipated cleanout frequencies were also calculated. The forebay has a minimum cleanout frequency of 5.2 years while the main pond portion of the SWMF was found to have a minimum cleanout frequency of about 90 years. Refer to Appendix E for forebay settling calculations and cleanout calculations.

4.3 Post-Development Modeling Results

A summary of the stage-storage-discharge relationship for the proposed SWM Facility is shown below in Table 4.6 and a detailed table showing the stage-storage-discharge relationships for the post-development SWM Facility is provided in Appendix C.

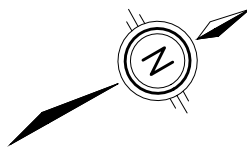
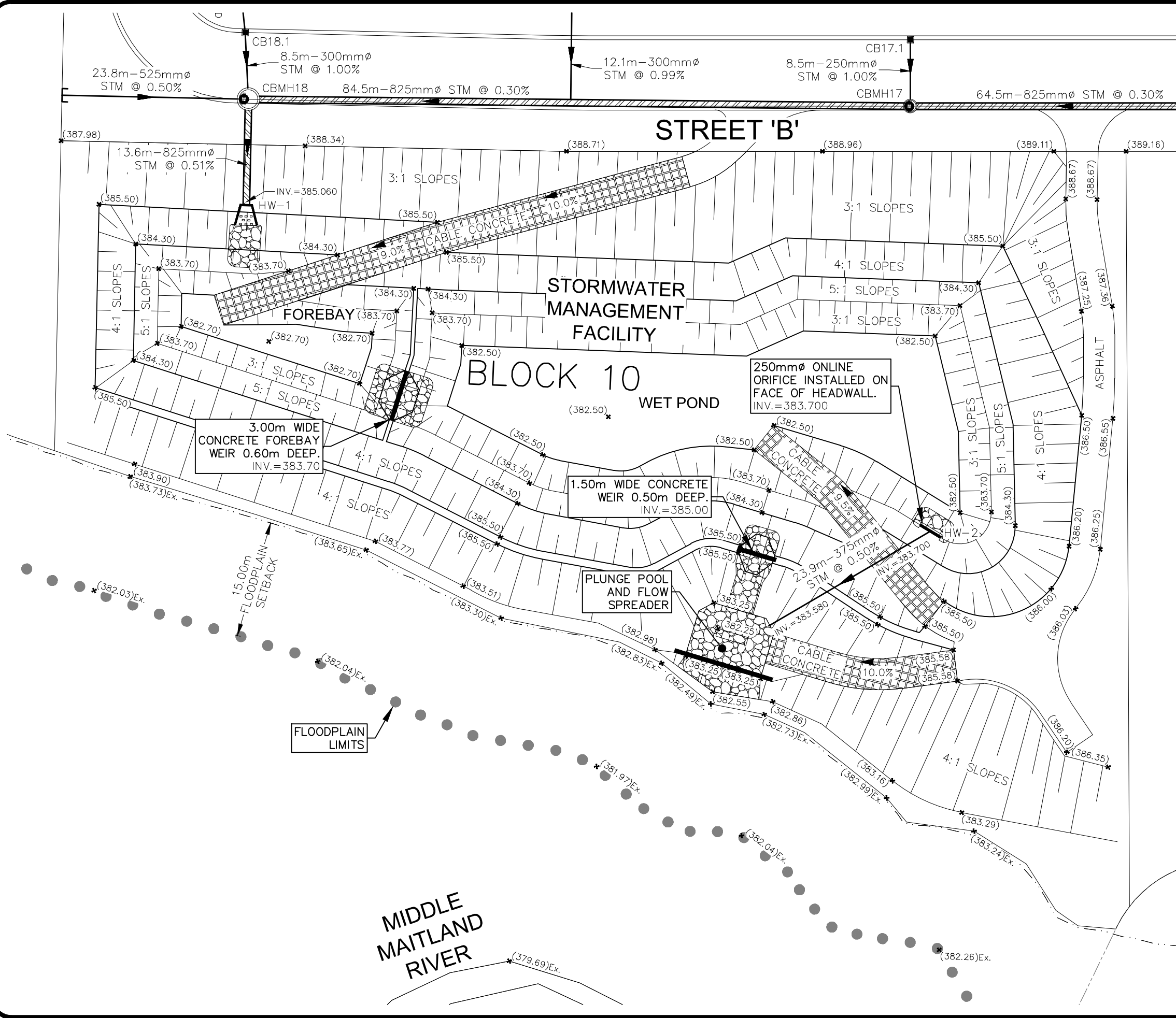
Table 4.6 – Post-Development SWM Facility Stage-Storage-Discharge Information

Elevation (m)	Discharge (m ³ /s)	Volume (m ³)		Remarks
		Total	Active	
382.50	--	0	--	Bottom of Main Pond
382.70	--	187.1	--	Bottom of Forebay
383.00	--	555.5	--	
383.20	--	843.8	--	
383.40	--	1167.6	--	
383.70	0.0000	1722.8	0.0	Permanent Pool Invert of 250mm Orifice
383.80	0.0114	1930.2	207.4	
383.90	0.0371	2151.8	429.0	
384.00	0.0573	2387.9	665.1	
384.10	0.0718	2638.7	915.9	
384.20	0.0839	2904.5	1181.7	
384.30	0.0944	3185.6	1462.8	Top of 5:1 bench
384.40	0.1039	3481.2	1758.4	
384.50	0.1125	3788.8	2066.0	
384.60	0.1206	4108.7	2385.9	
384.70	0.1281	4440.9	2718.1	
384.80	0.1353	4785.6	3062.8	
384.90	0.1420	5142.9	3420.1	
385.00	0.1485	5512.9	3790.1	Invert of 1.50m Weir
385.05	0.1784	5702.7	3979.9	
385.10	0.2359	5895.8	4173.0	
385.20	0.4221	6291.6	4568.8	
385.30	0.7050	6700.5	4977.7	
385.40	1.0908	7122.7	5399.9	
385.50	1.5867	7558.3	5835.5	Top of Pond

A summary of the peak flows for the pre-development and post-development conditions are displayed in Table 4.7. The detailed VO input and output files for the model can be found in Appendix B. A summary of the maximum ponding elevations and volumes for the SWM Facility is provided in Table 4.8 and the details of the post-development SWM Facility are shown in Figure 4.0 below.

Table 4.7 – Post-Development Summary of Peak Flows

Drainage Area		5-year Storm (m ³ /s)	10-year Storm (m ³ /s)	25-year Storm (m ³ /s)	50-year Storm (m ³ /s)	100-year Storm (m ³ /s)
Pre-Development						
Catchment 101		0.597	0.834	1.145	1.391	1.642
Catchment 102		0.083	0.107	0.137	0.159	0.181
TOTAL		0.666	0.922	1.257	1.521	1.790
Post-Development						
Catchment 201 (Uncontrolled)		0.203	0.269	0.354	0.418	0.531
Catchment 202 (Contributing External Lands)		0.083	0.107	0.137	0.159	0.181
Catchment 203 (Controlled to SWMF)		1.043	1.343	1.633	1.840	2.056
Catchment 204 (Minor Controlled, Major Uncontrolled)	Minor	0.301	0.304	0.304	0.304	0.304
	Major	---	0.046	0.109	0.151	0.195
SWM Facility Discharge (202 + 203 + 204 Minor)		0.120	0.135	0.170	0.305	0.469
Total Uncontrolled (201 + 204 Major)		0.203	0.269	0.389	0.484	0.726
TOTAL (SWMF + Uncontrolled)		0.287	0.367	0.482	0.595	0.836

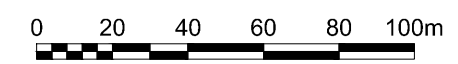


LEGEND

- MH 21.3m-300mm ϕ STM @ 1.30% STORM SEWER
- (DROP CURB) CONCRETE CURB
- (TOP) 3:1 (BOTTOM) EMBANKMENT (SLOPE AS NOTED)
- RIP RAP
- SHALLOW PIPE INSULATION

Peak Flows, Ponding Volumes & Ponding Depths

Storm Event	Peak Flow (m ³ /s)	Elevation (m)	Depth (m)	Storage Volume (m ³)
5-Year	0.287	384.59	0.89	2,355
10-Year	0.367	384.80	1.10	3,064
25-Year	0.482	385.04	1.34	3,928
50-Year	0.595	385.14	1.44	4,320
100-Year	0.836	385.22	1.52	4,639



PROJECT
WALTON AVENUE SUBDIVISION DESIGN

TITLE
SWM FACILITY DETAILS

Drawn	TNH	Scale	1:2,000	Figure 4.0
Checked	JMD	Project No.	60410_001	
Date	2025-03-03	Rev No.	0	

Table 4.8 – Summary of Maximum Ponding Elevations and Volumes

Storm Event	Maximum Ponding Elevation (m)	Maximum Ponding Depth (m)	Active Storage Volumes (m³)
5-Year	384.59	0.89	2355
10-Year	384.80	1.10	3064
25-Year	385.04	1.34	3928
50-Year	385.14	1.44	4320
100-Year	385.22	1.52	4639

5.0 EROSION AND SEDIMENT CONTROL MEASURES

Precautions will be taken during construction to limit erosion and sedimentation. Erosion and Sediment Control Plans will be prepared and will accompany the detailed design submission for the subject lands. The plans will illustrate the erosion and sediment control measures to be implemented during each phase of construction, which will limit impacts associated with site development.

Typically, the recommended construction sequence for erosion and sediment control measures will be as follows:

- Placement of all sediment control fencing where required;
- Construction of dry pond which will serve as a sediment basin for the site during construction;
- Construction of temporary swales to direct runoff to temporary hickenbottom drains with rock check dams as required to control velocities;
- Stripping and strategic placement of topsoil stockpiles. Placement of sediment control fencing around all stockpile areas; and
- Re-vegetation of completed areas as soon as possible after construction, including those areas not slated for construction within 60 days.

Where rock check dams are proposed to promote sedimentation and reduce velocities, clean aggregate is to be placed perpendicular to the direction of flow in the swale, with a small volume of excavation on the upstream side to provide storage for accumulated sediment.

Where hickenbottom drains are proposed to provide a temporary outlet for surface water, 150mm rip-rap is to be placed 1-meter-wide to the top of the hickenbottom.

Sediment control fencing shall consist of filter fabric attached to paige wire fencing and sealed at ground level. It will be installed at the perimeter of the work areas and intermittently on sloped areas where required. Sediment control fencing will be placed around all topsoil stockpiles.

Access to topsoil or fill storage areas will be located on the upstream side of storage piles. This practice will ensure continuity of the sediment control fencing in the downslope direction which is most vulnerable to erosion and sediment deposition. Further, topsoil and hydroseed will be placed on all exposed areas following the completion of grading activities.

It is recommended that during construction of the SWM Facility, monitoring and inspection of the erosion and sediment controls be conducted to ensure the satisfactory performance of these measures.

Reporting of the inspection and monitoring results should be distributed to the Municipality of North Perth and the Maitland Valley Conservation Authority. If it is found that the erosion and sediment control measures are not working adequately, they shall be augmented to the satisfaction of the Municipality of North Perth and the Maitland Valley Conservation Authority, based on field decisions.

6.0 OPERATION AND MAINTENANCE

The purpose of this section is to describe a maintenance approach for the SWM facilities described in this report. It is intended to be used by the developer prior to assumption of the facility, as well as by the Municipality of North Perth following its assumption for long term maintenance and monitoring. The plan generally consists of regular site inspections to ensure the facilities continues to function at design efficiency and benefit the surrounding environment.

The SWM facilities will experience the greatest amount of sediment loading during the development of the upstream drainage area. During this phase, there is the potential for large land areas to be stripped of natural vegetative cover, thereby increasing sediment loading. When construction is taking place within the upstream catchment area, regular inspections (including after every significant rainfall event of 25mm or greater) should be made of the specified erosion and sediment control measures to ensure they are in place and functioning. These measures are detailed on the engineering design drawings for the subdivision and are generally summarized below.

- It is recommended that sediment depth measurements be completed for the SWM facility each month during the construction phases of development.
- The proposed SWM Facility is to be maintained as required by the amount of sediment buildup. The facilities are to be inspected regularly during the first year after completion of any phase of construction and every 6 months after the first year.
- The proposed SWM Facility is required to be cleaned out immediately after each phase of construction.
- The SWM Facility areas (dry pond and plunge pool) are required to be cleaned out immediately after construction.
- The proposed catchbasin sumps are required to be cleaned out immediately after construction by vacuum truck or approved equivalent.
- The proposed sediment forebay within the SWMF is required to be cleaned out immediately after construction by vacuum truck or approved equivalent.

Furthermore, it is recommended that the owner initiate a post construction monitoring program for the proposed SWM facilities to ensure their long-term effectiveness. The post construction monitoring program should include:

- Monthly inspection of the SWM facility from April 1 to November 30 and inspection of other temporary and permanent erosion control works;
- Removal of debris that may accumulate and hinder the functionality of the SWM facility;

- Review of sediment accumulation within the SWM facility and the forebay. When sediment accumulation exceeds 150mm in depth, sediment is to be tested for contaminants and a method of disposal is to be determined; and
- On a yearly basis between April 1 to November 30, at least five water samples shall be taken at the outfall from the facilities to assess the Total Suspended Solid (TSS) concentrations in mg/l. The samples shall be taken within 24 hours after a significant rainfall event.

A detailed inspection checklist is provided in Appendix C which can be used to identify the status of inspection items. Copies of completed inspection checklists, as well as any associated photographs, should be stored together to form complete documentation of the ongoing condition of the facilities. Frequency of the post construction monitoring will be at the discretion of the Municipality of North Perth. It is recommended that a minimum of four (seasonal) inspections be made, annually.

General maintenance includes all tasks required for regular facility upkeep:

- Grass Cutting – Grass cutting is not recommended within the stormwater management facilities. Allowing the grass to grow acts as a natural deterrent to geese which may pollute the facility. If the grass is to be cut to improve the visual appeal of the SWM facility, it should be done as infrequently as possible and should be mowed parallel to the shoreline while directing the grass clippings uphill to reduce the potential increase in direct organic loading to the facility.
- Weed Control – In order to prevent the spread of unwanted weeds and non-native vegetation, the need for weed control should be assessed on an annual basis. To maintain the water quality of the facility, herbicides and pesticides should ideally not be used to stop the spread of these unwanted species. Instead, weeding should be done by hand to maintain both water quality and to protect surrounding vegetation.
- Plantings – During the first two years of operation, it is expected that the SWM facility vegetation will require some replanting or enhancement. The condition of the facility vegetation should be noted during the visual inspections and corrective actions noted.
- Trash Removal – Trash removal will prevent the clogging of inlets and outlets that could impact the operation of the facility. Trash removal should be completed in the spring and then on an as-required basis for the duration of the year.
- Clearing Outlet Structures – During visual inspections, the condition of the outlet riser and manhole, and the overflow weir for the facility should be observed to ensure that they are free and clear of debris and sediment and to ensure that orifices are able to function properly. Any maintenance of these items should be completed immediately as needed.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the foregoing analysis, it is concluded that:

- the imperviousness of the site will be increased from the existing levels, therefore, to meet the requirement of controlling the 5-year through 100-year storm events to predevelopment levels stormwater quantity controls are required;
- the post-development flows will be controlled by an online orifice and weir located within a wet pond stormwater management facility;
- the outlet controls and proposed SWM Facility will restrict post-development peak flows to be less than the pre-development (allowable) peak flows for the required storm events; and
- the post-development stormwater quality controls will be provided by the wet pond constructed in accordance with the MECP 2003 SWM Manual guidelines.

It is recommended that:

- the proposed SWM facility be constructed according to the proposed elevations and specifications as shown on the detailed design drawings;
- the proposed erosion and sediment control measures be implemented as shown on the detailed design soil erosion and sediment control drawings;
- one 250mm diameter on-line orifice be installed at the face of the proposed outlet headwall HW-2 at in invert elevation of 383.70m;
- one 1.5m wide and 0.50m deep concrete trapezoidal weir be installed near the 4.0m wide access roads at the low end of the dry pond at an elevation of 385.00m.

All of which is respectfully submitted,

MTE Consultants Inc.



Travis Hanko, E.I.T.
Designer
519-271-7952 ext. 2348
thanko@mte85.com



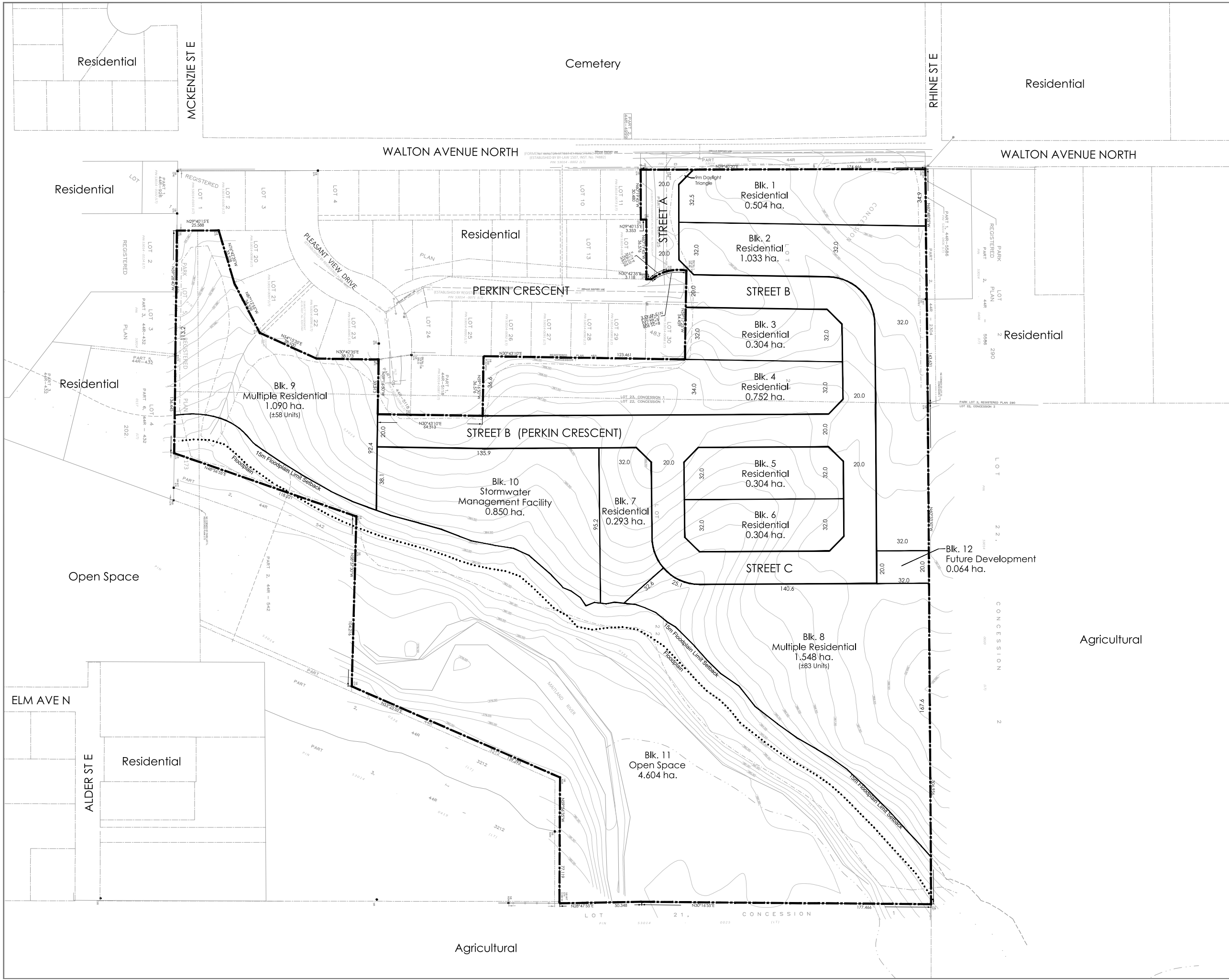
Jamie Dick, P.Eng.
Manager, Civil Engineering Division
519-271-7952 ext. 2337
jdick@mte85.com

TNH:cmb

M:\60410_001\04 - Reports\01 - MTE Reports\02 - Stormwater Management Report (SWM)\Rev-00\60410_001_SWM Report_2025-02-14_R00.docx

Appendix A

Draft Plan of Subdivision (Reduced)



DRAFT PLAN OF SUBDIVISION

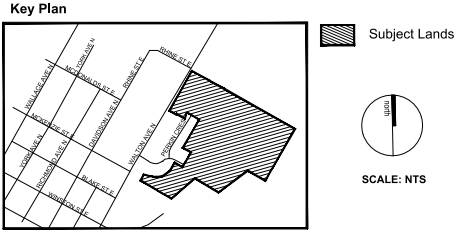
Legal Description
 PART OF LOTS 22 & 23, CONCESSION 1
 AND PART OF PARK LOT 5, REGISTERED PLAN 173
 TOWNSHIP OF WALLACE, NOW IN THE TOWN OF LISTOWEL
 COUNTY OF PERTH

Owner's Certificate
 I HEREBY AUTHORIZE MACNAUGHTON HERMSEN BRITTON CLARKSON PLANNING LIMITED
 TO SUBMIT THIS PLAN FOR APPROVAL.

DATE: _____ OWNER: _____

Surveyor's Certificate
 I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED ON THIS PLAN AND
 THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

DATE: _____ ONTARIO LAND SURVEYOR: _____



Additional Information Required Under Section 51(17) of the Planning Act R.S.O. 1990, c.P.13 as Amended

A. AS SHOWN	B. AS SHOWN	C. AS SHOWN
D. AS SHOWN	E. AS SHOWN	F. NONE
G. AS SHOWN	H. MUNICIPAL WATER SUPPLY	I. SILT/LOAM
J. AS SHOWN	K. ALL SERVICES AS REQUIRED	L. AS SHOWN

Area Schedule

Description	Block	Area (ha)	Units
Residential	1-7	3,494	±67
Multiple Residential	8, 9	2,638	±141
Stormwater Management Facility	10	0,850	
Open Space	11	4,604	
Future Development	12	0,064	
Roads		1,640	
TOTAL	12	13,290	±208

No.	Date	Issued / Revision	By
1.	Jan. 22, 2025	Preliminary Draft Plan	SP

Notes
 1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SHOWN.
 2. PROPERTY BOUNDARY PREPARED BY MTE CONSULTANTS INC.
 3. TOPOGRAPHIC SURVEY PREPARED BY VAN HARTEN, DEC. 12, 2024.
 4. PARCEL FABRIC ARE APPROXIMATE/ FOR INFORMATION PURPOSES ONLY.
 5. DAYLIGHT TRIANGLE 9.0 METRE.

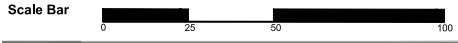


Approval Stamp

Date	January 22, 2025
File No.	15188M
Plan Scale	1:1,000 (Arch D)
Drawn By	SP
Checked By	XX

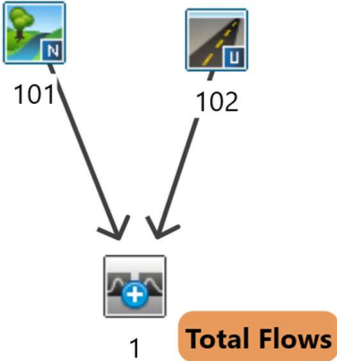
Project
 Walton Ave North
 Town of Listowel
 Municipality of North Perth

File Name Draft Plan of Subdivision **Dwg No.** 1 of 1



Appendix B

Pre-Development Modeling Details



Walton Street Subdivision
Catchment Characteristic Calcs
 Listowel, ON

Project Number: 60410_001
 Date: February 14, 2025
 Design By: T.Hanko
 File: Q:\60410_001\Stormwater Management\60410_001_Catchment Calcs_R00.xlsx

Catchment 101		Development Lands				
Nash Hydrograph		Area (ha)	C	HSG	CN	% Imp.
Row Crop - Contoured (Good)		8.521	0.20	C	82	0.0%
Open Space (Good - >75% Grass)		0.409	0.20	C	74	0.0%
Road - Paved (w/ Ditches)		0.080	0.52	C	92	45.0%
Total/Composite		9.0101	0.20		81.7	0.4%

Area A=	9.01 ha	Catchment Area=	90,101 m ²
Composite C=	0.20	Channel Length=	450 m
Slope S=	3.25 %	SF=	2
Length L=	100.0 m	(Overland Flow) L=	100.10 m

Airport Method (where C is less than 0.40)	$t = \frac{3.26(1.1-C)(L)^{0.5}}{S^{0.33}}$ $t = \frac{3.26(1.1-0.20)(100)^{0.5}}{(3.25)^{0.33}}$	t= TIME OF CONCENTRATION (min) L= LENGTH OF OVERLAND FLOW (m) C= RUNOFF COEFFICIENT S= CATCHMENT SURFACE SLOPE (%) A= WATERSHED AREA (ha)
	t= 19.89 min t _p =0.6t 0.20 hours	t_p= TIME TO PEAK (hrs)

L=	$\frac{\text{(Catchment Area)}}{\text{(SF)(Channel Length)}}$
SF= Shape Factor	2 for symmetrical catchments 1 for one-sided catchments

Catchment 102		Contributing External Lands				
Standard Hydrograph		Area (ha)	C	HSG	CN	% Imp.
Builtup - (45% Imp.)		0.547	0.52	C	85	45.0%
Streets & Roads (with blvd)		0.000	0.59	C	92	55.0%
Open Space (Good - >75% Grass)		0.000	0.20	C	74	0.0%
Total/Composite		0.5470	0.52		85.0	45.0%

Total Impervious	0.450
Directly Connected Impervious	0.100

	Pervious	Impervious
IA/Depression Storage	5.0	1.5
Length	25.0	<Calculated by VO>
Slope	2.00	2.00

L=	LENGTH OF OVERLAND FLOW (m)
C=	RUNOFF COEFFICIENT
S=	CATCHMENT SURFACE SLOPE (%)
A=	WATERSHED AREA (ha)

Storage Coeff. (min)= 1.40 (ii) 6.54 (ii)
 Unit Hyd. Tpeak (min)= 5.00 10.00
 Unit Hyd. peak (cms)= 0.33 0.14

PEAK FLOW (cms)= 0.02 0.07 0.083 (iii)
 TIME TO PEAK (hrs)= 2.42 2.50 2.50
 RUNOFF VOLUME (mm)= 56.76 36.89 38.88
 TOTAL RAINFALL (mm)= 58.26 58.26 58.26
 RUNOFF COEFFICIENT = 0.97 0.63 0.67

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 ***** WARNING: FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
 YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 85.0 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

=====
 V V I SSSS U U A L (v 6.2.2016)
 V V I SS U U A A L
 V V I SS U U A A A A L
 V V I SS U U A A L
 V V I SSSS UUUU A A LLLL

OOO TTTT TTTT H H Y Y M M OOO TM
 O O T T H H Y Y M M O O
 O O T T H H Y Y M M O O
 OOO T T H H Y Y M M OOO

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***** D E T A I L E D O U T P U T *****

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DATE: 02/12/2025 TIME: 09:42:34

USER:

COMMENTS: _____

 | ADD HYD (0001) |
1 + 2 = 3
 ID1= 1 (0101): AREA QPEAK TPEAK R.V.
 (ha) (cms) (hrs) (mm)
 9.01 0.597 2.58 24.25
 + ID2= 2 (0102): 0.55 0.083 2.50 38.88

 ID = 3 (0001): 9.56 0.666 2.58 25.08

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

=====
 V V I SSSS U U A L (v 6.2.2016)
 V V I SS U U A A L
 V V I SS U U A A A A L
 V V I SS U U A A L
 V V I SSSS UUUU A A LLLL

OOO TTTT TTTT H H Y Y M M OOO TM
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***** D E T A I L E D O U T P U T *****

 | CHICAGO STORM | IDF curve parameters: A= 875.105
 | Ptotal= 58.26 mm | B= 7.641
 | | C= 0.762

 used in: INTENSITY = A / (t + B)^C

Duration of storm = 6.00 hrs
 Storm time step = 5.00 min
 Time to peak ratio = 0.40

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	2.53	1.50	6.01	3.00	10.28	4.50	3.72
0.08	2.60	1.58	6.59	3.08	9.26	4.58	3.61
0.17	2.69	1.67	7.32	3.17	8.43	4.67	3.50
0.25	2.77	1.75	8.26	3.25	7.75	4.75	3.40
0.33	2.87	1.83	9.50	3.33	7.18	4.83	3.31
0.42	2.97	1.92	11.25	3.42	6.70	4.92	3.22
0.50	3.08	2.00	13.90	3.50	6.28	5.00	3.14
0.58	3.20	2.08	18.34	3.58	5.92	5.08	3.06
0.67	3.33	2.17	27.34	3.67	5.60	5.17	2.99
0.75	3.48	2.25	54.33	3.75	5.32	5.25	2.92
0.83	3.64	2.33	126.62	3.83	5.07	5.33	2.85
0.92	3.82	2.42	61.77	3.92	4.84	5.42	2.79
1.00	4.01	2.50	35.72	4.00	4.63	5.50	2.73
1.08	4.24	2.58	25.02	4.08	4.45	5.58	2.67
1.17	4.49	2.67	19.29	4.17	4.28	5.67	2.62
1.25	4.79	2.75	15.74	4.25	4.12	5.75	2.57
1.33	5.13	2.83	13.33	4.33	3.98	5.83	2.52
1.42	5.53	2.92	11.60	4.42	3.85	5.92	2.47

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DATE: 02/12/2025 TIME: 09:42:34

USER:

COMMENTS: _____

 ** SIMULATION : 010yr 6hr 5min Chicago **

 | CALIB |
 | NASHYD (0101) | Area (ha)= 9.01 Curve Number (CN)= 81.7
 | ID= 1 DT= 5.0 min | Ia (mm)= 7.00 # of Linear Res. (N)= 3.00
 | | U.H. Tp (hrs)= 0.20

 | CHICAGO STORM | IDF curve parameters: A=1062.156
 | Ptotal= 71.35 mm | B= 9.025
 | | C= 0.760

 used in: INTENSITY = A / (t + B)^C

Unit Hyd Qpeak (cms)= 1.721

Duration of storm = 6.00 hrs
 Storm time step = 5.00 min
 Time to peak ratio = 0.40

PEAK FLOW (cms)= 0.597 (i)
 TIME TO PEAK (hrs)= 2.583
 RUNOFF VOLUME (mm)= 24.247
 TOTAL RAINFALL (mm)= 58.258
 RUNOFF COEFFICIENT = 0.416

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 | CALIB |
 | STANDHYD (0102) | Area (ha)= 0.55
 | ID= 1 DT= 5.0 min | Total Imp(%)= 45.00 Dir. Conn.(%)= 10.00

IMPERVIOUS PERVIOUS (i)
 Surface Area (ha)= 0.25 0.30
 Dep. Storage (mm)= 1.50 5.00
 Average Slope (%)= 2.00 2.00
 Length (m)= 60.39 25.00
 Mannings n = 0.013 0.250

Max.Eff.Inten.(mm/hr)= 126.62 108.93
 over (min) 5.00 10.00

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	3.16	1.50	7.55	3.00	12.97	4.50	4.66
0.08	3.25	1.58	8.29	3.08	11.67	4.58	4.51
0.17	3.35	1.67	9.21	3.17	10.62	4.67	4.38
0.25	3.46	1.75	10.40	3.25	9.76	4.75	4.25
0.33	3.58	1.83	11.98	3.33	9.04	4.83	4.14
0.42	3.71	1.92	14.20	3.42	8.42	4.92	4.03
0.50	3.85	2.00	17.55	3.50	7.89	5.00	3.92
0.58	4.00	2.08	23.13	3.58	7.44	5.08	3.82
0.67	4.16	2.17	34.27	3.67	7.03	5.17	3.73
0.75	4.35	2.25	66.03	3.75	6.67	5.25	3.64
0.83	4.55	2.33	142.74	3.83	6.35	5.33	3.56
0.92	4.77	2.42	74.58	3.92	6.07	5.42	3.48
1.00	5.02	2.50	44.43	4.00	5.81	5.50	3.41
1.08	5.31	2.58	31.43	4.08	5.57	5.58	3.33
1.17	5.63	2.67	24.32	4.17	5.36	5.67	3.27
1.25	6.00	2.75	19.87	4.25	5.16	5.75	3.20
1.33	6.43	2.83	16.83	4.33	4.98	5.83	3.14
1.42	6.94	2.92	14.64	4.42	4.81	5.92	3.08

```

-----
| CALIB |
| NASHYD ( 0101) | Area (ha)= 9.01 Curve Number (CN)= 81.7
| ID= 1 DT= 5.0 min | Ia (mm)= 7.00 # of Linear Res. (N)= 3.00
| U.H. Tp (hrs)= 0.20
-----

```

Unit Hyd Qpeak (cms) = 1.721

PEAK FLOW (cms) = 0.834 (i)
 TIME TO PEAK (hrs) = 2.583
 RUNOFF VOLUME (mm) = 34.086
 TOTAL RAINFALL (mm) = 71.346
 RUNOFF COEFFICIENT = 0.478

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| STANDHYD ( 0102) | Area (ha) = 0.55
| ID= 1 DT= 5.0 min | Total Imp(%) = 45.00 Dir. Conn.(%) = 10.00
-----

```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)	0.25	0.30
Dep. Storage (mm)	1.50	5.00
Average Slope (%)	2.00	2.00
Length (m)	60.39	25.00
Mannings n	0.013	0.250
Max.Eff.Inten.(mm/hr)	142.74	135.79
over (min)	5.00	10.00
Storage Coeff. (min)	1.33 (ii)	6.04 (ii)
Unit Hyd. Tpeak (min)	5.00	10.00
Unit Hyd. peak (cms)	0.33	0.15
PEAK FLOW (cms)	0.02	0.10
TIME TO PEAK (hrs)	2.42	2.50
RUNOFF VOLUME (mm)	69.85	48.74
TOTAL RAINFALL (mm)	71.35	71.35
RUNOFF COEFFICIENT	0.98	0.68
		TOTALS
		0.107 (iii)
		2.50
		50.85
		71.35
		0.71

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 ***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
 YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 85.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| ADD HYD ( 0001) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
| (ha) (cms) (hrs) (mm)
-----
ID1= 1 ( 0101): 9.01 0.834 2.58 34.09
+ ID2= 2 ( 0102): 0.55 0.107 2.50 50.85
=====
ID = 3 ( 0001): 9.56 0.923 2.58 35.05
-----

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

FINISH

```

V V I SSSS U U A L (v 6.2.2016)
V V I SS U U A A L
V V I SS U U A A A A L
V V I SS U U A A L
VV I SSSS UUUU A A LLLL

```

```

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO

```

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
 Output filename: C:\Users\THanko\AppData\Local\Civica\XH5\leaf1c2b-0257-432e-99fb-1cbb4fcb08d\79b53f03-79e5-4d0a-aed1-7b21f067c3d3\scena
 Summary filename: C:\Users\THanko\AppData\Local\Civica\XH5\leaf1c2b-0257-432e-99fb-1cbb4fcb08d\79b53f03-79e5-4d0a-aed1-7b21f067c3d3\scena

DATE: 02/12/2025

TIME: 09:42:34

USER:

COMMENTS:

```

-----
*****
** SIMULATION : 025yr 6hr 5min Chicago **
*****

```

```

-----
| CHICAGO STORM | IDF curve parameters: A=1319.273
| Ptotal= 87.31 mm | B= 10.500
| C= 0.762
-----
used in: INTENSITY = A / (t + B)^C

```

Duration of storm = 6.00 hrs
 Storm time step = 5.00 min
 Time to peak ratio = 0.40

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	3.88	1.50	9.39	3.00	16.27	4.50	5.75
0.08	4.00	1.58	10.33	3.08	14.61	4.58	5.57
0.17	4.12	1.67	11.50	3.17	13.28	4.67	5.40
0.25	4.26	1.75	13.00	3.25	12.19	4.75	5.25
0.33	4.41	1.83	15.01	3.33	11.28	4.83	5.10
0.42	4.57	1.92	17.82	3.42	10.50	4.92	4.96
0.50	4.74	2.00	22.05	3.50	9.83	5.00	4.83
0.58	4.93	2.08	29.07	3.58	9.25	5.08	4.71
0.67	5.14	2.17	42.86	3.67	8.74	5.17	4.59
0.75	5.36	2.25	80.42	3.75	8.29	5.25	4.49
0.83	5.62	2.33	163.42	3.83	7.89	5.33	4.38
0.92	5.90	2.42	90.33	3.92	7.53	5.42	4.28
1.00	6.21	2.50	55.21	4.00	7.20	5.50	4.19
1.08	6.57	2.58	39.39	4.08	6.90	5.58	4.10
1.17	6.98	2.67	30.56	4.17	6.63	5.67	4.02
1.25	7.44	2.75	24.98	4.25	6.39	5.75	3.94
1.33	7.99	2.83	21.15	4.33	6.16	5.83	3.86
1.42	8.63	2.92	18.37	4.42	5.95	5.92	3.78

```

-----
| CALIB |
| NASHYD ( 0101) | Area (ha)= 9.01 Curve Number (CN)= 81.7
| ID= 1 DT= 5.0 min | Ia (mm)= 7.00 # of Linear Res. (N)= 3.00
| U.H. Tp (hrs)= 0.20
-----

```

Unit Hyd Qpeak (cms) = 1.721

PEAK FLOW (cms) = 1.145 (i)
 TIME TO PEAK (hrs) = 2.583
 RUNOFF VOLUME (mm) = 46.919
 TOTAL RAINFALL (mm) = 87.310
 RUNOFF COEFFICIENT = 0.537

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| STANDHYD ( 0102) | Area (ha)= 0.55
| ID= 1 DT= 5.0 min | Total Imp(%) = 45.00 Dir. Conn.(%) = 10.00
-----

```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)	0.25	0.30
Dep. Storage (mm)	1.50	5.00
Average Slope (%)	2.00	2.00
Length (m)	60.39	25.00
Mannings n	0.013	0.250
Max.Eff.Inten.(mm/hr)	163.42	168.84
over (min)	5.00	10.00
Storage Coeff. (min)	1.26 (ii)	5.58 (ii)
Unit Hyd. Tpeak (min)	5.00	10.00
Unit Hyd. peak (cms)	0.33	0.16

PEAK FLOW (cms) = 0.02 0.12 *TOTALS*
 TIME TO PEAK (hrs) = 2.42 2.50 0.137 (iii)
 RUNOFF VOLUME (mm) = 85.81 63.58 65.80
 TOTAL RAINFALL (mm) = 87.31 87.31 87.31
 RUNOFF COEFFICIENT = 0.98 0.73 0.75

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 ***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
 YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 85.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| ADD HYD ( 0001) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
| (ha) (cms) (hrs) (mm)
-----
ID1= 1 ( 0101): 9.01 1.145 2.58 46.92
+ ID2= 2 ( 0102): 0.55 0.137 2.50 65.80
=====
ID = 3 ( 0001): 9.56 1.257 2.58 48.00
-----

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
V V I SSSS U U A L (v 6.2.2016)
V V I SS U U A A L
V V I SS U U A A A A L
V V I SS U U A A L
VV I SSSS UUUU A A LLLL
```

```
PEAK FLOW (cms)= 0.03 0.14 *TOTALS*
TIME TO PEAK (hrs)= 2.42 2.50 2.50
RUNOFF VOLUME (mm)= 98.44 75.53 77.82
TOTAL RAINFALL (mm)= 99.94 99.94 99.94
RUNOFF COEFFICIENT = 0.98 0.76 0.78
```

```
OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y M M O O
O O T T H H Y Y M M O O
OOO T T H H Y Y M M OOO
```

```
***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING: FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.
```

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- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 85.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voindat
Output filename: C:\Users\THanko\AppData\Local\Civica\XH5\leafc2b-0257-432e-99fb-1cbb4fcb08d\524a522a-060d-407f-8c6b-94bf1979884f\scena
Summary filename: C:\Users\THanko\AppData\Local\Civica\XH5\leafc2b-0257-432e-99fb-1cbb4fcb08d\524a522a-060d-407f-8c6b-94bf1979884f\scena

```
-----
| ADD HYD ( 0001) |
| 1 + 2 = 3 |
-----
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 1 ( 0101): 9.01 1.391 2.58 57.54
+ ID2= 2 ( 0102): 0.55 0.159 2.50 77.82
=====
ID = 3 ( 0001): 9.56 1.521 2.58 58.70
```

DATE: 02/12/2025 TIME: 09:42:34

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

COMMENTS: _____

```
V V I SSSS U U A L (v 6.2.2016)
V V I SS U U A A L
V V I SS U U A A A A L
V V I SS U U A A L
VV I SSSS UUUU A A LLLL
```

```
OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y M M O O
O O T T H H Y Y M M O O
OOO T T H H Y Y M M OOO
```

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***** D E T A I L E D O U T P U T *****

```
-----
| CHICAGO STORM | IDF curve parameters: A=1560.739
| Ptotal= 99.94 mm | B= 12.129
-----
C= 0.767
used in: INTENSITY = A / (t + B)^C

Duration of storm = 6.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.40
```

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voindat
Output filename: C:\Users\THanko\AppData\Local\Civica\XH5\leafc2b-0257-432e-99fb-1cbb4fcb08d\2239cb8d-84b4-4d40-81e8-c09209a10f66\scena
Summary filename: C:\Users\THanko\AppData\Local\Civica\XH5\leafc2b-0257-432e-99fb-1cbb4fcb08d\2239cb8d-84b4-4d40-81e8-c09209a10f66\scena

DATE: 02/12/2025 TIME: 09:42:34

USER:

COMMENTS: _____

```
*****
** SIMULATION : 100yr 6hr 5min Chicago **
*****
```

```
-----
| CALIB |
| NASHYD ( 0101) | Area (ha)= 9.01 Curve Number (CN)= 81.7
| ID= 1 DT= 5.0 min | Ia (mm)= 7.00 # of Linear Res. (N)= 3.00
-----
U.H. Tp(hrs)= 0.20
```

```
-----
| CHICAGO STORM | IDF curve parameters: A=1821.990
| Ptotal=112.28 mm | B= 13.507
-----
C= 0.773
used in: INTENSITY = A / (t + B)^C
```

Unit Hyd Qpeak (cms)= 1.721

Duration of storm = 6.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.40

PEAK FLOW (cms)= 1.391 (i)
TIME TO PEAK (hrs)= 2.583
RUNOFF VOLUME (mm)= 57.543
TOTAL RAINFALL (mm)= 99.943
RUNOFF COEFFICIENT = 0.576

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	4.90	1.50	12.31	3.00	21.73	4.50	7.39
0.08	5.06	1.58	13.58	3.08	19.46	4.58	7.14
0.17	5.22	1.67	15.19	3.17	17.64	4.67	6.92
0.25	5.40	1.75	17.25	3.25	16.14	4.75	6.71
0.33	5.60	1.83	20.01	3.33	14.88	4.83	6.52
0.42	5.81	1.92	23.87	3.42	13.82	4.92	6.33
0.50	6.04	2.00	29.65	3.50	12.90	5.00	6.16
0.58	6.29	2.08	39.15	3.58	12.11	5.08	6.00
0.67	6.56	2.17	57.29	3.67	11.42	5.17	5.85
0.75	6.87	2.25	103.00	3.75	10.80	5.25	5.70
0.83	7.20	2.33	190.94	3.83	10.26	5.33	5.56
0.92	7.58	2.42	114.64	3.92	9.77	5.42	5.43
1.00	8.00	2.50	73.00	4.00	9.33	5.50	5.31
1.08	8.48	2.58	52.81	4.08	8.93	5.58	5.20
1.17	9.03	2.67	41.14	4.17	8.56	5.67	5.08
1.25	9.66	2.75	33.63	4.25	8.23	5.75	4.98
1.33	10.39	2.83	28.43	4.33	7.93	5.83	4.88
1.42	11.26	2.92	24.62	4.42	7.65	5.92	4.78

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| CALIB |
| STANDHYD ( 0102) | Area (ha)= 0.55
| ID= 1 DT= 5.0 min | Total Imp(%)= 45.00 Dir. Conn.(%)= 10.00
-----
```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.25	0.30
Dep. Storage (mm)=	1.50	5.00
Average Slope (%)=	2.00	2.00
Length (m)=	60.39	25.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	176.63	192.35
over (min)	5.00	10.00
Storage Coeff. (min)=	1.22 (ii)	5.32 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.33	0.16

```

| CALIB |
| NASHYD ( 0101) | Area (ha)= 9.01 Curve Number (CN)= 81.7
| ID= 1 DT= 5.0 min | Ia (mm)= 7.00 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.20

```

```

Unit Hyd Qpeak (cms)= 1.721

PEAK FLOW (cms)= 1.642 (i)
TIME TO PEAK (hrs)= 2.583
RUNOFF VOLUME (mm)= 68.216
TOTAL RAINFALL (mm)= 112.280
RUNOFF COEFFICIENT = 0.608

```

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| STANDHYD ( 0102) | Area (ha)= 0.55
| ID= 1 DT= 5.0 min | Total Imp(%)= 45.00 Dir. Conn.(%)= 10.00
-----

```

	IMPERVIOUS	PERVIOUS (i)	
Surface Area (ha)=	0.25	0.30	
Dep. Storage (mm)=	1.50	5.00	
Average Slope (%)=	2.00	2.00	
Length (m)=	60.39	25.00	
Mannings n =	0.013	0.250	
Max.Eff.Inten.(mm/hr)=	190.94	216.10	
over (min)	5.00	10.00	
Storage Coeff. (min)=	1.18 (ii)	5.10 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.33	0.16	
			TOTALS
PEAK FLOW (cms)=	0.03	0.16	0.181 (iii)
TIME TO PEAK (hrs)=	2.42	2.50	2.50
RUNOFF VOLUME (mm)=	110.78	87.33	89.66
TOTAL RAINFALL (mm)=	112.28	112.28	112.28
RUNOFF COEFFICIENT =	0.99	0.78	0.80

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

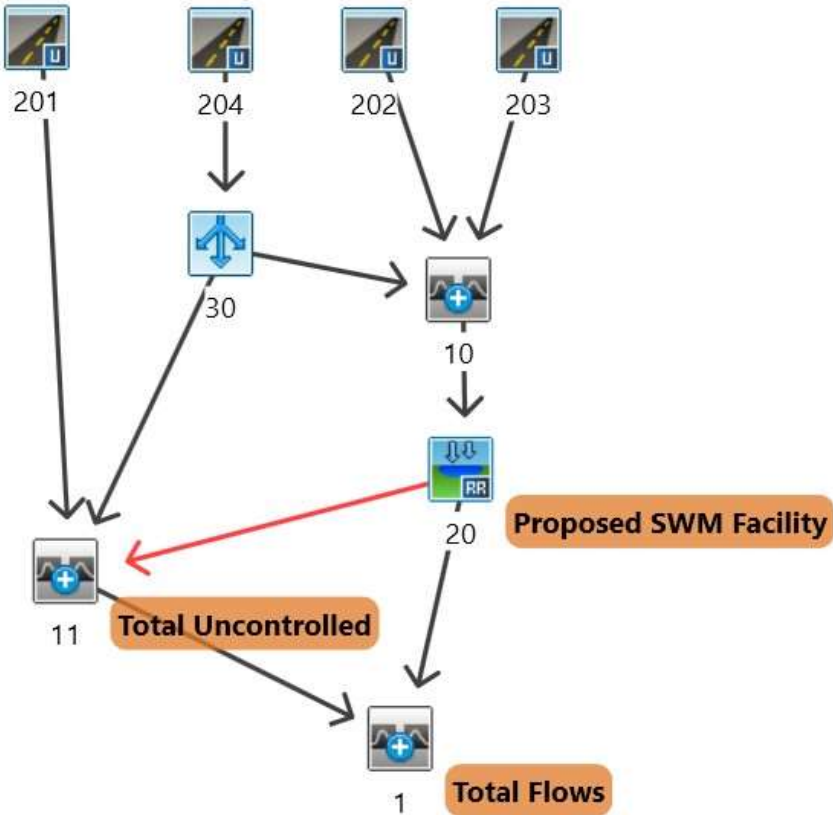
-----
| ADD HYD ( 0001) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
-----
| (ha) (cms) (hrs) (mm)
ID1= 1 ( 0101): 9.01 1.642 2.58 68.22
+ ID2= 2 ( 0102): 0.55 0.181 2.50 89.66
=====
ID = 3 ( 0001): 9.56 1.790 2.58 69.44

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

Appendix C

Post-Development Modeling Details



Walton Street Subdivision
Catchment Characteristic Calcs
Listowel, ON

Project Number: 60410_001
Date: February 14, 2025
Design By: T.Hanko
File: Q:\60410_001\Stormwater Management\60410_001_Catchment Calcs_R00.xlsx

Catchment 201		Uncontrolled Development Lands				
Standard Hydrograph		Area (ha)	C	HSG	CN	% Imp.
Builtup - (35% Imp.)	(Rear Yards)	0.989	0.45	C	82	35.0%
Builtup - (45% Imp.)		0.339	0.52	C	85	45.0%
Open Space (Good - >75% Grass)		0.289	0.20	C	74	0.0%
Impervious (Gravel, Asphalt)		0.021	0.90	C	98	100.0%
Total/Composite		1.6385	0.42		81.4	31.7%

Area A=	1.64 ha
Composite C=	0.42
Total Impervious	0.317
Directly Connected Impervious	0.100

	Pervious	Impervious
IA/Depression Storage	5.0	1.5
Length (L)	15.0	<Calculated by VO>
Slope (S)	2.00	2.00

L= LENGTH OF OVERLAND FLOW (m)
C= RUNOFF COEFFICIENT
S= CATCHMENT SURFACE SLOPE (%)
A= WATERSHED AREA (ha)

Catchment 202		Contributing External Lands				
Standard Hydrograph		Area (ha)	C	HSG	CN	% Imp.
Builtup - (45% Imp.)		0.547	0.52	C	85	45.0%
Streets & Roads (with blvd)		0.000	0.59	C	92	55.0%
Open Space (Good - >75% Grass)		0.000	0.20	C	74	0.0%
Total/Composite		0.5470	0.52		85.0	45.0%

Total Impervious	0.450
Directly Connected Impervious	0.100

	Pervious	Impervious
IA/Depression Storage	5.0	1.5
Length	25.0	<Calculated by VO>
Slope	2.00	2.00

L= LENGTH OF OVERLAND FLOW (m)
C= RUNOFF COEFFICIENT
S= CATCHMENT SURFACE SLOPE (%)
A= WATERSHED AREA (ha)

Catchment 203		Controlled Development Lands				
Standard Hydrograph		Area (ha)	C	HSG	CN	% Imp.
Builtup - (75% Imp.)		0.737	0.73	C	92	75.0%
Builtup - (45% Imp.)		3.132	0.52	C	85	45.0%
SWM Pond		0.451	0.90	C	98	100.0%
Open Space (Good - >75% Grass)		0.184	0.20	C	74	0.0%
Streets & Roads (with blvd)		1.684	0.59	C	92	55.0%
Total/Composite		6.1873	0.58		88.4	54.0%

Total Impervious	0.540
Directly Connected Impervious	0.450

	Pervious	Impervious
IA/Depression Storage	5.0	1.5
Length (L)	40.0	<Calculated by VO>
Slope (S)	2.00	2.00

L= LENGTH OF OVERLAND FLOW (m)
C= RUNOFF COEFFICIENT
S= CATCHMENT SURFACE SLOPE (%)
A= WATERSHED AREA (ha)

$$L = \frac{\text{(Catchment Area)}}{\text{(SF)} \cdot \text{(Channel Length)}}$$
SF= Shape Factor
2 for symmetrical catchments
1 for one-sided catchments
Catchment Area= 61,873 m²
Channel Length= 925 m
SF= 2
L= 33.40 m

Catchment 204		Medium Density Block - Minor controlled, Major uncontrolled				
Post-Development Conditions	Area (ha)	C	HSG	CN	% Imp.	
Builtup - (75% Imp.)	1.184	0.73	C	92	75.0%	
Builtup - (45% Imp.)	0.000	0.52	C	85	45.0%	
Impervious (Gravel, Asphalt)	0.000	0.90	C	98	100.0%	
Open Space (Good - >75% Grass)	0.000	0.20	C	74	0.0%	
Total/Composite	1.1844	0.73		92.0	75.0%	

Total Impervious	0.750
Directly Connected Impervious	0.600

	Pervious	Impervious
IA/Depression Storage	5.0	1.5
Length (L)	40.0	<Calculated by VO>
Slope (S)	2.00	2.00

$$L = \frac{\text{(Catchment Area)}}{\text{(SF)(Channel Length)}}$$

SF= Shape Factor
2 for symmetrical catchments
1 for one-sided catchments

Catchment Area= 11,844 m²
Channel Length= 150 m
SF= 2
L= 39.50 m

L= LENGTH OF OVERLAND FLOW (m)
C= RUNOFF COEFFICIENT
S= CATCHMENT SURFACE SLOPE (%)
A= WATERSHED AREA (ha)

Catchment OGS		Characteristics for the 5-year flows into the OGS Unit (203 + 204, excluding SMWF)				
Post-Development Conditions	Area (ha)	C	HSG	CN	% Imp.	
Builtup - (75% Imp.)	1.921	0.73	C	92	75.0%	
Builtup - (45% Imp.)	3.132	0.52	C	85	45.0%	
SWM Pond	0.000	0.90	C	98	100.0%	
Open Space (Good - >75% Grass)	0.000	0.20	C	74	0.0%	
Streets & Roads (with blvd)	1.684	0.59	C	92	55.0%	
Total/Composite	6.7367	0.59		88.7	56.1%	

Total Impervious	0.561
Directly Connected Impervious	0.500

	Pervious	Impervious
IA/Depression Storage	5.0	1.5
Length (L)	40.0	<Calculated by VO>
Slope (S)	2.00	2.00

THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

V V I SSSS U U A L (v 6.2.2016)
V V I SS U U A A L
V V I SS U U A A A A L
V V I SS U U A A L
V V I SSSS UUUU A A LLLL
  
```

```

-----
| CALIB |
| STANHYD ( 0202) | Area (ha)= 0.55
| ID= 1 DT= 5.0 min | Total Imp(%)= 45.00 Dir. Conn.(%)= 10.00
-----
  
```

```

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y Y M M O O
OOO T T H H Y Y M M OOO
  
```

```

-----
Surface Area (ha)= 0.25 IMPERVIOUS PERVIOUS (i)
Dep. Storage (mm)= 1.50 5.00
Average Slope (%)= 2.00 2.00
Length (m)= 60.39 25.00
Mannings n = 0.013 0.250
  
```

```

Max.Eff.Inten.(mm/hr)= 126.62 108.93
over (min) 5.00 10.00
Storage Coeff. (min)= 1.40 (ii) 6.54 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.33 0.14
  
```

```

-----
PEAK FLOW (cms)= 0.02 0.07 *TOTALS* 0.083 (iii)
TIME TO PEAK (hrs)= 2.42 2.50 2.50
RUNOFF VOLUME (mm)= 56.76 36.89 38.88
TOTAL RAINFALL (mm)= 58.26 58.26 58.26
RUNOFF COEFFICIENT = 0.97 0.63 0.67
  
```

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 ***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
 YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 85.0 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| STANHYD ( 0203) | Area (ha)= 6.19
| ID= 1 DT= 5.0 min | Total Imp(%)= 54.00 Dir. Conn.(%)= 45.00
-----
  
```

```

-----
Surface Area (ha)= 3.34 IMPERVIOUS PERVIOUS (i)
Dep. Storage (mm)= 1.50 5.00
Average Slope (%)= 2.00 2.00
Length (m)= 203.10 40.00
Mannings n = 0.013 0.250
  
```

```

Max.Eff.Inten.(mm/hr)= 126.62 77.52
over (min) 5.00 15.00
Storage Coeff. (min)= 2.89 (ii) 10.70 (ii)
Unit Hyd. Tpeak (min)= 5.00 15.00
Unit Hyd. peak (cms)= 0.28 0.09
  
```

```

-----
PEAK FLOW (cms)= 0.87 0.38 *TOTALS* 1.043 (iii)
TIME TO PEAK (hrs)= 2.42 2.58 2.42
RUNOFF VOLUME (mm)= 56.76 35.68 45.16
TOTAL RAINFALL (mm)= 58.26 58.26 58.26
RUNOFF COEFFICIENT = 0.97 0.61 0.78
  
```

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 88.4 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| STANHYD ( 0204) | Area (ha)= 1.18
| ID= 1 DT= 5.0 min | Total Imp(%)= 75.00 Dir. Conn.(%)= 60.00
-----
  
```

```

-----
Surface Area (ha)= 0.89 IMPERVIOUS PERVIOUS (i)
Dep. Storage (mm)= 1.50 5.00
Average Slope (%)= 2.00 2.00
Length (m)= 88.86 40.00
Mannings n = 0.013 0.250
  
```

```

Max.Eff.Inten.(mm/hr)= 126.62 129.38
over (min) 5.00 10.00
Storage Coeff. (min)= 1.76 (ii) 6.28 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.32 0.15
  
```

```

-----
PEAK FLOW (cms)= 0.24 0.09 *TOTALS* 0.301 (iii)
TIME TO PEAK (hrs)= 2.42 2.50 2.42
RUNOFF VOLUME (mm)= 56.76 44.09 51.69
TOTAL RAINFALL (mm)= 58.26 58.26 58.26
RUNOFF COEFFICIENT = 0.97 0.76 0.89
  
```

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 92.0 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| DIVERHYD ( 0030) |
  
```

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voindat
 Output filename: C:\Users\Thanko\AppData\Local\Civica\XH5\leaf1c2b-0257-432e-99fb-1cbb4fcb08d\09d9de7f-3687-4057-a162-0f4b75fae991\scena
 Summary filename: C:\Users\Thanko\AppData\Local\Civica\XH5\leaf1c2b-0257-432e-99fb-1cbb4fcb08d\09d9de7f-3687-4057-a162-0f4b75fae991\scena

DATE: 02/14/2025 TIME: 10:27:46

USER:

COMMENTS: _____

```

*****
** SIMULATION : 005yr 6hr 5min Chicago **
*****
  
```

```

-----
| CHICAGO STORM | IDF curve parameters: A= 875.105
| Ptotal= 58.26 mm | B= 7.641
| | C= 0.762
-----
used in: INTENSITY = A / (t + B)^C

Duration of storm = 6.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.40
  
```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	2.53	1.50	6.01	3.00	10.28	4.50	3.72
0.08	2.60	1.58	6.59	3.08	9.26	4.58	3.61
0.17	2.69	1.67	7.32	3.17	8.43	4.67	3.50
0.25	2.77	1.75	8.26	3.25	7.75	4.75	3.40
0.33	2.87	1.83	9.50	3.33	7.18	4.83	3.31
0.42	2.97	1.92	11.25	3.42	6.70	4.92	3.22
0.50	3.08	2.00	13.90	3.50	6.28	5.00	3.14
0.58	3.20	2.08	18.34	3.58	5.92	5.08	3.06
0.67	3.33	2.17	27.34	3.67	5.60	5.17	2.99
0.75	3.48	2.25	54.33	3.75	5.32	5.25	2.92
0.83	3.64	2.33	126.62	3.83	5.07	5.33	2.85
0.92	3.82	2.42	61.77	3.92	4.84	5.42	2.79
1.00	4.01	2.50	35.72	4.00	4.63	5.50	2.73
1.08	4.24	2.58	25.02	4.08	4.45	5.58	2.67
1.17	4.49	2.67	19.29	4.17	4.28	5.67	2.62
1.25	4.79	2.75	15.74	4.25	4.12	5.75	2.57
1.33	5.13	2.83	13.33	4.33	3.98	5.83	2.52
1.42	5.53	2.92	11.60	4.42	3.85	5.92	2.47

```

-----
| CALIB |
| STANHYD ( 0201) | Area (ha)= 1.64
| ID= 1 DT= 5.0 min | Total Imp(%)= 31.70 Dir. Conn.(%)= 10.00
-----
  
```

```

-----
Surface Area (ha)= 0.52 IMPERVIOUS PERVIOUS (i)
Dep. Storage (mm)= 1.50 5.00
Average Slope (%)= 2.00 2.00
Length (m)= 104.51 15.00
Mannings n = 0.013 0.250

Max.Eff.Inten.(mm/hr)= 126.62 69.90
over (min) 5.00 10.00
Storage Coeff. (min)= 1.94 (ii) 6.46 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.31 0.14

*TOTALS*
PEAK FLOW (cms)= 0.06 0.17 0.203 (iii)
TIME TO PEAK (hrs)= 2.42 2.50 2.50
RUNOFF VOLUME (mm)= 56.76 30.11 32.77
TOTAL RAINFALL (mm)= 58.26 58.26 58.26
RUNOFF COEFFICIENT = 0.97 0.52 0.56
  
```

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 ***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
 YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 81.4 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL

| IN= 1 # OUT= 5 |

Outflow / Inflow Relationships

Flow 1 +	Flow 2 +	Flow 3 +	Flow 4 +	Flow 5 =	Total
(cms)	(cms)	(cms)	(cms)	(cms)	(cms)
0.00	0.00	0.00	0.00	0.00	0.00
0.30	0.00	0.00	0.00	0.00	0.30
0.30	4.70	0.00	0.00	0.00	5.00

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
TOTAL HYD.(ID= 1):	1.18	0.30	2.42	51.69
ID= 2 (2):	1.18	0.30	2.42	51.69
ID= 3 (2):	0.00	0.00	2.42	51.69
ID= 4 (2):	0.00	0.00	0.00	0.00
ID= 5 (2):	0.00	0.00	0.00	0.00
ID= 6 (2):	0.00	0.00	0.00	0.00

+ ID2= 2 (0020): 7.92 0.120 3.83 45.65
 ID = 3 (0001): 9.56 0.287 2.50 43.44

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

V V I SSSSS U U A L (v 6.2.2016)
 V V I SS U U A A L
 V V I SS U U A A A A L
 V V I SS U U A A L
 V V I SSSSS UUUU A A LLLL

OOO TTTT TTTT H H Y Y M M OOO TM
 O O T T H H Y Y M M O O
 O O T T H H Y Y M M O O
 OOO T T H H Y Y M M OOO

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| ADD HYD (0010) |

1 + 2 = 3	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (0202):	0.55	0.083	2.50	38.88
+ ID2= 2 (0203):	6.19	1.043	2.42	45.16
ID = 3 (0010):	6.73	1.109	2.42	44.65

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| ADD HYD (0010) |

3 + 2 = 1	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 3 (0010):	6.73	1.109	2.42	44.65
+ ID2= 2 (0030):	1.18	0.301	2.42	51.69
ID = 1 (0010):	7.92	1.410	2.42	45.71

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| RESERVOIR(0020) |

OVERFLOW IS ON

| IN= 2--> OUT= 1 |
 | DT= 5.0 min |

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.1281	0.2718
0.0114	0.0207	0.1353	0.3063
0.0371	0.0429	0.1420	0.3420
0.0573	0.0665	0.1485	0.3790
0.0718	0.0916	0.1784	0.3980
0.0839	0.1182	0.2359	0.4173
0.0944	0.1463	0.4221	0.4569
0.1039	0.1758	0.7050	0.4978
0.1125	0.2066	1.0908	0.5400
0.1206	0.2386	1.5867	0.5835

INFLOW : ID= 2 (0010)	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
OUTFLOW: ID= 1 (0020)	7.918	1.410	2.42	45.71
OVERFLOW: ID= 3 (0003)	0.000	0.000	0.00	0.00

TOTAL NUMBER OF SIMULATION OVERFLOW = 0
 CUMULATIVE TIME OF OVERFLOW (HOURS) = 0.00
 PERCENTAGE OF TIME OVERFLOWING (%) = 0.00

PEAK FLOW REDUCTION [Qout/Qin] (%) = 8.50
 TIME SHIFT OF PEAK FLOW (min) = 85.00
 MAXIMUM STORAGE USED (ha.m.) = 0.2355

| ADD HYD (0011) |

1 + 2 = 3	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (0020):	0.00	0.000	0.00	0.00
+ ID2= 2 (0201):	1.64	0.203	2.50	32.77
ID = 3 (0011):	1.64	0.203	2.50	32.77

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| ADD HYD (0011) |

3 + 2 = 1	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 3 (0011):	1.64	0.203	2.50	32.77
+ ID2= 2 (0030):	0.00	0.000	2.42	51.69
ID = 1 (0011):	1.64	0.203	2.50	32.78

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| ADD HYD (0001) |

1 + 2 = 3	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (0011):	1.64	0.203	2.50	32.78

***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
 Output filename: C:\Users\THanko\AppData\Local\Civica\5\leaf1c2b-0257-432e-99fb-1cbb4fcbe08d\38e9b70a-bba7-45a5-86d5-53adab14cb71\scena
 Summary filename: C:\Users\THanko\AppData\Local\Civica\5\leaf1c2b-0257-432e-99fb-1cbb4fcbe08d\38e9b70a-bba7-45a5-86d5-53adab14cb71\scena

DATE: 02/14/2025 TIME: 10:27:46

USER:

COMMENTS:

 ** SIMULATION : 010yr 6hr 5min Chicago **

| CHICAGO STORM | IDF curve parameters: A=1062.156
 | Ptotal= 71.35 mm | B= 9.025
 C= 0.760

used in: INTENSITY = A / (t + B)^C

Duration of storm = 6.00 hrs
 Storm time step = 5.00 min
 Time to peak ratio = 0.40

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	3.16	1.50	7.55	3.00	12.97	4.50	4.66
0.08	3.25	1.58	8.29	3.08	11.67	4.58	4.51
0.17	3.35	1.67	9.21	3.17	10.62	4.67	4.38
0.25	3.46	1.75	10.40	3.25	9.76	4.75	4.25
0.33	3.58	1.83	11.98	3.33	9.04	4.83	4.14
0.42	3.71	1.92	14.20	3.42	8.42	4.92	4.03
0.50	3.85	2.00	17.55	3.50	7.89	5.00	3.92
0.58	4.00	2.08	23.13	3.58	7.44	5.08	3.82
0.67	4.16	2.17	34.27	3.67	7.03	5.17	3.73
0.75	4.35	2.25	66.03	3.75	6.67	5.25	3.64
0.83	4.55	2.33	142.74	3.83	6.35	5.33	3.56
0.92	4.77	2.42	74.58	3.92	6.07	5.42	3.48
1.00	5.02	2.50	44.43	4.00	5.81	5.50	3.41
1.08	5.31	2.58	31.43	4.08	5.57	5.58	3.33
1.17	5.63	2.67	24.32	4.17	5.36	5.67	3.27
1.25	6.00	2.75	19.87	4.25	5.16	5.75	3.20
1.33	6.43	2.83	16.83	4.33	4.98	5.83	3.14
1.42	6.94	2.92	14.64	4.42	4.81	5.92	3.08

| CALIB |
 | STANDHYD (0201) | Area (ha)= 1.64
 | ID= 1 DT= 5.0 min | Total Imp(%)= 31.70 Dir. Conn.(%)= 10.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.52	1.12
Dep. Storage (mm)=	1.50	5.00
Average Slope (%)=	2.00	2.00
Length (m)=	104.51	15.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	142.74	90.22
over (min)	5.00	10.00
Storage Coeff. (min)=	1.85 (ii)	5.93 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.32	0.15

TOTALS
 PEAK FLOW (cms)= 0.06 0.23 0.269 (iii)
 TIME TO PEAK (hrs)= 2.42 2.50 2.50
 RUNOFF VOLUME (mm)= 69.85 40.89 43.78
 TOTAL RAINFALL (mm)= 71.35 71.35 71.35
 RUNOFF COEFFICIENT = 0.98 0.57 0.61

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 81.4 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB          |
| STANDHYD ( 0202) | Area (ha)= 0.55
| ID= 1 DT= 5.0 min | Total Imp(%)= 45.00 Dir. Conn.(%)= 10.00
-----

```

```

-----
                IMPERVIOUS    PERVIOUS (i)
Surface Area (ha)= 0.25      0.30
Dep. Storage (mm)= 1.50     5.00
Average Slope (%)= 2.00     2.00
Length (m)= 60.39          25.00
Mannings n = 0.013         0.250

Max.Eff.Inten.(mm/hr)= 142.74 135.79
over (min) = 5.00         10.00
Storage Coeff. (min)= 1.33 (ii) 6.04 (ii)
Unit Hyd. Tpeak (min)= 5.00    10.00
Unit Hyd. peak (cms)= 0.33     0.15

                *TOTALS*
PEAK FLOW (cms)= 0.02        0.10        0.107 (iii)
TIME TO PEAK (hrs)= 2.42     2.50        2.50
RUNOFF VOLUME (mm)= 69.85    48.74       50.85
TOTAL RAINFALL (mm)= 71.35   71.35       71.35
RUNOFF COEFFICIENT = 0.98    0.68        0.71
-----

```

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-----
| DIVERTHYD( 0030) |
| IN= 1 # OUT= 5 |
-----

```

```

Outflow / Inflow Relationships

Flow 1 + Flow 2 + Flow 3 + Flow 4 + Flow 5 = Total
(cms) (cms) (cms) (cms) (cms) (cms)
0.00 0.00 0.00 0.00 0.00 0.00
0.30 0.00 0.00 0.00 0.00 0.30
0.30 4.70 0.00 0.00 0.00 5.00
-----

```

```

-----
                AREA    QPEAK    TPEAK    R.V.
                (ha)    (cms)    (hrs)    (mm)
TOTAL HYD. (ID= 1): 1.18 0.35 2.42 64.60
=====
ID= 2 ( 2) : 1.16 0.30 2.42 64.60
ID= 3 ( 2) : 0.02 0.05 2.42 64.60
ID= 4 ( 2) : 0.00 0.00 0.00 0.00
ID= 5 ( 2) : 0.00 0.00 0.00 0.00
ID= 6 ( 2) : 0.00 0.00 0.00 0.00
-----

```

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 85.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB          |
| STANDHYD ( 0203) | Area (ha)= 6.19
| ID= 1 DT= 5.0 min | Total Imp(%)= 54.00 Dir. Conn.(%)= 45.00
-----

```

```

-----
                IMPERVIOUS    PERVIOUS (i)
Surface Area (ha)= 3.34      2.85
Dep. Storage (mm)= 1.50     5.00
Average Slope (%)= 2.00     2.00
Length (m)= 203.10         40.00
Mannings n = 0.013         0.250

Max.Eff.Inten.(mm/hr)= 142.74 97.37
over (min) = 5.00         10.00
Storage Coeff. (min)= 2.75 (ii) 9.89 (ii)
Unit Hyd. Tpeak (min)= 5.00    10.00
Unit Hyd. peak (cms)= 0.28     0.11

                *TOTALS*
PEAK FLOW (cms)= 1.00        0.53        1.343 (iii)
TIME TO PEAK (hrs)= 2.42     2.50        2.42
RUNOFF VOLUME (mm)= 69.85    47.46       57.54
TOTAL RAINFALL (mm)= 71.35   71.35       71.35
RUNOFF COEFFICIENT = 0.98    0.67        0.81
-----

```

```

-----
| ADD HYD ( 0010) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
                (ha) (cms) (hrs) (mm)
ID1= 1 ( 0202): 0.55 0.107 2.50 50.85
+ ID2= 2 ( 0203): 6.19 1.343 2.42 57.54
=====
ID = 3 ( 0010): 6.73 1.428 2.42 56.99
-----

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0010) |
| 3 + 2 = 1 | AREA QPEAK TPEAK R.V.
                (ha) (cms) (hrs) (mm)
ID1= 3 ( 0010): 6.73 1.428 2.42 56.99
+ ID2= 2 ( 0030): 1.16 0.304 2.42 64.60
=====
ID = 1 ( 0010): 7.90 1.732 2.42 58.11
-----

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| RESERVOIR( 0020) | OVERFLOW IS ON
| IN= 2--> OUT= 1 |
| DT= 5.0 min |
-----
                OUTFLOW    STORAGE    OUTFLOW    STORAGE
                (cms)    (ha.m.) | (cms)    (ha.m.)
0.0000 0.0000 | 0.1281 0.2718
0.0114 0.0207 | 0.1353 0.3063
0.0371 0.0429 | 0.1420 0.3420
0.0573 0.0665 | 0.1485 0.3790
0.0718 0.0916 | 0.1784 0.3980
0.0839 0.1182 | 0.2359 0.4173
0.0944 0.1463 | 0.4221 0.4569
0.1039 0.1758 | 0.7050 0.4978
0.1125 0.2066 | 1.0908 0.5400
0.1206 0.2386 | 1.5867 0.5835
-----

```

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 88.4 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB          |
| STANDHYD ( 0204) | Area (ha)= 1.18
| ID= 1 DT= 5.0 min | Total Imp(%)= 75.00 Dir. Conn.(%)= 60.00
-----

```

```

-----
                IMPERVIOUS    PERVIOUS (i)
Surface Area (ha)= 0.89      0.30
Dep. Storage (mm)= 1.50     5.00
Average Slope (%)= 2.00     2.00
Length (m)= 88.86         40.00
Mannings n = 0.013         0.250

Max.Eff.Inten.(mm/hr)= 142.74 155.48
over (min) = 5.00         10.00
Storage Coeff. (min)= 1.68 (ii) 5.99 (ii)
Unit Hyd. Tpeak (min)= 5.00    10.00
Unit Hyd. peak (cms)= 0.32     0.15

                *TOTALS*
PEAK FLOW (cms)= 0.27        0.11        0.350 (iii)
TIME TO PEAK (hrs)= 2.42     2.50        2.42
RUNOFF VOLUME (mm)= 69.85    56.74       64.60
TOTAL RAINFALL (mm)= 71.35   71.35       71.35
RUNOFF COEFFICIENT = 0.98    0.80        0.91
-----

```

```

INFLOW : ID= 2 ( 0010) 7.897 1.732 2.42 58.11
OUTFLOW: ID= 1 ( 0020) 7.897 0.135 4.00 58.05
OVERFLOW: ID= 3 ( 0003) 0.000 0.000 0.00 0.00
-----

```

```

TOTAL NUMBER OF SIMULATION OVERFLOW = 0
CUMULATIVE TIME OF OVERFLOW (HOURS) = 0.00
PERCENTAGE OF TIME OVERFLOWING (%) = 0.00
-----

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PEAK FLOW REDUCTION [Qout/Qin](%)= 7.81
TIME SHIFT OF PEAK FLOW (min)= 95.00
MAXIMUM STORAGE USED (ha.m.)= 0.3064
-----

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-----
| ADD HYD ( 0011) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
                (ha) (cms) (hrs) (mm)
*** W A R N I N G : HYDROGRAPH 0020 <ID= 1> IS DRY.
*** W A R N I N G : HYDROGRAPH 0011 = HYDROGRAPH 0201
ID1= 1 ( 0020): 0.00 0.000 0.00 0.00
+ ID2= 2 ( 0201): 1.64 0.269 2.50 43.78
=====
ID = 3 ( 0011): 1.64 0.269 2.50 43.78
-----

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0011) |
| 3 + 2 = 1 | AREA QPEAK TPEAK R.V.
                (ha) (cms) (hrs) (mm)
ID1= 3 ( 0011): 1.64 0.269 2.50 43.78
+ ID2= 2 ( 0030): 0.02 0.046 2.42 64.60
=====
ID = 1 ( 0011): 1.66 0.269 2.50 44.06
-----

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 92.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL

TIME TO PEAK (hrs)= 2.42 2.50 2.50
 RUNOFF VOLUME (mm)= 85.81 54.68 57.79
 TOTAL RAINFALL (mm)= 87.31 87.31 87.31
 RUNOFF COEFFICIENT = 0.98 0.63 0.66

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 ***** WARNING: FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
 YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 81.4 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ID	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0011):	1.66	0.269	2.50	44.06
+ ID2= 2 (0020):	7.90	0.135	4.00	58.05
ID = 3 (0001):	9.56	0.367	2.50	55.62

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

V V I SSSS U U A L (v 6.2.2016)
 V V I SS U U A A L
 V V I SS U U AAAAA L
 V V I SS U U A A L
 VV I SSSS UUUU A A LLLLL

OOO TTTT TTTT H H Y Y M M OOO TM
 O O T T H H Y Y M M O O
 O O T T H H Y Y M M O O
 OOO T T H H Y M M OOO

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
 Output filename: C:\Users\Thanko\AppData\Local\Civica\XH5\leaf1c2b-0257-432e-99fb-1cbb4fcb08d\ba982218-51a9-45da-815a-f3da6118702d\scena
 Summary filename: C:\Users\Thanko\AppData\Local\Civica\XH5\leaf1c2b-0257-432e-99fb-1cbb4fcb08d\ba982218-51a9-45da-815a-f3da6118702d\scena

DATE: 02/14/2025 TIME: 10:27:47

USER:

COMMENTS: _____

CALIB |
 | STANDHYD (0202) | Area (ha)= 0.55
 | ID= 1 DT= 5.0 min | Total Imp(%)= 45.00 Dir. Conn.(%)= 10.00

IMPERVIOUS PERVIOUS (i)
 Surface Area (ha)= 0.25 0.30
 Dep. Storage (mm)= 1.50 5.00
 Average Slope (%)= 2.00 2.00
 Length (m)= 60.39 25.00
 Mannings n = 0.013 0.250
 Max.Eff.Inten.(mm/hr)= 163.42 168.84
 over (min) 5.00 10.00
 Storage Coeff. (min)= 1.26 (ii) 5.58 (ii)
 Unit Hyd. Tpeak (min)= 5.00 10.00
 Unit Hyd. peak (cms)= 0.33 0.16

TOTALS
 PEAK FLOW (cms)= 0.02 0.12 0.137 (iii)
 TIME TO PEAK (hrs)= 2.42 2.50 2.50
 RUNOFF VOLUME (mm)= 85.81 63.58 65.80
 TOTAL RAINFALL (mm)= 87.31 87.31 87.31
 RUNOFF COEFFICIENT = 0.98 0.73 0.75

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 ***** WARNING: FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
 YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 85.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB |
 | STANDHYD (0203) | Area (ha)= 6.19
 | ID= 1 DT= 5.0 min | Total Imp(%)= 54.00 Dir. Conn.(%)= 45.00

IMPERVIOUS PERVIOUS (i)
 Surface Area (ha)= 3.34 2.85
 Dep. Storage (mm)= 1.50 5.00
 Average Slope (%)= 2.00 2.00
 Length (m)= 203.10 40.00
 Mannings n = 0.013 0.250
 Max.Eff.Inten.(mm/hr)= 163.42 121.74
 over (min) 5.00 10.00
 Storage Coeff. (min)= 2.61 (ii) 9.13 (ii)
 Unit Hyd. Tpeak (min)= 5.00 10.00
 Unit Hyd. peak (cms)= 0.29 0.12

TOTALS
 PEAK FLOW (cms)= 1.16 0.70 1.633 (iii)
 TIME TO PEAK (hrs)= 2.42 2.50 2.42
 RUNOFF VOLUME (mm)= 85.81 62.25 72.85
 TOTAL RAINFALL (mm)= 87.31 87.31 87.31
 RUNOFF COEFFICIENT = 0.98 0.71 0.83

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 ***** WARNING: FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
 YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 88.4 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB |
 | STANDHYD (0204) | Area (ha)= 1.18
 | ID= 1 DT= 5.0 min | Total Imp(%)= 75.00 Dir. Conn.(%)= 60.00

IMPERVIOUS PERVIOUS (i)
 Surface Area (ha)= 0.89 0.30
 Dep. Storage (mm)= 1.50 5.00
 Average Slope (%)= 2.00 2.00
 Length (m)= 88.86 40.00
 Mannings n = 0.013 0.250
 Max.Eff.Inten.(mm/hr)= 163.42 187.20
 over (min) 5.00 10.00
 Storage Coeff. (min)= 1.59 (ii) 5.67 (ii)
 Unit Hyd. Tpeak (min)= 5.00 10.00
 Unit Hyd. peak (cms)= 0.33 0.15

TOTALS
 PEAK FLOW (cms)= 0.32 0.14 0.413 (iii)
 TIME TO PEAK (hrs)= 2.42 2.50 2.42
 RUNOFF VOLUME (mm)= 85.81 72.33 80.41
 TOTAL RAINFALL (mm)= 87.31 87.31 87.31
 RUNOFF COEFFICIENT = 0.98 0.83 0.92

CHICAGO STORM | IDF curve parameters: A=1319.273
 | Ptotal= 87.31 mm | B= 10.500
 C= 0.762
 used in: INTENSITY = A / (t + B)^C
 Duration of storm = 6.00 hrs
 Storm time step = 5.00 min
 Time to peak ratio = 0.40

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	3.88	1.50	9.39	3.00	16.27	4.50	5.75
0.08	4.00	1.58	10.33	3.08	14.61	4.58	5.57
0.17	4.12	1.67	11.50	3.17	13.28	4.67	5.40
0.25	4.26	1.75	13.00	3.25	12.19	4.75	5.25
0.33	4.41	1.83	15.01	3.33	11.28	4.83	5.10
0.42	4.57	1.92	17.82	3.42	10.50	4.92	4.96
0.50	4.74	2.00	22.05	3.50	9.83	5.00	4.83
0.58	4.93	2.08	29.07	3.58	9.25	5.08	4.71
0.67	5.14	2.17	42.86	3.67	8.74	5.17	4.59
0.75	5.36	2.25	80.42	3.75	8.29	5.25	4.49
0.83	5.62	2.33	163.42	3.83	7.89	5.33	4.38
0.92	5.90	2.42	90.33	3.92	7.53	5.42	4.28
1.00	6.21	2.50	55.21	4.00	7.20	5.50	4.19
1.08	6.57	2.58	39.39	4.08	6.90	5.58	4.10
1.17	6.98	2.67	30.56	4.17	6.63	5.67	4.02
1.25	7.44	2.75	24.98	4.25	6.39	5.75	3.94
1.33	7.99	2.83	21.15	4.33	6.16	5.83	3.86
1.42	8.63	2.92	18.37	4.42	5.95	5.92	3.78

CALIB |
 | STANDHYD (0201) | Area (ha)= 1.64
 | ID= 1 DT= 5.0 min | Total Imp(%)= 31.70 Dir. Conn.(%)= 10.00

IMPERVIOUS PERVIOUS (i)
 Surface Area (ha)= 0.52 1.12
 Dep. Storage (mm)= 1.50 5.00
 Average Slope (%)= 2.00 2.00
 Length (m)= 104.51 15.00
 Mannings n = 0.013 0.250
 Max.Eff.Inten.(mm/hr)= 163.42 115.83
 over (min) 5.00 10.00
 Storage Coeff. (min)= 1.75 (ii) 5.45 (ii)
 Unit Hyd. Tpeak (min)= 5.00 10.00
 Unit Hyd. peak (cms)= 0.32 0.16
 TOTALS
 PEAK FLOW (cms)= 0.07 0.31 0.354 (iii)

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 92.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 | DIVERTHYD (0030) |
IN= 1 # OUT= 5

Outflow / Inflow Relationships

Flow 1 +	Flow 2 +	Flow 3 +	Flow 4 +	Flow 5 =	Total
(cms)	(cms)	(cms)	(cms)	(cms)	(cms)
0.00	0.00	0.00	0.00	0.00	0.00
0.30	0.00	0.00	0.00	0.00	0.30
0.30	4.70	0.00	0.00	0.00	5.00

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
TOTAL HYD. (ID= 1):	1.18	0.41	2.42	80.41
ID= 2 (2) :	1.14	0.30	2.42	80.41
ID= 3 (2) :	0.05	0.11	2.42	80.41
ID= 4 (2) :	0.00	0.00	0.00	0.00
ID= 5 (2) :	0.00	0.00	0.00	0.00
ID= 6 (2) :	0.00	0.00	0.00	0.00

 | ADD HYD (0010) |
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0202):	0.55	0.137	2.50	65.80
+ ID2= 2 (0203):	6.19	1.633	2.42	72.85
ID = 3 (0010):	6.73	1.743	2.42	72.28

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 | ADD HYD (0010) |
3 + 2 = 1

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0010):	6.73	1.743	2.42	72.28
+ ID2= 2 (0030):	1.14	0.304	2.42	80.41
ID = 1 (0010):	7.87	2.047	2.42	73.46

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 | RESERVOIR (0020) |
 | IN= 2---> OUT= 1 |
DT= 5.0 min

OVERFLOW IS ON

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.1281	0.2718
0.0114	0.0207	0.1353	0.3063
0.0371	0.0429	0.1420	0.3420
0.0573	0.0665	0.1485	0.3790
0.0718	0.0916	0.1784	0.3980
0.0839	0.1182	0.2359	0.4173
0.0944	0.1463	0.4221	0.4569
0.1039	0.1758	0.7050	0.4978
0.1125	0.2066	1.0908	0.5400
0.1206	0.2386	1.5867	0.5835

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0010)	7.872	2.047	2.42	73.46
OUTFLOW: ID= 1 (0020)	7.872	0.170	4.00	73.40
OVERFLOW: ID= 3 (0003)	0.000	0.000	0.00	0.00

TOTAL NUMBER OF SIMULATION OVERFLOW = 0
 CUMULATIVE TIME OF OVERFLOW (HOURS) = 0.00
 PERCENTAGE OF TIME OVERFLOWING (%) = 0.00

PEAK FLOW REDUCTION [Qout/Qin](%) = 8.31
 TIME SHIFT OF PEAK FLOW (min) = 95.00
 MAXIMUM STORAGE USED (ha.m.) = 0.3928

 | ADD HYD (0011) |
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0020):	0.00	0.000	0.00	0.00
+ ID2= 2 (0201):	1.64	0.354	2.50	57.79
ID = 3 (0011):	1.64	0.354	2.50	57.79

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 | ADD HYD (0011) |
3 + 2 = 1

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0011):	1.64	0.354	2.50	57.79

+ ID2= 2 (0030):	0.05	0.109	2.42	80.41
ID = 1 (0011):	1.69	0.389	2.42	58.42

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 | ADD HYD (0001) |
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0011):	1.69	0.389	2.42	58.42
+ ID2= 2 (0020):	7.87	0.170	4.00	73.40
ID = 3 (0001):	9.56	0.482	2.42	70.76

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

V V I SSSSS U U A L (v 6.2.2016)
 V V I SS U U A A L
 V V I SS U U AAAAA L
 V V I SS U U A A L
 VV I SSSSS UUUUU A A LLLLL
 OOO TTTT TTTT H H Y Y M M OOO TM
 O O T T H H Y Y M M O O
 O O T T H H Y Y M M O O
 OOO T T H H Y Y M M OOO

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
 Output filename: C:\Users\THanko\AppData\Local\Civica\5\leaf1c2b-0257-432e-99fb-1cbb4fcbe08d\ddd7639e-0cad-41d9-bb0b-9dfa0228bbd9\scena
 Summary filename: C:\Users\THanko\AppData\Local\Civica\5\leaf1c2b-0257-432e-99fb-1cbb4fcbe08d\ddd7639e-0cad-41d9-bb0b-9dfa0228bbd9\scena

DATE: 02/14/2025 TIME: 10:27:47

USER:

COMMENTS:

 ** SIMULATION : 050yr 6hr 5min Chicago **

 | CHICAGO STORM | IDF curve parameters: A=1560.739
 | Ptotal= 99.94 mm | B= 12.129
 C= 0.767

 used in: INTENSITY = A / (t + B)^C
 Duration of storm = 6.00 hrs
 Storm time step = 5.00 min
 Time to peak ratio = 0.40

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	4.41	1.50	10.88	3.00	19.04	4.50	6.60
0.08	4.55	1.58	11.99	3.08	17.07	4.58	6.39
0.17	4.70	1.67	13.38	3.17	15.50	4.67	6.19
0.25	4.86	1.75	15.16	3.25	14.20	4.75	6.01
0.33	5.03	1.83	17.55	3.33	13.11	4.83	5.84
0.42	5.21	1.92	20.89	3.42	12.19	4.92	5.67
0.50	5.42	2.00	25.89	3.50	11.40	5.00	5.52
0.58	5.64	2.08	34.16	3.58	10.72	5.08	5.38
0.67	5.88	2.17	50.14	3.67	10.11	5.17	5.25
0.75	6.14	2.25	91.77	3.75	9.58	5.25	5.12
0.83	6.44	2.33	176.63	3.83	9.11	5.33	5.00
0.92	6.77	2.42	102.53	3.92	8.68	5.42	4.88
1.00	7.14	2.50	64.18	4.00	8.30	5.50	4.78
1.08	7.56	2.58	46.16	4.08	7.95	5.58	4.67
1.17	8.03	2.67	35.90	4.17	7.63	5.67	4.57
1.25	8.58	2.75	29.35	4.25	7.34	5.75	4.48
1.33	9.22	2.83	24.83	4.33	7.07	5.83	4.39
1.42	9.98	2.92	21.54	4.42	6.83	5.92	4.31

 | CALIB |
 | STANDHYD (0201) | Area (ha)= 1.64
 | ID= 1 DT= 5.0 min | Total Imp(%)= 31.70 Dir. Conn.(%)= 10.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.52	1.12
Dep. Storage (mm)=	1.50	5.00
Average Slope (%)=	2.00	2.00
Length (m)=	104.51	15.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	176.63	134.58

over (min) 5.00 10.00
 Storage Coeff. (min)= 1.70 (ii) 5.18 (ii)
 Unit Hyd. Tpeak (min)= 5.00 10.00
 Unit Hyd. peak (cms)= 0.32 0.16

TOTALS
 PEAK FLOW (cms)= 0.08 0.37 0.418 (iii)
 TIME TO PEAK (hrs)= 2.42 2.50 2.50
 RUNOFF VOLUME (mm)= 98.44 65.94 69.19
 TOTAL RAINFALL (mm)= 99.94 99.94 99.94
 RUNOFF COEFFICIENT = 0.98 0.66 0.69

PEAK FLOW (cms)= 0.34 0.15 0.455 (iii)
 TIME TO PEAK (hrs)= 2.42 2.50 2.42
 RUNOFF VOLUME (mm)= 98.44 84.74 92.96
 TOTAL RAINFALL (mm)= 99.94 99.94 99.94
 RUNOFF COEFFICIENT = 0.98 0.85 0.93

TOTALS

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 ***** WARNING: FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
 YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 81.4 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
 | STANDHYD (0202) | Area (ha)= 0.55
 | ID= 1 DT= 5.0 min | Total Imp(%)= 45.00 Dir. Conn.(%)= 10.00

IMPERVIOUS PERVIOUS (i)
 Surface Area (ha)= 0.25 0.30
 Dep. Storage (mm)= 1.50 5.00
 Average Slope (%)= 2.00 2.00
 Length (m)= 60.39 25.00
 Mannings n = 0.013 0.250
 Max.Eff.Inten.(mm/hr)= 176.63 192.35
 over (min)= 5.00 10.00
 Storage Coeff. (min)= 1.22 (ii) 5.32 (ii)
 Unit Hyd. Tpeak (min)= 5.00 10.00
 Unit Hyd. peak (cms)= 0.33 0.16

TOTALS
 PEAK FLOW (cms)= 0.03 0.14 0.159 (iii)
 TIME TO PEAK (hrs)= 2.42 2.50 2.50
 RUNOFF VOLUME (mm)= 98.44 75.53 77.82
 TOTAL RAINFALL (mm)= 99.94 99.94 99.94
 RUNOFF COEFFICIENT = 0.98 0.76 0.78

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 ***** WARNING: FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
 YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 85.0 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
 | STANDHYD (0203) | Area (ha)= 6.19
 | ID= 1 DT= 5.0 min | Total Imp(%)= 54.00 Dir. Conn.(%)= 45.00

IMPERVIOUS PERVIOUS (i)
 Surface Area (ha)= 3.34 2.85
 Dep. Storage (mm)= 1.50 5.00
 Average Slope (%)= 2.00 2.00
 Length (m)= 203.10 40.00
 Mannings n = 0.013 0.250
 Max.Eff.Inten.(mm/hr)= 176.63 139.08
 over (min)= 5.00 10.00
 Storage Coeff. (min)= 2.53 (ii) 8.71 (ii)
 Unit Hyd. Tpeak (min)= 5.00 10.00
 Unit Hyd. peak (cms)= 0.29 0.12

TOTALS
 PEAK FLOW (cms)= 1.27 0.82 1.840 (iii)
 TIME TO PEAK (hrs)= 2.42 2.50 2.42
 RUNOFF VOLUME (mm)= 98.44 74.17 85.09
 TOTAL RAINFALL (mm)= 99.94 99.94 99.94
 RUNOFF COEFFICIENT = 0.98 0.74 0.85

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 88.4 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
 | STANDHYD (0204) | Area (ha)= 1.18
 | ID= 1 DT= 5.0 min | Total Imp(%)= 75.00 Dir. Conn.(%)= 60.00

IMPERVIOUS PERVIOUS (i)
 Surface Area (ha)= 0.89 0.30
 Dep. Storage (mm)= 1.50 5.00
 Average Slope (%)= 2.00 2.00
 Length (m)= 88.86 40.00
 Mannings n = 0.013 0.250
 Max.Eff.Inten.(mm/hr)= 176.63 209.28
 over (min)= 5.00 10.00
 Storage Coeff. (min)= 1.54 (ii) 5.50 (ii)
 Unit Hyd. Tpeak (min)= 5.00 10.00
 Unit Hyd. peak (cms)= 0.33 0.16

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 92.0 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 | DIVERTHYD(0030) |
IN= 1 # OUT= 5

Outflow / Inflow Relationships

Flow 1	Flow 2	Flow 3	Flow 4	Flow 5	Total
(cms)	(cms)	(cms)	(cms)	(cms)	(cms)
0.00	0.00	0.00	0.00	0.00	0.00
0.30	0.00	0.00	0.00	0.00	0.30
0.30	4.70	0.00	0.00	0.00	5.00

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
TOTAL HYD. (ID= 1):	1.18	0.45	2.42	92.96
ID= 2 (2):	1.12	0.30	2.42	92.96
ID= 3 (2):	0.07	0.15	2.42	92.96
ID= 4 (2):	0.00	0.00	0.00	0.00
ID= 5 (2):	0.00	0.00	0.00	0.00
ID= 6 (2):	0.00	0.00	0.00	0.00

 | ADD HYD (0010) |
 | 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
 (ha) (cms) (hrs) (mm)
 ID1= 1 (0202): 0.55 0.159 2.50 77.82
 + ID2= 2 (0203): 6.19 1.840 2.42 85.09

 ID = 3 (0010): 6.73 1.968 2.42 84.50

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 | ADD HYD (0010) |
 | 3 + 2 = 1 | AREA QPEAK TPEAK R.V.
 (ha) (cms) (hrs) (mm)
 ID1= 3 (0010): 6.73 1.968 2.42 84.50
 + ID2= 2 (0030): 1.12 0.304 2.42 92.96

 ID = 1 (0010): 7.85 2.272 2.42 85.70

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 | RESERVOIR(0020) | OVERFLOW IS ON
 | IN= 2---> OUT= 1 |
DT= 5.0 min

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.1281	0.2718
0.0114	0.0207	0.1353	0.3063
0.0371	0.0429	0.1420	0.3420
0.0573	0.0665	0.1485	0.3790
0.0718	0.0916	0.1784	0.3980
0.0839	0.1182	0.2359	0.4173
0.0944	0.1463	0.4221	0.4569
0.1039	0.1758	0.7050	0.4978
0.1125	0.2066	1.0908	0.5400
0.1206	0.2386	1.5867	0.5835

INFLOW : ID= 2 (0010)	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
7.851	7.851	2.272	2.42	85.70
OUTFLOW: ID= 1 (0020)	7.851	0.305	3.42	85.65
OVERFLOW: ID= 3 (0003)	0.000	0.000	0.00	0.00

TOTAL NUMBER OF SIMULATION OVERFLOW = 0
 CUMULATIVE TIME OF OVERFLOW (HOURS) = 0.00
 PERCENTAGE OF TIME OVERFLOWING (%) = 0.00

PEAK FLOW REDUCTION [Qout/Qin] (%) = 13.41
 TIME SHIFT OF PEAK FLOW (min) = 60.00
 MAXIMUM STORAGE USED (ha.m.) = 0.4320

 | ADD HYD (0011) |
 | 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
 (ha) (cms) (hrs) (mm)
 *** W A R N I N G : HYDROGRAPH 0020 <ID= 1> IS DRY.
 *** W A R N I N G : HYDROGRAPH 0011 = HYDROGRAPH 0201
 ID1= 1 (0020): 0.00 0.000 0.00 0.00
 + ID2= 2 (0201): 1.64 0.418 2.50 69.19

 ID = 3 (0011): 1.64 0.418 2.50 69.19

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0011)	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0011):	1.64	0.418	2.50	69.19
+ ID2= 2 (0030):	0.07	0.151	2.42	92.96
ID = 1 (0011):	1.71	0.484	2.42	70.13

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0001)	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0011):	1.71	0.484	2.42	70.13
+ ID2= 2 (0020):	7.85	0.305	3.42	85.65
ID = 3 (0001):	9.56	0.595	2.50	82.88

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
V V I SSSS U U A A L (v 6.2.2016)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSS UUUU A A LLLL
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OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y M M O O O
O O T T H H Y Y M M O O O
OOO T T H H Y Y M M OOO
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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voindat
Output filename: C:\Users\THanko\AppData\Local\Civica\XH5\leafic2b-0257-432e-99fb-1cbb4fcb08d\7e587a84-aabb-40a1-937b-7487b7e6d475\scena
Summary filename: C:\Users\THanko\AppData\Local\Civica\XH5\leafic2b-0257-432e-99fb-1cbb4fcb08d\7e587a84-aabb-40a1-937b-7487b7e6d475\scena

DATE: 02/14/2025 TIME: 10:27:47
USER:

COMMENTS: _____

** SIMULATION : 100Yr 6hr 5min Chicago **

CHICAGO STORM | IDF curve parameters: A=1821.990
| Ptotal=112.28 mm | B= 13.507
C= 0.773
used in: INTENSITY = A / (t + B)^C
Duration of storm = 6.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.40

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	4.90	1.50	12.31	3.00	21.73	4.50	7.39
0.08	5.06	1.58	13.58	3.08	19.46	4.58	7.14
0.17	5.22	1.67	15.19	3.17	17.64	4.67	6.92
0.25	5.40	1.75	17.25	3.25	16.14	4.75	6.71
0.33	5.60	1.83	20.01	3.33	14.88	4.83	6.52
0.42	5.81	1.92	23.87	3.42	13.82	4.92	6.33
0.50	6.04	2.00	29.65	3.50	12.90	5.00	6.16
0.58	6.29	2.08	39.15	3.58	12.11	5.08	6.00
0.67	6.56	2.17	57.29	3.67	11.42	5.17	5.85
0.75	6.87	2.25	103.00	3.75	10.80	5.25	5.70
0.83	7.20	2.33	190.94	3.83	10.26	5.33	5.56
0.92	7.58	2.42	114.64	3.92	9.77	5.42	5.43
1.00	8.00	2.50	73.00	4.00	9.33	5.50	5.31
1.08	8.48	2.58	52.81	4.08	8.93	5.58	5.20
1.17	9.03	2.67	41.14	4.17	8.56	5.67	5.08
1.25	9.66	2.75	33.63	4.25	8.23	5.75	4.98
1.33	10.39	2.83	28.43	4.33	7.93	5.83	4.88
1.42	11.26	2.92	24.62	4.42	7.65	5.92	4.78

CALIB | Area (ha)= 1.64
STANDHYD (0201) | Total Imp(%)= 31.70 Dir. Conn.(%)= 10.00
ID= 1 DT= 5.0 min |
Surface Area (ha)= IMPERVIOUS 0.52 PERVIOUS (i) 1.12

Dep. Storage (mm)= 1.50 5.00
Average Slope (%)= 2.00 2.00
Length (m)= 104.51 15.00
Mannings n = 0.013 0.250
Max.Eff.Inten.(mm/hr)= 190.94 153.62
over (min)= 5.00 5.00
Storage Coeff. (min)= 1.65 (ii) 4.94 (ii)
Unit Hyd. Tpeak (min)= 5.00 5.00
Unit Hyd. peak (cms)= 0.32 0.22

TOTALS

PEAK FLOW (cms)= 0.08 0.45 0.531 (iii)
TIME TO PEAK (hrs)= 2.42 2.42 2.42
RUNOFF VOLUME (mm)= 110.78 77.16 80.52
TOTAL RAINFALL (mm)= 112.28 112.28 112.28
RUNOFF COEFFICIENT = 0.99 0.69 0.72

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20% YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 81.4 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB | Area (ha)= 0.55
STANDHYD (0202) | Total Imp(%)= 45.00 Dir. Conn.(%)= 10.00
ID= 1 DT= 5.0 min |

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 0.25 0.30
Dep. Storage (mm)= 1.50 5.00
Average Slope (%)= 2.00 2.00
Length (m)= 60.39 25.00
Mannings n = 0.013 0.250

Max.Eff.Inten.(mm/hr)= 190.94 216.10
over (min)= 5.00 10.00
Storage Coeff. (min)= 1.18 (ii) 5.10 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.33 0.16

TOTALS

PEAK FLOW (cms)= 0.03 0.16 0.181 (iii)
TIME TO PEAK (hrs)= 2.42 2.50 2.50
RUNOFF VOLUME (mm)= 110.78 87.33 89.66
TOTAL RAINFALL (mm)= 112.28 112.28 112.28
RUNOFF COEFFICIENT = 0.99 0.78 0.80

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20% YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 85.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB | Area (ha)= 6.19
STANDHYD (0203) | Total Imp(%)= 54.00 Dir. Conn.(%)= 45.00
ID= 1 DT= 5.0 min |

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 3.34 2.85
Dep. Storage (mm)= 1.50 5.00
Average Slope (%)= 2.00 2.00
Length (m)= 203.10 40.00
Mannings n = 0.013 0.250

Max.Eff.Inten.(mm/hr)= 190.94 156.56
over (min)= 5.00 10.00
Storage Coeff. (min)= 2.45 (ii) 8.35 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.30 0.12

TOTALS

PEAK FLOW (cms)= 1.38 0.95 2.056 (iii)
TIME TO PEAK (hrs)= 2.42 2.50 2.42
RUNOFF VOLUME (mm)= 110.78 85.94 97.12
TOTAL RAINFALL (mm)= 112.28 112.28 112.28
RUNOFF COEFFICIENT = 0.99 0.77 0.86

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20% YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 88.4 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB | Area (ha)= 1.18
STANDHYD (0204) | Total Imp(%)= 75.00 Dir. Conn.(%)= 60.00
ID= 1 DT= 5.0 min |

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 0.89 0.30
Dep. Storage (mm)= 1.50 5.00
Average Slope (%)= 2.00 2.00
Length (m)= 88.86 40.00
Mannings n = 0.013 0.250

Max.Eff.Inten.(mm/hr)= 190.94 231.72
 over (min) 5.00 10.00
 Storage Coeff. (min)= 1.49 (ii) 5.33 (ii)
 Unit Hyd. Tpeak (min)= 5.00 10.00
 Unit Hyd. peak (cms)= 0.33 0.16

TOTALS
 PEAK FLOW (cms)= 0.37 0.17 0.499 (iii)
 TIME TO PEAK (hrs)= 2.42 2.50 2.42
 RUNOFF VOLUME (mm)= 110.78 96.90 105.23
 TOTAL RAINFALL (mm)= 112.28 112.28 112.28
 RUNOFF COEFFICIENT = 0.99 0.86 0.94

+ ID2= 2 (0201): 1.64 0.531 2.42 80.52
 =====
 ID = 3 (0011): 1.64 0.531 2.42 80.52

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 | ADD HYD (0011) |
 | 3 + 2 = 1 | AREA QPEAK TPEAK R.V.
 (ha) (cms) (hrs) (mm)
 ID1= 3 (0011): 1.64 0.531 2.42 80.52
 + ID2= 2 (0030): 0.08 0.195 2.42 105.23
 =====
 ID = 1 (0011): 1.72 0.726 2.42 81.73

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 | ADD HYD (0001) |
 | 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
 (ha) (cms) (hrs) (mm)
 ID1= 1 (0011): 1.72 0.726 2.42 81.73
 + ID2= 2 (0020): 7.83 0.469 3.17 97.68
 =====
 ID = 3 (0001): 9.56 0.836 2.42 94.80

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 92.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 | DIVERTHYD(0030) |
 | IN= 1 # OUT= 5 |

Outflow / Inflow Relationships

Flow 1	Flow 2	Flow 3	Flow 4	Flow 5	Total
(cms)	(cms)	(cms)	(cms)	(cms)	(cms)
0.00	0.00	0.00	0.00	0.00	0.00
0.30	0.00	0.00	0.00	0.00	0.30
0.30	4.70	0.00	0.00	0.00	5.00

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
TOTAL HYD.(ID= 1):	1.18	0.50	2.42	105.23
ID= 2 (2) :	1.10	0.30	2.42	105.23
ID= 3 (2) :	0.08	0.20	2.42	105.23
ID= 4 (2) :	0.00	0.00	0.00	0.00
ID= 5 (2) :	0.00	0.00	0.00	0.00
ID= 6 (2) :	0.00	0.00	0.00	0.00

 | ADD HYD (0010) |
 | 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
 (ha) (cms) (hrs) (mm)
 ID1= 1 (0202): 0.55 0.181 2.50 89.66
 + ID2= 2 (0203): 6.19 2.056 2.42 97.12
 =====
 ID = 3 (0010): 6.73 2.203 2.42 96.51

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 | ADD HYD (0010) |
 | 3 + 2 = 1 | AREA QPEAK TPEAK R.V.
 (ha) (cms) (hrs) (mm)
 ID1= 3 (0010): 6.73 2.203 2.42 96.51
 + ID2= 2 (0030): 1.10 0.304 2.42 105.23
 =====
 ID = 1 (0010): 7.83 2.507 2.42 97.73

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 | RESERVOIR(0020) | OVERFLOW IS ON
 | IN= 2---> OUT= 1 |
DT= 5.0 min

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.1281	0.2718
0.0114	0.0207	0.1353	0.3063
0.0371	0.0429	0.1420	0.3420
0.0573	0.0665	0.1485	0.3790
0.0718	0.0916	0.1784	0.3980
0.0839	0.1182	0.2359	0.4173
0.0944	0.1463	0.4221	0.4569
0.1039	0.1758	0.7050	0.4978
0.1125	0.2066	1.0908	0.5400
0.1206	0.2386	1.5867	0.5835

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0010)	7.834	2.507	2.42	97.73
OUTFLOW: ID= 1 (0020)	7.834	0.469	3.17	97.68
OVERFLOW: ID= 3 (0003)	0.000	0.000	0.00	0.00

TOTAL NUMBER OF SIMULATION OVERFLOW = 0
 CUMULATIVE TIME OF OVERFLOW (HOURS) = 0.00
 PERCENTAGE OF TIME OVERFLOWING (%) = 0.00

PEAK FLOW REDUCTION [Qout/Qin](%) = 18.71
 TIME SHIFT OF PEAK FLOW (min) = 45.00
 MAXIMUM STORAGE USED (ha.m.) = 0.4639

 | ADD HYD (0011) |
 | 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
 (ha) (cms) (hrs) (mm)
 *** W A R N I N G : HYDROGRAPH 0020 <ID= 1> IS DRY.
 *** W A R N I N G : HYDROGRAPH 0011 = HYDROGRAPH 0201
 ID1= 1 (0020): 0.00 0.000 0.00 0.00

Appendix D

Stormwater Management Facility Details



Walton Ave Subdivision Design
STORMWATER MANAGEMENT
 Listowel, ON

Project Number: 60410_001
 Date: February 14, 2025
 Design By: T.Hanko
 File: Q:\60410_001\Stormwater Management\60410_001_Master SWM Facility Design Sheet_R00.xlsx

Orifice Calculations			
$Q_o = C_d * A_o * (2 * g * H_o)^{0.5}$			
	Orifice 1	Orifice 2	Orifice 3
C_d	0.63	0.63	0.63
Invert (m)	383.70	500.00	500.00
Width (m)			
Diameter/Height (m)	0.250		
Type (H/V)	V	V	V

C_d	Description
0.63	Orifice Plate
0.80	Orifice Tube

Weir Calculations		
$Q_w = 2/3 * C_d * (2g)^{1/2} * L * H_w^{3/2} + 8/15 * C_d * (2g)^{1/2} * \tan \theta * H_w^{5/2}$		
C_d	0.50	0.50
Invert (m)	385.00	500.00
Length (m)	1.500	
Side Slope (H:V)	3	1
Side Slope (rad)	1.249	0.785

STAGE-DISCHARGE RELATIONSHIP

Stage	Forebay	Main Pond	Orifice 1			Orifice 2			Orifice 3			Weir 1 Flow	Weir 2 Flow	Total Flow
			Area	H_o	Flow	Area	H_o	Flow	Area	H_o	Flow			
m	m^3	m^3	m^2	m	m^3/s	m^2	m	m^3/s	m^2	m	m^3/s	m^3/s		m^3/s
382.50	0.0	0.0												
382.60	0.0	90.6												
382.70	0.0	187.1												
382.80	12.0	289.6												
382.90	26.1	398.2												
383.00	42.6	512.9												
383.10	61.4	633.9												
383.20	82.7	761.1												
383.30	106.4	894.8												
383.40	132.8	1034.9												
383.50	161.7	1181.6												
383.60	193.3	1334.8												
383.70	228.0	1494.8												
Stage	Total Volume	Active Volume												
383.70	1722.8	0.0	0.00	0.00	0.0000	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000
383.80	1930.2	207.4	0.02	0.05	0.0114	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0114
383.90	2151.8	429.0	0.04	0.10	0.0371	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0371
384.00	2387.9	665.1	0.05	0.18	0.0573	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0573
384.10	2638.7	915.9	0.05	0.28	0.0718	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0718
384.20	2904.5	1181.7	0.05	0.38	0.0839	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0839
384.30	3185.6	1462.8	0.05	0.48	0.0944	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0944
384.40	3481.2	1758.4	0.05	0.58	0.1039	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.1039
384.50	3788.8	2066.0	0.05	0.68	0.1125	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.1125
384.60	4108.7	2385.9	0.05	0.78	0.1206	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.1206
384.70	4440.9	2718.1	0.05	0.88	0.1281	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.1281
384.80	4785.6	3062.8	0.05	0.98	0.1353	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.1353
384.90	5142.9	3420.1	0.05	1.08	0.1420	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.1420
385.00	5512.9	3790.1	0.05	1.18	0.1485	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.1485
385.05	5702.7	3979.9	0.05	1.23	0.1516	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0267	0.0000	0.1784
385.10	5895.8	4173.0	0.05	1.28	0.1547	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0812	0.0000	0.2359
385.20	6291.6	4568.8	0.05	1.38	0.1606	0.00	0.00	0.0000	0.00	0.00	0.0000	0.2615	0.0000	0.4221
385.30	6700.5	4977.7	0.05	1.48	0.1664	0.00	0.00	0.0000	0.00	0.00	0.0000	0.5386	0.0000	0.7050
385.40	7122.7	5399.9	0.05	1.58	0.1719	0.00	0.00	0.0000	0.00	0.00	0.0000	0.9189	0.0000	1.0908
385.50	7558.3	5835.5	0.05	1.68	0.1773	0.00	0.00	0.0000	0.00	0.00	0.0000	1.4094	0.0000	1.5867



Walton Ave Subdivision Design
STORMWATER MANAGEMENT
 Listowel, ON

Project Number: 60410_001
 Date: February 14, 2025
 Design By: T.Hanko
 File: Q:\60410_001\Stormwater Management\60410_001_Master SWM Facility Design Sheet_R00.xl

FALLING HEAD DRAWDOWN CALCULATION
 MOE SWM Planning and Design Manual, 2003

$$t = \frac{0.66C_2h^{1.5} + 2C_3h^{0.5}}{2.75A_o} \quad \text{Equation 4.11}$$

where

t =	44166 s	drawdown time
	12.3 hr	
A _p =	3787.97 m ²	surface area of the pond
C =	0.63	discharge coefficient
d =	250 mm	diameter of the orifice
A _o =	0.04909 m ²	cross-sectional area of the orifice
g =	9.81 m/s ²	gravitational acceleration constant
h ₁ =	385.000 m	starting water elevation above the orifice
h ₂ =	383.700 m	ending water elevation above the orifice
h =	1.3 m	maximum water elevation above the orifice
C ₂ =	1347.27	slope coefficient from the area-depth linear regression
C ₃ =	2036.52	intercept from the area-depth linear regression

	ELEVATION <i>m</i>	STAGE <i>m</i>	AREA <i>m</i> ²	COMMENTS
1	383.700	0	1989.0	Permanent pool
2	383.800	0.1	2140.2	
3	383.900	0.2	2291.4	
4	384.000	0.3	2442.5	
5	384.100	0.4	2593.7	
6	384.200	0.5	2744.9	
7	384.300	0.6	2896.1	
8	384.400	0.7	3017.5	
9	384.500	0.8	3139.0	
10	384.600	0.9	3260.5	
11	384.700	1	3382.0	
12	384.800	1.1	3503.4	
13	384.900	1.2	3624.9	
14	385.000	1.3	3746.4	

DRAWDOWN TIME: 44166 s
 12.3 hr

Regression Output:

m ₁ =	1347.27	slope coefficient from the area-depth linear regression
b =	2036.52	intercept from the area-depth linear regression
se ₁ =	21.43	standard error for coefficient m ₁
se _b =	16.39	standard error for constant b
R ² =	0.9970	coefficient of determination
se _y =	32.32	standard error of the y estimate
F =	3952.20	F statistic
df =	12	degrees of freedom
SS _{reg} =	4129408	regression sum of squares
SS _{resid} =	12538	residual sum of squares

Appendix E

Quality Control Details



**Walton Ave Subdivision Design
STORMWATER MANAGEMENT**
Listowel, ON

Project Number: 60410_001
Date: February 14, 2025
Design By: T.Hanko
File: Q:\60410_001\Stormwater Management\60410_001_Master SWM Facility Design Sheet_R00.xlsx

FOREBAY DESIGN CALCULATIONS
MOE SWM Planning and Design Manual, 2003

Forebay Design Flows

Flow into forebay during the 1.5-year return period event **1.410 m³/s**
Flow into forebay during the 25 mm - 4 hour design storm event **0.708 m³/s**
Peak flow from main pond outlet for the 25mm design storm (from MIDUSS) **0.068 m³/s**

Forebay Characteristics

b = **6.5 m** bottom width
y = **1 m** depth
z = **3 :1** side slope
w = **9.5 m** average width
R = **0.74 m** hydraulic radius
A = **9.5 m²** cross-sectional area

1. Length Calculation Based on Settling Velocity

L = forebay flow length (m)

r = length-to-width ratio

Q_p = peak flow rate through forebay (m³/s)

v_s = settling velocity (m/s)

Equation 4.5: Forebay Settling Length

a) Required Settling Length (assuming Q_p = forebay through-flow & v_s = 0.0055 m/s)

Q_p = **0.71 m³/s** peak flow rate through forebay

v_s = **0.0055 m/s** settling velocity

r = **1.42** length-to-width ratio

L = **13.5 m** required settling length

L = **13.5 m** trial length

settle velocity
length-to-width ratio
required settling length
trial length

Table 1: Average settling velocities

	Mass Removed	Particle Size Range	Average Settling Velocity
	%	µm	m/s
Enhanced:	80 - 100	x ≤ 20	0.00000254
	70 - 80	20 < x ≤ 40	0.00001300
	Normal:	60 - 70	40 < x ≤ 60
Basic:	40 - 60	60 < x ≤ 130	0.00012700
	Medium Sand:	20 - 40	130 < x ≤ 400
Gross Grit:	0 - 20	400 < x ≤ 4000	0.00550333

b) Required Settling Length (assuming Q_p = pond discharge & v_s = 0.0003 m/s)

Q_p = **0.068 m³/s** peak flow rate through forebay

v_s = **0.0003 m/s** settling velocity

r = **2.49** length-to-width ratio

L = **23.7 m** required settling length

L = **23.7 m** trial length

peak flow rate through forebay
settle velocity
length-to-width ratio
required settling length
trial length

2. Length Calculation Based on Flow Dispersion Length

Q = **1.41 m³/s** inlet flow rate

d = **1 m** depth of permanent pool in forebay

V_f = **0.50 m/s** desired velocity in forebay (typical value ≤ 0.50 m/s)

L = **22.6 m** required length of dispersion

Equation 4.6: Dispersion Length

depth of permanent pool in forebay
desired velocity in forebay (typical value ≤ 0.50 m/s)
required length of dispersion

3. Required Forebay Length

L = **23.7 m** design length

r = **2.50** design length-to-width ratio (typical minimum of 2.0)

design length
design length-to-width ratio (typical minimum of 2.0)

4. Scour Velocity

v_s = **0.15 m/s** scour velocity (typical value = 0.15 m/s)

v = **0.148 m/s** actual velocity

OK The actual velocity through the forebay is less than the scour velocity.

5. Weir Flow From Forebay

L = **3 m** length of crest of weir

α = **1.65** coefficient

H = **0.5 m** head

Q = **1.75 m³/s** discharge

Equation 4.4: Weir Flow

length of crest of weir
coefficient
head
discharge

OK The weir flow from the forebay exceeds the flow entering the forebay

6. Estimated Cleanout Frequencies

a) Forebay

Forebay volume **228 m³**

Estimated TSS removal efficiency **80%**

Impervious level **52.3%**

Estimated annual sediment loading **1.9 m³/ha**

Contributing area **9.557 ha**

Annual sediment volume **15 m³/yr**

Cleanout frequency for 33% volume reduction **5.2 years**

228 m³
80%
52.3%
1.9 m³/ha
9.557 ha
15 m³/yr
5.2 years

Table 2: Annual sediment loading

Impervious Level	Annual Loading
%	m ³ /ha
35%	0.6
55%	1.9
70%	2.8
85%	3.8

b) Stormwater Management Pond

Wetpond volume (excluding forebay) **1495 m³**

Estimated TSS removal efficiency **30%**

Impervious level **52.3%**

Estimated annual sediment loading **1.9 m³/ha**

Contributing area **9.557 ha**

Annual sediment volume **5 m³/yr**

Cleanout frequency for 33% volume reduction **90.6 years**

1495 m³
30%
52.3%
1.9 m³/ha
9.557 ha
5 m³/yr
90.6 years

THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

=====
V V I SSSS U U A L (v 6.2.2016)
V V I SS U U A A L
V V I SS U U A A A A L
V V I SS U U A A L
V V I SSSS UUUU A A LLLL
  
```

```

-----
| CALIB |
| STANDHYD ( 0202) | Area (ha)= 0.55
| ID= 1 DT= 5.0 min | Total Imp(%)= 45.00 Dir. Conn.(%)= 10.00
-----
  
```

```

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y Y M M O O
OOO T T H H Y Y M M OOO
  
```

```

-----
Surface Area (ha)= 0.25 IMPERVIOUS 0.30 PERVIOUS (i)
Dep. Storage (mm)= 1.50 5.00
Average Slope (%)= 2.00 2.00
Length (m)= 60.39 25.00
Mannings n = 0.013 0.250
  
```

```

Max.Eff.Inten.(mm/hr)= 79.55 40.02
over (min) 5.00 10.00
Storage Coeff. (min)= 1.68 (ii) 9.36 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.32 0.12
  
```

```

*TOTALS*
PEAK FLOW (cms)= 0.01 0.02 0.026 (iii)
TIME TO PEAK (hrs)= 2.42 2.50 2.50
RUNOFF VOLUME (mm)= 26.02 11.54 12.98
TOTAL RAINFALL (mm)= 27.52 27.52 27.52
RUNOFF COEFFICIENT = 0.95 0.42 0.47
  
```

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 ***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
 YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 85.0 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| STANDHYD ( 0203) | Area (ha)= 6.19
| ID= 1 DT= 5.0 min | Total Imp(%)= 54.00 Dir. Conn.(%)= 45.00
-----
  
```

```

-----
Surface Area (ha)= 3.34 IMPERVIOUS 2.85 PERVIOUS (i)
Dep. Storage (mm)= 1.50 5.00
Average Slope (%)= 2.00 2.00
Length (m)= 203.10 40.00
Mannings n = 0.013 0.250
  
```

```

Max.Eff.Inten.(mm/hr)= 79.55 21.18
over (min) 5.00 20.00
Storage Coeff. (min)= 3.48 (ii) 16.61 (ii)
Unit Hyd. Tpeak (min)= 5.00 20.00
Unit Hyd. peak (cms)= 0.26 0.06
  
```

```

*TOTALS*
PEAK FLOW (cms)= 0.51 0.09 0.529 (iii)
TIME TO PEAK (hrs)= 2.42 2.67 2.42
RUNOFF VOLUME (mm)= 26.02 10.63 17.56
TOTAL RAINFALL (mm)= 27.52 27.52 27.52
RUNOFF COEFFICIENT = 0.95 0.39 0.64
  
```

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 88.4 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| STANDHYD ( 0204) | Area (ha)= 1.18
| ID= 1 DT= 5.0 min | Total Imp(%)= 75.00 Dir. Conn.(%)= 60.00
-----
  
```

```

-----
Surface Area (ha)= 0.89 IMPERVIOUS 0.30 PERVIOUS (i)
Dep. Storage (mm)= 1.50 5.00
Average Slope (%)= 2.00 2.00
Length (m)= 88.86 40.00
Mannings n = 0.013 0.250
  
```

```

Max.Eff.Inten.(mm/hr)= 79.55 55.97
over (min) 5.00 15.00
Storage Coeff. (min)= 2.12 (ii) 11.02 (ii)
Unit Hyd. Tpeak (min)= 5.00 15.00
Unit Hyd. peak (cms)= 0.31 0.09
  
```

```

*TOTALS*
PEAK FLOW (cms)= 0.15 0.03 0.157 (iii)
TIME TO PEAK (hrs)= 2.42 2.58 2.42
RUNOFF VOLUME (mm)= 26.02 15.58 21.84
TOTAL RAINFALL (mm)= 27.52 27.52 27.52
RUNOFF COEFFICIENT = 0.95 0.57 0.79
  
```

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 92.0 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| DIVERTHYD ( 0030) |
-----
  
```

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voindat
 Output filename: C:\Users\Thanko\AppData\Local\Civica\XH5\leaf1c2b-0257-432e-99fb-1cbb4fcb08d\2fef9716-9c57-48e1-9611-a903dd5ca598\scena
 Summary filename: C:\Users\Thanko\AppData\Local\Civica\XH5\leaf1c2b-0257-432e-99fb-1cbb4fcb08d\2fef9716-9c57-48e1-9611-a903dd5ca598\scena

DATE: 02/14/2025 TIME: 10:27:47

USER:

COMMENTS: _____

```

*****
** SIMULATION : 25mm 6hr 5 min Chicago **
*****
  
```

```

-----
| CHICAGO STORM | IDF curve parameters: A= 440.440
| Ptotal= 27.52 mm | B= 4.125
| | C= 0.774
-----
used in: INTENSITY = A / (t + B)^C

Duration of storm = 6.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.40
  
```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	1.10	1.50	2.59	3.00	4.37	4.50	1.62
0.08	1.14	1.58	2.83	3.08	3.95	4.58	1.57
0.17	1.17	1.67	3.14	3.17	3.60	4.67	1.52
0.25	1.21	1.75	3.53	3.25	3.32	4.75	1.48
0.33	1.25	1.83	4.05	3.33	3.08	4.83	1.44
0.42	1.30	1.92	4.78	3.42	2.88	4.92	1.40
0.50	1.34	2.00	5.88	3.50	2.70	5.00	1.37
0.58	1.39	2.08	7.75	3.58	2.55	5.08	1.33
0.67	1.45	2.17	11.67	3.67	2.42	5.17	1.30
0.75	1.51	2.25	25.29	3.75	2.30	5.25	1.27
0.83	1.58	2.33	79.55	3.83	2.19	5.33	1.24
0.92	1.66	2.42	29.30	3.92	2.10	5.42	1.22
1.00	1.74	2.50	15.51	4.00	2.01	5.50	1.19
1.08	1.84	2.58	10.63	4.08	1.93	5.58	1.17
1.17	1.95	2.67	8.15	4.17	1.86	5.67	1.14
1.25	2.07	2.75	6.65	4.25	1.79	5.75	1.12
1.33	2.22	2.83	5.64	4.33	1.73	5.83	1.10
1.42	2.39	2.92	4.92	4.42	1.67	5.92	1.08

```

-----
| CALIB |
| STANDHYD ( 0201) | Area (ha)= 1.64
| ID= 1 DT= 5.0 min | Total Imp(%)= 31.70 Dir. Conn.(%)= 10.00
-----
  
```

```

-----
IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 0.52 1.12
Dep. Storage (mm)= 1.50 5.00
Average Slope (%)= 2.00 2.00
Length (m)= 104.51 15.00
Mannings n = 0.013 0.250

Max.Eff.Inten.(mm/hr)= 79.55 22.02
over (min) 5.00 10.00
Storage Coeff. (min)= 2.33 (ii) 9.51 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.30 0.12

*TOTALS*
PEAK FLOW (cms)= 0.03 0.04 0.058 (iii)
TIME TO PEAK (hrs)= 2.42 2.50 2.50
RUNOFF VOLUME (mm)= 26.02 8.31 10.07
TOTAL RAINFALL (mm)= 27.52 27.52 27.52
RUNOFF COEFFICIENT = 0.95 0.30 0.37
  
```

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
 ***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
 YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 81.4 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL

| IN= 1 # OUT= 5 |

Outflow / Inflow Relationships

Flow 1 +	Flow 2 +	Flow 3 +	Flow 4 +	Flow 5 =	Total
(cms)	(cms)	(cms)	(cms)	(cms)	(cms)
0.00	0.00	0.00	0.00	0.00	0.00
0.30	0.00	0.00	0.00	0.00	0.30
0.30	4.70	0.00	0.00	0.00	5.00

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
TOTAL HYD. (ID= 1):	1.18	0.16	2.42	21.84
ID= 2 (2) :	1.18	0.16	2.42	21.84
ID= 3 (2) :	0.00	0.00	2.42	21.84
ID= 4 (2) :	0.00	0.00	0.00	0.00
ID= 5 (2) :	0.00	0.00	0.00	0.00
ID= 6 (2) :	0.00	0.00	0.00	0.00

+ ID2= 2 (0020): 7.92 0.068 3.50 17.82
 =====
 ID = 3 (0001): 9.56 0.099 2.50 16.49

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

FINISH
=====

| ADD HYD (0010) |

1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0202):	0.55	0.026	2.50	12.98
+ ID2= 2 (0203):	6.19	0.529	2.42	17.56
=====				
ID = 3 (0010):	6.73	0.552	2.42	17.18

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| ADD HYD (0010) |

3 + 2 = 1	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0010):	6.73	0.552	2.42	17.18
+ ID2= 2 (0030):	1.18	0.156	2.42	21.84
=====				
ID = 1 (0010):	7.92	0.708	2.42	17.88

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| RESERVOIR (0020) |

OVERFLOW IS ON

| IN= 2--> OUT= 1 |
| DT= 5.0 min |

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.1281	0.2718
0.0114	0.0207	0.1353	0.3063
0.0371	0.0429	0.1420	0.3420
0.0573	0.0665	0.1485	0.3790
0.0718	0.0916	0.1784	0.3980
0.0839	0.1182	0.2359	0.4173
0.0944	0.1463	0.4221	0.4569
0.1039	0.1758	0.7050	0.4978
0.1125	0.2066	1.0908	0.5400
0.1206	0.2386	1.5867	0.5835

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0010)	7.918	0.708	2.42	17.88
OUTFLOW: ID= 1 (0020)	7.918	0.068	3.50	17.82
OVERFLOW: ID= 3 (0003)	0.000	0.000	0.00	0.00

TOTAL NUMBER OF SIMULATION OVERFLOW = 0
 CUMULATIVE TIME OF OVERFLOW (HOURS) = 0.00
 PERCENTAGE OF TIME OVERFLOWING (%) = 0.00

PEAK FLOW REDUCTION [Qout/Qin] (%) = 9.54
 TIME SHIFT OF PEAK FLOW (min) = 65.00
 MAXIMUM STORAGE USED (ha.m.) = 0.0843

| ADD HYD (0011) |

1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
*** W A R N I N G : HYDROGRAPH 0020 <ID= 1> IS DRY.				
*** W A R N I N G : HYDROGRAPH 0011 = HYDROGRAPH 0201				
ID1= 1 (0020):	0.00	0.000	0.00	0.00
+ ID2= 2 (0201):	1.64	0.058	2.50	10.07
=====				
ID = 3 (0011):	1.64	0.058	2.50	10.07

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| ADD HYD (0011) |

3 + 2 = 1	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0011):	1.64	0.058	2.50	10.07
+ ID2= 2 (0030):	0.00	0.000	2.42	21.84
=====				
ID = 1 (0011):	1.64	0.058	2.50	10.08

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| ADD HYD (0001) |

1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0011):	1.64	0.058	2.50	10.08