FUNCTIONAL SERVICING REPORT

WATERSAND CONSTRUCTION C/O DG GROUP
PHASE 2 SALEM SECONDARY PLAN

PROPOSED RESIDENTIAL DEVELOPMENT

CITY OF BARRIE

PROJECT 5184 **NOVEMBER 2022**

Revision	Description	Prepared		Checked	
		By	Date	By	Date
0.	FSR Submission	H. Liu	November 2022	S. Katukurunde	November 2022

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive
Concord, Ontario L4K 4R3

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1 INTRODUCTION

'Schaeffer and Associates Ltd.' has been retained by the Watersand Construction C/O DG Group to provide a Functional Servicing Report (FSR) in support of Phase 2 of the proposed residential development south of Mckay Road in the Salem Secondary Plan Area (SSP) within the City of Barrie.

This FSR proposes a municipal servicing scheme that demonstrates the viability of storm drainage, sanitary and water supply servicing for the proposed development, with consideration for applicable municipal guidelines, policies, design criteria, and previous planning resolutions.

1.1 Context and Site Location

The subject site was previously analyzed as part of the *Sub-watershed Impact Study (SIS), Salem Annexed Lands, City of Barrie completed by Schaeffers Consulting Engineers* dated December 2017. The Salem Secondary Plan (SSP) lands are bound by Salem Road and Lockhart Road to the north, Huronia Road to the east, County Road 27 to the west and the southern boundary is a mid-concession line south of McKay Road between Simcoe County Road 27 to the west and Huronia Road. The southern boundary is also the municipal boundary between City of Barrie and Town of Innisfil. A location plan is provided in **Figure 1.1**.

The Salem Annexed lands are to be developed in three phases, with each phase to be developed in stages. The subject site is part of Phase 2 Stage 1 as described in the SIS. The subject site is bound by MacKay Road to the north, open lands to the east and west which are expected to be developed, and undisturbed land to the south as illustrated on **Figure 1.1** and **Figure 1.2**. The subject lands fall along the jurisdictional boundary of the Nottawasaga Valley Conservation Authority (NVCA). The total area of the subject site is 32.96 ha.

The following sections of this report provide strategic information regarding the water supply, sanitary servicing and stormwater management (SWM) for the subject lands. The provided information ensures compatibility with the existing storm, sanitary and water supply services, and future design considerations to service the annex lands.

1.2 Background Studies and Documentation

The following studies and design criteria were utilized in the preparation of this FSR:

- Subwatershed Impact Study (SIS) for Salem Annexed Lands prepared by Schaeffers Consulting Engineers, December 2017.
- Geotechnical Investigation, Proposed Residential Development by EXP Services Inc., September 2017.
- Hydrogeological Investigation, Watersand Development (Draft) by EXP Services Inc., October 2017.
- City of Barrie, Storm Drainage and Stormwater Management Policies and Design Guidelines, December 2017.
- City of Barrie Master Plans for Wastewater Collection, Multi-Modal Active Transportation, Drainage and Stormwater, Water Storage and Distribution, all prepared by AMEC Environment and Infrastructure, October 2013.
- City of Barrie, Infiltration Low Impact Development Screening Process.
- City of Barrie, Lot Grading and Drainage Standards and Design Manual (Draft), June 2016.
- Stormwater Management Planning and Design Manual, Ministry of Environment (MOECC), March 2003.
- Nottawasaga Valley Conservation Authority (NVCA) Stormwater Technical Guide (2013).
- Lake Simcoe Region Conservation Authority (LSRCA) Technical Guidelines for Stormwater Management Submissions, September 2016.
- Stormwater Management Report, SWM Pond A, prepared by Schaeffers Consulting Engineers, December 2018.
- InfoWater Modeling Brief, prepared by Schaeffers Consulting Engineers, April 2020.

1.3 Proposed Development Plan and Population

As previously mentioned, the subject site is 32.96 ha in area, the total developable area is approximately 27.32 ha. 211 single detached residential units and 55 townhouse units are proposed within the development. The development further proposes 2 site plans. An 8.10 ha recreational center is proposed along the northeast quadrant of the development. Similarly, a 2.42 ha elementary school is proposed at the southwest quadrant of the site. A 0.30 ha SWM Block is proposed at the boundary of City of Barrie at the southern corner of the site, however this block is proposed to be extended 2.48 ha south into the Town of Innisfil lands as part of the proposed land annexation. The stormwater management pond shall be maintained by the City of Barrie. Access to the subject site is provided along Mckay Road, and roadway is proposed bisecting the site that connects to the proposed Watersand Phase 1 subdivision to the east and a future subdivision to the west. The proposed development is shown in **Figure 1.2.** The following table summarizes the anticipated population of the development based on the City of Barrie design guidelines.

Table 1.1 : Estimated Design Population

Land Use	Criteria	Units/ Area (ha)	Design Population
Detached Residential Units	3.13 ppu	211	661
Townhouse Units	2.34	55	129
Recreational Centre	28 m^3/day/ha	8.10	1009*
School	28 m^3/day/ha	2.42	301*
TOTAL			**2100**

Note: Equivalent population calculated due to missing building information*

1.4 Existing Site Conditions

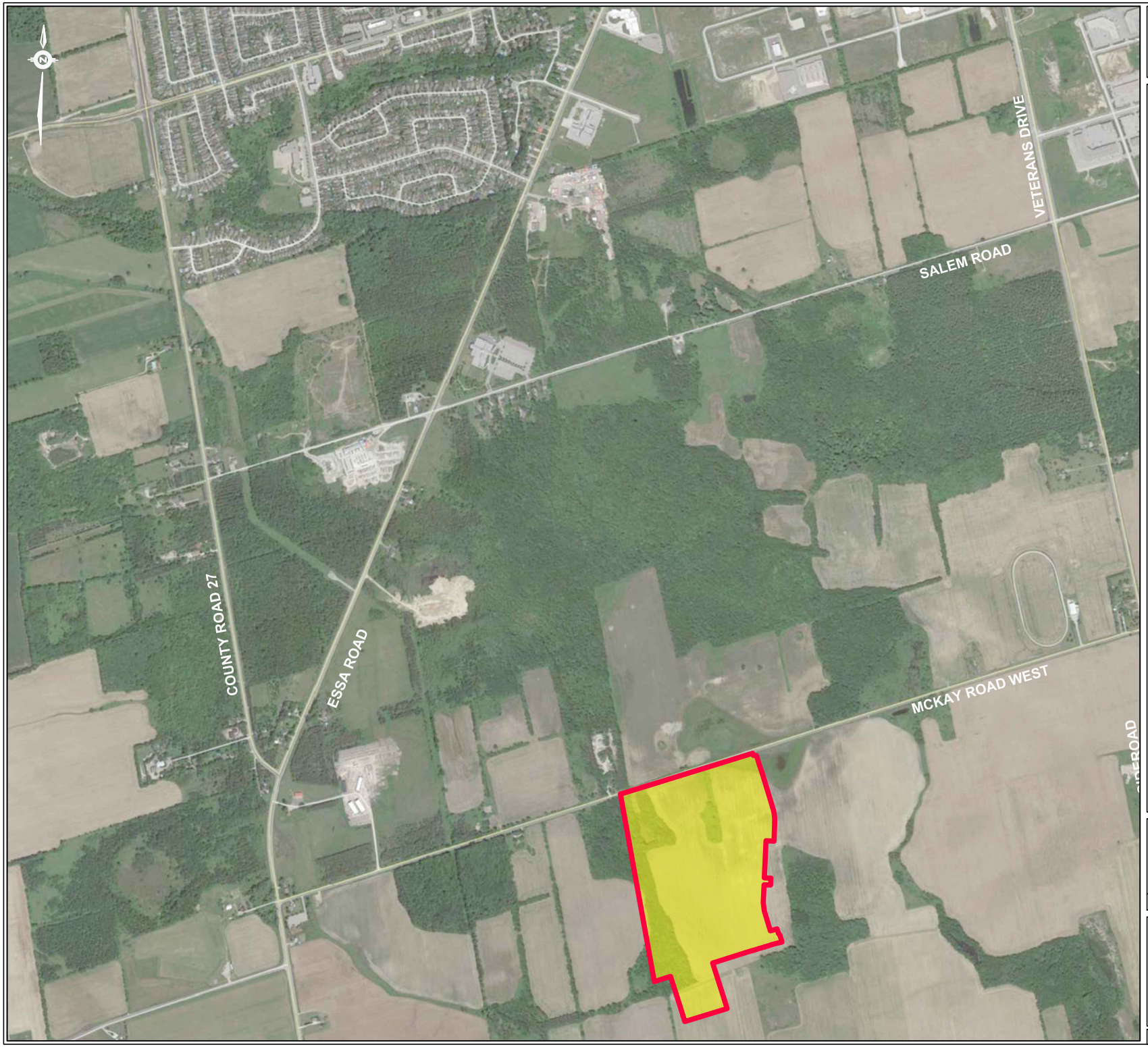
Existing site conditions were reviewed using a topographic survey conducted by Holding Jones Vanderveen Inc. in July, 2018 and previous studies. As mentioned in Section 1.2. the subject site is located within the NVCA watershed. Currently, the subject site is predominantly used for agricultural purposes and the site area remains predominantly undeveloped. The ground generally descends southwest towards the Thornton Creek with a relatively flat slope.

According to the Soil Survey of Simcoe County Report (1962), the predominant soil types throughout this study area are Tioga and Bondhead Sandy Loams. Both of these soil types are expected to provide "good" drainage and are classified as a Type "B" MTO hydrologic soil group. Geotechnical investigation conducted by EXP indicates that the native soils comprised of sand, silty sand, silty clay, clayey silt, silt, silty sand till, and peat. The predominant soil type found in the subject site is glacial silty sand till and almost all boreholes encountered a silty sand till deposit.

A hydrogeological investigation was also carried out on the subject site by EXP. Seasonal high groundwater contours, based on the most recent site data, were requested from EXP in May 2022. These elevations were utilized in the preliminary design of the site services, appended in **Appendix A**. Relevant background information is also provided in **Appendix A**.

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WATERSAND RESIDENTIAL SUBDIVISION
PHASE 2 SALEM SECONDARY PLAN AREA
CITY OF BARRIE

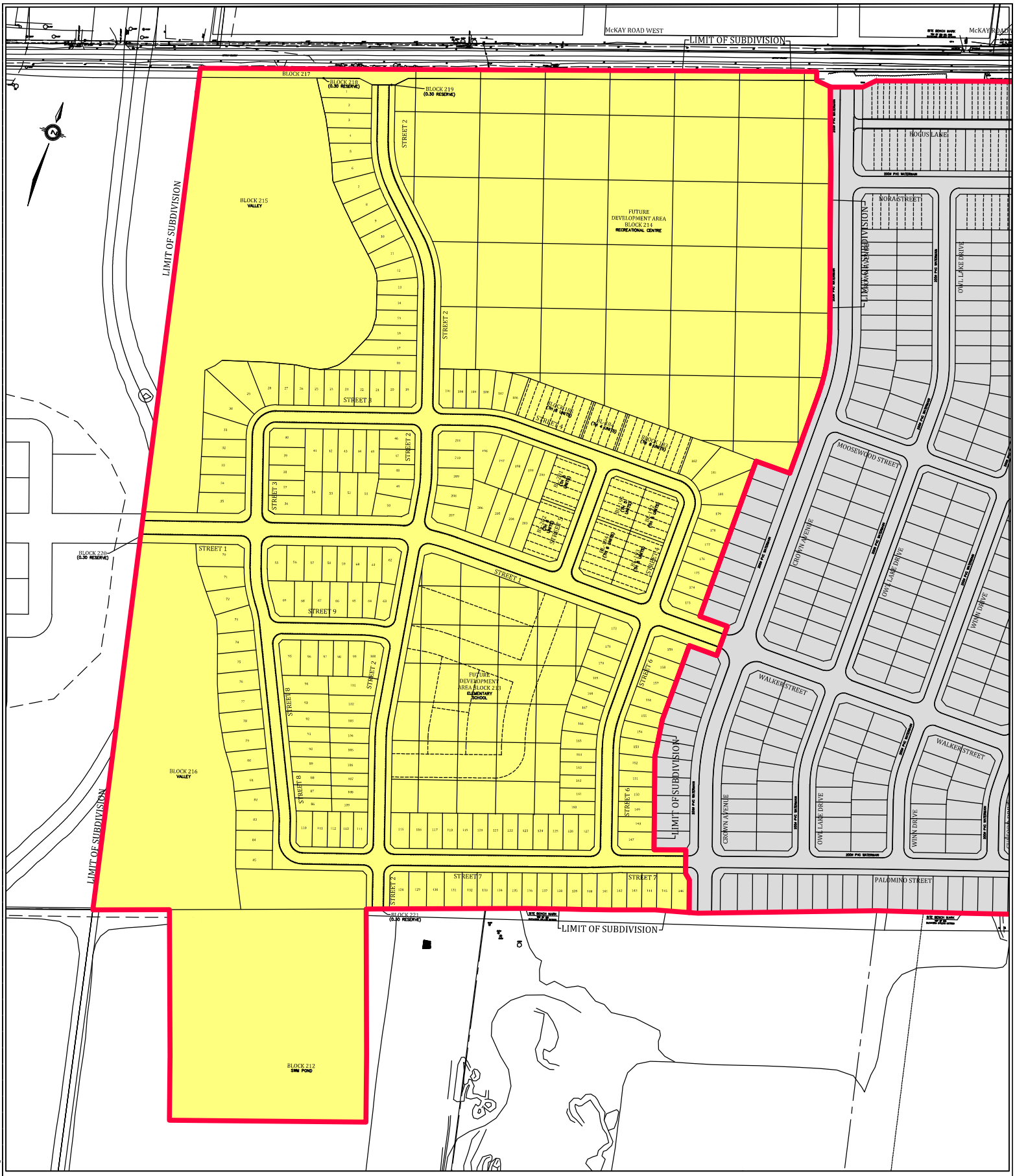
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SUBJECT AREA

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
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FIGURE 1.1
LOCATION PLAN

2022-5184	JUNE 2022	SCALE: N.T.S.



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WATERSAND SUBDIVISION PHASE 2 (SUBJECT AREA)

WATERSAND SUBDIVISION PHASE 1

FIGURE 1.2
DEVELOPMENT PLAN

2022-5184	JUNE 2022	SCALE:

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2 WATER SUPPLY SERVICING

A conceptual municipal water servicing plan for the SSP lands was proposed in the City of Barrie Water Storage and Distribution Master Plan for Intensification Areas and Annexed Lands (AMEC Report), prepared by AMEC (October 2013). The Water Supply services for the subject site follows the proposed servicing plan explored in the referenced SIS, dated 2017.

Currently, the City of Barrie has five pressure districts:

- District 1 (HWL = 281.2 meters above sea level (masl)) (PD1)
- District 2 North (324.09 masl) (PD2N)
- District 3 North (347 masl) (PD3N)
- District 2 South (308 masl) (PD2S)
- District 3 South (350.2 masl) (PD3S)

Majority of SSP lands including the subject site fall within PD3S. It is to note that the subject site development falls under Phase 2 of SSP development plan.

2.1 Existing Water Supply Servicing

There is currently no distribution system within the vicinity of the subject site. Just north of the Salem Road, still in PD3S, are two pump stations and the Mapleview reservoir storage facility that services the pre-annexation area. There are also key tie-in points identified, all at the border of the SSP land, they consist of:

- A 300 mm diameter main running along Salem Road east of Veteran's Drive,
- A 500 mm diameter main running along Veterans Drive between King Street and Mapleview Drive, this main connects to the Mapleview Reservoir.

It is to note that Phase 1 infrastructure is intended to be in place prior to the development of Phase 2:

- 400 mm diameter main running along Mckay Road West
- 400 mm diameter main along Watersand Phase 1 road crossing Thornton Creek
- 500 mm diameter CPP watermain along Veteran's Drive
- 400 mm diameter watermain along Veteran's Drive

2.2 Water Supply Servicing Design Criteria

Water distribution criteria based on City of Barrie Water Distribution Policies and Design Guidelines (2012) are summarized as the following:

- Watermains for the ultimate development shall be designed in accordance with the current City of Barrie Water Storage and Distribution Master Plan.
- The average residential daily demand of 225 L per capita per day and 28 m^3/ha*day for institutional and commercial land use.
- Peaking factors per MECP guidelines are as follows: Maximum Daily Flow = 2.5, Minimum Hour Flow = 0.45, Peak Hour Flow = 3.75
- Fire flow demands: 100 L/s for single family homes, 155 L/s for townhouses, 200 L/s for institutional and convenience, and 283 L/s for commercial as per the recommendation of City of Barrie based on the recently updated design criteria. The architectural details are not available for townhouses, school block and commercial block, therefore, the water supply for public fire protection calculation was not done. All flows must arrive with a minimum pressure of 140 kPa.
- Allowable pressure range under operating conditions (peak hour – min hour) shall be within 275 kPa – 700 kPa.
- The watermain size shall be determined by fire flow plus maximum day use.
- Minimum size of watermain is 150 mmØ.
- The Hazen Williams coefficients used in the model are listed in the table below.

Pipe Diameter (mmØ)	Hazen-Williams Coefficient 'C'
150	100
200-300	110
350-600	120
Over 600	130

- The following minimum and maximum pressures apply to all watermains.

a) The minimum pressure during the peak hourly demand – 275 kPa.

b) Maximum pressure during the minimum hourly demand – 690 kPa.

c) Minimum Fire Flow pressure when the system is tested for Fire Flow during Max daily flow – 140 kPa.

2.3 Proposed Water Supply Servicing Plan

The SIS presented a water distribution network during Phase 2 of the Salem Secondary Plan (see Figure 7.4 in **Appendix A**). The subject site will connect to the future watermains intended to be in place along Mckay Road West and the Watersand Phase 1 development to the east as shown in **Figure 2.1.** As per the InfoWater Modeling Brief prepared by Schaeffers dated April 15th, 2020, internal watermains sized 200 mm and 300 mm were deemed appropriate to service the subject site (Figure 5.4 provided in **Appendix A**). Similar fire flows noted in Section 2.2 were used for this analysis. It is to note that internal watermain sizing will be finalized through the detailed design process. Furthermore, as noted previously, FUS calculations shall be carried out at this stage when detailed plans for the proposed lots, commercial and school buildings are available. Lastly, as per the AMEC Master Plan, Phase 2 development requires a pumping station and a storage facility in order to satisfy the water volume demands. These facilities are to be located at the south east quadrant of Salem Road and Veteran's Drive. The pumping station is specified to be supplied by the existing Surface Water Treatment Plant (SWTP) through a series of 750 mm diameter transmission mains. The pumping station is to be appropriately incorporated into any future modelling work once details regarding the pumping configuration are available.

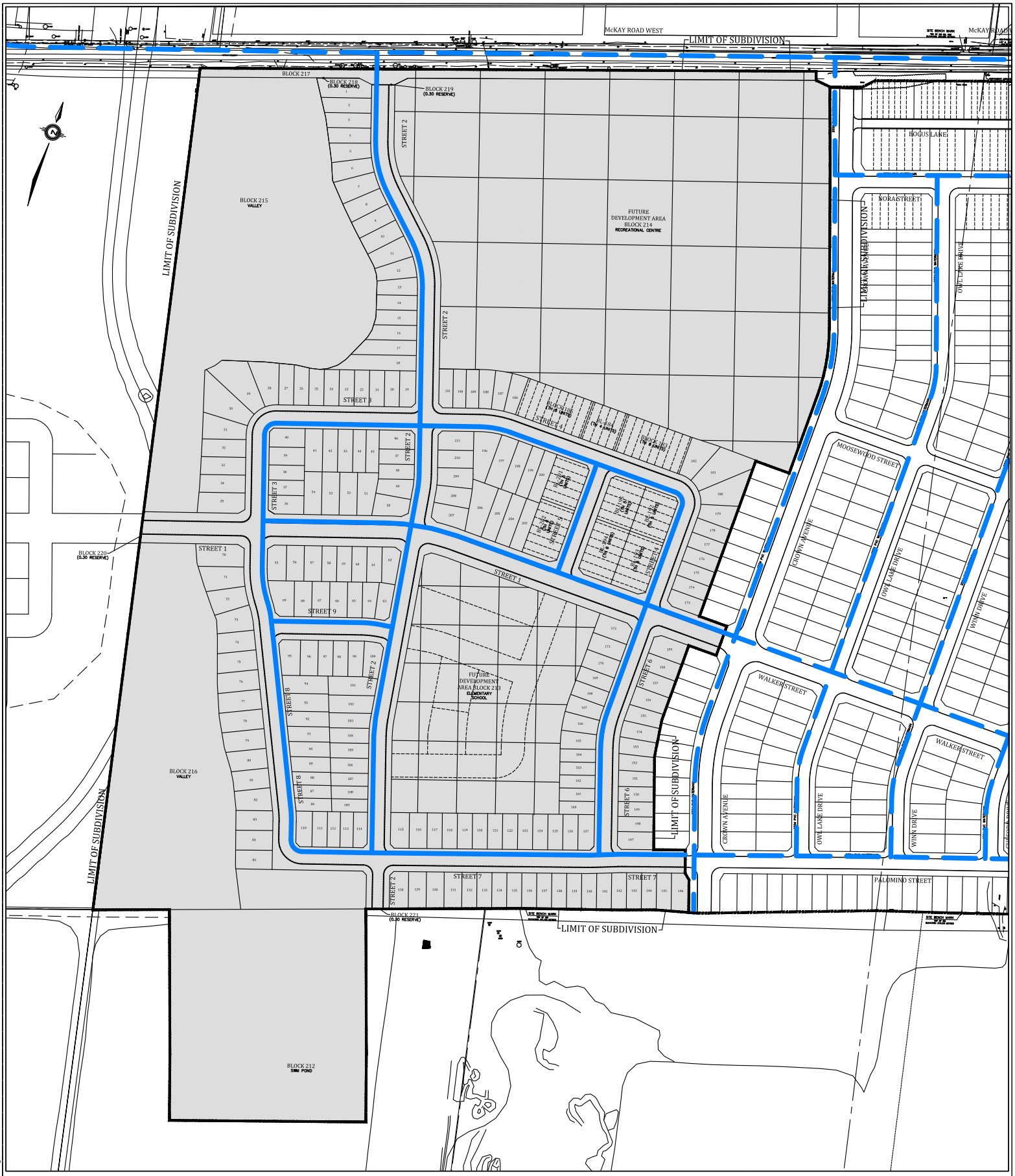
Table 2.1 - Water Supply Demand

Total Population (persons)	Residential Average Day Demand (L/person/day)	Average Daily Demand (L/s)	Peak Hour Factor	Peak Hour Demand (L/s)	Max Day Factor	Max Day Demand (L/s)	Fire Flow + Max Day Demand (L/s)
2100	225	5.47	3.75	20.50	2.5	13.67	296.67

Notes:

Commercial and Institutional Demand calculated as per 28 m^3/ ha / day

Fire Flow of 283 L/s for Commercial and Institutional



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6 Ronrose Drive, Concord, Ontario L4K 4R3
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- WATERSAND SUBDIVISION PHASE 2 (SUBJECT AREA)
- PHASE 2 WATERMAINS
- PHASE 1 WATERMAINS

FIGURE 2.1
WATER SUPPLY SERVICING PLAN

2022-5184	JUNE 2022	SCALE:

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3 SANITARY SERVICING

The wastewater servicing plan for SSP lands was initially addressed in the Barrie's Wastewater Collection Master Plan (WCMP) for Intensification Areas and Annexed Lands, prepared by AMEC (October 2013). The ultimate servicing strategy for the subject site follows the Sanitary servicing plan explored in the referenced SIS, dated 2017 with some changes.

3.1 Existing Sanitary Servicing

Currently there are no existing sanitary infrastructure within the vicinity of the site. As per the SIS, sanitary servicing for the subject site will be provided by the future Mckay Road trunk Sewer intended to be constructed as part of SSP Phase 1 development. Through the detailed design of Mckay Road West, a 1200 mm diameter reinforced concrete micro-tunneling sanitary trunk sewer was proposed along Mckay Road for the conveyance of sewage from SSP lands.

3.2 Sanitary Design Criteria

As per the City of Barrie's Design Criteria for sewers, the following guidelines were used in the design calculations for the sanitary sewers:

- A sewage flow rate of 225 L/cap/day for residential;
- 28 m^3/ha/day for commercial and institutional;
- An infiltration rate (extraneous flow) of 0.1 L/sec/ha;
- Peaking Factor: based on Harmon's Peaking Factor;
- Population Density of 3.13 ppu for low density and 2.34 ppu for medium density;
- Maximum velocity shall not be greater than 3.0 m/s with pipe flowing full;
- Minimum velocity shall not be less than 0.6 m/s at actual flow, and
- Minimum pipe diameter of 200 mm (as agreed with City in areas where cleaning velocity cannot be achieved).

3.3 Proposed Sanitary Servicing Plan

It is proposed to drain the subject site through a gravity system to the proposed sanitary trunk sewer along Mckay Road West. The subject site's sanitary system will be connected to the easterly Watersands Phase 1 subdivision and will ultimately drain towards the Mckay Road Trunk Sewer.

Due to grading constraints, it was anticipated during the SIS stage that the subject site will require a pump station to drain the southern portion of the site to the Mckay Road trunk sewer. However, it is now proposed to drain the entire site east towards the Watersands Phase 1 subdivision through a 250 mm diameter pipe along Walker Street, and eventually discharging to the sanitary trunk sewer along Mckay Road West. The internal design of the sewers shall be conducted during the detailed design stage of the site. The table below provides a summary of the anticipated sanitary sewage flows.

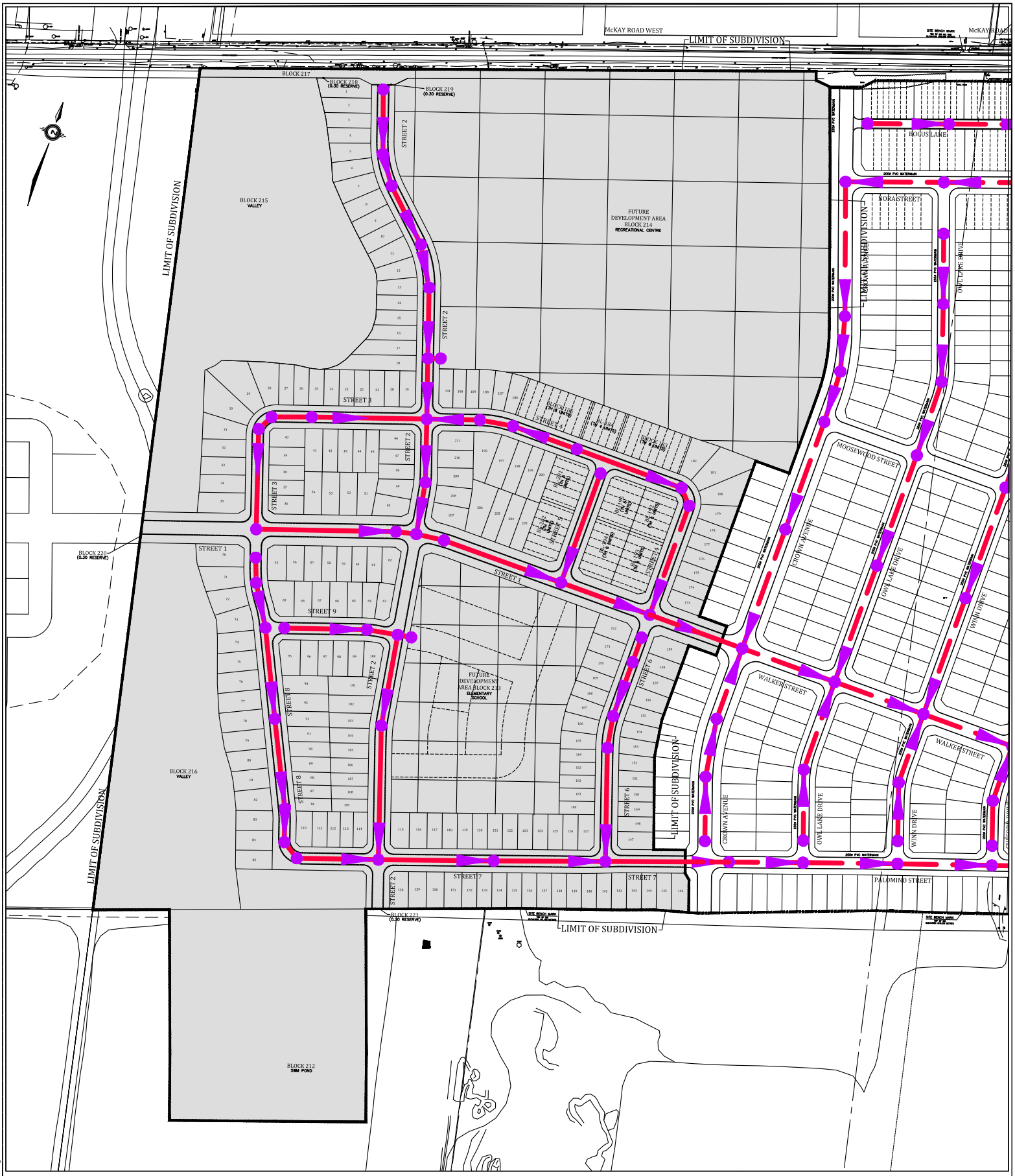
Table 3.1 - Sanitary Servicing Requirements

Average Residential Demand (L/ s)	Residential Population (persons)	Harmon's Peaking Factor (M)*	Infiltration (L/ha/s)	Total Developable Area (ha)	Total Peak Flow (L/s)
5.47	2100	3.57	2.65	26.54	22.17

Notes:

Commercial and Institutional Demand calculated as per 28 m^3/ ha / day

An equivalent residential population of 2100 calculated including the commercial & institutional demand flows to determine the Harmon Peaking Factor.



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CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
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- WATERSAND SUBDIVISION PHASE 2 (SUBJECT AREA)
- PHASE 2 SANITARY SEWERS
- PHASE 1 SANITARY SEWERS

FIGURE 3.1
SANITARY SERVICING PLAN

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4 STORMWATER MANAGEMENT

4.1 Existing Storm Infrastructure

There is no existing stormwater infrastructure in the vicinity of the subject site. Under pre-development conditions, a majority of the site drains towards Thornton Creek as shown in **Figure 4.1**. In existing condition, stormwater flows to the creek as sheet flow and in some instances via road side ditches along McKay Road.

4.2 Stormwater Design Criteria

Major SWM controls related to the Study Area have been established following the project team discussions with the City of Barrie, Town of Innisfil, LSRCA and NVCA staff. Some specific requirements were adopted through additional consultation with the Conservation Authorities and the municipalities as per their current technical guidelines.

In general, the SWM design criteria and requirements follow the City of Barrie's Stormwater Management Policies and Design guidelines (2009). Where deemed necessary, the MECP's Stormwater Management Planning and Design (SWMPD) Manual (2003) will be applied as a minimum. The following summarizes the general design criteria applicable to the stormwater conveyance system within the Salem lands development:

SWM Pond

- Enhanced (Level 1) water quality protection is required. Using Table 3.2 from the MECP SWMPD Manual (March 2003) the permanent pool storage shall be calculated;
- The required erosion control release rate and storage targets were determined from the Drainage and SWM Master Plan (DSWMMP) presented in Table 4.4.15 below, please note that the parameters for Reach THO1 were used;

Table 4.4.15: End-of-Pipe Stormwater Management Requirements[1,3]										
Subwatershed	Reach	Outlet Node	Cumulative Unitary Storage Rate (m^3/imp. ha)				Unitary Discharge Rate (m^3/s/ha)			
			Erosion Control	Flood Control[2]			Erosion Control	Flood Control		
				5 Yr	25 Yr	100 Yr		5 Yr	25 Yr	100 Yr
Bear Creek	BEA1	9001	410	850	1000	1300	0.0012	0.007	0.013	0.030
	BEA2	9005	440	1030	1280	1580	0.0012	0.007	0.013	0.030
Thornton Creek	THO1	9024	430	920	1070	1420	0.0011	0.007	0.013	0.025
	THO2	9017	370	860	960	1310	0.0013	0.009	0.018	0.036
Lover's Creel	LOV2	9251	400	850	1050	1300	0.0011	0.010	0.020	0.050
	LOV4	9142	400	1000	1250	1400	0.0012	0.007	0.012	0.027
	LOV6	9201	400	900	1050	1350	0.0013	0.007	0.013	0.030
	LOV8	9350	460	1060	1310	1510	0.0012	0.007	0.012	0.027
Hewitts Creek	-	9140	450	900	1050	1300	0.0006	0.007	0.013	0.030
Sandy Cove Creek	SAN2	9284	310	760	835	1235	0.0010	0.010	0.020	0.040
	SAN3	9281	320	770	845	1245	0.0011	0.010	0.020	0.040

Note: [1] Water quality: Volumetric requirements for permanent pool storage are in addition to storage provided here and are to be provided in accordance with Ministry of the Environment Enhanced Level treatment.
[2] Includes erosion control volume
[3] Volumes do not include LID

- Quantity control is to be provided by attenuating 2-year to 100-year storm events to pre-development levels based on a pre-development drainage area of 15.51 ha (SWM Pond C), as per the SIS, 9045 is proposed to be the outlet node for the entire site, with contributing catchments being 523, 528, 545, and 546. Through a detailed analysis of the existing topography and drainage conditions, it was determined that portions of catchments 528 and 546 drain into node 9045, resulting in an area of 15.51 ha;
- The hydrologic modelling to size the SWM ponds has been conducted using the 24-hour SCS Type II storm distribution for 2-year to 100-year storm events as mentioned in the DWSMMP and the SIS after modelling SWM Pond storage requirements using the 4-hour Chicago, 6-hour SCS, 12-hour SCS and the 24-hour SCS storm distributions;
- The SWM ponds must be landscaped with low maintenance ground cover and vegetation to discourage access;
- A stable access road must be provided around the SWM ponds to provide access to the headwall, and the outlet structure. The access road must be designed to support the weight

of maintenance vehicles and should provide for adequate turning radius and entrance and exit slopes;

Major and Minor System Design:

- Foundation drains and weeping tiles will not be connected to storm sewers;
- The public roadways shall be designed to safely convey the greater of the 100-year or the Regional flows from all contributing areas;
- Minor drainage system shall be designed for the 5-year storm event using the Modified Rational Method and City of Barrie IDF curves;
- Modified Rational Method formula:
    - Q = 2.78 CIA/1000, where
        - Q: flow rate in m^3/s
        - C: runoff coefficient (dimensionless)
        - I: rainfall intensity in mm/hr
        - A: area in ha

Storm sewer design shall be based on City of Barrie Rainfall Intensity Curve with a Time of Concentration of 10 minutes. The formula expressed as $I = A / (t+B)^c$, where I is rainfall intensity in mm/hr and t is time in minutes. The parameters for the 2-year to 100-year storm events are provided in **Table 4.1** below:

Table 4.1: City of Barrie Rainfall Intensity Parameters

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
A	678.085	853.608	975.865	1146.275	1236.152	1426.408
B	4.699	4.699	4.699	4.922	4.699	5.273
C	0.781	0.766	0.760	0.757	0.751	0.759

Phosphorus Loading:

- NVCA Guidelines require a maximum allowable post-development phosphorus loading of 100% pre-development loading, and best efforts to an additional 20% reduction beyond this level. However, NVCA does recognize that in some circumstances, this 20% reduction cannot be achieved and therefore, NVCA requires that the TP load at post development condition, at least matches with that of pre-development;
- NVCA Phosphorus Budget tool shall be used to calculate both pre- and post-development phosphorus loading based on land use;

Volume Control:

- The NVCA Guideline does not have a requirement for volumetric control. However, during the completion of the SIS study, it was agreed that the SIS lands will recommend similar volumetric control to the Lake Simcoe Region Conservation Authority (LSRCA) Guideline *2.2.2* to the extent possible;

Water Balance:

- Use best management practices to satisfy pre-development infiltration volumes;
- Aim to provide 25 mm of retention and infiltration for the recreational centre and school blocks, with 5 mm of infiltration to be provided at a minimum;

Operation and Maintenance Manual:

- An operation and maintenance manual shall be prepared and submitted in accordance with the City of Barrie Guidelines.

4.3 Proposed Stormwater Management Scheme

For the subject site, the minor system will convey stormwater runoff from storms up to and including the 5- year design storm to the SWM Pond. Stormwater runoff in excess of the minor system up to the flows generated from the 100-year storm event will be conveyed along the major system towards the SWM Pond. The proposed stormwater infrastructure is illustrated in **Figure**

4.3. Please refer to the proposed servicing and grading plan attached in **Appendix E**. As per City guidelines, sump pumps will be connected to grade. Storm sewers will be designed as per the City of Barrie design criteria, additional information regarding the storm sewers can be found in the detailed design.

It is proposed in the SIS for the Salem Annex Lands to provide stormwater quality and quantity control for the subject site through the use of an end-of-pipe stormwater management pond (referred to as SWM Pond C) as shown in **Figure 4.2**. SWM Pond C is proposed to discharge to Thornton Creek. The following section provides preliminary design details for the SWM Pond.

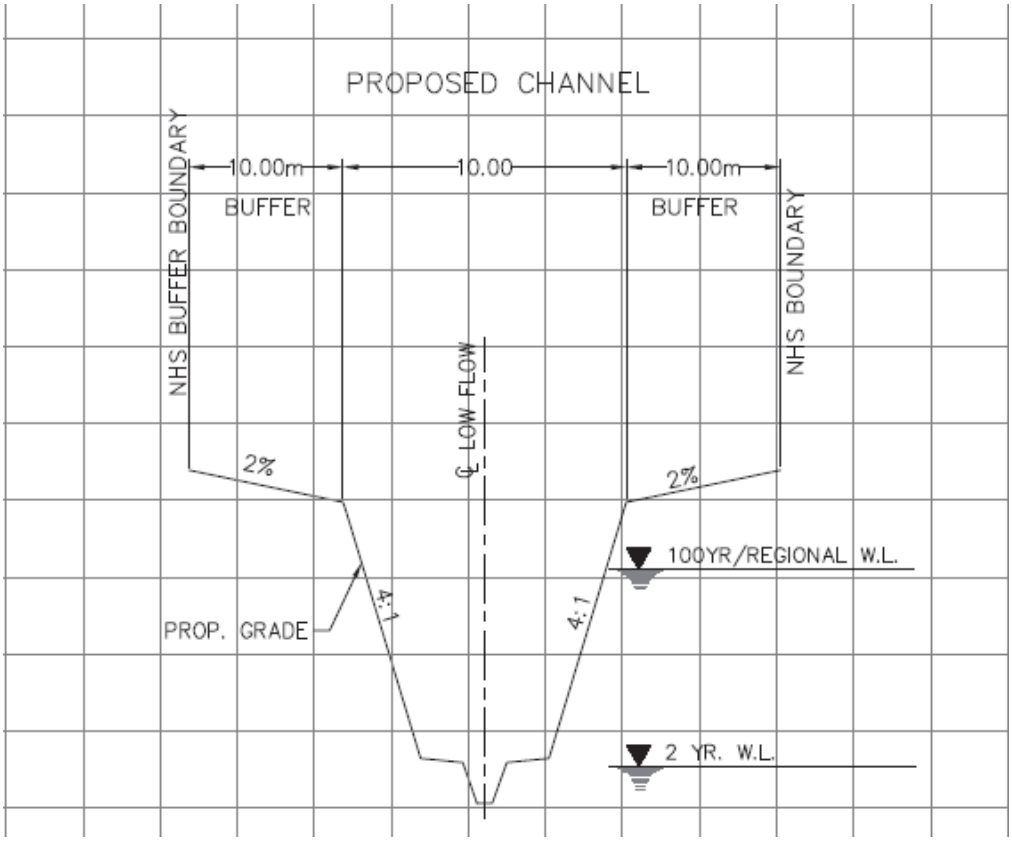
Additionally, the subject site will include the use of Low Impact Development (LID) techniques to mitigate water balance concerns and improve stormwater quality. This site is proposed to include an infiltration bed within the wet cell of the SWM Pond. The infiltration bed will help achieve infiltration needs as outlined in the Water Balance (matching post-development infiltration volumes to pre-development levels) and Volume Control (retention of 25 mm runoff during a storm event) criterion, as well as help improve water quality to meet Phosphorus Loading guidelines (matching post-development TP load with pre-development levels, ideally reducing TP by 20%), as provided by NVCA.

4.4 Thornton Creek Floodplain and Engineered Channel

A hydraulic analysis of Thornton Creek was conducted as part of a Flood Plain Study entitled *"Floodplain Analysis Report, Salem Secondary Plan – Annexed Lands, City of Barrie"* by Schaeffer and Associates Ltd. in December of 2017. This study was appended in the Salem SIS. An engineered channel was proposed along the western NHS area to convey storm drainage towards the branch of Thornton Creek, please reference **Appendix A** (PDF pages 88-95). This channel shall be designed to have a baseflow channel, a 2-year conveyance channel and an adjacent floodplain in accordance with natural channel principles. The engineered channel shall be designed for the greater of the 1:100-year design storm or Timmins storm event, as well as, include lined material within the baseflow and 2-year conveyance channel. As evident by the approved

conceptual design, the proposed low flow geometry of the channel will contain the 2-year flow. The channel will also include vegetated slopes with a maximum side slop of 4:1 (H:V). Please see below for a snippet of the proposed channel.

Schematic 1: Conceptual Engineered Channel



As per the approved floodplain analysis, the engineered channel shall be sized to convey a maximum of 11.12 m^3/s (100-year 4-hour Chicago). Please refer to **Appendix A** for the approved floodline drawings and channel flow results from HEC-RAS. Additionally, a road crossing of the NHS is proposed to connect the planned future subdivision west of the subject site. The subdivision road crossing is proposed to be a 3.66m x 1.52m CON/SPAN culvert as per the approved analysis. At the inlet of the culvert, the channel has a maximum flow of 7.57 m^3/s (100-year 4-hour Chicago), thus, the culvert shall be sized to convey a maximum of 7.57 m^3/s. The final design of

the crossing will be completed during the design of the road. Furthermore, any works regarding the environmental and erosion analysis shall be conducted during the detailed design stage.

4.5 SWM Pond C Design

The purpose of this section is to demonstrate that the proposed SWM Pond is designed to provide sufficient stormwater quality, quantity, and erosion control in accordance with the City of Barrie, NVCA and MECP requirements.

The SWM Pond has been designed with the following objectives:

- Ensure Enhanced (Level 1) water quality protection;
- Use water quantity control as per pre-development flow rates;
- Ensure erosion control is based on Table 4.4.15 of the DSWMMP;
- Provide an infiltration cell to satisfy volume control (25 mm retention), phosphorus loading reduction (match pre- to post-development TP loads) and water balance (match pre- to post-development infiltration volumes) requirements;

SWM Pond C is proposed to be located at south boundary of the Salem lands, between Thornton Creek East and West, within Phase 2. The SWM Pond C block is located within Innisfil lands owned by DG Group. The location of Pond C is shown in **Figure 4.2**. Please note that SWM Pond C is subject to future studies which may alter the design, such as slope stability and groundwater impacts, prior to finalizing the design.

4.5.1 Allowable Release Rates

The allowable release rates for this facility were guided by the pre-development drainage area. As per the approved hydrologic model from the SIS, 9045 is proposed to be the outlet node for the entire site, with contributing catchments being 523, 528, 545, and 546, as demonstrated in **Figure 6-3** of the SIS (**Appendix A**). However, due to detailed analysis of the existing topography and drainage conditions, it was determined that 3.56 ha of catchment 546, 8.76 ha of catchment 523 and 3.19 ha of catchment 528 drain into node 9045, resulting in an area of 15.51 ha. Catchments 546, 523 and 528 are sloped towards node 9045 in existing conditions and are considered as

contributing drainage areas for calculating allowable release rates. As per the post-development drainage plan in the SIS, node 9045 would be the outlet for SWM Pond C because of its proximity. Pre-development peak flows discharging into 9045 can be found in **Table 4.2** below.

The storm distribution which resulted in the largest volume requirement was chosen for modelling purposes as it would also account for all other storm events. As concluded in the AMEC DWSMMP, and in the SIS, the 24-hour SCS storm distribution resulted in the highest volumetric requirements.

Table 4.2: Allowable release rates for SWM Pond C (24HR SCS, 12HR SCS, 6HR SCS & 4HR Chicago Storm)

Return Period	24-HR SCS TYPE II Allowable Release Rates (m^3/s)	12-HR SCS TYPE II Allowable Release Rates (m^3/s)	6-HR SCS TYPE II Allowable Release Rates (m^3/s)	4-HR CHICAGO Allowable Release Rates (m^3/s)
2-Year	0.186	0.158	0.148	0.102
5-Year	0.353	0.305	0.304	0.201
10-Year	0.481	0.421	0.426	0.281
25-Year	0.658	0.582	0.600	0.396
50-Year	0.799	0.712	0.740	0.484
100-Year	0.946	0.846	0.888	0.583

4.5.2 Proposed Drainage Area

The proposed catchment area for Pond C is 28.25 ha and it is primarily composed of residential areas with a minor high-density townhouse area, a school, and a recreational centre. The calculated composite imperviousness for this drainage area is 71%. It is to note that a portion of Mckay Road is proposed to be diverted to this SWM Pond. A table summarizing the drainage area land uses can be found in **Table 4.3**.

Table 4.3: Post-Development Drainage Area Summary

Land Use	Area (ha)	Imperviousness (%)
Residential Detached House (Mix)	7.93	60
Townhouses	1.06	86
SWM Pond C	2.78	50
School	2.42	79
Recreational Centre	8.10	79
ROW	5.03	79
External ROW (McKay Rd)	0.93	80
TOTAL	**28.25**	**71**

4.5.3 Erosion Control

As discussed in **Section 4.2,** erosion control target release rates and retention volumes are set as per Table 4.4.15 of the DSWMMP. **Table 4.4** demonstrates the proposed erosion control targets for SWM Pond C. Detailed Calculations can be found in **Appendix B**.

Table 4.4: SWM Pond C Erosion Control Requirements

Parameter	Value
Drainage Area (ha)	28.25
Erosion Control Volume (m^3)	8,625
Erosion Control Peak Release Rate (m^3/s)	0.047
Subwatershed	Thornton Creek
Reach	THO1

Necessary details on the required outlet control structure and orifice to meet target release rates for erosion control will be provided in the detailed design stage.

4.5.4 Quantity Control

Quantity control targets are based on pre-development release rates calculated using a pre-development drainage area of 15.51 ha, as summarized in **Table 4.2**. The allowable release rates

established in **Section 4.5.1** above were used to find the required active storage volume within SWM Pond C, as seen in **Table 4.5**. As recommended in the AMEC DWSMMP, and the Salem SIS, a 24-hour SCS Type II was used to size the SWM Pond, as the 24-hour SCS generates the largest volume, hence satisfying all other storm events.

Table 4.5: Allowable release rates and required storage for SWM Pond C

Return Period	24-HR SCS TYPE II		12-HR SCS TYPE II		6-HR SCS TYPE II		4-HR CHICAGO	
	Allowable Release Rate (m^3/s)	Required Storage (m^3)	Allowable Release Rate (m^3/s)	Required Storage (m^3)	Allowable Release Rate (m^3/s)	Required Storage (m^3)	Allowable Release Rate (m^3/s)	Required Storage (m^3)
2YR	0.186	9,300	0.158	8,880	0.148	8,780	0.102	8,625
5YR	0.353	12,390	0.305	11,460	0.304	11,570	0.201	10,400
10YR	0.481	14,680	0.421	13,480	0.426	13,670	0.281	12,030
25YR	0.658	17,540	0.582	16,080	0.600	16,350	0.396	14,090
50YR	0.799	19,670	0.712	18,060	0.740	18,350	0.484	15,570
100YR	0.946	21,790	0.846	19,980	0.888	20,360	0.583	17,020

4.5.5 Quality Control

Quality control will be provided by the Permanent Pool sized to provide 80% TSS removal for Enhanced level of removal. The required water quality storage and permanent pool volumes were calculated corresponding to the 2003 MECP SWMPD manual and seen in **Table 4.6**. Please refer to **Appendix B** for detailed calculations.

Table 4.6: SWM Pond C Water Quality Requirements

Parameter	Value
Level of Protection	1 (enchanced)
Drainage Area (ha)	28.25
Total Imperviousness (%)	71
Required Permanent Pool Volume (m^3)	5,292
Provided Total Volume (m^3)	9,960

Table 4.7: Summary of Proposed SWM Facility

Parameter	Value
SIS Pre-Development Area (ha)	15.51
Drainage Area (ha)	28.25
Impervious Area (%)	71
Permanent Pool Storage (m^3) (Required)	5,292
Permanent Pool Storage (m^3) (Provided)	9,960
Erosion Control Average Release Rate (m^3/sec)	0.031
Erosion Control Peak Release Rate (m^3/sec)	0.047
Erosion Control Storage (Required) (m^3)	8,625
100 Year Storm Storage (Required) (m^3)	21,790
100 Year Storm Storage (Provided) (m^3)	22,664
Governing Storm	SCS 24hr
100 Year Target Release Rate (m^3/s)	0.946

4.6 Volume Control

The NVCA does not have a clear criterion for volumetric control. However, during the completion of SIS study, an agreement was made that the SIS lands will recommend similar volumetric control to the Lake Simcoe Region Conservation Authority (LSRCA) Guidelines. The LSRCA guideline requires the retention of 25 mm of runoff from Major Developments as per the Lake Simcoe Protection Plan (LSPP), dated July 2009. The creation of four or more lots, the construction of a building or buildings within a ground floor area of 500 m^2 or more, or the establishment of a major recreational use is defined as a major development by the LSPP. Water must be retained on site to be infiltrated, filtrated or re-used whilst still being able to capture the next rainfall event, in order to meet this criterion. The following sub-sections discuss the mitigation measures to meet the volumetric targets of areas draining to SWM Pond C.

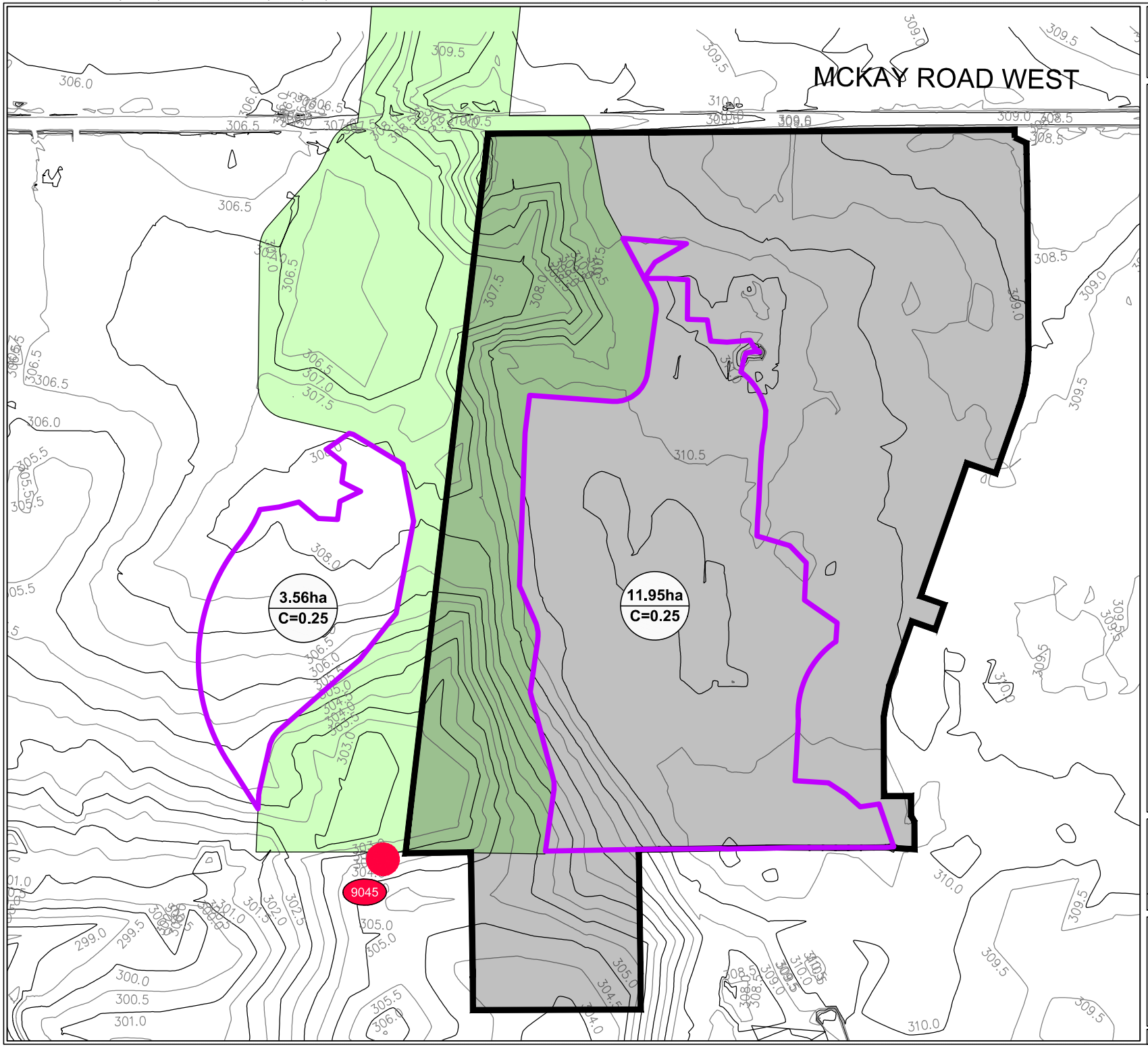
The total retention target for the proposed subdivision is calculated based on the proposed developable land with an area of 16.80 ha. It is to note that the area of the proposed recreational centre and school blocks are not included in this area, as they will aim to provide 25 mm of retention within their respective sites, with an absolute minimum of 5 mm infiltrated on site. Moreover, the external portion of Mckay Road that is proposed to be diverted to this SWM Pond

is also not included. Nevertheless, a preliminary volume control target of 25 mm retention results in retention targets of:

- 1,599.75 m^3 {8.10 ha x 0.79 imp x 25 mm x 10} for the recreational centre, and 477.95 m^3 {2.42 ha x 0.79 imp x 25 mm x 10} for the school block
- 2,772.00 m^3 {16.80 ha x 0.66 imp x 25 mm x 10} for the rest of the subdivision

Due to the favorable soil conditions for onsite retention and infiltration, as provided by EXP's hydrogeological studies, the volume targets will be met through the implementation of LIDs that will facilitate infiltration. Topsoil amendment is proposed in the front and rear yards of residential lots to provide additional infiltration and contribute towards the volume control requirement. A 150 mm topsoil amendment results in 2,125 m^3 {3.54 ha x 150 mm x 10 x 0.40} of soil retention capacity. However, to remain consistent with the LID manual by the Toronto and Region Conservation Authority (TRCA), topsoil amendment is credited 25% retention of the runoff volume from downspout disconnection of proposed roofs (4.82 ha), which is 271 m^3 {4.82 ha x 25 mm x 10 x 0.90 x 25%}. Furthermore, an infiltration bed is proposed in the SWM pond to satisfy the remaining of the volume control requirement. This infiltration bed is sized to retain 25 mm from 16.80 ha of the developable area and have a footprint of 2400 m^2 (average) with a drawdown time of 69 hours. This drawdown time was calculated by dividing the required retention volume of 2,501 m^3 {2772 m^3- 271 m^3} by an infiltration flux of 36 m^3/hr (infiltration rate of 38 mm/h), detailed calculations can be found in **Appendix B**. Please note that the infiltration rate (used to find infiltration flux) is the same as the adjacent subdivision to the east (Watersands Phase 1) because of the subject site's proximity and similar soil conditions. However, future in-situ testing will be conducted and the infiltration flux, along with the required footprint area, will be adjusted accordingly. Additionally, meeting the Volume Control requirement would also satisfy the Water Balance infiltration needs, as well as, improving the water quality and reduce Phosphorus Loading.

Phil Gotfried



WATERSAND RESIDENTIAL SUBDIVISION
PHASE 2 SALEM SECONDARY PLAN AREA
CITY OF BARRIE

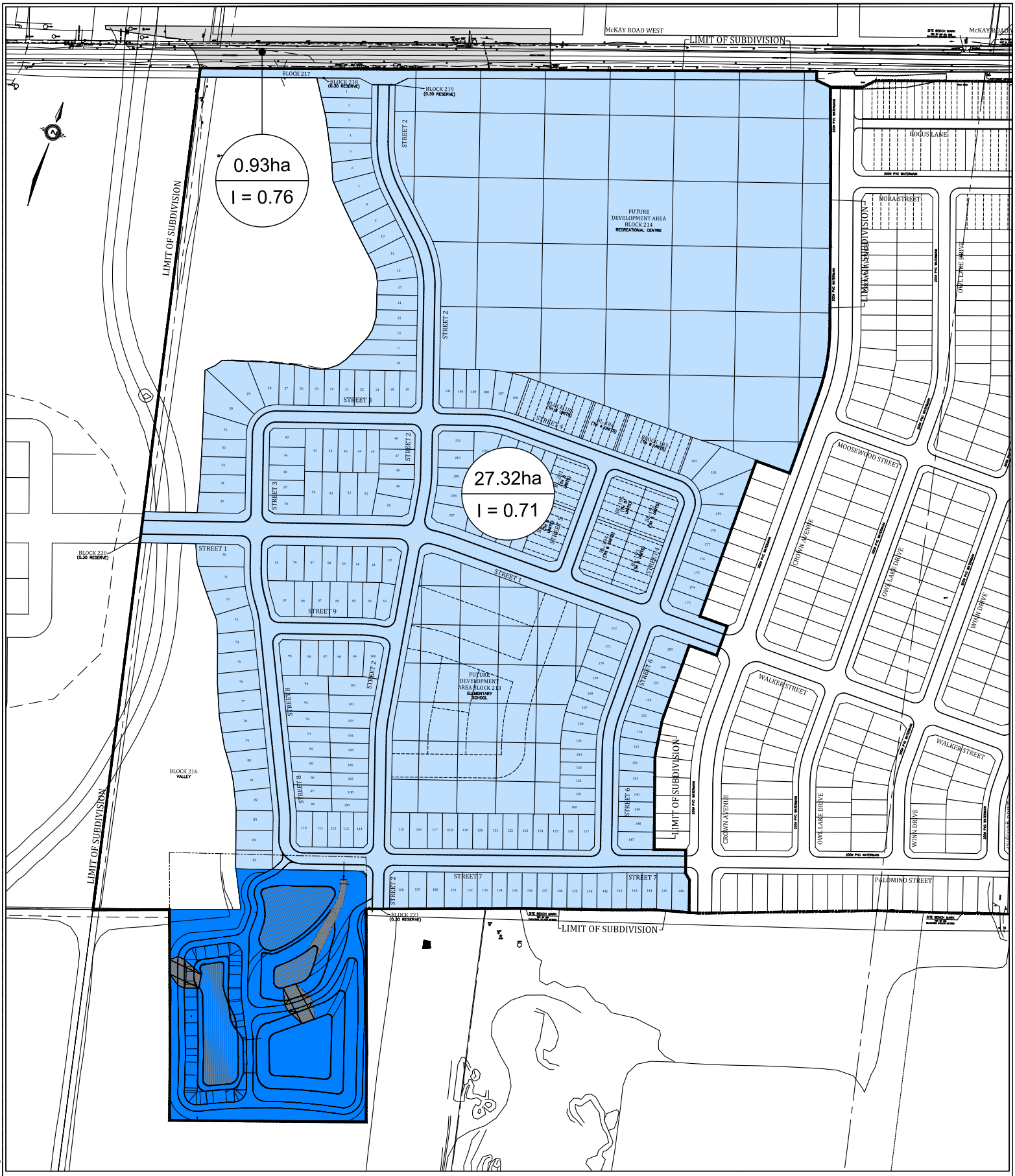
LEGEND

- SUBJECT AREA
- NATURAL HERITAGE SYSTEM
- PRE DEVELOPMENT CATCHMENTS BOUNDARY
- NODE LOCATION
- 9017 NODE ID

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE 4-1
PRE-DEVELOPMENT DRAINAGE AREA

2022-5184	JUNE 2022	SCALE: N.T.S.



WATERSAND RESIDENTIAL SUBDIVISION - PHASE 2 SALEM SECONDARY PLAN AREA
CITY OF BARRIE

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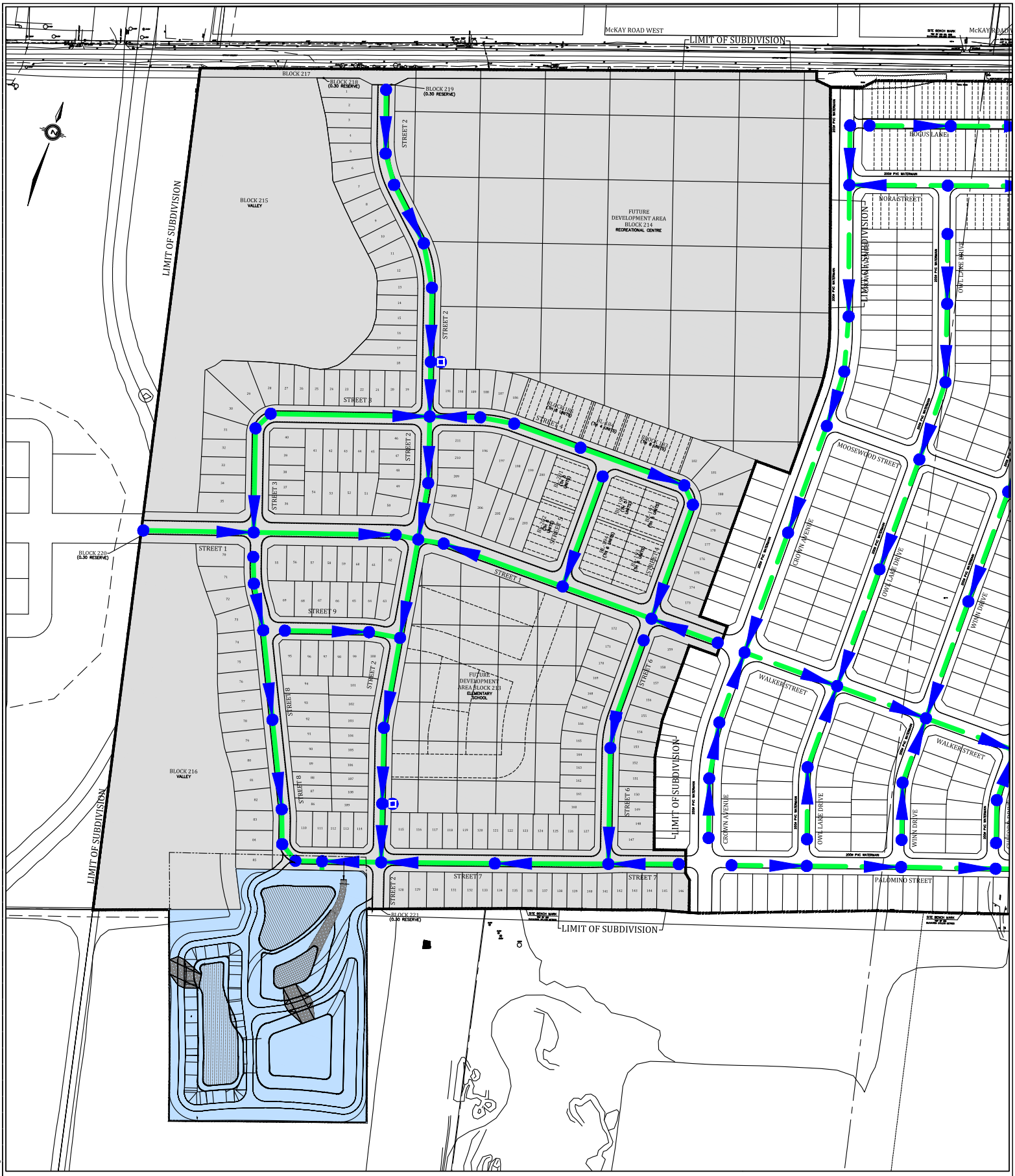
LEGEND

- WATERSAND SUBDIVISION PHASE 2 (SUBJECT AREA)
- PROPOSED SWM POND 'C'
- PROPOSED DRAINAGE AREA
- EXTERNAL DRAINAGE AREA

FIGURE 4.2
POST-DEVELOPMENT
DRAINAGE PLAN

2022-5184	JUNE 2022	SCALE:

Phil Gelfried
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WATERSAND RESIDENTIAL SUBDIVISION - PHASE 2 SALEM SECONDARY PLAN AREA
CITY OF BARRIE

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Tel: (905) 738-6100 Email: general@schaeffers.com
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LEGEND

- WATERSAND SUBDIVISION PHASE 2 (SUBJECT AREA)
- PROPOSED SWM POND 'C' BLOCK
- PHASE 2 STORM SEWERS
- PHASE 1 STORM SEWERS

FIGURE 4.3
STORM SERVICING PLAN

2022-5184	JUNE 2022	SCALE:

Phil Gelfried
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4.7 Total Phosphorous Reduction Criteria

As the subject site is in the NVCA jurisdiction, the following criteria applies:

- The target within the NVCA is based on their Stormwater Technical Guide, Dated December, 2013. NVCA prefers that at all new development's TP load at post development stage is reduced by 20% from that of predevelopment. However, NVCA recognizes that in some circumstances, this target cannot be achieved and therefore, at least, NVCA requires that the TP load at post development stage matches with that of pre-development.

The phosphorous control for the subject site was applied to the post-development drainage area of SWM Pond C excluding the recreational centre and school blocks. These individual sites are proposed to investigate a site-specific phosphorus control strategy during the Site Plan Application (SPA) process. Pre-development targets were set by the expected annual phosphorous loads for the drainage area based on existing land cover. The phosphorous analysis was conducted using the recommended Phosphorus Budget Tool by the NVCA. Detailed calculations are provided in **Appendix B**.

During post-development conditions, the land cover is expected to be more impervious, and the phosphorous load output is expected to increase due to construction materials of roads, roofs and fertilizer (lawns). Based on loading rates outlined in the NVCA tools, the annual post development phosphorous load is calculated and found in **Table 4.8**.

Table 4.8: SWM Pond C Phosphorus Loading Summary

SWM Pond C – Drainage Area	
Drainage Area (ha)	16.80
Pre-Development Annual Load (Kg/yr)	2.71
Post-Development Annual Load (Kg/yr)	6.92
P Load Deficit (Kg/yr)	4.21

Mitigation measures for the drainage area will be provided via a treatment train approach through the use of a SWM Pond, and an infiltration bed within the SWM Pond. These LID techniques were selected based on the grading, groundwater table and spatial constraints at the subject site.

Considering these limitations, the LID's summarized in **Table 4.9** are deemed the most feasible. Additional details regarding the LID's will be further explained n the detailed design stage.

Table 4.9: Feasible LID Measures

Area ID	Mitigation Measures 1	Mitigation Measure 2
SWM C	SWM Pond (63%)	Infiltration Bed (60%)

The TP mitigation rates for the above-mentioned LID's were based on the Phosphorous Budget Tool. As demonstrated in **Table 4.10**, post-development loads can be reduced to pre-development levels based on the proposed mitigation measures for the subject site. For the drainage area of SWM Pond C, the total area will receive treatment from the SWM Pond, as well as, infiltration within the SWM Pond. The intention of these mitigation measures is to ensure that the total annual phosphorous loads, as a result of the development adjacent to Thornton Creek, can be successfully reduced by 20% compared to pre-development TP loads. At the very least, the NVCA requires the post-development TP loads to match pre-development levels. The total pre-development annual load for the total area of 16.80 ha is 2.71 kg/yr. The proposed TP mitigation measures will reduce the post-development annual load to 0.56 kg/yr; a 79% TP reduction from pre-development condition. Please refer to **Table 4.10** for pre-development and post-development (with mitigation) annual load comparison. Please see **Appendix B** for detailed Phosphorus loading calculations.

Table 4.10: Post-Development Phosphorous Load Summary

Area ID	Pre-Development Annual Load (Kg/yr)	Post-Development after Mitigaton Annual Loads (Kg/yr)	TP Reduction (Pre to Post) (%)
SWM C	2.71	0.56	79.34

4.8 Water Balance

The water balance analysis for the subject site was conducted for a total developable area of 27.32 ha, as 0.93 ha of external ROW of McKay Road draining into SWM Pond C was excluded. Please note that the NHS Valley was not included in the water balance as the valley will remain undeveloped.

The primary target of this water balance was to estimate appropriate measures required to meet pre-development infiltration to maintain groundwater recharge. As per Source Water Protection Atlas, the subject site (Residential and Employment Lands) is not within a Wellhead Protection Area. An annual precipitation of 933 mm, and an annual evapotranspiration of 597 mm was calculated for the water balance analysis using precipitation data from 1978-2006 Barrie WPCC Station by Environment Canada. For pervious areas, the MECP infiltration factor was calculated to be 0.65 [Rolling to Flat Land (0.25) + Sandy Loam (0.3) + Cultivated Land (0.1)]. This calculation is in conformance with an existing hydrogeological assessment conducted by R.J. Burnside for the Salem Secondary Plan Area.

The pre-development condition has an annual infiltration, evapotranspiration, and surface runoff of 59,667 m^3, 163,100 m^3, and 32,128 m^3, respectively. The water balance analysis reveals that without infiltration measures, the post-development infiltration is reduced to 17,903 m^3. To match the pre-development target, it is proposed to utilize best management practices to optimize infiltration. An infiltration cell is proposed within SWM Pond C to meet the volumetric control needs of the site. Expectedly, having to size the infiltration bed to meet the 25 mm volume retention targets results in sufficient capacity to meet water balance demands. Moreover, the backyards and front lawns of detached residential lots will be utilized for topsoil amendment, further increasing infiltration. Please note that the recreational centre and school blocks should aim to retain and infiltrate runoff from a 25 mm event on site, with 5 mm being the minimum. As revealed through the analysis, only a 2.6 mm event is required to be infiltrated within the subdivision area to satisfy the Water Balance.

Please refer to **Appendix B** for a detailed analysis on water balance.

Table 4.11: Water Budget – Summary Table

Characteristics	Site				
	Pre-Development	Post-Development	Change (Pre to Post)	Post-development with mitigation	Change (pre to post with mitigation)
Inputs (Volumes)					
Precipitation (m^3/year)	254896	254896	0%	254896	0%
Total Inputs (m^3/year)	254896	254896	0%	254896	0%
Outputs (Volumes)					
Precipitation surplus (m^3/year)	91795	188116	105%	188116	105%
Net Surplus (m^3/year)	91795	188116	105%	188116	105%
Total Evapotranspiration (m^3/year)	163100	66780	-59%	72711	-55%
Total Infiltration (m^3/year)	59667	17903	-70%	61490	3%
Total Runoff (m^3/year)	32128	170213	430%	120694	276%
Total Outputs (m^3/year)	254896	254896	0%	254896	0%

5 EROSION AND SEDIMENT CONTROL

Sediment and erosion control measures are generally used to minimize the effects of erosion from the construction site. The list below provides potential erosion and sediment control measures that can be implemented during construction. The proposed preliminary ESC plan is attached in **Appendix D**. Detailed ESC plans along with an ESC report will be presented at the appropriate stages.

- Environmental fencing (Double silt fence with strawbaled in between);
- Cut off swales;
- Sediment traps;
- Filtrexx Siltsoxx;
- Mud mats for access roads;
- Temporary sediment ponds (Including appropriate outlet protection and turbidity control);
- Pump

At a later stage, a site alteration report shall be submitted in accordance with City of Barrie and NVCA guidelines.

6 CONCLUSIONS

This Functional Servicing Report presents a municipal servicing scheme for the proposed Watersand Phase 2 subdivision located within the Salem Annexed Lands in the City of Barrie.

Stormwater Management

A SWM Pond (SWM Pond C) is proposed to provide water quantity, quality and erosion control. An area of 28.25 ha drains to SWM Pond C, which includes a 0.93 ha of external ROW area. An infiltration cell is proposed within the pond to achieve water balance (matching pre- to post-development infiltration), phosphorus loading (matching pre- to post-development TP load, ideally reduction of 20% from pre-development conditions) and volume control (retention of 25 mm of runoff during a storm event) requirements. Final SWM Pond C details shall be confirmed in the detailed design process.

For the subject site, the minor system will convey stormwater runoff from storms up to and including the 5- year design storm to the SWM Ponds. Stormwater runoff in excess of the minor system up to the flows generated from the 100-year storm event will be conveyed via the major system and controlled by the SWM Pond. Storm sewer sizing shall be confirmed through the detailed design process.

Sanitary Servicing

The wastewater servicing plan for SSP lands was initially addressed in the Barrie's Wastewater Collection Master Plan (WCMP) for Intensification Areas and Annexed Lands, prepared by AMEC (October 2013). A phased sanitary servicing plan is proposed for the subject site. The ultimate sanitary servicing plan is to service the subject site by the trunk sewers along McKay Road to Huronia Road. Internal sanitary sewer sizing shall be confirmed through the detailed design process.

Water Supply

The site is located in Pressure District PD3S. The proposed development will connect to the future watermains intended to be in place along Mckay Road West and the Watersand Phase 1 development to the east as shown on **Figure 2.1**. Internal watermains sized 200 mm and 300 mm

were determined to be appropriate for this site. As per the AMEC Master Plan, Phase 2 development requires a pumping station and a storage facility in order to satisfy the water volume demands. These facilities are proposed to be at the southeast quadrant of Salem Road and Veteran's Drive. Internal watermain sizing shall be confirmed through the detailed design process.

Should you have any questions or comments please do not hesitate to call the undersigned.

Respectfully Submitted,

SCHAEFFER & ASSOCIATES LTD.

LICENSED PROFESSIONAL ENGINEER
S. N. R. KATUKURUNDE WELLALAG
100554812
11/01/2023
PROVINCE OF ONTARIO

Howie Liu, E.I.T, B.Eng.
Water Resources Analyst

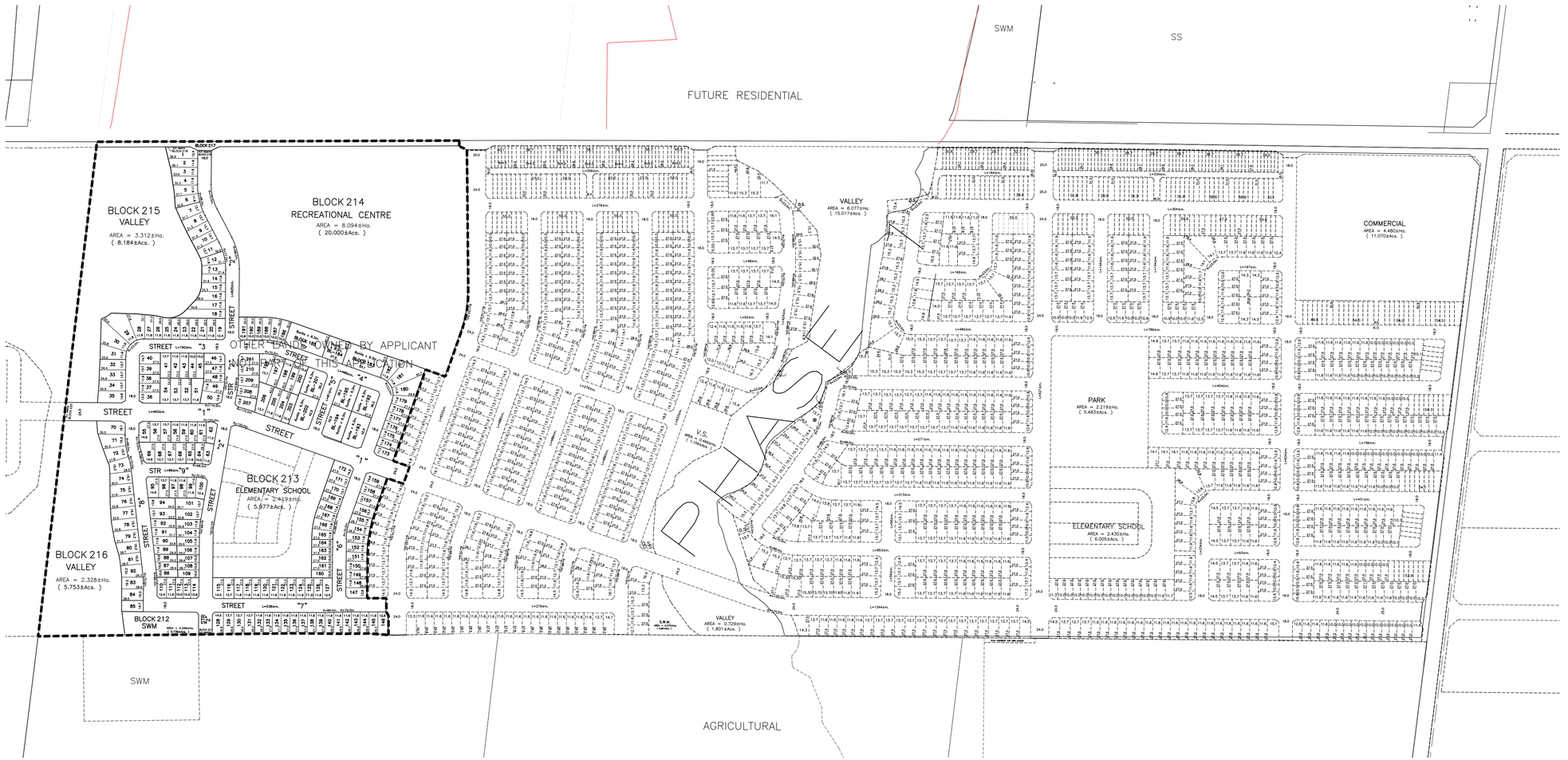
Sadh Katukurunde, P.Eng.
Water Resources Engineer

APPENDIX A: BACKGROUND

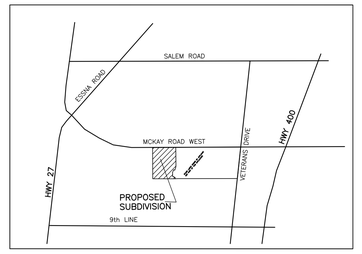
Draft Plan

DRAFT PLAN OF SUBDIVISION
PART OF THE NORTH HALF OF LOT 3, ALL OF THE NORTH HALF OF LOT 4 AND PART OF LOT 5, CONCESSION 9
(GEOGRAPHIC TOWNSHIP OF INNISFIL)
CITY OF BARRIE
COUNTY OF SIMCOE

SCALE 1:2000



DRAFT PLAN T–



KEY PLAN

SECTION 51, PLANNING ACT, ADDITIONAL INFORMATION

A. AS SHOWN ON DRAFT PLAN
B. AS SHOWN ON DRAFT PLAN
C. AS SHOWN ON DRAFT PLAN
D. SEE SCHEDULE OF LAND USE
E. AS SHOWN ON DRAFT PLAN
F. AS SHOWN ON DRAFT PLAN
G. AS SHOWN ON DRAFT PLAN
H. MUNICIPAL PIPED WATER AVAILABLE AT TIME OF DEVELOPMENT
I. CLAY–LOAM
J. AS SHOWN ON DRAFT PLAN
K. SANITARY AND STORM SEWERS, GARBAGE COLLECTION, FIRE PROTECTION
L. AS SHOWN ON DRAFT PLAN

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED AS SHOWN ON THIS PLAN, AND THEIR RELATIONSHIP TO THE ADJACENT LAND ARE ACCURATELY AND CORRECTLY SHOWN.

DATE ----------

GARY B. VANDERVEEN
ONTARIO LAND SURVEYOR

HOLDING JONES VANDERVEEN INC.

OWNER'S CERTIFICATE

I AUTHORIZE KLM PLANNING PARTNERS INC. TO PREPARE AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION TO THE CIITY OF BARRIE FOR APPROVAL.

OWNER

WATERSAND CONSTRUCTION LTD.

C/O

DG GROUP
30 FLORAL PARKWAY
SUITE 300
CONCORD, ONTARIO
L4K 4R1

ROBERT De GASPERIS
A.S.O.

SCHEDULE OF LAND USE

TOTAL AREA OF LAND = 119.032±Ha. (294.134±Acs.)

PHASE 2

TOTAL AREA FOR PHASE 2 = 30.468±Ha. (75.288±Acs.)

	BLOCKS	LOTS	UNITS	±Ha.	±Acs.
LOTS FOR SINGLE FAMILY DWELLINGS					
LOTS 12–16, 22–30 and 65–79 MIN. LOT FRONTAGE=15.3m. MIN. AREA=420.75sq.m.		29	29	1.630	4.028
LOTS 5–11, 17–21, 34–36, 41, 47–52, 61–64, 80, 88–91, 96, 97, 129–132, 162–165, 167, 171, 172, 176–178, 185–190 and 194–196 MIN. LOT FRONTAGE=13.7m. MIN. AREA=376.75sq.m.		56	56	2.379	5.879
LOTS 1–4, 31–33, 37, 38, 42–46, 53–56, 60, 84–87, 92–95, 98–101, 105, 106, 118–128, 133–144, 166, 168, 169, 173, 179–184, 191–193 and 197–199 MIN. LOT FRONTAGE=11.6m. MIN. AREA=319.0sq.m.		72	72	2.681	6.625
LOTS 39, 40, 57–59, 81–83, 102–104, 107–109, 113–117, 145–161, 170, 174, 175, 200 and 201 MIN. LOT FRONTAGE=10.0m. MIN. AREA=275.0sq.m.		41	41	1.275	3.150
MEDIUM DENSITY					
STREET TOWNHOUSES					
BLOCKS 110–112 and 202–205 MIN. UNIT FRONTAGE=6.3m.	9		54	1.009	2.493
SUBTOTAL	9	202	255	8.974	22.175
BLOCK 212 – S.W.M.	1			0.299	0.739
BLOCK 213 – ELEMENTARY SCHOOL	1			2.419	5.977
BLOCK 214 – RECREATIONAL CENTRE	1			8.094	20.000
BLOCKS 215 and 216 – VALLEY	2			5.640	13.937
BLOCK 217 – ROAD WIDENING	1			0.347	0.858
BLOCKS 218 – 221 – 0.3m. RESERVE	4			0.002	0.005
STREETS				4.693	11.597
24.0m. WIDE TOTAL LENGTH= 463.6m. AREA= 1.111±Ha. 18.0m. WIDE TOTAL LENGTH= 1990.0m. AREA= 3.582±Ha.					
TOTAL TOTAL LENGTH= 2453.6m. AREA= 4.693±Ha.					
TOTAL	19	202	255	30.468	75.288

NOTE – ELEVATIONS RELATED TO CANADIAN GEODETIC DATUM

KLM PLANNING PARTNERS INC.
64 JARDIN DRIVE - UNIT 1B, CONCORD ONTARIO L4K 3P3
TEL: (905) 669-4055 FAX: (905) 669-0097 design@klmplanning.com

Planning ● Design ● Development

PROJECT No. P-2899

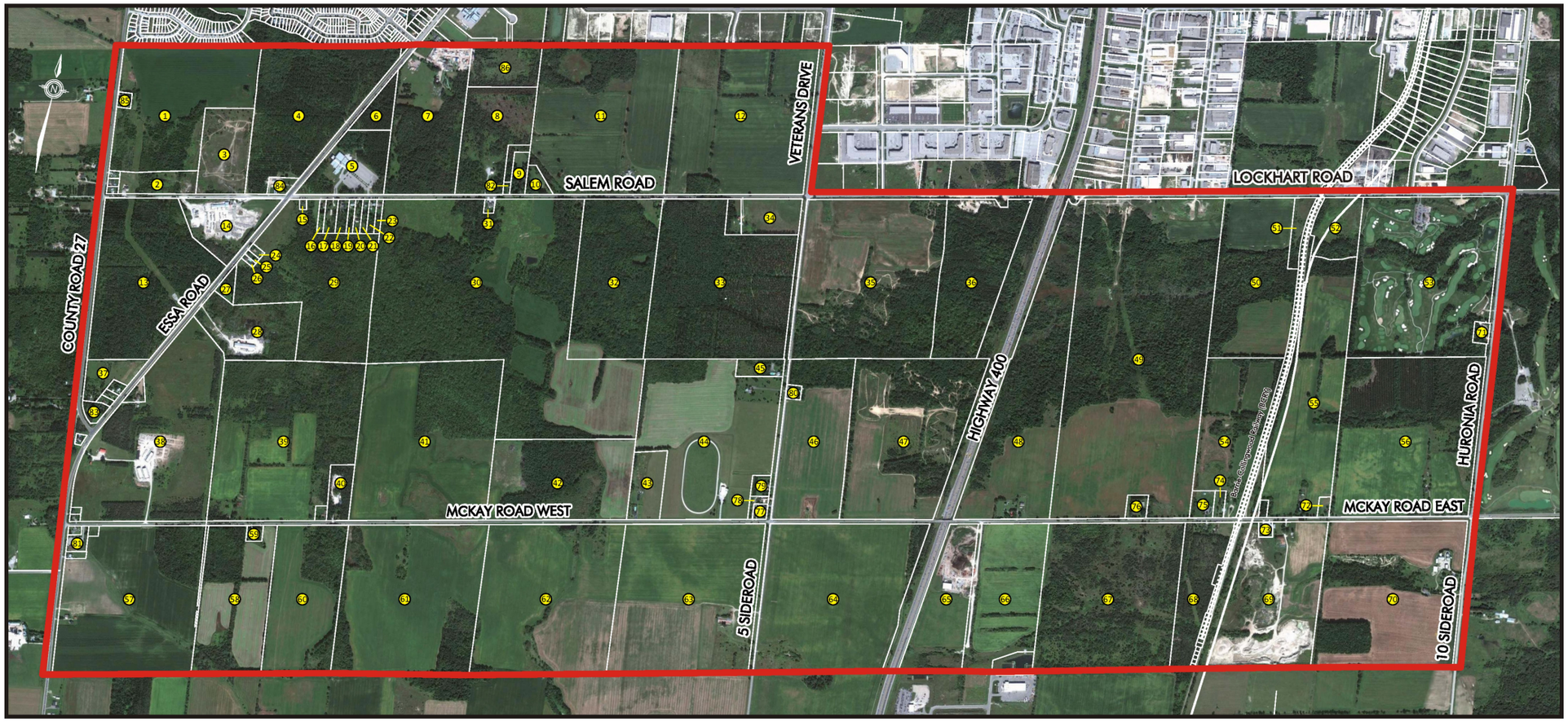
SCALE 1:2000 JUNE 19, 2020

(2899DES4) X-REF: (2899MAS2 & 2899TOPO)

DWG. No. - 20:3

Land Ownership

SALEM OWNERSHIP MAP



DIRECTORY

1. - DI POCE (INNISFIL) INC (P)
8001 Country Road 27
2. - BERRY, BRUCE
500 Salem Road
3. - DIRECTOR MUNICIPAL SUBSIDIES
450 Salem Road
4. - BARRIE FINANCIAL INC (P)
851 Essa Road
5. - EMMANUEL BAPTIST CHURCH OF BAR
374 Salem Road
6. - EMMANUEL HOLDINGS (BARRIE) INC
850 Essa Road
7. - MCCLYMONT, JENNIFER (P)
800 Essa Road
8. - HONEYWOOD LAND CORPORATION (P)
3944 Salem Road
9. - LACASSE, NATALIE NOELLA
264 Salem Road
10. - WIGHT, BRIAN MICHAEL
260 Salem Road
11. - WIGHT, THERESA K
200 Salem Road
12. - BELKER HOLDINGS LIMITED
700 Veteran's Drive
13. - CRISDAWN CONSTRUCTION INC (P)
1001 Essa Road
14. - UNILOCK LIMITED (P)
441 Salem Road
15. - LORANGER, JENNIFER LYNN
399 Salem Road
16. - BEAULIEU, J GARRY
377 Salem Road
17. - MALISANI, ANTONIO SILVANO
373 Salem Road
18. - VILLECOURT, DANIEL
365 Salem Road
19. - GIRAN, STEPHEN
361 Salem Road
20. - WHITESIDE, MATTHEW
357 Salem Road
21. - THOMPSON, RITA M
353 Salem Road
22. - RODRIGUES, JAMES
349 Salem Road
23. - AUST, AMANDA
345 Salem Road
24. - TAMBLING, GLEN ROBERT
942 Essa Road
25. - MACFARLANE, CRAIG WILLIAM
948 Essa Road
26. - COULSON, ROSE MARIE
952 Essa Road
27. - VEENSTRA, JAN
980 Essa Road
28. - 796572 ONTARIO LIMITED
1000 Essa Road
29. - WORMWOOD DEVELOPMENTS INC (P)
910 Essa Road
30. - WORMWOOD DEVELOPMENTS INC (P)
259 Salem Road
31. - DALLEY, SEAN LAWRENCE
279 Salem Road
32. - 1369739 ONTARIO LIMITED
185 Salem Road
33. - COUNTY OF SIMCOE
161 Salem Road
34. - WAR HORSE HOLDINGS LIMITED
121 Salem Road
35. - WORMWOOD DEVELOPMENTS INC (P)
89 Salem Road
36. - MINISTRY OF TRANSPORTATION
19 Salem Road
37. - BOON, DIRK
7805 County Road 27
38. - TRANS CANADA POLE LTD
7735 County Road 27
39. - WATERSAND CONSTRUCTION LIMITED (P)
412 McKay Road West
40. - MARSHMAN, GLENDON GEORGE
350 McKay Road West
41. - RUBY RED MAPLE DEVELOPMENT INC (P)
300 McKay Road West
42. - H & H CAPITAL GROUP LTD. (P)
228 McKay Road West
43. - H & H CAPITAL GROUP LTD. (P)
180 McKay Road West
44. - H & H CAPITAL GROUP LTD. (P)
854 Veteran's Drive
45. - MCPHERSON, CATHERINE FLORA
844 Veteran's Drive
46. - WATERSAND CONSTRUCTION LIMITED (P)
72 McKay Road West
47. - MIAN, ABDUL QUYYUM
20 McKay Road West
48. - MIAN, QAYYUM ABDUL
36 McKay Road East
49. - MIAN, QAYYUM ABDUL IN TRUST
31 Lockhart Road
50. - WESTGARTH-TAYLOR, JUDITH ANN
111 Lockhart Road
51. - WICE, MERVIN B
135 Lockhart Road
52. - IWASJUK, IRENE
159 Lockhart Road
53. - INNISBROOK GOLF COURSE
211 Lockhart Road
54. - 1793904 ONTARIO INC
170 McKay Road East
55. - 1004260 ONTARIO INC
206 McKay Road East
56. - POPE, MONA GLADYS
280 McKay Road East
57. - WATERSAND CONSTRUCTION LIMITED (P)
7625 County Road 27
58. - WORMWOOD DEVELOPMENTS INC (P)
387 McKay Road West
59. - WORMWOOD DEVELOPMENTS INC (P)
397 McKay Road West
60. - PERTHSHIRE INVESTMENT INC (P)
373 McKay Road West
61. - WATERSAND CONSTRUCTION LIMITED (P)
301 McKay Road West
62. - WATERSAND CONSTRUCTION LIMITED (P)
229 McKay Road West
63. - WATERSAND CONSTRUCTION LIMITED (P)
980 Veteran's Drive
64. - WATERSAND CONSTRUCTION LIMITED (P)
45 McKay Road West
65. - MIAN, QAYYUM ABDUL
17 McKay Road East
66. - JULIAN HOLDINGS INC
45 McKay Road East
67. - WORMWOOD DEVELOPMENTS INC (P)
111 McKay Road East
68. - LENNOX, DONALD J
149 McKay Road East
69. - BOWMAN, LOIS CHRISTINA
197 McKay Road East
70. - HUBBERT, BRANT WILLIAM
1032 Huronia Road
71. - LAWSON, BRIAN CHARLES
872 Huronia Road
72. - CARRUTHERS, WILLIAM BURT
222 McKay Road East
73. - BICKELL, DONALD ALLAN
185 McKay Road East
74. - JAMESON, JOHN DAVID
160 McKay Road East
75. - MALTESE, LEONARD
150 McKay Road East
76. - 1045990 ONTARIO INC
110 McKay Road East
77. - MITTON, LENORA CHRISTINE
922 Veteran's Drive
78. - STELLA, JONATHAN
918 Veteran's Drive
79. - BOROS, OLGA ESTATE
910 Veteran's Drive
80. - DROPE, HARRY BRYAN
851 Veteran's Drive
81. - MAPLEVIEW CONGREGATION OF JEHO
497 McKay Road West
82. - PRATT, JAMES ROBERT
272 Salem Road
83. - TSEKOS, HELEN
1091 Essa Road
84. - EISSES, MARGARET K
901 Essa Road
85. - BRETT, PAUL JACKSON
8029 County Road 27
86. - SIMCOE MUSKOKA DISTRICT SCHOOL BOARD
740 Essa Road

Figure 3.1 Salem Secondary Plan Area Ownership

SALEM SECONDARY PLAN BOUNDARY

(P) = PARTICIPATING OWNER

P-2442-OWNERSHIP MAP

Michalski Nielsen ASSOCIATES LIMITED

Cunningham Environmental Associates

SEPT 12, 2014

KLM PLANNING PARTNERS INC.
Planning • Design • Development
64 JARDIN DRIVE - UNIT 1B, CONCORD, ONT. L4K 3P3
PHONE (905) 669-4055 FAX (905) 669-0097 design@klmplanning.com

SWM Pond Design Criteria

Stormwater Management Pond Design Criteria

Design Criteria	Town of Innisfil	City of Barrie	LSRCA	NVCA	Schaeffers Recommendations
Storm Design	1: 2 year, 1:5 year, 1:10 year, 1:25 year, 1:50 year, 1:100 year and the Regional Storms shall be applied for quantity control and the 25 mm 4-hour Chicago storm shall be applied for erosion control as required. In order to determine the critical design storms, the SCS Type II (6-hr, 12-hr and 24-hr durations) and the 4-hour Chicago storm distributions for the 1:2 year through 1:100 year return period shall be applied. Unless otherwise directed by the City, Hurricane Hazel shall be applied throughout the City as the Regional storm for the sizing of municipal infrastructure associated with storm drainage and stormwater management.	1: 2 year, 1:5 year, 1:10 year, 1:25 year, 1:50 year, 1:100 year and the Regional Storms shall be applied for quantity control and the 25 mm 4-hour Chicago storm shall be applied for erosion control as required. In order to determine the critical design storms, the SCS Type II (6-hr, 12-hr and 24-hr durations) and the 4-hour Chicago storm distributions for the 1:2 year through 1:100 year return period shall be applied. Unless otherwise directed by the City, Hurricane Hazel shall be applied throughout the City as the Regional storm for the sizing of municipal infrastructure associated with storm drainage and stormwater management.	The following design storms are to be used for modeling sites with drainage areas greater than 5 hectares (refer to distribution tables in Appendix C): 4 hour Chicago with 10 minute time steps. - 12 hour SCS Type II distribution (this storm is required for use by LSRCA and the surrounding municipalities).	Both the 4-hour Chicago and 24-hour SCS Type II storms must be modelled for the specified storm events. Unless specified otherwise by the municipality, the NVCA, a subwatershed study or fluvial geomorphic analysis, post-development peak flow rates must not exceed corresponding pre-development rates for the 1:2-year, 1:5-year, 1:10-year, 1:25- year, 1:50-year and 1:100-year design storm events. The regional event for the NVCA jurisdiction is the Timmins Storm event with a total rainfall runoff of 193 mm over a 12 - hour period.	1: 2 year, 1:5 year, 1:10 year, 1:25 year, 1:50 year, 1:100 year and the Regional Storms shall be applied for quantity control and the 25 mm 4-hour Chicago storm shall be applied for erosion control as required. In order to determine the critical design storms, the SCS Type II (6-hr, 12-hr and 24-hr durations) and the 4-hour Chicago storm distributions for the 1:2 year through 1:100 year return period shall be applied. Unless otherwise directed by the City, Hurricane Hazel shall be applied throughout the City as the Regional storm for the sizing of municipal infrastructure associated with storm drainage and stormwater management.
Stormwater Quality Protection level	Enhanced level of protection is required.	Enhanced level of protection is required.	Enhanced level of protection is required which is corresponds to long term average removal of 80% of suspended solids. For Phosphorous removal 63%.	For percent impervious values above 55%, the following equation should be used: y=(-38.0839 x 58.24687+ 987.8003 x X^0.706798)/(58.24687 + X^0.706798). For percent impervious below 55%, the following equation should be used: y = 52.5 * X + 2.5. As a minimum standard, the NVCA requires the matching of post-development phosphorous loads to pre-development levels. The NVCA would prefer all new development to achieve a 20% reduction from pre-development levels in phosphorous loadings.	Enhanced level of protection. Phosphorous loading shall be done to satisfy NVCA and LSRCA criteria.
Active Storage Detention	25 mm 48-hour detention as a minimum will be required, depending on the results of the geomorphic assessment study.	24 hrs (12 hrs if in conflict with minimum orifice size)	Detention time - minimum 24 hrs	25 mm 48-hour detention as a minimum will be required, depending on the results of the geomorphic assessment study.	Extended detention to satisfy DSWMMP
Forebay	1- Minimum Depth 1.5m, with Length to Width Ratio of 2:1 2- Maximum Area 33% of total Permanent Pool and 3- Preferred Maximum Volume 20% of total Permanent Pool.	1- The minimum depth in the forebay shall be 1.0 m with Length to Width Ratio of 2:1, 2- A berm shall be constructed with a forebay spillway invert at the NWL with appropriate erosion protection to enable, as a minimum, the flow of the water quality event (25 mm event) without overtopping any other part of the forebay into the main cell of the facility. The minimum top width of the berm shall be 1.0 m. 3- A dewatering sump shall be installed to enable the drawdown of the permanent pool for maintenance and sediment removal. Where feasible, the forebay sump shall be connected to the pond outlet structure with a control valve to drain by gravity. Where draining by gravity is not feasible, a dewatering sump shall be included and drained by pump. 4- Demonstrate by a geotechnical engineer that the bearing capacity of native soils on the bottom of the forebay is sufficient to support maintenance machinery for the removal of the sediment, the bottom of the forebay shall be lined with 300 mm of 50 mm diameter crusher run rock, or as recommended by a geotechnical engineer. Unstable native soils may warrant the use of geotextile lining under the rock.	1- Minimum depth 1 m. 2- Forebay Area - % of Total Permanent Pool Area maximum 33 %, 3- length-to-width ratio minimum 2:1.	1- Minimum Depth 1.0 m- preferred 1.5 m 2- Maximum Area 33% of total Permanent Pool, and 3- Preferred Maximum Volume 20% of total Permanent Pool.	1- Minimum Depth 1.5m, with Length to Width Ratio of 2:1 2- Maximum Area 33% of total Permanent Pool and 3- Preferred Maximum Volume 20% of total Permanent Pool.
Length to Width Ratio of Pond	Minimum 3:1 - Preferred 4:1 to 5:1.	Minimum 3:1 - Preferred 4:1 to 5:1.	Minimum 3:1 - Preferred 4:1 to 5:1.	Minimum 3:1 - Preferred 4:1 to 5:1.	Minimum 3:1 - Preferred 4:1 to 5:1.
Permanent Pool Depth	Maximum depth of 2.5 m; and mean depth 1 m to 2 m.	Maximum depth 2.5 m with a mean depth of 1.0 to 2.0 m. The maximum depth of a wet pond shall be 4.5 m from the pond bottom.	The elevation of the permanent pool to be set above the 100-year flood elevation. Maximum 3 m.	The elevation of the permanent pool to be set above the 100-year flood elevation.	Maximum depth of 2.5 m.
Active Storage Depth	Active storage depth of 2 m	Maximum 1.5 m- Preferred 1.0 m. Total (including quantity control) 2 m	Water Quality and Erosion Control: maximum 1.5 m- Preferred 1.0 m. Total (including quantity control) 2 m	Water Quality and Erosion Control: maximum 1.5 m- Preferred 1.0 m. Total (including quantity control) 2 m	As per Town Standards
Side Slopes (Grading)	A minimum side slope of 4:1 above and below the safety shelf. A safety shelf shall be provided with a slope of 7:1 extending 3 m horizontally above and below the normal water level. 4:1 where the slope backs on to the rear yard lot line or an adjacent valley system. 4:1 where the pond is adjacent to a municipal boundary. 5:1 where the slope backs on to an adjacent road system. 5:1 where the pond is being used as part of a trail system or passive recreation.	The maximum slope from the bottom of the permanent pool to 0.5m below the NWL shall be 3:1 (h:v). Within 3 m on either side of the NWL, the maximum slope shall be 6:1. Elsewhere, the maximum slopes shall be 4:1 (where the slope backs on to the rear yard lot line or an adjacent valley system), 5:1 (where the slope backs on to an adjacent road system), and 3:1 in a fenced facility. Retaining walls are not permitted in the pond block.	Side Slopes at Permanent Pool Elevation - 5:1 for 3 m horizontally on either side of the permanent water line, maximum 3:1 elsewhere.	Sides: 5:1 for 3 m on either side of the permanent pool- Preferred 7:1 near normal water level plus use of 0.3 m steps. Elsewhere: 3:1, preferred 4:1	As per Town Standards
Inlet	Minimum 450 mm, preferred pipe slope > 1%. If submerged , obvert 150 mm below expected maximum ice depth.	Inlet structures shall be installed with the invert set to the NWL or higher. Submerged inlets shall only be permitted if the obvert of the pipe lies below the maximum anticipated thickness of ice. Suitable erosion control and energy dissipation treatment shall be provided at all inlets to the pond. Headwalls and safety grating shall be installed at all inlets per OPSD. SWM pond inlet elevations are to be designed such that the 1:5 year storm design sewer capacity as per the storm sewer design sheet is maintained and not reduced due to tail water conditions.	Inlet Design - minimum 450 mm, preferred pipe slope > 1 %	Minimum 450 mm, preferred pipe slope > 1%. If submerged , obvert 150 mm below expected maximum ice depth.	Minimum 450 mm, preferred pipe slope > 1%. If submerged , obvert 150 mm below expected maximum ice depth.
Outlet	A control manhole with a central wall designed with orifice or notch configuration should be placed at the top of the berm outside of the emergency spillway. This The outlet will be designed to operate under free flow conditions. The outlet should also include a maintenance pipe with shut off valve for draining.	The return period water surface elevations of the receiving body must be determined and verified to ensure the proper operation of the outlet structure. Anti-seepage collars shall be installed on all outlet pipes or as directed by a geotechnical engineer.	Outlet Design - minimum 450 mm outlet pipe, Pipe slope > 1 %	A look at preliminary grades for the stormwater management design; this should consider groundwater conditions, elevations at the proposed outlet(s). Confirmation that the outlet from the development is suitable; if the outlet is across private land then the NVCA will require written confirmation from the affected land owner. (Outfalls should be located as a minimum above the level of the 25-year flood limit and outside of the low flow channel to avoid disturbance to the watercourse; Outfalls that require hard structures, such as headwalls or pipes, should be located outside of the 100-year erosion limit unless it is not technically feasible. If not technically feasible then the outfall should at least be located in an area where active erosion is not occurring). Disturbance to forested valley slopes and adjacent wooded or wetland habitats needs to be avoided and/or minimized to the extent possible.	As per Town Standards
Maintenance Access	Maintenance access is required to the inlet and outlet structures, forebays, sediment drying areas, and emergency spillways. Where possible, the maintenance access is to be looped to provide two access points to all key features. When this is not possible, dead end access may be provided with a hammerhead turning area of 4 m by 17 m with a 12 m centreline turning radius. Where the acces road enters the forebay below the P.P NWL, the forebay ramp shall be constructed with the lining of the bottom of the forebay as recommended by a Geotechnical Engineer. In this case, a minimum width of 4 m must be provided for the ramp with a maximum grade of 10%. Maintenance access roads shall be set a minimum of 0.30 m above the maximum pond water level.	Maintenance access roads are required to all inlets, outlet structures, sediment forebays, and sediment drying areas (if applicable) within the SWM facilities. Where feasible, two access points shall be provided from the municipal road allowance such that the access road is looped to key hydraulic features. In situations where this is not practical, dead end access roads shall be designed with a hammerhead turning area consisting of a minimum hammerhead width of 17.0 m and a 12.0 m centerline turning radius. The maintenance access road shall consist of a minimum 300 mm of compacted granular "A" with a surface treatment consisting of 50 mm topsoil and Simcoe County Native Seed Mixture. The access roads shall provide for all-weather ingress and egress with a minimum width of 5.0 m and a maximum grade of 10%. Curves on all access roads shall have a maximum centerline radius of 12.0 m. Where the access road enters the forebay below the NWL, the forebay ramp shall be constructed consistent with the lining of the bottom of the forebay or as recommended by a geotechnical engineer. Ramp access should favour "green" solutions.	Provided to approval of municipality.	Provided to approval of municipality.	In accordance with the City of Barrie requirement
Sediment Drying Area	Sediment drying areas are to be incorporated into the design of the stormwater management facility such that water from the sediment drains back into the sediment forebay with a slope of 2% to 4%. The sediment drying area shall be designed to accommodate 30% of the forebay volume with a maximum sediment stockpile depth of 1m and maximum side slopes of 10:1. Sediment drying areas should be located in areas that avoid high publicity. Accessible from the maintenance access road, and above the 5 year water level.	To be provided above maximum water quality water level. Drainage to be returned to the pond. Should only be incorporated into the design when it imposes no additional land requirement.	Provide caliper material to screen adjacent private lands and facility infrastructure - ensure that spreading and suckering vegetation (ie. sumac, ash, willow) are setback approximately 3m from private property, access roads and sediment drying areas.		As per Town Standards
Buffer	MOE-Minimum 7.5 m above maximum quality/erosion control water level. Minimum 3.0 m above high water level for quantity control.	MOE- Minimum 7.5 m above maximum quality/erosion control water level. Minimum 3.0 m above high water level for quantity control.	Minimum 7.5 m horizontally above maximum water quality/erosion control water level for extended detention wet ponds.		Minimum 7.5 m above maximum quality/erosion control water level. Minimum 3.0 m above high water level for quality control.
Emergency Spillway	All SWM facilities shall be designed with an emergency spillway. The emergency spillway shall be designed to convey the larger of the unrouted 1:100 year or the Regional peak flow with the invert of the spillway set, as a minimum, at the 100-yr controlled water level (or Regional controlled water level for ponds where Regional control may be required). A freeboard of 0.3 m shall be provided above the maximum routed water level under the Regional storm. The erosion protection shall be integrated with a natural vegetated surface treatment that is aesthetically pleasing. Spillway side sopes shall not be steeper than 3:1 and shall be no steeper than 10% when incorporated into the access road. The spillway shall not be directly above the outlet control structure and a minimum clearance of 3.0 m shall be provided.	All SWM facilities shall be designed with an emergency spillway. The emergency spillway shall be designed to convey the larger of the unrouted 1:100 year or the Regional peak flow with the invert of the spillway set, as a minimum, at the 100-yr controlled water level (or Regional controlled water level for ponds where Regional control may be required). A freeboard of 0.3 m shall be provided above the maximum routed water level under the Regional storm. The erosion protection shall be integrated with a natural vegetated surface treatment that is aesthetically pleasing. Spillway side sopes shall not be steeper than 3:1 and shall be no steeper than 10% when incorporated into the access road. The spillway shall not be directly above the outlet control structure and a minimum clearance of 3.0 m shall be provided.	A stage - storage - discharge table must be included and contain the elevations of the outlet and emergency spillway, as well as the elevation of each storm event.	Emergency spillways from stormwater management ponds that have side slopes should be modelled as trapezoidal broad crested weirs whose discharge is determined by the combined discharge of representative triangular and rectangular broad crested weirs.	As per City of Barrie Criteria
Fencing	Fencing shall be installed where the stormwater management facilities abut private lots, municipal boundaries, elementary schools and active recreation areas frequented by young children unless maximum slopes of 6:1 are provided. All stormwater management facilities are to be designed such that perimeter fencing is not required where it is adjacent to municipal right of ways. Gates with a locking system shall be provided on all maintenance road access points	Fencing shall be installed where the SWM facilities abut private lots unless maximum slopes of 6:1 are provided.			As per Town Standards
Signage	Shall be provided in clearly visible locations, as approved by the Town.	Warning signs shall be clearly visible and erected at all access points to the SWM facility in accordance with City of Barrie Standard BSD-83.			In accordance with the City of Barrie requirement and shall be reviewed and approved by the Town of Innisfil as well for ponds within the Town of Innisfil
Landscaping	A minimum 6 meter wide landscaping buffer with a maximum slope of 4:1 will be required where there are residential lots adjacent to a SWM pond.				As per Town Standards
Operation and Maintenance Manual	Will be required as part of the design of facility, including inspection checklists, maintenance descriptions, projected frequency and recommendations for facility clean up.	An operation and maintenance manual shall be prepared that identifies on-going operation protocol and maintenance issues (as required by the Lake Simcoe Protection Plan), including, but not limited to, the following: - the procedure for draining the forebay and sediment removal. - the annual sediment loading rate and estimated sediment accumulation in the facility. - the sediment clean out frequency. - the inspection procedures and frequency of inspections. - a description of the pond features and pond operating characteristics. - a monitoring program plan for periodic water quality sampling for priority SWM works as per the Lake Simcoe Protection Plan.	An Operation and Maintenance (O & M) manual must be prepared and submitted which includes sequencing and Maintenance/Inspection schedule and notes.	A stand-alone operation and maintenance (O & M) document will be required to accompany the design of the stormwater management facility prior to final approval by the NVCA (identify the location for where cleanouts of the forebay and main cell will be completed from, how the pond will be drawn down, the type of equipment to be used, the location of the sediment drying area if one has been provided and any special operation considerations that must be utilized such as by-pass piping or valves).	Will be provided
Maximum Depth	The maximum depth in a wet pond should be restricted to 3 metres	The maximum depth of a wet pond shall be 4.5 m from the pond bottom.	Extended Detention Depth - maximum 1.5 m (water quality and erosion control), maximum 2 m (total including quantity control), permanent pool water level maximum 3 m		As per Town standards
Freeboard	0.3 m of freeboard.	A 0.3 m freeboard is required above the maximum routed water level under the Regional Storm or 100 year for ponds intended to provide post-to-pre control for the 100 year event.	0.3 m of freeboard		0.3 m
Berming	Berms around wetlands and wet ponds shall be designed with a minimum top width of 3.0 m (where trails and access roads are not located) with a 3:1 maximum side slope on the outside. The core of the berms shall be constructed with engineered fill on the basis of the recommendations of a licensed geotechnical engineer. Topsoil is not permitted for berm construction except as a dressing to support vegetation on the top of the core. For pond berms exceeding 2.0 m in height from the top of the berm to the toe of slope, the berm must be designed by a qualified professional engineer in accordance with the latest edition of the Ontario Dam Safety Guidelines (MNR).	A minimum top width of 2.0 m with a 3:1 maximum side slope on the outside.	berm design - Notes on the construction of the pond berms must be provided on the detailed design drawings (i.e. acceptable soils with low permeability to be used, inspection by a geo-technical engineer and compaction %). These notes are required for both the permanent stormwater management facilities and the temporary sediment ponds where a berm is required to form the facility.		As per Town Standards
Groundwater Elevation	The groundwater elevation from the location of the proposed SWM Block must be compared to the permanent pool water level. In the case of groundwater being lower, liners shall be installed as specified by the Geotechnical consultant to satisfy underlying soil conditions. In the case groundwater is higher, an investigation must be conducted to ensure the proposed design mitigates impact to local groundwater levels to the satisfaction of the Town. The design shall be guided by Geotechnical recommendations.	The bottom of the SWM pond shall be a minimum of 1.0 m above the seasonal high GWL unless it can be demonstrated by a hydrogeologist to the satisfaction of the City that there will be no impact to groundwater elevation and groundwater quality. Otherwise, if it is not feasible to maintain the required separation distance, a suitable liner shall be installed based on consultation with a hydrogeologist.		Geotechnical samples, boreholes or test pits in support of infiltration systems should be extended to a depth between 2.5 to 5 metres or until bedrock or fully saturated conditions are reached. A minimum of 1.5 metres below the proposed infiltration stormwater management practices will be required for samples with respect to these facilities. The determination of the location of the seasonably high groundwater level is recommended to be completed within the months of March, April and May, after the ground has thawed to account for the high groundwater table associated with the snowmelt event. A yearly record may be requested for infiltration practices by the NVCA and by certain municipalities. If data is not available or timing for testing does not meet the spring window, NVCA is prepared to work with the proponent to determine conservative assumptions as an alternative.	As per Town Standards
Thermal Impacts	When discharging stormwater to a watercourse identified as a Cold Water Fishery, mitigation measures such as shoreline planting, shading with trees, bottom draw outlet pipes from deeper pools, or cooling trenches shall be implemented in SWM facilities to minimize thermal loading to the receiving watercourse. Bottom draw quality control pipes should have an inlet invert 500 mm above the bottom of the SWM facility to prevent sediment from entering the pipe. Cooling trenches should have a minimum length of 30 m.	When discharging to a watercourse identified as a cold water fishery, mitigation measures such as shoreline planting, shading by trees, bottom draw outlet pipes from deeper pools, or cooling trenches shall be implemented to minimize thermal loading to the receiving watercourse.	Bottom draw outfalls are required within the LSRCA watershed.	Infiltration trenches or additional measures may be required to minimize thermal impacts to receiving watercourses that are classified as cold-water resources.	Bottom draw outlet, deeper Permanent pool, and Cooling trench in cold-water fisheries as necessary
Trails	Pedestrian circulation trails shall be incorporated into SWM facilities where public safety has been fully addressed in terms of access, side slopes and fencing requirements. The feasibility of connections to adjacent neighbourhood parks, recreation areas and existing trail networks is to be explored as part of the initial SWM facility submission plans to the satisfaction of the Town. Wherever possible trails shall be co-located with maintenance access roads.	Pedestrian circulation trails shall be incorporated into SWM facilities where public safety has been fully addressed in terms of access, side slopes and fencing requirements. The feasibility of connections to adjacent neighbourhood parks, recreation areas and existing trail networks is to be explored as part of the initial pond submission plans to the satisfaction of the City.	During the design stage, opportunities to incorporate amenities such as trails and seating areas around the SWMP should be explored to encourage safe public access and enhance the value of the facility within the community.		As per city of Barrie Criteria

Flood Plain Analysis



No.	DESCRIPTION	TOWN	DATE	BY
1.	REVISED BASED ON NEW PEAK FLOWS		2017-12-05	AC

REVISIONS

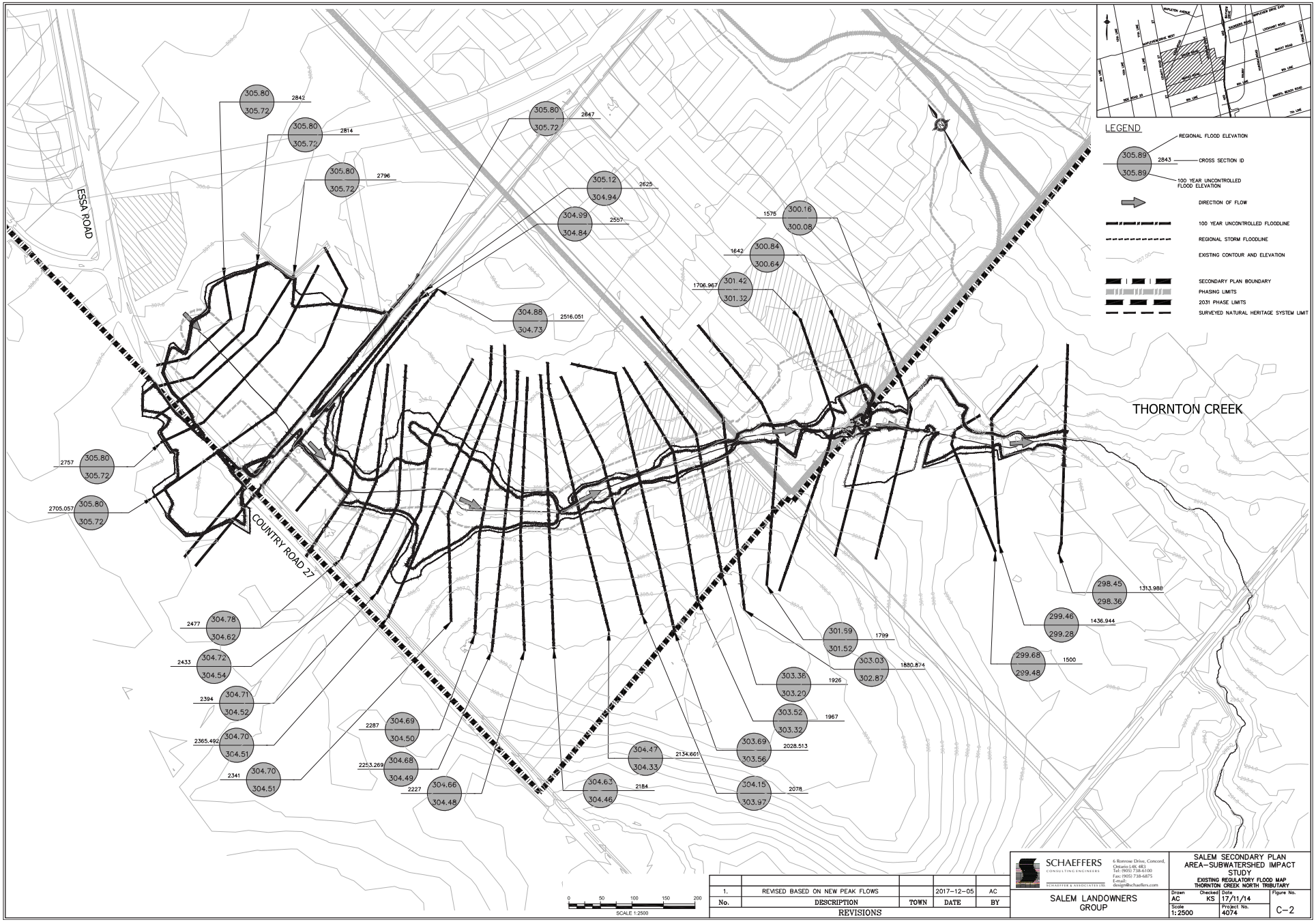
SCHAEFFERS CONSULTING ENGINEERS
SCHAEFFER & ASSOCIATES LTD.
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100
Fax: (905) 738-6875
E-mail: design@schaeffers.com

SALEM LANDOWNERS GROUP

SALEM SECONDARY PLAN AREA-SUBWATERSHED IMPACT STUDY

EXISTING REGULATORY FLOOD MAP
THORNTON CREEK UPPER

Drawn	Checked	Date	Figure No.
AC	KS	17/11/14	C-1
Scale 1:2500		Project No. 4074	



No.	DESCRIPTION	TOWN	DATE	BY
1.	REVISED BASED ON NEW PEAK FLOWS		2017-12-05	AC

REVISIONS

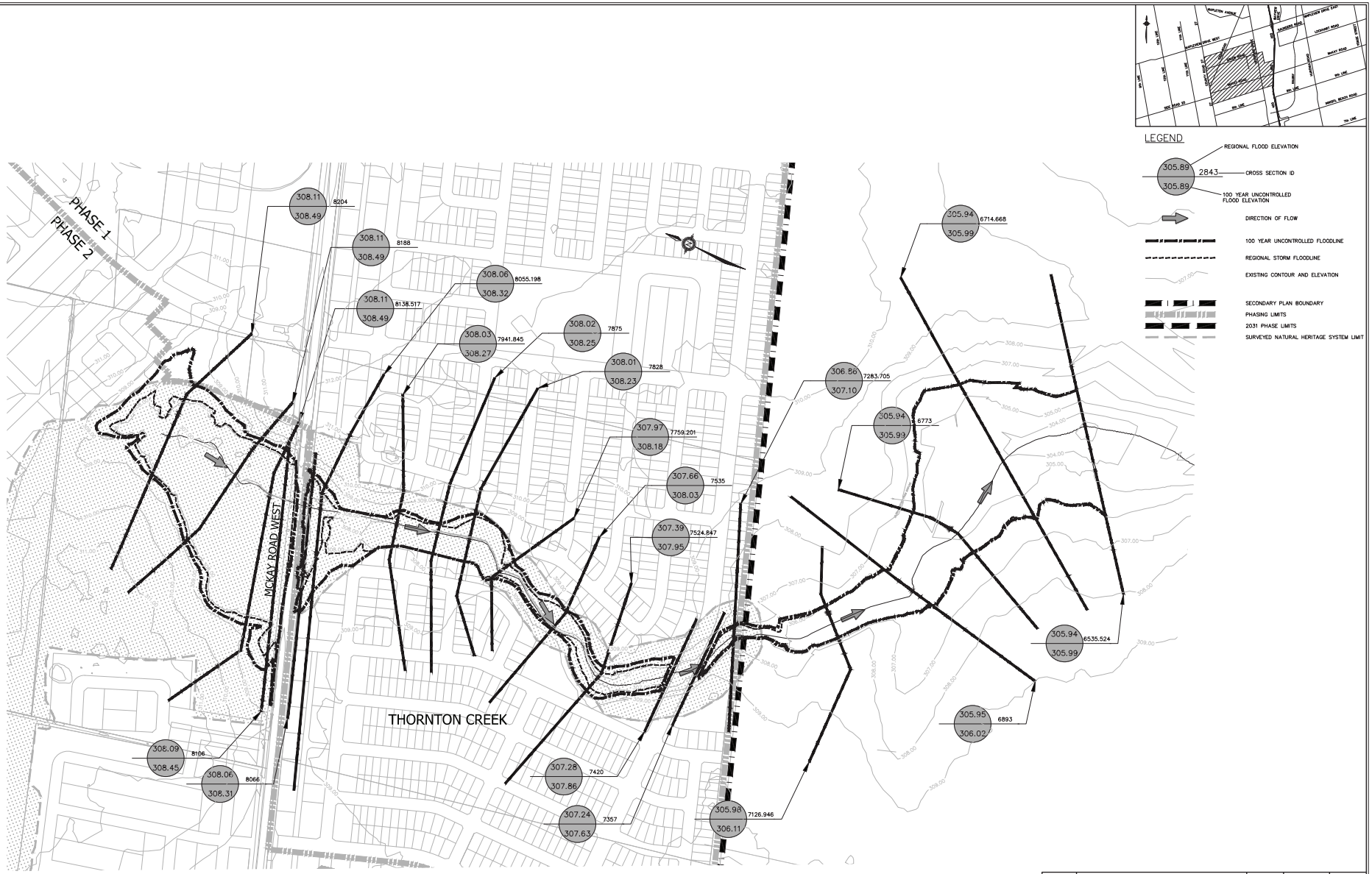
SCHAEFFERS CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100
Fax: (905) 738-6875
E-mail: design@schaeffers.com

SALEM LANDOWNERS GROUP

SALEM SECONDARY PLAN AREA–SUBWATERSHED IMPACT STUDY

EXISTING REGULATORY FLOOD MAP
THORNTON CREEK NORTH TRIBUTARY

Drawn	Checked	Date	Figure No.
AC	KS	17/11/14	C-2
Scale 1:2500		Project No. 4074	



No.	DESCRIPTION	TOWN	DATE	BY
2.	REVISED BASED ON NEW PEAK FLOWS		2017-12-11	AC
1.	REVISED NHS BASED ON KLM LIMITS		2016-09-01	AC

REVISIONS

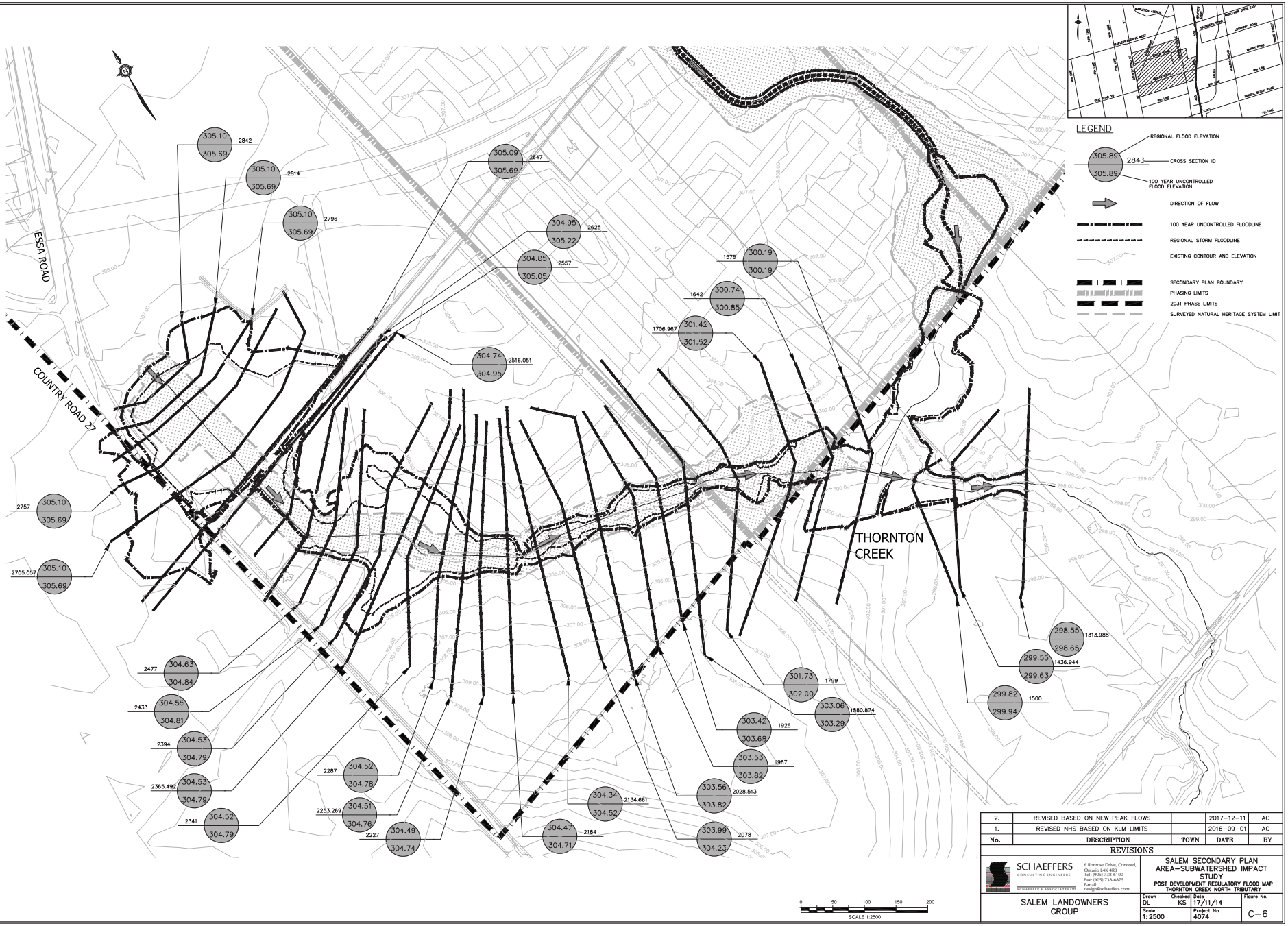
SCHAEFFERS CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100
Fax: (905) 738-6875
E-mail: design@schaeffers.com

SALEM SECONDARY PLAN AREA–SUBWATERSHED IMPACT STUDY

POST DEVELOPMENT REGULATORY FLOOD MAP THORNTON CREEK UPPER

SALEM LANDOWNERS GROUP

Drawn	Checked	Date	Figure No.
DL	KS	17/11/14	C–5
Scale 1:2500		Project No. 4074	



No.	DESCRIPTION	TOWN	DATE	BY
2.	REVISED BASED ON NEW PEAK FLOWS		2017-12-11	AC
1.	REVISED NHS BASED ON KLM LIMITS		2016-09-01	AC

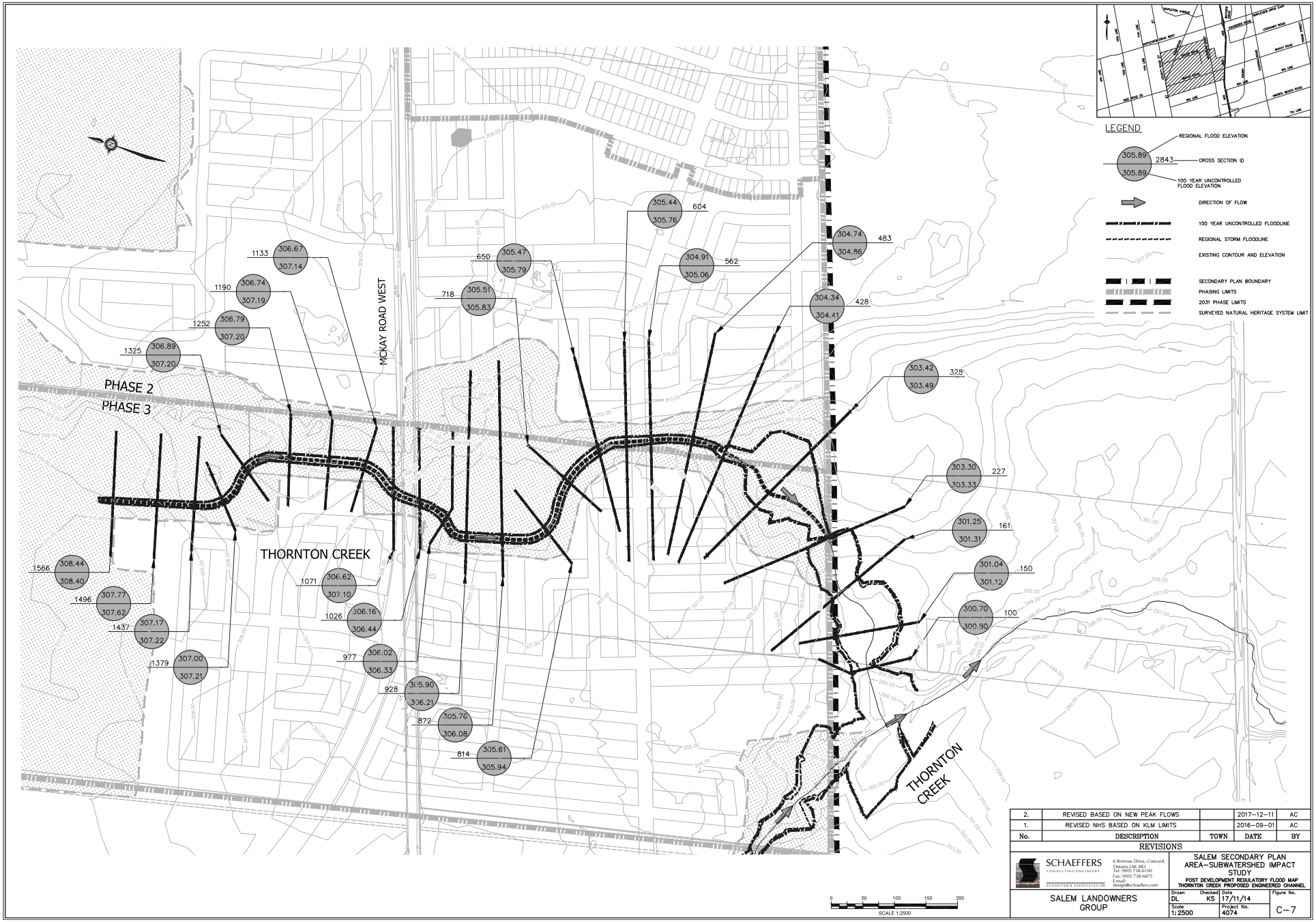
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SCHAEFFERS CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100
Fax: (905) 738-6875
E-mail: design@schaeffers.com

SALEM SECONDARY PLAN AREA-SUBWATERSHED IMPACT STUDY
POST DEVELOPMENT REGULATORY FLOOD MAP
THORNTON CREEK NORTH TRIBUTARY

SALEM LANDOWNERS GROUP

Drawn	Checked	Date	Figure No.
DL	KS	17/11/14	C-6
Scale 1:2500		Project No. 4074	



No.	DESCRIPTION	TOWN	DATE	BY
2.	REVISED BASED ON NEW PEAK FLOWS		2017-12-11	AC
1.	REVISED NHS BASED ON KLM LIMITS		2016-09-01	AC

REVISIONS

SCHAEFFERS CONSULTING ENGINEERS
SCHAEFFER & ASSOCIATES LTD.
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100
Fax: (905) 738-6875
E-mail: design@schaeffers.com

SALEM SECONDARY PLAN AREA–SUBWATERSHED IMPACT STUDY

POST DEVELOPMENT REGULATORY FLOOD MAP
THORNTON CREEK PROPOSED ENGINEERED CHANNEL

SALEM LANDOWNERS GROUP

Drawn	Checked	Date	Figure No.
DL	KS	17/11/14	C–7
Scale 1:2500		Project No. 4074	

FLOODPLAIN ANALYSIS REPORT

ANNEXED LANDS
SALEM SECONDARY PLAN
CITY OF BARRIE

PROJECT: 2014-4074 **DECEMBER, 2017**

SCHAEFFERS
CONSULTING ENGINEERS

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Appendix D: Topographic Data Map
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1.0 Introduction

This report presents the floodplain analyses and results for the Annexed Lands within the limits of the Salem Secondary Plan. In this study hydraulic models of Bear Creek and Thornton Creek have been developed based on the best available data including detailed topographic survey data, AMEC HEC-RAS model and hydrologic models' outputs for Existing and Post-development conditions.

The main object of the current study is to prepare floodplains for Bear Creek and Thornton Creek within Nottawasaga Valley Conservation Authority (NVCA) limits based on the calculated flows and updated topographic data. Geo-HEC-RAS which is the GIS based software under the HEC-RAS engine is used for the digital floodplain mapping in this study.

This report will address the background information, methodology, hydraulic modelling procedure and floodplain preparation. Furthermore, the current hydraulic model and the obtained floodplains will be compared with existing Drainage and Stormwater Management Master Plan (DSWMMP) models and floodplains which were proposed by AMEC as a part of the City of Barrie Master Plan.

Since Lover's creek is mostly located beyond 2031 limits, the analysis of floodplain for Lover's Creek has become differed to the time when those developments within 2031 development boundary is being detail designed.

2.0 Study Area- Annexed Lands

The current study area which is the west block of the Annexed Lands is located along the City of Barrie old urban boundary which is limited from the east to the Huronia Road and from the west to the Country Road 27. Bear Creek and Thornton Creek are located at the west block of the Annexed Lands, both are tributaries of the Nottawasaga River and regulated by NVCA.

Three main reaches are modelled for Bear Creek (i.e., Bear Creek Upper and Lower and South-trib. main) and headwater of the Bear Creek roughly flows from south-east to the north-west of the current study area and ultimately will drain to the Nottawasaga River at west. Six reaches are considered for the current hydraulic model of the Thornton Creek (i.e., Thornton Creek upper (Eastern Tributary), middle, lower, South-trib. main, North-trib. Main (Western Tributary) and Proposed Engineered Channel). Thornton Creek upper, North-trib. main and Proposed Engineered Channel which are located at the Annexed Lands boundary drain from north to south and ultimately will drain to the Nottawasaga River at west. Figure 2.1 illustrates the study area of the subjected Annexed Lands within the limits of the Salem Secondary Plan. It should be noted that, tree reaches of the Thornton and two reaches of the Bear creaks are within the boundary of the Annexed lands.

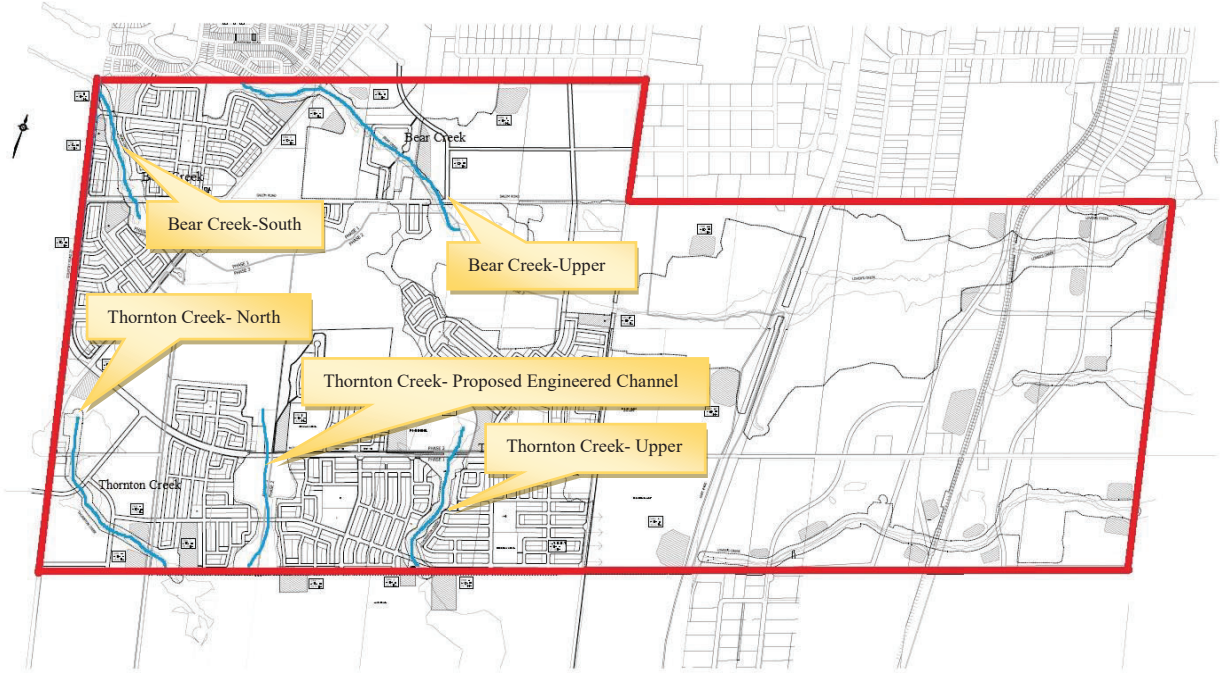


Figure 2.1: Study area of the subjected Annexed Lands

3.0 Methodology

Hydraulic models have been developed for Thornton Creek and Bear Creek using Geo-HEC-RAS model. The models' parameters and geometric data (i.e., reach alignment, cross-sections' location and geometry, hydraulic structures data) have been developed based on the best available data including detailed topographic data, aerial topographic data and the original HEC-RAS models which were used by AMEC. Hydraulic modelling and Steady Flow analyses are performed for Existing and Post-development conditions.

It should be noted that the Post-development flows and upgraded culverts are considered for this scenario. The model development procedure can be summarized as following:

- Determining the georeferenced alignment of the reach
- Generating surface terrain layer from elevation data source
- Determining the location of the cross-sections based on the DSWMMP existing model and the HEC-RAS manual criteria
- Creating Cross-sections from digital terrain layer along a river reach
- Adding hydraulic structures data to the model and calculating Ineffective Flow areas
- Determining the model parameters (e.g., Loss Coefficients and Manning's values, Flow length, Ineffective Flow Areas)
- Adding required storms' flows to the model
- Determining the boundary conditions for hydraulic modelling
- Steady flow analysis and water surface profile calculation
- Generating floodplain for storm events

4.0 Development of the Model

4.1 Input Data

4.1.1 Hydrologic Data

Geo-HEC-RAS models' flows have been updated based on the VO2 hydrologic models' outputs for uncontrolled 100-year and Regional storms (i.e., Timmins). According to the current provincial policy peak flows cannot be controlled by Stormwater Management for regulatory floodplain analysis. Based on the NVCA guidelines, Regional Storm (i.e., Timmins Storm) and 100-year storm events should be considered for floodplain mapping. It should be noted that, Hence, Regional and 100-year SCS type II 24 hour and 100-year Chicago 4 hour uncontrolled storm flows are modelled using VO2 and considered for the hydraulic modelling of the Thornton Creek.

According to the NVCA Natural Hazards Technical Guide, the 100-year flood is determined by the greater runoff generated by either the 1:100-year SCS Type II 24 hour or the 1:100-year 4 hour Chicago storms. Table 4.1 and Table 4.2 present the design flows for hydraulic modelling of the Thornton and Bear Creeks for existing condition and Table 4.3 and 4.4 presents simulated peak flows under post-development condition.

Table 4.1 Flows for the hydraulic modelling of Thornton Creeks - Existing Condition

Reach	Node	Cross Section Station	Peak Flow (m3/S)		
			SCS II 24HR (UC 100YR)	Regional	Chicago 4HR (UC 100YR)
North Trib Main (Western Tributary)	9025/9019	2842	3.474	7.553	3.030
	9024	1926	4.501	9.472	3.834
	9554	1500	7.425	14.289	6.307
Thornton_Creek Upper (Eastern Tributary)	5201	8204	0.919	2.016	0.804
	9014	8188	1.542	2.992	1.332
	9017	7283.705	3.536	6.634	3.072
	9545	6394.603	4.968	9.189	4.352
	9548	5459.043	7.393	13.597	6.528
	9549	3964.705	7.430	16.526	6.585
South_trib	557	463.5742	2.415	4.402	2.187
Thornton_Creek Middle	9550	3628.31	9.681	20.873	8.624
	9551	2407.671	10.801	24.229	9.620
Thornton_Creek Lower	9556	770.8709	19.779	44.808	17.525
	9558	389.2966	20.524	46.438	18.161

Table 4.2 Flows for the hydraulic modelling of Bear Creek - Existing Condition

Reach	Node	Cross Section Station	SCS II 24HR (UC 100YR)	Regional	Chicago 4HR (UN 100YR)
Main South Tributary	506/9003	2034	0.335	0.506	0.271
	9001	1493.186	1.856	2.481	1.506
Upper Bear creek	9000	4536	0.339	0.558	0.293
	9039/508	4128	1.016	1.675	0.880
	9012	3932.982	3.277	5.438	2.808
	9010	3194.309	3.294	5.559	2.824
	9005	2579	4.155	6.924	3.509
	9503	2329	8.002	8.324	8.882
	9543	1834.005	25.172	23.342	26.087
Lower Bear creek	9521	591.6011	28.233	31.400	28.044

Table 4.3 Flows for the hydraulic modelling of Thornton Creeks – Post-Development Condition

Reach	Node	Cross Section Station	Peak Flow (m3/S)		
			SCS II 24HR (UC 100YR)	Regional	Chicago 4HR (UC 100YR)
North Trib Main (Western Tributary)	532/9025	2842	7.971	3.732	10.042
	9024	1926	19.867	10.644	22.698
	9554	1500	25.428	20.331	26.610
Thornton_Creek Upper (Eastern Tributary)	5201	8204	0.426	0.904	0.378
	9014	8188	6.225	3.171	7.596
	9017	7283.705	18.033	9.805	20.665
	9545	6394.603	12.517	11.008	12.713
	9548	5459.043	11.590	13.717	11.143
	9549	3964.705	8.974	16.732	8.331
South_trib	557	463.5742	2.415	4.402	2.187
Thornton_Creek Middle	9550	3628.31	11.316	21.127	10.472
	9551	2407.671	12.691	24.611	11.745
Thornton_Creek Lower	9556	770.8709	27.979	47.746	26.371
	9558	389.2966	28.535	49.455	26.537
Proposed Engineered Channel	5361	1566	1.455	2.848	1.591
	9044	1133	7.336	4.480	9.254
	9034	650	6.534	4.932	7.565
	9045	227	10.971	7.575	11.120

Table 4.4 Flows for the hydraulic modelling of Bear Creek - Post-Development Condition

Reach	Node	Cross Section Station	SCS II 24HR (UC 100YR)	Regional	Chicago 4HR (UN 100YR)
Main South Tributary	9003	2034	4.886	2.118	6.480
	9004	1493.186	4.368	2.327	5.179
	9001	1290.42	10.340	5.179	12.305
Upper Bear creek	9000	4536	0.546	0.498	0.673
	9039/508	4128	1.639	1.494	2.020
	9012	3932.982	20.687	9.402	27.242
	9010	3194.309	24.449	13.286	28.135
	9005	2560.813	23.668	13.987	29.108
	9503	2329	26.799	16.362	32.077
	9543	1834.005	59.117	37.723	66.099
Lower Bear creek	9521	591.6011	69.123	48.600	75.652

4.1.2 Topographic Data

With reference to the City of Barrie Secondary plan, the existing HEC-RAS models which were proposed by AMEC were developed based on the digital elevation model (DEM, 10 m resolution). It is indicated that there is room for revising these models based on more accurate data. Hence, in order to increase the accuracy of the hydraulic modelling, in some parts of study areas, detailed topographic data were collected and used for creating Triangular Irregular Network (TIN). These sources of elevation data are used for generating digital terrain layers in Geo-HEC-RAS. Figure D-1 in Appendix D presents a map which shows where detail topographic data is available.

It should be noted that, aerial topographic data and the DSWMMP HEC-RAS models which were proposed by AMEC are used for the other parts of the study areas and the modeling and calculations should be updated based on detailed and updated topographic data.

4.2 Modelling Procedure in Geo-HEC-RAS

4.2.1 Cross-Sections

Based on the HEC-RAS computational method, topographic data should be converted to geometric configuration which is represented by Cross-section. Cross-sections' geometries are extracted at the required locations from the generated ground terrain layer. Alignment of the cross-sections should be perpendicular to the direction of the flow. Hence, for the left and the right overbanks, cross-sections alignments are drawn considering the flow directions based on the drawn flow centerline for the right and the left overbanks. Flow length for the main channel and centre line of the flow mass is used for manual calculation of overbank flow lengths using Geo-HEC-RAS.

Considering the lack of available observed information, Manning's values for the main channel and the left and the right overbanks are determined based on the best available information using

Table 3-1 of the HEC-RAS hydraulic reference manual and DSWMMP HEC-RAS models.

Contraction and Expansion Coefficients which are used for calculating losses in HEC-RAS steady flow computations should be considered in hydraulic modelling. In the current study, Contraction and Expansion Coefficients are set to 0.1 and 0.3 respectively where the changes in river cross-sections are small and the flow is subcritical (Table 3.3 HEC-RAS hydraulic reference manual). It should be noted that, Contraction and Expansion Coefficients are set to 0.3 and 0.5, respectively, at the hydraulic structures boundaries.

4.2.2 Boundary Conditions

The boundary conditions are set to be Normal Depth. The Normal Depth is calculated based on the slope of channel at the downstream of the reaches. Since the location of introduced boundary conditions are far from the subject study area, it can be anticipated that these normal depth conditions will not significantly impact on the analysis. Furthermore, Critical Depth is considered as upstream boundary condition of the model.

4.2.3 Hydraulic Structures

Hydraulic structures including culverts are modelled based on the best available data including field surveys and detailed topographic data or information from the current DSWMMP HEC-RAS model. In addition, considering recommendations of the City of Barrie Stormwater Management Policies and Design Guidelines, location of the controlling cross-sections at the culvert points are determined based on the HEC-RAS hydraulic reference manual recommendations. It should be noted that, all crossing information and culvert sizing should be verified and checked at detailed design stage.

In order to define Ineffective flow areas at the boundary cross-sections of the culverts, Contraction Reach at the upstream of the culvert are used based on 1:1 contraction rate and Expansion Reach at the downstream of the culvert considering 2:1 expansion rate. As mentioned

before, HEC-RAS hydraulic reference manual recommends values of 0.3 and 0.5 for contraction and expansion, respectively, for the boundary cross-sections of the culverts. Hence, these values are used in the current study as well. Based on the obtained hydraulic modelling results, existing culverts are analyzed and assessed. With aim of conveying flows under the post-development condition new culvert sizes are proposed and considered based on the city of Barrie standards. It should be noted, HEC-RAS hydraulic model is used to size the proposed culverts. Impact on upstream floodplain is also considered in culvert sizing analysis. According to DSWMMP, no watercourse present for culvert number 4 and 2000×1800 High Span structure has been proposed for future culvert size. Table 4.5 presents the existing and proposed culverts information for Thornton and Bear Creeks.

Table 4.5 Existing and proposed culverts information for Thornton and Bear Creeks

Culvert No.	Location	Future Road Class	Cross Section	Design Peak Flow (m3/s)		Structure		
				100 Yr (1)	Regulatory (2)	Type	Proposed (mm)	Existing (mm)
Bear Creek								
1	Country Rd. 27	Urban Arterial	1264	1.856	12.305	High Span	3660×1220	CSP-1400
3	Salem Rd.	Urban Arterial	1946	0.335	6.480	Box	1800×800	CSP-500
5	Essa Rd.	Urban Arterial	3150	3.294	28.135	High Span	5000×1000	CSP-900
10	Salem Rd.	Urban Arterial	4102	1.016	2.020	High Span	3660×1220	CSP-800
Thornton Creek								
13	McKay Rd.	Urban Arterial	7986	3.474	10.042	High Span	4270×1220	CSP Arch-1300×810
48	McKay Rd.	Urban Arterial	2635	1.542	7.596	High Span	4880×1220	CSP Arch-1300×810
101	McKay Rd.	Urban Arterial	1045	2.384 (3)	9.254	High Span	4880×1520	New Culvert
102	Proposed Rd.	Collector Road	670	2.698 (3)	7.565	High Span	3660×1520	New Culvert
103	Proposed Rd.	Collector Road	7391	3.536	20.665	High Span	4880×1520	New Culvert

(1) 100 Year SCS Type II 24 hour design storm Existing Condition
(2) Greater of 100 Year SCS Type II 24 hour, 100 Year Chicago 4 hour and Regional
(3) Controlled 100 Year SCS Type II 24 hour design storm Post-Development

4.3 Analysis of Geo-HEC-RAS Model Results and Floodplain Mapping

4.3.1 Thornton Creek

4.3.1.1 Existing Condition

Two Reaches of Thornton Creek are crossing the Salem lands. The Western Tributary of Thornton Creek passes through the lands that supposed to be developed past 2031. The Eastern Tributary passes through Phase 1 area. Steady Flow Analysis has been done in Geo-HEC-RAS model of the Thornton Creek to calculate water surface elevations and associated flood. As it is discussed before, based on the NVCA guidelines, Regional Storm (i.e., Timmins Storm) and 100-year storm events should be considered for floodplain preparation. It should be noted that, according to the current provincial policy, regulatory peak flows cannot be controlled by Stormwater Management. Hence, Regional and 100-year SCS 24 hour and 100-year Chicago 4 hour uncontrolled storm flows are modelled using VO2 and considered for the hydraulic modelling of the Thornton Creek. Table 4.6 and 4.7 present Thornton Creek modeling results for Upper (i.e., Eastern) and Main North Tributary (i.e., Western) under existing condition.

Table 4.6 Thornton Creek- Upper Geo-HEC-RAS water surface elevation results - Existing condition

Reach Name	Cross Section Station	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UC 100YR)		Regional		Regulatory
			Total Flow	W.S. Elev	Total Flow	W.S. Elev	Total Flow	W.S Elev	W.S. Elev.
		(m)	(m3/s)	(m)	(m3/s)	(m)	(m3/s)	(m)	(m)
Upper	8204	307.15	0.92	308.20	0.80	308.18	2.02	308.23	308.23
Upper	8188	307.13	1.54	308.20	1.33	308.18	2.99	308.23	308.23
Upper	8138.517	306.87	1.54	308.20	1.33	308.18	2.99	308.23	308.23
Upper	8106	306.69	1.54	308.20	1.33	308.18	2.99	308.23	308.23
Upper	8066	306.55	1.54	307.96	1.33	307.93	2.99	308.13	308.13
Upper	8055.198	307.10	2.22	307.96	1.94	307.93	4.31	308.13	308.13
Upper	7941.845	307.10	2.22	307.94	1.94	307.91	4.31	308.10	308.10

Reach Name	Cross Section Station	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UC 100YR)		Regional		Regulatory
			Total Flow	W.S. Elev	Total Flow	W.S. Elev	Total Flow	W.S. Elev	W.S. Elev.
		(m)	(m3/s)	(m)	(m3/s)	(m)	(m3/s)	(m)	(m)
Upper	7875	306.95	2.22	307.93	1.94	307.90	4.31	308.08	308.08
Upper	7828	306.78	2.22	307.92	1.94	307.89	4.31	308.07	308.07
Upper	7759.201	306.90	2.22	307.89	1.94	307.86	4.31	308.02	308.02
Upper	7535	306.63	2.22	307.63	1.94	307.61	4.31	307.75	307.75
Upper	7524.847	306.53	2.22	307.13	1.94	307.09	4.31	307.32	307.32
Upper	7409.061	306.38	2.22	307.03	1.94	307.00	4.31	307.21	307.21
Upper	7283.705	306.27	3.54	306.65	3.07	306.63	6.63	306.76	306.76
Upper	7126.946	305.06	3.54	305.65	3.07	305.45	6.63	305.93	305.93
Upper	6893	305.06	3.54	305.63	3.07	305.31	6.63	305.91	305.91
Upper	6773	304.61	3.54	305.63	3.07	305.28	6.63	305.91	305.91
Upper	6714.668	304.08	3.54	305.63	3.07	305.28	6.63	305.91	305.91
Upper	6535.524	302.67	3.54	305.63	3.07	305.28	6.63	305.91	305.91
Upper	6394.603	302.55	4.97	305.63	4.35	305.28	9.19	305.91	305.91
Upper	6352	303.18	4.97	305.63	4.35	305.28	9.19	305.91	305.91
Upper	6347.604	302.81	4.97	305.55	4.35	305.21	9.19	305.91	305.91
Upper	6331.505	302.73	4.97	304.03	4.35	304.06	9.19	304.29	304.29
Upper	6326	303.04	4.97	304.14	4.35	304.13	9.19	304.19	304.19
Upper	6257.457	302.97	4.97	304.15	4.35	304.14	9.19	304.21	304.21
Upper	6138.924	302.90	4.97	304.14	4.35	304.14	9.19	304.21	304.21
Upper	5986.767	303.03	4.97	304.14	4.35	304.14	9.19	304.20	304.20
Upper	5785.042	302.62	4.97	304.14	4.35	304.13	9.19	304.19	304.19
Upper	5625.478	302.33	4.97	304.14	4.35	304.13	9.19	304.19	304.19
Upper	5459.043	301.70	7.39	304.14	6.53	304.13	13.60	304.19	304.19
Upper	5379.186	302.17	7.39	304.14	6.53	304.13	13.60	304.19	304.19
Upper	5374	302.17	7.39	304.14	6.53	304.13	13.60	304.19	304.19
Upper	5355	302.12	7.39	303.42	6.53	303.31	13.60	304.10	304.10
Upper	5350	302.12	7.39	303.56	6.53	303.48	13.60	304.01	304.01
Upper	5240.396	301.97	7.39	303.39	6.53	303.32	13.60	303.86	303.86
Upper	5161	301.87	7.39	303.23	6.53	303.17	13.60	303.81	303.81
Upper	5064.254	301.74	7.39	302.82	6.53	302.81	13.60	303.65	303.65
Upper	4990.967	301.64	7.39	302.88	6.53	302.85	13.60	303.69	303.69
Upper	4909.995	301.53	7.39	302.87	6.53	302.84	13.60	303.69	303.69

Reach Name	Cross Section Station	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UC 100YR)		Regional		Regulatory
			Total Flow	W.S. Elev	Total Flow	W.S. Elev	Total Flow	W.S. Elev	W.S. Elev.
		(m)	(m3/s)	(m)	(m3/s)	(m)	(m3/s)	(m)	(m)
Upper	4773.478	301.36	7.39	302.86	6.53	302.84	13.60	303.69	303.69
Upper	4633.226	301.24	7.39	302.86	6.53	302.84	13.60	303.69	303.69
Upper	4539.129	301.10	7.39	302.86	6.53	302.84	13.60	303.69	303.69
Upper	4409.236	300.87	7.39	302.86	6.53	302.84	13.60	303.69	303.69
Upper	4326	300.93	7.39	302.86	6.53	302.84	13.60	303.69	303.69
Upper	4320.967	300.93	7.39	302.86	6.53	302.84	13.60	303.69	303.69
Upper	4291.792	300.76	7.39	302.07	6.53	301.96	13.60	302.71	302.71
Upper	4287	300.76	7.39	301.22	6.53	301.20	13.60	301.40	301.40
Upper	4183.054	300.45	7.39	301.14	6.53	301.11	13.60	301.33	301.33
Upper	4092.856	300.54	7.39	301.07	6.53	301.04	13.60	301.27	301.27
Upper	3964.705	300.41	7.43	300.83	6.59	300.80	16.53	301.07	301.07

Table 4.7 Thornton Creek-Main North tributary Geo-HEC-RAS water surface elevation results – Existing condition

Reach Name	Cross Section Station	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UN 100YR)		Regional		Regulatory
			Total Flow	W.S. Elev.	Total Flow	W.S. Elev.	Total Flow	W.S. Elev.	W.S. Elev.
		(m)	(m3/s)	(m)	(m3/s)	(m)	(m3/s)	(m)	(m)
Main	2842	304.60	3.47	305.72	3.03	305.71	7.55	305.80	305.80
Main	2814	304.38	3.47	305.72	3.03	305.71	7.55	305.80	305.80
Main	2796	304.38	3.47	305.72	3.03	305.71	7.55	305.80	305.80
Main	2757	304.41	3.47	305.72	3.03	305.71	7.55	305.80	305.80
Main	2705.057	304.52	3.47	305.72	3.03	305.71	7.55	305.80	305.80
Main	2647	304.35	3.47	305.72	3.03	305.71	7.55	305.80	305.80
Main	2625	304.30	3.47	304.94	3.03	304.91	7.55	305.12	305.12
Main	2557	304.32	3.47	304.84	3.03	304.82	7.55	304.99	304.99
Main	2516.051	304.15	3.47	304.73	3.03	304.71	7.55	304.88	304.88
Main	2477	304.13	3.47	304.62	3.03	304.60	7.55	304.78	304.78
Main	2433	304.03	3.47	304.54	3.03	304.51	7.55	304.72	304.72
Main	2394	303.99	3.47	304.52	3.03	304.49	7.55	304.71	304.71
Main	2365.492	303.93	3.47	304.51	3.03	304.48	7.55	304.70	304.70
Main	2341	303.90	3.47	304.51	3.03	304.48	7.55	304.70	304.70
Main	2287	303.79	3.47	304.50	3.03	304.47	7.55	304.69	304.69
Main	2253.269	303.71	3.47	304.49	3.03	304.46	7.55	304.68	304.68
Main	2227	303.71	3.47	304.48	3.03	304.45	7.55	304.66	304.66
Main	2184	303.64	3.47	304.46	3.03	304.43	7.55	304.63	304.63
Main	2134.661	303.62	3.47	304.33	3.03	304.31	7.55	304.47	304.47
Main	2078	303.34	3.47	303.97	3.03	303.94	7.55	304.15	304.15
Main	2028.513	303.07	3.47	303.56	3.03	303.54	7.55	303.69	303.69
Main	1967	302.62	3.47	303.32	3.03	303.28	7.55	303.52	303.52
Main	1926	302.48	4.50	303.20	3.83	303.17	9.47	303.38	303.38
Main	1880.874	302.40	4.50	302.87	3.83	302.84	9.47	303.03	303.03
Main	1799	300.65	4.50	301.52	3.83	301.48	9.47	301.69	301.69
Main	1706.967	300.54	4.50	301.32	3.83	301.31	9.47	301.42	301.42
Main	1642	299.80	4.50	300.64	3.83	300.61	9.47	300.84	300.84
Main	1575	299.31	4.50	300.08	3.83	300.04	9.47	300.16	300.16
Main	1500	298.70	7.43	299.48	6.31	299.44	14.29	299.68	299.68
Main	1436.944	298.83	7.43	299.28	6.31	299.25	14.29	299.46	299.46

Reach Name	Cross Section Station	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UN 100YR)		Regional		Regulatory
			Total Flow	W.S. Elev.	Total Flow	W.S. Elev.	Total Flow	W.S. Elev.	W.S. Elev.
		(m)	(m3/s)	(m)	(m3/s)	(m)	(m3/s)	(m)	(m)
Main	1313.988	297.87	7.43	298.36	6.31	298.36	14.29	298.45	298.45
Main	1074.984	296.71	7.43	297.12	6.31	297.04	14.29	297.37	297.37
Main	939.6914	296.15	7.43	297.11	6.31	297.05	14.29	297.35	297.35
Main	888	295.44	7.43	297.10	6.31	297.04	14.29	297.33	297.33
Main	882.5558	295.44	7.43	297.10	6.31	297.03	14.29	297.33	297.33
Main	866.5558	295.30	7.43	296.39	6.31	296.35	14.29	296.60	296.60
Main	861	295.30	7.43	295.67	6.31	295.64	14.29	295.79	295.79
Main	804.3427	294.20	7.43	294.73	6.31	294.70	14.29	294.89	294.89
Main	734.4726	293.65	7.43	294.09	6.31	294.06	14.29	294.24	294.24
Main	681.6157	293.01	7.43	293.61	6.31	293.56	14.29	293.81	293.81
Main	598.6232	292.26	7.43	292.87	6.31	292.84	14.29	293.05	293.05
Main	456.731	290.72	7.43	291.15	6.31	291.13	14.29	291.29	291.29
Main	389.4664	289.99	7.43	290.46	6.31	290.42	14.29	290.64	290.64
Main	269.1317	288.65	7.43	289.31	6.31	289.27	14.29	289.52	289.52
Main	101.4483	286.63	7.43	286.88	6.31	286.85	14.29	286.97	286.97

4.3.1.2 Post-Development Condition

Geo-HEC-RAS model of the Thornton Creek is analyzed under the Steady Flow calculation and water surface elevations and associated flood lines are obtained from the Geo-HEC-RAS outputs. It should be noted that, according to the current provincial policy, regulatory peak flows cannot be controlled by Stormwater Management. Hence, Regional and 100-year SCS 24 hour and 100-year Chicago 4 hour uncontrolled storm flows are modelled using VO2 and considered for the hydraulic modelling of the Thornton Creek.

The Thornton Creek Geo-HEC-RAS water surface elevation results for the study area are presented in Table 4.8 and Table 4.9 for Upper Thornton Creek and Main North tributary of the

Thornton Creek. Geo-HEC-RAS summary results are presented in Appendix B.

The existing condition of the original ground at Middle Tributary of the Thornton Creek is very flat and there is no major water course for conveying flows from areas North of McKay Road (NHS areas as well as drainage area contributing to SWM Ponds C and K). Furthermore, the surface run-off from this area drains through the proposed development in Phase 3. Hence, to convey post-development flows from this area and divert the flow from future Phase 3 lands, an engineered channel is proposed to collect and convey the run-off from northern tributary areas (NHS areas as well as drainage area contributing to SWM Pond K) to Thornton Creek. Detail of the proposed conceptual engineered channel cross-section is presented in Appendix A. Furthermore, supporting documents provided in Appendix C illustrate the proposed diversion channel and the relocated culvert on McKay Road. The modeling results of diversion channel are summarized in Table 4.6.

It should be noted that, it is also recommended in the DSWMMP to convey the upstream flows through the area by a municipal drain. Current design of the proposed engineered channel is conceptual only and it should be further developed at the detail design stage. According to the City of Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines, the design of the channel should be consistent with accepted natural channel design principles. A channel shall be designed to have a baseflow channel, a 2-year conveyance channel and an adjacent floodplain in accordance with natural channel principles. It is indicated that, channel should be designed for the regulatory flood run-off (the greater of the 1:100 year design storm or Timmins storm event) with approved lined material within the baseflow and 2-year conveyance channel and with slopes vegetated to the satisfaction of the City. In addition, Maximum side slope shall not exceed 4:1 (H:V).

Flood lines for Regional Storm (i.e., Timmins Storm) and critical 100-year uncontrolled storms (i.e., 100-year SCS 24 hour and 100-year Chicago 4 hour) are developed based on the calculated

water surface elevations and the generated terrain elevation layer in Geo-HEC-RAS model. Thornton Floodplains Drawings are represented in Appendix C. The west side of Thornton-Upper is currently a flat area and subsequently the floodplain will become spread at that area. However, by considering the grading plan and providing required elevations at the back of the property line of lots, the floodplain will be confined within NHS limits.

Table 4.8 Thornton Creek- Upper Geo-HEC-RAS water surface elevation results

Reach Name	Cross Section	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UN 100YR)		Regional	
			Total Flow	W.S. Elev.	Total Flow	W.S. Elev.	Total Flow	W.S. Elev.
		(m)	(m3/s)	(m)	(m3/s)	(m)	(m3/s)	(m)
Upper	8204	307.15	0.43	308.37	0.38	308.49	0.90	308.11
Upper	8188	307.13	6.23	308.37	7.60	308.49	3.17	308.11
Upper	8138.517	306.87	6.23	308.37	7.60	308.49	3.17	308.11
Upper	8106	306.93	6.23	308.34	7.60	308.45	3.17	308.09
Upper	8066	306.57	6.23	308.23	7.60	308.31	3.17	308.06
Upper	8055.198	307.12	6.23	308.24	7.60	308.32	3.17	308.06
Upper	7941.845	307.10	6.23	308.20	7.60	308.27	3.17	308.03
Upper	7875	306.95	6.23	308.18	7.60	308.25	3.17	308.02
Upper	7828	306.78	6.23	308.16	7.60	308.23	3.17	308.01
Upper	7759.201	306.90	6.23	308.11	7.60	308.18	3.17	307.97
Upper	7535	306.63	6.23	307.90	7.60	308.03	3.17	307.66
Upper	7524.847	306.53	6.23	307.79	7.60	307.95	3.17	307.39
Upper	7420	306.33	6.23	307.70	7.60	307.86	3.17	307.28
Upper	7357	306.13	6.23	307.55	7.60	307.63	3.17	307.24
Upper	7283.705	306.27	18.03	307.05	20.67	307.10	9.81	306.86
Upper	7126.946	305.06	18.03	306.09	20.67	306.11	9.81	305.98
Upper	6893	305.06	18.03	306.02	20.67	306.02	9.81	305.95
Upper	6773	304.61	18.03	305.99	20.67	305.99	9.81	305.94
Upper	6714.668	304.08	18.03	305.99	20.67	305.99	9.81	305.94
Upper	6535.524	302.67	18.03	305.99	20.67	305.99	9.81	305.94

Table 4.9 Thornton Creek-Main North tributary Geo-HEC-RAS water surface elevation results

Reach Name	Cross Section	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UN 100YR)		Regional	
			Total Flow	W.S. Elev.	Total Flow	W.S. Elev.	Total Flow	W.S. Elev.
		(m)	(m3/s)	(m)	(m3/s)	(m)	(m3/s)	(m)
Main	2842	304.60	7.97	305.55	10.04	305.69	3.73	305.10
Main	2814	304.38	7.97	305.55	10.04	305.69	3.73	305.10
Main	2796	304.38	7.97	305.55	10.04	305.69	3.73	305.10
Main	2757	304.41	7.97	305.55	10.04	305.69	3.73	305.10
Main	2705.057	304.52	7.97	305.54	10.04	305.69	3.73	305.10
Main	2647	304.35	7.97	305.54	10.04	305.69	3.73	305.09
Main	2625	304.30	7.97	305.15	10.04	305.22	3.73	304.95
Main	2557	304.32	7.97	305.00	10.04	305.05	3.73	304.85
Main	2516.051	304.15	7.97	304.89	10.04	304.95	3.73	304.74
Main	2477	304.13	7.97	304.79	10.04	304.84	3.73	304.63
Main	2433	304.03	7.97	304.74	10.04	304.81	3.73	304.55
Main	2394	303.99	7.97	304.72	10.04	304.79	3.73	304.53
Main	2365.492	303.93	7.97	304.72	10.04	304.79	3.73	304.53
Main	2341	303.90	7.97	304.72	10.04	304.79	3.73	304.52
Main	2287	303.79	7.97	304.71	10.04	304.78	3.73	304.52
Main	2253.269	303.71	7.97	304.69	10.04	304.76	3.73	304.51
Main	2227	303.71	7.97	304.68	10.04	304.74	3.73	304.49
Main	2184	303.64	7.97	304.65	10.04	304.71	3.73	304.47
Main	2134.661	303.62	7.97	304.48	10.04	304.52	3.73	304.34
Main	2078	303.34	7.97	304.15	10.04	304.23	3.73	303.99
Main	2028.513	303.07	7.97	303.77	10.04	303.82	3.73	303.56
Main	1967	302.62	7.97	303.76	10.04	303.82	3.73	303.53
Main	1926	302.48	19.87	303.62	22.70	303.68	10.64	303.42
Main	1880.874	302.40	19.87	303.24	22.70	303.29	10.64	303.06
Main	1799	300.65	19.87	301.94	22.70	302.00	10.64	301.73
Main	1706.967	300.54	19.87	301.51	22.70	301.52	10.64	301.42
Main	1642	299.80	19.87	300.85	22.70	300.85	10.64	300.74
Main	1575	299.31	19.87	300.19	22.70	300.19	10.64	300.19

Table 4.10 Thornton Creek-Proposed Engineered Channel water surface elevation results

Reach Name	Cross Section	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UN 100YR)		Regional	
			Total Flow	W.S. Elev.	Total Flow	W.S. Elev.	Total Flow	W.S. Elev.
		(m)	(m3/s)	(m)	(m3/s)	(m)	(m3/s)	(m)
Channel	1566.00	308.12	1.46	308.35	1.59	308.40	2.85	308.44
Channel	1496.00	307.44	1.46	307.67	1.59	307.62	2.85	307.77
Channel	1437.00	306.85	1.46	307.08	1.59	307.22	2.85	307.17
Channel	1379.00	306.51	1.46	307.04	1.59	307.21	2.85	307.00
Channel	1325.00	306.38	1.46	307.03	1.59	307.20	2.85	306.89
Channel	1252.00	306.21	1.46	307.02	1.59	307.20	2.85	306.79
Channel	1190.00	306.08	1.46	307.02	1.59	307.19	2.85	306.74
Channel	1133.00	305.95	7.34	306.96	9.25	307.14	4.48	306.67
Channel	1071.00	305.82	7.34	306.92	9.25	307.10	4.48	306.62
Channel	1026.00	305.67	7.34	306.34	9.25	306.44	4.48	306.16
Channel	977.00	305.44	7.34	306.22	9.25	306.33	4.48	306.02
Channel	928.00	305.31	7.34	306.10	9.25	306.21	4.48	305.90
Channel	872.00	305.16	7.34	305.96	9.25	306.08	4.48	305.76
Channel	814.00	304.95	7.34	305.82	9.25	305.94	4.48	305.61
Channel	718.00	304.72	7.34	305.71	9.25	305.83	4.48	305.51
Channel	650.00	304.53	6.53	305.67	7.57	305.79	4.93	305.47
Channel	604.00	304.40	6.53	305.63	7.57	305.76	4.93	305.44
Channel	562.00	304.29	6.53	305.01	7.57	305.06	4.93	304.91
Channel	483.00	304.11	6.53	304.81	7.57	304.86	4.93	304.74
Channel	428.00	304.01	6.53	304.39	7.57	304.41	4.93	304.34
Channel	328.00	302.81	6.53	303.48	7.57	303.49	4.93	303.42
Channel	227.00	303.07	10.97	303.33	11.12	303.33	7.58	303.30
Channel	161.00	300.99	10.97	301.30	11.12	301.31	7.58	301.25
Channel	150.00	300.64	10.97	301.11	11.12	301.12	7.58	301.04
Channel	100.00	300.26	10.97	300.80	11.12	300.80	7.58	300.70

4.3.2 Bear Creek

4.3.2.1 Existing Condition

According to the existing condition of the study area, two Reaches of Bear Creek are crossing the Salem lands. Both Upper and South Reaches are located within the Phase 1 limits in northwest quadrant of the Study Area. Under existing condition, similar to the Thornton Creek, the Bear Creek cross-sections have been updated based on available field survey information and aerial topographic data.

Hydraulic modeling has been done in Geo HEC-RAS to calculated water surface elevations and flood lines for existing condition scenario. As discussed in Section 4, Simulated peak flows have been used in hydraulic modeling procedure. The summary of the modeling results has been presented in Table 11 and Table 12 below for South Tributary of the Bear Creek and Upper Bear Creek respectively.

Table 4.11 South Tributary of the Bear Creek Geo-HEC-RAS water surface elevation results – Existing Condition

Reach Name	Cross Section Station	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UN 100YR)		Regional		Regulatory
			Total Flow	W.S. Elev.	Total Flow	W.S. Elev.	Total Flow	W.S. Elev.	W.S. Elev.
		(m)	(m3/s)	(m)	(m3/s)	(m)	(m3/s)	(m)	(m)
Main	2034	305.50	0.33	305.86	0.27	305.80	0.51	305.92	305.92
Main	2024	305.16	0.33	305.86	0.27	305.80	0.51	305.92	305.92
Main	2003	304.48	0.33	305.86	0.27	305.80	0.51	305.92	305.92
Main	1975	304.43	0.33	305.86	0.27	305.80	0.51	305.92	305.92
Main	1957.6	304.72	0.33	305.86	0.27	305.80	0.51	305.92	305.92
Main	1952.89	305.18	0.33	305.86	0.27	305.80	0.51	305.92	305.92
Main	1939.98	304.62	0.33	304.71	0.27	304.70	0.51	304.73	304.73
Main	1933.82	304.26	0.33	304.33	0.27	304.33	0.51	304.34	304.34
Main	1914	303.98	0.33	304.09	0.27	304.08	0.51	304.11	304.11
Main	1896	303.75	0.33	303.83	0.27	303.83	0.51	303.84	303.84

Reach Name	Cross Section Station	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UN 100YR)		Regional		Regulatory
			Total Flow	W.S. Elev.	Total Flow	W.S. Elev.	Total Flow	W.S. Elev.	W.S. Elev.
		(m)	(m3/s)	(m)	(m3/s)	(m)	(m3/s)	(m)	(m)
Main	1882	303.06	0.33	303.22	0.27	303.21	0.51	303.24	303.24
Main	1849	303.07	0.33	303.16	0.27	303.15	0.51	303.18	303.18
Main	1837.551	302.33	0.33	302.38	0.27	302.38	0.51	302.38	302.38
Main	1773	300.27	0.33	300.34	0.27	300.33	0.51	300.36	300.36
Main	1730.224	299.09	0.33	299.11	0.27	299.18	0.51	299.19	299.19
Main	1654	296.87	0.33	297.01	0.27	296.98	0.51	297.04	297.04
Main	1599.655	295.17	0.33	295.38	0.27	295.36	0.51	295.40	295.40
Main	1549	293.37	0.33	293.55	0.27	293.53	0.51	293.58	293.58
Main	1493.186	292.10	1.86	292.41	1.51	292.39	2.48	292.44	292.44
Main	1460	291.58	1.86	291.89	1.51	291.86	2.48	291.89	291.89
Main	1430.742	290.61	1.86	290.92	1.51	290.90	2.48	291.00	291.00
Main	1381	288.92	1.86	289.52	1.51	289.42	2.48	289.75	289.75
Main	1351	288.92	1.86	289.49	1.51	289.35	2.48	289.74	289.74
Main	1290.42	288.26	1.86	289.50	1.51	289.36	2.48	289.74	289.74
Main	1283	288.30	1.86	289.48	1.51	289.35	2.48	289.72	289.72
Main	1240	286.89	1.86	287.28	1.51	287.24	2.48	287.33	287.33
Main	1233.458	286.74	1.86	287.27	1.51	287.23	2.48	287.33	287.33
Main	1189	286.74	1.86	287.05	1.51	287.03	2.48	287.09	287.09
Main	1150.896	285.75	1.86	286.23	1.51	286.19	2.48	286.28	286.28
Main	1117	285.49	1.86	285.85	1.51	285.83	2.48	285.90	285.90
Main	1081	284.87	1.86	285.16	1.51	285.13	2.48	285.18	285.18
Main	1018.358	282.98	1.86	283.11	1.51	283.10	2.48	283.15	283.15
Main	973	281.85	1.86	282.15	1.51	282.14	2.48	282.19	282.19
Main	905.2302	279.70	1.86	280.05	1.51	279.99	2.48	280.08	280.08
Main	866	279.03	1.86	279.47	1.51	279.42	2.48	279.52	279.52
Main	733.8125	277.12	1.86	277.26	1.51	277.25	2.48	277.27	277.27
Main	628.1875	274.50	1.86	274.69	1.51	274.67	2.48	274.72	274.72
Main	435.3435	269.73	1.86	269.96	1.51	269.96	2.48	270.00	270.00
Main	280.6801	266.63	1.86	266.89	1.51	266.85	2.48	266.91	266.91
Main	164.5903	263.35	1.86	263.58	1.51	263.58	2.48	263.61	263.61

According to the R.J. Burnside Technical Memorandum for Crisdawn South Salem Road Crossing and Site Channel Analysis on June 1, 2017, considering small upstream drainage area (i.e., Less than 25 ha), this site (Upstream of culvert #3) is not regulated for flood hazards and only safe conveyance/diversion of the regulatory flow should be considered. For more detail please refer to Appendix G-3 of the SIS Report (December 2017).

Table 4.12 Upper Bear Creek Geo-HEC-RAS water surface elevation results – Existing Condition

Reach Name	Cross Section Station	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UC 100YR)		Regional		Regulatory
			Total Flow	W.S. Elev	Total Flow	W.S. Elev	Total Flow	W.S. Elev	W.S. Elev.
		(m)	(m3/s)	(m)	(m3/s)	(m)	(m3/s)	(m)	(m)
Upper	4536	310.86	0.34	310.97	0.29	310.97	0.56	310.96	310.97
Upper	4498	310.27	0.34	310.32	0.29	310.32	0.56	310.56	310.56
Upper	4375.777	309.56	0.34	310.06	0.29	310.02	0.56	310.56	310.56
Upper	4276.75	309.95	0.34	310.06	0.29	310.01	0.56	310.56	310.56
Upper	4162.725	309.52	0.34	310.06	0.29	309.90	0.56	310.56	310.56
Upper	4128	309.38	1.02	310.06	0.88	309.90	1.68	310.56	310.56
Upper	4101.763	308.82	1.02	310.05	0.88	309.89	1.68	310.56	310.56
Upper	4090	308.83	1.02	309.09	0.88	309.07	1.68	309.15	309.15
Upper	4063.35	308.62	1.02	308.95	0.88	308.93	1.68	309.02	309.02
Upper	4036	308.63	1.02	308.84	0.88	308.83	1.68	308.89	308.89
Upper	4000	308.04	1.02	308.41	0.88	308.39	1.68	308.48	308.48
Upper	3968	307.66	1.02	307.94	0.88	307.93	1.68	308.01	308.01
Upper	3932.982	306.81	3.28	307.56	2.81	307.51	5.44	307.72	307.72
Upper	3898	306.66	3.28	307.38	2.81	307.34	5.44	307.54	307.54
Upper	3843	306.62	3.28	306.92	2.81	306.90	5.44	307.00	307.00
Upper	3814	306.27	3.28	306.56	2.81	306.54	5.44	306.63	306.63
Upper	3748.546	305.76	3.28	306.06	2.81	306.04	5.44	306.15	306.15
Upper	3714	305.39	3.28	305.79	2.81	305.77	5.44	305.88	305.88
Upper	3660	304.92	3.28	305.25	2.81	305.22	5.44	305.33	305.33
Upper	3617.646	304.53	3.28	304.92	2.81	304.89	5.44	305.01	305.01
Upper	3570	304.14	3.28	304.57	2.81	304.54	5.44	304.66	304.66
Upper	3526	303.64	3.28	304.00	2.81	303.98	5.44	304.09	304.09

Reach Name	Cross Section Station	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UC 100YR)		Regional		Regulatory
			Total Flow	W.S. Elev	Total Flow	W.S. Elev	Total Flow	W.S. Elev	W.S. Elev.
		(m)	(m3/s)	(m)	(m3/s)	(m)	(m3/s)	(m)	(m)
Upper	3503.294	303.35	3.28	303.70	2.81	303.67	5.44	303.78	303.78
Upper	3432.865	302.52	3.28	303.31	2.81	303.28	5.44	303.41	303.41
Upper	3376	302.04	3.28	303.31	2.81	303.28	5.44	303.41	303.41
Upper	3312.375	302.65	3.28	303.20	2.81	303.19	5.44	303.30	303.30
Upper	3255	301.88	3.28	302.70	2.81	302.67	5.44	302.83	302.83
Upper	3194.309	302.14	3.29	302.52	2.82	302.50	5.56	302.69	302.69
Upper	3169	301.33	3.29	302.19	2.82	302.10	5.56	302.66	302.66
Upper	3164	301.17	3.29	302.21	2.82	302.11	5.56	302.61	302.61
Upper	3137	301.08	3.29	301.69	2.82	301.67	5.56	301.76	301.76
Upper	3132	301.13	3.29	301.66	2.82	301.64	5.56	301.75	301.75
Upper	3106	301.00	3.29	301.35	2.82	301.33	5.56	301.43	301.43
Upper	3090	300.75	3.29	301.17	2.82	301.13	5.56	301.30	301.30
Upper	3077	300.53	3.29	301.09	2.82	301.06	5.56	301.24	301.24
Upper	3054	300.21	3.29	300.75	2.82	300.72	5.56	300.89	300.89
Upper	3000.647	299.77	3.29	300.46	2.82	300.42	5.56	300.66	300.66
Upper	2999	299.71	3.29	300.28	2.82	300.24	5.56	300.40	300.40
Upper	2997	299.27	3.29	299.94	2.82	299.92	5.56	300.05	300.05
Upper	2939.565	298.68	3.29	299.14	2.82	299.11	5.56	299.23	299.23
Upper	2936	298.08	3.29	298.78	2.82	298.74	5.56	298.92	298.92
Upper	2919	298.05	3.29	298.53	2.82	298.50	5.56	298.64	298.64
Upper	2900	297.41	3.29	298.02	2.82	297.99	5.56	298.15	298.15
Upper	2881	296.97	3.29	297.61	2.82	297.57	5.56	297.76	297.76
Upper	2871	296.78	3.29	297.29	2.82	297.27	5.56	297.37	297.37
Upper	2832.683	296.63	3.29	297.25	2.82	297.20	5.56	297.47	297.47
Upper	2830	296.46	3.29	297.23	2.82	297.17	5.56	297.46	297.46
Upper	2828	296.24	3.29	296.94	2.82	296.89	5.56	297.13	297.13
Upper	2805	295.92	3.29	296.16	2.82	296.15	5.56	296.20	296.20
Upper	2791	295.13	3.29	295.77	2.82	295.73	5.56	295.91	295.91
Upper	2765	294.87	3.29	295.36	2.82	295.33	5.56	295.50	295.50
Upper	2729	294.08	3.29	294.87	2.82	294.82	5.56	295.05	295.05
Upper	2713	293.78	3.29	294.52	2.82	294.48	5.56	294.68	294.68
Upper	2701	293.26	3.29	293.90	2.82	293.86	5.56	294.02	294.02

Reach Name	Cross Section Station	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UC 100YR)		Regional		Regulatory
			Total Flow	W.S. Elev	Total Flow	W.S. Elev	Total Flow	W.S. Elev	W.S. Elev.
		(m)	(m3/s)	(m)	(m3/s)	(m)	(m3/s)	(m)	(m)
Upper	2690	292.82	3.29	293.54	2.82	293.48	5.56	293.75	293.75
Upper	2653.32	292.48	3.29	293.39	2.82	293.35	5.56	293.56	293.56
Upper	2646	292.10	3.29	292.84	2.82	292.79	5.56	293.01	293.01
Upper	2633	291.94	3.29	292.80	2.82	292.76	5.56	292.93	292.93
Upper	2623	291.55	3.29	292.81	2.82	292.77	5.56	292.94	292.94
Upper	2611	291.44	3.29	292.67	2.82	292.64	5.56	292.77	292.77
Upper	2605	291.37	3.29	291.77	2.82	291.73	5.56	291.88	291.88
Upper	2591	291.06	3.29	291.64	2.82	291.61	5.56	291.78	291.78
Upper	2560.813	290.69	4.16	291.16	3.51	291.12	6.92	291.28	291.28
Upper	2560	290.25	4.16	291.05	3.51	290.99	6.92	291.26	291.26
Upper	2551	290.05	4.16	290.90	3.51	290.85	6.92	291.06	291.06
Upper	2536	289.69	4.16	290.90	3.51	290.85	6.92	291.08	291.08
Upper	2512	289.02	4.16	290.63	3.51	290.60	6.92	290.76	290.76
Upper	2494	288.91	4.16	289.83	3.51	289.80	6.92	290.00	290.00
Upper	2469.197	288.86	4.16	289.51	3.51	289.47	6.92	289.98	289.98
Upper	2449	288.29	4.16	288.71	3.51	288.66	6.92	289.99	289.99
Upper	2426	287.76	4.16	288.58	3.51	288.52	6.92	289.99	289.99
Upper	2412	287.68	4.16	288.32	3.51	288.28	6.92	289.98	289.98
Upper	2396.922	287.55	4.16	288.27	3.51	288.05	6.92	289.98	289.98
Upper	2391	286.50	4.16	288.24	3.51	288.02	6.92	289.96	289.96

RJBA also simulated the flood plain area between ESSA Road and Lougheed Road and documented their findings in the Summary Report for Digital Floodplain Mapping for Bear Creek within the Salem Secondary Plan (July 2014). SCE's review of the RJBA report found their recommendations to be acceptable and that the findings are in general conformance with the analysis completed afterwards for the SIS.

The review of survey information and DSWMMP revealed that the watercourse profile and cross-sections along the creek downstream of Essa Road should be significantly revised. This

observation has been taken into consideration in the RJBA report. For more detail please refer to Appendix G-1 of the SIS Report (December 2017).

4.3.2.2 Post-Development Condition

Similar to the Thornton Creek, Steady Flow analysis is performed for the hydraulic modelling of the Bear Creek and Regional storm (i.e., Timmins Storm) and 100-year SCS type II 24 hour and 100-year Chicago 4 hour storm events are considered for floodplain preparation. The post-development flow nodes map is presented in Appendix A. Based on the hydrology simulation results, 100-year 4 hour Chicago storm events creates higher flows and considered as regulatory storm event for both Upper Bear Creek and South Tributary of the Bear Creek.

The Bear Creek Geo-HEC-RAS water surface elevation results for post-development scenario considering upgraded culverts and post-development flows are presented in Table 4.13 and Table 4.14 for Upper Bear Creek and South Tributary of the Bear Creek respectively. It should be noted that the Geo-HEC-RAS model summary outputs are presented in Appendix B.

Table 4.13 Upper Bear Creek Geo-HEC-RAS water surface elevation results

Reach Name	Cross Section Station	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UC 100YR)		Regional		Regulatory
			Total Flow	W.S. Elev	Total Flow	W.S. Elev	Total Flow	W.S. Elev	W.S. Elev.
		(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m)
Upper	4536	310.86	0.55	310.98	0.67	311.00	0.50	310.98	311.00
Upper	4498	310.27	0.55	310.34	0.67	310.34	0.50	310.34	310.34
Upper	4375.777	309.56	0.55	310.03	0.67	310.04	0.50	310.03	310.04
Upper	4276.75	309.95	0.55	310.02	0.67	310.02	0.50	310.01	310.02
Upper	4162.725	309.52	0.55	309.80	0.67	309.86	0.50	309.78	309.86
Upper	4128	309.38	1.64	309.78	2.02	309.85	1.49	309.75	309.85
Upper	4123	309.29	1.64	309.75	2.02	309.82	1.49	309.72	309.82
Upper	4081	308.47	1.64	309.02	2.02	309.05	1.49	309.01	309.05
Upper	4063.35	308.62	1.64	309.02	2.02	309.06	1.49	309.01	309.06
Upper	4036	308.63	1.64	308.89	2.02	308.92	1.49	308.89	308.92
Upper	4000	308.04	1.64	308.48	2.02	308.65	1.49	308.44	308.65
Upper	3968	307.66	1.64	308.46	2.02	308.64	1.49	308.02	308.64
Upper	3932.982	306.81	20.69	308.32	27.24	308.49	9.40	307.93	308.49
Upper	3898	306.66	20.69	308.10	27.24	308.25	9.40	307.74	308.25
Upper	3843	306.62	20.69	307.41	27.24	307.53	9.40	307.12	307.53
Upper	3814	306.27	20.69	306.98	27.24	307.08	9.40	306.75	307.08
Upper	3748.546	305.76	20.69	306.52	27.24	306.63	9.40	306.28	306.63
Upper	3714	305.39	20.69	306.23	27.24	306.33	9.40	305.99	306.33
Upper	3660	304.92	20.69	305.69	27.24	305.79	9.40	305.45	305.79
Upper	3617.646	304.53	20.69	305.35	27.24	305.42	9.40	305.14	305.42
Upper	3570	304.14	20.69	304.99	27.24	305.09	9.40	304.77	305.09
Upper	3526	303.64	20.69	304.44	27.24	304.53	9.40	304.22	304.53
Upper	3503.294	303.35	20.69	304.27	27.24	304.35	9.40	303.99	304.35
Upper	3432.865	302.52	20.69	303.65	27.24	303.76	9.40	303.44	303.76
Upper	3376	302.04	20.69	303.64	27.24	303.74	9.40	303.46	303.74
Upper	3312.375	302.65	20.69	303.55	27.24	303.64	9.40	303.35	303.64
Upper	3255	301.88	20.69	303.22	27.24	303.27	9.40	303.02	303.27
Upper	3194.309	302.14	24.45	302.86	28.14	302.94	13.29	302.85	302.94
Upper	3169	301.33	24.45	302.87	28.14	302.95	13.29	302.85	302.95
Upper	3164	301.17	24.45	302.87	28.14	302.94	13.29	302.85	302.94
Upper	3137	301.08	24.45	302.27	28.14	302.36	13.29	301.92	302.36

Reach Name	Cross Section Station	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UC 100YR)		Regional		Regulatory
			Total Flow	W.S. Elev	Total Flow	W.S. Elev	Total Flow	W.S. Elev	W.S. Elev.
		(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m)
Upper	3132	301.13	24.45	302.14	28.14	302.20	13.29	301.93	302.20
Upper	3106	301.00	24.45	301.96	28.14	302.04	13.29	301.68	302.04
Upper	3090	300.75	24.45	301.91	28.14	301.99	13.29	301.62	301.99
Upper	3077	300.53	24.45	301.87	28.14	301.96	13.29	301.57	301.96
Upper	3054	300.21	24.45	301.52	28.14	301.64	13.29	301.17	301.64
Upper	3000.647	299.77	24.45	301.50	28.14	301.60	13.29	301.09	301.60
Upper	2999	299.71	24.45	301.08	28.14	301.17	13.29	300.74	301.17
Upper	2997	299.27	24.45	300.52	28.14	300.59	13.29	300.26	300.59
Upper	2939.565	298.68	24.45	299.83	28.14	299.91	13.29	299.52	299.91
Upper	2936	298.08	24.45	299.58	28.14	299.67	13.29	299.26	299.67
Upper	2919	298.05	24.45	299.21	28.14	299.28	13.29	298.92	299.28
Upper	2900	297.41	24.45	298.72	28.14	298.80	13.29	298.45	298.80
Upper	2881	296.97	24.45	298.45	28.14	298.60	13.29	298.09	298.60
Upper	2871	296.78	24.45	298.52	28.14	298.65	13.29	298.02	298.65
Upper	2832.683	296.63	24.45	298.50	28.14	298.63	13.29	298.00	298.63
Upper	2830	296.46	24.45	298.50	28.14	298.63	13.29	298.00	298.63
Upper	2828	296.24	24.45	297.96	28.14	298.08	13.29	297.56	298.08
Upper	2805	295.92	24.45	296.51	28.14	296.57	13.29	296.34	296.57
Upper	2791	295.13	24.45	296.65	28.14	296.76	13.29	296.25	296.76
Upper	2765	294.87	24.45	296.19	28.14	296.29	13.29	295.85	296.29
Upper	2729	294.08	24.45	295.97	28.14	296.09	13.29	295.50	296.09
Upper	2713	293.78	24.45	295.50	28.14	295.61	13.29	295.10	295.61
Upper	2701	293.26	24.45	294.65	28.14	294.75	13.29	294.31	294.75
Upper	2690	292.82	24.45	294.52	28.14	294.59	13.29	294.25	294.59
Upper	2653.32	292.48	24.45	293.90	28.14	294.00	13.29	293.55	294.00
Upper	2646	292.10	24.45	293.73	28.14	293.83	13.29	293.38	293.83
Upper	2633	291.94	24.45	293.44	28.14	293.50	13.29	293.20	293.50
Upper	2623	291.55	24.45	293.56	28.14	293.65	13.29	293.26	293.65
Upper	2611	291.44	24.45	293.25	28.14	293.31	13.29	293.01	293.31
Upper	2605	291.37	24.45	292.66	28.14	292.79	13.29	292.23	292.79
Upper	2591	291.06	24.45	292.42	28.14	292.46	13.29	292.05	292.46
Upper	2560.813	290.69	23.67	292.45	29.11	292.53	13.99	292.25	292.53

Reach Name	Cross Section Station	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UC 100YR)		Regional		Regulatory
			Total Flow	W.S. Elev	Total Flow	W.S. Elev	Total Flow	W.S. Elev	W.S. Elev.
		(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m)
Upper	2560	290.25	23.67	292.48	29.11	292.58	13.99	292.26	292.58
Upper	2551	290.05	23.67	292.45	29.11	292.54	13.99	292.25	292.54
Upper	2536	289.69	23.67	292.46	29.11	292.55	13.99	292.25	292.55
Upper	2512	289.02	23.67	292.44	29.11	292.53	13.99	292.24	292.53
Upper	2494	288.91	23.67	292.44	29.11	292.53	13.99	292.24	292.53
Upper	2469.197	288.86	23.67	292.45	29.11	292.53	13.99	292.24	292.53
Upper	2449	288.29	23.67	292.45	29.11	292.53	13.99	292.24	292.53
Upper	2426	287.76	23.67	292.45	29.11	292.53	13.99	292.24	292.53
Upper	2412	287.68	23.67	292.45	29.11	292.53	13.99	292.24	292.53
Upper	2396.922	287.55	23.67	292.45	29.11	292.53	13.99	292.24	292.53
Upper	2391	286.50	23.67	292.45	29.11	292.53	13.99	292.24	292.53

As discussed before, where field topographic information is available, Geo-HEC-RAS ultra-resolution terrain elevation layer is used for generating the floodplains for 100-year uncontrolled and Regional events storms from the obtained water surface elevations of Bear Creek. Floodplains Drawings of the Bear Creek are presented in Appendix C. It should be noted that, according to NVCA Natural Hazards Technical Guide, 100-year uncontrolled floodplains are created considering the widest generated floodplains by 100-year SCS type II 24 hour and 100-year Chicago 4 hour storms.

Based on the observed differences between geometry of the Schaeffers Consulting Engineers (SCE) and DSWMMP models in area with aerial topographic data, gathering detailed topographic data is recommended for floodplain refinement of these areas in the detailed design phase.

Table 4.14 South Tributary of the Bear Creek Geo-HEC-RAS water surface elevation results

Reach Name	Cross Section Station	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UN 100YR)		Regional		Regulatory
			Total Flow	W.S. Elev.	Total Flow	W.S. Elev.	Total Flow	W.S. Elev.	W.S. Elev.
		(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m)
Main	2034	305.50	4.89	306.23	6.48	306.96	2.12	305.70	306.96
Main	2024	305.16	4.89	306.23	6.48	306.96	2.12	305.39	306.96
Main	2003	304.48	4.89	306.23	6.48	306.96	2.12	305.40	306.96
Main	1975	304.43	4.89	306.23	6.48	306.96	2.12	305.40	306.96
Main	1970	304.45	4.89	306.21	6.48	306.95	2.12	305.39	306.95
Main	1922	304.05	4.89	304.38	6.48	304.43	2.12	304.28	304.43
Main	1914	303.98	4.89	304.26	6.48	304.24	2.12	304.19	304.26
Main	1896	303.75	4.89	304.01	6.48	304.04	2.12	303.92	304.04
Main	1882	303.06	4.89	303.48	6.48	303.53	2.12	303.37	303.53
Main	1849	303.07	4.89	303.33	6.48	303.36	2.12	303.25	303.36
Main	1837.551	302.33	4.89	302.45	6.48	302.47	2.12	302.42	302.47
Main	1773	300.27	4.89	300.50	6.48	300.53	2.12	300.42	300.53
Main	1730.224	299.09	4.89	299.35	6.48	299.38	2.12	299.26	299.38
Main	1654	296.87	4.89	297.22	6.48	297.26	2.12	297.13	297.26
Main	1599.655	295.17	4.89	295.75	6.48	295.82	2.12	295.57	295.82
Main	1549	293.37	4.89	293.81	6.48	293.86	2.12	293.71	293.86
Main	1493.186	292.10	4.37	292.47	5.18	292.55	2.33	292.44	292.55
Main	1460	291.58	4.37	292.03	5.18	292.05	2.33	291.92	292.05
Main	1430.742	290.61	4.37	291.04	5.18	291.08	2.33	290.95	291.08
Main	1381	288.92	4.37	290.02	5.18	290.49	2.33	289.48	290.49
Main	1351	288.92	4.37	290.01	5.18	290.49	2.33	289.34	290.49
Main	1290.42	288.26	10.34	290.01	12.31	290.48	5.18	289.33	290.48
Main	1283	288.30	10.34	289.93	12.31	290.42	5.18	289.28	290.42
Main	1240	286.89	10.34	287.75	12.31	287.87	5.18	287.46	287.87
Main	1233.458	286.74	10.34	287.72	12.31	287.78	5.18	287.51	287.78
Main	1189	286.74	10.34	287.36	12.31	287.41	5.18	287.21	287.41
Main	1150.896	285.75	10.34	286.65	12.31	286.71	5.18	286.44	286.71
Main	1117	285.49	10.34	286.26	12.31	286.32	5.18	286.06	286.32
Main	1081	284.87	10.34	285.33	12.31	285.36	5.18	285.24	285.36
Main	1018.358	282.98	10.34	283.41	12.31	283.46	5.18	283.26	283.46
Main	973	281.85	10.34	282.43	12.31	282.47	5.18	282.31	282.47

Reach Name	Cross Section Station	Min Channel Elevation	SCS II 24HR (UC 100YR)		Chicago 4HR (UN 100YR)		Regional		Regulatory
			Total Flow	W.S. Elev.	Total Flow	W.S. Elev.	Total Flow	W.S. Elev.	W.S. Elev.
		(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m)
Main	905.2302	279.70	10.34	280.39	12.31	280.45	5.18	280.19	280.45
Main	866	279.03	10.34	279.73	12.31	279.85	5.18	279.65	279.85
Main	733.8125	277.12	10.34	277.45	12.31	277.46	5.18	277.34	277.46
Main	628.1875	274.50	10.34	274.90	12.31	274.96	5.18	274.80	274.96
Main	435.3435	269.73	10.34	270.24	12.31	270.26	5.18	270.09	270.26
Main	280.6801	266.63	10.34	267.09	12.31	267.14	5.18	267.00	267.14
Main	164.5903	263.35	10.34	263.85	12.31	263.86	5.18	263.70	263.86

5.0 Summary and Conclusion

This document has provided the water surface elevation results and associated floodplains of the Thornton Creek and Bear Creek at the Salem Secondary Plan-Annexed lands for existing and post-development conditions. In preparation to the modelling, SCE reviewed the original HEC-RAS models presented in the DSWMMP. Using the GEO HEC-RAS software the original models have been recreated to determine flood plain limits for the existing and post-development conditions of Salem lands.

A summary of the analysis results and findings are presented as follow:

- Both Thornton Creek and Bear Creek are under Nottawasaga Valley Conservation Authority (NVCA)

- Hydraulic modelling of both Bear and Thornton Creeks are performed using Geo-HEC-RAS software for Existing and Post-Development conditions

- Since Lover's creek is mostly located beyond 2031limits and the topographic data was not available for the majority of the study area, analysis of floodplain for Lover's Creek has become differed to the time when those developments within 2031 development boundary is being detail designed

- Under post-development condition, the obtained flows from VO2 model are used and the existing culverts are upsized in accordance to the city of Barrie standards to support the additional flow directed to the creeks under post-development scenario

- Considering Nottawasaga Valley Conservation Authority (NVCA) Natural Hazards Technical Guide, Regional and uncontrolled 100-year SCS type II 24 hour and 100-year

Chicago 4 hour storm events are simulated based on the current hydrology information as well as detailed topographic survey information (where available)

- Differences between geometry of the SCE and DSWMMP models specially, where the topographic data are available, indicate the need for gathering detailed topographic data for floodplain refinement of the remaining areas where the topographic data are not available

- The existing ground surface between Western and Eastern Tributaries of the Thornton Creek is very flat and there is no major water course for conveying flows from the areas north of McKay Road

- To convey post-development flows from areas North of McKay Road (NHS areas as well as drainage area contributing to SWM Ponds C and K) and divert the flow from future Phase 3 lands, an engineered channel is proposed to collect and convey the run-off from northern tributary areas (NHS areas as well as drainage area contributing to SWM Pond K) to Thornton Creek. Current design of the proposed engineered channel is conceptual only and it should be further developed at the detail design stage in accordance with the City of Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines.

- Results of the current study shows that obtained water surface elevations and floodplains should be refined based on the accurate modelling where the detailed topographic information is not available

- According to the RJBA Technical Memorandum for Crisdawn South (Parcel 13) Salem Road Crossing and Site Channel Analysis dated June 1, 2017, considering small upstream drainage area (less than 25 ha), this site (upstream of Culvert #3) is not regulated for

flood hazards and only safe conveyance/diversion of the regulatory flow should be considered

- Considerable differences are found between the SCE and the DSWMMP channel elevations at the downstream of the culvert number 5 in the Upper tributary of the Bear Creek. Hence, proposed floodplain should be revised based on the accurate topographical data

Respectfully Submitted,

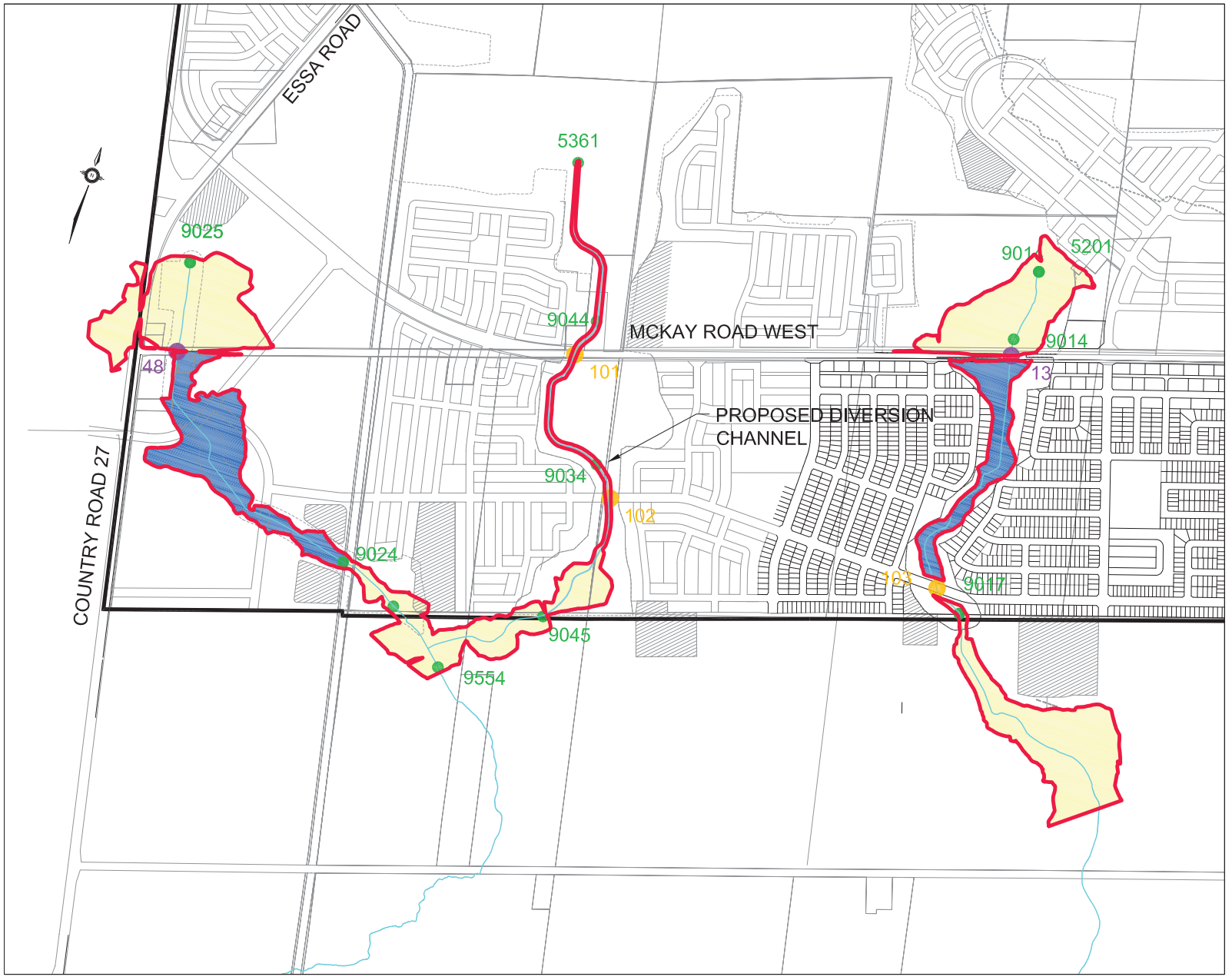
SCHAEFFER & ASSOCIATES LTD.



Farzad Fahimi, Ph.D.
Modeler / Analyst

Koryun Shahbikian, M.Eng., P.Eng., PMP
Associate

Appendix A: Geo-HEC-RAS Model Flow Nodes Map



SALEM COMMUNITY DEVELOPMENT AREA
CITY OF BARRIE

LEGEND

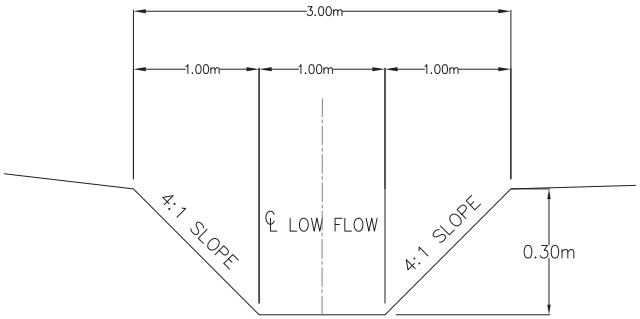
- SECONDARY DEVELOPMENT PLAN BOUNDARY
- PROPOSED REGULATORY FLOODLINES THORNTON CREEK WITHOUT DETAILED TOPOGRAPHIC INFORMATION
- PROPOSED REGULATORY FLOODLINES THORNTON CREEK WITH DETAILED TOPOGRAPHIC INFORMATION
- 9014 PROPOSED FLOW NODE
- EXISTING CULVERT LOCATION
- NEW PROPOSED CULVERT
- THORNTON CREEK

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE A-3
THORNTON CREEK FLOODPLAIN
POST-DEVELOPMENT CONDITIONS

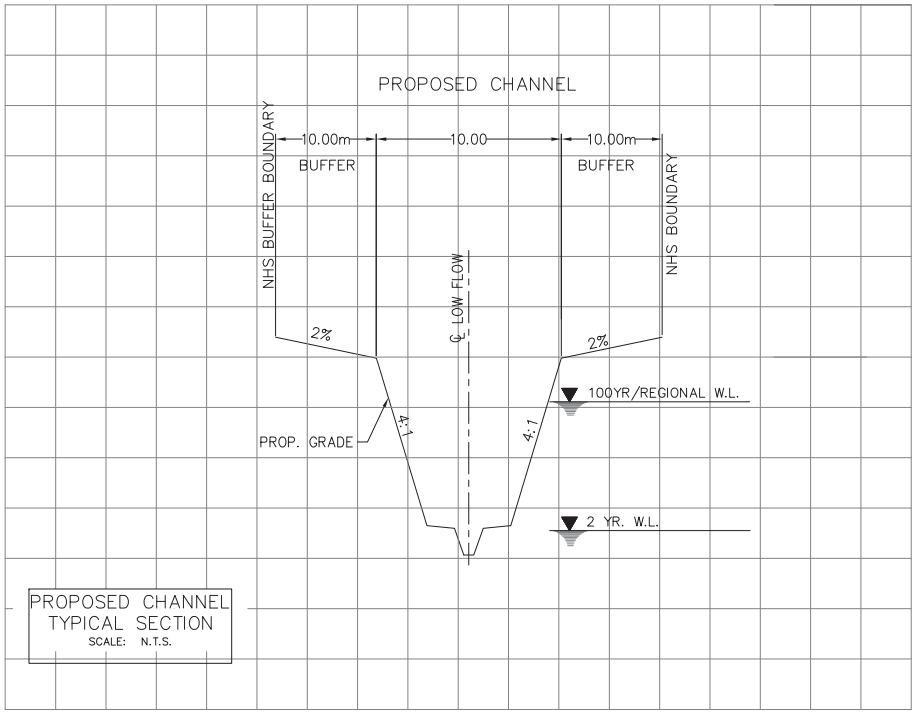
2014-4074	NOVEMBER 2017	SCALE: N.T.S.

Phil Gottfried
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ENLARGED DETAIL OF LOW FLOW CHANNEL

NOT TO SCALE



SALEM COMMUNITY DEVELOPMENT AREA
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FIGURE A-5
THORTON CREEK
TYPICAL SECTION
PROPOSED ENGINEERED CHANNEL

2014-4074	NOVEMBER 2017	SCALE: N.T.S.

Farzad Fahimi
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Thornton Creek- Engineered Channel- Geo- HEC-RAS Model Summary Output

HEC-RAS Plan: Post Development River: Engineered Reach: Channel

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Channel	1566	100 UC SCS 24 hr	1.46	308.12	308.35	308.29	308.39	0.009610	0.82	1.78	9.13	0.59
Channel	1566	Regional	2.85	308.12	308.44	308.37	308.50	0.010068	1.08	2.65	9.69	0.65
Channel	1566	Chicago UC 4 hr	1.59	308.12	308.40	308.30	308.43	0.005216	0.70	2.27	9.45	0.45
Channel	1496	100 UC SCS 24 hr	1.46	307.44	307.67		307.70	0.009821	0.82	1.76	9.13	0.60
Channel	1496	Regional	2.85	307.44	307.77		307.82	0.009587	1.06	2.69	9.73	0.63
Channel	1496	Chicago UC 4 hr	1.59	307.44	307.62	307.62	307.69	0.029843	1.21	1.32	8.83	1.00
Channel	1437	100 UC SCS 24 hr	1.46	306.85	307.08	307.02	307.11	0.010076	0.83	1.75	9.13	0.61
Channel	1437	Regional	2.85	306.85	307.17	307.10	307.23	0.010403	1.09	2.62	9.68	0.66
Channel	1437	Chicago UC 4 hr	1.59	306.85	307.22	307.03	307.24	0.001869	0.52	3.12	9.98	0.29
Channel	1379	100 UC SCS 24 hr	1.46	306.51	307.04	306.68	307.05	0.000421	0.32	4.74	10.77	0.14
Channel	1379	Regional	2.85	306.51	307.00	306.77	307.03	0.002185	0.69	4.29	10.53	0.33
Channel	1379	Chicago UC 4 hr	1.59	306.51	307.21	306.69	307.21	0.000190	0.26	6.58	11.73	0.10
Channel	1325	100 UC SCS 24 hr	1.46	306.38	307.03	306.54	307.03	0.000168	0.23	6.61	12.40	0.10
Channel	1325	Regional	2.85	306.38	306.89	306.62	306.91	0.001555	0.60	4.93	11.53	0.28
Channel	1325	Chicago UC 4 hr	1.59	306.38	307.20	306.55	307.20	0.000087	0.20	8.82	13.47	0.07
Channel	1252	100 UC SCS 24 hr	1.46	306.21	307.02		307.02	0.000088	0.20	8.12	12.61	0.07
Channel	1252	Regional	2.85	306.21	306.79		306.81	0.001113	0.55	5.39	11.25	0.24
Channel	1252	Chicago UC 4 hr	1.59	306.21	307.20		307.20	0.000052	0.17	10.41	13.67	0.06
Channel	1190	100 UC SCS 24 hr	1.46	306.08	307.02	306.24	307.02	0.000051	0.17	9.82	13.44	0.06
Channel	1190	Regional	2.85	306.08	306.74	306.33	306.75	0.000693	0.48	6.33	11.78	0.19
Channel	1190	Chicago UC 4 hr	1.59	306.08	307.19	306.25	307.20	0.000033	0.15	12.28	14.49	0.05
Channel	1133	100 UC SCS 24 hr	7.34	305.95	306.96	306.39	306.99	0.001029	0.78	10.62	13.62	0.25
Channel	1133	Regional	4.48	305.95	306.67	306.28	306.69	0.001325	0.70	6.88	11.90	0.27
Channel	1133	Chicago UC 4 hr	9.25	305.95	307.14	306.46	307.17	0.000911	0.83	13.12	14.67	0.25
Channel	1071	100 UC SCS 24 hr	7.34	305.82	306.92	306.20	306.94	0.000557	0.62	11.79	19.47	0.19
Channel	1071	Regional	4.48	305.82	306.62	306.10	306.64	0.000614	0.53	8.52	17.06	0.19
Channel	1071	Chicago UC 4 hr	9.25	305.82	307.10	306.26	307.13	0.000531	0.67	13.75	20.90	0.19
Channel	1044		Culvert									
Channel	1026	100 UC SCS 24 hr	7.34	305.67	306.34	306.09	306.41	0.003883	1.15	6.84	12.59	0.46
Channel	1026	Regional	4.48	305.67	306.16	305.98	306.21	0.004496	0.99	4.69	11.44	0.47

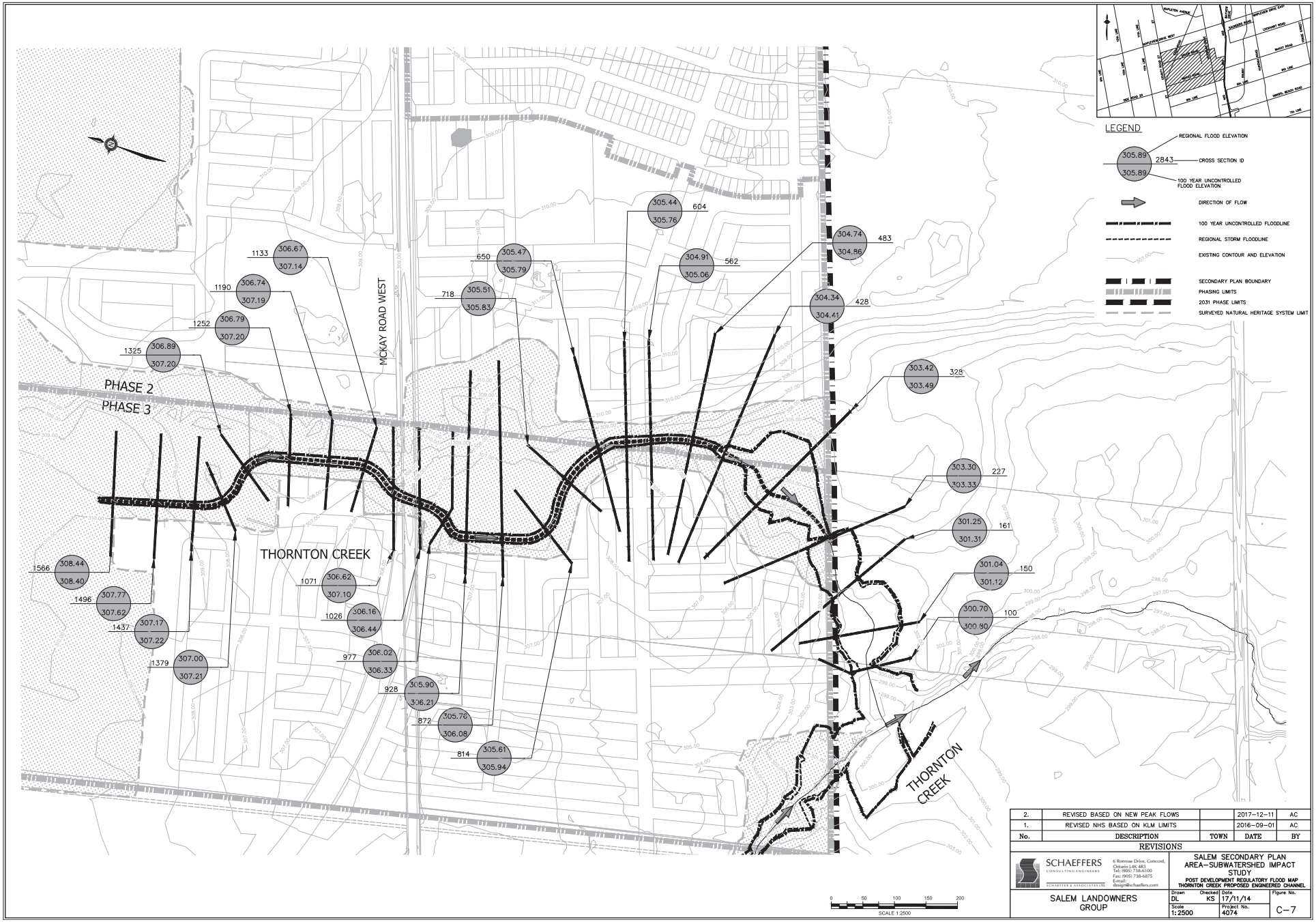
HEC-RAS Plan: Post Development River: Engineered Reach: Channel (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Channel	1026	Chicago UC 4 hr	9.25	305.67	306.44	306.15	306.52	0.003715	1.24	8.15	13.23	0.46
Channel	977	100 UC SCS 24 hr	7.34	305.44	306.22	305.85	306.26	0.002135	0.94	9.18	23.35	0.35
Channel	977	Regional	4.48	305.44	306.02	305.75	306.05	0.002298	0.79	5.92	12.44	0.34
Channel	977	Chicago UC 4 hr	9.25	305.44	306.33	305.92	306.38	0.001966	0.99	12.23	30.53	0.34
Channel	928	100 UC SCS 24 hr	7.34	305.31	306.10	305.76	306.15	0.002528	1.03	7.77	12.44	0.38
Channel	928	Regional	4.48	305.31	305.90	305.64	305.94	0.002661	0.86	5.45	11.27	0.37
Channel	928	Chicago UC 4 hr	9.25	305.31	306.21	305.81	306.27	0.002469	1.12	9.21	13.12	0.38
Channel	872	100 UC SCS 24 hr	7.34	305.16	305.96		306.01	0.002287	1.00	8.06	12.64	0.36
Channel	872	Regional	4.48	305.16	305.76		305.80	0.002446	0.84	5.62	11.42	0.36
Channel	872	Chicago UC 4 hr	9.25	305.16	306.08		306.14	0.002220	1.08	9.58	13.35	0.37
Channel	814	100 UC SCS 24 hr	7.34	304.95	305.82		305.86	0.001832	0.94	8.67	12.81	0.33
Channel	814	Regional	4.48	304.95	305.61		305.64	0.001838	0.77	6.16	11.59	0.31
Channel	814	Chicago UC 4 hr	9.25	304.95	305.94		305.99	0.001812	1.02	10.27	13.53	0.33
Channel	718	100 UC SCS 24 hr	7.34	304.72	305.71		305.74	0.001032	0.77	10.73	14.05	0.25
Channel	718	Regional	4.48	304.72	305.51		305.53	0.000854	0.60	8.10	12.85	0.22
Channel	718	Chicago UC 4 hr	9.25	304.72	305.83		305.86	0.001088	0.86	12.44	14.78	0.26
Channel	650	100 UC SCS 24 hr	6.53	304.53	305.67		305.69	0.000466	0.57	13.20	15.28	0.17
Channel	650	Regional	4.93	304.53	305.47		305.48	0.000535	0.54	10.27	14.02	0.18
Channel	650	Chicago UC 4 hr	7.57	304.53	305.79		305.81	0.000431	0.59	15.12	16.05	0.17
Channel	604	100 UC SCS 24 hr	6.53	304.40	305.63	304.84	305.66	0.000607	0.70	9.31	15.20	0.20
Channel	604	Regional	4.93	304.40	305.44	304.76	305.46	0.000628	0.63	7.79	14.00	0.20
Channel	604	Chicago UC 4 hr	7.57	304.40	305.76	304.88	305.78	0.000592	0.74	10.25	15.93	0.20
Channel	584		Culvert									
Channel	562	100 UC SCS 24 hr	6.53	304.29	305.01	304.71	305.06	0.002806	1.02	6.86	12.07	0.39
Channel	562	Regional	4.93	304.29	304.91	304.64	304.95	0.002726	0.90	5.76	11.49	0.38
Channel	562	Chicago UC 4 hr	7.57	304.29	305.06	304.74	305.12	0.002866	1.08	7.50	12.41	0.40
Channel	483	100 UC SCS 24 hr	6.53	304.11	304.81	304.52	304.87	0.002980	1.04	6.78	11.99	0.41
Channel	483	Regional	4.93	304.11	304.74	304.45	304.78	0.002565	0.89	5.90	11.54	0.37
Channel	483	Chicago UC 4 hr	7.57	304.11	304.86	304.56	304.92	0.003196	1.12	7.32	12.26	0.42

HEC-RAS Plan: Post Development River: Engineered Reach: Channel (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Channel	428	100 UC SCS 24 hr	6.53	304.01	304.39	304.39	304.50	0.022499	1.51	4.71	23.73	0.95
Channel	428	Regional	4.93	304.01	304.34	304.34	304.44	0.024525	1.39	3.73	21.43	0.96
Channel	428	Chicago UC 4 hr	7.57	304.01	304.41	304.41	304.54	0.022401	1.59	5.26	24.93	0.96
Channel	328	100 UC SCS 24 hr	6.53	302.81	303.48	303.03	303.48	0.000102	0.17	52.41	124.27	0.07
Channel	328	Regional	4.93	302.81	303.42	303.01	303.42	0.000089	0.15	45.01	121.61	0.07
Channel	328	Chicago UC 4 hr	7.57	302.81	303.49	303.04	303.49	0.000130	0.20	53.37	124.61	0.08
Channel	227	100 UC SCS 24 hr	10.97	303.07	303.33	303.33	303.40	0.029537	1.18	9.44	69.48	0.99
Channel	227	Regional	7.58	303.07	303.30	303.30	303.36	0.032860	1.07	7.15	64.14	1.01
Channel	227	Chicago UC 4 hr	11.12	303.07	303.33	303.33	303.40	0.029566	1.18	9.52	69.66	0.99
Channel	161	100 UC SCS 24 hr	10.97	300.99	301.30	301.24	301.36	0.010276	1.03	11.38	53.13	0.65
Channel	161	Regional	7.58	300.99	301.25	301.20	301.29	0.010807	0.91	8.65	48.38	0.64
Channel	161	Chicago UC 4 hr	11.12	300.99	301.31	301.25	301.36	0.010258	1.04	11.50	53.33	0.65
Channel	150	100 UC SCS 24 hr	10.97	300.64	301.11		301.12	0.001186	0.46	30.75	107.13	0.24
Channel	150	Regional	7.58	300.64	301.04		301.05	0.001230	0.41	23.05	101.24	0.23
Channel	150	Chicago UC 4 hr	11.12	300.64	301.12		301.13	0.001183	0.46	31.09	107.35	0.24
Channel	100	100 UC SCS 24 hr	10.97	300.26	300.80	300.80	300.93	0.015474	1.71	8.72	41.24	0.85
Channel	100	Regional	7.58	300.26	300.70	300.70	300.83	0.020244	1.63	5.42	24.96	0.93
Channel	100	Chicago UC 4 hr	11.12	300.26	300.80	300.80	300.93	0.015460	1.72	8.83	41.45	0.86

Appendix C: Geo-HEC-RAS Model Floodplains Drawings



No.	DESCRIPTION	TOWN	DATE	BY
2.	REVISED BASED ON NEW PEAK FLOWS		2017-12-11	AC
1.	REVISED NHS BASED ON KLM LIMITS		2016-09-01	AC

REVISIONS

SCHAEFFERS CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100
Fax: (905) 738-6875
E-mail: design@schaeffers.com

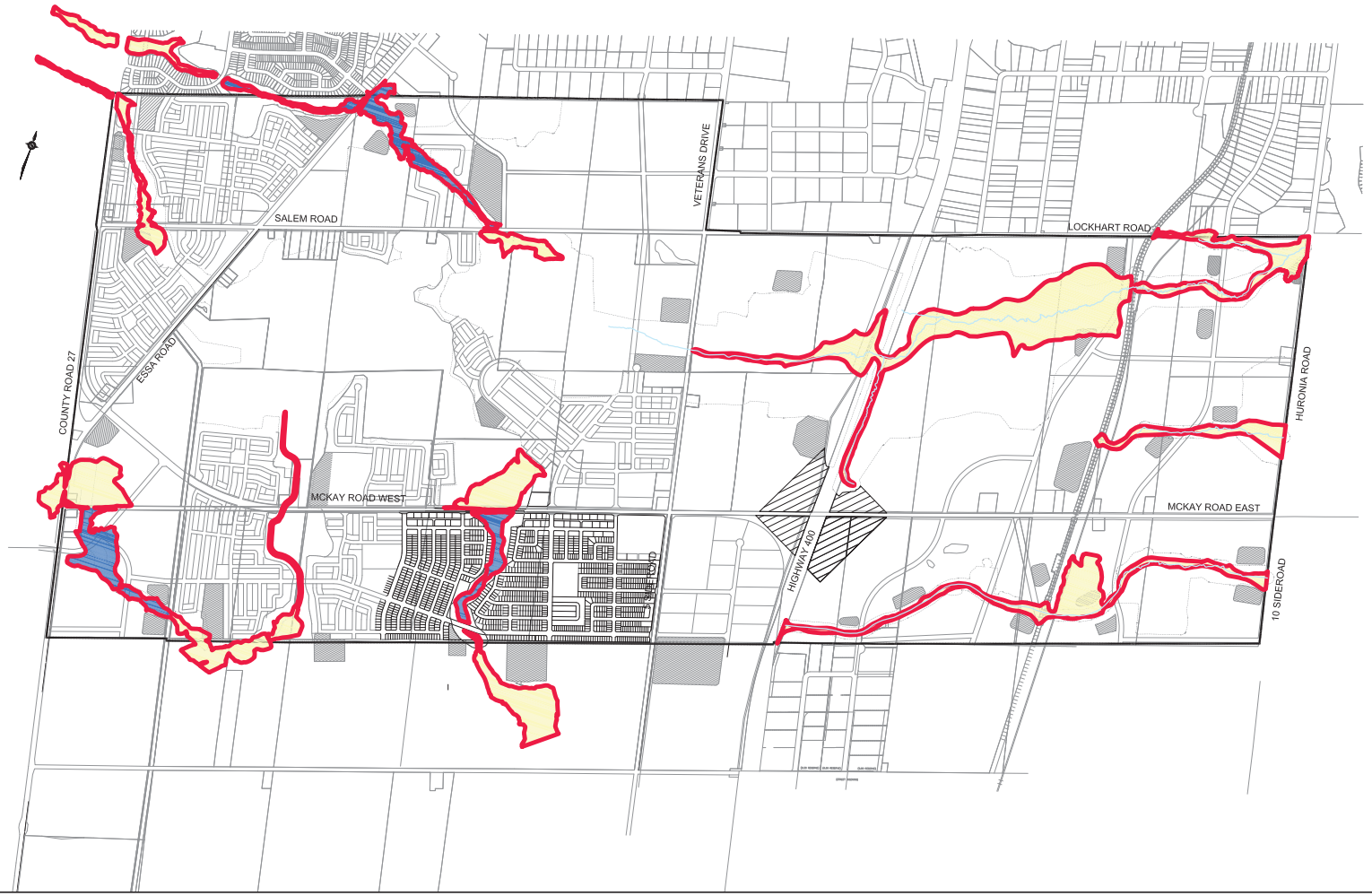
SALEM SECONDARY PLAN AREA–SUBWATERSHED IMPACT STUDY

POST DEVELOPMENT REGULATORY FLOOD MAP
THORNTON CREEK PROPOSED ENGINEERED CHANNEL

SALEM LANDOWNERS GROUP

Drawn	Checked	Date	Figure No.
DL	KS	17/11/14	C–7
Scale 1:2500		Project No. 4074	

Appendix D: Topographic Data Map



SALEM COMMUNITY DEVELOPMENT AREA
CITY OF BARRIE

LEGEND

- SECONDARY DEVELOPMENT PLAN BOUNDARY
- HIGHWAY / INTERCHANGE
- PROPOSED FLOODLINE AREAS WITH DETAILED TOPOGRAPHIC INFORMATION
- PROPOSED FLOODLINE AREAS WITHOUT DETAILED TOPOGRAPHIC INFORMATION

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE D-1
PROPOSED FLOODLINE LOCATIONS
AREAS OF DETAILED TOPO INFORMATION

2016-4074	NOVEMBER 2017	SCALE: N.T.S.

Phil Gottfried
W:\4000\4074 - Salem Secondary Plan\Drawings\Floodline Appendix\2017-12-15-4074-Floodline Topo.dwg

Salem SIS

6.4.5 Thornton Creek

The Thornton Creek watershed has a total drainage area of approximately 4095 ha. The portion of Thornton Creek watershed of approximately 497 ha is occupying the south-west quadrant of Salem area. There are two tributaries flowing from the north to south and draining into the Thornton Creek main stream, which ultimately turns to the west discharging into the Nottawasaga River. The dominant soil texture is sandy loam that is characterized with high to moderate infiltration rates.

A significant portion of the headwaters of Thornton Creek is maintained as NHS area. In most cases the NHS areas drain directly to an adjacent watercourse. However, some NHS areas drain by sheet flow, or possibly poorly defined swales, towards proposed residential development areas. The DSWMMP proposed to cutoff and convey the "clean" NHS runoff to Thornton Creek by a system of constructed channels along the boundary of the NHS. The channels would also provide a defined outlet for future SWM ponds that would otherwise not have an outlet (assuming existing drainage patterns are generally maintained) and could be designed to meet the NVCA definition of a "sufficient outlet". These projects are anticipated to be designed, constructed and funded by the directly benefitting landowners. The feasibility of parts or all of the channelization projects are subject to site specific constraints (detailed grading, internal and external servicing, land use) that must be evaluated by detailed NHS impact studies and detailed topographical survey. These projects would also be subject to approval of the City of Barrie and NVCA, therefore proponents should consult with the City of Barrie and NVCA to develop the preferred approach early in the detailed planning stage for the affected development area.

Recommended channel design, phasing and cost sharing considerations can be provided at detailed design stage following site specific detailed natural heritage impact and feasibility studies in consultation with the City and CAs.

In regards to cost sharing, the landowners group is currently undergoing a process to have a formal Cost Sharing Agreement (CSA) in place prior to draft plan approval of the first

subdivision. Cost sharing schedules will be prepared in support of the CSA, as per the wording of a signed CSA.

It is noted that collection of the NHS area drainage into the urban area storm sewer system still remains a functional and feasible option, should channelization be determined to be infeasible by environmental or other constraints.

Additional topographic information has been obtained for the Thornton Creek watershed. The pre-development catchment areas have been revised and are shown in Figure 6.4. The hydrologic model has been updated as per the revised catchment area plan. Input parameters have also been reviewed and adjusted as required. Pre-development flows through Thornton Creek are as summarized in Table 6.3. Model input parameters are provided in Appendix D.

Table 6.3: Summary of Pre-Development Peak Flows in Thornton Creek

Node	Storm Event	Peak Flow (m^3/s)	
		DSWMMP	SCE
9025	2	0.46	0.707
	5	0.90	1.016
	10	1.25	1.886
	25	1.77	2.549
	50	2.20	3.226
	100	2.66	3.474
9024	2	1.03	0.903
	5	1.98	1.302
	10	2.77	2.432
	25	3.95	3.297
	50	4.89	4.167
	100	5.84	4.501
9554	2	1.35	1.512
	5	2.86	2.179
	10	4.06	4.044
	25	5.82	5.449
	50	7.26	6.877
	100	8.83	7.425
9014	2	0.45	0.335

Node	Storm Event	Peak Flow (m^3/s)	
		DSWMMP	SCE
	5	0.85	0.475
	10	1.17	0.852
	25	1.61	1.139
	50	1.98	1.432
	100	2.36	1.542
9017	2	0.99	0.776
	5	1.94	1.105
	10	2.72	1.991
	25	3.79	2.641
	50	4.68	3.312
	100	5.61	3.556
9545	2	1.11	1.007
	5	2.32	1.433
	10	3.42	2.645
	25	4.95	3.615
	50	6.13	4.661
	100	7.44	4.968

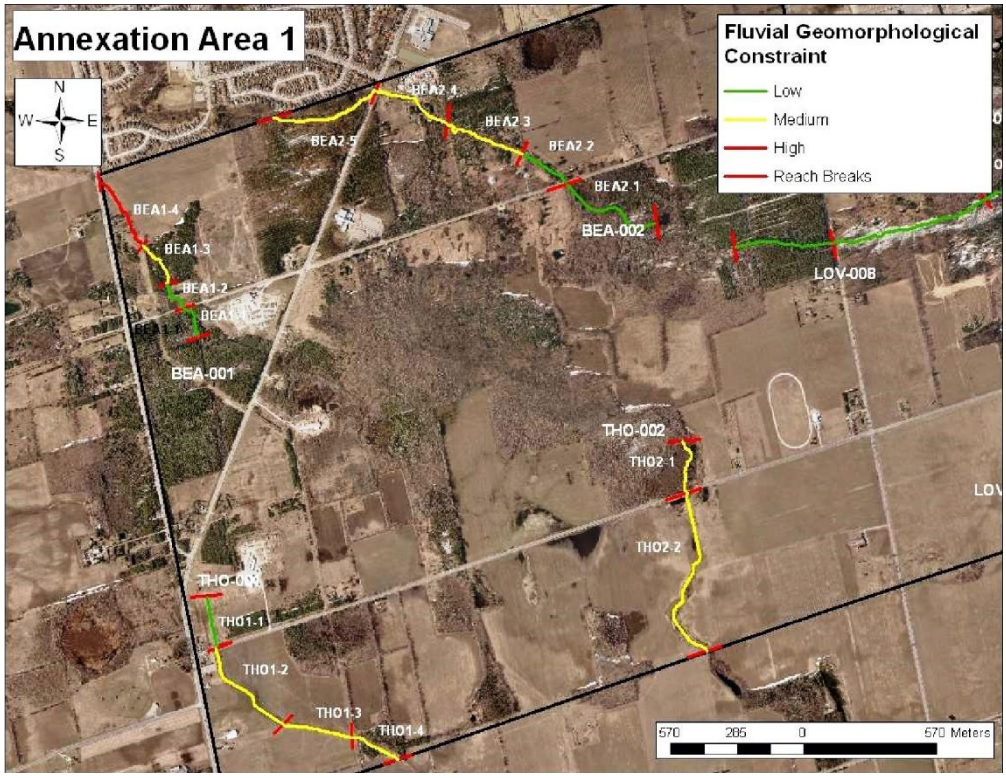
6.5 Meander Belt Investigation

Most watercourses in southern Ontario have a natural tendency to develop and maintain a meandering planform, provided there are no spatial constraints. A meander belt width assessment estimates the lateral extent that a meandering channel has historically occupied and will likely occupy in the future. Therefore, this assessment is useful for determining the potential limit of development for proposed activities in the vicinity of a stream.

This SIS report relies on the meander belt calculations included in the AMEC's DSWMMP for the most part. An additional analysis is provided for the Thornton Creek Reach THO2-2 only (see Appendix I). Further geomorphological studies to refine DSWMMP findings should be completed at the draft plan of subdivision stage.

When defining the meander belt width for a creek system, the MNRF treats unconfined and confined systems differently. Unconfined systems are those with poorly defined

Figure C6 – Preliminary geomorphic constraint rankings for the eastern extent of Annex Area 1



6.6 Erosion Threshold Analysis

Erosion assessment allows for a better understanding of erosion susceptibility of the study area watercourses under existing and future land use conditions. For the purposes of this report, the erosion threshold analysis included in the DSWMMP has been utilized. Brief summary of the DSWMMP findings relevant to the Salem lands is provided below.

Detailed geomorphological field data has been collected to detect areas of channel instability, and to model erosion thresholds for the channel bed at sites determined to be the most sensitive or representative. Lack of uncontrolled, defined channels and access issues have limited selection of the locations available to collect useful geomorphological data. Therefore, the channel geometries and sediment conditions have been examined in detail at five selected Reaches HEW 4-5, LOV 4-4, LOV 6-2, LOV 8 7 and SAN 4-1 only.

Standard protocols and known field indicators were used to quantify bankfull cross-sectional dimensions (i.e. depth and width). The "bankfull" channel generally represents the wetted area of the channel at the point where additional flow will spill into the floodplain. The cross-sections were measured at five locations at each of the detailed sites with the exception of Reach LOV 4-4, where four cross-sections were measured. The review of creek substrate conditions and soils included sampling of substrate using a modified Wolman pebble count (Wolman, 1954) and characterization of sub-pavement at each cross-section.

The detailed geomorphic field surveys for representative study area watercourses resulted in establishing erosion thresholds. An erosion threshold represents the sustained flow at which sediment along a channel bed will be entrained and transported. Multiple analytical methods (critical shear and threshold velocity models) were applied to the data generated for the selected reaches to define threshold flows for the bed of each study reach. The modeled results were examined for convergence and compatibility with field observations to provide appropriate and meaningful erosion thresholds in terms of critical discharge. Surrogate erosion thresholds have been devised in cases where site specific erosion thresholds were not developed as part of the field assessment.

The erosion thresholds were used to determine the cumulative exposure of the selected watercourses to erosive flows. The critical peak flow (Q_c) was calculated based on three methods: Fischenich (2001), Komar (1987), and Van Rijn (1984), with the most conservative method determining the Q_c. These methods are largely based on the median particle size of the creek substrate. The DSWMMP reviewed the five detailed sites and extrapolated the results for the remaining study area reaches. Of the five reaches evaluated in depth by the DSWMMP, three reaches are located within the Salem lands, namely LOV 4-4, LOV 6-2 and LOV 8-7.

Table 4.4.15 of the DSWMMP (reprinted below) summarizes the stormwater management requirements for end-of-pipe facilities in the Annexed Lands on a reach-by-reach basis.

Table 4.4.15: End-of-Pipe Stormwater Management Requirements[1,3]										
Subwatershed	Reach	Outlet Node	Cumulative Unitary Storage Rate (m^3/imp. ha)				Unitary Discharge Rate (m^3/s/ha)			
			Erosion Control	Flood Control[2]			Erosion Control	Flood Control		
				5 Yr	25 Yr	100 Yr		5 Yr	25 Yr	100 Yr
Bear Creek	BEA1	9001	410	850	1000	1300	0.0012	0.007	0.013	0.030
	BEA2	9005	440	1030	1280	1580	0.0012	0.007	0.013	0.030
Thornton Creek	THO1	9024	430	920	1070	1420	0.0011	0.007	0.013	0.025
	THO2	9017	370	860	960	1310	0.0013	0.009	0.018	0.036
Lover's Creel	LOV2	9251	400	850	1050	1300	0.0011	0.010	0.020	0.050
	LOV4	9142	400	1000	1250	1400	0.0012	0.007	0.012	0.027
	LOV6	9201	400	900	1050	1350	0.0013	0.007	0.013	0.030
	LOV8	9350	460	1060	1310	1510	0.0012	0.007	0.012	0.027
Hewitts Creek	-	9140	450	900	1050	1300	0.0006	0.007	0.013	0.030
Sandy Cove Creek	SAN2	9284	310	760	835	1235	0.0010	0.010	0.020	0.040
	SAN3	9281	320	770	845	1245	0.0011	0.010	0.020	0.040

Note: [1] Water quality: Volumetric requirements for permanent pool storage are in addition to storage provided here and are to be provided in accordance with Ministry of the Environment Enhanced Level treatment.
[2] Includes erosion control volume
[3] Volumes do not include LID

The erosion thresholds will inform hydrologic modelling of stormwater management solutions to determine the level of SWM controls required to prevent an increase in erosion under post development conditions. The guidelines presented in the table above were used to determine volumetric requirements for individual SWM facilities in the SIS. Erosion control requirements can be refined during the draft plan approval stage based on updated erosion threshold analyses. It should be noted that water quality extended detention is included in the erosion control volume. Therefore, the permanent pool volumetric requirements for water quality are in addition to the requirements presented in Table 4.4.15 and these should be provided in accordance with the MOE's Enhanced level treatment criteria for the selected type of SWM facility.

This SIS report relies on the erosion threshold calculations included in the AMEC's DSWMMP for the most part. Additional analysis is provided for the Thornton Creek Reach THO2-2 only (see Appendix I). Further geomorphological studies to refine DSWMMP findings should be completed at the draft plan of subdivision stage.

6.7 Proposed Stormwater Management Design

6.7.1 Minor and Major Drainage Systems

Storm drainage from the development will be managed using a dual concept consisting of a minor system and a major system. While the minor drainage system will mainly prevent stormwater damage to properties, the major drainage system will prevent flood damage to buildings and natural environment and ensure that the minor system operates adequately during and after major storm events. In combination, both systems will protect the receiving water bodies from potential impact by urban runoff.

The minor drainage system will include pipes and appurtenances sized to accommodate a 1 in 5-year storm peak flow from the development calculated using City of Barrie design criteria. Surface runoff exceeding the capacity of the minor storm sewers will be conveyed overland along internal road allowances, generally following the direction of the proposed minor system. In the event where overland flow conveyance is not feasible due to grading constraints, a total capture point will be provided and minor system will be sized accordingly for conveying a 100 year storm.

The major drainage system will include the street system, SWM detention facilities, parkland and any other routes required to convey surface runoff during rainfall events up to a 1 in 100 year return period. The major drainage system should be designed to accommodate runoff exceeding the capacity of the minor system for the larger of the 100-year storm event or Hurricane Hazel. There may be external drainage that needs to be conveyed through a site. In this case, there is a responsibility of the developer to convey the Regulatory Storm through the proposed development to a sufficient outlet as per Section 2.2.3 and 2.2.4 of the LSRCA's September 2016 SWM Guidelines.

In accordance with City of Barrie design criteria, foundation drain outlet from all residential units should be drained by sump pumps. There are two design options available for consideration: underground connection to storm sewer or at surface. Please

refer to the City of Barrie standards BSD – 75A, BSD – 75B and BSD – 76 included in Appendix H.

6.7.2 Quality Control

6.7.2.1 Total Suspended Solids (TSS) Removal

Quality control for the subject lands is based on the criteria presented in the SWM Planning and Design Manual (March 2003, MOECC), LSRCA SWM Guidelines (September 2016), NVCA Stormwater Technical Guide (December 2013), and City of Barrie Engineering Standards (2009). It is proposed to provide an Enhanced quality control, or 80% TSS removal. According to the MOECC guidelines, quality control can be achieved via infiltration facilities, wetlands, hybrid wetland/wet ponds, or wet ponds. Table 3.2 of the MOE Guidelines should be used in determining the water quality control storage volumes.

It should be noted that it is the goal of the conservation authorities to eliminate wet ponds in favor of a treatment train approach. Several LID techniques can be incorporated into the design to provide quality control. Potential LID measures are discussed further in Section 6.13. For the purposes of this SIS, SWM pond blocks were sized assuming wet ponds as a conservative measure. Permanent pool volumes for each SWM Pond are summarized in Table 6.7, Table 6.8 and Table 6.9.

During the detailed design stage if the consultant can demonstrate that water quality control requirements can be achieved without a wet pond, credit can be provided for a smaller pond.

6.7.2.2 Phosphorus Removal

As per the LSRCA guidelines, it is required that the proposed stormwater management scheme include a phosphorus removal plan. The goal of the SWM scheme is to meet pre-development phosphorus loading levels. The LSRCA also required the removal of 80% of the total phosphorus from all “Major Development”. A phosphorus removal plan, with

supporting calculations, is provided in Appendix F. The table below summarizes the pre- and post- development phosphorous levels with proposed mitigation measures for lands within the LSRCA boundaries. Phosphorous control was determined based on post-development drainage patterns.

It should be noted that some areas proposed for development are composed of land cover that produce very low phosphorous loads (crop land, forest etc.), and that developing this land increases loading rates by a large amount. Furthermore, topographic features, soil and groundwater table limit the application of feasible LID features to treat phosphorous. While not all subcatchments (drainage areas to SWM Ponds) are able mitigate phosphorous loads to below pre-development levels, it has been demonstrated that annual phosphorous loads can be reduced to below pre-development levels for all lands within LSRCA boundaries. The phosphorous analysis presented in Appendix F explores two scenarios due to insufficient groundwater data within the employment lands. Scenario 1 explores implementable LID's in the case of high groundwater table and Scenario 2 in the case of favorable groundwater condition. The analysis demonstrates that mitigation measures can be applied in either scenario to achieve an appropriate level of control.

Table 6.6.4: Summary of P Loading Calculation in Catchment Areas within LSRCA Boundary (Scenario 1: High Groundwater Levels in Unknown Areas)

AREA ID	Drainage Area (Ha)	PRE (kg/yr)	POST before Mitigation Measures (kg/yr)	POST after Mitigation Measures (kg/yr)
POND U (S2231)	24.57	12.29	41.82	5.42
POND V (S2223)	20.73	1.24	37.73	4.89
POND F (S2233)	33.99	7.67	33.65	12.45
POND M (S1421)	57.85	9.78	89.06	11.53
POND W (S2221)	39.03	14.85	71.03	9.20
NHS (S2232)	24.60	1.48	1.48	1.48
NHS (S2222)	69.31	4.16	4.16	4.16

AREA ID	Drainage Area (Ha)	PRE (kg/yr)	POST before Mitigation Measures (kg/yr)	POST after Mitigation Measures (kg/yr)
NHS (S2235)	5.83	0.35	0.35	0.35
Total	**275.91**	**51.83**	**279.28**	**49.47**

Table 6.6.5: Summary of P Loading Calculation in Catchment Areas within LSRCA Boundary (Scenario 2: Low Groundwater Levels in Unknown Areas)

AREA ID	Drainage Area (Ha)	PRE (kg/yr)	POST before Mitigation Measures (kg/yr)	POST after Mitigation Measures (kg/yr)
POND U (S2231)	24.57	12.29	41.82	5.42
POND V (S2223)	20.73	1.24	37.73	1.81
POND F (S2233)	33.99	7.67	33.65	12.45
POND M (S1421)	57.85	9.78	89.06	11.53
POND W (S2221)	39.03	14.85	71.03	3.42
NHS (S2232)	24.60	1.48	1.48	1.48
NHS (S2222)	69.31	4.16	4.16	4.16
NHS (S2235)	5.83	0.35	0.35	0.35
Total	**275.91**	**51.83**	**279.28**	**40.62**

A similar phosphorous plan was devised to demonstrate post to pre-level control for developable land within NVCA limits. LID measures were proposed considering limitation caused by natural topography, soil and groundwater. While the NVCA prefers 20% over control of annual phosphorous loading, best efforts were undertaken to over control, and compensate for drainage areas not feasible to achieve post to pre control. The table below demonstrates that post to pre control can be achieved, and post-development annual loading can be reduced up to 30 % below pre-development levels for total lands under NVCA boundaries. Intimate design assumptions and details are provided in Appendix F.

Table 6.6.6: Summary of P Loading Calculation in Catchment Areas within NVCA Boundary

AREA ID	Area (Ha)	PRE (kg/yr)	POST before Mitigation Measures (kg/yr)	POST after Mitigation Measures (kg/yr)
SWM A	56.56	11.50	51.22	6.63
SWM B	19.59	3.08	25.23	2.15
SWM C	31.11	7.35	27.58	3.57
SWM D	49.37	10.80	42.07	5.45
SWM O	15.90	2.86	16.81	2.18
SWM P	17.54	5.77	20.05	2.60
SWM N	47.17	11.48	43.96	5.69
SWM I	24.05	8.70	22.05	2.86
SWM J	4.45	0.42	4.19	0.54
SWM H	27.10	4.64	25.53	3.31
SWM G	21.96	5.84	21.92	2.84
SWM Q	14.99	7.21	15.60	2.02
SWM R	5.34	0.79	5.13	1.90
SWM E1	8.59	1.29	6.65	0.86
SWM E2	22.60	7.08	15.03	1.95
SWM K	27.47	4.48	21.54	2.79
SWM S	71	19.76	106.44	13.78
Sub-Total for SWM	**464.79**	**113.04**	**471.00**	**61.11**
LID B	4.95	3.14	5.51	0.65
LID O	1.01	0.18	1.12	1.12
LID I	6.79	1.42	7.55	0.98
LID Q	10.87	3.60	12.09	12.09
LID R	9.06	0.61	10.08	1.31
LID E	7.78	2.63	8.65	8.65
Sub-Total for LID	**40.46**	**11.57**	**44.46**	**24.80**

AREA ID	Area (Ha)	PRE (kg/yr)	POST before Mitigation Measures (kg/yr)	POST after Mitigation Measures (kg/yr)
TOTAL	**505.25**	**124.61**	**515.47**	**85.91**

6.7.3 Quantity Control

Table 4.4.15 from the DSWMMP (reprinted below) summarizes Peak flow control targets for the 5, 25, and 100 year storm events.

Table 4.4.15: End-of-Pipe Stormwater Management Requirements[1,3]

Subwatershed	Reach	Outlet Node	Cumulative Unitary Storage Rate (m^3/imp. ha)				Unitary Discharge Rate (m^3/s/ha)			
			Erosion Control	Flood Control[2]			Erosion Control	Flood Control		
				5 Yr	25 Yr	100 Yr		5 Yr	25 Yr	100 Yr
Bear Creek	BEA1	9001	410	850	1000	1300	0.0012	0.007	0.013	0.030
	BEA2	9005	440	1030	1280	1580	0.0012	0.007	0.013	0.030
Thornton Creek	THO1	9024	430	920	1070	1420	0.0011	0.007	0.013	0.025
	THO2	9017	370	860	960	1310	0.0013	0.009	0.018	0.036
Lover's Creel	LOV2	9251	400	850	1050	1300	0.0011	0.010	0.020	0.050
	LOV4	9142	400	1000	1250	1400	0.0012	0.007	0.012	0.027
	LOV6	9201	400	900	1050	1350	0.0013	0.007	0.013	0.030
	LOV8	9350	460	1060	1310	1510	0.0012	0.007	0.012	0.027
Hewitts Creek	-	9140	450	900	1050	1300	0.0006	0.007	0.013	0.030
Sandy Cove Creek	SAN2	9284	310	760	835	1235	0.0010	0.010	0.020	0.040
	SAN3	9281	320	770	845	1245	0.0011	0.010	0.020	0.040

Note: [1] Water quality: Volumetric requirements for permanent pool storage are in addition to storage provided here and are to be provided in accordance with Ministry of the Environment Enhanced Level treatment.
[2] Includes erosion control volume
[3] Volumes do not include LID

Based on discussions and comments received from regulatory agencies, it was determined that the existing conditions hydrology model required revisions. Consequentially, the unit flow rates from the DSWMMP are affected. The revised hydrology is discussed in Section 6.3.1.

Quantity control for the site is proposed to reduce post-development peak flows to pre-development levels. Target flows are based on existing conditions hydrologic modelling.

Erosion control targets in the DSWMMP were determined using a continuous model to compare the total excess shear stress in each watercourse. Attenuation was introduced in the future preferred land use condition until a minimum 95% (reduction) of the uncontrolled runoff shear stress was achieved. Erosion control is typically controlled by attenuating the 25mm rainfall event over 24-48 hours. Since the erosion control volumes and release rates presented in the DSWMMP are more conservative however, they were used to size the SWM ponds. Pond sizing is summarized in Section 6.8.

Table 4.4.8 below (excerpt from the DSWMMP) summarizes the required extended detention (erosion control) storage and discharge rates, by study area reach, for stormwater management in the Annexed Lands.

Table 4.4.8: Stormwater Management Erosion Control Requirements – Traditional SWM

Subwatershed	Reach	Surrogate Reach	Unitary Storage Rate (m^3/imp. ha)	Unitary Discharge Rate (m^3/s/ha)	Average Drawdown Time (Days)
Bear Creek	BEA1	LOV4	410	0.0012	4.0
	BEA2	LOV4	440	0.0012	5.4
Thornton Creek	THO1	LOV4	430	0.0011	4.7
	THO2	LOV4	370	0.0013	3.4
Lover's Creek	LOV2	LOV4	400	0.0011	4.4
	LOV4	-	400	0.0012	6.3
	LOV6	-	400	0.0013	5.9
	LOV8	-	460	0.0012	7.3
Hewitts Creek	-	-	450	0.0006	10.8
Sandy Cove Creek	SAN2	-	310	0.0010	3.5
	SAN3	SAN2	320	0.0011	3.0

6.7.4 Volume Control

The September 2016 LSRCA guidelines have indicated a requirement to retain or treat 25mm of rainfall on site. The 25mm volume could be reduced to 12.5mm or 5mm if sufficient constraints, such as cohesive soils, high groundwater, or excessive costs, are encountered.

It is proposed to use LIDs to the extent possible to achieve the desired level of volume control. Through the use of LIDs, as described in the TRCA/CVC LID Manual, credit could also be given towards infiltration and water quality requirements. This report

provides an outline of potential LID measures. Final determination of LID techniques however should be completed at the detailed design stage due to the specific nature of many LID measures.

6.7.5 Proposed Engineered Channel

An engineered channel is proposed between Thornton Creek East and West. This channel is required in order to convey external flows southerly around proposed developments, to Thornton Creek West, south of the site boundary. The channel will receive flows from the NHS areas, as well discharge from Ponds C and K. The location of the channel is shown in Figure 6.6.

Given that no major works are desired within the NHS areas, it is proposed to design the channel to be located within the 30m buffer. The channel must be functional while stable under a range of flow conditions and consist of low flow channel and a valley. The low flow channel should be sized to convey flows from frequent events up to and including the 2-year storm. The valley should be able to convey the larger of the uncontrolled 100-year flow or the Timmins storm with 0.3m vertical freeboard. A typical section is provided in Appendix G. Further hydraulic analysis is provided in Section 6.11.

6.8 Proposed Stormwater Management Ponds

The purpose of this section is to demonstrate that the proposed SWM ponds are designed to provide sufficient stormwater quality, quantity, and erosion control in accordance with the City of Barrie, LSRCA, NVCA and MOECC requirements.

The SWM ponds have been planned with the following objectives in mind:

- Ensure Enhanced (Level 1) water quality protection;
- Use water quantity control as per pre-development flow rates;
- Ensure erosion control based on Table 4.4.15 of the DSWMMP;
- Ensure phosphorous loading reduction in accordance with the current version of the LSRCA and NVCA guidelines;

- Achieve water balance objectives.

The following SWM techniques are proposed to achieve the abovementioned objectives:

- Wet pond facilities;
- Dry pond facilities; and
- LID Measures.

It should be noted that the proposed dry pond facilities are situated within park lands only and they will subject to the City's acceptance. Proposed pond locations in park spaces as per the City's latest directives should be reviewed and confirmed in a dialog with the City. Stormwater drainage for majority of the development lands will be supported by utilizing wet ponds and LID measures. However, a few locations have been identified, where traditional quality and quantity control by SWM ponds for future developments can be challenging due to topography. Alternative SWM solution such as use of underground storage systems (superpipe storage, box culverts and etc.) as well as the treatment train approach for quality control can be implemented for areas where stormwater cannot be drained to SWM ponds. At these locations LID techniques only may be considered, subject to design and approval limitations. Figure 6.1: SWM Pond & LID Areas presents the locations of potential SWM ponds. Further discussion of LID measures is provided in Section 6.13.

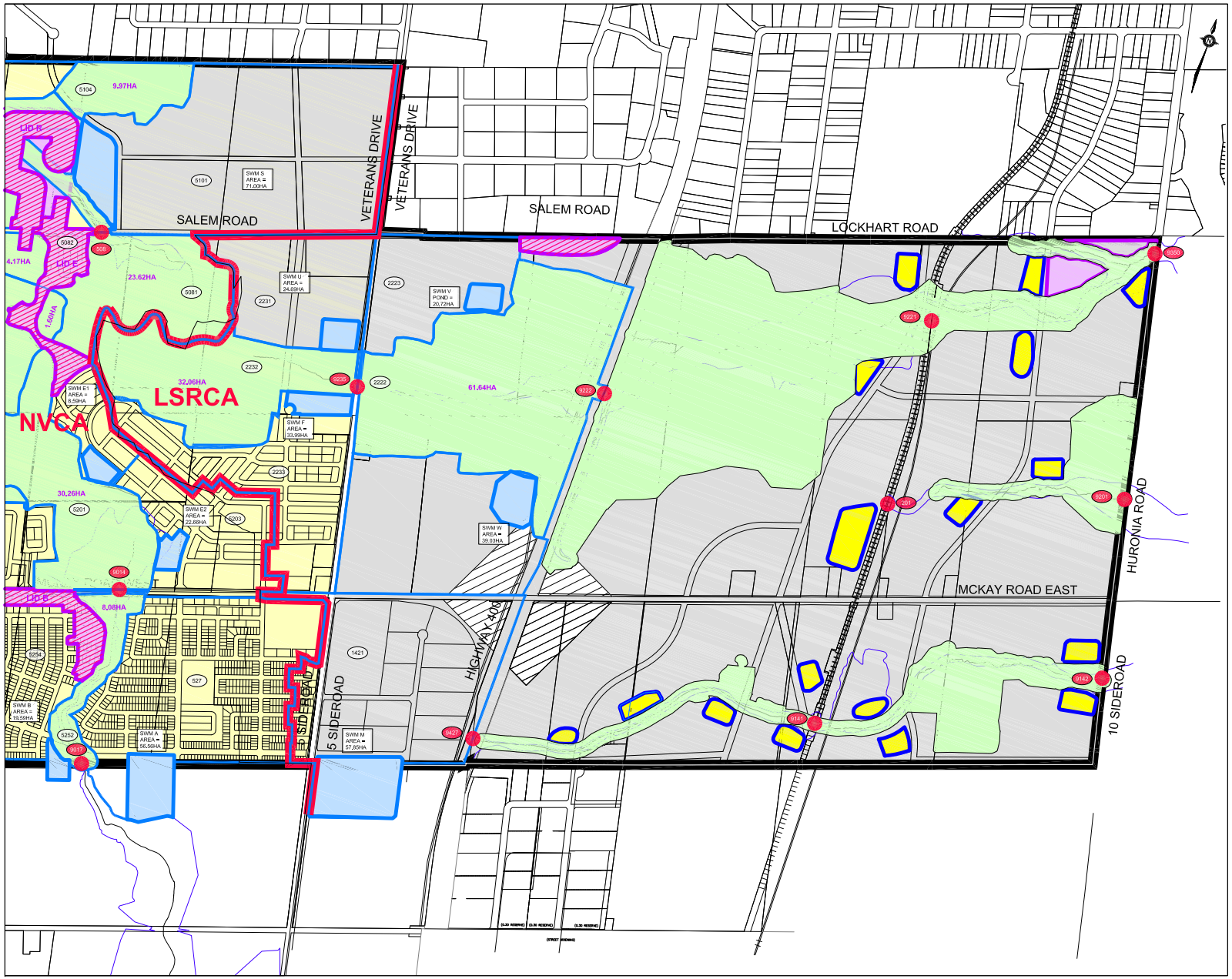
The SWM ponds were sized to provide storage to control post-development flows to pre-development levels. Pre-development target release rates were determined using VH3 modelling with the input parameters from the DSWMMP.

Current SWM wet pond sizing does not consider potential positive effects of the proposed LID measures. The LID measures for the areas being serviced by SWM wet ponds may provide additional quality level (for instance, reduction of phosphorus loading). In the future, if the area regulatory authorities would recognize the LIDs effects on SWM sizing, the wet ponds could be resized accordingly.

It should be noted that Ponds J and R may not be required due to the small size of the catchment area. Based on the MOE SWMPD Manual, ponds are generally not required for areas smaller than 5ha. In general it is difficult for ponds to maintain a permanent pool with catchment areas smaller than 5ha. The catchment areas for Ponds J and R, are 4.69ha and 5.34ha respectively. Furthermore, a large portion of the Pond R catchment area is on non-participating lands. Therefore, although pond blocks are shown, due to the size of the catchment areas Ponds J and R, are likely not feasible.

In general the 6 and 24 hour SCS storms generally required the largest pond volumes. The following tables present a summary of parameters for each proposed SWM wet pond and are organized by watershed. The drainage areas provided in the tables include the pond block areas.

The Salem Landowners Group has requested that additional focus be placed on SWM Ponds within the Phase 1, stage 1 area (Ponds A, B, C, D, E1, E2, F, G, H, I, J, K, and M) as those areas are further along in the design process. Preliminary pond volume requirements are provided for Ponds N, O, P, Q, R, S, U, V, and W. The following sections provide a brief summary of these ponds. Preliminary Pond design drawings are provided in Appendix D-8. Pond locations are illustrated in Figure 6.1. Figure 6.5 and Figure 6.6 provide a post-development drainage area plan, illustrating the catchment areas for the proposed ponds within the LSRCA and NVCA regulated areas.



SALEM COMMUNITY DEVELOPMENT AREA
CITY OF BARRIE

LEGEND

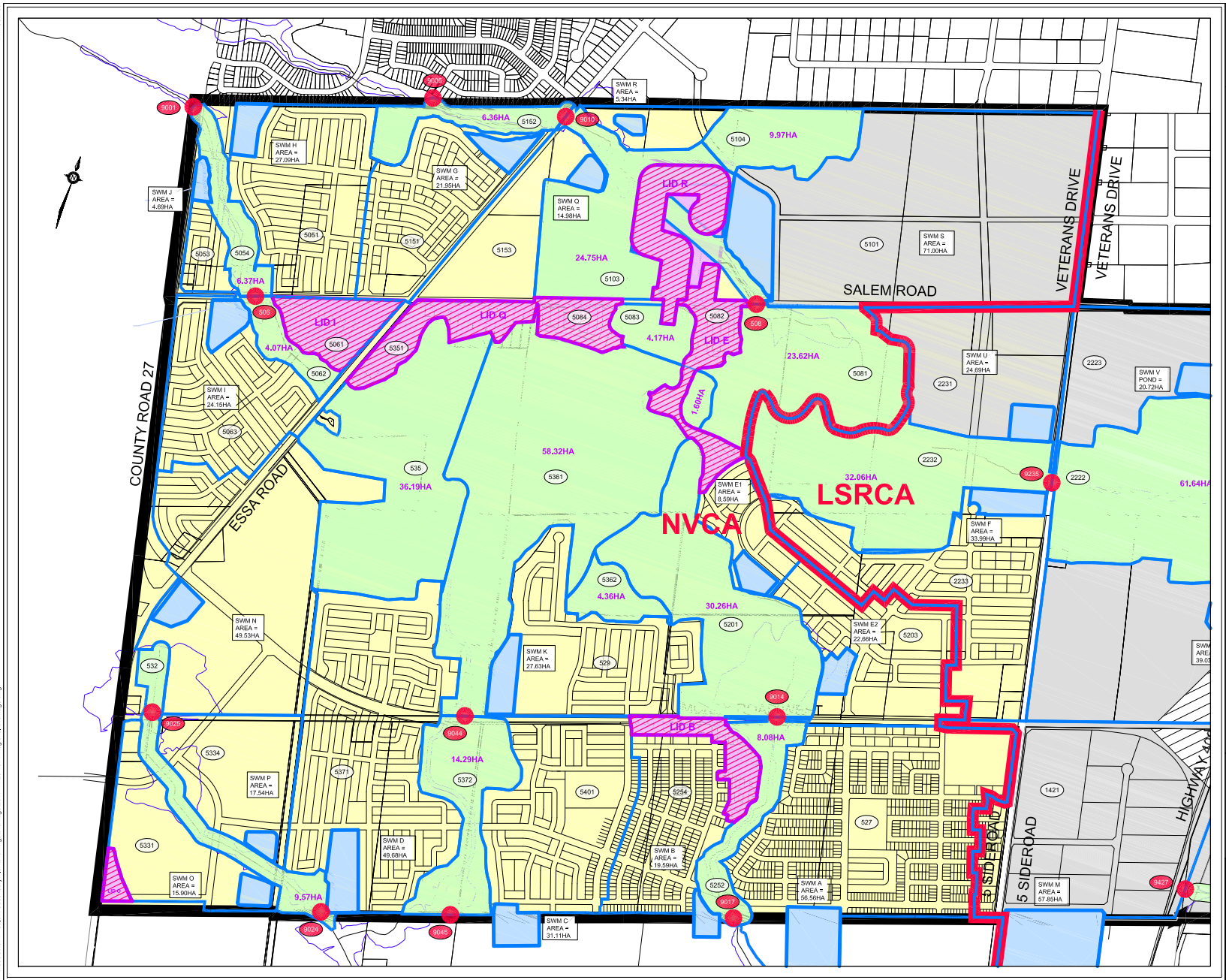
- SECONDARY DEVELOPMENT PLAN BOUNDARY
- HIGHWAY / INTERCHANGE
- NATURAL HERITAGE SYSTEM
- RESIDENTIAL AREA (SUPPORTED BY SWM POND)
- INDUSTRIAL (SUPPORTED BY SWM POND)
- POTENTIAL SWM FACILITY
- POTENTIAL AREAS DRAINING TO LID
- FUTURE POTENTIAL SWM FACILITY
- WATERSHED DIVIDE BOUNDARY BETWEEN NVCA & LSRCA
- POST DEVELOPMENT CATCHMENTS BOUNDARY
- LID AREA
- CATCHMENT ID
- NODE LOCATION
- NODE ID

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Tel: (905) 738-6100 Email: general@schaeffers.com
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FIGURE 6.5
POST-DEVELOPMENT
DRAINAGE PLAN
LSRCA

2014-4074	NOVEMBER 2017	SCALE: N.T.S.

Phil Gottfried
W:\4000\4074 - Salem Secondary Plan\Drawings\Drainage\2017-11-29-4074-Regional Drainage.dwg



SALEM COMMUNITY DEVELOPMENT AREA
CITY OF BARRIE

LEGEND

- SECONDARY DEVELOPMENT PLAN BOUNDARY
- HIGHWAY / INTERCHANGE
- NATURAL HERITAGE SYSTEM
- RESIDENTIAL AREA (SUPPORTED BY SWM POND)
- INDUSTRIAL (SUPPORTED BY SWM POND)
- POTENTIAL SWM FACILITY
- POTENTIAL AREAS DRAINING TO LID
- FUTURE POTENTIAL SWM FACILITY
- WATERSHED DIVIDE BOUNDARY BETWEEN NVCA & LSRCA
- POST DEVELOPMENT CATCHMENTS BOUNDARY
- LID AREA
- 9017 CATCHMENT ID
- NODE LOCATION
- 9017 NODE ID

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FIGURE 6.6
POST-DEVELOPMENT
DRAINAGE PLAN
NVCA

2014-4074	NOVEMBER 2017	SCALE: N.T.S.

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With regard to the SWM ponds (A, B, C and M) proposed outside of the Salem limits, it should be noted that the landowner (DG Group) for that development also owns the adjacent lands located immediately south of the Study Area limits. The DG Group is directly engaged in communications with the Town of Innisfil regarding the proposed solution. Addressing the legal and planning issues is a lengthy collaborative process for all involved parties. Therefore, it will be formalized beyond the preparation of the SIS report.

Table 6.7: Summary of Proposed SWM Ponds – Lovers Creek

Parameter	Stormwater Management Facility				
	F	M	U	V	W
Drainage Area (ha)	33.99	57.85	24.69	20.72	39.02
Impervious Area (%)	60	82	90	90	90
Permanent Storage (m^3)	5,495	11,859	5,391	4,524	8,519
Extended Detention Storage (m^3)	8,600	21,000	10,300	8,650	16,300
100 Year Storm Storage (Required) (m^3)	19,900	39,000	20,500	14,300	26,800
Peak Extended Detention Flow (m^3/s)	0.061	0.104	0.044	0.037	0.070
Governing Storm	SCS 24hr	SCS 24hr	SCS 24hr	SCS 24hr	SCS 24hr
100 Year Target Release Rate (m^3/s)	0.838	1.259	0.719	0.489	0.921
Required SWM Pond Area (ha)	1.92(1)	8.25(1)	1.48(2)	1.24(2)	2.34(2)

(1) Denotes area is based on preliminary design drawing
(2) Denotes area is based on 6% of catchment area

Table 6.8: Summary of Proposed SWM Ponds – Bear Creek

Parameter		Stormwater Management Facility					
	G	H	I	J	Q	R	S
Drainage Area (ha)	21.95	27.09	24.15	4.69	14.98	5.34	71.00
Impervious Area (%)	60	60	60	60	68	60	90
Permanent Storage (m^3)	3,549	4,380	3,904	758	2,701	863	15,502

Parameter		Stormwater Management Facility					
	G	H	I	J	Q	R	S
Extended Detention Storage (m^3)	5,800	6,660	6,200	1,200	4,750	1,410	29,600
100 Year Storm Storage (Required) (m^3)	12,000	11,300	14,800	2,300	9,100	2,600	60,000
Peak Extended Detention Flow (m^3/s)	0.040	0.049	0.043	0.008	0.027	0.010	0.128
Governing Storm	SCS 24hr	SCS 24hr	SCS 24hr	SCS 24hr	SCS 24hr	SCS 24hr	SCS 24hr
100 Year Target Release Rate (m^3/s)	1.017	1.188	0.437	0.357	0.776	0.403	1.984
Required SWM Block Area (ha)	1.54[(1)]	1.63[(1)]	1.62[(1)]	0.72[(1)]	0.90[(2)]	0.32[(2)]	3.12[(1)]

(1) Denotes area is based on preliminary design drawing
(2) Denotes area is based on 6% of catchment area

Table 6.9: Summary of Proposed SWM Ponds – Thornton Creek

Parameter	Stormwater Management Facility									
	A[3]	B[3]	C[3]	D	E1	E2	K	N	O	P
Drainage Area (ha)	56.56	19.59	31.11	49.68	8.59	22.66	27.63	49.53	15.90	17.54
Impervious Area (%)	60	60	60	60	62	62	67	60	60	60
Permanent Pool Volume (m^3)	9,144	3,167	5,029	8,032	1,429	3,769	4,918	8,007	2,571	2,836
Extended Detention Storage (m^3)	14,100	4,900	8,030	13,000	2,300	6,400	8,100	12,170	4,100	4,530
100 Year Storm Storage (Required) (m^3)	29,700	11,300	18,400	29,600	4,500	12,000	14,800	23,000	6,500	8,800
Peak Extended Detention Flow (m^3/s)	0.110	0.038	0.051	0.082	0.017	0.031	0.046	0.082	0.026	0.029
Governing Storm	SCS 24hr	SCS 24hr	SCS 24hr	SCS 24hr	SCS 24hr	SCS 24hr	SCS 24hr	SCS 24hr	SCS 24hr	SCS 24hr
100 Year Target Release Rate (m^3/s)	2.515	0.544	0.719	1.125	0.525	1.280	1.987	1.139	0.813	1.027
Required SWM Pond Area (ha)	3.85[1]	1.20[1]	2.02[1]	2.86[1]	1.33[1]	1.55[1]	2.20[1]	2.97[2]	0.96[2]	1.06[2]

(1) Denotes area is based on preliminary design drawing

(2) Denotes area is based on 6% of catchment area

(3) Denotes SWM Pond is all or partially located outside of the Salem limits

Quantity control criteria was based on the pre-development target rates summarized in Table 6.9. Quality control is based on an Enhanced level of TSS removal (80%) as defined in the 2003 MOE Manual. The extended detention volume and release rate is based on Table 4.4.15 of the DSWMMP, which is considered conservative compared to MOE guidelines ($40m^3$/ha) and NVCA criteria of 25 mm. The pond will discharge into Thornton Creek East, and the outlet should be in general conformance with the standard detail provided in Appendix D-8. A summary of Pond B design features are provided in Table 6.9. Further details are provided in Appendix D.

6.8.3 SWM Pond C

SWM Pond C is proposed to be located along the southern site boundary, between Thornton Creek East and West, adjacent NHS lands. A portion of the pond is situated within the Town of Innisfil, but is located on lands owned by the applicant. Refer to Figure 6.1 for pond locations.

The proposed catchment for Pond C is approximately 31.11 ha in area and generally consists of a residential and institutional land use. Pond C has been sized to provide quality, quantity and erosion control.

Quantity control criteria was based on the pre-development target rates summarized in Table 6.9. Quality control is based on an Enhanced level of TSS removal (80%) as defined in the 2003 MOE Manual. The extended detention volume and release rate is based on Table 4.4.15 of the DSWMMP, which is considered conservative when compared to the MOE guidelines ($40m^3$/ha) and NVCA criteria (25 mm). The pond will discharge into NHS lands and then a proposed diversion channel as shown in Figure 6.1. Ultimately runoff will discharge into Thornton Creek West. The outlet should be in general conformance with the standard detail provided in Appendix D-8. A summary of Pond C design features are provided in Table 6.9. Further details are provided in Appendix D.

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Consulting Engineers
SCHAEFFER & ASSOCIATES LTD.
6 Ronrose Drive, Concord,
Ontario L4K 4R3
Tel: (905) 738-6100
Fax: (905) 738-6875
design@schaeffers.com

PROJECT : 4074

SALEM IMPACT STUDY -EXISTING HYDROLOGY PARAMETERS

Bear & Thornton Creek																																		
Catchment ID	**520**	**521**	**522**	**523**	**524**	**525**	**526**	**527**	**528**	**529**	**530**	**531**	**532**	**533**	**534**	**535**	**536**	**537**	**538**	**539**	**540**	**541**	**542**	**543**	**545**	**546**	**601**	**602**	**603**	**604**	**605**	**606**	**607**	**608**
Area (ha) *	64.74	4.33	14.33	9.64	25.47	13.68	15.27	17.34	3.61	3.03	32.61	23.65	9.06	17.72	12.37	61.31	78.34	15.69	65.59	5.94	19.28	8.07	10.49	2.69	3.51	3.62	12.92	75.08	37.95	13.43	15.57	92.85	7.1	3.41
Hydrogeology Report†	Silty Sand	Silty sand	Sand/silty	Sand/silty	Sand/silty	Sand/Silty	Sand/Silty	Silty Sand	Silty Sand	Sand/Silty	Sand/Silty	Sand/Silty	Sand/silty	Sand	Sand	Sand	Sand/silty	Sand	Sand/ Gravelly sand	Sand/ Gravelly sand	Sand/ silty	Silty Clay/ Silty Sand	Silty Clay/ Silty Sand	Sand/Silty	Sand/silty	Sand/silty	Silty Clay	Sand/silty	Sand/silty	Sand/silty	Sand/gravel	Sand/gravel	Sand/silty	Sand/silty
Weighted CN II	64.0	65.5	37.1	65.2	63.4	67.8	68.1	68.6	68.0	68.0	60.2	57.9	36.2	60.8	68.7	55.6	51.5	55.3	48.2	38.2	65.2	78.2	78.2	68.0	66.1	68.0	67.6	53.2	53.9	51.9	58.5	37.8	60.7	75.0
Weighted CN III Δ	81.5	82.5	82.5	82.3	81.0	84.2	84.4	84.7	84.3	84.3	78.5	76.7	55.5	79.0	84.8	74.7	71.1	74.5	68.0	57.8	82.3	90.6	90.6	84.3	83.0	84.3	84.0	72.7	73.3	71.5	77.2	57.2	78.9	88.8
Initial Abstraction (Ia)	7.0	6.5	8.7	7.4	7.2	6.9	7.0	6.9	7.5	7.0	6.9	8.0	8.8	6.8	6.9	9.8	9.0	8.7	8.4	9.4	8.4	8.4	6.0	7.0	7.3	7.0	6.3	8.8	8.2	7.3	7.3	8.9	7.7	5.6
Length (L) *	645	230	287	316	640	258	121	680	271	276	1040	810	832	222	450	1115	1140	121	1048	798	633	426	180	292	412	385	447	675	420	510	214	657	464	125
Slope (S)	0.009	0.017	0.035	0.012	0.004	0.023	0.069	0.009	0.035	0.059	0.007	0.008	0.129	0.129	0.021	0.007	0.002	0.182	0.002	0.019	0.009	0.004	0.043	0.053	0.023	0.009	0.008	0.006	0.008	0.017	0.028	0.026	0.017	0.069
Time of Conc (Tc)	73	35	31	46	95	34	16	74	30	26	102	74	100	18	46	145	172	12	167	64	73	77	23	27	43	57	64	83	62	53	29	52	50	16
Time to peak (Tp) ¤	0.81	0.39	0.35	0.51	1.06	0.38	0.18	0.83	0.33	0.29	1.14	0.83	1.11	0.20	0.52	1.61	1.92	0.13	1.86	0.71	0.81	0.87	0.26	0.31	0.48	0.63	0.71	0.93	0.70	0.59	0.32	0.58	0.56	0.18
Cu (upland coeff)¥	2.7	2.7	0.6	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.3	2.3	0.6	2.7	2.7	2.3	0.6	0.6	2.7	0.6	2.7	2.7	2.7	2.7	2.7	2.7	2.7	0.6	0.6	2.7	2.7	2.7	0.6	0.6
Velocity ($V=Cu\ (S)^{0.5}$)	0.26	0.35	0.11	0.30	0.17	0.41	0.71	0.26	0.50	0.66	0.19	0.21	0.22	0.97	0.39	0.19	0.02	0.26	0.11	0.08	0.25	0.17	0.56	0.62	0.41	0.25	0.24	0.05	0.05	0.35	0.45	0.43	0.08	0.16

† - Salem Secondary Plan Area, Hydrogeological Assessment- Part 1 (Existing Conditions) by R.J.Burnside (Feb 2016)

¥ - Upland coefficient for different landuse; List is provided in the Appendix

* - Measured in AutoCAD

¤ - Calculated using Airport Method

Δ - AMC conversion table and the chart are included in the Appendix

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SCHAEFFER & ASSOCIATES LTD.
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Ontario L4K 4R3
Tel: (905) 738-6100
Fax: (905) 738-6875
design@schaeffers.com

PROJECT: 4074

Date: 06 Nov 2017

Weighted Average CN Determination for SWM Ponds

POND ID	SUB CATCHMENTS	CN	POND DRAINAGE AREA (ha)	WEIGHTED AVERAGE CN
A	525	67.84	15.28	68.2
	527	68.64	14.62	
B	526	68.08	11.51	68.1
C	523	65.19	8.94	66.2
	528	68.00	5.06	
D	540	65.16	12.15	65.16
E1	538	48.19	10.21	48.19
E2	538	48.19	15.90	48.19
F	602	53.23	19.69	53.23
K	520	64.04	16.40	59.92
	536	51.55	8.08	
N	530	60.17	30.30	59.15
	535	55.62	8.70	
O	533	60.83	14.74	60.83
P	534	68.68	11.76	68.68
Q	606	37.76	2.81	59.91
	607	60.69	6.96	
	608	74.99	3.77	
R	606	37.76	5.34	37.76
U	602	53.23	23.09	53.23
S	604	51.9	10.28	44.4
	605	58.5	16.11	
	606	37.8	44.61	

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Pre - development Calculation

Project: 4074

ID: 523 Pond C

Equivalent Slope Method*

# of Reaches	Height	Difference	Length (m)	Slope	Slope ^-.5
1	311.05	0.85	274.00	0.00	17.95
2	310.20	0.08	274.00	0.00	58.52
3	310.12				
Total			548.00		76.48
Sw(%)	0.43				

* Done using Auto Cad

Formulas

Equivalent Slope Method

$Sw=100*(n/\Sigma(Sn^{-.5}))^2$

Phil Gottfied

SALEM COMMUNITY DEVELOPMENT AREA
CITY OF BARRIE

LEGEND

- SECONDARY DEVELOPMENT PLAN BOUNDARY
- HIGHWAY / INTERCHANGE
- NATURAL HERITAGE SYSTEM
- WATERSHED DIVIDE BOUNDARY BETWEEN NVCA & LSRCA
- SUBWATERSHED BOUNDARY
- PRE DEVELOPMENT CATCHMENTS BOUNDARY
- NODE LOCATION
- 9017 NODE ID

SALEM ROAD
VETERANS DRIVE
LOCKHART ROAD
HURONIA ROAD
MCKAY ROAD WEST
MCKAY ROAD EAST
5 SIDEROAD
10 SIDEROAD
HIGHWAY 400
LSRCA
NVCA

S240 252.47ha
S210 133.17ha
S222 124.13ha
S221 109.40ha
S203 50.54ha
S191 22.45ha
S202 15.51ha
S201 49.24ha
S200 42.07ha
S140 53.44ha
S141 109.51ha
S142 75.08ha
S100 174.35ha
602 75.08ha
601 12.92ha
543 2.69ha

9350 9221 9235 9222 201 9201 9142 9141 9427

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FIGURE 6.3
PRE-DEVELOPMENT
DRAINAGE PLAN
LSRCA

2014-4074	NOVEMBER 2017	SCALE: N.T.S.

W:\4000's\4074 - Salem Secondary Plan\Drawings\Drainage\2017-11-29-4074-Existing Drainage.dwg

Phil Goldfed

SALEM COMMUNITY DEVELOPMENT AREA
CITY OF BARRIE

LEGEND

- SECONDARY DEVELOPMENT PLAN BOUNDARY
- HIGHWAY / INTERCHANGE
- NATURAL HERITAGE SYSTEM
- WATERSHED DIVIDE BOUNDARY BETWEEN NVCA & LSRCA
- SUBWATERSHED BOUNDARY
- PRE DEVELOPMENT CATCHMENTS BOUNDARY
- NODE LOCATION
- 9017 NODE ID

9001 9005 9010 9014 9017 9024 9025 9044 9045 506 508

606 92.85ha
605 15.57ha
607 7.10ha
505 39.83ha
515 30.66ha
608 3.41ha
604 13.43ha
603 37.95ha
506 25.00ha
531 22.31ha
530 32.61ha
535 61.31ha
536 78.34ha
520 21.59ha
538 65.59ha
537 24.65ha
534 12.37ha
521 4.33ha
525 13.68ha
541 8.07ha
542 10.49ha
533 17.72ha
540 12.15ha
523 9.64ha
524 25.47ha
526 15.27ha
546 3.62ha
539 5.94ha
527 17.34ha
529 3.03ha
532 9.06ha
545 3.51ha
528 9.19ha

SALEM ROAD
VETERANS DRIVE
COUNTY ROAD 27
ESSA ROAD
MCKAY ROAD WEST
5 SIDEROAD
HIGHWAY 400
LSRCA
NVCA

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FIGURE 6.4
PRE-DEVELOPMENT
DRAINAGE PLAN
NVCA

2014-4074	NOVEMBER 2017	SCALE: N.T.S.

W:\4000's\4074 - Salem Secondary Plan\Drawings\Drainage\2017-11-29-4074-Existing Drainage.dwg

Water Balance Study By R.J Burnside

9.0 Water Balance

9.1 Water Balance Components

A water balance is an accounting of the water resources within a given area. As a concept, the water balance is relatively simple and may be estimated from the following equation:

$$P = S + ET + R + I$$

Where:

P	=	precipitation
S	=	change in groundwater storage
ET	=	evapotranspiration/evaporation
R	=	surface water runoff
I	=	infiltration

The components of the water balance vary in space and time and depend on climatic conditions as well as the soil and land cover conditions (i.e., rainfall intensity, land slope, soil hydraulic conductivity and vegetation). Runoff, for example, occurs particularly during periods of snowmelt when the ground is frozen, or during intense rainfall events. Precise measurement of the water balance components is difficult and as such, approximations and simplifications are made to characterize the water balance of a property. Field observations of the drainage conditions, land cover and soil types, groundwater levels and local climatic records are important input considerations for the water balance calculations.

The groundwater balance components for the subject area are discussed below:

Precipitation (P)

The reported long-term average annual precipitation for the period between 1981 and 2010 for the property is 933 mm based on data from the Environment Canada Barrie WPCC (Station 6110557, 44°22'33.012" N, 79°41'23.010" W, elevation 221.0 masl). Average monthly records of precipitation and temperature from this station have been used for the water balance calculations in this study (Appendix C-7).

Storage (S)

Although there are groundwater storage gains and losses on a short-term basis, the net change in groundwater storage on a long-term basis is assumed to be zero so this term is dropped from the equation.

Evapotranspiration (ET)

Evapotranspiration and evaporation components vary based on the characteristics of the land surface cover (i.e., type of vegetation, soil moisture conditions, perviousness of surfaces, etc.). Potential evapotranspiration (PET) refers to the water loss from a vegetated surface to the atmosphere under conditions of an unlimited water supply. The actual rate of evapotranspiration (AET) is generally less than the PET under dry conditions (i.e., during the summer when there is a soil moisture deficit). In this report, the PET and AET have been calculated using a soil-moisture balance approach.

Water Surplus (R + I)

The difference between the mean annual P and the mean annual ET is referred to as the water surplus. Part of the water surplus travels across the surface of the soil as surface or overland runoff (R) and the remainder infiltrates the surficial soil (I). The infiltration is comprised of two end member components: one component that moves vertically downward to the groundwater table (referred to as recharge) and a second component that moves laterally through the topsoil profile or shallow soils as interflow that re-emerges locally to surface (i.e., as runoff) at some short time following cessation of precipitation. As opposed to the “direct” component of surface runoff that occurs during precipitation or snowmelt events, interflow becomes an “indirect” component of runoff. The interflow component of surface runoff is not accounted for in the water balance equation cited above since it is often difficult to distinguish between interflow and direct (overland) runoff, however both interflow and direct runoff together form the total surface water runoff component.

9.2 Approach and Methodology

The analytical approach to calculate the water balance involves monthly soil-moisture balance calculations to determine the pre-development and post-development infiltration volumes. A soil-moisture balance approach assumes that soils do not release water as potential recharge while a soil moisture deficit exists. During wetter periods, any excess of precipitation over evapotranspiration first goes to restore soil moisture. Once the soil moisture deficit is overcome, any further excess water can then pass through the soil as infiltration and either become interflow (indirect runoff) or recharge (deep infiltration).

A soil moisture storage capacity of 150 mm was used for the areas where the land cover was predominantly short to moderate-rooted vegetation in the fields and agricultural areas (Table C-7-1, Appendix C-7). A soil moisture storage capacity of 300 mm was used for wooded areas within the natural heritage system (Table C-7-2, Appendix C-7).

Tables C-7-1 and C-7-2 in Appendix C-7 detail the monthly potential evapotranspiration calculations accounting for latitude and climate, and then calculates the actual

evapotranspiration and water surplus components of the water balance based on the monthly precipitation and soil moisture conditions.

The MOECC SWM Planning and Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used and a corresponding runoff component was calculated for the soil moisture storage conditions. The calculated water balance components from this table is then used to assess the pre- and post-development volumes for runoff and infiltration by subwatershed as presented on Tables C-7-3, C-7-4 and C-7-5 in Appendix C-7.

9.3 Component Values

The detailed monthly calculations of the water balance components are provided in Tables C-7-1 and C-7-2 in Appendix C-7. For the water balance calculations it has been assumed that the study area generally has sandy loam soils for estimating the soil infiltration factor. The calculations show that a water surplus is generally available from November to May. The monthly water balance calculations illustrate how infiltration occurs during periods when there is sufficient water available to overcome the soil moisture storage requirements. The monthly calculations are summed to provide estimates of the annual water balance component values (Tables C-7-1 and C-7-2, Appendix C-7). A summary of these values is provided in Table 6.

Table 6: Water Balance Component Values

Water Balance Component	Agricultural Lands	Wooded Areas
Average Precipitation	933 mm/year	933 mm/year
Actual Evapotranspiration	593 mm/year	593 mm/year
Water Surplus	340 mm/year	340 mm/year
Infiltration	221 mm/year	255 mm/year
Runoff	119 mm/year	85 mm/year

9.4 Pre-Development Water Balance (Existing Conditions)

The total land area (within the Secondary Plan Area) within each of the subwatersheds is provided in Tables C-7-3 to C-7-5, Appendix C-7 and summarized below in Table 7. Based on these component values, an estimate of the total pre-development groundwater infiltration volume for each subwatershed was calculated, as presented in Tables C-7-3 to C-7-5, Appendix C-7. A summary of these values is provided in Table 7.

Table 7: Summary of Pre-Development Infiltration Volumes

Subwatershed/Watershed	Approx. Land Area (ha)	Average Annual Infiltration (m^3/year)
Lover's Creek	296	665,000
Thornton Creek	474	1,070,000
Bear Creek	246	544,000

9.5 Potential Urban Development Impacts to Water Balance

Development of an area affects the natural water balance. The most significant difference is the addition of impervious surfaces as a type of surface cover (i.e., roads, parking lots, driveways, and rooftops). Impervious surfaces prevent infiltration of water into the soils and the removal of the vegetation removes the evapotranspiration component of the natural water balance. The evaporation component from impervious surfaces is relatively minor (estimated to be 10% to 20% of precipitation) compared to the evapotranspiration component that occurs with vegetation in this area (about 64% of precipitation in the study area). So the net effect of the construction of impervious surfaces is that most of the precipitation that falls onto impervious surfaces becomes surplus water and direct runoff. The natural infiltration components (interflow and deep recharge) are reduced. In the context of the wetland units and the Natural Heritage System (NHS) and their noted dependence on rainfall, recharge infiltration is expected to maintain flows to creeks and support groundwater discharge or throughflow in lower sections of each watershed.

A water balance calculation of the potential water surplus for impervious areas is shown at the bottom of Table C-7-1 in Appendix C-7. There is an evaporation component from impervious surfaces and this is typically estimated to be between about 10% and 20% of the total precipitation. For the purposes of the calculations in this study, the evaporation has been estimated to be 15% of precipitation. The remaining 85% of the precipitation that falls on impervious surfaces is assumed to become runoff. Therefore, assuming an evaporation/loss from impervious surfaces of 15% of the precipitation, there is a potential water surplus from impervious areas of 793 mm/year.

It is noted that the proposed development will be serviced by municipal water supply and waste water services. Therefore there will be no impact on the water balance and local groundwater or surface water quantity and quality conditions related to any on-site groundwater supply pumping or disposal of septic effluent.

9.6 Post-Development Water Balance With No Mitigation

In order to assess the potential development impact on infiltration, the post-development infiltration volumes have been calculated for each of the subwatershed areas in Tables C-7-3 to C-7-5 in Appendix C-7. These calculations assume no mitigation is in

place. The total areas for the proposed land uses have been determined from the proposed development concept and the infiltration and runoff components for the post-development land uses have been calculated using the MOECC SWM Planning and Design Manual (2003) methodology based on topography, soil type and land cover as shown on Tables C-7-1 and C-7-2 in Appendix C-7. The total calculated post-development infiltration volume (without mitigation) for the study area is summarized in Table C-7-6, Appendix C-7 and provided in Table 8 below.

Table 8: Summary of Post-Development Infiltration Volumes

Subwatershed	Post Development Infiltration (m^3/year)	Post Development Infiltration Deficit (m^3/year)	Percentage Change
Lover's Creek	369,000	297,000	-45%
Thornton Creek	718,000	352,000	-33%
Bear Creek	362,000	182,000	-33%
Total Study Area	**1,449,000**	**831,000**	**-36%**

Comparing these post-development volumes to the pre-development volumes, the water balance calculations show that the proposed development has the potential to reduce the natural infiltration in the study area by between 33% and 45% (Table 8). The degree of impact is noted to depend on the type of development that will occur within each subwatershed with more intensive development and more impermeable surfaces such as those that occur with commercial development being noted to cause a more significant impact. Across the entire study area, the post-development infiltration deficit was estimated to be 831,000 m^3/year which is a 36% reduction over the pre-development infiltration estimate. LID measures for stormwater management are recommended to try to promote infiltration to make up the difference between the pre- and post-development infiltration volumes. As noted above, with the wide margins of error associated with this type of analysis, the infiltration deficit volumes are considered as reasonable estimates that are suitable as targets for the stormwater management and LID strategy design.

10.0 Proposed Development - Impact Evaluation and Mitigation

10.1 Potential Impacts to Natural Water Balance

The water balance computations completed as part of this study indicate that without LID measures, there could be an infiltration deficit of approximately 831,000 m^3 per year in the post development scenario (refer to Table 8).

As the natural infiltration components (interflow and deep recharge) are reduced in the post development scenario, these reductions may lead to reductions in overall

Hydrogeological Investigation

4 Hydrogeological Investigation Results

4.1 Soil Stratigraphy

Based on the results of the Geotechnical and Hydrogeological Investigations, a brief description of the general subsurface geology at the Site, in order of depth, is summarized in the following sections. The borehole logs are provided in Appendix A. Inferred geological cross sections traversing the Site are presented in Figures 7A and 7B.

Topsoil / Ploughed Soil

A surficial layer of topsoil 50 to 380 mm thick was encountered in all Boreholes. However, given use of the property for agricultural purposes disturbed (ploughed) soil should be expected to typical ploughing depths of up to 600 to 800 mm.

Pavement Structure

All boreholes advanced within the roadway of Veterans Drive and 5th Sideroad encountered a pavement structure comprised of an asphaltic layer with a thickness ranging from 75 to 200 mm overlying a 200 to 330 mm thick granular layer and within the road shoulder of Veterans Drive and 5th Sideroad encountered a pavement structure comprised of a surficial granular layer approximately 50 to 600 mm with the exception of Boreholes 152 and 157. The borehole advanced within the shoulder of McKay Road West encountered a pavement structure comprised of a surficial granular layer approximately 180 to 870 mm. The granular layer typically consisted of a sand and grave with trace to some silt. The granular fill is in a generally moist condition.

Sand Fill

Sand fill underlies the pavement structures in Boreholes 63, 117, 137, 146C, 149A, 150, 151, 152, 153, 154, 155, 157, 158 and 159. The fill extends to depths of approximately 0.7 to 3.2 m (~Elevation 306.2 to 311.3 m). Typically, the thickness of fill ranged from approximately 0.5 to 2.9 mbgs. The fill typically comprises of brown to reddish brown sand, trace to some silt, trace to some gravel and occasional organics were observed. Moisture contents in the fill ranged from approximately 6 to 28 %.

Native Soils

The native soils were intersected below the topsoil or fill at all borehole locations. The native soils comprise sand, silty sand, silty clay, clayey silt, silt, silty sand till, and peat and exist in various thicknesses, sequences, degrees of compactness and consistencies depending on location. Moisture contents in the native soils were recorded as follows:

- Sand/Silty Sand - approximately 1 to 29 %
- Silty Clay / Clayey Silt – approximately 8 to 22 %
- Silt – approximately 14 to 20 %
- Silty Sand Till – approximately 4% to 32 %

- Peat – approximately 68 and 260 %

Silty Sand Till

The predominant soil deposit at the site was a glacial silty sand till. The till deposit was encountered in borehole locations with the exception of boreholes 58, 106, 124, 14A, E27, E28, 150, 152, and154. The till contained trace gravel and occasional cobble. The till deposit existed in a compact to very dense state.

Silty Sand

In boreholes 99, 104, 108 133 and E44 discontinuous deposit of silty sand was encountered. The deposit typically contained trace gravel, trace clay and occasional silt seam. The deposit existed in a very loose to very dense state has moisture content ranging from 7 to 19%.

Silt

A discontinuous deposit of silt was encountered across the majority of the Site. The deposit typically contained some clay, some sand, trace gravel, and the occasional sand seam. The silt had a hard consistency and moisture content ranged from 7 to 24%.

Silty Clay

A discontinuous silty clay deposit was encountered along McKay Road West and Veterans Drive roadways. The deposit typically contained trace sand and trace gravel. The deposit existed in a hard consistency and had moisture content ranging from 8 to 26%.

Clayey Silt

Locally in borehole 103, a discontinuous deposit of clayey silt was encountered. The deposit was generally hard, and had moisture content was 14%.

Peat

Peat was encountered locally in Boreholes 31 and 76 in the southeastern portion of the site

Fine to Medium Sand

Deposits of fine to medium sand were overlaying, underlying and within the silty sand till deposit. The sand contains trace to some gravel, and trace to some silt. The deposit is generally in very loose to loose state and has a moisture contact ranging from 1 to 11%.

Water Bearing Sand

A water bearing sand was interpreted to be typically present in boreholes in Section 1 and 2 of the site. No significant wet sand layers were encountered in Section 4 while Section 3, 5 and 6 had a single location.

4.2 Groundwater Elevations and Flow Direction

Static groundwater level measurements were recorded for all available monitoring wells as part of the Hydrogeological Investigation. A summary of the static water level data as it relates to the elevation survey is summarized in Table 1-A (enclosed).

The highest groundwater elevation measured in the shallow wells, including the ones installed in a nested configuration was 310.48 masl (0.28 mbgs in BH-17 on June 22, 2017). The lowest groundwater measured in the noted wells was 300.4 masl (6.1 mbgs in BH-68 on August 18, 2017).

The highest groundwater elevation measured in the deep wells, including the ones installed in a nested configuration was 305.16 masl (7.79 mbgs in BH-151 on August 18, 2017). The lowest groundwater measured in the noted wells was 290.1 masl (19.9 mbgs in BH-137 on August 18, 2017).

Horizontal Groundwater Flow

Interpreted overburden groundwater flow maps based on the August 2017 monitoring events for the shallow and deep wells are presented in Figure 8 and Figure 9, respectively. The groundwater contour map delineated for the shallow water-bearing zone is based on the water level measurements recorded for all existing shallow wells, including the ones with a nested configuration installed across the Site; whereas the groundwater contour map delineated for the deep water-bearing zone is based on the water level measurements recorded for the deep wells installed in a nested configuration.

Based on the obtained water level measurements, the general direction of groundwater flows in both shallow and deep water-bearing zones are inferred to be approximately towards southeast of the Site. The general flow directions are consistent with the approximate trend of the creek traversing the centre of the Site (Figures 8 and 9) as well.

Vertical Groundwater Gradients

Based on the water level measurements completed in the nested wells, the inferred general vertical hydraulic gradient is to be approximately downward, towards deeper water-bearing zones.. The downward gradient suggests the Site to be in an area of groundwater recharge.

A summary of the hydraulic gradients observed at each monitoring well location is summarized in Table 1-A (enclosed).

It should be noted that the horizontal and vertical groundwater flow directions are subject to seasonal variations. As a result, further monitoring will provide a better understanding of groundwater flows within the overburden.

4.3 Hydraulic Connection between Surface Water Features and Groundwater

A total of four (4) pairs of nested mini-piezometers (MPs) were installed at the Site (Figure 2):

- One (1) pair of nested MPs (MP1D/S) located on the northern boundary of the northern block, in the tributary that intersects the northern block;
- One (1) pair of nested MPs (MP2D/S) located on the southern boundary of the northern block, in the tributary that intersects the northern block near the SWM ponds;
- One (1) pair of nested MPs (MP4D/S) located on the northern boundary of the southern block, in the tributary that intersects the southern block;
- One (1) pair of nested MPs (MP3D/S) located on the southern boundary of the southern block, in the tributary that intersects the southern block;

A summary of the measured groundwater levels in the MPs is summarized in Table 1-B (enclosed). The locations of the MPs are presented in Figures 2A through 2C.

In should be noted that since groundwater levels in the installed MPs had not be stabilized at the time of this report, and as such, the water level measurements for the noted MPs have not been used for contouring groundwater table.

4.4 Hydraulic Conductivity Testing

Sixteen (16) Single Well Response Tests (SWRT's) were completed on sixteen (16) monitoring wells, including single and the ones with nested configuration. The tests were completed to estimate the saturated hydraulic conductivity (K) of the water-bearing zones at the well screen intervals.

The static water level within the monitoring well was measured prior to the start of testing. In advance of performing SWRT, the monitoring well underwent development to remove fine grained sediments introduced into the screen following the well construction. The development process involved purging of the monitoring well to induce the flow of fresh formation water through the screen. The monitoring well was later permitted to fully recover prior to performing SWRT.

Hydraulic conductivity value was calculated from the SWRT data as per the Hvorslev solution included in the AQTESOLV Pro Version 4.50.002 software package. The semi-log plot for drawdown versus time is included in Appendix E.

A summary of the hydraulic conductivity (K) values estimated from the SWRTs are provided in Table 4-1 below.

Table 4-1: Summary of Hydraulic Conductivity Testing

Monitoring Well	Well Depth (mbgs)	Screen Interval (mbgs)		Soil Formation Screened	Estimated Hydraulic Conductivity (m/s)
		from	to		
BH-A2 (a) D	16.5	13.5	16.5	Sand	9×10^{-6}
BH-A2 (b) S	5.9	2.9	5.9	Silty Sand Till	2.7×10^{-7}
BH-A3 (a) D	18.3	15.3	18.3	Silt / Sand	4.3×10^{-6}
BH-A3 (b) S	6.1	3.1	6.1	Silty Sand Till	1.7×10^{-6}
BH-C2 (a) D	18.3	15.3	18.3	Silty Sand Till	5.1×10^{-7}
BH-C2 (b) S	7.6	4.6	7.6	Sand / Silty Sand Till	4.2×10^{-6}
BH-C3 (a) D	18.3	15.3	18.3	Sand / Silty Sand Till	3.8×10^{-6}
BH-C3 (b) S	7.6	4.6	7.6	Silty Sand Till	1.9×10^{-6}
BH-17	7.6	4.6	7.6	Silty Sand Till	7.8×10^{-7}
BH-54	6.1	3.1	6.1	Silty Sand Till / Sand	7.3×10^{-6}
BH-62	10.7	7.7	10.7	Silty Sand Till / Sand	4.05×10^{-6}
BH-64 (a) D	17.4	14.4	17.4	Sandy Silty Till / Sand	1.3×10^{-7}
BH-64 (b) S	6.1	3.1	6.1	Sand /Sandy Silt Till	4.0×10^{-6}
BH-68	7.6	4.6	7.6	Silty Sand Till	4.2×10^{-6}
BH-119	10.6	7.6	10.6	Silty Sand Till	4.2×10^{-7}
BH-151	9.1	6.1	9.1	Silty Sand Till / Sand	2.3×10^{-5}
Highest K value estimate for the tested water-bearing zones					2.3×10^{-5}
Geometric mean of the K values estimated for the tested water-bearing zones					2.1×10^{-6}

SWRT provides estimates of K values for the lithologic units in the immediate zone surrounding the well screen. As shown in Table 4-1, the highest K value is estimated to be 2.3×10^{-5} m/s. Further, the geometric mean of the K values for the tested water-bearing zones is estimated to be 2.1×10^{-6} m/s.

4.5 Groundwater Quality

To assess the suitability for discharge of pumped groundwater to the City of Barrie Sanitary and Storm sewers during dewatering activities, two (2) unfiltered groundwater samples were collected from monitoring wells BH-62 and BH-A2-S on August 17, 2017, using low flow sampling. Prior to collecting the water samples, approximately three (3) standing well volumes of groundwater were purged from the noted wells.

The samples were collected unfiltered and placed into pre-cleaned laboratory-supplied vials and/or bottles provided with analytical test group specific preservatives, as required. Dedicated nitrile gloves were used during sample handling. The groundwater samples were submitted to an independent laboratory named Maxxam Analytics Inc., in Mississauga, Ontario, for analysis.

For assessment purposes, the analytical results were compared to the Limits for Sanitary and Storm Sewers Discharge of the City of Barrie. A summary of the analytical results and the laboratory Certificate of Analysis (CofA) are enclosed in Appendix F.

The laboratory CofA showed that all parameters in both collected water samples were detected at the concentrations below the sanitary; whereas the concentrations of Total Suspended Solids (TSS) in the noted water samples exceeded the Storm limits.

Table 4-2: Summary of Analytical Results

Parameter	City of Barrie Sanitary Sewer Discharge Limit	City of Barrie Storm Sewer Discharge Limit	Concentration	
			BH-62	BH-A2 S
Total Suspended Solids (TSS) (mg/L)	350	15	**16**	**25**

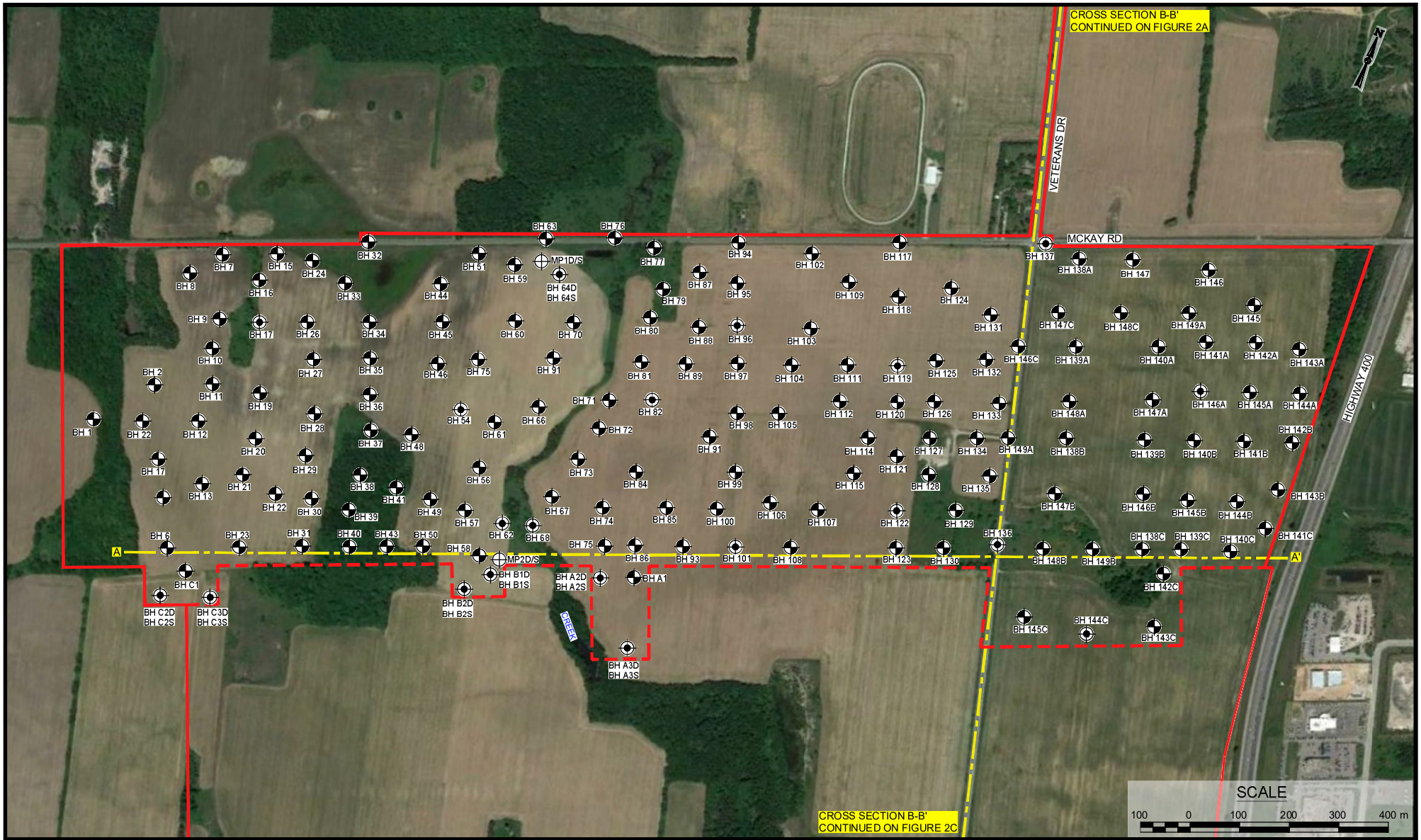
Notes:

Bold indicates concentration exceeds the Storm Sewer limits.

It should also be noted that, during construction, it is anticipated that TSS levels and associated contaminants (for example Metals), in the pumped groundwater may remain above the by-Law limits. Therefore, it is recommended that a suitable treatment method be implemented (filtration or decantation facilities and/ or any other applicable treatment system) during construction dewatering activities.

Further, approval to discharge water to municipal sewer system during construction will be required prior to any discharge.

If treatment systems are considered, the specifications of the treatment system(s) will need to be provided/adjusted by the treatment specialist/process engineer during the pre-design and commissioning stage of the system.



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LEGEND:

- APPROXIMATE SITE BOUNDARY
- MUNICIPAL BOUNDARY
- MINI-PIEZOMETER LOCATION
- BOREHOLE LOCATION
- BOREHOLE / MONITORING WELL LOCATION

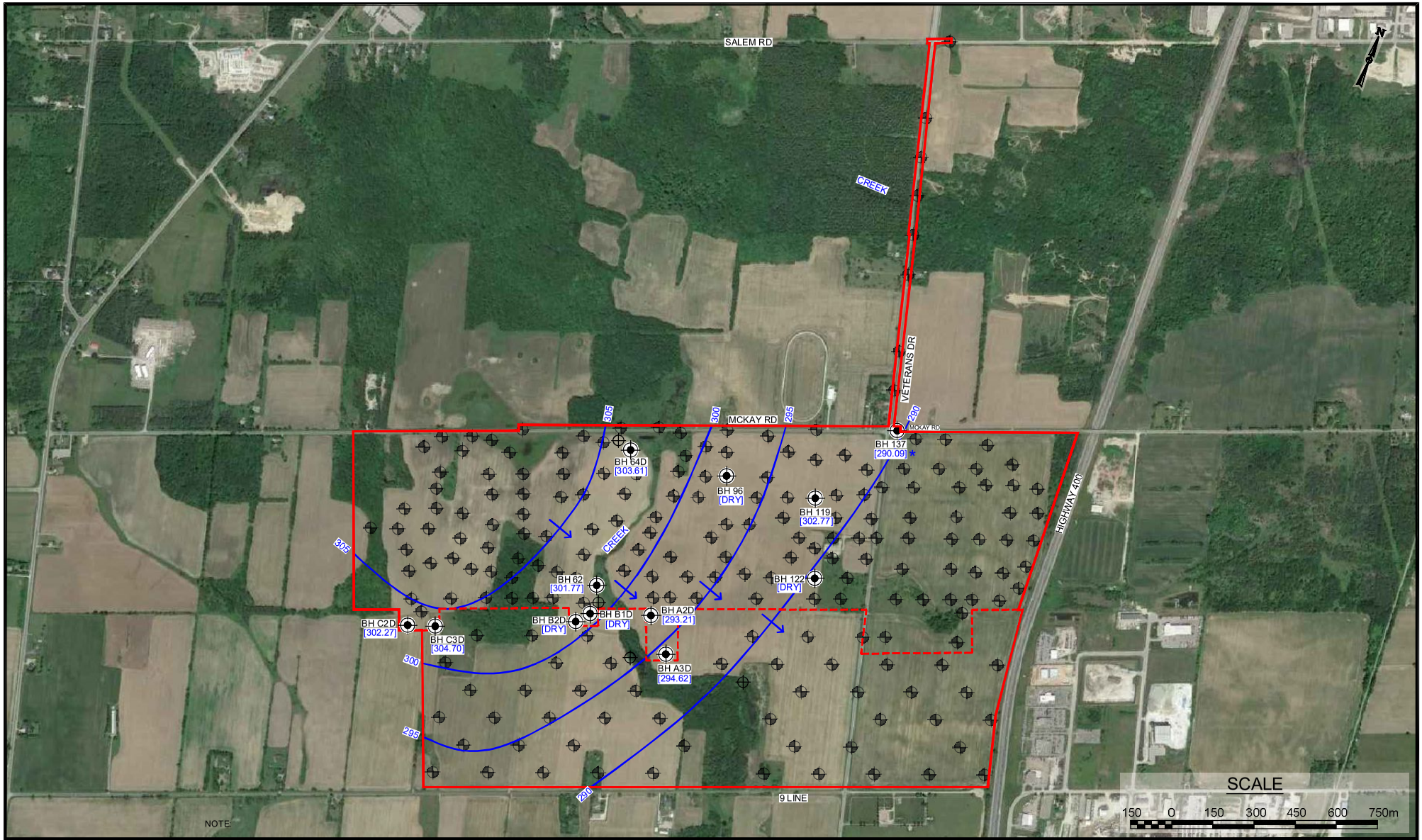
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BOREHOLE / MONITORING WELL / MINI-PIEZOMETER LOCATION PLAN

HYDROGEOLOGICAL INVESTIGATION
WATERSAND DEVELOPMENT
BARRIE / INNISFIL HEIGHTS, ONTARIO

JOB NO.:	DRAWN BY:
BRM-00038305-C0	AS
SCALE: AS NOTED	CHECKED BY: RS
DATE: OCTOBER 2017	FIG NO.: 2B

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LEGEND:

- APPROXIMATE SITE BOUNDARY
- MUNICIPAL BOUNDARY
- MINI-PIEZOMETER LOCATION (SEE FIGURE 2B, 2C FOR DETAILS)
- BOREHOLE / MONITORING WELL LOCATION
- BOREHOLE LOCATION (SEE FIGURE 2A, 2B, 2C FOR DETAILS)
- GROUNDWATER CONTOURS
- GROUNDWATER FLOW DIRECTION
- [XX.XX] GROUNDWATER ELEVATIONS AS MEASURED ON AUGUST 9 &10, 2017
- [XX.XX]* GROUNDWATER ELEVATION AS MEASURED ON AUGUST 18, 2017

NOTE: GROUNDWATER DATA FOR MONITORING WELLS MARKED AS [DRY] WAS OBTAINED BETWEEN JUNE 22, 2017 AND AUGUST 18, 2017

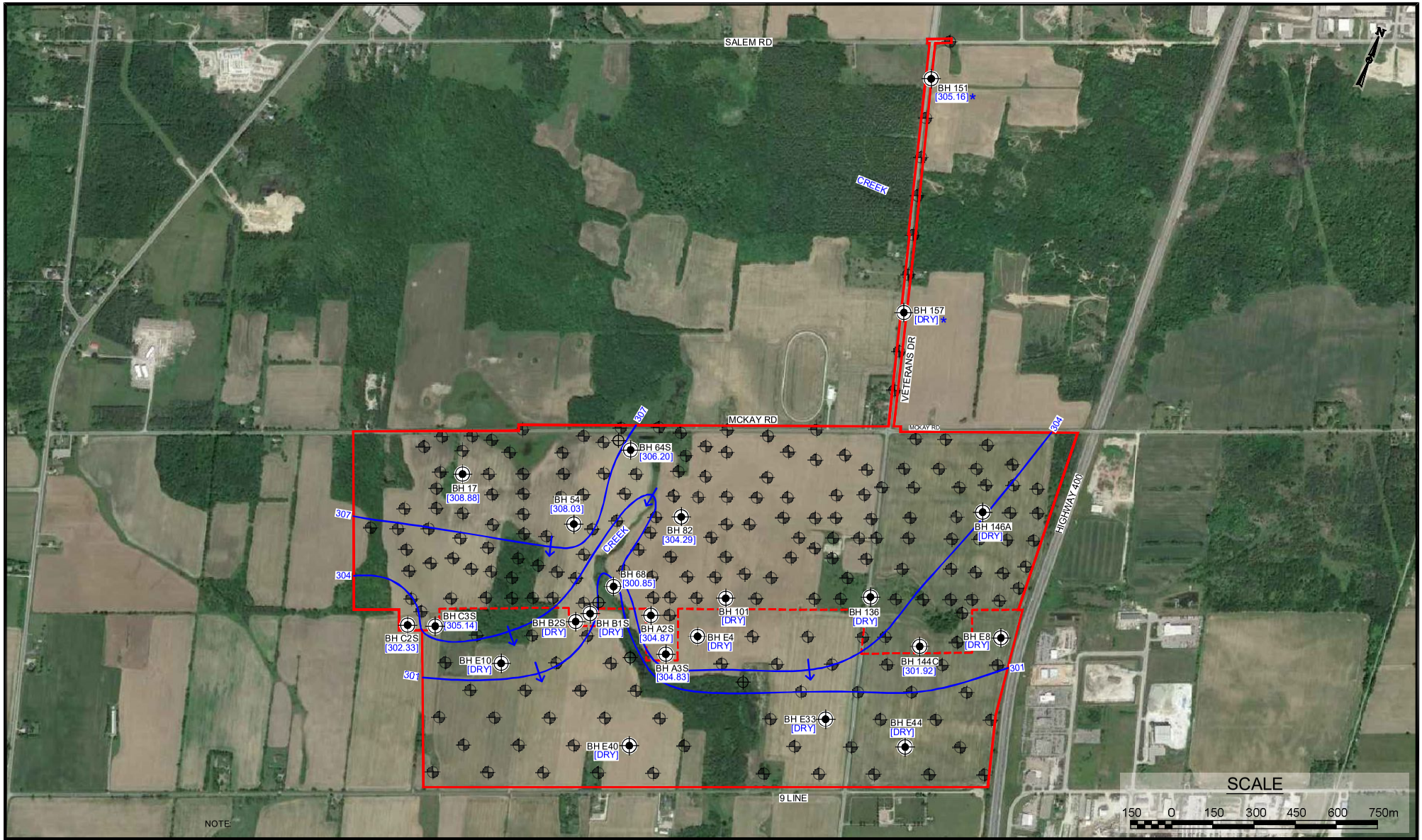
TITLE AND LOCATION:

DEEP GROUNDWATER CONTOURS

HYDROGEOLOGICAL INVESTIGATION
WATERSAND DEVELOPMENT
BARRIE / INNISFIL HEIGHTS, ONTARIO

JOB NO.:	DRAWN BY:
BRM-00038305-C0	AS
SCALE: AS NOTED	CHECKED BY: RS
DATE: OCTOBER 2017	FIG NO.: 8

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LEGEND:

- APPROXIMATE SITE BOUNDARY
- MUNICIPAL BOUNDARY
- MINI-PIEZOMETER LOCATION (SEE FIGURE 2B, 2C FOR DETAILS)
- BOREHOLE / MONITORING WELL LOCATION
- BOREHOLE LOCATION (SEE FIGURE 2A, 2B, 2C FOR DETAILS)
- GROUNDWATER CONTOURS
- GROUNDWATER FLOW DIRECTION
- [XX.XX] GROUNDWATER ELEVATIONS AS MEASURED ON AUGUST 9 &10, 2017
- [XX.XX]* GROUNDWATER ELEVATION AS MEASURED ON AUGUST 18, 2017

NOTE: GROUNDWATER DATA FOR MONITORING WELLS MARKED AS [DRY] WAS OBTAINED BETWEEN JUNE 22, 2017 AND AUGUST 18, 2017

TITLE AND LOCATION:
SHALLOW GROUNDWATER CONTOURS
HYDROGEOLOGICAL INVESTIGATION
WATERSAND DEVELOPMENT
BARRIE / INNISFIL HEIGHTS, ONTARIO

JOB NO.:	DRAWN BY:
BRM-00038305-C0	AS
SCALE: AS NOTED	CHECKED BY: RS
DATE: OCTOBER 2017	FIG NO.: 9

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EXP Seasonal High Grounwater Contours

SALEM RD

BH 151
[305.16]*

CREEK

BH 157
[DRY]*

VETERANS DR

MCKAY RD

MCKAY RD

309 308 307 306 305 304 303

BH 64S
[306.08]

BH 17
[309.12]

BH 54
[308.37]

BH 82
[304.29]*

CREEK

BH 146A
[DRY]

HIGHWAY 400

302

BH 68
[303.29]

BH A2S
[304.70]

BH 101
[303.69]

BH 136
[DRY]

301

BH C3S
[303.40]

BH B2S
[DRY]*

BH B1S
[DRY]*

BH C2S
[300.69]

BH E4
[DRY]*

BH E8
[DRY]

BH E10
[DRY]*

BH A3S
[306.32]

BH 144C
[301.09]

BH E33
[DRY]*

BH E44
[301.25]

BH E40
[DRY]

9 LINE

NOTE:

SCALE

150 0 150 300 450 600 750m

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- APPROXIMATE SITE BOUNDARY
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- MINI-PIEZOMETER LOCATION (SEE FIGURE 2B, 2C FOR DETAILS)
- BOREHOLE / MONITORING WELL LOCATION
- BOREHOLE LOCATION (SEE FIGURE 2A, 2B, 2C FOR DETAILS)
- GROUNDWATER CONTOURS
- [XX.XX] GROUNDWATER ELEVATIONS
- GROUND CONTOUR ELEVATIONS FROM 312.0 TO 302.0 MASL

NOTE: GROUNDWATER DATA FOR MONITORING WELLS WAS OBTAINED BETWEEN FEBRUARY 11 TO JULY 11, 2019

* DATA OBTAINED FROM 2017-2018

TITLE AND LOCATION:

GROUNDWATER CONTOURS

HYDROGEOLOGICAL INVESTIGATION
WATERSAND DEVELOPMENT
BARRIE / INNISFIL HEIGHTS, ONTARIO

JOB NO.:	DRAWN BY:
BRM-00038305-C0	AS
SCALE: AS NOTED	CHECKED BY: RS
DATE: MAY 2022	FIG NO.: 8

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InfoWater Modeling Brief

April 15, 2020

Our File: 2014-4074

City of Barrie Engineering Department
70 Collier Street
Barrie, ON
L4M 4T5

SCHAEFFERS
CONSULTING ENGINEERS

6 Ronrose Drive, Vaughan, Ontario L4K 4R3
Tel: (905) 738-6100 Fax: (905) 738-6875
Tor. Line: (416) 213-5590 E-mail: general@schaeffers.com

Attention: Mr. Ralph Scheunemann, P.Eng.
Senior Infrastructure Planning Engineer

Dear Mr. Scheunemann,

RE: InfoWater Modeling Brief
Water Supply Scheme Update for Salem Secondary Plan
Barrie Annexation Lands, City of Barrie

1 Introduction

This Brief has been prepared as per the discussions with the City of Barrie staff, in support of the design of the water supply distribution system for the Barrie Salem Secondary Plan Annexation (SSP) Lands west of the Highway 400 (any reference to SSP Lands indicate areas west of Hwy 400). A conceptual municipal water servicing plan for the SSP lands was proposed in the City of Barrie Water Storage and Distribution Master Plan for Intensification Areas and Annexed Lands (AMEC Report), prepared by AMEC (October 2013). This brief addresses the recent updates to the City of Barrie Water Supply fire flow requirements criteria.

2 Background Documents

The following documents were used for background information and design criteria in the creation of this water distribution analysis;

- Water Storage and Distribution Master Plan, AMEC Environment & Infrastructure, dated October 2013,
- Water Transmission and Distribution Policies and Design Guidelines, City of Barrie Engineering Department, dated December 2017,
- Sanitary Sewage Collection System Policies and Design Guideline, City of Barrie Engineering Department, dated October 2017,
- Design Guidelines for Drinking-Water Systems, Ministry of Environment (MOE),

dated 2008,

- City of Barrie Water Storage and Distribution Master Plan Update, Draft Report, by WSP, dated April 2019,
- Salem Secondary Plan Development Plan, by KLM Planning Partners Inc., dated April 30, 2019,
- Preliminary Grading Plan, Drawings 4A to 4D, by Schaeffer & Associates Ltd., dated November 14, 2017.

3 Existing Conditions

3.1 Existing Topography and Pressure Districts

Currently, the City of Barrie has five pressure districts:

- District 1 (HWL = 281.2 meters above sea level (masl)),
- District 2 North (324.09 masl),
- District 3 North (347 masl),
- District 2 South (308 masl) (PD2S),
- District 3 South (350.2 masl) (PD3S).

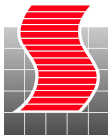
The SSP lands fall almost entirely in PD3S, with the eastern border of the Salem property falling in PD2S. The existing topography is known for the site, where the lowest elevation is in the northwest corner on the County Road 27 at 296 masl, and the highest is 313.5 masl occurring in the central region of the subject land. In general, the SSP lands have a fall from west to east.

3.2 Existing Water Supply Infrastructure

Currently, there are existing water supply infrastructure in the SSP lands:

- 400mmØ main on Essa Road, between Athabaska Road and Koda Street,
- 300mmØ main on County Road 27, between Lougheed Road and Mabern Street,
- 300mmØ main on Mabern Street, between County Road 27 and Essa Road,
- 300mmØ and 200mmØ mains inside the Crisdawn Construction Inc. lands, Bear Creek Subdivision,

Just north of the SSP lands, still in PD3S, are the two pump stations and the Mapleview reservoir



storage facility that services the pre-annexation area. There are also key tie-in points identified, all at the border of the SSP land, they consist of:

- 300mmØ main on Dunn Street ending at the southeast cul-de-sac of Dunn,
- 200mmØ main on Reid Drive ending at the south end of Reid Drive,
- 300mmØ main on Commerce Park Drive ending at the intersection with Veterans Drive,
- 300mmØ main on Lockhart Road from Huronia Road to the intersection of Salem Road and Veterans Drive (Lockhart Road is east of the Highway 400, Salem Road is west of the Highway 400),
- 500mmØ main on Veterans Drive ending at the intersection with Salem Road.

The existing infrastructure will be utilized during this expansion of PD3S.

4 Water Supply Design Criteria

The following design criteria will guide the future hydraulic modelling for the SSP land water distribution system:

- Average residential daily demand of 225 liters per capita per day, 28 m^3/ha/day for institutional and commercial land use, and 35 m^3/ha/day for general industrial land use;
- Peaking factors per the MOE Design Guidelines for Drinking Water Systems, Chapter 3, Table 3-1: Peaking factors which bases the peaking factor on the population. Peaking factors were established for each area (per the development plan by KLM);
- Fire Flow demands of: minimum of 100 l/s for single residential units, minimum of 155 l/s for townhouse blocks, minimum of 200 l/s for institutional areas, minimum of 283 l/s for commercial areas, and minimum of 333 l/s for industrial areas. All flows must arrive with a minimum pressure of 140 kPa (20 psi); Fire Underwriters Survey (FUS) Fire Protection calculations for required fire flows will be performed in the future when the detailed plans become available.
- Watermain velocity during the fire flow conditions must be under 5 m/s;
- The allowable pressure range under operating conditions (peak hour – min hour) shall be within 275 kPa – 700 kPa.
- Hazen-Williams formula was applied for computing the size of watermain pipes. The actual Hazen-Williams “C” values used in the WaterCAD model are listed in Table 1.

Table 1 Hazen-Williams Coefficients

Pipe Diameter(mm)	Hazen-Williams Coefficient
150	100
200 – 250	110
300 – 450	120
600 and larger	130

5 Proposed Water Distribution System

The SSP lands are proposed to be serviced along with PD3S. It is proposed to tie-in to the existing infrastructure noted above at the locations illustrated schematically in **Figures 5.1 to 5.5**.

5.1 Phasing

The conceptual plan for development involves three phases. In order to accommodate the phasing of construction, the implementation of the watermains will follow a strategic plan to service the SSP lands in the interim construction phases.

5.1.1 Phase 1 (2012 – 2021)

A 500mmØ watermain, proposed to run south on Veterans Drive from Salem Road to McKay Road. A 400mmØ Watermain is proposed to travel west on McKay Road to the originally planned 200mmØ Reid Drive extension. The Reid Drive extension watermain was changed to 300mmØ watermain based on the WSP Master Plan as this will satisfy the updated fire flow criteria if there are no interruptions of service on the 500mm Veterans Drive.

In the northwest area of SSP, a 400mmØ watermain is proposed to tie-in with the existing 400mmØ Essa Road main and continue south to Salem Road. From Essa Road and Salem Road intersection, a 500mmØ is proposed to travel east on Salem to Veterans Drive. These watermains are designed to supply the north-western and south – eastern quadrants of the SSP. For more details on the servicing strategy of Phase 1 please refer to **Figure 5.1** below.

In case of an interruption of service on the Veterans Drive, the fire flow requirements in Phase 1 will not be met since McKay Road watermain section to Huronia Drive will not be constructed at that point. Therefore, two alternative solutions are presented.

5.1.2 Phase 1 Alternative A (2012-2021)

In the Alternative A version of Phase 1 the proposed 300mmØ Reid Drive extension is not going to be constructed until a later date. To rectify this a temporary 400mmØ watermain is proposed to run alongside the 500mmØ watermain on Veterans Drive from Salem Road to McKay Road to serve as a redundant watermain and provide backup in case of interruption of service through the 500mmØ watermain. In order to reduce headloss in case of interruption of service through the 500mmØ watermain, three connections between the temporary 400mmØ watermain and 500mmØ watermain are proposed. Two interconnections are proposed at the location of future H & H Capital connection locations to the Veterans Drive main (proposed Streets "A" and "H" in the H & H Capital site), and a third interconnection is proposed halfway between Street "A" and Salem Road. This way the headloss is reduced in a case of interruption of service through any of the four sections of the 500mmØ watermain from Salem Road to McKay Road. Please refer to **Figure 5.2** for the Phase 1 Alternative A water supply servicing.

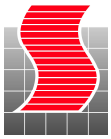
5.1.3 Phase 1 Alternative B (2012-2021)

In the Alternative B version of Phase 1 the Reid Drive Extension is upsized to 500mmØ from Salem Road to the proposed Street "A", and 400mm from Street "A" to McKay Road. With this alternative watermain sizing all of the fire flow requirements in Phase 1 will be satisfied in the case of interruption of service through any section of Veterans Drive 500mmØ watermain. Please refer to **Figure 5.3** for the presentation of Phase 1 Alternative B water supply servicing.

Both Phase 1 Alternatives have been analyzed in detail, and Alternative A was proposed to the City and was accepted by the City of Barrie.

5.1.4 Phase 2 (2022 – 2026)

The aforementioned McKay Road West 400mmØ watermain is proposed to extend further west as shown in **Figure 5.4**. The McKay Road West extension to Huronia Road was not considered for the purpose of this analysis. It is anticipated if this connection is provided the result will be improved. As per AMEC Master Plan in this phase of development an additional booster pumping station and storage facility are proposed in order to meet the water volume demands for the development area. The location of the new pumping station and storage facility is proposed on the south side of Salem Road east of Veterans Drive and west of Highway 400. The pumping station is specified to be supplied by the existing Surface Water Treatment Plant (SWTP) through



a series of 750mmØ transmission mains. These transmission mains have been modeled but left inactive in the InfoWater model. There is not enough information known at this concept phase to properly simulate the pumping configuration or the pressure reduction valves needed to employ this configuration.

Since Alternative A of Phase 1 will be constructed it should remain operational for fire flow purposes in this Phase.

5.1.5 Phase 3 (2027 – 2031)

The McKay Road 400mmØ watermain is proposed to extend west to the intersection of Essa and McKay Road West, thus creating looping of supply mains. The McKay Road West extension to Huronia Road was not considered for the purpose of our analysis. It is anticipated if this connection is provided the result will be improved. Please refer to **Figure 5.5** for the presentation of Phase 3 water supply servicing.

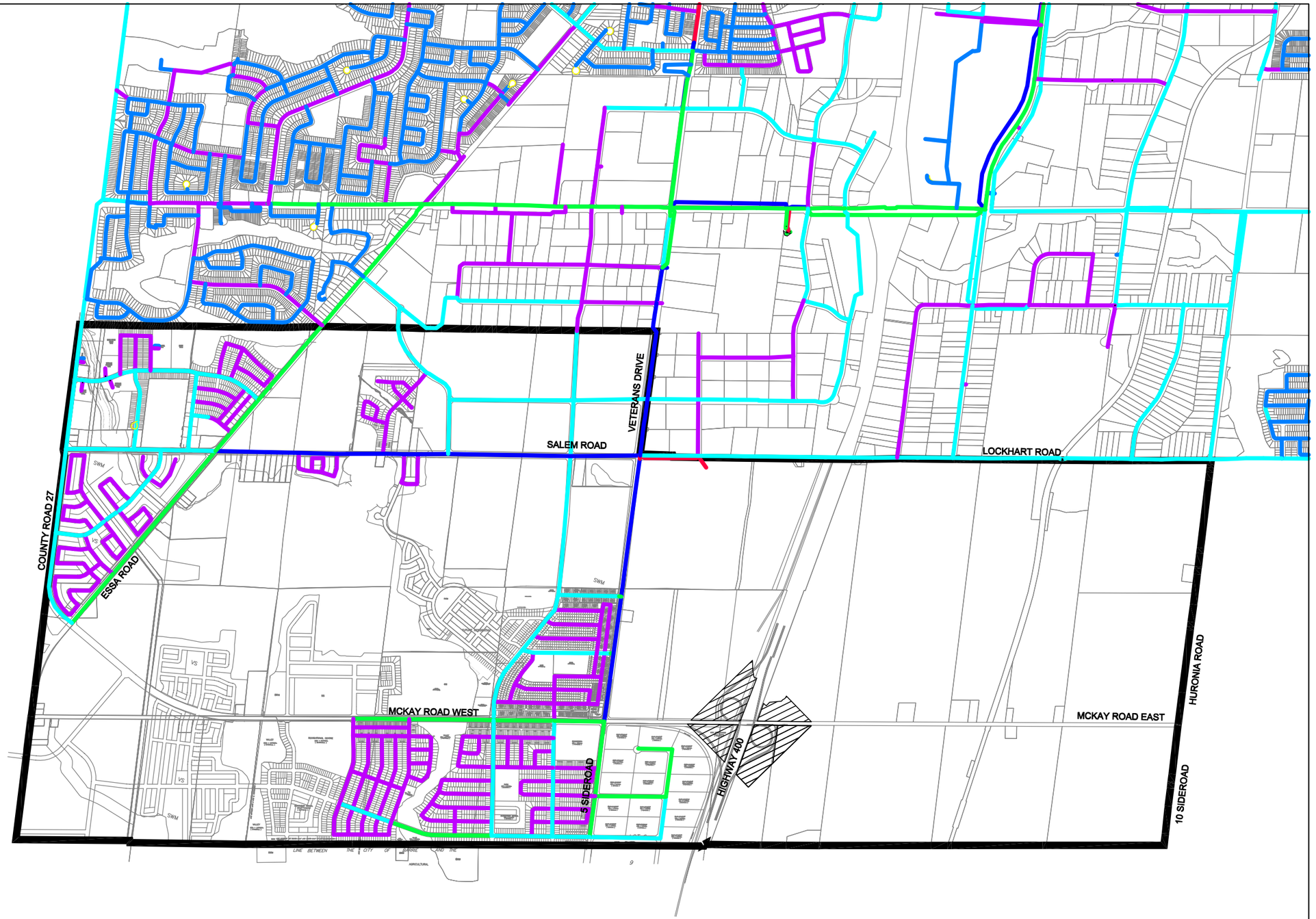
The non-participating land owners have been taken into consideration in the design of the water distribution system; with available mains for connection should they choose to develop the land.

For more detail on phasing please refer to the City of Barrie development phasing plan for the SSP area as shown in the Attachment.

6 Water Supply Analysis

Hydraulic modelling was performed using InfoWater software to confirm the adequacy of the preliminary water supply network design with respect to the watermain sizing and the required fire flow. The InfoWater water supply model based on City of Barrie Water Model 2S and 3S, provided by the City of Barrie, has been completed in order to analyze SSP water supply. The preliminary grading of the SSP was adopted from Preliminary Grading Plan, Drawings 4A to 4D, by Schaeffer & Associates Ltd., dated November 14, 2017. The land use, residential unit distribution and unit types were adopted from Salem Secondary Plan Development Plan, by KLM Planning Partners Inc., dated April 30, 2019. Water supply demand was calculated for each property based on the number of units or the land use and area, based on the existing information. If there was no information available on the unit types, single family units were assumed. The demand for each property was evenly distributed among the model junctions belonging to each property. The summary of the water supply demands is presented in the Attachment. There are no detailed plans, therefore, the minimum required fire flows were used in the InfoWater model. The fire flow

Bogdan Pavlovic



SALEM COMMUNITY DEVELOPMENT AREA
CITY OF BARRIE

LEGEND

- SECONDARY DEVELOPMENT PLAN BOUNDARY
- HIGHWAY / INTERCHANGE
- 50mmØ WATERMAIN
- 150mmØ WATERMAIN
- 200mmØ WATERMAIN
- 300mmØ WATERMAIN
- 400mmØ WATERMAIN
- 500mmØ WATERMAIN
- 600mmØ WATERMAIN
- 750mmØ WATERMAIN

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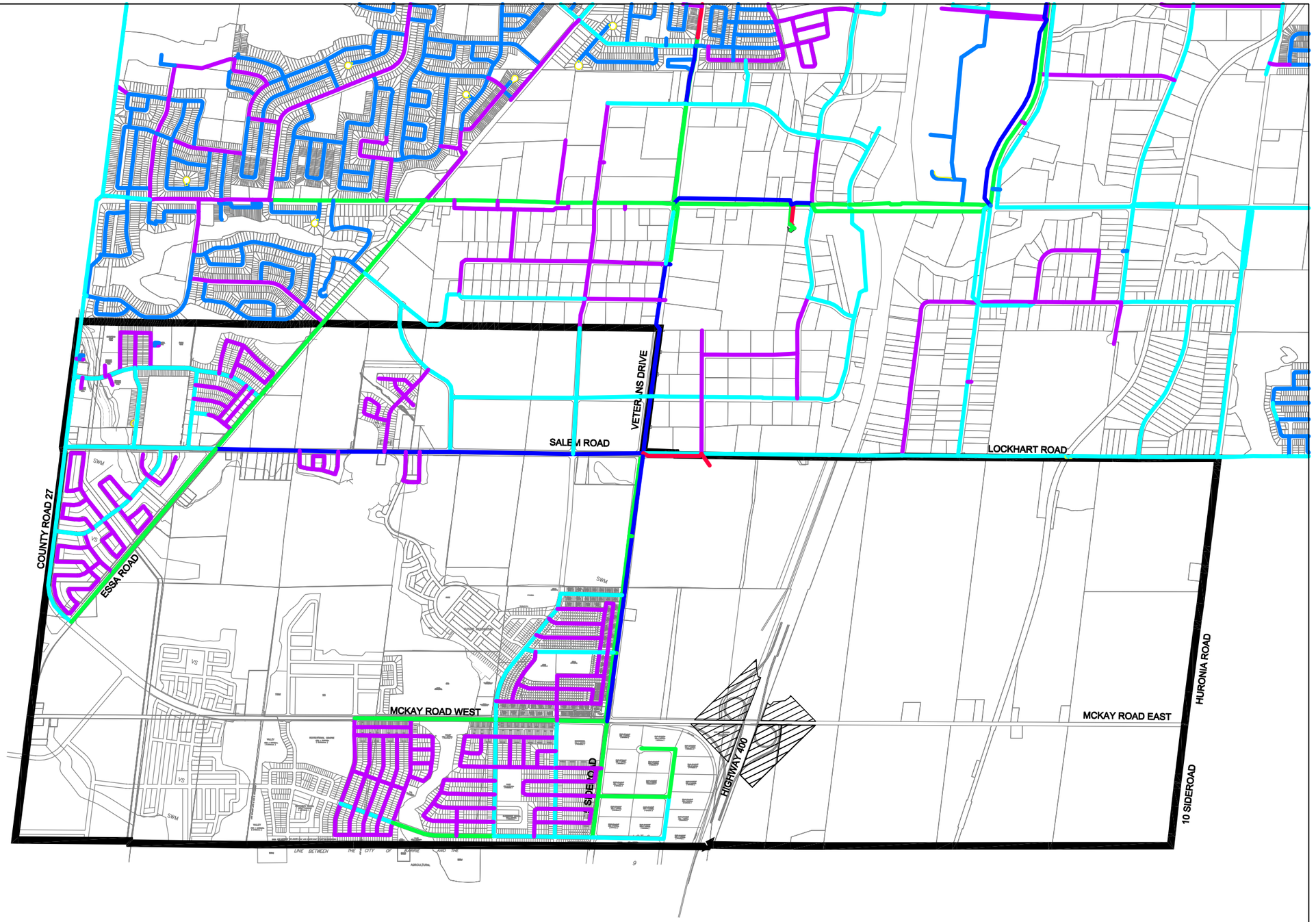
FIGURE 5.1
WATER SUPPLY PHASE 1
SALEM SECONDARY PLAN

2014-4074	APRIL 2020	SCALE: N.T.S.

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Bogdan Pavlovic

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SALEM COMMUNITY DEVELOPMENT AREA
CITY OF BARRIE

LEGEND

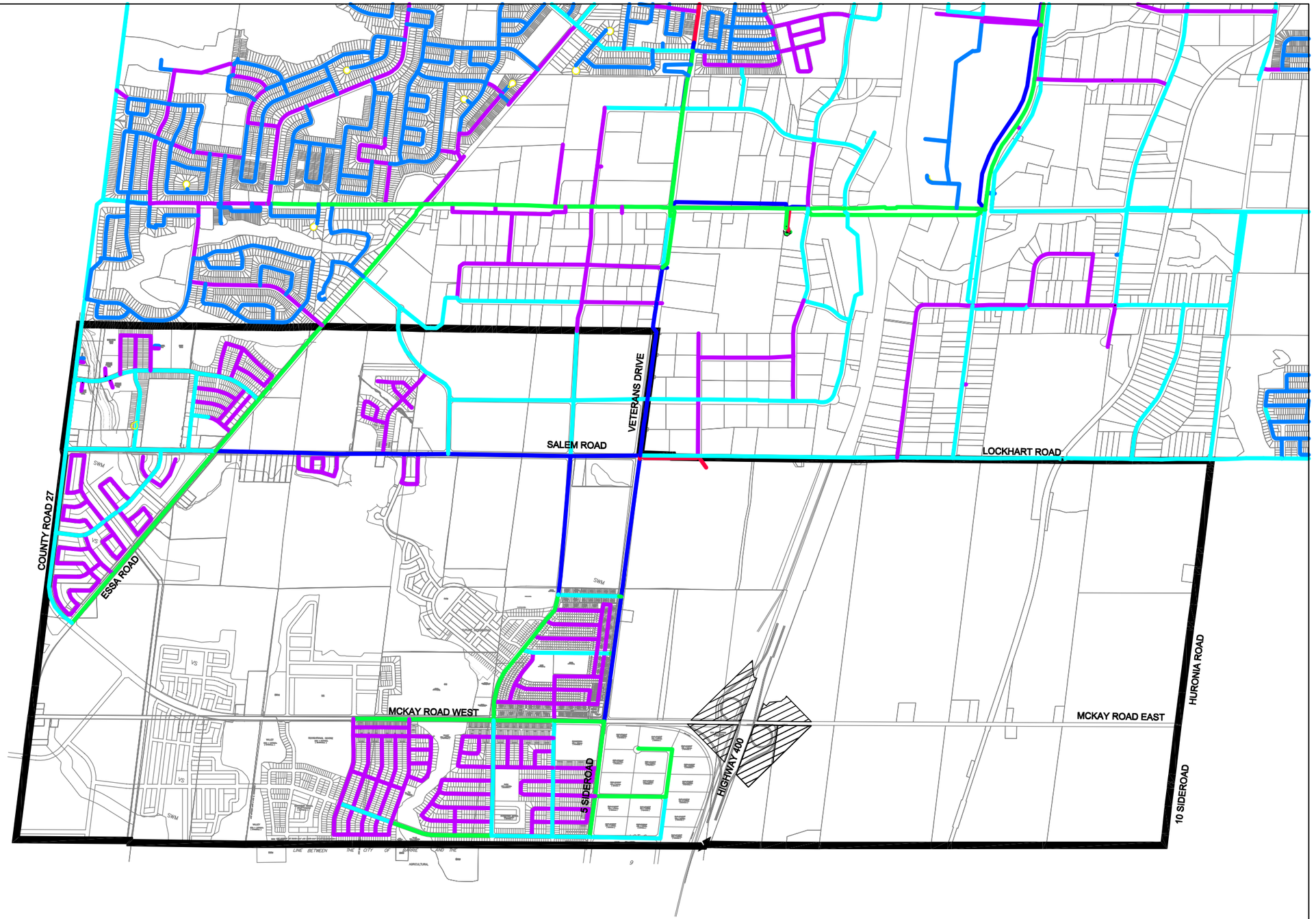
- SECONDARY DEVELOPMENT PLAN BOUNDARY
- HIGHWAY / INTERCHANGE
- 50mmØ WATERMAIN
- 150mmØ WATERMAIN
- 200mmØ WATERMAIN
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- 400mmØ WATERMAIN
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FIGURE 5.2
WATER SUPPLY PHASE 1 ALTERNATIVE A
SALEM SECONDARY PLAN

2014-4074	APRIL 2020	SCALE: N.T.S.

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SALEM COMMUNITY DEVELOPMENT AREA
CITY OF BARRIE

LEGEND

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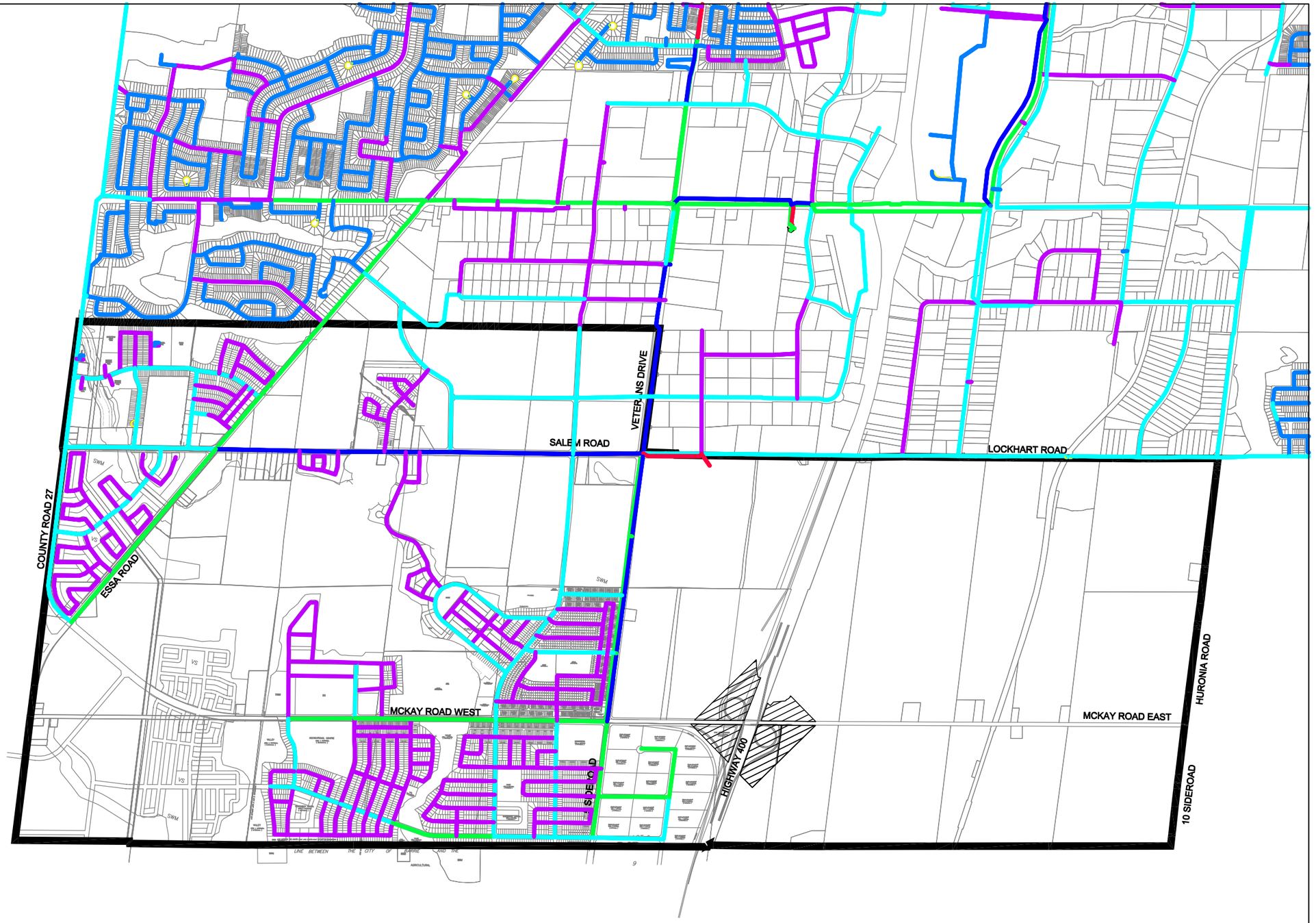
FIGURE 5.3
WATER SUPPLY PHASE 1 ALTERNATIVE B
SALEM SECONDARY PLAN

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SALEM COMMUNITY DEVELOPMENT AREA
CITY OF BARRIE



LEGEND

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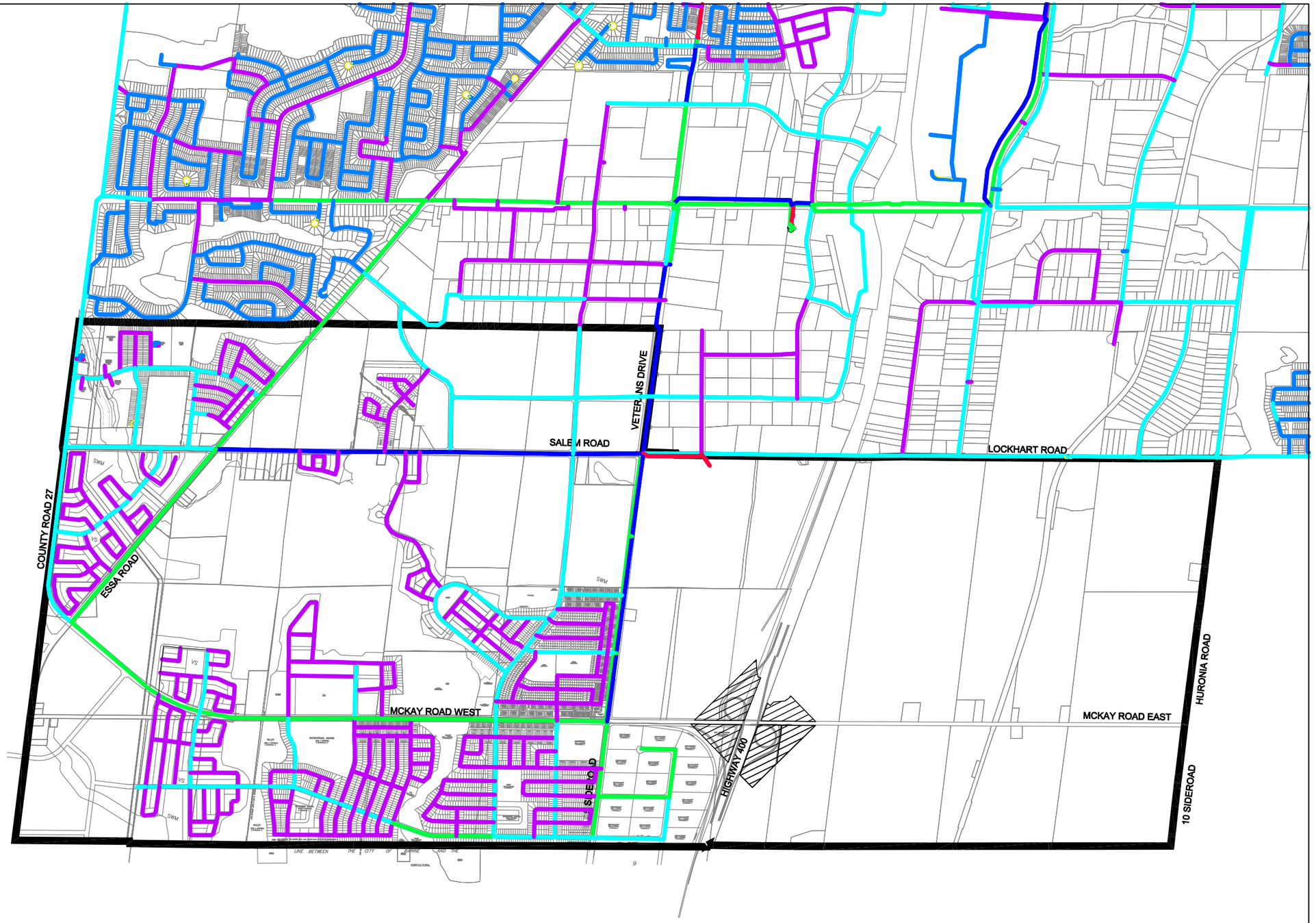
FIGURE 5.4
WATER SUPPLY PHASE 2
SALEM SECONDARY PLAN

2014-4074	APRIL 2020	SCALE: N.T.S.

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Bogdan Pavlovic

SALEM COMMUNITY DEVELOPMENT AREA
CITY OF BARRIE



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FIGURE 5.5
WATER SUPPLY PHASE 3
SALEM SECONDARY PLAN

2014-4074	APRIL 2020	SCALE: N.T.S.

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requirement was based on the land use or unit types, if available. The proposed watermain sizing is presented in **Figure 5.1 to 5.5**.

InfoWater modelling of the proposed water supply system demonstrated that the residential water supply demand and fire flow requirements are satisfied in SSP land for each of the construction Phases under the assumed boundary conditions and with the proposed watermain sizing.

7 Conclusion

The updated City of Barrie fire flow requirement can be met across the Salem Secondary Plan lands for each of the construction Phases with the proposed connections to the existing water distribution system and the proposed watermain sizing provided Phase 1 Alternative A solution on Veterans Drive is constructed. Detailed modeling will be performed in the future when more detailed plans become available for each of the construction Phases. We recommend the fire flows to be estimated based on the FUS fire flow calculations and Water Supply analysis to be done at each development stage. When building information is available, especially townhouse blocks, water supply modeling should be checked. Furthermore we strongly recommend that the water supply analysis to be checked and refined based on final design of the grading plan of each subdivision project. In each subdivision, water age should be analyzed and temporary water flushers might be necessary.

Should you have questions or comments, please do not hesitate to contact the undersigned.

Respectfully Submitted,

SCHAEFFERS CONSULTING ENGINEERS



Bogdan Pavlovic, **MESc., EIT**
Water Resources Analyst

Koryun Shahbikian, **LLM, M.Eng., P.Eng., PMP**
Partner

APPENDIX B: STORMWATER MANAGEMENT CALCULATIONS

TIMP & XIMP Calculations

PROJECT NO.:5184
PROJECT NAME: WATERSAND CONSTRUCTION
LOCATION: CITY OF BARRIE

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Runoff Coefficient, TIMP & XIMP calculations for Watersand Construction

SWM POND C- Drainage Areas-Ultimate Condition

Land Use	Area (ha)	C	A*C	TIMP	A x TIMP	XIMP	A x XIMP
Residential Detached House (Mix)	7.93	0.62	4.92	0.60	4.76	0.45	3.57
Townhouses	1.06	0.80	0.85	0.86	0.91	0.64	0.68
SWM Pond C Area	2.78	0.55	1.53	0.50	1.39	0.50	1.39
School	2.42	0.75	1.82	0.79	1.90	0.79	1.90
Recreational Centre	8.10	0.75	6.08	0.79	6.36	0.79	6.36
ROW	5.03	0.75	3.77	0.79	3.95	0.79	3.95
External ROW (Mckay Road Drainage)	0.93	0.76	0.71	0.80	0.74	0.80	0.74
Total Area	**28.25**	**0.70**	19.66	**0.71**	20.02	**0.66**	18.60

* Runoff coefficients are based on detailed calculations and City of Barrie Design Criteria

Erosion Control Calculations

PROJECT NO.:5184
PROJECT NAME: WATERSAND CONSTRUCTION
LOCATION: CITY OF BARRIE

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EROSION CONTROL - SWM POND C

Table 4.4.15: End-of-Pipe Stormwater Management Requirements[1,3]

Subwatershed	Reach	Outlet Node	Cumulative Unitary Storage Rate (m^3/imp. ha)				Unitary Discharge Rate (m^3/s/ha)			
			Erosion Control	Flood Control[2]			Erosion Control	Flood Control		
				5 Yr	25 Yr	100 Yr		5 Yr	25 Yr	100 Yr
Bear Creek	BEA1	9001	410	850	1000	1300	0.0012	0.007	0.013	0.030
	BEA2	9005	440	1030	1280	1580	0.0012	0.007	0.013	0.030
Thornton Creek	THO1	9024	430	920	1070	1420	0.0011	0.007	0.013	0.025
	THO2	9017	370	860	960	1310	0.0013	0.009	0.018	0.036
Lover's Creel	LOV2	9251	400	850	1050	1300	0.0011	0.010	0.020	0.050
	LOV4	9142	400	1000	1250	1400	0.0012	0.007	0.012	0.027
	LOV6	9201	400	900	1050	1350	0.0013	0.007	0.013	0.030
	LOV8	9350	460	1060	1310	1510	0.0012	0.007	0.012	0.027
Hewitts Creek	-	9140	450	900	1050	1300	0.0006	0.007	0.013	0.030
Sandy Cove Creek	SAN2	9284	310	760	835	1235	0.0010	0.010	0.020	0.040
	SAN3	9281	320	770	845	1245	0.0011	0.010	0.020	0.040

Note: [1] Water quality: Volumetric requirements for permanent pool storage are in addition to storage provided here and are to be provided in accordance with Ministry of the Environment Enhanced Level treatment.
[2] Includes erosion control volume
[3] Volumes do not include LID

Area Draining to SWM Pond C	28.25	ha	
Total Impervious Area (71%)	20.06	ha	[28.25 * 0.71]
Cumulative Unitary Storage (From 4.4.15)	8624.73	m^3	[20.06 * 430]
Unitary Discarge Rate (From 4.4.15)	0.031		[28.25 * 0.0011]
Peak Outflow	0.047		[0.031 * 1.5]

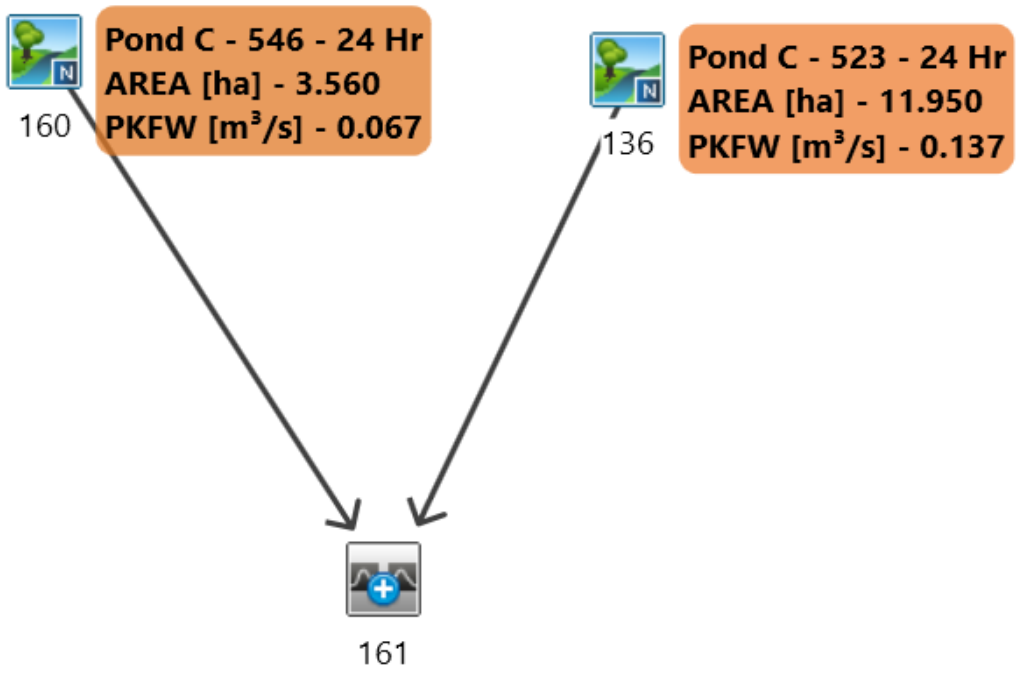
Visual OTTHYMO (VO5) Results

PROJECT NO.:5184
PROJECT NAME: Watersand Construction
LOCATION: City of Barrie

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Allowable Release Rates - SWM Pond C

Storm Event	Pre-Development Release Rate for SWM Pond C (m^3/s)			
	24Hr SCS	12Hr SCS	6Hr SCS	4Hr Chicago
2 Year	0.186	0.158	0.148	0.102
5 Year	0.353	0.305	0.304	0.201
10 Year	0.481	0.421	0.426	0.281
25 Year	0.658	0.582	0.600	0.396
50 Year	0.799	0.712	0.740	0.484
100 Year	0.946	0.846	0.888	0.583



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2-year to 100-year 6 Hour, 12 Hour, 24 Hour SCS Storm and 4 Hour Chicago Storm
Watersand South Residential Subdivision
Pre-Development

Job #: 2020-5184	**Date: June 2022**

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      O   O    T      T    H   H    Y    M   M  O   O
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COMMENTS: _____________________________________________________________


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  ** SIMULATION : Run 01                       **
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|                  |              1bad779e-5246-410c-a42e-3ccee7a1c0de\a3457ff2
| Ptotal= 55.00 mm |    Comments: SCS II 24H_2YR
--------------------
                       Duration of storm    = 24.00 hrs
                       Mass curve time step = 15.00 min

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.25    0.55 |  6.25    1.10 | 12.25    7.92 | 18.25    0.99
               0.50    0.55 |  6.50    1.10 | 12.50    7.92 | 18.50    0.99
               0.75    0.55 |  6.75    1.10 | 12.75    4.07 | 18.75    0.99
               1.00    0.55 |  7.00    1.10 | 13.00    4.07 | 19.00    0.99
               1.25    0.55 |  7.25    1.10 | 13.25    0.77 | 19.25    0.99
               1.50    0.55 |  7.50    1.10 | 13.50    0.77 | 19.50    0.99
               1.75    0.55 |  7.75    1.10 | 13.75    4.51 | 19.75    0.99
               2.00    0.99 |  8.00    1.10 | 14.00    4.51 | 20.00    0.99
               2.25    0.72 |  8.25    1.49 | 14.25    1.65 | 20.25    0.66
               2.50    0.71 |  8.50    1.48 | 14.50    1.65 | 20.50    0.66
               2.75    0.72 |  8.75    1.49 | 14.75    1.65 | 20.75    0.66
               3.00    0.71 |  9.00    1.49 | 15.00    1.65 | 21.00    0.66
               3.25    0.71 |  9.25    1.76 | 15.25    1.65 | 21.25    0.66
               3.50    0.71 |  9.50    1.76 | 15.50    1.65 | 21.50    0.66
               3.75    0.72 |  9.75    1.98 | 15.75    1.65 | 21.75    0.66
               4.00    0.71 | 10.00    1.98 | 16.00    1.65 | 22.00    0.66
               4.25    0.88 | 10.25    2.53 | 16.25    0.99 | 22.25    0.66
               4.50    0.88 | 10.50    2.53 | 16.50    0.99 | 22.50    0.66
               4.75    0.88 | 10.75    3.41 | 16.75    0.99 | 22.75    0.66
               5.00    0.88 | 11.00    3.41 | 17.00    0.99 | 23.00    0.66
               5.25    0.88 | 11.25    5.28 | 17.25    0.99 | 23.25    0.66
               5.50    0.88 | 11.50    5.28 | 17.50    0.99 | 23.50    0.66
               5.75    0.88 | 11.75   22.88 | 17.75    0.99 | 23.75    0.66
               6.00    0.88 | 12.00   60.72 | 18.00    0.99 | 24.00    0.66

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--------------------
| CALIB            |
| NASHYD   (  0136)|   Area     (ha)=  11.95   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.84

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
0.083    0.55 | 6.083    1.10 |12.083    7.93 | 18.08    0.99
0.167    0.55 | 6.167    1.10 |12.167    7.92 | 18.17    0.99
0.250    0.55 | 6.250    1.10 |12.250    7.92 | 18.25    0.99
0.333    0.55 | 6.333    1.10 |12.333    7.92 | 18.33    0.99
0.417    0.55 | 6.417    1.10 |12.417    7.92 | 18.42    0.99
0.500    0.55 | 6.500    1.10 |12.500    7.92 | 18.50    0.99
0.583    0.55 | 6.583    1.10 |12.583    4.07 | 18.58    0.99
0.667    0.55 | 6.667    1.10 |12.667    4.07 | 18.67    0.99
0.750    0.55 | 6.750    1.10 |12.750    4.07 | 18.75    0.99
0.833    0.55 | 6.833    1.10 |12.833    4.07 | 18.83    0.99
0.917    0.55 | 6.917    1.10 |12.917    4.07 | 18.92    0.99
1.000    0.55 | 7.000    1.10 |13.000    4.07 | 19.00    0.99
1.083    0.55 | 7.083    1.10 |13.083    0.77 | 19.08    0.99
1.167    0.55 | 7.167    1.10 |13.167    0.77 | 19.17    0.99
1.250    0.55 | 7.250    1.10 |13.250    0.77 | 19.25    0.99
1.333    0.55 | 7.333    1.10 |13.333    0.77 | 19.33    0.99
1.417    0.55 | 7.417    1.10 |13.417    0.77 | 19.42    0.99
1.500    0.55 | 7.500    1.10 |13.500    0.77 | 19.50    0.99
1.583    0.55 | 7.583    1.10 |13.583    4.51 | 19.58    0.99
1.667    0.55 | 7.667    1.10 |13.667    4.51 | 19.67    0.99
1.750    0.55 | 7.750    1.10 |13.750    4.51 | 19.75    0.99
1.833    0.99 | 7.833    1.10 |13.833    4.51 | 19.83    0.99
1.917    0.99 | 7.917    1.10 |13.917    4.51 | 19.92    0.99
2.000    0.99 | 8.000    1.10 |14.000    4.51 | 20.00    0.99
2.083    0.72 | 8.083    1.49 |14.083    1.65 | 20.08    0.66
2.167    0.72 | 8.167    1.49 |14.167    1.65 | 20.17    0.66
2.250    0.72 | 8.250    1.48 |14.250    1.65 | 20.25    0.66
2.333    0.71 | 8.333    1.48 |14.333    1.65 | 20.33    0.66
2.417    0.71 | 8.417    1.48 |14.417    1.65 | 20.42    0.66
2.500    0.71 | 8.500    1.48 |14.500    1.65 | 20.50    0.66
2.583    0.71 | 8.583    1.49 |14.583    1.65 | 20.58    0.66
2.667    0.72 | 8.667    1.49 |14.667    1.65 | 20.67    0.66
2.750    0.72 | 8.750    1.48 |14.750    1.65 | 20.75    0.66
2.833    0.71 | 8.833    1.49 |14.833    1.65 | 20.83    0.66
2.917    0.71 | 8.917    1.49 |14.917    1.65 | 20.92    0.66
3.000    0.71 | 9.000    1.49 |15.000    1.65 | 21.00    0.66
3.083    0.71 | 9.083    1.76 |15.083    1.65 | 21.08    0.66
3.167    0.71 | 9.167    1.76 |15.167    1.65 | 21.17    0.66
3.250    0.71 | 9.250    1.76 |15.250    1.65 | 21.25    0.66
3.333    0.71 | 9.333    1.76 |15.333    1.65 | 21.33    0.66
```

3.417	0.71	9.417	1.76	15.417	1.65	21.42	0.66
3.500	0.71	9.500	1.76	15.500	1.65	21.50	0.66
3.583	0.71	9.583	1.98	15.583	1.65	21.58	0.66
3.667	0.72	9.667	1.98	15.667	1.65	21.67	0.66
3.750	0.72	9.750	1.98	15.750	1.65	21.75	0.66
3.833	0.71	9.833	1.98	15.833	1.65	21.83	0.66
3.917	0.71	9.917	1.98	15.917	1.65	21.92	0.66
4.000	0.71	10.000	1.98	16.000	1.65	22.00	0.66
4.083	0.88	10.083	2.53	16.083	0.99	22.08	0.66
4.167	0.88	10.167	2.53	16.167	0.99	22.17	0.66
4.250	0.88	10.250	2.53	16.250	0.99	22.25	0.66
4.333	0.88	10.333	2.53	16.333	0.99	22.33	0.66
4.417	0.88	10.417	2.53	16.417	0.99	22.42	0.66
4.500	0.88	10.500	2.53	16.500	0.99	22.50	0.66
4.583	0.88	10.583	3.41	16.583	0.99	22.58	0.66
4.667	0.88	10.667	3.41	16.667	0.99	22.67	0.66
4.750	0.88	10.750	3.41	16.750	0.99	22.75	0.66
4.833	0.88	10.833	3.41	16.833	0.99	22.83	0.66
4.917	0.88	10.917	3.41	16.917	0.99	22.92	0.66
5.000	0.88	11.000	3.41	17.000	0.99	23.00	0.66
5.083	0.88	11.083	5.28	17.083	0.99	23.08	0.66
5.167	0.88	11.167	5.28	17.167	0.99	23.17	0.66
5.250	0.88	11.250	5.28	17.250	0.99	23.25	0.66
5.333	0.88	11.333	5.28	17.333	0.99	23.33	0.66
5.417	0.88	11.417	5.28	17.417	0.99	23.42	0.66
5.500	0.88	11.500	5.28	17.500	0.99	23.50	0.66
5.583	0.88	11.583	22.88	17.583	0.99	23.58	0.66
5.667	0.88	11.667	22.88	17.667	0.99	23.67	0.66
5.750	0.88	11.750	22.88	17.750	0.99	23.75	0.66
5.833	0.88	11.833	60.72	17.833	0.99	23.83	0.66
5.917	0.88	11.917	60.72	17.917	0.99	23.92	0.66
6.000	0.88	12.000	60.72	18.000	0.99	24.00	0.66

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.137 (i)
TIME TO PEAK (hrs)= 12.833
RUNOFF VOLUME (mm)= 13.310
TOTAL RAINFALL (mm)= 55.000
RUNOFF COEFFICIENT = 0.242

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

CALIB					
NASHYD (0160)	Area (ha)=	3.56	Curve Number (CN)=	67.0	
ID= 1 DT= 5.0 min	Ia (mm)=	7.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	0.42			

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.55	6.083	1.10	12.083	7.93	18.08	0.99
0.167	0.55	6.167	1.10	12.167	7.92	18.17	0.99
0.250	0.55	6.250	1.10	12.250	7.92	18.25	0.99
0.333	0.55	6.333	1.10	12.333	7.92	18.33	0.99
0.417	0.55	6.417	1.10	12.417	7.92	18.42	0.99
0.500	0.55	6.500	1.10	12.500	7.92	18.50	0.99
0.583	0.55	6.583	1.10	12.583	4.07	18.58	0.99
0.667	0.55	6.667	1.10	12.667	4.07	18.67	0.99
0.750	0.55	6.750	1.10	12.750	4.07	18.75	0.99
0.833	0.55	6.833	1.10	12.833	4.07	18.83	0.99
0.917	0.55	6.917	1.10	12.917	4.07	18.92	0.99
1.000	0.55	7.000	1.10	13.000	4.07	19.00	0.99
1.083	0.55	7.083	1.10	13.083	0.77	19.08	0.99
1.167	0.55	7.167	1.10	13.167	0.77	19.17	0.99
1.250	0.55	7.250	1.10	13.250	0.77	19.25	0.99
1.333	0.55	7.333	1.10	13.333	0.77	19.33	0.99
1.417	0.55	7.417	1.10	13.417	0.77	19.42	0.99
1.500	0.55	7.500	1.10	13.500	0.77	19.50	0.99
1.583	0.55	7.583	1.10	13.583	4.51	19.58	0.99
1.667	0.55	7.667	1.10	13.667	4.51	19.67	0.99
1.750	0.55	7.750	1.10	13.750	4.51	19.75	0.99
1.833	0.99	7.833	1.10	13.833	4.51	19.83	0.99
1.917	0.99	7.917	1.10	13.917	4.51	19.92	0.99
2.000	0.99	8.000	1.10	14.000	4.51	20.00	0.99
2.083	0.72	8.083	1.49	14.083	1.65	20.08	0.66
2.167	0.72	8.167	1.49	14.167	1.65	20.17	0.66
2.250	0.72	8.250	1.48	14.250	1.65	20.25	0.66
2.333	0.71	8.333	1.48	14.333	1.65	20.33	0.66
2.417	0.71	8.417	1.48	14.417	1.65	20.42	0.66
2.500	0.71	8.500	1.48	14.500	1.65	20.50	0.66
2.583	0.71	8.583	1.49	14.583	1.65	20.58	0.66
2.667	0.72	8.667	1.49	14.667	1.65	20.67	0.66
2.750	0.72	8.750	1.48	14.750	1.65	20.75	0.66
2.833	0.71	8.833	1.49	14.833	1.65	20.83	0.66
2.917	0.71	8.917	1.49	14.917	1.65	20.92	0.66
3.000	0.71	9.000	1.49	15.000	1.65	21.00	0.66
3.083	0.71	9.083	1.76	15.083	1.65	21.08	0.66
3.167	0.71	9.167	1.76	15.167	1.65	21.17	0.66
3.250	0.71	9.250	1.76	15.250	1.65	21.25	0.66
3.333	0.71	9.333	1.76	15.333	1.65	21.33	0.66
3.417	0.71	9.417	1.76	15.417	1.65	21.42	0.66
3.500	0.71	9.500	1.76	15.500	1.65	21.50	0.66
3.583	0.71	9.583	1.98	15.583	1.65	21.58	0.66
3.667	0.72	9.667	1.98	15.667	1.65	21.67	0.66
3.750	0.72	9.750	1.98	15.750	1.65	21.75	0.66
3.833	0.71	9.833	1.98	15.833	1.65	21.83	0.66
3.917	0.71	9.917	1.98	15.917	1.65	21.92	0.66
4.000	0.71	10.000	1.98	16.000	1.65	22.00	0.66
4.083	0.88	10.083	2.53	16.083	0.99	22.08	0.66
4.167	0.88	10.167	2.53	16.167	0.99	22.17	0.66
4.250	0.88	10.250	2.53	16.250	0.99	22.25	0.66
4.333	0.88	10.333	2.53	16.333	0.99	22.33	0.66
4.417	0.88	10.417	2.53	16.417	0.99	22.42	0.66
4.500	0.88	10.500	2.53	16.500	0.99	22.50	0.66
4.583	0.88	10.583	3.41	16.583	0.99	22.58	0.66
4.667	0.88	10.667	3.41	16.667	0.99	22.67	0.66
4.750	0.88	10.750	3.41	16.750	0.99	22.75	0.66
4.833	0.88	10.833	3.41	16.833	0.99	22.83	0.66
4.917	0.88	10.917	3.41	16.917	0.99	22.92	0.66
5.000	0.88	11.000	3.41	17.000	0.99	23.00	0.66
5.083	0.88	11.083	5.28	17.083	0.99	23.08	0.66
5.167	0.88	11.167	5.28	17.167	0.99	23.17	0.66
5.250	0.88	11.250	5.28	17.250	0.99	23.25	0.66
5.333	0.88	11.333	5.28	17.333	0.99	23.33	0.66
5.417	0.88	11.417	5.28	17.417	0.99	23.42	0.66
5.500	0.88	11.500	5.28	17.500	0.99	23.50	0.66
5.583	0.88	11.583	22.88	17.583	0.99	23.58	0.66
5.667	0.88	11.667	22.88	17.667	0.99	23.67	0.66
5.750	0.88	11.750	22.88	17.750	0.99	23.75	0.66
5.833	0.88	11.833	60.72	17.833	0.99	23.83	0.66
5.917	0.88	11.917	60.72	17.917	0.99	23.92	0.66
6.000	0.88	12.000	60.72	18.000	0.99	24.00	0.66

Unit Hyd Qpeak (cms)= 0.324

PEAK FLOW (cms)= 0.067 (i)

```
     TIME TO PEAK     (hrs)=  12.333
     RUNOFF VOLUME     (mm)=  13.308
     TOTAL RAINFALL    (mm)=  55.000
     RUNOFF COEFFICIENT    =   0.242

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
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--------------------
| ADD HYD  (  0161)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0136):    11.95   0.137    12.83    13.31
     + ID2= 2 (  0160):     3.56   0.067    12.33    13.31
       ================================================
       ID = 3 (  0161):    15.51   0.186    12.58    13.31

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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--------------------
| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              1bad779e-5246-410c-a42e-3ccee7a1c0de\8096a049
| Ptotal= 42.30 mm |    Comments: SCS II 6H_2YR
--------------------
                       Duration of storm    =  6.00 hrs
                       Mass curve time step = 15.00 min
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	1.69	1.75	4.23	3.25	9.31	4.75	2.54
0.50	1.69	2.00	4.23	3.50	9.31	5.00	2.54
0.75	2.54	2.25	5.08	3.75	4.23	5.25	1.69
1.00	2.54	2.50	5.08	4.00	4.23	5.50	1.69
1.25	2.54	2.75	25.38	4.25	3.38	5.75	1.69
1.50	2.54	3.00	65.99	4.50	3.38	6.00	1.69

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--------------------
| CALIB            |
| NASHYD   (  0162)|   Area     (ha)=   3.56   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.42

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.69	1.583	4.23	3.083	9.31	4.58	2.54
0.167	1.69	1.667	4.23	3.167	9.31	4.67	2.54
0.250	1.69	1.750	4.23	3.250	9.31	4.75	2.54
0.333	1.69	1.833	4.23	3.333	9.31	4.83	2.54
0.417	1.69	1.917	4.23	3.417	9.31	4.92	2.54
0.500	1.69	2.000	4.23	3.500	9.31	5.00	2.54
0.583	2.54	2.083	5.08	3.583	4.23	5.08	1.69
0.667	2.54	2.167	5.08	3.667	4.23	5.17	1.69
0.750	2.54	2.250	5.08	3.750	4.23	5.25	1.69
0.833	2.54	2.333	5.08	3.833	4.23	5.33	1.69
0.917	2.54	2.417	5.08	3.917	4.23	5.42	1.69
1.000	2.54	2.500	5.08	4.000	4.23	5.50	1.69
1.083	2.54	2.583	25.38	4.083	3.38	5.58	1.69
1.167	2.54	2.667	25.38	4.167	3.38	5.67	1.69
1.250	2.54	2.750	25.38	4.250	3.38	5.75	1.69
1.333	2.54	2.833	65.99	4.333	3.38	5.83	1.69
1.417	2.54	2.917	65.99	4.417	3.38	5.92	1.69
1.500	2.54	3.000	65.99	4.500	3.38	6.00	1.69

```
     Unit Hyd Qpeak  (cms)=   0.324

     PEAK FLOW       (cms)=   0.053 (i)
     TIME TO PEAK    (hrs)=   3.333
     RUNOFF VOLUME    (mm)=   7.767
     TOTAL RAINFALL   (mm)=  42.300
     RUNOFF COEFFICIENT   =   0.184

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
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--------------------
| CALIB            |
| NASHYD   (  0164)|   Area     (ha)=  11.95   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.84

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.69	1.583	4.23	3.083	9.31	4.58	2.54
0.167	1.69	1.667	4.23	3.167	9.31	4.67	2.54
0.250	1.69	1.750	4.23	3.250	9.31	4.75	2.54
0.333	1.69	1.833	4.23	3.333	9.31	4.83	2.54
0.417	1.69	1.917	4.23	3.417	9.31	4.92	2.54
0.500	1.69	2.000	4.23	3.500	9.31	5.00	2.54
0.583	2.54	2.083	5.08	3.583	4.23	5.08	1.69
0.667	2.54	2.167	5.08	3.667	4.23	5.17	1.69
0.750	2.54	2.250	5.08	3.750	4.23	5.25	1.69
0.833	2.54	2.333	5.08	3.833	4.23	5.33	1.69
0.917	2.54	2.417	5.08	3.917	4.23	5.42	1.69
1.000	2.54	2.500	5.08	4.000	4.23	5.50	1.69
1.083	2.54	2.583	25.38	4.083	3.38	5.58	1.69
1.167	2.54	2.667	25.38	4.167	3.38	5.67	1.69
1.250	2.54	2.750	25.38	4.250	3.38	5.75	1.69
1.333	2.54	2.833	65.99	4.333	3.38	5.83	1.69
1.417	2.54	2.917	65.99	4.417	3.38	5.92	1.69
1.500	2.54	3.000	65.99	4.500	3.38	6.00	1.69

```
     Unit Hyd Qpeak  (cms)=   0.543

     PEAK FLOW       (cms)=   0.110 (i)
     TIME TO PEAK    (hrs)=   3.917
     RUNOFF VOLUME    (mm)=   7.768
     TOTAL RAINFALL   (mm)=  42.300
     RUNOFF COEFFICIENT   =   0.184

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

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--------------------
| ADD HYD  (  0163)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0162):     3.56   0.053     3.33     7.77
     + ID2= 2 (  0164):    11.95   0.110     3.92     7.77
       ================================================
       ID = 3 (  0163):    15.51   0.148     3.67     7.77
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\1bad779e-5246-410c-a42e-3ccee7a1c0de\f78e34d8
Ptotal= 46.70 mm	Comments: SCS II 12H_2YR

Duration of storm = 12.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	1.17	3.25	1.87	6.25	8.41	9.25	1.63
0.50	1.17	3.50	1.87	6.50	8.41	9.50	1.63
0.75	1.17	3.75	1.87	6.75	3.74	9.75	1.63
1.00	1.17	4.00	1.87	7.00	3.74	10.00	1.63
1.25	1.17	4.25	2.80	7.25	2.80	10.25	0.93
1.50	1.17	4.50	2.80	7.50	2.80	10.50	0.93
1.75	1.17	4.75	3.74	7.75	2.80	10.75	0.93
2.00	1.17	5.00	3.74	8.00	2.80	11.00	0.93
2.25	1.40	5.25	5.60	8.25	1.63	11.25	0.93
2.50	1.40	5.50	5.60	8.50	1.63	11.50	0.93
2.75	1.40	5.75	22.42	8.75	1.63	11.75	0.93
3.00	1.40	6.00	61.64	9.00	1.63	12.00	0.93

CALIB			
NASHYD (0165)	Area (ha)= 3.56	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.42		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.17	3.083	1.87	6.083	8.41	9.08	1.63
0.167	1.17	3.167	1.87	6.167	8.41	9.17	1.63
0.250	1.17	3.250	1.87	6.250	8.41	9.25	1.63
0.333	1.17	3.333	1.87	6.333	8.41	9.33	1.63
0.417	1.17	3.417	1.87	6.417	8.41	9.42	1.63
0.500	1.17	3.500	1.87	6.500	8.41	9.50	1.63
0.583	1.17	3.583	1.87	6.583	3.74	9.58	1.63
0.667	1.17	3.667	1.87	6.667	3.74	9.67	1.63
0.750	1.17	3.750	1.87	6.750	3.74	9.75	1.63
0.833	1.17	3.833	1.87	6.833	3.74	9.83	1.63
0.917	1.17	3.917	1.87	6.917	3.74	9.92	1.63
1.000	1.17	4.000	1.87	7.000	3.74	10.00	1.63
1.083	1.17	4.083	2.80	7.083	2.80	10.08	0.93
1.167	1.17	4.167	2.80	7.167	2.80	10.17	0.93
1.250	1.17	4.250	2.80	7.250	2.80	10.25	0.93
1.333	1.17	4.333	2.80	7.333	2.80	10.33	0.93
1.417	1.17	4.417	2.80	7.417	2.80	10.42	0.93
1.500	1.17	4.500	2.80	7.500	2.80	10.50	0.93
1.583	1.17	4.583	3.74	7.583	2.80	10.58	0.93
1.667	1.17	4.667	3.74	7.667	2.80	10.67	0.93
1.750	1.17	4.750	3.74	7.750	2.80	10.75	0.93
1.833	1.17	4.833	3.74	7.833	2.80	10.83	0.93
1.917	1.17	4.917	3.74	7.917	2.80	10.92	0.93
2.000	1.17	5.000	3.74	8.000	2.80	11.00	0.93
2.083	1.40	5.083	5.60	8.083	1.63	11.08	0.93
2.167	1.40	5.167	5.60	8.167	1.63	11.17	0.93
2.250	1.40	5.250	5.60	8.250	1.63	11.25	0.93
2.333	1.40	5.333	5.60	8.333	1.63	11.33	0.93
2.417	1.40	5.417	5.60	8.417	1.63	11.42	0.93
2.500	1.40	5.500	5.60	8.500	1.63	11.50	0.93
2.583	1.40	5.583	22.42	8.583	1.63	11.58	0.93
2.667	1.40	5.667	22.42	8.667	1.63	11.67	0.93
2.750	1.40	5.750	22.42	8.750	1.63	11.75	0.93
2.833	1.40	5.833	61.64	8.833	1.63	11.83	0.93
2.917	1.40	5.917	61.64	8.917	1.63	11.92	0.93
3.000	1.40	6.000	61.64	9.000	1.63	12.00	0.93

Unit Hyd Qpeak (cms)= 0.324

PEAK FLOW (cms)= 0.057 (i)
TIME TO PEAK (hrs)= 6.333
RUNOFF VOLUME (mm)= 9.562
TOTAL RAINFALL (mm)= 46.700
RUNOFF COEFFICIENT = 0.205

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

CALIB			
NASHYD (0167)	Area (ha)= 11.95	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.84		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.17	3.083	1.87	6.083	8.41	9.08	1.63
0.167	1.17	3.167	1.87	6.167	8.41	9.17	1.63
0.250	1.17	3.250	1.87	6.250	8.41	9.25	1.63
0.333	1.17	3.333	1.87	6.333	8.41	9.33	1.63
0.417	1.17	3.417	1.87	6.417	8.41	9.42	1.63
0.500	1.17	3.500	1.87	6.500	8.41	9.50	1.63
0.583	1.17	3.583	1.87	6.583	3.74	9.58	1.63
0.667	1.17	3.667	1.87	6.667	3.74	9.67	1.63
0.750	1.17	3.750	1.87	6.750	3.74	9.75	1.63
0.833	1.17	3.833	1.87	6.833	3.74	9.83	1.63
0.917	1.17	3.917	1.87	6.917	3.74	9.92	1.63
1.000	1.17	4.000	1.87	7.000	3.74	10.00	1.63
1.083	1.17	4.083	2.80	7.083	2.80	10.08	0.93
1.167	1.17	4.167	2.80	7.167	2.80	10.17	0.93
1.250	1.17	4.250	2.80	7.250	2.80	10.25	0.93
1.333	1.17	4.333	2.80	7.333	2.80	10.33	0.93
1.417	1.17	4.417	2.80	7.417	2.80	10.42	0.93
1.500	1.17	4.500	2.80	7.500	2.80	10.50	0.93
1.583	1.17	4.583	3.74	7.583	2.80	10.58	0.93
1.667	1.17	4.667	3.74	7.667	2.80	10.67	0.93
1.750	1.17	4.750	3.74	7.750	2.80	10.75	0.93
1.833	1.17	4.833	3.74	7.833	2.80	10.83	0.93
1.917	1.17	4.917	3.74	7.917	2.80	10.92	0.93
2.000	1.17	5.000	3.74	8.000	2.80	11.00	0.93
2.083	1.40	5.083	5.60	8.083	1.63	11.08	0.93
2.167	1.40	5.167	5.60	8.167	1.63	11.17	0.93
2.250	1.40	5.250	5.60	8.250	1.63	11.25	0.93
2.333	1.40	5.333	5.60	8.333	1.63	11.33	0.93
2.417	1.40	5.417	5.60	8.417	1.63	11.42	0.93
2.500	1.40	5.500	5.60	8.500	1.63	11.50	0.93
2.583	1.40	5.583	22.42	8.583	1.63	11.58	0.93
2.667	1.40	5.667	22.42	8.667	1.63	11.67	0.93

2.750	1.40	5.750	22.42	8.750	1.63	11.75	0.93
2.833	1.40	5.833	61.64	8.833	1.63	11.83	0.93
2.917	1.40	5.917	61.64	8.917	1.63	11.92	0.93
3.000	1.40	6.000	61.64	9.000	1.63	12.00	0.93

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.116 (i)
TIME TO PEAK (hrs)= 6.833
RUNOFF VOLUME (mm)= 9.563
TOTAL RAINFALL (mm)= 46.700
RUNOFF COEFFICIENT = 0.205

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

ADD HYD (0166)		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
1 + 2 = 3	ID1= 1 (0165):	3.56	0.057	6.33	9.56
	+ ID2= 2 (0167):	11.95	0.116	6.83	9.56
	ID = 3 (0166):	15.51	0.158	6.67	9.56

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CHICAGO STORM | Ptotal= 36.96 mm

IDF curve parameters: A= 678.085
B= 4.699
C= 0.781
used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.17	2.47	1.17	18.78	2.17	5.73	3.17	2.93
0.33	2.82	1.33	83.11	2.33	4.89	3.33	2.72
0.50	3.31	1.50	24.57	2.50	4.28	3.50	2.55
0.67	4.05	1.67	13.01	2.67	3.82	3.67	2.39
0.83	5.30	1.83	9.01	2.83	3.46	3.83	2.26
1.00	7.98	2.00	6.97	3.00	3.17	4.00	2.15

CALIB | NASHYD (0168) | ID= 1 DT= 5.0 min

Area (ha)= 3.56 Curve Number (CN)= 67.0
Ia (mm)= 7.00 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.42

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.47	1.083	18.78	2.083	5.73	3.08	2.93
0.167	2.47	1.167	18.78	2.167	5.73	3.17	2.93
0.250	2.82	1.250	83.11	2.250	4.89	3.25	2.72
0.333	2.82	1.333	83.11	2.333	4.89	3.33	2.72
0.417	3.31	1.417	24.57	2.417	4.28	3.42	2.55
0.500	3.31	1.500	24.57	2.500	4.28	3.50	2.55
0.583	4.05	1.583	13.01	2.583	3.82	3.58	2.39
0.667	4.05	1.667	13.01	2.667	3.82	3.67	2.39
0.750	5.30	1.750	9.01	2.750	3.46	3.75	2.26
0.833	5.30	1.833	9.01	2.833	3.46	3.83	2.26
0.917	7.98	1.917	6.97	2.917	3.17	3.92	2.15
1.000	7.98	2.000	6.97	3.000	3.17	4.00	2.15

Unit Hyd Qpeak (cms)= 0.324

PEAK FLOW (cms)= 0.035 (i)
TIME TO PEAK (hrs)= 1.833
RUNOFF VOLUME (mm)= 5.786
TOTAL RAINFALL (mm)= 36.955
RUNOFF COEFFICIENT = 0.157

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

CALIB | NASHYD (0170) | ID= 1 DT= 5.0 min

Area (ha)= 11.95 Curve Number (CN)= 67.0
Ia (mm)= 7.00 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.84

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.47	1.083	18.78	2.083	5.73	3.08	2.93
0.167	2.47	1.167	18.78	2.167	5.73	3.17	2.93
0.250	2.82	1.250	83.11	2.250	4.89	3.25	2.72
0.333	2.82	1.333	83.11	2.333	4.89	3.33	2.72
0.417	3.31	1.417	24.57	2.417	4.28	3.42	2.55
0.500	3.31	1.500	24.57	2.500	4.28	3.50	2.55
0.583	4.05	1.583	13.01	2.583	3.82	3.58	2.39
0.667	4.05	1.667	13.01	2.667	3.82	3.67	2.39
0.750	5.30	1.750	9.01	2.750	3.46	3.75	2.26
0.833	5.30	1.833	9.01	2.833	3.46	3.83	2.26
0.917	7.98	1.917	6.97	2.917	3.17	3.92	2.15
1.000	7.98	2.000	6.97	3.000	3.17	4.00	2.15

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.077 (i)
TIME TO PEAK (hrs)= 2.500
RUNOFF VOLUME (mm)= 5.787
TOTAL RAINFALL (mm)= 36.955
RUNOFF COEFFICIENT = 0.157

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

ADD HYD (0169)		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
1 + 2 = 3	ID1= 1 (0168):	3.56	0.035	1.83	5.79
	+ ID2= 2 (0170):	11.95	0.077	2.50	5.79
	ID = 3 (0169):	15.51	0.102	2.25	5.79

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2006)
       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   TTTTT  TTTTT  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\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\4d5f0b49-3c0f-4ce6-9484-cb7238bd57e2\scenari
  Summary filename: C:\Users\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\4d5f0b49-3c0f-4ce6-9484-cb7238bd57e2\scenari


DATE: 06-29-2022                          TIME: 02:23:35

USER:



COMMENTS: _____________________________________________________________


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  ***********************************************
  ** SIMULATION : Run 02                       **
  ***********************************************

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| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              1bad779e-5246-410c-a42e-3ccee7a1c0de\efbc61a7
| Ptotal= 76.00 mm |    Comments: SCS II 24H_5YR
--------------------
                       Duration of storm    = 24.00 hrs
                       Mass curve time step = 15.00 min

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.25    0.76 |  6.25    1.52 | 12.25   10.94 | 18.25    1.37
                0.50    0.76 |  6.50    1.52 | 12.50   10.94 | 18.50    1.37
                0.75    0.76 |  6.75    1.52 | 12.75    5.62 | 18.75    1.37
                1.00    0.76 |  7.00    1.52 | 13.00    5.62 | 19.00    1.37
                1.25    0.76 |  7.25    1.52 | 13.25    1.06 | 19.25    1.37
                1.50    0.76 |  7.50    1.52 | 13.50    1.06 | 19.50    1.37
                1.75    0.76 |  7.75    1.52 | 13.75    6.23 | 19.75    1.37
                2.00    1.37 |  8.00    1.52 | 14.00    6.23 | 20.00    1.37
                2.25    0.99 |  8.25    2.05 | 14.25    2.28 | 20.25    0.91
                2.50    0.99 |  8.50    2.05 | 14.50    2.28 | 20.50    0.91
                2.75    0.99 |  8.75    2.05 | 14.75    2.28 | 20.75    0.91
                3.00    0.99 |  9.00    2.05 | 15.00    2.28 | 21.00    0.91
                3.25    0.99 |  9.25    2.43 | 15.25    2.28 | 21.25    0.91
                3.50    0.99 |  9.50    2.43 | 15.50    2.28 | 21.50    0.91
                3.75    0.99 |  9.75    2.74 | 15.75    2.28 | 21.75    0.91
                4.00    0.99 | 10.00    2.74 | 16.00    2.28 | 22.00    0.91
                4.25    1.22 | 10.25    3.50 | 16.25    1.37 | 22.25    0.91
                4.50    1.22 | 10.50    3.50 | 16.50    1.37 | 22.50    0.91
                4.75    1.22 | 10.75    4.71 | 16.75    1.37 | 22.75    0.91
                5.00    1.22 | 11.00    4.71 | 17.00    1.37 | 23.00    0.91
                5.25    1.22 | 11.25    7.30 | 17.25    1.37 | 23.25    0.91
                5.50    1.22 | 11.50    7.30 | 17.50    1.37 | 23.50    0.91
                5.75    1.22 | 11.75   31.62 | 17.75    1.37 | 23.75    0.91
                6.00    1.22 | 12.00   83.90 | 18.00    1.37 | 24.00    0.91

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| CALIB            |
| NASHYD   (  0136)|   Area     (ha)=  11.95   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.84

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    0.76 | 6.083    1.52 |12.083   10.95 | 18.08    1.37
               0.167    0.76 | 6.167    1.52 |12.167   10.94 | 18.17    1.37
               0.250    0.76 | 6.250    1.52 |12.250   10.94 | 18.25    1.37
               0.333    0.76 | 6.333    1.52 |12.333   10.94 | 18.33    1.37
               0.417    0.76 | 6.417    1.52 |12.417   10.94 | 18.42    1.37
               0.500    0.76 | 6.500    1.52 |12.500   10.94 | 18.50    1.37
               0.583    0.76 | 6.583    1.52 |12.583    5.62 | 18.58    1.37
               0.667    0.76 | 6.667    1.52 |12.667    5.62 | 18.67    1.37
               0.750    0.76 | 6.750    1.52 |12.750    5.62 | 18.75    1.37
               0.833    0.76 | 6.833    1.52 |12.833    5.62 | 18.83    1.37
               0.917    0.76 | 6.917    1.52 |12.917    5.62 | 18.92    1.37
               1.000    0.76 | 7.000    1.52 |13.000    5.62 | 19.00    1.37
               1.083    0.76 | 7.083    1.52 |13.083    1.06 | 19.08    1.37
               1.167    0.76 | 7.167    1.52 |13.167    1.06 | 19.17    1.37
               1.250    0.76 | 7.250    1.52 |13.250    1.06 | 19.25    1.37
               1.333    0.76 | 7.333    1.52 |13.333    1.06 | 19.33    1.37
               1.417    0.76 | 7.417    1.52 |13.417    1.06 | 19.42    1.37
               1.500    0.76 | 7.500    1.52 |13.500    1.06 | 19.50    1.37
               1.583    0.76 | 7.583    1.52 |13.583    6.23 | 19.58    1.37
               1.667    0.76 | 7.667    1.52 |13.667    6.23 | 19.67    1.37
               1.750    0.76 | 7.750    1.52 |13.750    6.23 | 19.75    1.37
               1.833    1.37 | 7.833    1.52 |13.833    6.23 | 19.83    1.37
               1.917    1.37 | 7.917    1.52 |13.917    6.23 | 19.92    1.37
               2.000    1.37 | 8.000    1.52 |14.000    6.23 | 20.00    1.37
               2.083    0.99 | 8.083    2.05 |14.083    2.28 | 20.08    0.91
               2.167    0.99 | 8.167    2.05 |14.167    2.28 | 20.17    0.91
               2.250    0.99 | 8.250    2.05 |14.250    2.28 | 20.25    0.91
               2.333    0.99 | 8.333    2.05 |14.333    2.28 | 20.33    0.91
               2.417    0.99 | 8.417    2.05 |14.417    2.28 | 20.42    0.91
               2.500    0.99 | 8.500    2.05 |14.500    2.28 | 20.50    0.91
               2.583    0.99 | 8.583    2.05 |14.583    2.28 | 20.58    0.91
               2.667    0.99 | 8.667    2.05 |14.667    2.28 | 20.67    0.91
               2.750    0.99 | 8.750    2.05 |14.750    2.28 | 20.75    0.91
               2.833    0.99 | 8.833    2.05 |14.833    2.28 | 20.83    0.91
               2.917    0.99 | 8.917    2.05 |14.917    2.28 | 20.92    0.91
               3.000    0.99 | 9.000    2.05 |15.000    2.28 | 21.00    0.91
               3.083    0.99 | 9.083    2.43 |15.083    2.28 | 21.08    0.91
               3.167    0.99 | 9.167    2.43 |15.167    2.28 | 21.17    0.91
               3.250    0.99 | 9.250    2.43 |15.250    2.28 | 21.25    0.91
```

3.333	0.99	9.333	2.43	15.333	2.28	21.33	0.91
3.417	0.99	9.417	2.43	15.417	2.28	21.42	0.91
3.500	0.99	9.500	2.43	15.500	2.28	21.50	0.91
3.583	0.99	9.583	2.74	15.583	2.28	21.58	0.91
3.667	0.99	9.667	2.74	15.667	2.28	21.67	0.91
3.750	0.99	9.750	2.74	15.750	2.28	21.75	0.91
3.833	0.99	9.833	2.74	15.833	2.28	21.83	0.91
3.917	0.99	9.917	2.74	15.917	2.28	21.92	0.91
4.000	0.99	10.000	2.74	16.000	2.28	22.00	0.91
4.083	1.22	10.083	3.50	16.083	1.37	22.08	0.91
4.167	1.22	10.167	3.50	16.167	1.37	22.17	0.91
4.250	1.22	10.250	3.50	16.250	1.37	22.25	0.91
4.333	1.22	10.333	3.50	16.333	1.37	22.33	0.91
4.417	1.22	10.417	3.50	16.417	1.37	22.42	0.91
4.500	1.22	10.500	3.50	16.500	1.37	22.50	0.91
4.583	1.22	10.583	4.71	16.583	1.37	22.58	0.91
4.667	1.22	10.667	4.71	16.667	1.37	22.67	0.91
4.750	1.22	10.750	4.71	16.750	1.37	22.75	0.91
4.833	1.22	10.833	4.71	16.833	1.37	22.83	0.91
4.917	1.22	10.917	4.71	16.917	1.37	22.92	0.91
5.000	1.22	11.000	4.71	17.000	1.37	23.00	0.91
5.083	1.22	11.083	7.30	17.083	1.37	23.08	0.91
5.167	1.22	11.167	7.30	17.167	1.37	23.17	0.91
5.250	1.22	11.250	7.30	17.250	1.37	23.25	0.91
5.333	1.22	11.333	7.30	17.333	1.37	23.33	0.91
5.417	1.22	11.417	7.30	17.417	1.37	23.42	0.91
5.500	1.22	11.500	7.30	17.500	1.37	23.50	0.91
5.583	1.22	11.583	31.61	17.583	1.37	23.58	0.91
5.667	1.22	11.667	31.62	17.667	1.37	23.67	0.91
5.750	1.22	11.750	31.62	17.750	1.37	23.75	0.91
5.833	1.22	11.833	83.90	17.833	1.37	23.83	0.91
5.917	1.22	11.917	83.90	17.917	1.37	23.92	0.91
6.000	1.22	12.000	83.90	18.000	1.37	24.00	0.91

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.259 (i)
TIME TO PEAK (hrs)= 12.833
RUNOFF VOLUME (mm)= 24.528
TOTAL RAINFALL (mm)= 76.000
RUNOFF COEFFICIENT = 0.323

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

CALIB					
NASHYD (0160)	Area (ha)=	3.56	Curve Number (CN)=	67.0	
ID= 1 DT= 5.0 min	Ia (mm)=	7.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	0.42			

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.76	6.083	1.52	12.083	10.95	18.08	1.37
0.167	0.76	6.167	1.52	12.167	10.94	18.17	1.37
0.250	0.76	6.250	1.52	12.250	10.94	18.25	1.37
0.333	0.76	6.333	1.52	12.333	10.94	18.33	1.37
0.417	0.76	6.417	1.52	12.417	10.94	18.42	1.37
0.500	0.76	6.500	1.52	12.500	10.94	18.50	1.37
0.583	0.76	6.583	1.52	12.583	5.62	18.58	1.37
0.667	0.76	6.667	1.52	12.667	5.62	18.67	1.37
0.750	0.76	6.750	1.52	12.750	5.62	18.75	1.37
0.833	0.76	6.833	1.52	12.833	5.62	18.83	1.37
0.917	0.76	6.917	1.52	12.917	5.62	18.92	1.37
1.000	0.76	7.000	1.52	13.000	5.62	19.00	1.37
1.083	0.76	7.083	1.52	13.083	1.06	19.08	1.37
1.167	0.76	7.167	1.52	13.167	1.06	19.17	1.37
1.250	0.76	7.250	1.52	13.250	1.06	19.25	1.37
1.333	0.76	7.333	1.52	13.333	1.06	19.33	1.37
1.417	0.76	7.417	1.52	13.417	1.06	19.42	1.37
1.500	0.76	7.500	1.52	13.500	1.06	19.50	1.37
1.583	0.76	7.583	1.52	13.583	6.23	19.58	1.37
1.667	0.76	7.667	1.52	13.667	6.23	19.67	1.37
1.750	0.76	7.750	1.52	13.750	6.23	19.75	1.37
1.833	1.37	7.833	1.52	13.833	6.23	19.83	1.37
1.917	1.37	7.917	1.52	13.917	6.23	19.92	1.37
2.000	1.37	8.000	1.52	14.000	6.23	20.00	1.37
2.083	0.99	8.083	2.05	14.083	2.28	20.08	0.91
2.167	0.99	8.167	2.05	14.167	2.28	20.17	0.91
2.250	0.99	8.250	2.05	14.250	2.28	20.25	0.91
2.333	0.99	8.333	2.05	14.333	2.28	20.33	0.91
2.417	0.99	8.417	2.05	14.417	2.28	20.42	0.91
2.500	0.99	8.500	2.05	14.500	2.28	20.50	0.91
2.583	0.99	8.583	2.05	14.583	2.28	20.58	0.91
2.667	0.99	8.667	2.05	14.667	2.28	20.67	0.91
2.750	0.99	8.750	2.05	14.750	2.28	20.75	0.91
2.833	0.99	8.833	2.05	14.833	2.28	20.83	0.91
2.917	0.99	8.917	2.05	14.917	2.28	20.92	0.91
3.000	0.99	9.000	2.05	15.000	2.28	21.00	0.91
3.083	0.99	9.083	2.43	15.083	2.28	21.08	0.91
3.167	0.99	9.167	2.43	15.167	2.28	21.17	0.91
3.250	0.99	9.250	2.43	15.250	2.28	21.25	0.91
3.333	0.99	9.333	2.43	15.333	2.28	21.33	0.91
3.417	0.99	9.417	2.43	15.417	2.28	21.42	0.91
3.500	0.99	9.500	2.43	15.500	2.28	21.50	0.91
3.583	0.99	9.583	2.74	15.583	2.28	21.58	0.91
3.667	0.99	9.667	2.74	15.667	2.28	21.67	0.91
3.750	0.99	9.750	2.74	15.750	2.28	21.75	0.91
3.833	0.99	9.833	2.74	15.833	2.28	21.83	0.91
3.917	0.99	9.917	2.74	15.917	2.28	21.92	0.91
4.000	0.99	10.000	2.74	16.000	2.28	22.00	0.91
4.083	1.22	10.083	3.50	16.083	1.37	22.08	0.91
4.167	1.22	10.167	3.50	16.167	1.37	22.17	0.91
4.250	1.22	10.250	3.50	16.250	1.37	22.25	0.91
4.333	1.22	10.333	3.50	16.333	1.37	22.33	0.91
4.417	1.22	10.417	3.50	16.417	1.37	22.42	0.91
4.500	1.22	10.500	3.50	16.500	1.37	22.50	0.91
4.583	1.22	10.583	4.71	16.583	1.37	22.58	0.91
4.667	1.22	10.667	4.71	16.667	1.37	22.67	0.91
4.750	1.22	10.750	4.71	16.750	1.37	22.75	0.91
4.833	1.22	10.833	4.71	16.833	1.37	22.83	0.91
4.917	1.22	10.917	4.71	16.917	1.37	22.92	0.91
5.000	1.22	11.000	4.71	17.000	1.37	23.00	0.91
5.083	1.22	11.083	7.30	17.083	1.37	23.08	0.91
5.167	1.22	11.167	7.30	17.167	1.37	23.17	0.91
5.250	1.22	11.250	7.30	17.250	1.37	23.25	0.91
5.333	1.22	11.333	7.30	17.333	1.37	23.33	0.91
5.417	1.22	11.417	7.30	17.417	1.37	23.42	0.91
5.500	1.22	11.500	7.30	17.500	1.37	23.50	0.91
5.583	1.22	11.583	31.61	17.583	1.37	23.58	0.91
5.667	1.22	11.667	31.62	17.667	1.37	23.67	0.91
5.750	1.22	11.750	31.62	17.750	1.37	23.75	0.91
5.833	1.22	11.833	83.90	17.833	1.37	23.83	0.91
5.917	1.22	11.917	83.90	17.917	1.37	23.92	0.91
6.000	1.22	12.000	83.90	18.000	1.37	24.00	0.91

Unit Hyd Qpeak (cms)= 0.324

```
     PEAK FLOW       (cms)=   0.127 (i)
     TIME TO PEAK    (hrs)=  12.333
     RUNOFF VOLUME    (mm)=  24.525
     TOTAL RAINFALL   (mm)=  76.000
     RUNOFF COEFFICIENT   =   0.323

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

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--------------------
| ADD HYD  (  0161)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0136):    11.95   0.259    12.83    24.53
      + ID2= 2 (  0160):     3.56   0.127    12.33    24.53
        ================================================
        ID = 3 (  0161):    15.51   0.353    12.58    24.53

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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--------------------
| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              1bad779e-5246-410c-a42e-3ccee7a1c0de\2eedf936
| Ptotal= 59.50 mm |    Comments: SCS II 6H_5YR
--------------------
                       Duration of storm    =  6.00 hrs
                       Mass curve time step = 15.00 min

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.25    2.38 |  1.75    5.95 |  3.25   13.09 |  4.75    3.57
                0.50    2.38 |  2.00    5.95 |  3.50   13.09 |  5.00    3.57
                0.75    3.57 |  2.25    7.14 |  3.75    5.95 |  5.25    2.38
                1.00    3.57 |  2.50    7.14 |  4.00    5.95 |  5.50    2.38
                1.25    3.57 |  2.75   35.70 |  4.25    4.76 |  5.75    2.38
                1.50    3.57 |  3.00   92.82 |  4.50    4.76 |  6.00    2.38

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--------------------
| CALIB            |
| NASHYD   (  0162)|   Area     (ha)=   3.56   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.42

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    2.38 | 1.583    5.95 | 3.083   13.09 |  4.58    3.57
               0.167    2.38 | 1.667    5.95 | 3.167   13.09 |  4.67    3.57
               0.250    2.38 | 1.750    5.95 | 3.250   13.09 |  4.75    3.57
               0.333    2.38 | 1.833    5.95 | 3.333   13.09 |  4.83    3.57
               0.417    2.38 | 1.917    5.95 | 3.417   13.09 |  4.92    3.57
               0.500    2.38 | 2.000    5.95 | 3.500   13.09 |  5.00    3.57
               0.583    3.57 | 2.083    7.14 | 3.583    5.95 |  5.08    2.38
               0.667    3.57 | 2.167    7.14 | 3.667    5.95 |  5.17    2.38
               0.750    3.57 | 2.250    7.14 | 3.750    5.95 |  5.25    2.38
               0.833    3.57 | 2.333    7.14 | 3.833    5.95 |  5.33    2.38
               0.917    3.57 | 2.417    7.14 | 3.917    5.95 |  5.42    2.38
               1.000    3.57 | 2.500    7.14 | 4.000    5.95 |  5.50    2.38
               1.083    3.57 | 2.583   35.70 | 4.083    4.76 |  5.58    2.38
               1.167    3.57 | 2.667   35.70 | 4.167    4.76 |  5.67    2.38
               1.250    3.57 | 2.750   35.70 | 4.250    4.76 |  5.75    2.38
               1.333    3.57 | 2.833   92.82 | 4.333    4.76 |  5.83    2.38
               1.417    3.57 | 2.917   92.82 | 4.417    4.76 |  5.92    2.38
               1.500    3.57 | 3.000   92.82 | 4.500    4.76 |  6.00    2.38

     Unit Hyd Qpeak  (cms)=   0.324

     PEAK FLOW       (cms)=   0.110 (i)
     TIME TO PEAK    (hrs)=   3.333
     RUNOFF VOLUME    (mm)=  15.517
     TOTAL RAINFALL   (mm)=  59.500
     RUNOFF COEFFICIENT   =   0.261

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

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--------------------
| CALIB            |
| NASHYD   (  0164)|   Area     (ha)=  11.95   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.84

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    2.38 | 1.583    5.95 | 3.083   13.09 |  4.58    3.57
               0.167    2.38 | 1.667    5.95 | 3.167   13.09 |  4.67    3.57
               0.250    2.38 | 1.750    5.95 | 3.250   13.09 |  4.75    3.57
               0.333    2.38 | 1.833    5.95 | 3.333   13.09 |  4.83    3.57
               0.417    2.38 | 1.917    5.95 | 3.417   13.09 |  4.92    3.57
               0.500    2.38 | 2.000    5.95 | 3.500   13.09 |  5.00    3.57
               0.583    3.57 | 2.083    7.14 | 3.583    5.95 |  5.08    2.38
               0.667    3.57 | 2.167    7.14 | 3.667    5.95 |  5.17    2.38
               0.750    3.57 | 2.250    7.14 | 3.750    5.95 |  5.25    2.38
               0.833    3.57 | 2.333    7.14 | 3.833    5.95 |  5.33    2.38
               0.917    3.57 | 2.417    7.14 | 3.917    5.95 |  5.42    2.38
               1.000    3.57 | 2.500    7.14 | 4.000    5.95 |  5.50    2.38
               1.083    3.57 | 2.583   35.70 | 4.083    4.76 |  5.58    2.38
               1.167    3.57 | 2.667   35.70 | 4.167    4.76 |  5.67    2.38
               1.250    3.57 | 2.750   35.70 | 4.250    4.76 |  5.75    2.38
               1.333    3.57 | 2.833   92.82 | 4.333    4.76 |  5.83    2.38
               1.417    3.57 | 2.917   92.82 | 4.417    4.76 |  5.92    2.38
               1.500    3.57 | 3.000   92.82 | 4.500    4.76 |  6.00    2.38

     Unit Hyd Qpeak  (cms)=   0.543

     PEAK FLOW       (cms)=   0.224 (i)
     TIME TO PEAK    (hrs)=   3.833
     RUNOFF VOLUME    (mm)=  15.519
     TOTAL RAINFALL   (mm)=  59.500
     RUNOFF COEFFICIENT   =   0.261

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

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--------------------
| ADD HYD  (  0163)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0162):     3.56   0.110     3.33    15.52
      + ID2= 2 (  0164):    11.95   0.224     3.83    15.52
        ================================================
```

ID = 3 (0163): 15.51 0.304 3.67 15.52

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\1bad779e-5246-410c-a42e-3ccee7a1c0de\1a9544a4
Ptotal= 64.30 mm	Comments: SCS II 12H_5YR

Duration of storm = 12.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	1.61	3.25	2.57	6.25	11.57	9.25	2.25
0.50	1.61	3.50	2.57	6.50	11.57	9.50	2.25
0.75	1.61	3.75	2.57	6.75	5.14	9.75	2.25
1.00	1.61	4.00	2.57	7.00	5.14	10.00	2.25
1.25	1.61	4.25	3.86	7.25	3.86	10.25	1.29
1.50	1.61	4.50	3.86	7.50	3.86	10.50	1.29
1.75	1.61	4.75	5.14	7.75	3.86	10.75	1.29
2.00	1.61	5.00	5.14	8.00	3.86	11.00	1.29
2.25	1.93	5.25	7.72	8.25	2.25	11.25	1.29
2.50	1.93	5.50	7.72	8.50	2.25	11.50	1.29
2.75	1.93	5.75	30.86	8.75	2.25	11.75	1.29
3.00	1.93	6.00	84.88	9.00	2.25	12.00	1.29

CALIB			
NASHYD (0165)	Area (ha)= 3.56	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.42		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.61	3.083	2.57	6.083	11.57	9.08	2.25
0.167	1.61	3.167	2.57	6.167	11.57	9.17	2.25
0.250	1.61	3.250	2.57	6.250	11.57	9.25	2.25
0.333	1.61	3.333	2.57	6.333	11.57	9.33	2.25
0.417	1.61	3.417	2.57	6.417	11.57	9.42	2.25
0.500	1.61	3.500	2.57	6.500	11.57	9.50	2.25
0.583	1.61	3.583	2.57	6.583	5.14	9.58	2.25
0.667	1.61	3.667	2.57	6.667	5.14	9.67	2.25
0.750	1.61	3.750	2.57	6.750	5.14	9.75	2.25
0.833	1.61	3.833	2.57	6.833	5.14	9.83	2.25
0.917	1.61	3.917	2.57	6.917	5.14	9.92	2.25
1.000	1.61	4.000	2.57	7.000	5.14	10.00	2.25
1.083	1.61	4.083	3.86	7.083	3.86	10.08	1.29
1.167	1.61	4.167	3.86	7.167	3.86	10.17	1.29
1.250	1.61	4.250	3.86	7.250	3.86	10.25	1.29
1.333	1.61	4.333	3.86	7.333	3.86	10.33	1.29
1.417	1.61	4.417	3.86	7.417	3.86	10.42	1.29
1.500	1.61	4.500	3.86	7.500	3.86	10.50	1.29
1.583	1.61	4.583	5.14	7.583	3.86	10.58	1.29
1.667	1.61	4.667	5.14	7.667	3.86	10.67	1.29
1.750	1.61	4.750	5.14	7.750	3.86	10.75	1.29
1.833	1.61	4.833	5.14	7.833	3.86	10.83	1.29
1.917	1.61	4.917	5.14	7.917	3.86	10.92	1.29
2.000	1.61	5.000	5.14	8.000	3.86	11.00	1.29
2.083	1.93	5.083	7.72	8.083	2.25	11.08	1.29
2.167	1.93	5.167	7.72	8.167	2.25	11.17	1.29
2.250	1.93	5.250	7.72	8.250	2.25	11.25	1.29
2.333	1.93	5.333	7.72	8.333	2.25	11.33	1.29
2.417	1.93	5.417	7.72	8.417	2.25	11.42	1.29
2.500	1.93	5.500	7.72	8.500	2.25	11.50	1.29
2.583	1.93	5.583	30.86	8.583	2.25	11.58	1.29
2.667	1.93	5.667	30.86	8.667	2.25	11.67	1.29
2.750	1.93	5.750	30.86	8.750	2.25	11.75	1.29
2.833	1.93	5.833	84.88	8.833	2.25	11.83	1.29
2.917	1.93	5.917	84.88	8.917	2.25	11.92	1.29
3.000	1.93	6.000	84.87	9.000	2.25	12.00	1.29

Unit Hyd Qpeak (cms)= 0.324

PEAK FLOW (cms)= 0.110 (i)
TIME TO PEAK (hrs)= 6.333
RUNOFF VOLUME (mm)= 17.998
TOTAL RAINFALL (mm)= 64.300
RUNOFF COEFFICIENT = 0.280

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

CALIB			
NASHYD (0167)	Area (ha)= 11.95	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.84		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.61	3.083	2.57	6.083	11.57	9.08	2.25
0.167	1.61	3.167	2.57	6.167	11.57	9.17	2.25
0.250	1.61	3.250	2.57	6.250	11.57	9.25	2.25
0.333	1.61	3.333	2.57	6.333	11.57	9.33	2.25
0.417	1.61	3.417	2.57	6.417	11.57	9.42	2.25
0.500	1.61	3.500	2.57	6.500	11.57	9.50	2.25
0.583	1.61	3.583	2.57	6.583	5.14	9.58	2.25
0.667	1.61	3.667	2.57	6.667	5.14	9.67	2.25
0.750	1.61	3.750	2.57	6.750	5.14	9.75	2.25
0.833	1.61	3.833	2.57	6.833	5.14	9.83	2.25
0.917	1.61	3.917	2.57	6.917	5.14	9.92	2.25
1.000	1.61	4.000	2.57	7.000	5.14	10.00	2.25
1.083	1.61	4.083	3.86	7.083	3.86	10.08	1.29
1.167	1.61	4.167	3.86	7.167	3.86	10.17	1.29
1.250	1.61	4.250	3.86	7.250	3.86	10.25	1.29
1.333	1.61	4.333	3.86	7.333	3.86	10.33	1.29
1.417	1.61	4.417	3.86	7.417	3.86	10.42	1.29
1.500	1.61	4.500	3.86	7.500	3.86	10.50	1.29
1.583	1.61	4.583	5.14	7.583	3.86	10.58	1.29
1.667	1.61	4.667	5.14	7.667	3.86	10.67	1.29
1.750	1.61	4.750	5.14	7.750	3.86	10.75	1.29
1.833	1.61	4.833	5.14	7.833	3.86	10.83	1.29
1.917	1.61	4.917	5.14	7.917	3.86	10.92	1.29
2.000	1.61	5.000	5.14	8.000	3.86	11.00	1.29
2.083	1.93	5.083	7.72	8.083	2.25	11.08	1.29
2.167	1.93	5.167	7.72	8.167	2.25	11.17	1.29
2.250	1.93	5.250	7.72	8.250	2.25	11.25	1.29
2.333	1.93	5.333	7.72	8.333	2.25	11.33	1.29
2.417	1.93	5.417	7.72	8.417	2.25	11.42	1.29
2.500	1.93	5.500	7.72	8.500	2.25	11.50	1.29
2.583	1.93	5.583	30.86	8.583	2.25	11.58	1.29

2.667	1.93	5.667	30.86	8.667	2.25	11.67	1.29
2.750	1.93	5.750	30.86	8.750	2.25	11.75	1.29
2.833	1.93	5.833	84.88	8.833	2.25	11.83	1.29
2.917	1.93	5.917	84.88	8.917	2.25	11.92	1.29
3.000	1.93	6.000	84.87	9.000	2.25	12.00	1.29

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.225 (i)
TIME TO PEAK (hrs)= 6.833
RUNOFF VOLUME (mm)= 18.000
TOTAL RAINFALL (mm)= 64.300
RUNOFF COEFFICIENT = 0.280

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

ADD HYD (0166)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0165):	3.56	0.110	6.33	18.00
	+ ID2= 2 (0167):	11.95	0.225	6.83	18.00
	ID = 3 (0166):	15.51	0.305	6.58	18.00

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CHICAGO STORM	IDF curve parameters: A= 853.608
Ptotal= 50.52 mm	B= 4.699
	C= 0.766

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

Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.17	3.57	1.17	25.64	2.17	8.12	3.17	4.22
0.33	4.07	1.33	108.92	2.33	6.96	3.33	3.93
0.50	4.76	1.50	33.31	2.50	6.12	3.50	3.68
0.67	5.79	1.67	17.99	2.67	5.48	3.67	3.47
0.83	7.53	1.83	12.60	2.83	4.97	3.83	3.28
1.00	11.20	2.00	9.82	3.00	4.56	4.00	3.12

CALIB			
NASHYD (0168)	Area (ha)= 3.56	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.42		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	3.57	1.083	25.64	2.083	8.12	3.08	4.22
0.167	3.57	1.167	25.64	2.167	8.12	3.17	4.22
0.250	4.07	1.250	108.92	2.250	6.96	3.25	3.93
0.333	4.07	1.333	108.92	2.333	6.96	3.33	3.93
0.417	4.76	1.417	33.31	2.417	6.12	3.42	3.68
0.500	4.76	1.500	33.31	2.500	6.12	3.50	3.68
0.583	5.79	1.583	17.99	2.583	5.48	3.58	3.47
0.667	5.79	1.667	17.99	2.667	5.48	3.67	3.47
0.750	7.53	1.750	12.60	2.750	4.97	3.75	3.28
0.833	7.53	1.833	12.60	2.833	4.97	3.83	3.28
0.917	11.20	1.917	9.82	2.917	4.56	3.92	3.12
1.000	11.20	2.000	9.82	3.000	4.56	4.00	3.12

Unit Hyd Qpeak (cms)= 0.324

PEAK FLOW (cms)= 0.070 (i)
TIME TO PEAK (hrs)= 1.833
RUNOFF VOLUME (mm)= 11.231
TOTAL RAINFALL (mm)= 50.521
RUNOFF COEFFICIENT = 0.222

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

CALIB			
NASHYD (0170)	Area (ha)= 11.95	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.84		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	3.57	1.083	25.64	2.083	8.12	3.08	4.22
0.167	3.57	1.167	25.64	2.167	8.12	3.17	4.22
0.250	4.07	1.250	108.92	2.250	6.96	3.25	3.93
0.333	4.07	1.333	108.92	2.333	6.96	3.33	3.93
0.417	4.76	1.417	33.31	2.417	6.12	3.42	3.68
0.500	4.76	1.500	33.31	2.500	6.12	3.50	3.68
0.583	5.79	1.583	17.99	2.583	5.48	3.58	3.47
0.667	5.79	1.667	17.99	2.667	5.48	3.67	3.47
0.750	7.53	1.750	12.60	2.750	4.97	3.75	3.28
0.833	7.53	1.833	12.60	2.833	4.97	3.83	3.28
0.917	11.20	1.917	9.82	2.917	4.56	3.92	3.12
1.000	11.20	2.000	9.82	3.000	4.56	4.00	3.12

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.151 (i)
TIME TO PEAK (hrs)= 2.417
RUNOFF VOLUME (mm)= 11.232
TOTAL RAINFALL (mm)= 50.521
RUNOFF COEFFICIENT = 0.222

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

ADD HYD (0169)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0168):	3.56	0.070	1.83	11.23
	+ ID2= 2 (0170):	11.95	0.151	2.42	11.23
	ID = 3 (0169):	15.51	0.201	2.25	11.23

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     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2006)
       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   TTTTT  TTTTT  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\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\30225998-ee23-42d7-a072-9d6a8329d3b2\scenari
  Summary filename: C:\Users\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\30225998-ee23-42d7-a072-9d6a8329d3b2\scenari


DATE: 06-29-2022                          TIME: 02:23:35

USER:



COMMENTS: _____________________________________________________________


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  ***********************************************
  ** SIMULATION : Run 03                       **
  ***********************************************

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| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              1bad779e-5246-410c-a42e-3ccee7a1c0de\a719fc83
| Ptotal= 89.90 mm |    Comments: SCS II 24H_10YR
--------------------

                       Duration of storm    = 24.00 hrs
                       Mass curve time step = 15.00 min

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.25    0.90 |  6.25    1.80 | 12.25   12.95 | 18.25    1.62
               0.50    0.90 |  6.50    1.80 | 12.50   12.95 | 18.50    1.62
               0.75    0.90 |  6.75    1.80 | 12.75    6.65 | 18.75    1.62
               1.00    0.90 |  7.00    1.80 | 13.00    6.65 | 19.00    1.62
               1.25    0.90 |  7.25    1.80 | 13.25    1.26 | 19.25    1.62
               1.50    0.90 |  7.50    1.80 | 13.50    1.26 | 19.50    1.62
               1.75    0.90 |  7.75    1.80 | 13.75    7.37 | 19.75    1.62
               2.00    1.62 |  8.00    1.80 | 14.00    7.37 | 20.00    1.62
               2.25    1.17 |  8.25    2.43 | 14.25    2.70 | 20.25    1.08
               2.50    1.17 |  8.50    2.43 | 14.50    2.70 | 20.50    1.08
               2.75    1.17 |  8.75    2.43 | 14.75    2.70 | 20.75    1.08
               3.00    1.17 |  9.00    2.43 | 15.00    2.70 | 21.00    1.08
               3.25    1.17 |  9.25    2.88 | 15.25    2.70 | 21.25    1.08
               3.50    1.17 |  9.50    2.88 | 15.50    2.70 | 21.50    1.08
               3.75    1.17 |  9.75    3.24 | 15.75    2.70 | 21.75    1.08
               4.00    1.17 | 10.00    3.24 | 16.00    2.70 | 22.00    1.08
               4.25    1.44 | 10.25    4.14 | 16.25    1.62 | 22.25    1.08
               4.50    1.44 | 10.50    4.14 | 16.50    1.62 | 22.50    1.08
               4.75    1.44 | 10.75    5.57 | 16.75    1.62 | 22.75    1.08
               5.00    1.44 | 11.00    5.57 | 17.00    1.62 | 23.00    1.08
               5.25    1.44 | 11.25    8.63 | 17.25    1.62 | 23.25    1.08
               5.50    1.44 | 11.50    8.63 | 17.50    1.62 | 23.50    1.08
               5.75    1.44 | 11.75   37.40 | 17.75    1.62 | 23.75    1.08
               6.00    1.44 | 12.00   99.25 | 18.00    1.62 | 24.00    1.08

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| CALIB            |
| NASHYD   (  0136)|   Area     (ha)=  11.95   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.84

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                                ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    0.90 |  6.083    1.80 |12.083   12.96 | 18.08    1.62
               0.167    0.90 |  6.167    1.80 |12.167   12.95 | 18.17    1.62
               0.250    0.90 |  6.250    1.80 |12.250   12.95 | 18.25    1.62
               0.333    0.90 |  6.333    1.80 |12.333   12.95 | 18.33    1.62
               0.417    0.90 |  6.417    1.80 |12.417   12.95 | 18.42    1.62
               0.500    0.90 |  6.500    1.80 |12.500   12.95 | 18.50    1.62
               0.583    0.90 |  6.583    1.80 |12.583    6.65 | 18.58    1.62
               0.667    0.90 |  6.667    1.80 |12.667    6.65 | 18.67    1.62
               0.750    0.90 |  6.750    1.80 |12.750    6.65 | 18.75    1.62
               0.833    0.90 |  6.833    1.80 |12.833    6.65 | 18.83    1.62
               0.917    0.90 |  6.917    1.80 |12.917    6.65 | 18.92    1.62
               1.000    0.90 |  7.000    1.80 |13.000    6.65 | 19.00    1.62
               1.083    0.90 |  7.083    1.80 |13.083    1.26 | 19.08    1.62
               1.167    0.90 |  7.167    1.80 |13.167    1.26 | 19.17    1.62
               1.250    0.90 |  7.250    1.80 |13.250    1.26 | 19.25    1.62
               1.333    0.90 |  7.333    1.80 |13.333    1.26 | 19.33    1.62
               1.417    0.90 |  7.417    1.80 |13.417    1.26 | 19.42    1.62
               1.500    0.90 |  7.500    1.80 |13.500    1.26 | 19.50    1.62
               1.583    0.90 |  7.583    1.80 |13.583    7.37 | 19.58    1.62
               1.667    0.90 |  7.667    1.80 |13.667    7.37 | 19.67    1.62
               1.750    0.90 |  7.750    1.80 |13.750    7.37 | 19.75    1.62
               1.833    1.62 |  7.833    1.80 |13.833    7.37 | 19.83    1.62
               1.917    1.62 |  7.917    1.80 |13.917    7.37 | 19.92    1.62
               2.000    1.62 |  8.000    1.80 |14.000    7.37 | 20.00    1.62
               2.083    1.17 |  8.083    2.43 |14.083    2.70 | 20.08    1.08
               2.167    1.17 |  8.167    2.43 |14.167    2.70 | 20.17    1.08
               2.250    1.17 |  8.250    2.43 |14.250    2.70 | 20.25    1.08
               2.333    1.17 |  8.333    2.43 |14.333    2.70 | 20.33    1.08
               2.417    1.17 |  8.417    2.43 |14.417    2.70 | 20.42    1.08
               2.500    1.17 |  8.500    2.43 |14.500    2.70 | 20.50    1.08
               2.583    1.17 |  8.583    2.43 |14.583    2.70 | 20.58    1.08
               2.667    1.17 |  8.667    2.43 |14.667    2.70 | 20.67    1.08
               2.750    1.17 |  8.750    2.43 |14.750    2.70 | 20.75    1.08
               2.833    1.17 |  8.833    2.43 |14.833    2.70 | 20.83    1.08
               2.917    1.17 |  8.917    2.43 |14.917    2.70 | 20.92    1.08
               3.000    1.17 |  9.000    2.43 |15.000    2.70 | 21.00    1.08
               3.083    1.17 |  9.083    2.88 |15.083    2.70 | 21.08    1.08
               3.167    1.17 |  9.167    2.88 |15.167    2.70 | 21.17    1.08
```

3.250	1.17	9.250	2.88	15.250	2.70	21.25	1.08
3.333	1.17	9.333	2.88	15.333	2.70	21.33	1.08
3.417	1.17	9.417	2.88	15.417	2.70	21.42	1.08
3.500	1.17	9.500	2.88	15.500	2.70	21.50	1.08
3.583	1.17	9.583	3.24	15.583	2.70	21.58	1.08
3.667	1.17	9.667	3.24	15.667	2.70	21.67	1.08
3.750	1.17	9.750	3.24	15.750	2.70	21.75	1.08
3.833	1.17	9.833	3.24	15.833	2.70	21.83	1.08
3.917	1.17	9.917	3.24	15.917	2.70	21.92	1.08
4.000	1.17	10.000	3.24	16.000	2.70	22.00	1.08
4.083	1.44	10.083	4.14	16.083	1.62	22.08	1.08
4.167	1.44	10.167	4.14	16.167	1.62	22.17	1.08
4.250	1.44	10.250	4.14	16.250	1.62	22.25	1.08
4.333	1.44	10.333	4.14	16.333	1.62	22.33	1.08
4.417	1.44	10.417	4.14	16.417	1.62	22.42	1.08
4.500	1.44	10.500	4.14	16.500	1.62	22.50	1.08
4.583	1.44	10.583	5.57	16.583	1.62	22.58	1.08
4.667	1.44	10.667	5.57	16.667	1.62	22.67	1.08
4.750	1.44	10.750	5.57	16.750	1.62	22.75	1.08
4.833	1.44	10.833	5.57	16.833	1.62	22.83	1.08
4.917	1.44	10.917	5.57	16.917	1.62	22.92	1.08
5.000	1.44	11.000	5.57	17.000	1.62	23.00	1.08
5.083	1.44	11.083	8.63	17.083	1.62	23.08	1.08
5.167	1.44	11.167	8.63	17.167	1.62	23.17	1.08
5.250	1.44	11.250	8.63	17.250	1.62	23.25	1.08
5.333	1.44	11.333	8.63	17.333	1.62	23.33	1.08
5.417	1.44	11.417	8.63	17.417	1.62	23.42	1.08
5.500	1.44	11.500	8.63	17.500	1.62	23.50	1.08
5.583	1.44	11.583	37.40	17.583	1.62	23.58	1.08
5.667	1.44	11.667	37.40	17.667	1.62	23.67	1.08
5.750	1.44	11.750	37.40	17.750	1.62	23.75	1.08
5.833	1.44	11.833	99.24	17.833	1.62	23.83	1.08
5.917	1.44	11.917	99.25	17.917	1.62	23.92	1.08
6.000	1.44	12.000	99.25	18.000	1.62	24.00	1.08

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.353 (i)
TIME TO PEAK (hrs)= 12.750
RUNOFF VOLUME (mm)= 33.039
TOTAL RAINFALL (mm)= 89.900
RUNOFF COEFFICIENT = 0.368

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

CALIB					
NASHYD (0160)	Area (ha)=	3.56	Curve Number (CN)=	67.0	
ID= 1 DT= 5.0 min	Ia (mm)=	7.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	0.42			

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.90	6.083	1.80	12.083	12.96	18.08	1.62
0.167	0.90	6.167	1.80	12.167	12.95	18.17	1.62
0.250	0.90	6.250	1.80	12.250	12.95	18.25	1.62
0.333	0.90	6.333	1.80	12.333	12.95	18.33	1.62
0.417	0.90	6.417	1.80	12.417	12.95	18.42	1.62
0.500	0.90	6.500	1.80	12.500	12.95	18.50	1.62
0.583	0.90	6.583	1.80	12.583	6.65	18.58	1.62
0.667	0.90	6.667	1.80	12.667	6.65	18.67	1.62
0.750	0.90	6.750	1.80	12.750	6.65	18.75	1.62
0.833	0.90	6.833	1.80	12.833	6.65	18.83	1.62
0.917	0.90	6.917	1.80	12.917	6.65	18.92	1.62
1.000	0.90	7.000	1.80	13.000	6.65	19.00	1.62
1.083	0.90	7.083	1.80	13.083	1.26	19.08	1.62
1.167	0.90	7.167	1.80	13.167	1.26	19.17	1.62
1.250	0.90	7.250	1.80	13.250	1.26	19.25	1.62
1.333	0.90	7.333	1.80	13.333	1.26	19.33	1.62
1.417	0.90	7.417	1.80	13.417	1.26	19.42	1.62
1.500	0.90	7.500	1.80	13.500	1.26	19.50	1.62
1.583	0.90	7.583	1.80	13.583	7.37	19.58	1.62
1.667	0.90	7.667	1.80	13.667	7.37	19.67	1.62
1.750	0.90	7.750	1.80	13.750	7.37	19.75	1.62
1.833	1.62	7.833	1.80	13.833	7.37	19.83	1.62
1.917	1.62	7.917	1.80	13.917	7.37	19.92	1.62
2.000	1.62	8.000	1.80	14.000	7.37	20.00	1.62
2.083	1.17	8.083	2.43	14.083	2.70	20.08	1.08
2.167	1.17	8.167	2.43	14.167	2.70	20.17	1.08
2.250	1.17	8.250	2.43	14.250	2.70	20.25	1.08
2.333	1.17	8.333	2.43	14.333	2.70	20.33	1.08
2.417	1.17	8.417	2.43	14.417	2.70	20.42	1.08
2.500	1.17	8.500	2.43	14.500	2.70	20.50	1.08
2.583	1.17	8.583	2.43	14.583	2.70	20.58	1.08
2.667	1.17	8.667	2.43	14.667	2.70	20.67	1.08
2.750	1.17	8.750	2.43	14.750	2.70	20.75	1.08
2.833	1.17	8.833	2.43	14.833	2.70	20.83	1.08
2.917	1.17	8.917	2.43	14.917	2.70	20.92	1.08
3.000	1.17	9.000	2.43	15.000	2.70	21.00	1.08
3.083	1.17	9.083	2.88	15.083	2.70	21.08	1.08
3.167	1.17	9.167	2.88	15.167	2.70	21.17	1.08
3.250	1.17	9.250	2.88	15.250	2.70	21.25	1.08
3.333	1.17	9.333	2.88	15.333	2.70	21.33	1.08
3.417	1.17	9.417	2.88	15.417	2.70	21.42	1.08
3.500	1.17	9.500	2.88	15.500	2.70	21.50	1.08
3.583	1.17	9.583	3.24	15.583	2.70	21.58	1.08
3.667	1.17	9.667	3.24	15.667	2.70	21.67	1.08
3.750	1.17	9.750	3.24	15.750	2.70	21.75	1.08
3.833	1.17	9.833	3.24	15.833	2.70	21.83	1.08
3.917	1.17	9.917	3.24	15.917	2.70	21.92	1.08
4.000	1.17	10.000	3.24	16.000	2.70	22.00	1.08
4.083	1.44	10.083	4.14	16.083	1.62	22.08	1.08
4.167	1.44	10.167	4.14	16.167	1.62	22.17	1.08
4.250	1.44	10.250	4.14	16.250	1.62	22.25	1.08
4.333	1.44	10.333	4.14	16.333	1.62	22.33	1.08
4.417	1.44	10.417	4.14	16.417	1.62	22.42	1.08
4.500	1.44	10.500	4.14	16.500	1.62	22.50	1.08
4.583	1.44	10.583	5.57	16.583	1.62	22.58	1.08
4.667	1.44	10.667	5.57	16.667	1.62	22.67	1.08
4.750	1.44	10.750	5.57	16.750	1.62	22.75	1.08
4.833	1.44	10.833	5.57	16.833	1.62	22.83	1.08
4.917	1.44	10.917	5.57	16.917	1.62	22.92	1.08
5.000	1.44	11.000	5.57	17.000	1.62	23.00	1.08
5.083	1.44	11.083	8.63	17.083	1.62	23.08	1.08
5.167	1.44	11.167	8.63	17.167	1.62	23.17	1.08
5.250	1.44	11.250	8.63	17.250	1.62	23.25	1.08
5.333	1.44	11.333	8.63	17.333	1.62	23.33	1.08
5.417	1.44	11.417	8.63	17.417	1.62	23.42	1.08
5.500	1.44	11.500	8.63	17.500	1.62	23.50	1.08
5.583	1.44	11.583	37.40	17.583	1.62	23.58	1.08
5.667	1.44	11.667	37.40	17.667	1.62	23.67	1.08
5.750	1.44	11.750	37.40	17.750	1.62	23.75	1.08
5.833	1.44	11.833	99.24	17.833	1.62	23.83	1.08
5.917	1.44	11.917	99.25	17.917	1.62	23.92	1.08
6.000	1.44	12.000	99.25	18.000	1.62	24.00	1.08

Unit Hyd Qpeak (cms)= 0.324

```
     PEAK FLOW       (cms)=   0.173 (i)
     TIME TO PEAK    (hrs)=  12.250
     RUNOFF VOLUME    (mm)=  33.036
     TOTAL RAINFALL   (mm)=  89.900
     RUNOFF COEFFICIENT   =   0.367

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

```
--------------------
| ADD HYD  (  0161)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0136):    11.95   0.353    12.75    33.04
     + ID2= 2 (  0160):     3.56   0.173    12.25    33.04
       ================================================
       ID = 3 (  0161):    15.51   0.481    12.58    33.04

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
```

```
--------------------
| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              1bad779e-5246-410c-a42e-3ccee7a1c0de\118845a2
| Ptotal= 70.80 mm |    Comments: SCS II 6H_10YR
--------------------

                       Duration of storm    =  6.00 hrs
                       Mass curve time step = 15.00 min
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	2.83	1.75	7.08	3.25	15.58	4.75	4.25
0.50	2.83	2.00	7.08	3.50	15.58	5.00	4.25
0.75	4.25	2.25	8.50	3.75	7.08	5.25	2.83
1.00	4.25	2.50	8.50	4.00	7.08	5.50	2.83
1.25	4.25	2.75	42.48	4.25	5.66	5.75	2.83
1.50	4.25	3.00	110.45	4.50	5.66	6.00	2.83

```
--------------------
| CALIB            |
| NASHYD   (  0162)|   Area     (ha)=   3.56   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.42

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.83	1.583	7.08	3.083	15.58	4.58	4.25
0.167	2.83	1.667	7.08	3.167	15.58	4.67	4.25
0.250	2.83	1.750	7.08	3.250	15.58	4.75	4.25
0.333	2.83	1.833	7.08	3.333	15.58	4.83	4.25
0.417	2.83	1.917	7.08	3.417	15.58	4.92	4.25
0.500	2.83	2.000	7.08	3.500	15.58	5.00	4.25
0.583	4.25	2.083	8.50	3.583	7.08	5.08	2.83
0.667	4.25	2.167	8.50	3.667	7.08	5.17	2.83
0.750	4.25	2.250	8.50	3.750	7.08	5.25	2.83
0.833	4.25	2.333	8.50	3.833	7.08	5.33	2.83
0.917	4.25	2.417	8.50	3.917	7.08	5.42	2.83
1.000	4.25	2.500	8.50	4.000	7.08	5.50	2.83
1.083	4.25	2.583	42.48	4.083	5.66	5.58	2.83
1.167	4.25	2.667	42.48	4.167	5.66	5.67	2.83
1.250	4.25	2.750	42.48	4.250	5.66	5.75	2.83
1.333	4.25	2.833	110.45	4.333	5.66	5.83	2.83
1.417	4.25	2.917	110.45	4.417	5.66	5.92	2.83
1.500	4.25	3.000	110.45	4.500	5.66	6.00	2.83

```
     Unit Hyd Qpeak  (cms)=   0.324

     PEAK FLOW       (cms)=   0.154 (i)
     TIME TO PEAK    (hrs)=   3.333
     RUNOFF VOLUME    (mm)=  21.545
     TOTAL RAINFALL   (mm)=  70.800
     RUNOFF COEFFICIENT   =   0.304

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

```
--------------------
| CALIB            |
| NASHYD   (  0164)|   Area     (ha)=  11.95   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.84

     NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.83	1.583	7.08	3.083	15.58	4.58	4.25
0.167	2.83	1.667	7.08	3.167	15.58	4.67	4.25
0.250	2.83	1.750	7.08	3.250	15.58	4.75	4.25
0.333	2.83	1.833	7.08	3.333	15.58	4.83	4.25
0.417	2.83	1.917	7.08	3.417	15.58	4.92	4.25
0.500	2.83	2.000	7.08	3.500	15.58	5.00	4.25
0.583	4.25	2.083	8.50	3.583	7.08	5.08	2.83
0.667	4.25	2.167	8.50	3.667	7.08	5.17	2.83
0.750	4.25	2.250	8.50	3.750	7.08	5.25	2.83
0.833	4.25	2.333	8.50	3.833	7.08	5.33	2.83
0.917	4.25	2.417	8.50	3.917	7.08	5.42	2.83
1.000	4.25	2.500	8.50	4.000	7.08	5.50	2.83
1.083	4.25	2.583	42.48	4.083	5.66	5.58	2.83
1.167	4.25	2.667	42.48	4.167	5.66	5.67	2.83
1.250	4.25	2.750	42.48	4.250	5.66	5.75	2.83
1.333	4.25	2.833	110.45	4.333	5.66	5.83	2.83
1.417	4.25	2.917	110.45	4.417	5.66	5.92	2.83
1.500	4.25	3.000	110.45	4.500	5.66	6.00	2.83

```
     Unit Hyd Qpeak  (cms)=   0.543

     PEAK FLOW       (cms)=   0.314 (i)
     TIME TO PEAK    (hrs)=   3.833
     RUNOFF VOLUME    (mm)=  21.547
     TOTAL RAINFALL   (mm)=  70.800
     RUNOFF COEFFICIENT   =   0.304

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

```
--------------------
| ADD HYD  (  0163)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0162):     3.56   0.154     3.33    21.55
     + ID2= 2 (  0164):    11.95   0.314     3.83    21.55
```

```
       ==================================================
       ID = 3 (  0163):    15.51   0.426     3.67    21.55

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              1bad779e-5246-410c-a42e-3ccee7a1c0de\2450d259
| Ptotal= 76.00 mm |    Comments: SCS II 12H_10YR
--------------------
                       Duration of storm    = 12.00 hrs
                       Mass curve time step = 15.00 min

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.25    1.90 |  3.25    3.04 |  6.25   13.68 |  9.25    2.66
                0.50    1.90 |  3.50    3.04 |  6.50   13.68 |  9.50    2.66
                0.75    1.90 |  3.75    3.04 |  6.75    6.08 |  9.75    2.66
                1.00    1.90 |  4.00    3.04 |  7.00    6.08 | 10.00    2.66
                1.25    1.90 |  4.25    4.56 |  7.25    4.56 | 10.25    1.52
                1.50    1.90 |  4.50    4.56 |  7.50    4.56 | 10.50    1.52
                1.75    1.90 |  4.75    6.08 |  7.75    4.56 | 10.75    1.52
                2.00    1.90 |  5.00    6.08 |  8.00    4.56 | 11.00    1.52
                2.25    2.28 |  5.25    9.12 |  8.25    2.66 | 11.25    1.52
                2.50    2.28 |  5.50    9.12 |  8.50    2.66 | 11.50    1.52
                2.75    2.28 |  5.75   36.48 |  8.75    2.66 | 11.75    1.52
                3.00    2.28 |  6.00  100.32 |  9.00    2.66 | 12.00    1.52

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0165)|   Area    (ha)=   3.56   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.42

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    1.90 | 3.083    3.04 | 6.083   13.68 |  9.08    2.66
               0.167    1.90 | 3.167    3.04 | 6.167   13.68 |  9.17    2.66
               0.250    1.90 | 3.250    3.04 | 6.250   13.68 |  9.25    2.66
               0.333    1.90 | 3.333    3.04 | 6.333   13.68 |  9.33    2.66
               0.417    1.90 | 3.417    3.04 | 6.417   13.68 |  9.42    2.66
               0.500    1.90 | 3.500    3.04 | 6.500   13.68 |  9.50    2.66
               0.583    1.90 | 3.583    3.04 | 6.583    6.08 |  9.58    2.66
               0.667    1.90 | 3.667    3.04 | 6.667    6.08 |  9.67    2.66
               0.750    1.90 | 3.750    3.04 | 6.750    6.08 |  9.75    2.66
               0.833    1.90 | 3.833    3.04 | 6.833    6.08 |  9.83    2.66
               0.917    1.90 | 3.917    3.04 | 6.917    6.08 |  9.92    2.66
               1.000    1.90 | 4.000    3.04 | 7.000    6.08 | 10.00    2.66
               1.083    1.90 | 4.083    4.56 | 7.083    4.56 | 10.08    1.52
               1.167    1.90 | 4.167    4.56 | 7.167    4.56 | 10.17    1.52
               1.250    1.90 | 4.250    4.56 | 7.250    4.56 | 10.25    1.52
               1.333    1.90 | 4.333    4.56 | 7.333    4.56 | 10.33    1.52
               1.417    1.90 | 4.417    4.56 | 7.417    4.56 | 10.42    1.52
               1.500    1.90 | 4.500    4.56 | 7.500    4.56 | 10.50    1.52
               1.583    1.90 | 4.583    6.08 | 7.583    4.56 | 10.58    1.52
               1.667    1.90 | 4.667    6.08 | 7.667    4.56 | 10.67    1.52
               1.750    1.90 | 4.750    6.08 | 7.750    4.56 | 10.75    1.52
               1.833    1.90 | 4.833    6.08 | 7.833    4.56 | 10.83    1.52
               1.917    1.90 | 4.917    6.08 | 7.917    4.56 | 10.92    1.52
               2.000    1.90 | 5.000    6.08 | 8.000    4.56 | 11.00    1.52
               2.083    2.28 | 5.083    9.12 | 8.083    2.66 | 11.08    1.52
               2.167    2.28 | 5.167    9.12 | 8.167    2.66 | 11.17    1.52
               2.250    2.28 | 5.250    9.12 | 8.250    2.66 | 11.25    1.52
               2.333    2.28 | 5.333    9.12 | 8.333    2.66 | 11.33    1.52
               2.417    2.28 | 5.417    9.12 | 8.417    2.66 | 11.42    1.52
               2.500    2.28 | 5.500    9.12 | 8.500    2.66 | 11.50    1.52
               2.583    2.28 | 5.583   36.48 | 8.583    2.66 | 11.58    1.52
               2.667    2.28 | 5.667   36.48 | 8.667    2.66 | 11.67    1.52
               2.750    2.28 | 5.750   36.48 | 8.750    2.66 | 11.75    1.52
               2.833    2.28 | 5.833  100.32 | 8.833    2.66 | 11.83    1.52
               2.917    2.28 | 5.917  100.32 | 8.917    2.66 | 11.92    1.52
               3.000    2.28 | 6.000  100.32 | 9.000    2.66 | 12.00    1.52

     Unit Hyd Qpeak  (cms)=   0.324

     PEAK FLOW       (cms)=   0.152 (i)
     TIME TO PEAK    (hrs)=   6.333
     RUNOFF VOLUME    (mm)=  24.525
     TOTAL RAINFALL   (mm)=  76.000
     RUNOFF COEFFICIENT   =   0.323

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

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| CALIB            |
| NASHYD   (  0167)|   Area    (ha)=  11.95   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.84

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    1.90 | 3.083    3.04 | 6.083   13.68 |  9.08    2.66
               0.167    1.90 | 3.167    3.04 | 6.167   13.68 |  9.17    2.66
               0.250    1.90 | 3.250    3.04 | 6.250   13.68 |  9.25    2.66
               0.333    1.90 | 3.333    3.04 | 6.333   13.68 |  9.33    2.66
               0.417    1.90 | 3.417    3.04 | 6.417   13.68 |  9.42    2.66
               0.500    1.90 | 3.500    3.04 | 6.500   13.68 |  9.50    2.66
               0.583    1.90 | 3.583    3.04 | 6.583    6.08 |  9.58    2.66
               0.667    1.90 | 3.667    3.04 | 6.667    6.08 |  9.67    2.66
               0.750    1.90 | 3.750    3.04 | 6.750    6.08 |  9.75    2.66
               0.833    1.90 | 3.833    3.04 | 6.833    6.08 |  9.83    2.66
               0.917    1.90 | 3.917    3.04 | 6.917    6.08 |  9.92    2.66
               1.000    1.90 | 4.000    3.04 | 7.000    6.08 | 10.00    2.66
               1.083    1.90 | 4.083    4.56 | 7.083    4.56 | 10.08    1.52
               1.167    1.90 | 4.167    4.56 | 7.167    4.56 | 10.17    1.52
               1.250    1.90 | 4.250    4.56 | 7.250    4.56 | 10.25    1.52
               1.333    1.90 | 4.333    4.56 | 7.333    4.56 | 10.33    1.52
               1.417    1.90 | 4.417    4.56 | 7.417    4.56 | 10.42    1.52
               1.500    1.90 | 4.500    4.56 | 7.500    4.56 | 10.50    1.52
               1.583    1.90 | 4.583    6.08 | 7.583    4.56 | 10.58    1.52
               1.667    1.90 | 4.667    6.08 | 7.667    4.56 | 10.67    1.52
               1.750    1.90 | 4.750    6.08 | 7.750    4.56 | 10.75    1.52
               1.833    1.90 | 4.833    6.08 | 7.833    4.56 | 10.83    1.52
               1.917    1.90 | 4.917    6.08 | 7.917    4.56 | 10.92    1.52
               2.000    1.90 | 5.000    6.08 | 8.000    4.56 | 11.00    1.52
               2.083    2.28 | 5.083    9.12 | 8.083    2.66 | 11.08    1.52
               2.167    2.28 | 5.167    9.12 | 8.167    2.66 | 11.17    1.52
               2.250    2.28 | 5.250    9.12 | 8.250    2.66 | 11.25    1.52
               2.333    2.28 | 5.333    9.12 | 8.333    2.66 | 11.33    1.52
               2.417    2.28 | 5.417    9.12 | 8.417    2.66 | 11.42    1.52
               2.500    2.28 | 5.500    9.12 | 8.500    2.66 | 11.50    1.52
```

2.583	2.28	5.583	36.48	8.583	2.66	11.58	1.52
2.667	2.28	5.667	36.48	8.667	2.66	11.67	1.52
2.750	2.28	5.750	36.48	8.750	2.66	11.75	1.52
2.833	2.28	5.833	100.32	8.833	2.66	11.83	1.52
2.917	2.28	5.917	100.32	8.917	2.66	11.92	1.52
3.000	2.28	6.000	100.32	9.000	2.66	12.00	1.52

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.310 (i)
TIME TO PEAK (hrs)= 6.833
RUNOFF VOLUME (mm)= 24.528
TOTAL RAINFALL (mm)= 76.000
RUNOFF COEFFICIENT = 0.323

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

ADD HYD (0166)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0165):	3.56	0.152	6.33	24.53
+ ID2= 2 (0167):	11.95	0.310	6.83	24.53
ID = 3 (0166):	15.51	0.421	6.58	24.53

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CHICAGO STORM	IDF curve parameters: A= 975.865
Ptotal= 59.69 mm	B= 4.699
	C= 0.760

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

Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.17	4.32	1.17	30.27	2.17	9.72	3.17	5.09
0.33	4.91	1.33	126.55	2.33	8.35	3.33	4.74
0.50	5.73	1.50	39.22	2.50	7.35	3.50	4.45
0.67	6.96	1.67	21.35	2.67	6.59	3.67	4.19
0.83	9.03	1.83	15.01	2.83	5.99	3.83	3.97
1.00	13.36	2.00	11.74	3.00	5.50	4.00	3.77

CALIB			
NASHYD (0168)	Area (ha)= 3.56	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.42		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	4.32	1.083	30.27	2.083	9.72	3.08	5.09
0.167	4.32	1.167	30.27	2.167	9.72	3.17	5.09
0.250	4.91	1.250	126.55	2.250	8.35	3.25	4.74
0.333	4.91	1.333	126.55	2.333	8.35	3.33	4.74
0.417	5.73	1.417	39.22	2.417	7.35	3.42	4.45
0.500	5.73	1.500	39.22	2.500	7.35	3.50	4.45
0.583	6.96	1.583	21.35	2.583	6.59	3.58	4.19
0.667	6.96	1.667	21.35	2.667	6.59	3.67	4.19
0.750	9.03	1.750	15.01	2.750	5.99	3.75	3.97
0.833	9.03	1.833	15.01	2.833	5.99	3.83	3.97
0.917	13.36	1.917	11.74	2.917	5.50	3.92	3.77
1.000	13.36	2.000	11.74	3.000	5.50	4.00	3.77

Unit Hyd Qpeak (cms)= 0.324

PEAK FLOW (cms)= 0.098 (i)
TIME TO PEAK (hrs)= 1.833
RUNOFF VOLUME (mm)= 15.615
TOTAL RAINFALL (mm)= 59.695
RUNOFF COEFFICIENT = 0.262

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

CALIB			
NASHYD (0170)	Area (ha)= 11.95	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.84		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	4.32	1.083	30.27	2.083	9.72	3.08	5.09
0.167	4.32	1.167	30.27	2.167	9.72	3.17	5.09
0.250	4.91	1.250	126.55	2.250	8.35	3.25	4.74
0.333	4.91	1.333	126.55	2.333	8.35	3.33	4.74
0.417	5.73	1.417	39.22	2.417	7.35	3.42	4.45
0.500	5.73	1.500	39.22	2.500	7.35	3.50	4.45
0.583	6.96	1.583	21.35	2.583	6.59	3.58	4.19
0.667	6.96	1.667	21.35	2.667	6.59	3.67	4.19
0.750	9.03	1.750	15.01	2.750	5.99	3.75	3.97
0.833	9.03	1.833	15.01	2.833	5.99	3.83	3.97
0.917	13.36	1.917	11.74	2.917	5.50	3.92	3.77
1.000	13.36	2.000	11.74	3.000	5.50	4.00	3.77

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.211 (i)
TIME TO PEAK (hrs)= 2.417
RUNOFF VOLUME (mm)= 15.617
TOTAL RAINFALL (mm)= 59.695
RUNOFF COEFFICIENT = 0.262

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

ADD HYD (0169)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0168):	3.56	0.098	1.83	15.62
+ ID2= 2 (0170):	11.95	0.211	2.42	15.62
ID = 3 (0169):	15.51	0.281	2.25	15.62

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     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2006)
       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   TTTTT  TTTTT  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\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\8de9ca2e-8186-4509-9a7d-c6b246141711\scenari
  Summary filename: C:\Users\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\8de9ca2e-8186-4509-9a7d-c6b246141711\scenari


DATE: 06-29-2022                          TIME: 02:23:36

USER:



COMMENTS: _____________________________________________________________


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  ***********************************************
  ** SIMULATION : Run 04                       **
  ***********************************************

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| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              1bad779e-5246-410c-a42e-3ccee7a1c0de\6d7a2231
| Ptotal=107.50 mm |    Comments: Mass 24-Hour SCS Type II Design Storm
--------------------
                       Duration of storm    = 24.00 hrs
                       Mass curve time step = 15.00 min

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs  mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.25    1.08 |  6.25    2.15 | 12.25   15.48 | 18.25    1.93
                0.50    1.08 |  6.50    2.15 | 12.50   15.48 | 18.50    1.94
                0.75    1.08 |  6.75    2.15 | 12.75    7.95 | 18.75    1.93
                1.00    1.08 |  7.00    2.15 | 13.00    7.96 | 19.00    1.94
                1.25    1.08 |  7.25    2.15 | 13.25    1.50 | 19.25    1.93
                1.50    1.07 |  7.50    2.15 | 13.50    1.50 | 19.50    1.94
                1.75    1.08 |  7.75    2.15 | 13.75    8.82 | 19.75    1.93
                2.00    1.93 |  8.00    2.15 | 14.00    8.82 | 20.00    1.94
                2.25    1.40 |  8.25    2.90 | 14.25    3.22 | 20.25    1.29
                2.50    1.40 |  8.50    2.90 | 14.50    3.22 | 20.50    1.29
                2.75    1.40 |  8.75    2.90 | 14.75    3.22 | 20.75    1.29
                3.00    1.40 |  9.00    2.90 | 15.00    3.23 | 21.00    1.29
                3.25    1.40 |  9.25    3.44 | 15.25    3.22 | 21.25    1.29
                3.50    1.40 |  9.50    3.44 | 15.50    3.22 | 21.50    1.29
                3.75    1.40 |  9.75    3.87 | 15.75    3.22 | 21.75    1.29
                4.00    1.40 | 10.00    3.87 | 16.00    3.22 | 22.00    1.29
                4.25    1.72 | 10.25    4.95 | 16.25    1.94 | 22.25    1.29
                4.50    1.72 | 10.50    4.95 | 16.50    1.93 | 22.50    1.29
                4.75    1.72 | 10.75    6.67 | 16.75    1.93 | 22.75    1.29
                5.00    1.72 | 11.00    6.66 | 17.00    1.94 | 23.00    1.29
                5.25    1.72 | 11.25   10.32 | 17.25    1.93 | 23.25    1.29
                5.50    1.72 | 11.50   10.32 | 17.50    1.94 | 23.50    1.29
                5.75    1.72 | 11.75   44.72 | 17.75    1.93 | 23.75    1.29
                6.00    1.72 | 12.00  118.68 | 18.00    1.94 | 24.00    1.29

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| CALIB            |
| NASHYD   (  0136)|   Area     (ha)=  11.95   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.84

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs  mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083   1.08 | 6.083    2.15 |12.083   15.49 | 18.08    1.94
                0.167   1.08 | 6.167    2.15 |12.167   15.48 | 18.17    1.93
                0.250   1.08 | 6.250    2.15 |12.250   15.48 | 18.25    1.93
                0.333   1.08 | 6.333    2.15 |12.333   15.48 | 18.33    1.94
                0.417   1.08 | 6.417    2.15 |12.417   15.48 | 18.42    1.94
                0.500   1.08 | 6.500    2.15 |12.500   15.48 | 18.50    1.94
                0.583   1.08 | 6.583    2.15 |12.583    7.96 | 18.58    1.94
                0.667   1.08 | 6.667    2.15 |12.667    7.95 | 18.67    1.93
                0.750   1.08 | 6.750    2.15 |12.750    7.95 | 18.75    1.93
                0.833   1.07 | 6.833    2.15 |12.833    7.95 | 18.83    1.94
                0.917   1.08 | 6.917    2.15 |12.917    7.96 | 18.92    1.94
                1.000   1.08 | 7.000    2.15 |13.000    7.96 | 19.00    1.94
                1.083   1.07 | 7.083    2.15 |13.083    1.51 | 19.08    1.94
                1.167   1.08 | 7.167    2.15 |13.167    1.50 | 19.17    1.93
                1.250   1.08 | 7.250    2.15 |13.250    1.50 | 19.25    1.93
                1.333   1.08 | 7.333    2.15 |13.333    1.50 | 19.33    1.94
                1.417   1.07 | 7.417    2.15 |13.417    1.50 | 19.42    1.94
                1.500   1.08 | 7.500    2.15 |13.500    1.50 | 19.50    1.94
                1.583   1.08 | 7.583    2.15 |13.583    8.81 | 19.58    1.93
                1.667   1.08 | 7.667    2.15 |13.667    8.82 | 19.67    1.93
                1.750   1.08 | 7.750    2.15 |13.750    8.82 | 19.75    1.94
                1.833   1.93 | 7.833    2.15 |13.833    8.81 | 19.83    1.94
                1.917   1.93 | 7.917    2.15 |13.917    8.82 | 19.92    1.94
                2.000   1.93 | 8.000    2.15 |14.000    8.82 | 20.00    1.93
                2.083   1.40 | 8.083    2.90 |14.083    3.23 | 20.08    1.29
                2.167   1.40 | 8.167    2.90 |14.167    3.22 | 20.17    1.29
                2.250   1.40 | 8.250    2.90 |14.250    3.22 | 20.25    1.29
                2.333   1.40 | 8.333    2.90 |14.333    3.22 | 20.33    1.29
                2.417   1.40 | 8.417    2.90 |14.417    3.22 | 20.42    1.29
                2.500   1.40 | 8.500    2.90 |14.500    3.22 | 20.50    1.29
                2.583   1.40 | 8.583    2.90 |14.583    3.22 | 20.58    1.29
                2.667   1.40 | 8.667    2.90 |14.667    3.22 | 20.67    1.29
                2.750   1.40 | 8.750    2.90 |14.750    3.22 | 20.75    1.29
                2.833   1.40 | 8.833    2.90 |14.833    3.23 | 20.83    1.29
                2.917   1.40 | 8.917    2.90 |14.917    3.23 | 20.92    1.29
                3.000   1.40 | 9.000    2.90 |15.000    3.23 | 21.00    1.29
                3.083   1.40 | 9.083    3.44 |15.083    3.22 | 21.08    1.29
```

3.167	1.40	9.167	3.44	15.167	3.22	21.17	1.29
3.250	1.40	9.250	3.44	15.250	3.22	21.25	1.29
3.333	1.40	9.333	3.44	15.333	3.22	21.33	1.29
3.417	1.40	9.417	3.44	15.417	3.22	21.42	1.29
3.500	1.40	9.500	3.44	15.500	3.22	21.50	1.29
3.583	1.40	9.583	3.87	15.583	3.22	21.58	1.29
3.667	1.40	9.667	3.87	15.667	3.22	21.67	1.29
3.750	1.40	9.750	3.87	15.750	3.22	21.75	1.29
3.833	1.40	9.833	3.87	15.833	3.22	21.83	1.29
3.917	1.40	9.917	3.87	15.917	3.22	21.92	1.29
4.000	1.40	10.000	3.87	16.000	3.22	22.00	1.29
4.083	1.72	10.083	4.94	16.083	1.94	22.08	1.29
4.167	1.72	10.167	4.95	16.167	1.94	22.17	1.29
4.250	1.72	10.250	4.95	16.250	1.94	22.25	1.29
4.333	1.72	10.333	4.94	16.333	1.94	22.33	1.29
4.417	1.72	10.417	4.95	16.417	1.93	22.42	1.29
4.500	1.72	10.500	4.95	16.500	1.93	22.50	1.29
4.583	1.72	10.583	6.66	16.583	1.94	22.58	1.29
4.667	1.72	10.667	6.67	16.667	1.93	22.67	1.29
4.750	1.72	10.750	6.67	16.750	1.93	22.75	1.29
4.833	1.72	10.833	6.66	16.833	1.94	22.83	1.29
4.917	1.72	10.917	6.66	16.917	1.94	22.92	1.29
5.000	1.72	11.000	6.66	17.000	1.94	23.00	1.29
5.083	1.72	11.083	10.32	17.083	1.94	23.08	1.29
5.167	1.72	11.167	10.32	17.167	1.93	23.17	1.29
5.250	1.72	11.250	10.32	17.250	1.93	23.25	1.29
5.333	1.72	11.333	10.32	17.333	1.94	23.33	1.29
5.417	1.72	11.417	10.32	17.417	1.94	23.42	1.29
5.500	1.72	11.500	10.32	17.500	1.94	23.50	1.29
5.583	1.72	11.583	44.72	17.583	1.94	23.58	1.29
5.667	1.72	11.667	44.72	17.667	1.93	23.67	1.29
5.750	1.72	11.750	44.72	17.750	1.93	23.75	1.29
5.833	1.72	11.833	118.67	17.833	1.94	23.83	1.29
5.917	1.72	11.917	118.68	17.917	1.94	23.92	1.29
6.000	1.72	12.000	118.68	18.000	1.94	24.00	1.29

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.484 (i)
TIME TO PEAK (hrs)= 12.750
RUNOFF VOLUME (mm)= 44.769
TOTAL RAINFALL (mm)= 107.500
RUNOFF COEFFICIENT = 0.416

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

CALIB					
NASHYD (0160)	Area (ha)=	3.56	Curve Number (CN)=	67.0	
ID= 1 DT= 5.0 min	Ia (mm)=	7.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	0.42			

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.08	6.083	2.15	12.083	15.49	18.08	1.94
0.167	1.08	6.167	2.15	12.167	15.48	18.17	1.93
0.250	1.08	6.250	2.15	12.250	15.48	18.25	1.93
0.333	1.08	6.333	2.15	12.333	15.48	18.33	1.94
0.417	1.08	6.417	2.15	12.417	15.48	18.42	1.94
0.500	1.08	6.500	2.15	12.500	15.48	18.50	1.94
0.583	1.08	6.583	2.15	12.583	7.96	18.58	1.94
0.667	1.08	6.667	2.15	12.667	7.95	18.67	1.93
0.750	1.08	6.750	2.15	12.750	7.95	18.75	1.93
0.833	1.07	6.833	2.15	12.833	7.95	18.83	1.94
0.917	1.08	6.917	2.15	12.917	7.96	18.92	1.94
1.000	1.08	7.000	2.15	13.000	7.96	19.00	1.94
1.083	1.07	7.083	2.15	13.083	1.51	19.08	1.94
1.167	1.08	7.167	2.15	13.167	1.50	19.17	1.93
1.250	1.08	7.250	2.15	13.250	1.50	19.25	1.93
1.333	1.08	7.333	2.15	13.333	1.50	19.33	1.94
1.417	1.07	7.417	2.15	13.417	1.50	19.42	1.94
1.500	1.08	7.500	2.15	13.500	1.50	19.50	1.94
1.583	1.08	7.583	2.15	13.583	8.81	19.58	1.93
1.667	1.08	7.667	2.15	13.667	8.82	19.67	1.93
1.750	1.08	7.750	2.15	13.750	8.82	19.75	1.94
1.833	1.93	7.833	2.15	13.833	8.81	19.83	1.94
1.917	1.93	7.917	2.15	13.917	8.82	19.92	1.94
2.000	1.93	8.000	2.15	14.000	8.82	20.00	1.93
2.083	1.40	8.083	2.90	14.083	3.23	20.08	1.29
2.167	1.40	8.167	2.90	14.167	3.22	20.17	1.29
2.250	1.40	8.250	2.90	14.250	3.22	20.25	1.29
2.333	1.40	8.333	2.90	14.333	3.22	20.33	1.29
2.417	1.40	8.417	2.90	14.417	3.22	20.42	1.29
2.500	1.40	8.500	2.90	14.500	3.22	20.50	1.29
2.583	1.40	8.583	2.90	14.583	3.22	20.58	1.29
2.667	1.40	8.667	2.90	14.667	3.22	20.67	1.29
2.750	1.40	8.750	2.90	14.750	3.22	20.75	1.29
2.833	1.40	8.833	2.90	14.833	3.23	20.83	1.29
2.917	1.40	8.917	2.90	14.917	3.23	20.92	1.29
3.000	1.40	9.000	2.90	15.000	3.23	21.00	1.29
3.083	1.40	9.083	3.44	15.083	3.22	21.08	1.29
3.167	1.40	9.167	3.44	15.167	3.22	21.17	1.29
3.250	1.40	9.250	3.44	15.250	3.22	21.25	1.29
3.333	1.40	9.333	3.44	15.333	3.22	21.33	1.29
3.417	1.40	9.417	3.44	15.417	3.22	21.42	1.29
3.500	1.40	9.500	3.44	15.500	3.22	21.50	1.29
3.583	1.40	9.583	3.87	15.583	3.22	21.58	1.29
3.667	1.40	9.667	3.87	15.667	3.22	21.67	1.29
3.750	1.40	9.750	3.87	15.750	3.22	21.75	1.29
3.833	1.40	9.833	3.87	15.833	3.22	21.83	1.29
3.917	1.40	9.917	3.87	15.917	3.22	21.92	1.29
4.000	1.40	10.000	3.87	16.000	3.22	22.00	1.29
4.083	1.72	10.083	4.94	16.083	1.94	22.08	1.29
4.167	1.72	10.167	4.95	16.167	1.94	22.17	1.29
4.250	1.72	10.250	4.95	16.250	1.94	22.25	1.29
4.333	1.72	10.333	4.94	16.333	1.94	22.33	1.29
4.417	1.72	10.417	4.95	16.417	1.93	22.42	1.29
4.500	1.72	10.500	4.95	16.500	1.93	22.50	1.29
4.583	1.72	10.583	6.66	16.583	1.94	22.58	1.29
4.667	1.72	10.667	6.67	16.667	1.93	22.67	1.29
4.750	1.72	10.750	6.67	16.750	1.93	22.75	1.29
4.833	1.72	10.833	6.66	16.833	1.94	22.83	1.29
4.917	1.72	10.917	6.66	16.917	1.94	22.92	1.29
5.000	1.72	11.000	6.66	17.000	1.94	23.00	1.29
5.083	1.72	11.083	10.32	17.083	1.94	23.08	1.29
5.167	1.72	11.167	10.32	17.167	1.93	23.17	1.29
5.250	1.72	11.250	10.32	17.250	1.93	23.25	1.29
5.333	1.72	11.333	10.32	17.333	1.94	23.33	1.29
5.417	1.72	11.417	10.32	17.417	1.94	23.42	1.29
5.500	1.72	11.500	10.32	17.500	1.94	23.50	1.29
5.583	1.72	11.583	44.72	17.583	1.94	23.58	1.29
5.667	1.72	11.667	44.72	17.667	1.93	23.67	1.29
5.750	1.72	11.750	44.72	17.750	1.93	23.75	1.29
5.833	1.72	11.833	118.67	17.833	1.94	23.83	1.29
5.917	1.72	11.917	118.68	17.917	1.94	23.92	1.29
6.000	1.72	12.000	118.68	18.000	1.94	24.00	1.29

```
     Unit Hyd Qpeak  (cms)=   0.324

     PEAK FLOW       (cms)=   0.236 (i)
     TIME TO PEAK    (hrs)=  12.250
     RUNOFF VOLUME    (mm)=  44.765
     TOTAL RAINFALL   (mm)= 107.500
     RUNOFF COEFFICIENT   =   0.416

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

ADD HYD (0161)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0136):	11.95	0.484	12.75	44.77
	+ ID2= 2 (0160):	3.56	0.236	12.25	44.77
	ID = 3 (0161):	15.51	0.658	12.58	44.77

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\1bad779e-5246-410c-a42e-3ccee7a1c0de\b7d4aaa8
Ptotal= 85.20 mm	Comments: SCS II 6H_25YR

Duration of storm = 6.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	3.41	1.75	8.52	3.25	18.74	4.75	5.11
0.50	3.41	2.00	8.52	3.50	18.74	5.00	5.11
0.75	5.11	2.25	10.22	3.75	8.52	5.25	3.41
1.00	5.11	2.50	10.22	4.00	8.52	5.50	3.41
1.25	5.11	2.75	51.12	4.25	6.82	5.75	3.41
1.50	5.11	3.00	132.91	4.50	6.82	6.00	3.41

CALIB			
NASHYD (0162)	Area (ha)= 3.56	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.42		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	3.41	1.583	8.52	3.083	18.74	4.58	5.11
0.167	3.41	1.667	8.52	3.167	18.74	4.67	5.11
0.250	3.41	1.750	8.52	3.250	18.74	4.75	5.11
0.333	3.41	1.833	8.52	3.333	18.74	4.83	5.11
0.417	3.41	1.917	8.52	3.417	18.74	4.92	5.11
0.500	3.41	2.000	8.52	3.500	18.74	5.00	5.11
0.583	5.11	2.083	10.22	3.583	8.52	5.08	3.41
0.667	5.11	2.167	10.22	3.667	8.52	5.17	3.41
0.750	5.11	2.250	10.22	3.750	8.52	5.25	3.41
0.833	5.11	2.333	10.22	3.833	8.52	5.33	3.41
0.917	5.11	2.417	10.22	3.917	8.52	5.42	3.41
1.000	5.11	2.500	10.22	4.000	8.52	5.50	3.41
1.083	5.11	2.583	51.12	4.083	6.82	5.58	3.41
1.167	5.11	2.667	51.12	4.167	6.82	5.67	3.41
1.250	5.11	2.750	51.12	4.250	6.82	5.75	3.41
1.333	5.11	2.833	132.91	4.333	6.82	5.83	3.41
1.417	5.11	2.917	132.91	4.417	6.82	5.92	3.41
1.500	5.11	3.000	132.91	4.500	6.82	6.00	3.41

```
     Unit Hyd Qpeak  (cms)=   0.324

     PEAK FLOW       (cms)=   0.218 (i)
     TIME TO PEAK    (hrs)=   3.333
     RUNOFF VOLUME    (mm)=  30.076
     TOTAL RAINFALL   (mm)=  85.200
     RUNOFF COEFFICIENT   =   0.353

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

CALIB			
NASHYD (0164)	Area (ha)= 11.95	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.84		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	3.41	1.583	8.52	3.083	18.74	4.58	5.11
0.167	3.41	1.667	8.52	3.167	18.74	4.67	5.11
0.250	3.41	1.750	8.52	3.250	18.74	4.75	5.11
0.333	3.41	1.833	8.52	3.333	18.74	4.83	5.11
0.417	3.41	1.917	8.52	3.417	18.74	4.92	5.11
0.500	3.41	2.000	8.52	3.500	18.74	5.00	5.11
0.583	5.11	2.083	10.22	3.583	8.52	5.08	3.41
0.667	5.11	2.167	10.22	3.667	8.52	5.17	3.41
0.750	5.11	2.250	10.22	3.750	8.52	5.25	3.41
0.833	5.11	2.333	10.22	3.833	8.52	5.33	3.41
0.917	5.11	2.417	10.22	3.917	8.52	5.42	3.41
1.000	5.11	2.500	10.22	4.000	8.52	5.50	3.41
1.083	5.11	2.583	51.12	4.083	6.82	5.58	3.41
1.167	5.11	2.667	51.12	4.167	6.82	5.67	3.41
1.250	5.11	2.750	51.12	4.250	6.82	5.75	3.41
1.333	5.11	2.833	132.91	4.333	6.82	5.83	3.41
1.417	5.11	2.917	132.91	4.417	6.82	5.92	3.41
1.500	5.11	3.000	132.91	4.500	6.82	6.00	3.41

```
     Unit Hyd Qpeak  (cms)=   0.543

     PEAK FLOW       (cms)=   0.443 (i)
     TIME TO PEAK    (hrs)=   3.833
     RUNOFF VOLUME    (mm)=  30.079
     TOTAL RAINFALL   (mm)=  85.200
     RUNOFF COEFFICIENT   =   0.353

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

ADD HYD (0163)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0162):	3.56	0.218	3.33	30.08

```
      + ID2= 2 (  0164):    11.95   0.443     3.83    30.08
        ================================================
        ID = 3 (  0163):    15.51   0.600     3.67    30.08

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              1bad779e-5246-410c-a42e-3ccee7a1c0de\8b21e398
| Ptotal= 90.70 mm |    Comments: SCS II 12H_25YR
--------------------
                       Duration of storm    = 12.00 hrs
                       Mass curve time step = 15.00 min

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.25    2.27 |  3.25    3.63 |  6.25   16.33 |  9.25    3.17
                0.50    2.27 |  3.50    3.63 |  6.50   16.33 |  9.50    3.17
                0.75    2.27 |  3.75    3.63 |  6.75    7.26 |  9.75    3.17
                1.00    2.27 |  4.00    3.63 |  7.00    7.26 | 10.00    3.17
                1.25    2.27 |  4.25    5.44 |  7.25    5.44 | 10.25    1.81
                1.50    2.27 |  4.50    5.44 |  7.50    5.44 | 10.50    1.81
                1.75    2.27 |  4.75    7.26 |  7.75    5.44 | 10.75    1.81
                2.00    2.27 |  5.00    7.26 |  8.00    5.44 | 11.00    1.81
                2.25    2.72 |  5.25   10.88 |  8.25    3.17 | 11.25    1.81
                2.50    2.72 |  5.50   10.88 |  8.50    3.17 | 11.50    1.81
                2.75    2.72 |  5.75   43.54 |  8.75    3.17 | 11.75    1.81
                3.00    2.72 |  6.00  119.72 |  9.00    3.17 | 12.00    1.81

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| CALIB            |
| NASHYD   (  0165)|   Area    (ha)=   3.56   Curve Number   (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.42

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                        ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    2.27 | 3.083    3.63 | 6.083   16.33 |  9.08    3.17
               0.167    2.27 | 3.167    3.63 | 6.167   16.33 |  9.17    3.17
               0.250    2.27 | 3.250    3.63 | 6.250   16.33 |  9.25    3.17
               0.333    2.27 | 3.333    3.63 | 6.333   16.33 |  9.33    3.17
               0.417    2.27 | 3.417    3.63 | 6.417   16.33 |  9.42    3.17
               0.500    2.27 | 3.500    3.63 | 6.500   16.33 |  9.50    3.17
               0.583    2.27 | 3.583    3.63 | 6.583    7.26 |  9.58    3.17
               0.667    2.27 | 3.667    3.63 | 6.667    7.26 |  9.67    3.17
               0.750    2.27 | 3.750    3.63 | 6.750    7.26 |  9.75    3.17
               0.833    2.27 | 3.833    3.63 | 6.833    7.26 |  9.83    3.17
               0.917    2.27 | 3.917    3.63 | 6.917    7.26 |  9.92    3.17
               1.000    2.27 | 4.000    3.63 | 7.000    7.26 | 10.00    3.17
               1.083    2.27 | 4.083    5.44 | 7.083    5.44 | 10.08    1.81
               1.167    2.27 | 4.167    5.44 | 7.167    5.44 | 10.17    1.81
               1.250    2.27 | 4.250    5.44 | 7.250    5.44 | 10.25    1.81
               1.333    2.27 | 4.333    5.44 | 7.333    5.44 | 10.33    1.81
               1.417    2.27 | 4.417    5.44 | 7.417    5.44 | 10.42    1.81
               1.500    2.27 | 4.500    5.44 | 7.500    5.44 | 10.50    1.81
               1.583    2.27 | 4.583    7.26 | 7.583    5.44 | 10.58    1.81
               1.667    2.27 | 4.667    7.26 | 7.667    5.44 | 10.67    1.81
               1.750    2.27 | 4.750    7.26 | 7.750    5.44 | 10.75    1.81
               1.833    2.27 | 4.833    7.26 | 7.833    5.44 | 10.83    1.81
               1.917    2.27 | 4.917    7.26 | 7.917    5.44 | 10.92    1.81
               2.000    2.27 | 5.000    7.26 | 8.000    5.44 | 11.00    1.81
               2.083    2.72 | 5.083   10.88 | 8.083    3.17 | 11.08    1.81
               2.167    2.72 | 5.167   10.88 | 8.167    3.17 | 11.17    1.81
               2.250    2.72 | 5.250   10.88 | 8.250    3.17 | 11.25    1.81
               2.333    2.72 | 5.333   10.88 | 8.333    3.17 | 11.33    1.81
               2.417    2.72 | 5.417   10.88 | 8.417    3.17 | 11.42    1.81
               2.500    2.72 | 5.500   10.88 | 8.500    3.17 | 11.50    1.81
               2.583    2.72 | 5.583   43.54 | 8.583    3.17 | 11.58    1.81
               2.667    2.72 | 5.667   43.54 | 8.667    3.17 | 11.67    1.81
               2.750    2.72 | 5.750   43.54 | 8.750    3.17 | 11.75    1.81
               2.833    2.72 | 5.833  119.72 | 8.833    3.17 | 11.83    1.81
               2.917    2.72 | 5.917  119.72 | 8.917    3.17 | 11.92    1.81
               3.000    2.72 | 6.000  119.72 | 9.000    3.17 | 12.00    1.81

     Unit Hyd Qpeak  (cms)=   0.324

     PEAK FLOW       (cms)=   0.209 (i)
     TIME TO PEAK    (hrs)=   6.333
     RUNOFF VOLUME    (mm)=  33.548
     TOTAL RAINFALL   (mm)=  90.700
     RUNOFF COEFFICIENT   =   0.370

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

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| CALIB            |
| NASHYD   (  0167)|   Area    (ha)=  11.95   Curve Number   (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.84

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                        ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    2.27 | 3.083    3.63 | 6.083   16.33 |  9.08    3.17
               0.167    2.27 | 3.167    3.63 | 6.167   16.33 |  9.17    3.17
               0.250    2.27 | 3.250    3.63 | 6.250   16.33 |  9.25    3.17
               0.333    2.27 | 3.333    3.63 | 6.333   16.33 |  9.33    3.17
               0.417    2.27 | 3.417    3.63 | 6.417   16.33 |  9.42    3.17
               0.500    2.27 | 3.500    3.63 | 6.500   16.33 |  9.50    3.17
               0.583    2.27 | 3.583    3.63 | 6.583    7.26 |  9.58    3.17
               0.667    2.27 | 3.667    3.63 | 6.667    7.26 |  9.67    3.17
               0.750    2.27 | 3.750    3.63 | 6.750    7.26 |  9.75    3.17
               0.833    2.27 | 3.833    3.63 | 6.833    7.26 |  9.83    3.17
               0.917    2.27 | 3.917    3.63 | 6.917    7.26 |  9.92    3.17
               1.000    2.27 | 4.000    3.63 | 7.000    7.26 | 10.00    3.17
               1.083    2.27 | 4.083    5.44 | 7.083    5.44 | 10.08    1.81
               1.167    2.27 | 4.167    5.44 | 7.167    5.44 | 10.17    1.81
               1.250    2.27 | 4.250    5.44 | 7.250    5.44 | 10.25    1.81
               1.333    2.27 | 4.333    5.44 | 7.333    5.44 | 10.33    1.81
               1.417    2.27 | 4.417    5.44 | 7.417    5.44 | 10.42    1.81
               1.500    2.27 | 4.500    5.44 | 7.500    5.44 | 10.50    1.81
               1.583    2.27 | 4.583    7.26 | 7.583    5.44 | 10.58    1.81
               1.667    2.27 | 4.667    7.26 | 7.667    5.44 | 10.67    1.81
               1.750    2.27 | 4.750    7.26 | 7.750    5.44 | 10.75    1.81
               1.833    2.27 | 4.833    7.26 | 7.833    5.44 | 10.83    1.81
               1.917    2.27 | 4.917    7.26 | 7.917    5.44 | 10.92    1.81
               2.000    2.27 | 5.000    7.26 | 8.000    5.44 | 11.00    1.81
               2.083    2.72 | 5.083   10.88 | 8.083    3.17 | 11.08    1.81
               2.167    2.72 | 5.167   10.88 | 8.167    3.17 | 11.17    1.81
               2.250    2.72 | 5.250   10.88 | 8.250    3.17 | 11.25    1.81
               2.333    2.72 | 5.333   10.88 | 8.333    3.17 | 11.33    1.81
               2.417    2.72 | 5.417   10.88 | 8.417    3.17 | 11.42    1.81
```

2.500	2.72	5.500	10.88	8.500	3.17	11.50	1.81
2.583	2.72	5.583	43.54	8.583	3.17	11.58	1.81
2.667	2.72	5.667	43.54	8.667	3.17	11.67	1.81
2.750	2.72	5.750	43.54	8.750	3.17	11.75	1.81
2.833	2.72	5.833	119.72	8.833	3.17	11.83	1.81
2.917	2.72	5.917	119.72	8.917	3.17	11.92	1.81
3.000	2.72	6.000	119.72	9.000	3.17	12.00	1.81

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.428 (i)
TIME TO PEAK (hrs)= 6.833
RUNOFF VOLUME (mm)= 33.551
TOTAL RAINFALL (mm)= 90.700
RUNOFF COEFFICIENT = 0.370

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

ADD HYD (0166)		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0165):		3.56	0.209	6.33	33.55
+ ID2= 2 (0167):		11.95	0.428	6.83	33.55
ID = 3 (0166):		15.51	0.582	6.58	33.55

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CHICAGO STORM	IDF curve parameters:	A=1146.275
Ptotal= 71.24 mm		B= 4.922
		C= 0.757

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

Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.17	5.22	1.17	36.37	2.17	11.74	3.17	6.15
0.33	5.94	1.33	148.15	2.33	10.09	3.33	5.74
0.50	6.93	1.50	47.06	2.50	8.89	3.50	5.38
0.67	8.42	1.67	25.72	2.67	7.96	3.67	5.08
0.83	10.91	1.83	18.11	2.83	7.24	3.83	4.80
1.00	16.13	2.00	14.17	3.00	6.65	4.00	4.57

CALIB					
NASHYD (0168)	Area (ha)=	3.56	Curve Number (CN)=	67.0	
ID= 1 DT= 5.0 min	Ia (mm)=	7.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	0.42			

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	5.22	1.083	36.37	2.083	11.74	3.08	6.15
0.167	5.22	1.167	36.37	2.167	11.74	3.17	6.15
0.250	5.94	1.250	148.15	2.250	10.09	3.25	5.74
0.333	5.94	1.333	148.15	2.333	10.09	3.33	5.74
0.417	6.93	1.417	47.06	2.417	8.89	3.42	5.38
0.500	6.93	1.500	47.06	2.500	8.89	3.50	5.38
0.583	8.42	1.583	25.72	2.583	7.96	3.58	5.08
0.667	8.42	1.667	25.72	2.667	7.96	3.67	5.08
0.750	10.91	1.750	18.11	2.750	7.24	3.75	4.80
0.833	10.91	1.833	18.11	2.833	7.24	3.83	4.80
0.917	16.13	1.917	14.17	2.917	6.65	3.92	4.57
1.000	16.13	2.000	14.17	3.000	6.65	4.00	4.57

Unit Hyd Qpeak (cms)= 0.324

PEAK FLOW (cms)= 0.139 (i)
TIME TO PEAK (hrs)= 1.833
RUNOFF VOLUME (mm)= 21.790
TOTAL RAINFALL (mm)= 71.236
RUNOFF COEFFICIENT = 0.306

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

CALIB					
NASHYD (0170)	Area (ha)=	11.95	Curve Number (CN)=	67.0	
ID= 1 DT= 5.0 min	Ia (mm)=	7.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	0.84			

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	5.22	1.083	36.37	2.083	11.74	3.08	6.15
0.167	5.22	1.167	36.37	2.167	11.74	3.17	6.15
0.250	5.94	1.250	148.15	2.250	10.09	3.25	5.74
0.333	5.94	1.333	148.15	2.333	10.09	3.33	5.74
0.417	6.93	1.417	47.06	2.417	8.89	3.42	5.38
0.500	6.93	1.500	47.06	2.500	8.89	3.50	5.38
0.583	8.42	1.583	25.72	2.583	7.96	3.58	5.08
0.667	8.42	1.667	25.72	2.667	7.96	3.67	5.08
0.750	10.91	1.750	18.11	2.750	7.24	3.75	4.80
0.833	10.91	1.833	18.11	2.833	7.24	3.83	4.80
0.917	16.13	1.917	14.17	2.917	6.65	3.92	4.57
1.000	16.13	2.000	14.17	3.000	6.65	4.00	4.57

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.297 (i)
TIME TO PEAK (hrs)= 2.417
RUNOFF VOLUME (mm)= 21.792
TOTAL RAINFALL (mm)= 71.236
RUNOFF COEFFICIENT = 0.306

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

ADD HYD (0169)		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0168):		3.56	0.139	1.83	21.79
+ ID2= 2 (0170):		11.95	0.297	2.42	21.79

```
       ID = 3 (  0169):    15.51   0.396     2.17    21.79

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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================================================================================
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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2006)
       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   TTTTT  TTTTT  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\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\eea06c3d-ada8-4e29-92f5-020f9585f137\scenari
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DATE: 06-29-2022                          TIME: 02:23:37

USER:



COMMENTS: _____________________________________________________________


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  ***********************************************
  ** SIMULATION : Run 05                       **
  ***********************************************

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| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              1bad779e-5246-410c-a42e-3ccee7a1c0de\62c328ea
| Ptotal=120.60 mm |    Comments: Mass 24-Hour SCS Type II Design Storm
--------------------
                       Duration of storm    = 24.00 hrs
                       Mass curve time step = 15.00 min

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.25    1.21 |  6.25    2.41 | 12.25   17.37 | 18.25    2.17
               0.50    1.21 |  6.50    2.41 | 12.50   17.37 | 18.50    2.17
               0.75    1.21 |  6.75    2.41 | 12.75    8.92 | 18.75    2.17
               1.00    1.21 |  7.00    2.41 | 13.00    8.92 | 19.00    2.17
               1.25    1.21 |  7.25    2.41 | 13.25    1.69 | 19.25    2.17
               1.50    1.21 |  7.50    2.41 | 13.50    1.69 | 19.50    2.17
               1.75    1.21 |  7.75    2.41 | 13.75    9.89 | 19.75    2.17
               2.00    2.17 |  8.00    2.41 | 14.00    9.89 | 20.00    2.17
               2.25    1.57 |  8.25    3.26 | 14.25    3.62 | 20.25    1.45
               2.50    1.57 |  8.50    3.26 | 14.50    3.62 | 20.50    1.45
               2.75    1.57 |  8.75    3.26 | 14.75    3.62 | 20.75    1.45
               3.00    1.57 |  9.00    3.26 | 15.00    3.62 | 21.00    1.45
               3.25    1.57 |  9.25    3.86 | 15.25    3.62 | 21.25    1.45
               3.50    1.57 |  9.50    3.86 | 15.50    3.62 | 21.50    1.45
               3.75    1.57 |  9.75    4.34 | 15.75    3.62 | 21.75    1.45
               4.00    1.57 | 10.00    4.34 | 16.00    3.62 | 22.00    1.45
               4.25    1.93 | 10.25    5.55 | 16.25    2.17 | 22.25    1.45
               4.50    1.93 | 10.50    5.55 | 16.50    2.17 | 22.50    1.45
               4.75    1.93 | 10.75    7.48 | 16.75    2.17 | 22.75    1.45
               5.00    1.93 | 11.00    7.48 | 17.00    2.17 | 23.00    1.45
               5.25    1.93 | 11.25   11.58 | 17.25    2.17 | 23.25    1.45
               5.50    1.93 | 11.50   11.58 | 17.50    2.17 | 23.50    1.45
               5.75    1.93 | 11.75   50.17 | 17.75    2.17 | 23.75    1.45
               6.00    1.93 | 12.00  133.14 | 18.00    2.17 | 24.00    1.45

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--------------------
| CALIB            |
| NASHYD   (  0136)|   Area     (ha)=  11.95   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.84

      NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
     TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
      hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
    0.083    1.21 | 6.083    2.41 |12.083   17.38 | 18.08    2.17
    0.167    1.21 | 6.167    2.41 |12.167   17.37 | 18.17    2.17
    0.250    1.21 | 6.250    2.41 |12.250   17.37 | 18.25    2.17
    0.333    1.21 | 6.333    2.41 |12.333   17.37 | 18.33    2.17
    0.417    1.21 | 6.417    2.41 |12.417   17.37 | 18.42    2.17
    0.500    1.21 | 6.500    2.41 |12.500   17.37 | 18.50    2.17
    0.583    1.21 | 6.583    2.41 |12.583    8.93 | 18.58    2.17
    0.667    1.21 | 6.667    2.41 |12.667    8.92 | 18.67    2.17
    0.750    1.21 | 6.750    2.41 |12.750    8.92 | 18.75    2.17
    0.833    1.21 | 6.833    2.41 |12.833    8.92 | 18.83    2.17
    0.917    1.21 | 6.917    2.41 |12.917    8.92 | 18.92    2.17
    1.000    1.21 | 7.000    2.41 |13.000    8.92 | 19.00    2.17
    1.083    1.21 | 7.083    2.41 |13.083    1.69 | 19.08    2.17
    1.167    1.21 | 7.167    2.41 |13.167    1.69 | 19.17    2.17
    1.250    1.21 | 7.250    2.41 |13.250    1.69 | 19.25    2.17
    1.333    1.21 | 7.333    2.41 |13.333    1.69 | 19.33    2.17
    1.417    1.21 | 7.417    2.41 |13.417    1.69 | 19.42    2.17
    1.500    1.21 | 7.500    2.41 |13.500    1.69 | 19.50    2.17
    1.583    1.21 | 7.583    2.41 |13.583    9.89 | 19.58    2.17
    1.667    1.21 | 7.667    2.41 |13.667    9.89 | 19.67    2.17
    1.750    1.21 | 7.750    2.41 |13.750    9.89 | 19.75    2.17
    1.833    2.17 | 7.833    2.41 |13.833    9.89 | 19.83    2.17
    1.917    2.17 | 7.917    2.41 |13.917    9.89 | 19.92    2.17
    2.000    2.17 | 8.000    2.41 |14.000    9.89 | 20.00    2.17
    2.083    1.57 | 8.083    3.26 |14.083    3.62 | 20.08    1.45
    2.167    1.57 | 8.167    3.26 |14.167    3.62 | 20.17    1.45
    2.250    1.57 | 8.250    3.26 |14.250    3.62 | 20.25    1.45
    2.333    1.57 | 8.333    3.26 |14.333    3.62 | 20.33    1.45
    2.417    1.57 | 8.417    3.26 |14.417    3.62 | 20.42    1.45
    2.500    1.57 | 8.500    3.26 |14.500    3.62 | 20.50    1.45
    2.583    1.57 | 8.583    3.26 |14.583    3.62 | 20.58    1.45
    2.667    1.57 | 8.667    3.26 |14.667    3.62 | 20.67    1.45
    2.750    1.57 | 8.750    3.26 |14.750    3.62 | 20.75    1.45
    2.833    1.57 | 8.833    3.26 |14.833    3.62 | 20.83    1.45
    2.917    1.57 | 8.917    3.26 |14.917    3.62 | 20.92    1.45
    3.000    1.57 | 9.000    3.26 |15.000    3.62 | 21.00    1.45
```

3.083	1.57	9.083	3.86	15.083	3.62	21.08	1.45
3.167	1.57	9.167	3.86	15.167	3.62	21.17	1.45
3.250	1.57	9.250	3.86	15.250	3.62	21.25	1.45
3.333	1.57	9.333	3.86	15.333	3.62	21.33	1.45
3.417	1.57	9.417	3.86	15.417	3.62	21.42	1.45
3.500	1.57	9.500	3.86	15.500	3.62	21.50	1.45
3.583	1.57	9.583	4.34	15.583	3.62	21.58	1.45
3.667	1.57	9.667	4.34	15.667	3.62	21.67	1.45
3.750	1.57	9.750	4.34	15.750	3.62	21.75	1.45
3.833	1.57	9.833	4.34	15.833	3.62	21.83	1.45
3.917	1.57	9.917	4.34	15.917	3.62	21.92	1.45
4.000	1.57	10.000	4.34	16.000	3.62	22.00	1.45
4.083	1.93	10.083	5.55	16.083	2.17	22.08	1.45
4.167	1.93	10.167	5.55	16.167	2.17	22.17	1.45
4.250	1.93	10.250	5.55	16.250	2.17	22.25	1.45
4.333	1.93	10.333	5.55	16.333	2.17	22.33	1.45
4.417	1.93	10.417	5.55	16.417	2.17	22.42	1.45
4.500	1.93	10.500	5.55	16.500	2.17	22.50	1.45
4.583	1.93	10.583	7.48	16.583	2.17	22.58	1.45
4.667	1.93	10.667	7.48	16.667	2.17	22.67	1.45
4.750	1.93	10.750	7.48	16.750	2.17	22.75	1.45
4.833	1.93	10.833	7.48	16.833	2.17	22.83	1.45
4.917	1.93	10.917	7.48	16.917	2.17	22.92	1.45
5.000	1.93	11.000	7.48	17.000	2.17	23.00	1.45
5.083	1.93	11.083	11.58	17.083	2.17	23.08	1.45
5.167	1.93	11.167	11.58	17.167	2.17	23.17	1.45
5.250	1.93	11.250	11.58	17.250	2.17	23.25	1.45
5.333	1.93	11.333	11.58	17.333	2.17	23.33	1.45
5.417	1.93	11.417	11.58	17.417	2.17	23.42	1.45
5.500	1.93	11.500	11.58	17.500	2.17	23.50	1.45
5.583	1.93	11.583	50.17	17.583	2.17	23.58	1.45
5.667	1.93	11.667	50.17	17.667	2.17	23.67	1.45
5.750	1.93	11.750	50.17	17.750	2.17	23.75	1.45
5.833	1.93	11.833	133.13	17.833	2.17	23.83	1.45
5.917	1.93	11.917	133.14	17.917	2.17	23.92	1.45
6.000	1.93	12.000	133.14	18.000	2.17	24.00	1.45

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.587 (i)
TIME TO PEAK (hrs)= 12.750
RUNOFF VOLUME (mm)= 54.062
TOTAL RAINFALL (mm)= 120.600
RUNOFF COEFFICIENT = 0.448

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

CALIB			
NASHYD (0160)	Area (ha)= 3.56	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.42		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.21	6.083	2.41	12.083	17.38	18.08	2.17
0.167	1.21	6.167	2.41	12.167	17.37	18.17	2.17
0.250	1.21	6.250	2.41	12.250	17.37	18.25	2.17
0.333	1.21	6.333	2.41	12.333	17.37	18.33	2.17
0.417	1.21	6.417	2.41	12.417	17.37	18.42	2.17
0.500	1.21	6.500	2.41	12.500	17.37	18.50	2.17
0.583	1.21	6.583	2.41	12.583	8.93	18.58	2.17
0.667	1.21	6.667	2.41	12.667	8.92	18.67	2.17
0.750	1.21	6.750	2.41	12.750	8.92	18.75	2.17
0.833	1.21	6.833	2.41	12.833	8.92	18.83	2.17
0.917	1.21	6.917	2.41	12.917	8.92	18.92	2.17
1.000	1.21	7.000	2.41	13.000	8.92	19.00	2.17
1.083	1.21	7.083	2.41	13.083	1.69	19.08	2.17
1.167	1.21	7.167	2.41	13.167	1.69	19.17	2.17
1.250	1.21	7.250	2.41	13.250	1.69	19.25	2.17
1.333	1.21	7.333	2.41	13.333	1.69	19.33	2.17
1.417	1.21	7.417	2.41	13.417	1.69	19.42	2.17
1.500	1.21	7.500	2.41	13.500	1.69	19.50	2.17
1.583	1.21	7.583	2.41	13.583	9.89	19.58	2.17
1.667	1.21	7.667	2.41	13.667	9.89	19.67	2.17
1.750	1.21	7.750	2.41	13.750	9.89	19.75	2.17
1.833	2.17	7.833	2.41	13.833	9.89	19.83	2.17
1.917	2.17	7.917	2.41	13.917	9.89	19.92	2.17
2.000	2.17	8.000	2.41	14.000	9.89	20.00	2.17
2.083	1.57	8.083	3.26	14.083	3.62	20.08	1.45
2.167	1.57	8.167	3.26	14.167	3.62	20.17	1.45
2.250	1.57	8.250	3.26	14.250	3.62	20.25	1.45
2.333	1.57	8.333	3.26	14.333	3.62	20.33	1.45
2.417	1.57	8.417	3.26	14.417	3.62	20.42	1.45
2.500	1.57	8.500	3.26	14.500	3.62	20.50	1.45
2.583	1.57	8.583	3.26	14.583	3.62	20.58	1.45
2.667	1.57	8.667	3.26	14.667	3.62	20.67	1.45
2.750	1.57	8.750	3.26	14.750	3.62	20.75	1.45
2.833	1.57	8.833	3.26	14.833	3.62	20.83	1.45
2.917	1.57	8.917	3.26	14.917	3.62	20.92	1.45
3.000	1.57	9.000	3.26	15.000	3.62	21.00	1.45
3.083	1.57	9.083	3.86	15.083	3.62	21.08	1.45
3.167	1.57	9.167	3.86	15.167	3.62	21.17	1.45
3.250	1.57	9.250	3.86	15.250	3.62	21.25	1.45
3.333	1.57	9.333	3.86	15.333	3.62	21.33	1.45
3.417	1.57	9.417	3.86	15.417	3.62	21.42	1.45
3.500	1.57	9.500	3.86	15.500	3.62	21.50	1.45
3.583	1.57	9.583	4.34	15.583	3.62	21.58	1.45
3.667	1.57	9.667	4.34	15.667	3.62	21.67	1.45
3.750	1.57	9.750	4.34	15.750	3.62	21.75	1.45
3.833	1.57	9.833	4.34	15.833	3.62	21.83	1.45
3.917	1.57	9.917	4.34	15.917	3.62	21.92	1.45
4.000	1.57	10.000	4.34	16.000	3.62	22.00	1.45
4.083	1.93	10.083	5.55	16.083	2.17	22.08	1.45
4.167	1.93	10.167	5.55	16.167	2.17	22.17	1.45
4.250	1.93	10.250	5.55	16.250	2.17	22.25	1.45
4.333	1.93	10.333	5.55	16.333	2.17	22.33	1.45
4.417	1.93	10.417	5.55	16.417	2.17	22.42	1.45
4.500	1.93	10.500	5.55	16.500	2.17	22.50	1.45
4.583	1.93	10.583	7.48	16.583	2.17	22.58	1.45
4.667	1.93	10.667	7.48	16.667	2.17	22.67	1.45
4.750	1.93	10.750	7.48	16.750	2.17	22.75	1.45
4.833	1.93	10.833	7.48	16.833	2.17	22.83	1.45
4.917	1.93	10.917	7.48	16.917	2.17	22.92	1.45
5.000	1.93	11.000	7.48	17.000	2.17	23.00	1.45
5.083	1.93	11.083	11.58	17.083	2.17	23.08	1.45
5.167	1.93	11.167	11.58	17.167	2.17	23.17	1.45
5.250	1.93	11.250	11.58	17.250	2.17	23.25	1.45
5.333	1.93	11.333	11.58	17.333	2.17	23.33	1.45
5.417	1.93	11.417	11.58	17.417	2.17	23.42	1.45
5.500	1.93	11.500	11.58	17.500	2.17	23.50	1.45
5.583	1.93	11.583	50.17	17.583	2.17	23.58	1.45
5.667	1.93	11.667	50.17	17.667	2.17	23.67	1.45
5.750	1.93	11.750	50.17	17.750	2.17	23.75	1.45
5.833	1.93	11.833	133.13	17.833	2.17	23.83	1.45
5.917	1.93	11.917	133.14	17.917	2.17	23.92	1.45
6.000	1.93	12.000	133.14	18.000	2.17	24.00	1.45

```
     Unit Hyd Qpeak  (cms)=   0.324

     PEAK FLOW       (cms)=   0.287 (i)
     TIME TO PEAK    (hrs)=  12.250
     RUNOFF VOLUME    (mm)=  54.057
     TOTAL RAINFALL   (mm)= 120.600
     RUNOFF COEFFICIENT   =   0.448

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

```
--------------------
| ADD HYD  (  0161)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0136):    11.95   0.587    12.75    54.06
     + ID2= 2 (  0160):     3.56   0.287    12.25    54.06
       ================================================
       ID = 3 (  0161):    15.51   0.799    12.58    54.06

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
```

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--------------------
| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              1bad779e-5246-410c-a42e-3ccee7a1c0de\c45cd20f
| Ptotal= 95.90 mm |    Comments: SCS II 6H_50YR
--------------------
                       Duration of storm    =  6.00 hrs
                       Mass curve time step = 15.00 min

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.25    3.84 |  1.75    9.59 |  3.25   21.10 |  4.75    5.75
                0.50    3.84 |  2.00    9.59 |  3.50   21.10 |  5.00    5.75
                0.75    5.75 |  2.25   11.51 |  3.75    9.59 |  5.25    3.84
                1.00    5.75 |  2.50   11.51 |  4.00    9.59 |  5.50    3.84
                1.25    5.75 |  2.75   57.54 |  4.25    7.67 |  5.75    3.84
                1.50    5.75 |  3.00  149.60 |  4.50    7.67 |  6.00    3.84
```

```
--------------------
| CALIB            |
| NASHYD   (  0162)|   Area     (ha)=   3.56   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.42

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                        ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    3.84 | 1.583    9.59 | 3.083   21.10 |  4.58    5.75
               0.167    3.84 | 1.667    9.59 | 3.167   21.10 |  4.67    5.75
               0.250    3.84 | 1.750    9.59 | 3.250   21.10 |  4.75    5.75
               0.333    3.84 | 1.833    9.59 | 3.333   21.10 |  4.83    5.75
               0.417    3.84 | 1.917    9.59 | 3.417   21.10 |  4.92    5.75
               0.500    3.84 | 2.000    9.59 | 3.500   21.10 |  5.00    5.75
               0.583    5.75 | 2.083   11.51 | 3.583    9.59 |  5.08    3.84
               0.667    5.75 | 2.167   11.51 | 3.667    9.59 |  5.17    3.84
               0.750    5.75 | 2.250   11.51 | 3.750    9.59 |  5.25    3.84
               0.833    5.75 | 2.333   11.51 | 3.833    9.59 |  5.33    3.84
               0.917    5.75 | 2.417   11.51 | 3.917    9.59 |  5.42    3.84
               1.000    5.75 | 2.500   11.51 | 4.000    9.59 |  5.50    3.84
               1.083    5.75 | 2.583   57.54 | 4.083    7.67 |  5.58    3.84
               1.167    5.75 | 2.667   57.54 | 4.167    7.67 |  5.67    3.84
               1.250    5.75 | 2.750   57.54 | 4.250    7.67 |  5.75    3.84
               1.333    5.75 | 2.833  149.60 | 4.333    7.67 |  5.83    3.84
               1.417    5.75 | 2.917  149.60 | 4.417    7.67 |  5.92    3.84
               1.500    5.75 | 3.000  149.60 | 4.500    7.67 |  6.00    3.84

     Unit Hyd Qpeak  (cms)=   0.324

     PEAK FLOW       (cms)=   0.269 (i)
     TIME TO PEAK    (hrs)=   3.333
     RUNOFF VOLUME    (mm)=  36.926
     TOTAL RAINFALL   (mm)=  95.900
     RUNOFF COEFFICIENT   =   0.385

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

```
--------------------
| CALIB            |
| NASHYD   (  0164)|   Area     (ha)=  11.95   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.84

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                        ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    3.84 | 1.583    9.59 | 3.083   21.10 |  4.58    5.75
               0.167    3.84 | 1.667    9.59 | 3.167   21.10 |  4.67    5.75
               0.250    3.84 | 1.750    9.59 | 3.250   21.10 |  4.75    5.75
               0.333    3.84 | 1.833    9.59 | 3.333   21.10 |  4.83    5.75
               0.417    3.84 | 1.917    9.59 | 3.417   21.10 |  4.92    5.75
               0.500    3.84 | 2.000    9.59 | 3.500   21.10 |  5.00    5.75
               0.583    5.75 | 2.083   11.51 | 3.583    9.59 |  5.08    3.84
               0.667    5.75 | 2.167   11.51 | 3.667    9.59 |  5.17    3.84
               0.750    5.75 | 2.250   11.51 | 3.750    9.59 |  5.25    3.84
               0.833    5.75 | 2.333   11.51 | 3.833    9.59 |  5.33    3.84
               0.917    5.75 | 2.417   11.51 | 3.917    9.59 |  5.42    3.84
               1.000    5.75 | 2.500   11.51 | 4.000    9.59 |  5.50    3.84
               1.083    5.75 | 2.583   57.54 | 4.083    7.67 |  5.58    3.84
               1.167    5.75 | 2.667   57.54 | 4.167    7.67 |  5.67    3.84
               1.250    5.75 | 2.750   57.54 | 4.250    7.67 |  5.75    3.84
               1.333    5.75 | 2.833  149.60 | 4.333    7.67 |  5.83    3.84
               1.417    5.75 | 2.917  149.60 | 4.417    7.67 |  5.92    3.84
               1.500    5.75 | 3.000  149.60 | 4.500    7.67 |  6.00    3.84

     Unit Hyd Qpeak  (cms)=   0.543

     PEAK FLOW       (cms)=   0.546 (i)
     TIME TO PEAK    (hrs)=   3.833
     RUNOFF VOLUME    (mm)=  36.930
     TOTAL RAINFALL   (mm)=  95.900
     RUNOFF COEFFICIENT   =   0.385

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

```
--------------------
| ADD HYD  (  0163)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
```

```
       ID1= 1 (  0162):     3.56   0.269     3.33    36.93
     + ID2= 2 (  0164):    11.95   0.546     3.83    36.93
       ================================================
       ID = 3 (  0163):    15.51   0.740     3.67    36.93

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
```

MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\1bad779e-5246-410c-a42e-3ccee7a1c0de\cbe81c21
Ptotal=101.70 mm	Comments: SCS II 12H_50YR

Duration of storm = 12.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	2.54	3.25	4.07	6.25	18.31	9.25	3.56
0.50	2.54	3.50	4.07	6.50	18.31	9.50	3.56
0.75	2.54	3.75	4.07	6.75	8.14	9.75	3.56
1.00	2.54	4.00	4.07	7.00	8.14	10.00	3.56
1.25	2.54	4.25	6.10	7.25	6.10	10.25	2.03
1.50	2.54	4.50	6.10	7.50	6.10	10.50	2.03
1.75	2.54	4.75	8.14	7.75	6.10	10.75	2.03
2.00	2.54	5.00	8.14	8.00	6.10	11.00	2.03
2.25	3.05	5.25	12.20	8.25	3.56	11.25	2.03
2.50	3.05	5.50	12.20	8.50	3.56	11.50	2.03
2.75	3.05	5.75	48.82	8.75	3.56	11.75	2.03
3.00	3.05	6.00	134.24	9.00	3.56	12.00	2.03

CALIB			
NASHYD (0165)	Area (ha)= 3.56	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.42		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.54	3.083	4.07	6.083	18.31	9.08	3.56
0.167	2.54	3.167	4.07	6.167	18.31	9.17	3.56
0.250	2.54	3.250	4.07	6.250	18.31	9.25	3.56
0.333	2.54	3.333	4.07	6.333	18.31	9.33	3.56
0.417	2.54	3.417	4.07	6.417	18.31	9.42	3.56
0.500	2.54	3.500	4.07	6.500	18.31	9.50	3.56
0.583	2.54	3.583	4.07	6.583	8.14	9.58	3.56
0.667	2.54	3.667	4.07	6.667	8.14	9.67	3.56
0.750	2.54	3.750	4.07	6.750	8.14	9.75	3.56
0.833	2.54	3.833	4.07	6.833	8.14	9.83	3.56
0.917	2.54	3.917	4.07	6.917	8.14	9.92	3.56
1.000	2.54	4.000	4.07	7.000	8.14	10.00	3.56
1.083	2.54	4.083	6.10	7.083	6.10	10.08	2.03
1.167	2.54	4.167	6.10	7.167	6.10	10.17	2.03
1.250	2.54	4.250	6.10	7.250	6.10	10.25	2.03
1.333	2.54	4.333	6.10	7.333	6.10	10.33	2.03
1.417	2.54	4.417	6.10	7.417	6.10	10.42	2.03
1.500	2.54	4.500	6.10	7.500	6.10	10.50	2.03
1.583	2.54	4.583	8.14	7.583	6.10	10.58	2.03
1.667	2.54	4.667	8.14	7.667	6.10	10.67	2.03
1.750	2.54	4.750	8.14	7.750	6.10	10.75	2.03
1.833	2.54	4.833	8.14	7.833	6.10	10.83	2.03
1.917	2.54	4.917	8.14	7.917	6.10	10.92	2.03
2.000	2.54	5.000	8.14	8.000	6.10	11.00	2.03
2.083	3.05	5.083	12.20	8.083	3.56	11.08	2.03
2.167	3.05	5.167	12.20	8.167	3.56	11.17	2.03
2.250	3.05	5.250	12.20	8.250	3.56	11.25	2.03
2.333	3.05	5.333	12.20	8.333	3.56	11.33	2.03
2.417	3.05	5.417	12.20	8.417	3.56	11.42	2.03
2.500	3.05	5.500	12.20	8.500	3.56	11.50	2.03
2.583	3.05	5.583	48.82	8.583	3.56	11.58	2.03
2.667	3.05	5.667	48.82	8.667	3.56	11.67	2.03
2.750	3.05	5.750	48.82	8.750	3.56	11.75	2.03
2.833	3.05	5.833	134.24	8.833	3.56	11.83	2.03
2.917	3.05	5.917	134.24	8.917	3.56	11.92	2.03
3.000	3.05	6.000	134.24	9.000	3.56	12.00	2.03

Unit Hyd Qpeak (cms)= 0.324

PEAK FLOW (cms)= 0.256 (i)
TIME TO PEAK (hrs)= 6.333
RUNOFF VOLUME (mm)= 40.796
TOTAL RAINFALL (mm)= 101.700
RUNOFF COEFFICIENT = 0.401

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

CALIB			
NASHYD (0167)	Area (ha)= 11.95	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.84		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.54	3.083	4.07	6.083	18.31	9.08	3.56
0.167	2.54	3.167	4.07	6.167	18.31	9.17	3.56
0.250	2.54	3.250	4.07	6.250	18.31	9.25	3.56
0.333	2.54	3.333	4.07	6.333	18.31	9.33	3.56
0.417	2.54	3.417	4.07	6.417	18.31	9.42	3.56
0.500	2.54	3.500	4.07	6.500	18.31	9.50	3.56
0.583	2.54	3.583	4.07	6.583	8.14	9.58	3.56
0.667	2.54	3.667	4.07	6.667	8.14	9.67	3.56
0.750	2.54	3.750	4.07	6.750	8.14	9.75	3.56
0.833	2.54	3.833	4.07	6.833	8.14	9.83	3.56
0.917	2.54	3.917	4.07	6.917	8.14	9.92	3.56
1.000	2.54	4.000	4.07	7.000	8.14	10.00	3.56
1.083	2.54	4.083	6.10	7.083	6.10	10.08	2.03
1.167	2.54	4.167	6.10	7.167	6.10	10.17	2.03
1.250	2.54	4.250	6.10	7.250	6.10	10.25	2.03
1.333	2.54	4.333	6.10	7.333	6.10	10.33	2.03
1.417	2.54	4.417	6.10	7.417	6.10	10.42	2.03
1.500	2.54	4.500	6.10	7.500	6.10	10.50	2.03
1.583	2.54	4.583	8.14	7.583	6.10	10.58	2.03
1.667	2.54	4.667	8.14	7.667	6.10	10.67	2.03
1.750	2.54	4.750	8.14	7.750	6.10	10.75	2.03
1.833	2.54	4.833	8.14	7.833	6.10	10.83	2.03
1.917	2.54	4.917	8.14	7.917	6.10	10.92	2.03
2.000	2.54	5.000	8.14	8.000	6.10	11.00	2.03
2.083	3.05	5.083	12.20	8.083	3.56	11.08	2.03
2.167	3.05	5.167	12.20	8.167	3.56	11.17	2.03
2.250	3.05	5.250	12.20	8.250	3.56	11.25	2.03
2.333	3.05	5.333	12.20	8.333	3.56	11.33	2.03

2.417	3.05	5.417	12.20	8.417	3.56	11.42	2.03
2.500	3.05	5.500	12.20	8.500	3.56	11.50	2.03
2.583	3.05	5.583	48.82	8.583	3.56	11.58	2.03
2.667	3.05	5.667	48.82	8.667	3.56	11.67	2.03
2.750	3.05	5.750	48.82	8.750	3.56	11.75	2.03
2.833	3.05	5.833	134.24	8.833	3.56	11.83	2.03
2.917	3.05	5.917	134.24	8.917	3.56	11.92	2.03
3.000	3.05	6.000	134.24	9.000	3.56	12.00	2.03

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.523 (i)
TIME TO PEAK (hrs)= 6.833
RUNOFF VOLUME (mm)= 40.800
TOTAL RAINFALL (mm)= 101.700
RUNOFF COEFFICIENT = 0.401

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

ADD HYD (0166)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0165):	3.56	0.256	6.33	40.80
	+ ID2= 2 (0167):	11.95	0.523	6.83	40.80
	ID = 3 (0166):	15.51	0.712	6.58	40.80

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CHICAGO STORM	IDF curve parameters: A=1236.152
Ptotal= 79.45 mm	B= 4.699
	C= 0.751

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

Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.17	5.93	1.17	40.22	2.17	13.20	3.17	6.98
0.33	6.74	1.33	164.22	2.33	11.37	3.33	6.51
0.50	7.85	1.50	51.92	2.50	10.03	3.50	6.11
0.67	9.50	1.67	28.58	2.67	9.00	3.67	5.77
0.83	12.27	1.83	20.23	2.83	8.19	3.83	5.46
1.00	18.04	2.00	15.88	3.00	7.53	4.00	5.19

CALIB					
NASHYD (0168)	Area (ha)=	3.56	Curve Number (CN)=	67.0	
ID= 1 DT= 5.0 min	Ia (mm)=	7.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	0.42			

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	5.93	1.083	40.22	2.083	13.20	3.08	6.98
0.167	5.93	1.167	40.22	2.167	13.20	3.17	6.98
0.250	6.74	1.250	164.22	2.250	11.37	3.25	6.51
0.333	6.74	1.333	164.22	2.333	11.37	3.33	6.51
0.417	7.85	1.417	51.92	2.417	10.03	3.42	6.11
0.500	7.85	1.500	51.92	2.500	10.03	3.50	6.11
0.583	9.50	1.583	28.58	2.583	9.00	3.58	5.77
0.667	9.50	1.667	28.58	2.667	9.00	3.67	5.77
0.750	12.27	1.750	20.23	2.750	8.19	3.75	5.46
0.833	12.27	1.833	20.23	2.833	8.19	3.83	5.46
0.917	18.04	1.917	15.88	2.917	7.53	3.92	5.19
1.000	18.04	2.000	15.88	3.000	7.53	4.00	5.19

Unit Hyd Qpeak (cms)= 0.324

PEAK FLOW (cms)= 0.170 (i)
TIME TO PEAK (hrs)= 1.833
RUNOFF VOLUME (mm)= 26.569
TOTAL RAINFALL (mm)= 79.453
RUNOFF COEFFICIENT = 0.334

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

CALIB					
NASHYD (0170)	Area (ha)=	11.95	Curve Number (CN)=	67.0	
ID= 1 DT= 5.0 min	Ia (mm)=	7.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	0.84			

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	5.93	1.083	40.22	2.083	13.20	3.08	6.98
0.167	5.93	1.167	40.22	2.167	13.20	3.17	6.98
0.250	6.74	1.250	164.22	2.250	11.37	3.25	6.51
0.333	6.74	1.333	164.22	2.333	11.37	3.33	6.51
0.417	7.85	1.417	51.92	2.417	10.03	3.42	6.11
0.500	7.85	1.500	51.92	2.500	10.03	3.50	6.11
0.583	9.50	1.583	28.58	2.583	9.00	3.58	5.77
0.667	9.50	1.667	28.58	2.667	9.00	3.67	5.77
0.750	12.27	1.750	20.23	2.750	8.19	3.75	5.46
0.833	12.27	1.833	20.23	2.833	8.19	3.83	5.46
0.917	18.04	1.917	15.88	2.917	7.53	3.92	5.19
1.000	18.04	2.000	15.88	3.000	7.53	4.00	5.19

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.362 (i)
TIME TO PEAK (hrs)= 2.417
RUNOFF VOLUME (mm)= 26.571
TOTAL RAINFALL (mm)= 79.453
RUNOFF COEFFICIENT = 0.334

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

ADD HYD (0169)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0168):	3.56	0.170	1.83	26.57
	+ ID2= 2 (0170):	11.95	0.362	2.42	26.57

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       ==================================================
       ID = 3 (  0169):    15.51   0.484     2.17    26.57

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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 FINISH
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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2006)
       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   TTTTT  TTTTT  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\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\aa578032-ace7-4dcd-91f7-f7489ab775af\scenari
  Summary filename: C:\Users\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\aa578032-ace7-4dcd-91f7-f7489ab775af\scenari


DATE: 06-29-2022                          TIME: 02:23:37

USER:



COMMENTS: _____________________________________________________________


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  ***********************************************
  ** SIMULATION : Run 06                       **
  ***********************************************

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| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              1bad779e-5246-410c-a42e-3ccee7a1c0de\1bad87f9
| Ptotal=133.60 mm |    Comments: Mass 24-Hour SCS Type II Design Storm
--------------------
                       Duration of storm    = 24.00 hrs
                       Mass curve time step = 15.00 min

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.25    1.34 |  6.25    2.67 | 12.25   19.24 | 18.25    2.40
               0.50    1.34 |  6.50    2.67 | 12.50   19.24 | 18.50    2.40
               0.75    1.34 |  6.75    2.67 | 12.75    9.89 | 18.75    2.40
               1.00    1.34 |  7.00    2.67 | 13.00    9.89 | 19.00    2.40
               1.25    1.34 |  7.25    2.67 | 13.25    1.87 | 19.25    2.40
               1.50    1.34 |  7.50    2.67 | 13.50    1.87 | 19.50    2.40
               1.75    1.34 |  7.75    2.67 | 13.75   10.96 | 19.75    2.40
               2.00    2.40 |  8.00    2.67 | 14.00   10.96 | 20.00    2.40
               2.25    1.74 |  8.25    3.61 | 14.25    4.01 | 20.25    1.60
               2.50    1.74 |  8.50    3.61 | 14.50    4.01 | 20.50    1.60
               2.75    1.74 |  8.75    3.61 | 14.75    4.01 | 20.75    1.60
               3.00    1.74 |  9.00    3.61 | 15.00    4.01 | 21.00    1.60
               3.25    1.74 |  9.25    4.28 | 15.25    4.01 | 21.25    1.60
               3.50    1.74 |  9.50    4.28 | 15.50    4.01 | 21.50    1.60
               3.75    1.74 |  9.75    4.81 | 15.75    4.01 | 21.75    1.60
               4.00    1.74 | 10.00    4.81 | 16.00    4.01 | 22.00    1.60
               4.25    2.14 | 10.25    6.15 | 16.25    2.40 | 22.25    1.60
               4.50    2.14 | 10.50    6.15 | 16.50    2.40 | 22.50    1.60
               4.75    2.14 | 10.75    8.28 | 16.75    2.40 | 22.75    1.60
               5.00    2.14 | 11.00    8.28 | 17.00    2.40 | 23.00    1.60
               5.25    2.14 | 11.25   12.83 | 17.25    2.40 | 23.25    1.60
               5.50    2.14 | 11.50   12.83 | 17.50    2.40 | 23.50    1.60
               5.75    2.14 | 11.75   55.58 | 17.75    2.40 | 23.75    1.60
               6.00    2.14 | 12.00  147.49 | 18.00    2.40 | 24.00    1.60

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| CALIB            |
| NASHYD   (  0136)|   Area     (ha)=  11.95   Curve Number    (CN)= 67.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   7.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.84

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                              ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    1.34 | 6.083    2.67 |12.083   19.25 | 18.08    2.40
               0.167    1.34 | 6.167    2.67 |12.167   19.24 | 18.17    2.40
               0.250    1.34 | 6.250    2.67 |12.250   19.24 | 18.25    2.40
               0.333    1.34 | 6.333    2.67 |12.333   19.24 | 18.33    2.40
               0.417    1.34 | 6.417    2.67 |12.417   19.24 | 18.42    2.40
               0.500    1.34 | 6.500    2.67 |12.500   19.24 | 18.50    2.40
               0.583    1.34 | 6.583    2.67 |12.583    9.89 | 18.58    2.40
               0.667    1.34 | 6.667    2.67 |12.667    9.89 | 18.67    2.40
               0.750    1.34 | 6.750    2.67 |12.750    9.89 | 18.75    2.40
               0.833    1.34 | 6.833    2.67 |12.833    9.89 | 18.83    2.40
               0.917    1.34 | 6.917    2.67 |12.917    9.89 | 18.92    2.40
               1.000    1.34 | 7.000    2.67 |13.000    9.89 | 19.00    2.40
               1.083    1.34 | 7.083    2.67 |13.083    1.87 | 19.08    2.40
               1.167    1.34 | 7.167    2.67 |13.167    1.87 | 19.17    2.40
               1.250    1.34 | 7.250    2.67 |13.250    1.87 | 19.25    2.40
               1.333    1.34 | 7.333    2.67 |13.333    1.87 | 19.33    2.40
               1.417    1.34 | 7.417    2.67 |13.417    1.87 | 19.42    2.40
               1.500    1.34 | 7.500    2.67 |13.500    1.87 | 19.50    2.40
               1.583    1.34 | 7.583    2.67 |13.583   10.95 | 19.58    2.40
               1.667    1.34 | 7.667    2.67 |13.667   10.96 | 19.67    2.40
               1.750    1.34 | 7.750    2.67 |13.750   10.96 | 19.75    2.40
               1.833    2.40 | 7.833    2.67 |13.833   10.96 | 19.83    2.40
               1.917    2.40 | 7.917    2.67 |13.917   10.96 | 19.92    2.40
               2.000    2.40 | 8.000    2.67 |14.000   10.96 | 20.00    2.40
               2.083    1.74 | 8.083    3.61 |14.083    4.01 | 20.08    1.60
               2.167    1.74 | 8.167    3.61 |14.167    4.01 | 20.17    1.60
               2.250    1.74 | 8.250    3.61 |14.250    4.01 | 20.25    1.60
               2.333    1.74 | 8.333    3.61 |14.333    4.01 | 20.33    1.60
               2.417    1.74 | 8.417    3.61 |14.417    4.01 | 20.42    1.60
               2.500    1.74 | 8.500    3.61 |14.500    4.01 | 20.50    1.60
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2.583	1.74	8.583	3.61	14.583	4.01	20.58	1.60
2.667	1.74	8.667	3.61	14.667	4.01	20.67	1.60
2.750	1.74	8.750	3.61	14.750	4.01	20.75	1.60
2.833	1.74	8.833	3.61	14.833	4.01	20.83	1.60
2.917	1.74	8.917	3.61	14.917	4.01	20.92	1.60
3.000	1.74	9.000	3.61	15.000	4.01	21.00	1.60
3.083	1.74	9.083	4.28	15.083	4.01	21.08	1.60
3.167	1.74	9.167	4.28	15.167	4.01	21.17	1.60
3.250	1.74	9.250	4.28	15.250	4.01	21.25	1.60
3.333	1.74	9.333	4.28	15.333	4.01	21.33	1.60
3.417	1.74	9.417	4.28	15.417	4.01	21.42	1.60
3.500	1.74	9.500	4.28	15.500	4.01	21.50	1.60
3.583	1.74	9.583	4.81	15.583	4.01	21.58	1.60
3.667	1.74	9.667	4.81	15.667	4.01	21.67	1.60
3.750	1.74	9.750	4.81	15.750	4.01	21.75	1.60
3.833	1.74	9.833	4.81	15.833	4.01	21.83	1.60
3.917	1.74	9.917	4.81	15.917	4.01	21.92	1.60
4.000	1.74	10.000	4.81	16.000	4.01	22.00	1.60
4.083	2.14	10.083	6.15	16.083	2.41	22.08	1.60
4.167	2.14	10.167	6.15	16.167	2.40	22.17	1.60
4.250	2.14	10.250	6.15	16.250	2.40	22.25	1.60
4.333	2.14	10.333	6.15	16.333	2.40	22.33	1.60
4.417	2.14	10.417	6.15	16.417	2.40	22.42	1.60
4.500	2.14	10.500	6.15	16.500	2.40	22.50	1.60
4.583	2.14	10.583	8.28	16.583	2.40	22.58	1.60
4.667	2.14	10.667	8.28	16.667	2.40	22.67	1.60
4.750	2.14	10.750	8.28	16.750	2.40	22.75	1.60
4.833	2.14	10.833	8.28	16.833	2.40	22.83	1.60
4.917	2.14	10.917	8.28	16.917	2.40	22.92	1.60
5.000	2.14	11.000	8.28	17.000	2.40	23.00	1.60
5.083	2.14	11.083	12.83	17.083	2.40	23.08	1.60
5.167	2.14	11.167	12.83	17.167	2.40	23.17	1.60
5.250	2.14	11.250	12.83	17.250	2.40	23.25	1.60
5.333	2.14	11.333	12.83	17.333	2.40	23.33	1.60
5.417	2.14	11.417	12.83	17.417	2.40	23.42	1.60
5.500	2.14	11.500	12.83	17.500	2.40	23.50	1.60
5.583	2.14	11.583	55.57	17.583	2.40	23.58	1.60
5.667	2.14	11.667	55.58	17.667	2.40	23.67	1.60
5.750	2.14	11.750	55.58	17.750	2.40	23.75	1.60
5.833	2.14	11.833	147.48	17.833	2.40	23.83	1.60
5.917	2.14	11.917	147.49	17.917	2.40	23.92	1.60
6.000	2.14	12.000	147.49	18.000	2.40	24.00	1.60

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.695 (i)
TIME TO PEAK (hrs)= 12.750
RUNOFF VOLUME (mm)= 63.676
TOTAL RAINFALL (mm)= 133.600
RUNOFF COEFFICIENT = 0.477

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

CALIB			
NASHYD (0160)	Area (ha)= 3.56	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.42		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.34	6.083	2.67	12.083	19.25	18.08	2.40
0.167	1.34	6.167	2.67	12.167	19.24	18.17	2.40
0.250	1.34	6.250	2.67	12.250	19.24	18.25	2.40
0.333	1.34	6.333	2.67	12.333	19.24	18.33	2.40
0.417	1.34	6.417	2.67	12.417	19.24	18.42	2.40
0.500	1.34	6.500	2.67	12.500	19.24	18.50	2.40
0.583	1.34	6.583	2.67	12.583	9.89	18.58	2.40
0.667	1.34	6.667	2.67	12.667	9.89	18.67	2.40
0.750	1.34	6.750	2.67	12.750	9.89	18.75	2.40
0.833	1.34	6.833	2.67	12.833	9.89	18.83	2.40
0.917	1.34	6.917	2.67	12.917	9.89	18.92	2.40
1.000	1.34	7.000	2.67	13.000	9.89	19.00	2.40
1.083	1.34	7.083	2.67	13.083	1.87	19.08	2.40
1.167	1.34	7.167	2.67	13.167	1.87	19.17	2.40
1.250	1.34	7.250	2.67	13.250	1.87	19.25	2.40
1.333	1.34	7.333	2.67	13.333	1.87	19.33	2.40
1.417	1.34	7.417	2.67	13.417	1.87	19.42	2.40
1.500	1.34	7.500	2.67	13.500	1.87	19.50	2.40
1.583	1.34	7.583	2.67	13.583	10.95	19.58	2.40
1.667	1.34	7.667	2.67	13.667	10.96	19.67	2.40
1.750	1.34	7.750	2.67	13.750	10.96	19.75	2.40
1.833	2.40	7.833	2.67	13.833	10.96	19.83	2.40
1.917	2.40	7.917	2.67	13.917	10.96	19.92	2.40
2.000	2.40	8.000	2.67	14.000	10.96	20.00	2.40
2.083	1.74	8.083	3.61	14.083	4.01	20.08	1.60
2.167	1.74	8.167	3.61	14.167	4.01	20.17	1.60
2.250	1.74	8.250	3.61	14.250	4.01	20.25	1.60
2.333	1.74	8.333	3.61	14.333	4.01	20.33	1.60
2.417	1.74	8.417	3.61	14.417	4.01	20.42	1.60
2.500	1.74	8.500	3.61	14.500	4.01	20.50	1.60
2.583	1.74	8.583	3.61	14.583	4.01	20.58	1.60
2.667	1.74	8.667	3.61	14.667	4.01	20.67	1.60
2.750	1.74	8.750	3.61	14.750	4.01	20.75	1.60
2.833	1.74	8.833	3.61	14.833	4.01	20.83	1.60
2.917	1.74	8.917	3.61	14.917	4.01	20.92	1.60
3.000	1.74	9.000	3.61	15.000	4.01	21.00	1.60
3.083	1.74	9.083	4.28	15.083	4.01	21.08	1.60
3.167	1.74	9.167	4.28	15.167	4.01	21.17	1.60
3.250	1.74	9.250	4.28	15.250	4.01	21.25	1.60
3.333	1.74	9.333	4.28	15.333	4.01	21.33	1.60
3.417	1.74	9.417	4.28	15.417	4.01	21.42	1.60
3.500	1.74	9.500	4.28	15.500	4.01	21.50	1.60
3.583	1.74	9.583	4.81	15.583	4.01	21.58	1.60
3.667	1.74	9.667	4.81	15.667	4.01	21.67	1.60
3.750	1.74	9.750	4.81	15.750	4.01	21.75	1.60
3.833	1.74	9.833	4.81	15.833	4.01	21.83	1.60
3.917	1.74	9.917	4.81	15.917	4.01	21.92	1.60
4.000	1.74	10.000	4.81	16.000	4.01	22.00	1.60
4.083	2.14	10.083	6.15	16.083	2.41	22.08	1.60
4.167	2.14	10.167	6.15	16.167	2.40	22.17	1.60
4.250	2.14	10.250	6.15	16.250	2.40	22.25	1.60
4.333	2.14	10.333	6.15	16.333	2.40	22.33	1.60
4.417	2.14	10.417	6.15	16.417	2.40	22.42	1.60
4.500	2.14	10.500	6.15	16.500	2.40	22.50	1.60
4.583	2.14	10.583	8.28	16.583	2.40	22.58	1.60
4.667	2.14	10.667	8.28	16.667	2.40	22.67	1.60
4.750	2.14	10.750	8.28	16.750	2.40	22.75	1.60
4.833	2.14	10.833	8.28	16.833	2.40	22.83	1.60
4.917	2.14	10.917	8.28	16.917	2.40	22.92	1.60
5.000	2.14	11.000	8.28	17.000	2.40	23.00	1.60
5.083	2.14	11.083	12.83	17.083	2.40	23.08	1.60
5.167	2.14	11.167	12.83	17.167	2.40	23.17	1.60
5.250	2.14	11.250	12.83	17.250	2.40	23.25	1.60
5.333	2.14	11.333	12.83	17.333	2.40	23.33	1.60
5.417	2.14	11.417	12.83	17.417	2.40	23.42	1.60
5.500	2.14	11.500	12.83	17.500	2.40	23.50	1.60

5.583	2.14	11.583	55.57	17.583	2.40	23.58	1.60
5.667	2.14	11.667	55.58	17.667	2.40	23.67	1.60
5.750	2.14	11.750	55.58	17.750	2.40	23.75	1.60
5.833	2.14	11.833	147.48	17.833	2.40	23.83	1.60
5.917	2.14	11.917	147.49	17.917	2.40	23.92	1.60
6.000	2.14	12.000	147.49	18.000	2.40	24.00	1.60

Unit Hyd Qpeak (cms)= 0.324

PEAK FLOW (cms)= 0.340 (i)
TIME TO PEAK (hrs)= 12.250
RUNOFF VOLUME (mm)= 63.670
TOTAL RAINFALL (mm)= 133.600
RUNOFF COEFFICIENT = 0.477

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

ADD HYD (0161)		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0136):		11.95	0.695	12.75	63.68
+ ID2= 2 (0160):		3.56	0.340	12.25	63.67
ID = 3 (0161):		15.51	0.946	12.58	63.67

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\1bad779e-5246-410c-a42e-3ccee7a1c0de\06dbffa2
Ptotal=106.50 mm	Comments: SCS II 6H_100YR

Duration of storm = 6.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	4.26	1.75	10.65	3.25	23.43	4.75	6.39
0.50	4.26	2.00	10.65	3.50	23.43	5.00	6.39
0.75	6.39	2.25	12.78	3.75	10.65	5.25	4.26
1.00	6.39	2.50	12.78	4.00	10.65	5.50	4.26
1.25	6.39	2.75	63.90	4.25	8.52	5.75	4.26
1.50	6.39	3.00	166.14	4.50	8.52	6.00	4.26

CALIB					
NASHYD (0162)	Area (ha)=	3.56	Curve Number (CN)=	67.0	
ID= 1 DT= 5.0 min	Ia (mm)=	7.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	0.42			

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	4.26	1.583	10.65	3.083	23.43	4.58	6.39
0.167	4.26	1.667	10.65	3.167	23.43	4.67	6.39
0.250	4.26	1.750	10.65	3.250	23.43	4.75	6.39
0.333	4.26	1.833	10.65	3.333	23.43	4.83	6.39
0.417	4.26	1.917	10.65	3.417	23.43	4.92	6.39
0.500	4.26	2.000	10.65	3.500	23.43	5.00	6.39
0.583	6.39	2.083	12.78	3.583	10.65	5.08	4.26
0.667	6.39	2.167	12.78	3.667	10.65	5.17	4.26
0.750	6.39	2.250	12.78	3.750	10.65	5.25	4.26
0.833	6.39	2.333	12.78	3.833	10.65	5.33	4.26
0.917	6.39	2.417	12.78	3.917	10.65	5.42	4.26
1.000	6.39	2.500	12.78	4.000	10.65	5.50	4.26
1.083	6.39	2.583	63.90	4.083	8.52	5.58	4.26
1.167	6.39	2.667	63.90	4.167	8.52	5.67	4.26
1.250	6.39	2.750	63.90	4.250	8.52	5.75	4.26
1.333	6.39	2.833	166.14	4.333	8.52	5.83	4.26
1.417	6.39	2.917	166.14	4.417	8.52	5.92	4.26
1.500	6.39	3.000	166.14	4.500	8.52	6.00	4.26

Unit Hyd Qpeak (cms)= 0.324

PEAK FLOW (cms)= 0.322 (i)
TIME TO PEAK (hrs)= 3.333
RUNOFF VOLUME (mm)= 44.074
TOTAL RAINFALL (mm)= 106.500
RUNOFF COEFFICIENT = 0.414

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

CALIB					
NASHYD (0164)	Area (ha)=	11.95	Curve Number (CN)=	67.0	
ID= 1 DT= 5.0 min	Ia (mm)=	7.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	0.84			

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	4.26	1.583	10.65	3.083	23.43	4.58	6.39
0.167	4.26	1.667	10.65	3.167	23.43	4.67	6.39
0.250	4.26	1.750	10.65	3.250	23.43	4.75	6.39
0.333	4.26	1.833	10.65	3.333	23.43	4.83	6.39
0.417	4.26	1.917	10.65	3.417	23.43	4.92	6.39
0.500	4.26	2.000	10.65	3.500	23.43	5.00	6.39
0.583	6.39	2.083	12.78	3.583	10.65	5.08	4.26
0.667	6.39	2.167	12.78	3.667	10.65	5.17	4.26
0.750	6.39	2.250	12.78	3.750	10.65	5.25	4.26
0.833	6.39	2.333	12.78	3.833	10.65	5.33	4.26
0.917	6.39	2.417	12.78	3.917	10.65	5.42	4.26
1.000	6.39	2.500	12.78	4.000	10.65	5.50	4.26
1.083	6.39	2.583	63.90	4.083	8.52	5.58	4.26
1.167	6.39	2.667	63.90	4.167	8.52	5.67	4.26
1.250	6.39	2.750	63.90	4.250	8.52	5.75	4.26
1.333	6.39	2.833	166.14	4.333	8.52	5.83	4.26
1.417	6.39	2.917	166.14	4.417	8.52	5.92	4.26
1.500	6.39	3.000	166.14	4.500	8.52	6.00	4.26

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.655 (i)
TIME TO PEAK (hrs)= 3.833
RUNOFF VOLUME (mm)= 44.078
TOTAL RAINFALL (mm)= 106.500
RUNOFF COEFFICIENT = 0.414

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

ADD HYD (0163)		AREA	QPEAK	TPEAK	R.V.
		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0162):	3.56	0.322	3.33	44.07
+	ID2= 2 (0164):	11.95	0.655	3.83	44.08
	ID = 3 (0163):	15.51	0.888	3.58	44.08

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

MASS STORM	Filename: C:\Users\hliu\AppD ata\Local\Temp\ 1bad779e-5246-410c-a42e-3ccee7a1c0de\b2dbabe9
Ptotal=112.50 mm	Comments: SCS II 12H_100YR

Duration of storm = 12.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	2.81	3.25	4.50	6.25	20.25	9.25	3.94
0.50	2.81	3.50	4.50	6.50	20.25	9.50	3.94
0.75	2.81	3.75	4.50	6.75	9.00	9.75	3.94
1.00	2.81	4.00	4.50	7.00	9.00	10.00	3.94
1.25	2.81	4.25	6.75	7.25	6.75	10.25	2.25
1.50	2.81	4.50	6.75	7.50	6.75	10.50	2.25
1.75	2.81	4.75	9.00	7.75	6.75	10.75	2.25
2.00	2.81	5.00	9.00	8.00	6.75	11.00	2.25
2.25	3.38	5.25	13.50	8.25	3.94	11.25	2.25
2.50	3.37	5.50	13.50	8.50	3.94	11.50	2.25
2.75	3.38	5.75	54.00	8.75	3.94	11.75	2.25
3.00	3.38	6.00	148.50	9.00	3.94	12.00	2.25

CALIB NASHYD (0165) ID= 1 DT= 5.0 min	Area (ha)= 3.56	Curve Number (CN)= 67.0
	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.42	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.81	3.083	4.50	6.083	20.25	9.08	3.94
0.167	2.81	3.167	4.50	6.167	20.25	9.17	3.94
0.250	2.81	3.250	4.50	6.250	20.25	9.25	3.94
0.333	2.81	3.333	4.50	6.333	20.25	9.33	3.94
0.417	2.81	3.417	4.50	6.417	20.25	9.42	3.94
0.500	2.81	3.500	4.50	6.500	20.25	9.50	3.94
0.583	2.81	3.583	4.50	6.583	9.00	9.58	3.94
0.667	2.81	3.667	4.50	6.667	9.00	9.67	3.94
0.750	2.81	3.750	4.50	6.750	9.00	9.75	3.94
0.833	2.81	3.833	4.50	6.833	9.00	9.83	3.94
0.917	2.81	3.917	4.50	6.917	9.00	9.92	3.94
1.000	2.81	4.000	4.50	7.000	9.00	10.00	3.94
1.083	2.81	4.083	6.75	7.083	6.75	10.08	2.25
1.167	2.81	4.167	6.75	7.167	6.75	10.17	2.25
1.250	2.81	4.250	6.75	7.250	6.75	10.25	2.25
1.333	2.81	4.333	6.75	7.333	6.75	10.33	2.25
1.417	2.81	4.417	6.75	7.417	6.75	10.42	2.25
1.500	2.81	4.500	6.75	7.500	6.75	10.50	2.25
1.583	2.81	4.583	9.00	7.583	6.75	10.58	2.25
1.667	2.81	4.667	9.00	7.667	6.75	10.67	2.25
1.750	2.81	4.750	9.00	7.750	6.75	10.75	2.25
1.833	2.81	4.833	9.00	7.833	6.75	10.83	2.25
1.917	2.81	4.917	9.00	7.917	6.75	10.92	2.25
2.000	2.81	5.000	9.00	8.000	6.75	11.00	2.25
2.083	3.38	5.083	13.50	8.083	3.94	11.08	2.25
2.167	3.38	5.167	13.50	8.167	3.94	11.17	2.25
2.250	3.38	5.250	13.50	8.250	3.94	11.25	2.25
2.333	3.37	5.333	13.50	8.333	3.94	11.33	2.25
2.417	3.37	5.417	13.50	8.417	3.94	11.42	2.25
2.500	3.37	5.500	13.50	8.500	3.94	11.50	2.25
2.583	3.37	5.583	54.00	8.583	3.94	11.58	2.25
2.667	3.38	5.667	54.00	8.667	3.94	11.67	2.25
2.750	3.38	5.750	54.00	8.750	3.94	11.75	2.25
2.833	3.37	5.833	148.50	8.833	3.94	11.83	2.25
2.917	3.38	5.917	148.50	8.917	3.94	11.92	2.25
3.000	3.38	6.000	148.50	9.000	3.94	12.00	2.25

Unit Hyd Qpeak (cms)= 0.324

PEAK FLOW (cms)= 0.304 (i)
TIME TO PEAK (hrs)= 6.333
RUNOFF VOLUME (mm)= 48.260
TOTAL RAINFALL (mm)= 112.500
RUNOFF COEFFICIENT = 0.429

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

CALIB NASHYD (0167) ID= 1 DT= 5.0 min	Area (ha)= 11.95	Curve Number (CN)= 67.0
	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.84	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.81	3.083	4.50	6.083	20.25	9.08	3.94
0.167	2.81	3.167	4.50	6.167	20.25	9.17	3.94
0.250	2.81	3.250	4.50	6.250	20.25	9.25	3.94
0.333	2.81	3.333	4.50	6.333	20.25	9.33	3.94
0.417	2.81	3.417	4.50	6.417	20.25	9.42	3.94
0.500	2.81	3.500	4.50	6.500	20.25	9.50	3.94
0.583	2.81	3.583	4.50	6.583	9.00	9.58	3.94
0.667	2.81	3.667	4.50	6.667	9.00	9.67	3.94
0.750	2.81	3.750	4.50	6.750	9.00	9.75	3.94
0.833	2.81	3.833	4.50	6.833	9.00	9.83	3.94
0.917	2.81	3.917	4.50	6.917	9.00	9.92	3.94
1.000	2.81	4.000	4.50	7.000	9.00	10.00	3.94
1.083	2.81	4.083	6.75	7.083	6.75	10.08	2.25
1.167	2.81	4.167	6.75	7.167	6.75	10.17	2.25
1.250	2.81	4.250	6.75	7.250	6.75	10.25	2.25
1.333	2.81	4.333	6.75	7.333	6.75	10.33	2.25
1.417	2.81	4.417	6.75	7.417	6.75	10.42	2.25
1.500	2.81	4.500	6.75	7.500	6.75	10.50	2.25
1.583	2.81	4.583	9.00	7.583	6.75	10.58	2.25
1.667	2.81	4.667	9.00	7.667	6.75	10.67	2.25
1.750	2.81	4.750	9.00	7.750	6.75	10.75	2.25
1.833	2.81	4.833	9.00	7.833	6.75	10.83	2.25

1.917	2.81	4.917	9.00	7.917	6.75	10.92	2.25
2.000	2.81	5.000	9.00	8.000	6.75	11.00	2.25
2.083	3.38	5.083	13.50	8.083	3.94	11.08	2.25
2.167	3.38	5.167	13.50	8.167	3.94	11.17	2.25
2.250	3.38	5.250	13.50	8.250	3.94	11.25	2.25
2.333	3.37	5.333	13.50	8.333	3.94	11.33	2.25
2.417	3.37	5.417	13.50	8.417	3.94	11.42	2.25
2.500	3.37	5.500	13.50	8.500	3.94	11.50	2.25
2.583	3.37	5.583	54.00	8.583	3.94	11.58	2.25
2.667	3.38	5.667	54.00	8.667	3.94	11.67	2.25
2.750	3.38	5.750	54.00	8.750	3.94	11.75	2.25
2.833	3.37	5.833	148.50	8.833	3.94	11.83	2.25
2.917	3.38	5.917	148.50	8.917	3.94	11.92	2.25
3.000	3.38	6.000	148.50	9.000	3.94	12.00	2.25

Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.621 (i)
TIME TO PEAK (hrs)= 6.750
RUNOFF VOLUME (mm)= 48.265
TOTAL RAINFALL (mm)= 112.500
RUNOFF COEFFICIENT = 0.429

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

ADD HYD (0166)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0165):	3.56	0.304	6.33	48.26
+ ID2= 2 (0167):	11.95	0.621	6.75	48.27
ID = 3 (0166):	15.51	0.846	6.58	48.26

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CHICAGO STORM	IDF curve parameters: A=1426.408
Ptotal= 87.58 mm	B= 5.273
	C= 0.759

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

Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.17	6.41	1.17	45.22	2.17	14.50	3.17	7.56
0.33	7.29	1.33	180.15	2.33	12.44	3.33	7.04
0.50	8.52	1.50	58.54	2.50	10.94	3.50	6.60
0.67	10.36	1.67	31.96	2.67	9.80	3.67	6.22
0.83	13.45	1.83	22.45	2.83	8.90	3.83	5.89
1.00	19.96	2.00	17.52	3.00	8.16	4.00	5.59

CALIB			
NASHYD (0168)	Area (ha)= 3.56	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.42		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	6.41	1.083	45.22	2.083	14.50	3.08	7.56
0.167	6.41	1.167	45.22	2.167	14.50	3.17	7.56
0.250	7.29	1.250	180.15	2.250	12.44	3.25	7.04
0.333	7.29	1.333	180.15	2.333	12.44	3.33	7.04
0.417	8.52	1.417	58.54	2.417	10.94	3.42	6.60
0.500	8.52	1.500	58.54	2.500	10.94	3.50	6.60
0.583	10.36	1.583	31.96	2.583	9.80	3.58	6.22
0.667	10.36	1.667	31.96	2.667	9.80	3.67	6.22
0.750	13.45	1.750	22.45	2.750	8.90	3.75	5.89
0.833	13.45	1.833	22.45	2.833	8.90	3.83	5.89
0.917	19.96	1.917	17.52	2.917	8.16	3.92	5.59
1.000	19.96	2.000	17.52	3.000	8.16	4.00	5.59

Unit Hyd Qpeak (cms)= 0.324

PEAK FLOW (cms)= 0.205 (i)
TIME TO PEAK (hrs)= 1.833
RUNOFF VOLUME (mm)= 31.565
TOTAL RAINFALL (mm)= 87.580
RUNOFF COEFFICIENT = 0.360

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

CALIB			
NASHYD (0170)	Area (ha)= 11.95	Curve Number (CN)= 67.0	
ID= 1 DT= 5.0 min	Ia (mm)= 7.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.84		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	6.41	1.083	45.22	2.083	14.50	3.08	7.56
0.167	6.41	1.167	45.22	2.167	14.50	3.17	7.56
0.250	7.29	1.250	180.15	2.250	12.44	3.25	7.04
0.333	7.29	1.333	180.15	2.333	12.44	3.33	7.04
0.417	8.52	1.417	58.54	2.417	10.94	3.42	6.60
0.500	8.52	1.500	58.54	2.500	10.94	3.50	6.60
0.583	10.36	1.583	31.96	2.583	9.80	3.58	6.22
0.667	10.36	1.667	31.96	2.667	9.80	3.67	6.22
0.750	13.45	1.750	22.45	2.750	8.90	3.75	5.89
0.833	13.45	1.833	22.45	2.833	8.90	3.83	5.89
0.917	19.96	1.917	17.52	2.917	8.16	3.92	5.59
1.000	19.96	2.000	17.52	3.000	8.16	4.00	5.59

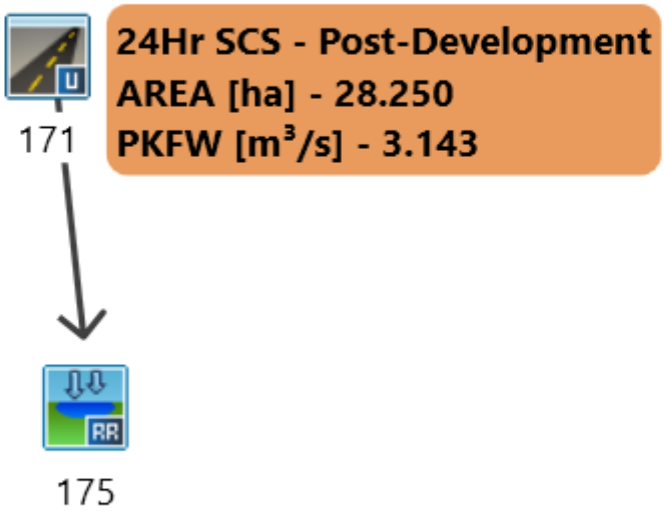
Unit Hyd Qpeak (cms)= 0.543

PEAK FLOW (cms)= 0.436 (i)
TIME TO PEAK (hrs)= 2.417
RUNOFF VOLUME (mm)= 31.568
TOTAL RAINFALL (mm)= 87.580
RUNOFF COEFFICIENT = 0.360

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

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--------------------
| ADD HYD  (  0169)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0168):      3.56   0.205     1.83    31.56
      + ID2= 2 (  0170):     11.95   0.436     2.42    31.57
        ================================================
        ID = 3 (  0169):     15.51   0.583     2.17    31.57

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
```



SCHAEFFERS
CONSULTING ENGINEERS

2-year to 100-year 6 Hour, 12 Hour, 24 Hour SCS Storm and 4 Hour Chicago Storm
Watersand South Residential Subdivision
Post-Development

Job #: 2020-5184	**Date: June 2022**

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================================================================================
==========================

      V    V   I    SSSSS  U   U    A    L             (v 6.2.2006)
      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   TTTTT  TTTTT  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\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\97b41b95-090f-4056-b934-402551086127\scenari
  Summary filename: C:\Users\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\97b41b95-090f-4056-b934-402551086127\scenari


DATE: 06-29-2022                          TIME: 02:29:54

USER:



COMMENTS: _____________________________________________________________


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  ***********************************************
  ** SIMULATION : Run 01                       **
  ***********************************************

--------------------
| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              2b7bf0a5-557e-4a78-9392-0a739a5df2b5\a3457ff2
| Ptotal= 55.00 mm |    Comments: SCS II 24H_2YR
--------------------
                       Duration of storm    = 24.00 hrs
                       Mass curve time step = 15.00 min

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.25    0.55 |  6.25    1.10 | 12.25    7.92 | 18.25    0.99
               0.50    0.55 |  6.50    1.10 | 12.50    7.92 | 18.50    0.99
               0.75    0.55 |  6.75    1.10 | 12.75    4.07 | 18.75    0.99
               1.00    0.55 |  7.00    1.10 | 13.00    4.07 | 19.00    0.99
               1.25    0.55 |  7.25    1.10 | 13.25    0.77 | 19.25    0.99
               1.50    0.55 |  7.50    1.10 | 13.50    0.77 | 19.50    0.99
               1.75    0.55 |  7.75    1.10 | 13.75    4.51 | 19.75    0.99
               2.00    0.99 |  8.00    1.10 | 14.00    4.51 | 20.00    0.99
               2.25    0.72 |  8.25    1.49 | 14.25    1.65 | 20.25    0.66
               2.50    0.71 |  8.50    1.48 | 14.50    1.65 | 20.50    0.66
               2.75    0.72 |  8.75    1.49 | 14.75    1.65 | 20.75    0.66
               3.00    0.71 |  9.00    1.49 | 15.00    1.65 | 21.00    0.66
               3.25    0.71 |  9.25    1.76 | 15.25    1.65 | 21.25    0.66
               3.50    0.71 |  9.50    1.76 | 15.50    1.65 | 21.50    0.66
               3.75    0.72 |  9.75    1.98 | 15.75    1.65 | 21.75    0.66
               4.00    0.71 | 10.00    1.98 | 16.00    1.65 | 22.00    0.66
               4.25    0.88 | 10.25    2.53 | 16.25    0.99 | 22.25    0.66
               4.50    0.88 | 10.50    2.53 | 16.50    0.99 | 22.50    0.66
               4.75    0.88 | 10.75    3.41 | 16.75    0.99 | 22.75    0.66
               5.00    0.88 | 11.00    3.41 | 17.00    0.99 | 23.00    0.66
               5.25    0.88 | 11.25    5.28 | 17.25    0.99 | 23.25    0.66
               5.50    0.88 | 11.50    5.28 | 17.50    0.99 | 23.50    0.66
               5.75    0.88 | 11.75   22.88 | 17.75    0.99 | 23.75    0.66
               6.00    0.88 | 12.00   60.72 | 18.00    0.99 | 24.00    0.66

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0171)|   Area     (ha)=  28.25
|ID= 1 DT= 5.0 min |   Total Imp(%)=  71.00   Dir. Conn.(%)=  66.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=       20.06          8.19
     Dep. Storage      (mm)=        1.00          1.50
     Average Slope      (%)=        1.00          2.00
     Length             (m)=      433.97         40.00
     Mannings n            =       0.013         0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                                ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    0.55 |  6.083    1.10 |12.083    7.93 | 18.08    0.99
               0.167    0.55 |  6.167    1.10 |12.167    7.92 | 18.17    0.99
               0.250    0.55 |  6.250    1.10 |12.250    7.92 | 18.25    0.99
               0.333    0.55 |  6.333    1.10 |12.333    7.92 | 18.33    0.99
               0.417    0.55 |  6.417    1.10 |12.417    7.92 | 18.42    0.99
               0.500    0.55 |  6.500    1.10 |12.500    7.92 | 18.50    0.99
               0.583    0.55 |  6.583    1.10 |12.583    4.07 | 18.58    0.99
               0.667    0.55 |  6.667    1.10 |12.667    4.07 | 18.67    0.99
               0.750    0.55 |  6.750    1.10 |12.750    4.07 | 18.75    0.99
               0.833    0.55 |  6.833    1.10 |12.833    4.07 | 18.83    0.99
               0.917    0.55 |  6.917    1.10 |12.917    4.07 | 18.92    0.99
               1.000    0.55 |  7.000    1.10 |13.000    4.07 | 19.00    0.99
               1.083    0.55 |  7.083    1.10 |13.083    0.77 | 19.08    0.99
               1.167    0.55 |  7.167    1.10 |13.167    0.77 | 19.17    0.99
               1.250    0.55 |  7.250    1.10 |13.250    0.77 | 19.25    0.99
               1.333    0.55 |  7.333    1.10 |13.333    0.77 | 19.33    0.99
               1.417    0.55 |  7.417    1.10 |13.417    0.77 | 19.42    0.99
               1.500    0.55 |  7.500    1.10 |13.500    0.77 | 19.50    0.99
               1.583    0.55 |  7.583    1.10 |13.583    4.51 | 19.58    0.99
               1.667    0.55 |  7.667    1.10 |13.667    4.51 | 19.67    0.99
               1.750    0.55 |  7.750    1.10 |13.750    4.51 | 19.75    0.99
               1.833    0.99 |  7.833    1.10 |13.833    4.51 | 19.83    0.99
               1.917    0.99 |  7.917    1.10 |13.917    4.51 | 19.92    0.99
               2.000    0.99 |  8.000    1.10 |14.000    4.51 | 20.00    0.99
               2.083    0.72 |  8.083    1.49 |14.083    1.65 | 20.08    0.66
               2.167    0.72 |  8.167    1.49 |14.167    1.65 | 20.17    0.66
               2.250    0.72 |  8.250    1.48 |14.250    1.65 | 20.25    0.66
               2.333    0.71 |  8.333    1.48 |14.333    1.65 | 20.33    0.66
               2.417    0.71 |  8.417    1.48 |14.417    1.65 | 20.42    0.66
               2.500    0.71 |  8.500    1.48 |14.500    1.65 | 20.50    0.66
               2.583    0.71 |  8.583    1.49 |14.583    1.65 | 20.58    0.66
               2.667    0.72 |  8.667    1.49 |14.667    1.65 | 20.67    0.66
               2.750    0.72 |  8.750    1.48 |14.750    1.65 | 20.75    0.66
               2.833    0.71 |  8.833    1.49 |14.833    1.65 | 20.83    0.66
```

2.917	0.71	8.917	1.49	14.917	1.65	20.92	0.66
3.000	0.71	9.000	1.49	15.000	1.65	21.00	0.66
3.083	0.71	9.083	1.76	15.083	1.65	21.08	0.66
3.167	0.71	9.167	1.76	15.167	1.65	21.17	0.66
3.250	0.71	9.250	1.76	15.250	1.65	21.25	0.66
3.333	0.71	9.333	1.76	15.333	1.65	21.33	0.66
3.417	0.71	9.417	1.76	15.417	1.65	21.42	0.66
3.500	0.71	9.500	1.76	15.500	1.65	21.50	0.66
3.583	0.71	9.583	1.98	15.583	1.65	21.58	0.66
3.667	0.72	9.667	1.98	15.667	1.65	21.67	0.66
3.750	0.72	9.750	1.98	15.750	1.65	21.75	0.66
3.833	0.71	9.833	1.98	15.833	1.65	21.83	0.66
3.917	0.71	9.917	1.98	15.917	1.65	21.92	0.66
4.000	0.71	10.000	1.98	16.000	1.65	22.00	0.66
4.083	0.88	10.083	2.53	16.083	0.99	22.08	0.66
4.167	0.88	10.167	2.53	16.167	0.99	22.17	0.66
4.250	0.88	10.250	2.53	16.250	0.99	22.25	0.66
4.333	0.88	10.333	2.53	16.333	0.99	22.33	0.66
4.417	0.88	10.417	2.53	16.417	0.99	22.42	0.66
4.500	0.88	10.500	2.53	16.500	0.99	22.50	0.66
4.583	0.88	10.583	3.41	16.583	0.99	22.58	0.66
4.667	0.88	10.667	3.41	16.667	0.99	22.67	0.66
4.750	0.88	10.750	3.41	16.750	0.99	22.75	0.66
4.833	0.88	10.833	3.41	16.833	0.99	22.83	0.66
4.917	0.88	10.917	3.41	16.917	0.99	22.92	0.66
5.000	0.88	11.000	3.41	17.000	0.99	23.00	0.66
5.083	0.88	11.083	5.28	17.083	0.99	23.08	0.66
5.167	0.88	11.167	5.28	17.167	0.99	23.17	0.66
5.250	0.88	11.250	5.28	17.250	0.99	23.25	0.66
5.333	0.88	11.333	5.28	17.333	0.99	23.33	0.66
5.417	0.88	11.417	5.28	17.417	0.99	23.42	0.66
5.500	0.88	11.500	5.28	17.500	0.99	23.50	0.66
5.583	0.88	11.583	22.88	17.583	0.99	23.58	0.66
5.667	0.88	11.667	22.88	17.667	0.99	23.67	0.66
5.750	0.88	11.750	22.88	17.750	0.99	23.75	0.66
5.833	0.88	11.833	60.72	17.833	0.99	23.83	0.66
5.917	0.88	11.917	60.72	17.917	0.99	23.92	0.66
6.000	0.88	12.000	60.72	18.000	0.99	24.00	0.66

			TOTALS
Max.Eff.Inten.(mm/hr)=	60.72	48.80	
over (min)	10.00	20.00	
Storage Coeff. (min)=	7.52 (ii)	16.93 (ii)	
Unit Hyd. Tpeak (min)=	10.00	20.00	
Unit Hyd. peak (cms)=	0.13	0.06	
PEAK FLOW (cms)=	2.70	0.60	3.143 (iii)
TIME TO PEAK (hrs)=	12.00	12.17	12.00
RUNOFF VOLUME (mm)=	54.00	31.38	46.31
TOTAL RAINFALL (mm)=	55.00	55.00	55.00
RUNOFF COEFFICIENT =	0.98	0.57	0.84

(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.

RESERVOIR(0175) / IN= 2---> OUT= 1 / DT= 5.0 min	OVERFLOW IS OFF			
	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.4810	1.4680
	0.0470	0.8600	0.6580	1.7540
	0.1860	0.9300	0.7990	1.9670
	0.3530	1.2390	0.9460	2.1790

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0171)	28.250	3.143	12.00	46.31
OUTFLOW: ID= 1 (0175)	28.250	0.184	14.25	44.46

PEAK FLOW REDUCTION [Qout/Qin](%)= 5.86
TIME SHIFT OF PEAK FLOW (min)=135.00
MAXIMUM STORAGE USED (ha.m.)= 0.9295

MASS STORM / Ptotal= 42.30 mm	Filename: C:\Users\hliu\AppData\Local\Temp\2b7bf0a5-557e-4a78-9392-0a739a5df2b5\8096a049
	Comments: SCS II 6H_2YR

Duration of storm = 6.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	1.69	1.75	4.23	3.25	9.31	4.75	2.54
0.50	1.69	2.00	4.23	3.50	9.31	5.00	2.54
0.75	2.54	2.25	5.08	3.75	4.23	5.25	1.69
1.00	2.54	2.50	5.08	4.00	4.23	5.50	1.69
1.25	2.54	2.75	25.38	4.25	3.38	5.75	1.69
1.50	2.54	3.00	65.99	4.50	3.38	6.00	1.69

CALIB / STANDHYD (0172) / ID= 1 DT= 5.0 min	Area (ha)= 28.25	Total Imp(%)= 71.00	Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	20.06	8.19
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	433.97	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.69	1.583	4.23	3.083	9.31	4.58	2.54
0.167	1.69	1.667	4.23	3.167	9.31	4.67	2.54
0.250	1.69	1.750	4.23	3.250	9.31	4.75	2.54
0.333	1.69	1.833	4.23	3.333	9.31	4.83	2.54
0.417	1.69	1.917	4.23	3.417	9.31	4.92	2.54
0.500	1.69	2.000	4.23	3.500	9.31	5.00	2.54
0.583	2.54	2.083	5.08	3.583	4.23	5.08	1.69
0.667	2.54	2.167	5.08	3.667	4.23	5.17	1.69
0.750	2.54	2.250	5.08	3.750	4.23	5.25	1.69
0.833	2.54	2.333	5.08	3.833	4.23	5.33	1.69
0.917	2.54	2.417	5.08	3.917	4.23	5.42	1.69
1.000	2.54	2.500	5.08	4.000	4.23	5.50	1.69
1.083	2.54	2.583	25.38	4.083	3.38	5.58	1.69
1.167	2.54	2.667	25.38	4.167	3.38	5.67	1.69
1.250	2.54	2.750	25.38	4.250	3.38	5.75	1.69
1.333	2.54	2.833	65.99	4.333	3.38	5.83	1.69

1.417	2.54	2.917	65.99	4.417	3.38	5.92	1.69
1.500	2.54	3.000	65.99	4.500	3.38	6.00	1.69

			TOTALS
Max.Eff.Inten.(mm/hr)=	65.99	48.03	
over (min)	5.00	20.00	
Storage Coeff. (min)=	7.28 (ii)	16.74 (ii)	
Unit Hyd. Tpeak (min)=	5.00	20.00	
Unit Hyd. peak (cms)=	0.17	0.06	
PEAK FLOW (cms)=	3.13	0.56	3.523 (iii)
TIME TO PEAK (hrs)=	3.00	3.17	3.00
RUNOFF VOLUME (mm)=	41.30	21.23	34.48
TOTAL RAINFALL (mm)=	42.30	42.30	42.30
RUNOFF COEFFICIENT =	0.98	0.50	0.82

(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.

RESERVOIR(0176)	OVERFLOW IS OFF
IN= 2---> OUT= 1	
DT= 5.0 min	

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.4260	1.3670
0.0470	0.8600	0.6000	1.6350
0.1480	0.8780	0.7400	1.8350
0.3040	1.1570	0.8880	2.0360

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0172)	28.250	3.523	3.00	34.48
OUTFLOW: ID= 1 (0176)	28.250	0.141	5.25	33.17

PEAK FLOW REDUCTION [Qout/Qin](%)= 4.00
TIME SHIFT OF PEAK FLOW (min)=135.00
MAXIMUM STORAGE USED (ha.m.)= 0.8768

MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\2b7bf0a5-557e-4a78-9392-0a739a5df2b5\f78e34d8
Ptotal= 46.70 mm	Comments: SCS II 12H_2YR

Duration of storm = 12.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	1.17	3.25	1.87	6.25	8.41	9.25	1.63
0.50	1.17	3.50	1.87	6.50	8.41	9.50	1.63
0.75	1.17	3.75	1.87	6.75	3.74	9.75	1.63
1.00	1.17	4.00	1.87	7.00	3.74	10.00	1.63
1.25	1.17	4.25	2.80	7.25	2.80	10.25	0.93
1.50	1.17	4.50	2.80	7.50	2.80	10.50	0.93
1.75	1.17	4.75	3.74	7.75	2.80	10.75	0.93
2.00	1.17	5.00	3.74	8.00	2.80	11.00	0.93
2.25	1.40	5.25	5.60	8.25	1.63	11.25	0.93
2.50	1.40	5.50	5.60	8.50	1.63	11.50	0.93
2.75	1.40	5.75	22.42	8.75	1.63	11.75	0.93
3.00	1.40	6.00	61.64	9.00	1.63	12.00	0.93

CALIB	
STANDHYD (0173)	Area (ha)= 28.25
ID= 1 DT= 5.0 min	Total Imp(%)= 71.00 Dir. Conn.(%)= 66.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	20.06	8.19
Dep. Storage (mm)=	1.00	1.50
Average Slope (%)=	1.00	2.00
Length (m)=	433.97	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.17	3.083	1.87	6.083	8.41	9.08	1.63
0.167	1.17	3.167	1.87	6.167	8.41	9.17	1.63
0.250	1.17	3.250	1.87	6.250	8.41	9.25	1.63
0.333	1.17	3.333	1.87	6.333	8.41	9.33	1.63
0.417	1.17	3.417	1.87	6.417	8.41	9.42	1.63
0.500	1.17	3.500	1.87	6.500	8.41	9.50	1.63
0.583	1.17	3.583	1.87	6.583	3.74	9.58	1.63
0.667	1.17	3.667	1.87	6.667	3.74	9.67	1.63
0.750	1.17	3.750	1.87	6.750	3.74	9.75	1.63
0.833	1.17	3.833	1.87	6.833	3.74	9.83	1.63
0.917	1.17	3.917	1.87	6.917	3.74	9.92	1.63
1.000	1.17	4.000	1.87	7.000	3.74	10.00	1.63
1.083	1.17	4.083	2.80	7.083	2.80	10.08	0.93
1.167	1.17	4.167	2.80	7.167	2.80	10.17	0.93
1.250	1.17	4.250	2.80	7.250	2.80	10.25	0.93
1.333	1.17	4.333	2.80	7.333	2.80	10.33	0.93
1.417	1.17	4.417	2.80	7.417	2.80	10.42	0.93
1.500	1.17	4.500	2.80	7.500	2.80	10.50	0.93
1.583	1.17	4.583	3.74	7.583	2.80	10.58	0.93
1.667	1.17	4.667	3.74	7.667	2.80	10.67	0.93
1.750	1.17	4.750	3.74	7.750	2.80	10.75	0.93
1.833	1.17	4.833	3.74	7.833	2.80	10.83	0.93
1.917	1.17	4.917	3.74	7.917	2.80	10.92	0.93
2.000	1.17	5.000	3.74	8.000	2.80	11.00	0.93
2.083	1.40	5.083	5.60	8.083	1.63	11.08	0.93
2.167	1.40	5.167	5.60	8.167	1.63	11.17	0.93
2.250	1.40	5.250	5.60	8.250	1.63	11.25	0.93
2.333	1.40	5.333	5.60	8.333	1.63	11.33	0.93
2.417	1.40	5.417	5.60	8.417	1.63	11.42	0.93
2.500	1.40	5.500	5.60	8.500	1.63	11.50	0.93
2.583	1.40	5.583	22.42	8.583	1.63	11.58	0.93
2.667	1.40	5.667	22.42	8.667	1.63	11.67	0.93
2.750	1.40	5.750	22.42	8.750	1.63	11.75	0.93
2.833	1.40	5.833	61.64	8.833	1.63	11.83	0.93
2.917	1.40	5.917	61.64	8.917	1.63	11.92	0.93
3.000	1.40	6.000	61.64	9.000	1.63	12.00	0.93

			TOTALS
Max.Eff.Inten.(mm/hr)=	61.64	46.72	
over (min)	5.00	20.00	
Storage Coeff. (min)=	7.48 (ii)	17.05 (ii)	
Unit Hyd. Tpeak (min)=	5.00	20.00	
Unit Hyd. peak (cms)=	0.17	0.06	
PEAK FLOW (cms)=	2.90	0.56	3.301 (iii)
TIME TO PEAK (hrs)=	6.00	6.17	6.00
RUNOFF VOLUME (mm)=	45.70	24.66	38.55

```
     TOTAL RAINFALL   (mm)=      46.70        46.70          46.70
     RUNOFF COEFFICIENT   =       0.98         0.53           0.83


       (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.

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--------------------
| RESERVOIR(  0177)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000   |   0.4210     1.3480
                         0.0470     0.8600   |   0.5820     1.6080
                         0.1580     0.8880   |   0.7120     1.8060
                         0.3050     1.1460   |   0.8460     1.9980

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0173)     28.250     3.301      6.00      38.55
   OUTFLOW: ID= 1 (  0177)     28.250     0.153      8.17      37.08

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  4.62
                  TIME SHIFT OF PEAK FLOW         (min)=130.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.8867

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--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 678.085
| Ptotal= 36.96 mm |                          B=   4.699
--------------------                          C=   0.781
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  4.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.17    2.47 |  1.17   18.78 |  2.17    5.73 |  3.17    2.93
                0.33    2.82 |  1.33   83.11 |  2.33    4.89 |  3.33    2.72
                0.50    3.31 |  1.50   24.57 |  2.50    4.28 |  3.50    2.55
                0.67    4.05 |  1.67   13.01 |  2.67    3.82 |  3.67    2.39
                0.83    5.30 |  1.83    9.01 |  2.83    3.46 |  3.83    2.26
                1.00    7.98 |  2.00    6.97 |  3.00    3.17 |  4.00    2.15


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--------------------
| CALIB            |
| STANDHYD (  0174)|   Area    (ha)=  28.25
|ID= 1 DT= 5.0 min |   Total Imp(%)=  71.00   Dir. Conn.(%)=  66.00
--------------------

                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      20.06         8.19
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     433.97        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
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                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    2.47 | 1.083   18.78 | 2.083    5.73 |  3.08    2.93
                0.167    2.47 | 1.167   18.78 | 2.167    5.73 |  3.17    2.93
                0.250    2.82 | 1.250   83.11 | 2.250    4.89 |  3.25    2.72
                0.333    2.82 | 1.333   83.11 | 2.333    4.89 |  3.33    2.72
                0.417    3.31 | 1.417   24.57 | 2.417    4.28 |  3.42    2.55
                0.500    3.31 | 1.500   24.57 | 2.500    4.28 |  3.50    2.55
                0.583    4.05 | 1.583   13.01 | 2.583    3.82 |  3.58    2.39
                0.667    4.05 | 1.667   13.01 | 2.667    3.82 |  3.67    2.39
                0.750    5.30 | 1.750    9.01 | 2.750    3.46 |  3.75    2.26
                0.833    5.30 | 1.833    9.01 | 2.833    3.46 |  3.83    2.26
                0.917    7.98 | 1.917    6.97 | 2.917    3.17 |  3.92    2.15
                1.000    7.98 | 2.000    6.97 | 3.000    3.17 |  4.00    2.15

     Max.Eff.Inten.(mm/hr)=      83.11        42.38
               over (min)        5.00        20.00
     Storage Coeff.  (min)=      6.64 (ii)   16.59 (ii)
     Unit Hyd. Tpeak (min)=      5.00        20.00
     Unit Hyd. peak  (cms)=      0.18         0.06
                                                        *TOTALS*
     PEAK FLOW       (cms)=      3.54         0.45        3.704 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.58         1.33
     RUNOFF VOLUME    (mm)=     35.96        17.22        29.59
     TOTAL RAINFALL   (mm)=     36.96        36.96        36.96
     RUNOFF COEFFICIENT   =      0.97         0.47         0.80


       (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.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0178)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000   |   0.2810     1.2030
                         0.0470     0.8600   |   0.3960     1.4090
                         0.1020     0.8601   |   0.4840     1.5570
                         0.2010     1.0400   |   0.5830     1.7020

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0174)     28.250     3.704      1.33      29.59
   OUTFLOW: ID= 1 (  0178)     28.250     0.043      4.25      28.43

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  1.17
                  TIME SHIFT OF PEAK FLOW         (min)=175.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.7926

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      V    V   I    SSSSS  U   U    A    L              (v 6.2.2006)
      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
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       OOO   TTTTT  TTTTT  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\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\a4820c09-e76e-4ee8-b0a9-9640a05c5e2a\scenari
  Summary filename: C:\Users\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\a4820c09-e76e-4ee8-b0a9-9640a05c5e2a\scenari


DATE: 06-29-2022                          TIME: 02:29:55

USER:



COMMENTS: _____________________________________________________________


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  ***********************************************
  ** SIMULATION : Run 02                       **
  ***********************************************

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| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              2b7bf0a5-557e-4a78-9392-0a739a5df2b5\efbc61a7
| Ptotal= 76.00 mm |    Comments: SCS II 24H_5YR
--------------------

                       Duration of storm    = 24.00 hrs
                       Mass curve time step = 15.00 min

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.25    0.76 |  6.25    1.52 | 12.25   10.94 | 18.25    1.37
                0.50    0.76 |  6.50    1.52 | 12.50   10.94 | 18.50    1.37
                0.75    0.76 |  6.75    1.52 | 12.75    5.62 | 18.75    1.37
                1.00    0.76 |  7.00    1.52 | 13.00    5.62 | 19.00    1.37
                1.25    0.76 |  7.25    1.52 | 13.25    1.06 | 19.25    1.37
                1.50    0.76 |  7.50    1.52 | 13.50    1.06 | 19.50    1.37
                1.75    0.76 |  7.75    1.52 | 13.75    6.23 | 19.75    1.37
                2.00    1.37 |  8.00    1.52 | 14.00    6.23 | 20.00    1.37
                2.25    0.99 |  8.25    2.05 | 14.25    2.28 | 20.25    0.91
                2.50    0.99 |  8.50    2.05 | 14.50    2.28 | 20.50    0.91
                2.75    0.99 |  8.75    2.05 | 14.75    2.28 | 20.75    0.91
                3.00    0.99 |  9.00    2.05 | 15.00    2.28 | 21.00    0.91
                3.25    0.99 |  9.25    2.43 | 15.25    2.28 | 21.25    0.91
                3.50    0.99 |  9.50    2.43 | 15.50    2.28 | 21.50    0.91
                3.75    0.99 |  9.75    2.74 | 15.75    2.28 | 21.75    0.91
                4.00    0.99 | 10.00    2.74 | 16.00    2.28 | 22.00    0.91
                4.25    1.22 | 10.25    3.50 | 16.25    1.37 | 22.25    0.91
                4.50    1.22 | 10.50    3.50 | 16.50    1.37 | 22.50    0.91
                4.75    1.22 | 10.75    4.71 | 16.75    1.37 | 22.75    0.91
                5.00    1.22 | 11.00    4.71 | 17.00    1.37 | 23.00    0.91
                5.25    1.22 | 11.25    7.30 | 17.25    1.37 | 23.25    0.91
                5.50    1.22 | 11.50    7.30 | 17.50    1.37 | 23.50    0.91
                5.75    1.22 | 11.75   31.62 | 17.75    1.37 | 23.75    0.91
                6.00    1.22 | 12.00   83.90 | 18.00    1.37 | 24.00    0.91

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| CALIB            |
| STANDHYD (  0171)|   Area    (ha)=  28.25
|ID= 1 DT= 5.0 min |   Total Imp(%)=  71.00   Dir. Conn.(%)=  66.00
--------------------

                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       20.06          8.19
     Dep. Storage     (mm)=        1.00          1.50
     Average Slope     (%)=        1.00          2.00
     Length            (m)=      433.97         40.00
     Mannings n             =     0.013         0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                              ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    0.76 | 6.083    1.52 |12.083   10.95 | 18.08    1.37
               0.167    0.76 | 6.167    1.52 |12.167   10.94 | 18.17    1.37
               0.250    0.76 | 6.250    1.52 |12.250   10.94 | 18.25    1.37
               0.333    0.76 | 6.333    1.52 |12.333   10.94 | 18.33    1.37
               0.417    0.76 | 6.417    1.52 |12.417   10.94 | 18.42    1.37
               0.500    0.76 | 6.500    1.52 |12.500   10.94 | 18.50    1.37
               0.583    0.76 | 6.583    1.52 |12.583    5.62 | 18.58    1.37
               0.667    0.76 | 6.667    1.52 |12.667    5.62 | 18.67    1.37
               0.750    0.76 | 6.750    1.52 |12.750    5.62 | 18.75    1.37
               0.833    0.76 | 6.833    1.52 |12.833    5.62 | 18.83    1.37
               0.917    0.76 | 6.917    1.52 |12.917    5.62 | 18.92    1.37
               1.000    0.76 | 7.000    1.52 |13.000    5.62 | 19.00    1.37
               1.083    0.76 | 7.083    1.52 |13.083    1.06 | 19.08    1.37
               1.167    0.76 | 7.167    1.52 |13.167    1.06 | 19.17    1.37
               1.250    0.76 | 7.250    1.52 |13.250    1.06 | 19.25    1.37
               1.333    0.76 | 7.333    1.52 |13.333    1.06 | 19.33    1.37
               1.417    0.76 | 7.417    1.52 |13.417    1.06 | 19.42    1.37
               1.500    0.76 | 7.500    1.52 |13.500    1.06 | 19.50    1.37
               1.583    0.76 | 7.583    1.52 |13.583    6.23 | 19.58    1.37
               1.667    0.76 | 7.667    1.52 |13.667    6.23 | 19.67    1.37
               1.750    0.76 | 7.750    1.52 |13.750    6.23 | 19.75    1.37
               1.833    1.37 | 7.833    1.52 |13.833    6.23 | 19.83    1.37
               1.917    1.37 | 7.917    1.52 |13.917    6.23 | 19.92    1.37
               2.000    1.37 | 8.000    1.52 |14.000    6.23 | 20.00    1.37
               2.083    0.99 | 8.083    2.05 |14.083    2.28 | 20.08    0.91
               2.167    0.99 | 8.167    2.05 |14.167    2.28 | 20.17    0.91
               2.250    0.99 | 8.250    2.05 |14.250    2.28 | 20.25    0.91
               2.333    0.99 | 8.333    2.05 |14.333    2.28 | 20.33    0.91
               2.417    0.99 | 8.417    2.05 |14.417    2.28 | 20.42    0.91
               2.500    0.99 | 8.500    2.05 |14.500    2.28 | 20.50    0.91
               2.583    0.99 | 8.583    2.05 |14.583    2.28 | 20.58    0.91
               2.667    0.99 | 8.667    2.05 |14.667    2.28 | 20.67    0.91
               2.750    0.99 | 8.750    2.05 |14.750    2.28 | 20.75    0.91
               2.833    0.99 | 8.833    2.05 |14.833    2.28 | 20.83    0.91
               2.917    0.99 | 8.917    2.05 |14.917    2.28 | 20.92    0.91
               3.000    0.99 | 9.000    2.05 |15.000    2.28 | 21.00    0.91
               3.083    0.99 | 9.083    2.43 |15.083    2.28 | 21.08    0.91
               3.167    0.99 | 9.167    2.43 |15.167    2.28 | 21.17    0.91
               3.250    0.99 | 9.250    2.43 |15.250    2.28 | 21.25    0.91
               3.333    0.99 | 9.333    2.43 |15.333    2.28 | 21.33    0.91
               3.417    0.99 | 9.417    2.43 |15.417    2.28 | 21.42    0.91
               3.500    0.99 | 9.500    2.43 |15.500    2.28 | 21.50    0.91
               3.583    0.99 | 9.583    2.74 |15.583    2.28 | 21.58    0.91
```

3.667	0.99	9.667	2.74	15.667	2.28	21.67	0.91
3.750	0.99	9.750	2.74	15.750	2.28	21.75	0.91
3.833	0.99	9.833	2.74	15.833	2.28	21.83	0.91
3.917	0.99	9.917	2.74	15.917	2.28	21.92	0.91
4.000	0.99	10.000	2.74	16.000	2.28	22.00	0.91
4.083	1.22	10.083	3.50	16.083	1.37	22.08	0.91
4.167	1.22	10.167	3.50	16.167	1.37	22.17	0.91
4.250	1.22	10.250	3.50	16.250	1.37	22.25	0.91
4.333	1.22	10.333	3.50	16.333	1.37	22.33	0.91
4.417	1.22	10.417	3.50	16.417	1.37	22.42	0.91
4.500	1.22	10.500	3.50	16.500	1.37	22.50	0.91
4.583	1.22	10.583	4.71	16.583	1.37	22.58	0.91
4.667	1.22	10.667	4.71	16.667	1.37	22.67	0.91
4.750	1.22	10.750	4.71	16.750	1.37	22.75	0.91
4.833	1.22	10.833	4.71	16.833	1.37	22.83	0.91
4.917	1.22	10.917	4.71	16.917	1.37	22.92	0.91
5.000	1.22	11.000	4.71	17.000	1.37	23.00	0.91
5.083	1.22	11.083	7.30	17.083	1.37	23.08	0.91
5.167	1.22	11.167	7.30	17.167	1.37	23.17	0.91
5.250	1.22	11.250	7.30	17.250	1.37	23.25	0.91
5.333	1.22	11.333	7.30	17.333	1.37	23.33	0.91
5.417	1.22	11.417	7.30	17.417	1.37	23.42	0.91
5.500	1.22	11.500	7.30	17.500	1.37	23.50	0.91
5.583	1.22	11.583	31.61	17.583	1.37	23.58	0.91
5.667	1.22	11.667	31.62	17.667	1.37	23.67	0.91
5.750	1.22	11.750	31.62	17.750	1.37	23.75	0.91
5.833	1.22	11.833	83.90	17.833	1.37	23.83	0.91
5.917	1.22	11.917	83.90	17.917	1.37	23.92	0.91
6.000	1.22	12.000	83.90	18.000	1.37	24.00	0.91

			TOTALS
Max.Eff.Inten.(mm/hr)=	83.90	75.93	
over (min)	5.00	15.00	
Storage Coeff. (min)=	6.61 (ii)	14.49 (ii)	
Unit Hyd. Tpeak (min)=	5.00	15.00	
Unit Hyd. peak (cms)=	0.18	0.08	
PEAK FLOW (cms)=	4.05	1.06	5.000 (iii)
TIME TO PEAK (hrs)=	12.00	12.08	12.00
RUNOFF VOLUME (mm)=	75.00	49.43	66.31
TOTAL RAINFALL (mm)=	76.00	76.00	76.00
RUNOFF COEFFICIENT =	0.99	0.65	0.87

(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.

RESERVOIR(0175)	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.4810	1.4680
	0.0470	0.8600	0.6580	1.7540
	0.1860	0.9300	0.7990	1.9670
	0.3530	1.2390	0.9460	2.1790

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0171)	28.250	5.000	12.00	66.31
OUTFLOW: ID= 1 (0175)	28.250	0.352	13.08	64.43

PEAK FLOW REDUCTION [Qout/Qin](%)= 7.05
TIME SHIFT OF PEAK FLOW (min)= 65.00
MAXIMUM STORAGE USED (ha.m.)= 1.2386

MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\2b7bf0a5-557e-4a78-9392-0a739a5df2b5\2eedf936
Ptotal= 59.50 mm	Comments: SCS II 6H_5YR

Duration of storm = 6.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	2.38	1.75	5.95	3.25	13.09	4.75	3.57
0.50	2.38	2.00	5.95	3.50	13.09	5.00	3.57
0.75	3.57	2.25	7.14	3.75	5.95	5.25	2.38
1.00	3.57	2.50	7.14	4.00	5.95	5.50	2.38
1.25	3.57	2.75	35.70	4.25	4.76	5.75	2.38
1.50	3.57	3.00	92.82	4.50	4.76	6.00	2.38

CALIB	
STANDHYD (0172)	Area (ha)= 28.25
ID= 1 DT= 5.0 min	Total Imp(%)= 71.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	20.06	8.19
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	433.97	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.38	1.583	5.95	3.083	13.09	4.58	3.57
0.167	2.38	1.667	5.95	3.167	13.09	4.67	3.57
0.250	2.38	1.750	5.95	3.250	13.09	4.75	3.57
0.333	2.38	1.833	5.95	3.333	13.09	4.83	3.57
0.417	2.38	1.917	5.95	3.417	13.09	4.92	3.57
0.500	2.38	2.000	5.95	3.500	13.09	5.00	3.57
0.583	3.57	2.083	7.14	3.583	5.95	5.08	2.38
0.667	3.57	2.167	7.14	3.667	5.95	5.17	2.38
0.750	3.57	2.250	7.14	3.750	5.95	5.25	2.38
0.833	3.57	2.333	7.14	3.833	5.95	5.33	2.38
0.917	3.57	2.417	7.14	3.917	5.95	5.42	2.38
1.000	3.57	2.500	7.14	4.000	5.95	5.50	2.38
1.083	3.57	2.583	35.70	4.083	4.76	5.58	2.38
1.167	3.57	2.667	35.70	4.167	4.76	5.67	2.38
1.250	3.57	2.750	35.70	4.250	4.76	5.75	2.38
1.333	3.57	2.833	92.82	4.333	4.76	5.83	2.38
1.417	3.57	2.917	92.82	4.417	4.76	5.92	2.38
1.500	3.57	3.000	92.82	4.500	4.76	6.00	2.38

			TOTALS
Max.Eff.Inten.(mm/hr)=	92.82	78.34	
over (min)	5.00	15.00	
Storage Coeff. (min)=	6.35 (ii)	14.13 (ii)	
Unit Hyd. Tpeak (min)=	5.00	15.00	
Unit Hyd. peak (cms)=	0.19	0.08	

PEAK FLOW	(cms)=	4.52	1.06	5.438 (iii)
TIME TO PEAK	(hrs)=	3.00	3.08	3.00
RUNOFF VOLUME	(mm)=	58.50	35.14	50.56
TOTAL RAINFALL	(mm)=	59.50	59.50	59.50
RUNOFF COEFFICIENT	=	0.98	0.59	0.85

(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.

RESERVOIR(0176)	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.4260	1.3670
	0.0470	0.8600	0.6000	1.6350
	0.1480	0.8780	0.7400	1.8350
	0.3040	1.1570	0.8880	2.0360

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0172)	28.250	5.438	3.00	50.56
OUTFLOW: ID= 1 (0176)	28.250	0.303	4.67	49.16

PEAK FLOW REDUCTION [Qout/Qin](%)= 5.58
TIME SHIFT OF PEAK FLOW (min)=100.00
MAXIMUM STORAGE USED (ha.m.)= 1.1558

MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\2b7bf0a5-557e-4a78-9392-0a739a5df2b5\1a9544a4
Ptotal= 64.30 mm	Comments: SCS II 12H_5YR

Duration of storm = 12.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	1.61	3.25	2.57	6.25	11.57	9.25	2.25
0.50	1.61	3.50	2.57	6.50	11.57	9.50	2.25
0.75	1.61	3.75	2.57	6.75	5.14	9.75	2.25
1.00	1.61	4.00	2.57	7.00	5.14	10.00	2.25
1.25	1.61	4.25	3.86	7.25	3.86	10.25	1.29
1.50	1.61	4.50	3.86	7.50	3.86	10.50	1.29
1.75	1.61	4.75	5.14	7.75	3.86	10.75	1.29
2.00	1.61	5.00	5.14	8.00	3.86	11.00	1.29
2.25	1.93	5.25	7.72	8.25	2.25	11.25	1.29
2.50	1.93	5.50	7.72	8.50	2.25	11.50	1.29
2.75	1.93	5.75	30.86	8.75	2.25	11.75	1.29
3.00	1.93	6.00	84.88	9.00	2.25	12.00	1.29

CALIB	
STANDHYD (0173)	Area (ha)= 28.25
ID= 1 DT= 5.0 min	Total Imp(%)= 71.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	20.06	8.19
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	433.97	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.61	3.083	2.57	6.083	11.57	9.08	2.25
0.167	1.61	3.167	2.57	6.167	11.57	9.17	2.25
0.250	1.61	3.250	2.57	6.250	11.57	9.25	2.25
0.333	1.61	3.333	2.57	6.333	11.57	9.33	2.25
0.417	1.61	3.417	2.57	6.417	11.57	9.42	2.25
0.500	1.61	3.500	2.57	6.500	11.57	9.50	2.25
0.583	1.61	3.583	2.57	6.583	5.14	9.58	2.25
0.667	1.61	3.667	2.57	6.667	5.14	9.67	2.25
0.750	1.61	3.750	2.57	6.750	5.14	9.75	2.25
0.833	1.61	3.833	2.57	6.833	5.14	9.83	2.25
0.917	1.61	3.917	2.57	6.917	5.14	9.92	2.25
1.000	1.61	4.000	2.57	7.000	5.14	10.00	2.25
1.083	1.61	4.083	3.86	7.083	3.86	10.08	1.29
1.167	1.61	4.167	3.86	7.167	3.86	10.17	1.29
1.250	1.61	4.250	3.86	7.250	3.86	10.25	1.29
1.333	1.61	4.333	3.86	7.333	3.86	10.33	1.29
1.417	1.61	4.417	3.86	7.417	3.86	10.42	1.29
1.500	1.61	4.500	3.86	7.500	3.86	10.50	1.29
1.583	1.61	4.583	5.14	7.583	3.86	10.58	1.29
1.667	1.61	4.667	5.14	7.667	3.86	10.67	1.29
1.750	1.61	4.750	5.14	7.750	3.86	10.75	1.29
1.833	1.61	4.833	5.14	7.833	3.86	10.83	1.29
1.917	1.61	4.917	5.14	7.917	3.86	10.92	1.29
2.000	1.61	5.000	5.14	8.000	3.86	11.00	1.29
2.083	1.93	5.083	7.72	8.083	2.25	11.08	1.29
2.167	1.93	5.167	7.72	8.167	2.25	11.17	1.29
2.250	1.93	5.250	7.72	8.250	2.25	11.25	1.29
2.333	1.93	5.333	7.72	8.333	2.25	11.33	1.29
2.417	1.93	5.417	7.72	8.417	2.25	11.42	1.29
2.500	1.93	5.500	7.72	8.500	2.25	11.50	1.29
2.583	1.93	5.583	30.86	8.583	2.25	11.58	1.29
2.667	1.93	5.667	30.86	8.667	2.25	11.67	1.29
2.750	1.93	5.750	30.86	8.750	2.25	11.75	1.29
2.833	1.93	5.833	84.88	8.833	2.25	11.83	1.29
2.917	1.93	5.917	84.88	8.917	2.25	11.92	1.29
3.000	1.93	6.000	84.87	9.000	2.25	12.00	1.29

Max.Eff.Inten.(mm/hr)=		84.88	73.34	
over (min)		5.00	15.00	
Storage Coeff. (min)=		6.58 (ii)	14.57 (ii)	
Unit Hyd. Tpeak (min)=		5.00	15.00	
Unit Hyd. peak (cms)=		0.18	0.08	
				TOTALS
PEAK FLOW	(cms)=	4.10	1.00	4.976 (iii)
TIME TO PEAK	(hrs)=	6.00	6.08	6.00
RUNOFF VOLUME	(mm)=	63.30	39.22	55.11
TOTAL RAINFALL	(mm)=	64.30	64.30	64.30
RUNOFF COEFFICIENT	=	0.98	0.61	0.86

(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.

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| RESERVOIR(  0177)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000   |   0.4210      1.3480
                         0.0470     0.8600   |   0.5820      1.6080
                         0.1580     0.8880   |   0.7120      1.8060
                         0.3050     1.1460   |   0.8460      1.9980

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0173)     28.250     4.976      6.00      55.11
   OUTFLOW: ID= 1 (  0177)     28.250     0.304      7.42      53.60

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  6.11
                  TIME SHIFT OF PEAK FLOW          (min)= 85.00
                  MAXIMUM  STORAGE   USED        (ha.m.)=  1.1444

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| CHICAGO STORM    |    IDF curve parameters: A= 853.608
| Ptotal= 50.52 mm |                          B=   4.699
--------------------                          C=   0.766
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  4.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.17    3.57 |  1.17   25.64 |  2.17    8.12 |  3.17    4.22
                0.33    4.07 |  1.33  108.92 |  2.33    6.96 |  3.33    3.93
                0.50    4.76 |  1.50   33.31 |  2.50    6.12 |  3.50    3.68
                0.67    5.79 |  1.67   17.99 |  2.67    5.48 |  3.67    3.47
                0.83    7.53 |  1.83   12.60 |  2.83    4.97 |  3.83    3.28
                1.00   11.20 |  2.00    9.82 |  3.00    4.56 |  4.00    3.12


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| CALIB            |
| STANDHYD (  0174)|   Area     (ha)=  28.25
|ID= 1 DT= 5.0 min |   Total Imp(%)=  71.00   Dir. Conn.(%)=  66.00
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                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=     20.06         8.19
     Dep. Storage     (mm)=      1.00         1.50
     Average Slope     (%)=      1.00         2.00
     Length            (m)=    433.97        40.00
     Manning n            =     0.013        0.250

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    3.57 | 1.083   25.64 | 2.083    8.12 |  3.08    4.22
               0.167    3.57 | 1.167   25.64 | 2.167    8.12 |  3.17    4.22
               0.250    4.07 | 1.250  108.92 | 2.250    6.96 |  3.25    3.93
               0.333    4.07 | 1.333  108.92 | 2.333    6.96 |  3.33    3.93
               0.417    4.76 | 1.417   33.31 | 2.417    6.12 |  3.42    3.68
               0.500    4.76 | 1.500   33.31 | 2.500    6.12 |  3.50    3.68
               0.583    5.79 | 1.583   17.99 | 2.583    5.48 |  3.58    3.47
               0.667    5.79 | 1.667   17.99 | 2.667    5.48 |  3.67    3.47
               0.750    7.53 | 1.750   12.60 | 2.750    4.97 |  3.75    3.28
               0.833    7.53 | 1.833   12.60 | 2.833    4.97 |  3.83    3.28
               0.917   11.20 | 1.917    9.82 | 2.917    4.56 |  3.92    3.12
               1.000   11.20 | 2.000    9.82 | 3.000    4.56 |  4.00    3.12

    Max.Eff.Inten.(mm/hr)=     108.92        67.58
              over (min)         5.00        15.00
    Storage Coeff.  (min)=       5.96 (ii)   10.86 (ii)
    Unit Hyd. Tpeak (min)=       5.00        15.00
    Unit Hyd. peak  (cms)=       0.19         0.09
                                                          *TOTALS*
    PEAK FLOW       (cms)=       4.81         0.90          5.303 (iii)
    TIME TO PEAK    (hrs)=       1.33         1.50           1.33
    RUNOFF VOLUME    (mm)=      49.52        27.72          42.11
    TOTAL RAINFALL   (mm)=      50.52        50.52          50.52
    RUNOFF COEFFICIENT   =       0.98         0.55           0.83

      (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.

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| RESERVOIR(  0178)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000   |   0.2810      1.2030
                         0.0470     0.8600   |   0.3960      1.4090
                         0.1020     0.8601   |   0.4840      1.5570
                         0.2010     1.0400   |   0.5830      1.7020

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0174)     28.250     5.303      1.33      42.11
   OUTFLOW: ID= 1 (  0178)     28.250     0.200      4.00      40.78

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  3.78
                  TIME SHIFT OF PEAK FLOW          (min)=160.00
                  MAXIMUM  STORAGE   USED        (ha.m.)=  1.0395

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       V    V   I    SSSSS  U   U    A    L                (v 6.2.2006)
       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   TTTTT  TTTTT  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\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-a266-6b877f48bd3e\071ba1e5-7d9d-4036-8f03-2450afc2974f\scenari
Summary filename: C:\Users\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-a266-6b877f48bd3e\071ba1e5-7d9d-4036-8f03-2450afc2974f\scenari

DATE: 06-29-2022 TIME: 02:29:53

USER:

COMMENTS: _____

****
** SIMULATION : Run 03 **
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MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\2b7bf0a5-557e-4a78-9392-0a739a5df2b5\a719fc83
Ptotal= 89.90 mm	Comments: SCS II 24H_10YR

Duration of storm = 24.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	0.90	6.25	1.80	12.25	12.95	18.25	1.62
0.50	0.90	6.50	1.80	12.50	12.95	18.50	1.62
0.75	0.90	6.75	1.80	12.75	6.65	18.75	1.62
1.00	0.90	7.00	1.80	13.00	6.65	19.00	1.62
1.25	0.90	7.25	1.80	13.25	1.26	19.25	1.62
1.50	0.90	7.50	1.80	13.50	1.26	19.50	1.62
1.75	0.90	7.75	1.80	13.75	7.37	19.75	1.62
2.00	1.62	8.00	1.80	14.00	7.37	20.00	1.62
2.25	1.17	8.25	2.43	14.25	2.70	20.25	1.08
2.50	1.17	8.50	2.43	14.50	2.70	20.50	1.08
2.75	1.17	8.75	2.43	14.75	2.70	20.75	1.08
3.00	1.17	9.00	2.43	15.00	2.70	21.00	1.08
3.25	1.17	9.25	2.88	15.25	2.70	21.25	1.08
3.50	1.17	9.50	2.88	15.50	2.70	21.50	1.08
3.75	1.17	9.75	3.24	15.75	2.70	21.75	1.08
4.00	1.17	10.00	3.24	16.00	2.70	22.00	1.08
4.25	1.44	10.25	4.14	16.25	1.62	22.25	1.08
4.50	1.44	10.50	4.14	16.50	1.62	22.50	1.08
4.75	1.44	10.75	5.57	16.75	1.62	22.75	1.08
5.00	1.44	11.00	5.57	17.00	1.62	23.00	1.08
5.25	1.44	11.25	8.63	17.25	1.62	23.25	1.08
5.50	1.44	11.50	8.63	17.50	1.62	23.50	1.08
5.75	1.44	11.75	37.40	17.75	1.62	23.75	1.08
6.00	1.44	12.00	99.25	18.00	1.62	24.00	1.08

CALIB	
STANDHYD (0171)	Area (ha)= 28.25
ID= 1 DT= 5.0 min	Total Imp(%)= 71.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	20.06	8.19
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	433.97	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.90	6.083	1.80	12.083	12.96	18.08	1.62
0.167	0.90	6.167	1.80	12.167	12.95	18.17	1.62
0.250	0.90	6.250	1.80	12.250	12.95	18.25	1.62
0.333	0.90	6.333	1.80	12.333	12.95	18.33	1.62
0.417	0.90	6.417	1.80	12.417	12.95	18.42	1.62
0.500	0.90	6.500	1.80	12.500	12.95	18.50	1.62
0.583	0.90	6.583	1.80	12.583	6.65	18.58	1.62
0.667	0.90	6.667	1.80	12.667	6.65	18.67	1.62
0.750	0.90	6.750	1.80	12.750	6.65	18.75	1.62
0.833	0.90	6.833	1.80	12.833	6.65	18.83	1.62
0.917	0.90	6.917	1.80	12.917	6.65	18.92	1.62
1.000	0.90	7.000	1.80	13.000	6.65	19.00	1.62
1.083	0.90	7.083	1.80	13.083	1.26	19.08	1.62
1.167	0.90	7.167	1.80	13.167	1.26	19.17	1.62
1.250	0.90	7.250	1.80	13.250	1.26	19.25	1.62
1.333	0.90	7.333	1.80	13.333	1.26	19.33	1.62
1.417	0.90	7.417	1.80	13.417	1.26	19.42	1.62
1.500	0.90	7.500	1.80	13.500	1.26	19.50	1.62
1.583	0.90	7.583	1.80	13.583	7.37	19.58	1.62
1.667	0.90	7.667	1.80	13.667	7.37	19.67	1.62
1.750	0.90	7.750	1.80	13.750	7.37	19.75	1.62
1.833	1.62	7.833	1.80	13.833	7.37	19.83	1.62
1.917	1.62	7.917	1.80	13.917	7.37	19.92	1.62
2.000	1.62	8.000	1.80	14.000	7.37	20.00	1.62
2.083	1.17	8.083	2.43	14.083	2.70	20.08	1.08
2.167	1.17	8.167	2.43	14.167	2.70	20.17	1.08
2.250	1.17	8.250	2.43	14.250	2.70	20.25	1.08
2.333	1.17	8.333	2.43	14.333	2.70	20.33	1.08
2.417	1.17	8.417	2.43	14.417	2.70	20.42	1.08
2.500	1.17	8.500	2.43	14.500	2.70	20.50	1.08
2.583	1.17	8.583	2.43	14.583	2.70	20.58	1.08
2.667	1.17	8.667	2.43	14.667	2.70	20.67	1.08
2.750	1.17	8.750	2.43	14.750	2.70	20.75	1.08
2.833	1.17	8.833	2.43	14.833	2.70	20.83	1.08
2.917	1.17	8.917	2.43	14.917	2.70	20.92	1.08
3.000	1.17	9.000	2.43	15.000	2.70	21.00	1.08
3.083	1.17	9.083	2.88	15.083	2.70	21.08	1.08
3.167	1.17	9.167	2.88	15.167	2.70	21.17	1.08
3.250	1.17	9.250	2.88	15.250	2.70	21.25	1.08
3.333	1.17	9.333	2.88	15.333	2.70	21.33	1.08
3.417	1.17	9.417	2.88	15.417	2.70	21.42	1.08
3.500	1.17	9.500	2.88	15.500	2.70	21.50	1.08
3.583	1.17	9.583	3.24	15.583	2.70	21.58	1.08
3.667	1.17	9.667	3.24	15.667	2.70	21.67	1.08
3.750	1.17	9.750	3.24	15.750	2.70	21.75	1.08
3.833	1.17	9.833	3.24	15.833	2.70	21.83	1.08
3.917	1.17	9.917	3.24	15.917	2.70	21.92	1.08

4.000	1.17	10.000	3.24	16.000	2.70	22.00	1.08
4.083	1.44	10.083	4.14	16.083	1.62	22.08	1.08
4.167	1.44	10.167	4.14	16.167	1.62	22.17	1.08
4.250	1.44	10.250	4.14	16.250	1.62	22.25	1.08
4.333	1.44	10.333	4.14	16.333	1.62	22.33	1.08
4.417	1.44	10.417	4.14	16.417	1.62	22.42	1.08
4.500	1.44	10.500	4.14	16.500	1.62	22.50	1.08
4.583	1.44	10.583	5.57	16.583	1.62	22.58	1.08
4.667	1.44	10.667	5.57	16.667	1.62	22.67	1.08
4.750	1.44	10.750	5.57	16.750	1.62	22.75	1.08
4.833	1.44	10.833	5.57	16.833	1.62	22.83	1.08
4.917	1.44	10.917	5.57	16.917	1.62	22.92	1.08
5.000	1.44	11.000	5.57	17.000	1.62	23.00	1.08
5.083	1.44	11.083	8.63	17.083	1.62	23.08	1.08
5.167	1.44	11.167	8.63	17.167	1.62	23.17	1.08
5.250	1.44	11.250	8.63	17.250	1.62	23.25	1.08
5.333	1.44	11.333	8.63	17.333	1.62	23.33	1.08
5.417	1.44	11.417	8.63	17.417	1.62	23.42	1.08
5.500	1.44	11.500	8.63	17.500	1.62	23.50	1.08
5.583	1.44	11.583	37.40	17.583	1.62	23.58	1.08
5.667	1.44	11.667	37.40	17.667	1.62	23.67	1.08
5.750	1.44	11.750	37.40	17.750	1.62	23.75	1.08
5.833	1.44	11.833	99.24	17.833	1.62	23.83	1.08
5.917	1.44	11.917	99.25	17.917	1.62	23.92	1.08
6.000	1.44	12.000	99.25	18.000	1.62	24.00	1.08

			TOTALS
Max.Eff.Inten.(mm/hr)=	99.25	94.35	
over (min)	5.00	15.00	
Storage Coeff. (min)=	6.18 (ii)	13.41 (ii)	
Unit Hyd. Tpeak (min)=	5.00	15.00	
Unit Hyd. peak (cms)=	0.19	0.08	
PEAK FLOW (cms)=	4.85	1.37	6.083 (iii)
TIME TO PEAK (hrs)=	12.00	12.08	12.00
RUNOFF VOLUME (mm)=	88.90	61.91	79.72
TOTAL RAINFALL (mm)=	89.90	89.90	89.90
RUNOFF COEFFICIENT =	0.99	0.69	0.89

(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.

RESERVOIR(0175)	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.4810	1.4680
	0.0470	0.8600	0.6580	1.7540
	0.1860	0.9300	0.7990	1.9670
	0.3530	1.2390	0.9460	2.1790

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0171)	28.250	6.083	12.00	79.72
OUTFLOW: ID= 1 (0175)	28.250	0.480	13.00	77.83

PEAK FLOW REDUCTION [Qout/Qin](%)= 7.89
TIME SHIFT OF PEAK FLOW (min)= 60.00
MAXIMUM STORAGE USED (ha.m.)= 1.4668

MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\2b7bf0a5-557e-4a78-9392-0a739a5df2b5\118845a2
Ptotal= 70.80 mm	Comments: SCS II 6H_10YR

Duration of storm = 6.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	2.83	1.75	7.08	3.25	15.58	4.75	4.25
0.50	2.83	2.00	7.08	3.50	15.58	5.00	4.25
0.75	4.25	2.25	8.50	3.75	7.08	5.25	2.83
1.00	4.25	2.50	8.50	4.00	7.08	5.50	2.83
1.25	4.25	2.75	42.48	4.25	5.66	5.75	2.83
1.50	4.25	3.00	110.45	4.50	5.66	6.00	2.83

CALIB	
STANDHYD (0172)	Area (ha)= 28.25
ID= 1 DT= 5.0 min	Total Imp(%)= 71.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	20.06	8.19
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	433.97	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.83	1.583	7.08	3.083	15.58	4.58	4.25
0.167	2.83	1.667	7.08	3.167	15.58	4.67	4.25
0.250	2.83	1.750	7.08	3.250	15.58	4.75	4.25
0.333	2.83	1.833	7.08	3.333	15.58	4.83	4.25
0.417	2.83	1.917	7.08	3.417	15.58	4.92	4.25
0.500	2.83	2.000	7.08	3.500	15.58	5.00	4.25
0.583	4.25	2.083	8.50	3.583	7.08	5.08	2.83
0.667	4.25	2.167	8.50	3.667	7.08	5.17	2.83
0.750	4.25	2.250	8.50	3.750	7.08	5.25	2.83
0.833	4.25	2.333	8.50	3.833	7.08	5.33	2.83
0.917	4.25	2.417	8.50	3.917	7.08	5.42	2.83
1.000	4.25	2.500	8.50	4.000	7.08	5.50	2.83
1.083	4.25	2.583	42.48	4.083	5.66	5.58	2.83
1.167	4.25	2.667	42.48	4.167	5.66	5.67	2.83
1.250	4.25	2.750	42.48	4.250	5.66	5.75	2.83
1.333	4.25	2.833	110.45	4.333	5.66	5.83	2.83
1.417	4.25	2.917	110.45	4.417	5.66	5.92	2.83
1.500	4.25	3.000	110.45	4.500	5.66	6.00	2.83

			TOTALS
Max.Eff.Inten.(mm/hr)=	110.45	99.08	
over (min)	5.00	15.00	
Storage Coeff. (min)=	5.92 (ii)	10.80 (ii)	
Unit Hyd. Tpeak (min)=	5.00	15.00	
Unit Hyd. peak (cms)=	0.19	0.09	
PEAK FLOW (cms)=	5.43	1.51	6.779 (iii)
TIME TO PEAK (hrs)=	3.00	3.08	3.00
RUNOFF VOLUME (mm)=	69.80	44.85	61.32
TOTAL RAINFALL (mm)=	70.80	70.80	70.80

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     RUNOFF COEFFICIENT   =       0.99         0.63          0.87

       (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.

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| RESERVOIR(  0176)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.4260     1.3670
                          0.0470     0.8600   |   0.6000     1.6350
                          0.1480     0.8780   |   0.7400     1.8350
                          0.3040     1.1570   |   0.8880     2.0360

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0172)     28.250     6.779      3.00      61.32
   OUTFLOW: ID= 1 (  0176)     28.250     0.425      4.50      59.88

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  6.26
                  TIME SHIFT OF PEAK FLOW         (min)= 90.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  1.3648

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| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              2b7bf0a5-557e-4a78-9392-0a739a5df2b5\2450d259
| Ptotal= 76.00 mm |    Comments: SCS II 12H_10YR
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                       Duration of storm    = 12.00 hrs
                       Mass curve time step = 15.00 min

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.25    1.90 |  3.25    3.04 |  6.25   13.68 |  9.25    2.66
                0.50    1.90 |  3.50    3.04 |  6.50   13.68 |  9.50    2.66
                0.75    1.90 |  3.75    3.04 |  6.75    6.08 |  9.75    2.66
                1.00    1.90 |  4.00    3.04 |  7.00    6.08 | 10.00    2.66
                1.25    1.90 |  4.25    4.56 |  7.25    4.56 | 10.25    1.52
                1.50    1.90 |  4.50    4.56 |  7.50    4.56 | 10.50    1.52
                1.75    1.90 |  4.75    6.08 |  7.75    4.56 | 10.75    1.52
                2.00    1.90 |  5.00    6.08 |  8.00    4.56 | 11.00    1.52
                2.25    2.28 |  5.25    9.12 |  8.25    2.66 | 11.25    1.52
                2.50    2.28 |  5.50    9.12 |  8.50    2.66 | 11.50    1.52
                2.75    2.28 |  5.75   36.48 |  8.75    2.66 | 11.75    1.52
                3.00    2.28 |  6.00  100.32 |  9.00    2.66 | 12.00    1.52

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| CALIB            |
| STANDHYD (  0173)|   Area    (ha)=  28.25
|ID= 1 DT= 5.0 min |   Total Imp(%)=  71.00   Dir. Conn.(%)=  66.00
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                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      20.06         8.19
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     433.97        40.00
     Mannings n           =      0.013        0.250
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NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083   1.90 | 3.083    3.04 | 6.083   13.68 |  9.08    2.66
                0.167   1.90 | 3.167    3.04 | 6.167   13.68 |  9.17    2.66
                0.250   1.90 | 3.250    3.04 | 6.250   13.68 |  9.25    2.66
                0.333   1.90 | 3.333    3.04 | 6.333   13.68 |  9.33    2.66
                0.417   1.90 | 3.417    3.04 | 6.417   13.68 |  9.42    2.66
                0.500   1.90 | 3.500    3.04 | 6.500   13.68 |  9.50    2.66
                0.583   1.90 | 3.583    3.04 | 6.583    6.08 |  9.58    2.66
                0.667   1.90 | 3.667    3.04 | 6.667    6.08 |  9.67    2.66
                0.750   1.90 | 3.750    3.04 | 6.750    6.08 |  9.75    2.66
                0.833   1.90 | 3.833    3.04 | 6.833    6.08 |  9.83    2.66
                0.917   1.90 | 3.917    3.04 | 6.917    6.08 |  9.92    2.66
                1.000   1.90 | 4.000    3.04 | 7.000    6.08 | 10.00    2.66
                1.083   1.90 | 4.083    4.56 | 7.083    4.56 | 10.08    1.52
                1.167   1.90 | 4.167    4.56 | 7.167    4.56 | 10.17    1.52
                1.250   1.90 | 4.250    4.56 | 7.250    4.56 | 10.25    1.52
                1.333   1.90 | 4.333    4.56 | 7.333    4.56 | 10.33    1.52
                1.417   1.90 | 4.417    4.56 | 7.417    4.56 | 10.42    1.52
                1.500   1.90 | 4.500    4.56 | 7.500    4.56 | 10.50    1.52
                1.583   1.90 | 4.583    6.08 | 7.583    4.56 | 10.58    1.52
                1.667   1.90 | 4.667    6.08 | 7.667    4.56 | 10.67    1.52
                1.750   1.90 | 4.750    6.08 | 7.750    4.56 | 10.75    1.52
                1.833   1.90 | 4.833    6.08 | 7.833    4.56 | 10.83    1.52
                1.917   1.90 | 4.917    6.08 | 7.917    4.56 | 10.92    1.52
                2.000   1.90 | 5.000    6.08 | 8.000    4.56 | 11.00    1.52
                2.083   2.28 | 5.083    9.12 | 8.083    2.66 | 11.08    1.52
                2.167   2.28 | 5.167    9.12 | 8.167    2.66 | 11.17    1.52
                2.250   2.28 | 5.250    9.12 | 8.250    2.66 | 11.25    1.52
                2.333   2.28 | 5.333    9.12 | 8.333    2.66 | 11.33    1.52
                2.417   2.28 | 5.417    9.12 | 8.417    2.66 | 11.42    1.52
                2.500   2.28 | 5.500    9.12 | 8.500    2.66 | 11.50    1.52
                2.583   2.28 | 5.583   36.48 | 8.583    2.66 | 11.58    1.52
                2.667   2.28 | 5.667   36.48 | 8.667    2.66 | 11.67    1.52
                2.750   2.28 | 5.750   36.48 | 8.750    2.66 | 11.75    1.52
                2.833   2.28 | 5.833  100.32 | 8.833    2.66 | 11.83    1.52
                2.917   2.28 | 5.917  100.32 | 8.917    2.66 | 11.92    1.52
                3.000   2.28 | 6.000  100.32 | 9.000    2.66 | 12.00    1.52

     Max.Eff.Inten.(mm/hr)=     100.32         91.65
               over (min)          5.00         15.00
     Storage Coeff.  (min)=        6.16 (ii)    13.46 (ii)
     Unit Hyd. Tpeak (min)=        5.00         15.00
     Unit Hyd. peak  (cms)=        0.19          0.08
                                                          *TOTALS*
     PEAK FLOW       (cms)=        4.90          1.30       6.054 (iii)
     TIME TO PEAK    (hrs)=        6.00          6.08        6.00
     RUNOFF VOLUME    (mm)=       75.00         49.43       66.31
     TOTAL RAINFALL   (mm)=       76.00         76.00       76.00
     RUNOFF COEFFICIENT   =        0.99          0.65        0.87

       (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.

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| RESERVOIR(  0177)|     OVERFLOW IS OFF
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IN= 2---> OUT= 1					
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)	
	0.0000	0.0000	0.4210	1.3480	
	0.0470	0.8600	0.5820	1.6080	
	0.1580	0.8880	0.7120	1.8060	
	0.3050	1.1460	0.8460	1.9980	

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0173)	28.250	6.054	6.00	66.31
OUTFLOW: ID= 1 (0177)	28.250	0.420	7.17	64.75

PEAK FLOW REDUCTION [Qout/Qin](%)= 6.94
TIME SHIFT OF PEAK FLOW (min)= 70.00
MAXIMUM STORAGE USED (ha.m.)= 1.3470

CHICAGO STORM	IDF curve parameters: A= 975.865
Ptotal= 59.69 mm	B= 4.699
	C= 0.760

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

Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.17	4.32	1.17	30.27	2.17	9.72	3.17	5.09
0.33	4.91	1.33	126.55	2.33	8.35	3.33	4.74
0.50	5.73	1.50	39.22	2.50	7.35	3.50	4.45
0.67	6.96	1.67	21.35	2.67	6.59	3.67	4.19
0.83	9.03	1.83	15.01	2.83	5.99	3.83	3.97
1.00	13.36	2.00	11.74	3.00	5.50	4.00	3.77

CALIB	
STANDHYD (0174)	Area (ha)= 28.25
ID= 1 DT= 5.0 min	Total Imp(%)= 71.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	20.06	8.19
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	433.97	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	4.32	1.083	30.27	2.083	9.72	3.08	5.09
0.167	4.32	1.167	30.27	2.167	9.72	3.17	5.09
0.250	4.91	1.250	126.55	2.250	8.35	3.25	4.74
0.333	4.91	1.333	126.55	2.333	8.35	3.33	4.74
0.417	5.73	1.417	39.22	2.417	7.35	3.42	4.45
0.500	5.73	1.500	39.22	2.500	7.35	3.50	4.45
0.583	6.96	1.583	21.35	2.583	6.59	3.58	4.19
0.667	6.96	1.667	21.35	2.667	6.59	3.67	4.19
0.750	9.03	1.750	15.01	2.750	5.99	3.75	3.97
0.833	9.03	1.833	15.01	2.833	5.99	3.83	3.97
0.917	13.36	1.917	11.74	2.917	5.50	3.92	3.77
1.000	13.36	2.000	11.74	3.000	5.50	4.00	3.77

Max.Eff.Inten.(mm/hr)=	126.55	86.05		
over (min)	5.00	15.00		
Storage Coeff. (min)=	5.61 (ii)	10.23 (ii)		
Unit Hyd. Tpeak (min)=	5.00	15.00		
Unit Hyd. peak (cms)=	0.20	0.09		
			TOTALS	
PEAK FLOW (cms)=	5.69	1.17	6.352 (iii)	
TIME TO PEAK (hrs)=	1.33	1.50	1.33	
RUNOFF VOLUME (mm)=	58.69	35.31	50.74	
TOTAL RAINFALL (mm)=	59.69	59.69	59.69	
RUNOFF COEFFICIENT =	0.98	0.59	0.85	

(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.

RESERVOIR(0178)	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.2810	1.2030
	0.0470	0.8600	0.3960	1.4090
	0.1020	0.8601	0.4840	1.5570
	0.2010	1.0400	0.5830	1.7020

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0174)	28.250	6.352	1.33	50.74
OUTFLOW: ID= 1 (0178)	28.250	0.281	4.00	49.36

PEAK FLOW REDUCTION [Qout/Qin](%)= 4.42
TIME SHIFT OF PEAK FLOW (min)=160.00
MAXIMUM STORAGE USED (ha.m.)= 1.2029

```
       V    V   I    SSSSS  U   U    A    L              (v 6.2.2006)
       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   TTTTT  TTTTT  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\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-a266-6b877f48bd3e\49943b8a-82fa-4470-aeba-388c45152428\scenari
Summary filename: C:\Users\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-a266-6b877f48bd3e\49943b8a-82fa-4470-aeba-388c45152428\scenari

DATE: 06-29-2022 TIME: 02:29:54

USER:

COMMENTS: _____

** SIMULATION : Run 04 **

MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\2b7bf0a5-557e-4a78-9392-0a739a5df2b5\6d7a2231
Ptotal=107.50 mm	Comments: Mass 24-Hour SCS Type II Design Storm

Duration of storm = 24.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	1.08	6.25	2.15	12.25	15.48	18.25	1.93
0.50	1.08	6.50	2.15	12.50	15.48	18.50	1.94
0.75	1.08	6.75	2.15	12.75	7.95	18.75	1.93
1.00	1.08	7.00	2.15	13.00	7.96	19.00	1.94
1.25	1.08	7.25	2.15	13.25	1.50	19.25	1.93
1.50	1.07	7.50	2.15	13.50	1.50	19.50	1.94
1.75	1.08	7.75	2.15	13.75	8.82	19.75	1.93
2.00	1.93	8.00	2.15	14.00	8.82	20.00	1.94
2.25	1.40	8.25	2.90	14.25	3.22	20.25	1.29
2.50	1.40	8.50	2.90	14.50	3.22	20.50	1.29
2.75	1.40	8.75	2.90	14.75	3.22	20.75	1.29
3.00	1.40	9.00	2.90	15.00	3.23	21.00	1.29
3.25	1.40	9.25	3.44	15.25	3.22	21.25	1.29
3.50	1.40	9.50	3.44	15.50	3.22	21.50	1.29
3.75	1.40	9.75	3.87	15.75	3.22	21.75	1.29
4.00	1.40	10.00	3.87	16.00	3.22	22.00	1.29
4.25	1.72	10.25	4.95	16.25	1.94	22.25	1.29
4.50	1.72	10.50	4.95	16.50	1.93	22.50	1.29
4.75	1.72	10.75	6.67	16.75	1.93	22.75	1.29
5.00	1.72	11.00	6.66	17.00	1.94	23.00	1.29
5.25	1.72	11.25	10.32	17.25	1.93	23.25	1.29
5.50	1.72	11.50	10.32	17.50	1.94	23.50	1.29
5.75	1.72	11.75	44.72	17.75	1.93	23.75	1.29
6.00	1.72	12.00	118.68	18.00	1.94	24.00	1.29

CALIB	
STANDHYD (0171)	Area (ha)= 28.25
ID= 1 DT= 5.0 min	Total Imp(%)= 71.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	20.06	8.19
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	433.97	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.08	6.083	2.15	12.083	15.49	18.08	1.94
0.167	1.08	6.167	2.15	12.167	15.48	18.17	1.93
0.250	1.08	6.250	2.15	12.250	15.48	18.25	1.93
0.333	1.08	6.333	2.15	12.333	15.48	18.33	1.94
0.417	1.08	6.417	2.15	12.417	15.48	18.42	1.94
0.500	1.08	6.500	2.15	12.500	15.48	18.50	1.94
0.583	1.08	6.583	2.15	12.583	7.96	18.58	1.94
0.667	1.08	6.667	2.15	12.667	7.95	18.67	1.93
0.750	1.08	6.750	2.15	12.750	7.95	18.75	1.93
0.833	1.07	6.833	2.15	12.833	7.95	18.83	1.94
0.917	1.08	6.917	2.15	12.917	7.96	18.92	1.94
1.000	1.08	7.000	2.15	13.000	7.96	19.00	1.94
1.083	1.07	7.083	2.15	13.083	1.51	19.08	1.94
1.167	1.08	7.167	2.15	13.167	1.50	19.17	1.93
1.250	1.08	7.250	2.15	13.250	1.50	19.25	1.93
1.333	1.08	7.333	2.15	13.333	1.50	19.33	1.94
1.417	1.07	7.417	2.15	13.417	1.50	19.42	1.94
1.500	1.08	7.500	2.15	13.500	1.50	19.50	1.94
1.583	1.08	7.583	2.15	13.583	8.81	19.58	1.93
1.667	1.08	7.667	2.15	13.667	8.82	19.67	1.93
1.750	1.08	7.750	2.15	13.750	8.82	19.75	1.94
1.833	1.93	7.833	2.15	13.833	8.81	19.83	1.94
1.917	1.93	7.917	2.15	13.917	8.82	19.92	1.94
2.000	1.93	8.000	2.15	14.000	8.82	20.00	1.93
2.083	1.40	8.083	2.90	14.083	3.23	20.08	1.29
2.167	1.40	8.167	2.90	14.167	3.22	20.17	1.29
2.250	1.40	8.250	2.90	14.250	3.22	20.25	1.29
2.333	1.40	8.333	2.90	14.333	3.22	20.33	1.29
2.417	1.40	8.417	2.90	14.417	3.22	20.42	1.29
2.500	1.40	8.500	2.90	14.500	3.22	20.50	1.29
2.583	1.40	8.583	2.90	14.583	3.22	20.58	1.29
2.667	1.40	8.667	2.90	14.667	3.22	20.67	1.29
2.750	1.40	8.750	2.90	14.750	3.22	20.75	1.29
2.833	1.40	8.833	2.90	14.833	3.23	20.83	1.29
2.917	1.40	8.917	2.90	14.917	3.23	20.92	1.29
3.000	1.40	9.000	2.90	15.000	3.23	21.00	1.29
3.083	1.40	9.083	3.44	15.083	3.22	21.08	1.29
3.167	1.40	9.167	3.44	15.167	3.22	21.17	1.29
3.250	1.40	9.250	3.44	15.250	3.22	21.25	1.29
3.333	1.40	9.333	3.44	15.333	3.22	21.33	1.29
3.417	1.40	9.417	3.44	15.417	3.22	21.42	1.29
3.500	1.40	9.500	3.44	15.500	3.22	21.50	1.29
3.583	1.40	9.583	3.87	15.583	3.22	21.58	1.29
3.667	1.40	9.667	3.87	15.667	3.22	21.67	1.29
3.750	1.40	9.750	3.87	15.750	3.22	21.75	1.29
3.833	1.40	9.833	3.87	15.833	3.22	21.83	1.29
3.917	1.40	9.917	3.87	15.917	3.22	21.92	1.29
4.000	1.40	10.000	3.87	16.000	3.22	22.00	1.29
4.083	1.72	10.083	4.94	16.083	1.94	22.08	1.29
4.167	1.72	10.167	4.95	16.167	1.94	22.17	1.29
4.250	1.72	10.250	4.95	16.250	1.94	22.25	1.29
4.333	1.72	10.333	4.94	16.333	1.94	22.33	1.29
4.417	1.72	10.417	4.95	16.417	1.93	22.42	1.29
4.500	1.72	10.500	4.95	16.500	1.93	22.50	1.29
4.583	1.72	10.583	6.66	16.583	1.94	22.58	1.29
4.667	1.72	10.667	6.67	16.667	1.93	22.67	1.29

4.750	1.72	10.750	6.67	16.750	1.93	22.75	1.29
4.833	1.72	10.833	6.66	16.833	1.94	22.83	1.29
4.917	1.72	10.917	6.66	16.917	1.94	22.92	1.29
5.000	1.72	11.000	6.66	17.000	1.94	23.00	1.29
5.083	1.72	11.083	10.32	17.083	1.94	23.08	1.29
5.167	1.72	11.167	10.32	17.167	1.93	23.17	1.29
5.250	1.72	11.250	10.32	17.250	1.93	23.25	1.29
5.333	1.72	11.333	10.32	17.333	1.94	23.33	1.29
5.417	1.72	11.417	10.32	17.417	1.94	23.42	1.29
5.500	1.72	11.500	10.32	17.500	1.94	23.50	1.29
5.583	1.72	11.583	44.72	17.583	1.94	23.58	1.29
5.667	1.72	11.667	44.72	17.667	1.93	23.67	1.29
5.750	1.72	11.750	44.72	17.750	1.93	23.75	1.29
5.833	1.72	11.833	118.67	17.833	1.94	23.83	1.29
5.917	1.72	11.917	118.68	17.917	1.94	23.92	1.29
6.000	1.72	12.000	118.68	18.000	1.94	24.00	1.29

				TOTALS
Max.Eff.Inten.(mm/hr)=	118.68	117.89		
over (min)	5.00	15.00		
Storage Coeff. (min)=	5.76 (ii)	10.50 (ii)		
Unit Hyd. Tpeak (min)=	5.00	15.00		
Unit Hyd. peak (cms)=	0.20	0.09		
PEAK FLOW (cms)=	5.85	1.88		7.593 (iii)
TIME TO PEAK (hrs)=	12.00	12.08		12.00
RUNOFF VOLUME (mm)=	106.50	78.11		96.85
TOTAL RAINFALL (mm)=	107.50	107.50		107.50
RUNOFF COEFFICIENT =	0.99	0.73		0.90

(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.

RESERVOIR(0175)	OVERFLOW IS OFF
IN= 2---> OUT= 1	
DT= 5.0 min	

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.4810	1.4680
0.0470	0.8600	0.6580	1.7540
0.1860	0.9300	0.7990	1.9670
0.3530	1.2390	0.9460	2.1790

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0171)	28.250	7.593	12.00	96.85
OUTFLOW: ID= 1 (0175)	28.250	0.657	12.92	94.93

PEAK FLOW REDUCTION [Qout/Qin](%)= 8.66
TIME SHIFT OF PEAK FLOW (min)= 55.00
MAXIMUM STORAGE USED (ha.m.)= 1.7530

MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\2b7bf0a5-557e-4a78-9392-0a739a5df2b5\b7d4aaa8
Ptotal= 85.20 mm	Comments: SCS II 6H_25YR

Duration of storm = 6.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	3.41	1.75	8.52	3.25	18.74	4.75	5.11
0.50	3.41	2.00	8.52	3.50	18.74	5.00	5.11
0.75	5.11	2.25	10.22	3.75	8.52	5.25	3.41
1.00	5.11	2.50	10.22	4.00	8.52	5.50	3.41
1.25	5.11	2.75	51.12	4.25	6.82	5.75	3.41
1.50	5.11	3.00	132.91	4.50	6.82	6.00	3.41

CALIB	
STANDHYD (0172)	Area (ha)= 28.25
ID= 1 DT= 5.0 min	Total Imp(%)= 71.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	20.06	8.19
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	433.97	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	3.41	1.583	8.52	3.083	18.74	4.58	5.11
0.167	3.41	1.667	8.52	3.167	18.74	4.67	5.11
0.250	3.41	1.750	8.52	3.250	18.74	4.75	5.11
0.333	3.41	1.833	8.52	3.333	18.74	4.83	5.11
0.417	3.41	1.917	8.52	3.417	18.74	4.92	5.11
0.500	3.41	2.000	8.52	3.500	18.74	5.00	5.11
0.583	5.11	2.083	10.22	3.583	8.52	5.08	3.41
0.667	5.11	2.167	10.22	3.667	8.52	5.17	3.41
0.750	5.11	2.250	10.22	3.750	8.52	5.25	3.41
0.833	5.11	2.333	10.22	3.833	8.52	5.33	3.41
0.917	5.11	2.417	10.22	3.917	8.52	5.42	3.41
1.000	5.11	2.500	10.22	4.000	8.52	5.50	3.41
1.083	5.11	2.583	51.12	4.083	6.82	5.58	3.41
1.167	5.11	2.667	51.12	4.167	6.82	5.67	3.41
1.250	5.11	2.750	51.12	4.250	6.82	5.75	3.41
1.333	5.11	2.833	132.91	4.333	6.82	5.83	3.41
1.417	5.11	2.917	132.91	4.417	6.82	5.92	3.41
1.500	5.11	3.000	132.91	4.500	6.82	6.00	3.41

				TOTALS
Max.Eff.Inten.(mm/hr)=	132.91	125.99		
over (min)	5.00	15.00		
Storage Coeff. (min)=	5.50 (ii)	10.03 (ii)		
Unit Hyd. Tpeak (min)=	5.00	15.00		
Unit Hyd. peak (cms)=	0.20	0.10		
PEAK FLOW (cms)=	6.60	1.99		8.399 (iii)
TIME TO PEAK (hrs)=	3.00	3.08		3.00
RUNOFF VOLUME (mm)=	84.20	57.65		75.17
TOTAL RAINFALL (mm)=	85.20	85.20		85.20
RUNOFF COEFFICIENT =	0.99	0.68		0.88

(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.

```
| RESERVOIR(  0176)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000   |   0.4260     1.3670
                         0.0470     0.8600   |   0.6000     1.6350
                         0.1480     0.8780   |   0.7400     1.8350
                         0.3040     1.1570   |   0.8880     2.0360

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0172)     28.250     8.399      3.00      75.17
   OUTFLOW: ID= 1 (  0176)     28.250     0.599      4.08      73.70

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  7.13
                  TIME SHIFT OF PEAK FLOW         (min)= 65.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  1.6337
```

```
| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              2b7bf0a5-557e-4a78-9392-0a739a5df2b5\8b21e398
| Ptotal= 90.70 mm |    Comments: SCS II 12H_25YR
```

Duration of storm = 12.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	2.27	3.25	3.63	6.25	16.33	9.25	3.17
0.50	2.27	3.50	3.63	6.50	16.33	9.50	3.17
0.75	2.27	3.75	3.63	6.75	7.26	9.75	3.17
1.00	2.27	4.00	3.63	7.00	7.26	10.00	3.17
1.25	2.27	4.25	5.44	7.25	5.44	10.25	1.81
1.50	2.27	4.50	5.44	7.50	5.44	10.50	1.81
1.75	2.27	4.75	7.26	7.75	5.44	10.75	1.81
2.00	2.27	5.00	7.26	8.00	5.44	11.00	1.81
2.25	2.72	5.25	10.88	8.25	3.17	11.25	1.81
2.50	2.72	5.50	10.88	8.50	3.17	11.50	1.81
2.75	2.72	5.75	43.54	8.75	3.17	11.75	1.81
3.00	2.72	6.00	119.72	9.00	3.17	12.00	1.81

```
| CALIB            |
| STANDHYD (  0173)|   Area    (ha)=  28.25
|ID= 1 DT= 5.0 min |   Total Imp(%)=  71.00   Dir. Conn.(%)=  66.00
```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	20.06	8.19
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	433.97	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.27	3.083	3.63	6.083	16.33	9.08	3.17
0.167	2.27	3.167	3.63	6.167	16.33	9.17	3.17
0.250	2.27	3.250	3.63	6.250	16.33	9.25	3.17
0.333	2.27	3.333	3.63	6.333	16.33	9.33	3.17
0.417	2.27	3.417	3.63	6.417	16.33	9.42	3.17
0.500	2.27	3.500	3.63	6.500	16.33	9.50	3.17
0.583	2.27	3.583	3.63	6.583	7.26	9.58	3.17
0.667	2.27	3.667	3.63	6.667	7.26	9.67	3.17
0.750	2.27	3.750	3.63	6.750	7.26	9.75	3.17
0.833	2.27	3.833	3.63	6.833	7.26	9.83	3.17
0.917	2.27	3.917	3.63	6.917	7.26	9.92	3.17
1.000	2.27	4.000	3.63	7.000	7.26	10.00	3.17
1.083	2.27	4.083	5.44	7.083	5.44	10.08	1.81
1.167	2.27	4.167	5.44	7.167	5.44	10.17	1.81
1.250	2.27	4.250	5.44	7.250	5.44	10.25	1.81
1.333	2.27	4.333	5.44	7.333	5.44	10.33	1.81
1.417	2.27	4.417	5.44	7.417	5.44	10.42	1.81
1.500	2.27	4.500	5.44	7.500	5.44	10.50	1.81
1.583	2.27	4.583	7.26	7.583	5.44	10.58	1.81
1.667	2.27	4.667	7.26	7.667	5.44	10.67	1.81
1.750	2.27	4.750	7.26	7.750	5.44	10.75	1.81
1.833	2.27	4.833	7.26	7.833	5.44	10.83	1.81
1.917	2.27	4.917	7.26	7.917	5.44	10.92	1.81
2.000	2.27	5.000	7.26	8.000	5.44	11.00	1.81
2.083	2.72	5.083	10.88	8.083	3.17	11.08	1.81
2.167	2.72	5.167	10.88	8.167	3.17	11.17	1.81
2.250	2.72	5.250	10.88	8.250	3.17	11.25	1.81
2.333	2.72	5.333	10.88	8.333	3.17	11.33	1.81
2.417	2.72	5.417	10.88	8.417	3.17	11.42	1.81
2.500	2.72	5.500	10.88	8.500	3.17	11.50	1.81
2.583	2.72	5.583	43.54	8.583	3.17	11.58	1.81
2.667	2.72	5.667	43.54	8.667	3.17	11.67	1.81
2.750	2.72	5.750	43.54	8.750	3.17	11.75	1.81
2.833	2.72	5.833	119.72	8.833	3.17	11.83	1.81
2.917	2.72	5.917	119.72	8.917	3.17	11.92	1.81
3.000	2.72	6.000	119.72	9.000	3.17	12.00	1.81

Max.Eff.Inten.(mm/hr)=	119.72	114.99		
over (min)	5.00	15.00		
Storage Coeff. (min)=	5.74 (ii)	10.46 (ii)		
Unit Hyd. Tpeak (min)=	5.00	15.00		
Unit Hyd. peak (cms)=	0.20	0.09		
				TOTALS
PEAK FLOW (cms)=	5.90	1.81		7.552 (iii)
TIME TO PEAK (hrs)=	6.00	6.08		6.00
RUNOFF VOLUME (mm)=	89.70	62.64		80.50
TOTAL RAINFALL (mm)=	90.70	90.70		90.70
RUNOFF COEFFICIENT =	0.99	0.69		0.89

(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.

```
| RESERVOIR(  0177)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000   |   0.4210     1.3480
                         0.0470     0.8600   |   0.5820     1.6080
                         0.1580     0.8880   |   0.7120     1.8060
                         0.3050     1.1460   |   0.8460     1.9980

                                AREA     QPEAK     TPEAK       R.V.
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```
                              (ha)      (cms)      (hrs)       (mm)
   INFLOW : ID= 2 (  0173)     28.250      7.552      6.00      80.50
   OUTFLOW: ID= 1 (  0177)     28.250      0.582      7.00      78.91

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  7.70
                  TIME SHIFT OF PEAK FLOW          (min)= 60.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  1.6073

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--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1146.275
| Ptotal= 71.24 mm |                          B=   4.922
--------------------                          C=   0.757
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  4.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =  0.33

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.17    5.22 |  1.17   36.37 |  2.17   11.74 |  3.17    6.15
                0.33    5.94 |  1.33  148.15 |  2.33   10.09 |  3.33    5.74
                0.50    6.93 |  1.50   47.06 |  2.50    8.89 |  3.50    5.38
                0.67    8.42 |  1.67   25.72 |  2.67    7.96 |  3.67    5.08
                0.83   10.91 |  1.83   18.11 |  2.83    7.24 |  3.83    4.80
                1.00   16.13 |  2.00   14.17 |  3.00    6.65 |  4.00    4.57


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--------------------
| CALIB            |
| STANDHYD (  0174)|   Area    (ha)=  28.25
|ID= 1 DT= 5.0 min |   Total Imp(%)=  71.00   Dir. Conn.(%)=  66.00
--------------------

                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      20.06         8.19
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     433.97        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    5.22 | 1.083   36.37 | 2.083   11.74 |  3.08    6.15
               0.167    5.22 | 1.167   36.37 | 2.167   11.74 |  3.17    6.15
               0.250    5.94 | 1.250  148.15 | 2.250   10.09 |  3.25    5.74
               0.333    5.94 | 1.333  148.15 | 2.333   10.09 |  3.33    5.74
               0.417    6.93 | 1.417   47.06 | 2.417    8.89 |  3.42    5.38
               0.500    6.93 | 1.500   47.06 | 2.500    8.89 |  3.50    5.38
               0.583    8.42 | 1.583   25.72 | 2.583    7.96 |  3.58    5.08
               0.667    8.42 | 1.667   25.72 | 2.667    7.96 |  3.67    5.08
               0.750   10.91 | 1.750   18.11 | 2.750    7.24 |  3.75    4.80
               0.833   10.91 | 1.833   18.11 | 2.833    7.24 |  3.83    4.80
               0.917   16.13 | 1.917   14.17 | 2.917    6.65 |  3.92    4.57
               1.000   16.13 | 2.000   14.17 | 3.000    6.65 |  4.00    4.57

     Max.Eff.Inten.(mm/hr)=     148.15       109.90
               over (min)         5.00        10.00
     Storage Coeff.  (min)=       5.27 (ii)    9.61 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.21         0.11

                                                          *TOTALS*
     PEAK FLOW       (cms)=       6.78         1.63          8.138 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.42          1.33
     RUNOFF VOLUME    (mm)=      70.24        45.23         61.74
     TOTAL RAINFALL   (mm)=      71.24        71.24         71.24
     RUNOFF COEFFICIENT   =       0.99         0.64          0.87


       (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.

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--------------------
| RESERVOIR(  0178)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2810     1.2030
                          0.0470     0.8600   |   0.3960     1.4090
                          0.1020     0.8601   |   0.4840     1.5570
                          0.2010     1.0400   |   0.5830     1.7020

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0174)     28.250      8.138      1.33      61.74
   OUTFLOW: ID= 1 (  0178)     28.250      0.396      3.58      60.31

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  4.86
                  TIME SHIFT OF PEAK FLOW          (min)=135.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  1.4088

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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2006)
       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   TTTTT  TTTTT  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\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\17944b49-be41-41d4-802c-d1e925b69dcf\scenari
  Summary filename: C:\Users\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\17944b49-be41-41d4-802c-d1e925b69dcf\scenari


DATE: 06-29-2022                          TIME: 02:29:54

USER:
```

COMMENTS: _____

**** SIMULATION : Run 05 ****

MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\2b7bf0a5-557e-4a78-9392-0a739a5df2b5\62c328ea
Ptotal=120.60 mm	Comments: Mass 24-Hour SCS Type II Design Storm

Duration of storm = 24.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	1.21	6.25	2.41	12.25	17.37	18.25	2.17
0.50	1.21	6.50	2.41	12.50	17.37	18.50	2.17
0.75	1.21	6.75	2.41	12.75	8.92	18.75	2.17
1.00	1.21	7.00	2.41	13.00	8.92	19.00	2.17
1.25	1.21	7.25	2.41	13.25	1.69	19.25	2.17
1.50	1.21	7.50	2.41	13.50	1.69	19.50	2.17
1.75	1.21	7.75	2.41	13.75	9.89	19.75	2.17
2.00	2.17	8.00	2.41	14.00	9.89	20.00	2.17
2.25	1.57	8.25	3.26	14.25	3.62	20.25	1.45
2.50	1.57	8.50	3.26	14.50	3.62	20.50	1.45
2.75	1.57	8.75	3.26	14.75	3.62	20.75	1.45
3.00	1.57	9.00	3.26	15.00	3.62	21.00	1.45
3.25	1.57	9.25	3.86	15.25	3.62	21.25	1.45
3.50	1.57	9.50	3.86	15.50	3.62	21.50	1.45
3.75	1.57	9.75	4.34	15.75	3.62	21.75	1.45
4.00	1.57	10.00	4.34	16.00	3.62	22.00	1.45
4.25	1.93	10.25	5.55	16.25	2.17	22.25	1.45
4.50	1.93	10.50	5.55	16.50	2.17	22.50	1.45
4.75	1.93	10.75	7.48	16.75	2.17	22.75	1.45
5.00	1.93	11.00	7.48	17.00	2.17	23.00	1.45
5.25	1.93	11.25	11.58	17.25	2.17	23.25	1.45
5.50	1.93	11.50	11.58	17.50	2.17	23.50	1.45
5.75	1.93	11.75	50.17	17.75	2.17	23.75	1.45
6.00	1.93	12.00	133.14	18.00	2.17	24.00	1.45

CALIB	
STANDHYD (0171)	Area (ha)= 28.25
ID= 1 DT= 5.0 min	Total Imp(%)= 71.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	20.06	8.19
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	433.97	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.21	6.083	2.41	12.083	17.38	18.08	2.17
0.167	1.21	6.167	2.41	12.167	17.37	18.17	2.17
0.250	1.21	6.250	2.41	12.250	17.37	18.25	2.17
0.333	1.21	6.333	2.41	12.333	17.37	18.33	2.17
0.417	1.21	6.417	2.41	12.417	17.37	18.42	2.17
0.500	1.21	6.500	2.41	12.500	17.37	18.50	2.17
0.583	1.21	6.583	2.41	12.583	8.93	18.58	2.17
0.667	1.21	6.667	2.41	12.667	8.92	18.67	2.17
0.750	1.21	6.750	2.41	12.750	8.92	18.75	2.17
0.833	1.21	6.833	2.41	12.833	8.92	18.83	2.17
0.917	1.21	6.917	2.41	12.917	8.92	18.92	2.17
1.000	1.21	7.000	2.41	13.000	8.92	19.00	2.17
1.083	1.21	7.083	2.41	13.083	1.69	19.08	2.17
1.167	1.21	7.167	2.41	13.167	1.69	19.17	2.17
1.250	1.21	7.250	2.41	13.250	1.69	19.25	2.17
1.333	1.21	7.333	2.41	13.333	1.69	19.33	2.17
1.417	1.21	7.417	2.41	13.417	1.69	19.42	2.17
1.500	1.21	7.500	2.41	13.500	1.69	19.50	2.17
1.583	1.21	7.583	2.41	13.583	9.89	19.58	2.17
1.667	1.21	7.667	2.41	13.667	9.89	19.67	2.17
1.750	1.21	7.750	2.41	13.750	9.89	19.75	2.17
1.833	2.17	7.833	2.41	13.833	9.89	19.83	2.17
1.917	2.17	7.917	2.41	13.917	9.89	19.92	2.17
2.000	2.17	8.000	2.41	14.000	9.89	20.00	2.17
2.083	1.57	8.083	3.26	14.083	3.62	20.08	1.45
2.167	1.57	8.167	3.26	14.167	3.62	20.17	1.45
2.250	1.57	8.250	3.26	14.250	3.62	20.25	1.45
2.333	1.57	8.333	3.26	14.333	3.62	20.33	1.45
2.417	1.57	8.417	3.26	14.417	3.62	20.42	1.45
2.500	1.57	8.500	3.26	14.500	3.62	20.50	1.45
2.583	1.57	8.583	3.26	14.583	3.62	20.58	1.45
2.667	1.57	8.667	3.26	14.667	3.62	20.67	1.45
2.750	1.57	8.750	3.26	14.750	3.62	20.75	1.45
2.833	1.57	8.833	3.26	14.833	3.62	20.83	1.45
2.917	1.57	8.917	3.26	14.917	3.62	20.92	1.45
3.000	1.57	9.000	3.26	15.000	3.62	21.00	1.45
3.083	1.57	9.083	3.86	15.083	3.62	21.08	1.45
3.167	1.57	9.167	3.86	15.167	3.62	21.17	1.45
3.250	1.57	9.250	3.86	15.250	3.62	21.25	1.45
3.333	1.57	9.333	3.86	15.333	3.62	21.33	1.45
3.417	1.57	9.417	3.86	15.417	3.62	21.42	1.45
3.500	1.57	9.500	3.86	15.500	3.62	21.50	1.45
3.583	1.57	9.583	4.34	15.583	3.62	21.58	1.45
3.667	1.57	9.667	4.34	15.667	3.62	21.67	1.45
3.750	1.57	9.750	4.34	15.750	3.62	21.75	1.45
3.833	1.57	9.833	4.34	15.833	3.62	21.83	1.45
3.917	1.57	9.917	4.34	15.917	3.62	21.92	1.45
4.000	1.57	10.000	4.34	16.000	3.62	22.00	1.45
4.083	1.93	10.083	5.55	16.083	2.17	22.08	1.45
4.167	1.93	10.167	5.55	16.167	2.17	22.17	1.45
4.250	1.93	10.250	5.55	16.250	2.17	22.25	1.45
4.333	1.93	10.333	5.55	16.333	2.17	22.33	1.45
4.417	1.93	10.417	5.55	16.417	2.17	22.42	1.45
4.500	1.93	10.500	5.55	16.500	2.17	22.50	1.45
4.583	1.93	10.583	7.48	16.583	2.17	22.58	1.45
4.667	1.93	10.667	7.48	16.667	2.17	22.67	1.45
4.750	1.93	10.750	7.48	16.750	2.17	22.75	1.45
4.833	1.93	10.833	7.48	16.833	2.17	22.83	1.45
4.917	1.93	10.917	7.48	16.917	2.17	22.92	1.45
5.000	1.93	11.000	7.48	17.000	2.17	23.00	1.45
5.083	1.93	11.083	11.58	17.083	2.17	23.08	1.45
5.167	1.93	11.167	11.58	17.167	2.17	23.17	1.45
5.250	1.93	11.250	11.58	17.250	2.17	23.25	1.45
5.333	1.93	11.333	11.58	17.333	2.17	23.33	1.45
5.417	1.93	11.417	11.58	17.417	2.17	23.42	1.45

5.500	1.93	11.500	11.58	17.500	2.17	23.50	1.45
5.583	1.93	11.583	50.17	17.583	2.17	23.58	1.45
5.667	1.93	11.667	50.17	17.667	2.17	23.67	1.45
5.750	1.93	11.750	50.17	17.750	2.17	23.75	1.45
5.833	1.93	11.833	133.13	17.833	2.17	23.83	1.45
5.917	1.93	11.917	133.14	17.917	2.17	23.92	1.45
6.000	1.93	12.000	133.14	18.000	2.17	24.00	1.45

				TOTALS
Max.Eff.Inten.(mm/hr)=	133.14	135.49		
over (min)	5.00	15.00		
Storage Coeff. (min)=	5.50 (ii)	10.03 (ii)		
Unit Hyd. Tpeak (min)=	5.00	15.00		
Unit Hyd. peak (cms)=	0.20	0.10		
PEAK FLOW (cms)=	6.61	2.20		8.654 (iii)
TIME TO PEAK (hrs)=	12.00	12.08		12.00
RUNOFF VOLUME (mm)=	119.60	90.36		109.66
TOTAL RAINFALL (mm)=	120.60	120.60		120.60
RUNOFF COEFFICIENT =	0.99	0.75		0.91

(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.

RESERVOIR(0175)	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.4810	1.4680
	0.0470	0.8600	0.6580	1.7540
	0.1860	0.9300	0.7990	1.9670
	0.3530	1.2390	0.9460	2.1790

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0171)	28.250	8.654	12.00	109.66
OUTFLOW: ID= 1 (0175)	28.250	0.798	12.83	107.71

PEAK FLOW REDUCTION [Qout/Qin](%)= 9.22
TIME SHIFT OF PEAK FLOW (min)= 50.00
MAXIMUM STORAGE USED (ha.m.)= 1.9661

MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\2b7bf0a5-557e-4a78-9392-0a739a5df2b5\c45cd20f
Ptotal= 95.90 mm	Comments: SCS II 6H_50YR

Duration of storm = 6.00 hrs
Mass curve time step = 15.00 min

TIME (hrs)	RAIN (mm/hr)	TIME (hrs)	RAIN (mm/hr)	TIME (hrs)	RAIN (mm/hr)	TIME (hrs)	RAIN (mm/hr)
0.25	3.84	1.75	9.59	3.25	21.10	4.75	5.75
0.50	3.84	2.00	9.59	3.50	21.10	5.00	5.75
0.75	5.75	2.25	11.51	3.75	9.59	5.25	3.84
1.00	5.75	2.50	11.51	4.00	9.59	5.50	3.84
1.25	5.75	2.75	57.54	4.25	7.67	5.75	3.84
1.50	5.75	3.00	149.60	4.50	7.67	6.00	3.84

CALIB			
STANDHYD (0172)	Area (ha)= 28.25		
ID= 1 DT= 5.0 min	Total Imp(%)= 71.00	Dir. Conn.(%)= 66.00	
	IMPERVIOUS	PERVIOUS (i)	
Surface Area (ha)=	20.06	8.19	
Dep. Storage (mm)=	1.00	1.50	
Average Slope (%)=	1.00	2.00	
Length (m)=	433.97	40.00	
Mannings n =	0.013	0.250	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME (hrs)	RAIN (mm/hr)	TIME (hrs)	RAIN (mm/hr)	TIME (hrs)	RAIN (mm/hr)	TIME (hrs)	RAIN (mm/hr)
0.083	3.84	1.583	9.59	3.083	21.10	4.58	5.75
0.167	3.84	1.667	9.59	3.167	21.10	4.67	5.75
0.250	3.84	1.750	9.59	3.250	21.10	4.75	5.75
0.333	3.84	1.833	9.59	3.333	21.10	4.83	5.75
0.417	3.84	1.917	9.59	3.417	21.10	4.92	5.75
0.500	3.84	2.000	9.59	3.500	21.10	5.00	5.75
0.583	5.75	2.083	11.51	3.583	9.59	5.08	3.84
0.667	5.75	2.167	11.51	3.667	9.59	5.17	3.84
0.750	5.75	2.250	11.51	3.750	9.59	5.25	3.84
0.833	5.75	2.333	11.51	3.833	9.59	5.33	3.84
0.917	5.75	2.417	11.51	3.917	9.59	5.42	3.84
1.000	5.75	2.500	11.51	4.000	9.59	5.50	3.84
1.083	5.75	2.583	57.54	4.083	7.67	5.58	3.84
1.167	5.75	2.667	57.54	4.167	7.67	5.67	3.84
1.250	5.75	2.750	57.54	4.250	7.67	5.75	3.84
1.333	5.75	2.833	149.60	4.333	7.67	5.83	3.84
1.417	5.75	2.917	149.60	4.417	7.67	5.92	3.84
1.500	5.75	3.000	149.60	4.500	7.67	6.00	3.84

				TOTALS
Max.Eff.Inten.(mm/hr)=	149.60	146.18		
over (min)	5.00	10.00		
Storage Coeff. (min)=	5.25 (ii)	9.57 (ii)		
Unit Hyd. Tpeak (min)=	5.00	10.00		
Unit Hyd. peak (cms)=	0.21	0.11		
PEAK FLOW (cms)=	7.47	2.50		9.971 (iii)
TIME TO PEAK (hrs)=	3.00	3.00		3.00
RUNOFF VOLUME (mm)=	94.90	67.39		85.55
TOTAL RAINFALL (mm)=	95.90	95.90		95.90
RUNOFF COEFFICIENT =	0.99	0.70		0.89

(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.

RESERVOIR(0176)	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.4260	1.3670
	0.0470	0.8600	0.6000	1.6350
	0.1480	0.8780	0.7400	1.8350

```
                      0.3040     1.1570   |   0.8880      2.0360

                           AREA      QPEAK     TPEAK       R.V.
                           (ha)      (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0172)     28.250      9.971      3.00      85.55
   OUTFLOW: ID= 1 (  0176)     28.250      0.739      4.00      84.05

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  7.42
                  TIME SHIFT OF PEAK FLOW         (min)= 60.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  1.8343

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| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              2b7bf0a5-557e-4a78-9392-0a739a5df2b5\cbe81c21
| Ptotal=101.70 mm |    Comments: SCS II 12H_50YR
--------------------
                      Duration of storm    = 12.00 hrs
                      Mass curve time step = 15.00 min

               TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.25    2.54 |  3.25    4.07 |  6.25   18.31 |  9.25    3.56
               0.50    2.54 |  3.50    4.07 |  6.50   18.31 |  9.50    3.56
               0.75    2.54 |  3.75    4.07 |  6.75    8.14 |  9.75    3.56
               1.00    2.54 |  4.00    4.07 |  7.00    8.14 | 10.00    3.56
               1.25    2.54 |  4.25    6.10 |  7.25    6.10 | 10.25    2.03
               1.50    2.54 |  4.50    6.10 |  7.50    6.10 | 10.50    2.03
               1.75    2.54 |  4.75    8.14 |  7.75    6.10 | 10.75    2.03
               2.00    2.54 |  5.00    8.14 |  8.00    6.10 | 11.00    2.03
               2.25    3.05 |  5.25   12.20 |  8.25    3.56 | 11.25    2.03
               2.50    3.05 |  5.50   12.20 |  8.50    3.56 | 11.50    2.03
               2.75    3.05 |  5.75   48.82 |  8.75    3.56 | 11.75    2.03
               3.00    3.05 |  6.00  134.24 |  9.00    3.56 | 12.00    2.03

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| CALIB            |
| STANDHYD (  0173)|   Area    (ha)=  28.25
|ID= 1 DT= 5.0 min |   Total Imp(%)=  71.00   Dir. Conn.(%)=  66.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      20.06         8.19
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     433.97        40.00
     Mannings n           =      0.013        0.250

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
              0.083    2.54 | 3.083    4.07 | 6.083   18.31 |  9.08    3.56
              0.167    2.54 | 3.167    4.07 | 6.167   18.31 |  9.17    3.56
              0.250    2.54 | 3.250    4.07 | 6.250   18.31 |  9.25    3.56
              0.333    2.54 | 3.333    4.07 | 6.333   18.31 |  9.33    3.56
              0.417    2.54 | 3.417    4.07 | 6.417   18.31 |  9.42    3.56
              0.500    2.54 | 3.500    4.07 | 6.500   18.31 |  9.50    3.56
              0.583    2.54 | 3.583    4.07 | 6.583    8.14 |  9.58    3.56
              0.667    2.54 | 3.667    4.07 | 6.667    8.14 |  9.67    3.56
              0.750    2.54 | 3.750    4.07 | 6.750    8.14 |  9.75    3.56
              0.833    2.54 | 3.833    4.07 | 6.833    8.14 |  9.83    3.56
              0.917    2.54 | 3.917    4.07 | 6.917    8.14 |  9.92    3.56
              1.000    2.54 | 4.000    4.07 | 7.000    8.14 | 10.00    3.56
              1.083    2.54 | 4.083    6.10 | 7.083    6.10 | 10.08    2.03
              1.167    2.54 | 4.167    6.10 | 7.167    6.10 | 10.17    2.03
              1.250    2.54 | 4.250    6.10 | 7.250    6.10 | 10.25    2.03
              1.333    2.54 | 4.333    6.10 | 7.333    6.10 | 10.33    2.03
              1.417    2.54 | 4.417    6.10 | 7.417    6.10 | 10.42    2.03
              1.500    2.54 | 4.500    6.10 | 7.500    6.10 | 10.50    2.03
              1.583    2.54 | 4.583    8.14 | 7.583    6.10 | 10.58    2.03
              1.667    2.54 | 4.667    8.14 | 7.667    6.10 | 10.67    2.03
              1.750    2.54 | 4.750    8.14 | 7.750    6.10 | 10.75    2.03
              1.833    2.54 | 4.833    8.14 | 7.833    6.10 | 10.83    2.03
              1.917    2.54 | 4.917    8.14 | 7.917    6.10 | 10.92    2.03
              2.000    2.54 | 5.000    8.14 | 8.000    6.10 | 11.00    2.03
              2.083    3.05 | 5.083   12.20 | 8.083    3.56 | 11.08    2.03
              2.167    3.05 | 5.167   12.20 | 8.167    3.56 | 11.17    2.03
              2.250    3.05 | 5.250   12.20 | 8.250    3.56 | 11.25    2.03
              2.333    3.05 | 5.333   12.20 | 8.333    3.56 | 11.33    2.03
              2.417    3.05 | 5.417   12.20 | 8.417    3.56 | 11.42    2.03
              2.500    3.05 | 5.500   12.20 | 8.500    3.56 | 11.50    2.03
              2.583    3.05 | 5.583   48.82 | 8.583    3.56 | 11.58    2.03
              2.667    3.05 | 5.667   48.82 | 8.667    3.56 | 11.67    2.03
              2.750    3.05 | 5.750   48.82 | 8.750    3.56 | 11.75    2.03
              2.833    3.05 | 5.833  134.24 | 8.833    3.56 | 11.83    2.03
              2.917    3.05 | 5.917  134.24 | 8.917    3.56 | 11.92    2.03
              3.000    3.05 | 6.000  134.24 | 9.000    3.56 | 12.00    2.03

     Max.Eff.Inten.(mm/hr)=     134.24       132.59
               over (min)          5.00        10.00
     Storage Coeff.  (min)=       5.48 (ii)    9.99 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.20         0.11
                                                          *TOTALS*
     PEAK FLOW       (cms)=       6.66         2.26          8.918 (iii)
     TIME TO PEAK    (hrs)=       6.00         6.00           6.00
     RUNOFF VOLUME    (mm)=     100.70        72.73          91.19
     TOTAL RAINFALL   (mm)=     101.70       101.70         101.70
     RUNOFF COEFFICIENT   =       0.99         0.72           0.90

       (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.

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--------------------
| RESERVOIR(  0177)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.4210     1.3480
                          0.0470     0.8600   |   0.5820     1.6080
                          0.1580     0.8880   |   0.7120     1.8060
                          0.3050     1.1460   |   0.8460     1.9980

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0173)     28.250      8.918      6.00      91.19
   OUTFLOW: ID= 1 (  0177)     28.250      0.711      6.83      89.58

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  7.98
                  TIME SHIFT OF PEAK FLOW         (min)= 50.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  1.8053

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| CHICAGO STORM    |    IDF curve parameters: A=1236.152
| Ptotal= 79.45 mm |                          B=   4.699
--------------------                          C=   0.751
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  4.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =  0.33

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.17    5.93 |  1.17   40.22 |  2.17   13.20 |  3.17    6.98
                0.33    6.74 |  1.33  164.22 |  2.33   11.37 |  3.33    6.51
                0.50    7.85 |  1.50   51.92 |  2.50   10.03 |  3.50    6.11
                0.67    9.50 |  1.67   28.58 |  2.67    9.00 |  3.67    5.77
                0.83   12.27 |  1.83   20.23 |  2.83    8.19 |  3.83    5.46
                1.00   18.04 |  2.00   15.88 |  3.00    7.53 |  4.00    5.19


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| CALIB            |
| STANDHYD (  0174)|   Area    (ha)=  28.25
|ID= 1 DT= 5.0 min |   Total Imp(%)=  71.00   Dir. Conn.(%)=  66.00
--------------------

                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      20.06         8.19
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     433.97        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    5.93 | 1.083   40.22 | 2.083   13.20 |  3.08    6.98
               0.167    5.93 | 1.167   40.22 | 2.167   13.20 |  3.17    6.98
               0.250    6.74 | 1.250  164.22 | 2.250   11.37 |  3.25    6.51
               0.333    6.74 | 1.333  164.22 | 2.333   11.37 |  3.33    6.51
               0.417    7.85 | 1.417   51.92 | 2.417   10.03 |  3.42    6.11
               0.500    7.85 | 1.500   51.92 | 2.500   10.03 |  3.50    6.11
               0.583    9.50 | 1.583   28.58 | 2.583    9.00 |  3.58    5.77
               0.667    9.50 | 1.667   28.58 | 2.667    9.00 |  3.67    5.77
               0.750   12.27 | 1.750   20.23 | 2.750    8.19 |  3.75    5.46
               0.833   12.27 | 1.833   20.23 | 2.833    8.19 |  3.83    5.46
               0.917   18.04 | 1.917   15.88 | 2.917    7.53 |  3.92    5.19
               1.000   18.04 | 2.000   15.88 | 3.000    7.53 |  4.00    5.19

     Max.Eff.Inten.(mm/hr)=     164.22       127.92
               over (min)         5.00        10.00
     Storage Coeff.  (min)=       5.05 (ii)    9.22 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.21         0.12
                                                      *TOTALS*
     PEAK FLOW       (cms)=       7.59         1.92       9.220 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.42        1.33
     RUNOFF VOLUME    (mm)=      78.45        52.50       69.63
     TOTAL RAINFALL   (mm)=      79.45        79.45       79.45
     RUNOFF COEFFICIENT   =       0.99         0.66        0.88

       (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.

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--------------------
| RESERVOIR(  0178)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |  0.2810      1.2030
                          0.0470     0.8600   |  0.3960      1.4090
                          0.1020     0.8601   |  0.4840      1.5570
                          0.2010     1.0400   |  0.5830      1.7020

                                    AREA     QPEAK     TPEAK       R.V.
                                    (ha)     (cms)     (hrs)       (mm)
       INFLOW : ID= 2 (  0174)     28.250     9.220      1.33      69.63
       OUTFLOW: ID= 1 (  0178)     28.250     0.484      3.42      68.18

                     PEAK   FLOW   REDUCTION [Qout/Qin](%)=  5.25
                     TIME SHIFT OF PEAK FLOW          (min)=125.00
                     MAXIMUM  STORAGE   USED       (ha.m.)=  1.5568

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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2006)
       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   TTTTT  TTTTT  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\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\51c45a79-4b64-4154-b166-fd18bb2132c6\scenari
  Summary filename: C:\Users\hliu\AppData\Local\Civica\VH5\b41b348d-2025-43d3-
a266-6b877f48bd3e\51c45a79-4b64-4154-b166-fd18bb2132c6\scenari


DATE: 06-29-2022                          TIME: 02:29:54

USER:


COMMENTS: _____

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  ** SIMULATION : Run 06                         **
  ************************************************

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| MASS STORM       |    Filename: C:\Users\hliu\AppD
|                  |              ata\Local\Temp\
|                  |              2b7bf0a5-557e-4a78-9392-0a739a5df2b5\1bad87f9
| Ptotal=133.60 mm |    Comments: Mass 24-Hour SCS Type II Design Storm
--------------------
                       Duration of storm    = 24.00 hrs
                       Mass curve time step = 15.00 min
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	1.34	6.25	2.67	12.25	19.24	18.25	2.40
0.50	1.34	6.50	2.67	12.50	19.24	18.50	2.40
0.75	1.34	6.75	2.67	12.75	9.89	18.75	2.40
1.00	1.34	7.00	2.67	13.00	9.89	19.00	2.40
1.25	1.34	7.25	2.67	13.25	1.87	19.25	2.40
1.50	1.34	7.50	2.67	13.50	1.87	19.50	2.40
1.75	1.34	7.75	2.67	13.75	10.96	19.75	2.40
2.00	2.40	8.00	2.67	14.00	10.96	20.00	2.40
2.25	1.74	8.25	3.61	14.25	4.01	20.25	1.60
2.50	1.74	8.50	3.61	14.50	4.01	20.50	1.60
2.75	1.74	8.75	3.61	14.75	4.01	20.75	1.60
3.00	1.74	9.00	3.61	15.00	4.01	21.00	1.60
3.25	1.74	9.25	4.28	15.25	4.01	21.25	1.60
3.50	1.74	9.50	4.28	15.50	4.01	21.50	1.60
3.75	1.74	9.75	4.81	15.75	4.01	21.75	1.60
4.00	1.74	10.00	4.81	16.00	4.01	22.00	1.60
4.25	2.14	10.25	6.15	16.25	2.40	22.25	1.60
4.50	2.14	10.50	6.15	16.50	2.40	22.50	1.60
4.75	2.14	10.75	8.28	16.75	2.40	22.75	1.60
5.00	2.14	11.00	8.28	17.00	2.40	23.00	1.60
5.25	2.14	11.25	12.83	17.25	2.40	23.25	1.60
5.50	2.14	11.50	12.83	17.50	2.40	23.50	1.60
5.75	2.14	11.75	55.58	17.75	2.40	23.75	1.60
6.00	2.14	12.00	147.49	18.00	2.40	24.00	1.60

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| CALIB            |
| STANDHYD (  0171)|   Area    (ha)=  28.25
|ID= 1 DT= 5.0 min |   Total Imp(%)=  71.00   Dir. Conn.(%)=  66.00
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```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	20.06	8.19
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	433.97	40.00
Mannings n	=	0.013	0.250

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        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
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---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.34	6.083	2.67	12.083	19.25	18.08	2.40
0.167	1.34	6.167	2.67	12.167	19.24	18.17	2.40
0.250	1.34	6.250	2.67	12.250	19.24	18.25	2.40
0.333	1.34	6.333	2.67	12.333	19.24	18.33	2.40
0.417	1.34	6.417	2.67	12.417	19.24	18.42	2.40
0.500	1.34	6.500	2.67	12.500	19.24	18.50	2.40
0.583	1.34	6.583	2.67	12.583	9.89	18.58	2.40
0.667	1.34	6.667	2.67	12.667	9.89	18.67	2.40
0.750	1.34	6.750	2.67	12.750	9.89	18.75	2.40
0.833	1.34	6.833	2.67	12.833	9.89	18.83	2.40
0.917	1.34	6.917	2.67	12.917	9.89	18.92	2.40
1.000	1.34	7.000	2.67	13.000	9.89	19.00	2.40
1.083	1.34	7.083	2.67	13.083	1.87	19.08	2.40
1.167	1.34	7.167	2.67	13.167	1.87	19.17	2.40
1.250	1.34	7.250	2.67	13.250	1.87	19.25	2.40
1.333	1.34	7.333	2.67	13.333	1.87	19.33	2.40
1.417	1.34	7.417	2.67	13.417	1.87	19.42	2.40
1.500	1.34	7.500	2.67	13.500	1.87	19.50	2.40
1.583	1.34	7.583	2.67	13.583	10.95	19.58	2.40
1.667	1.34	7.667	2.67	13.667	10.96	19.67	2.40
1.750	1.34	7.750	2.67	13.750	10.96	19.75	2.40
1.833	2.40	7.833	2.67	13.833	10.96	19.83	2.40
1.917	2.40	7.917	2.67	13.917	10.96	19.92	2.40
2.000	2.40	8.000	2.67	14.000	10.96	20.00	2.40
2.083	1.74	8.083	3.61	14.083	4.01	20.08	1.60
2.167	1.74	8.167	3.61	14.167	4.01	20.17	1.60
2.250	1.74	8.250	3.61	14.250	4.01	20.25	1.60
2.333	1.74	8.333	3.61	14.333	4.01	20.33	1.60
2.417	1.74	8.417	3.61	14.417	4.01	20.42	1.60
2.500	1.74	8.500	3.61	14.500	4.01	20.50	1.60
2.583	1.74	8.583	3.61	14.583	4.01	20.58	1.60
2.667	1.74	8.667	3.61	14.667	4.01	20.67	1.60
2.750	1.74	8.750	3.61	14.750	4.01	20.75	1.60
2.833	1.74	8.833	3.61	14.833	4.01	20.83	1.60
2.917	1.74	8.917	3.61	14.917	4.01	20.92	1.60
3.000	1.74	9.000	3.61	15.000	4.01	21.00	1.60
3.083	1.74	9.083	4.28	15.083	4.01	21.08	1.60
3.167	1.74	9.167	4.28	15.167	4.01	21.17	1.60
3.250	1.74	9.250	4.28	15.250	4.01	21.25	1.60
3.333	1.74	9.333	4.28	15.333	4.01	21.33	1.60
3.417	1.74	9.417	4.28	15.417	4.01	21.42	1.60
3.500	1.74	9.500	4.28	15.500	4.01	21.50	1.60
3.583	1.74	9.583	4.81	15.583	4.01	21.58	1.60
3.667	1.74	9.667	4.81	15.667	4.01	21.67	1.60
3.750	1.74	9.750	4.81	15.750	4.01	21.75	1.60
3.833	1.74	9.833	4.81	15.833	4.01	21.83	1.60
3.917	1.74	9.917	4.81	15.917	4.01	21.92	1.60
4.000	1.74	10.000	4.81	16.000	4.01	22.00	1.60
4.083	2.14	10.083	6.15	16.083	2.41	22.08	1.60
4.167	2.14	10.167	6.15	16.167	2.40	22.17	1.60
4.250	2.14	10.250	6.15	16.250	2.40	22.25	1.60
4.333	2.14	10.333	6.15	16.333	2.40	22.33	1.60
4.417	2.14	10.417	6.15	16.417	2.40	22.42	1.60
4.500	2.14	10.500	6.15	16.500	2.40	22.50	1.60
4.583	2.14	10.583	8.28	16.583	2.40	22.58	1.60
4.667	2.14	10.667	8.28	16.667	2.40	22.67	1.60
4.750	2.14	10.750	8.28	16.750	2.40	22.75	1.60
4.833	2.14	10.833	8.28	16.833	2.40	22.83	1.60
4.917	2.14	10.917	8.28	16.917	2.40	22.92	1.60
5.000	2.14	11.000	8.28	17.000	2.40	23.00	1.60
5.083	2.14	11.083	12.83	17.083	2.40	23.08	1.60
5.167	2.14	11.167	12.83	17.167	2.40	23.17	1.60
5.250	2.14	11.250	12.83	17.250	2.40	23.25	1.60
5.333	2.14	11.333	12.83	17.333	2.40	23.33	1.60
5.417	2.14	11.417	12.83	17.417	2.40	23.42	1.60
5.500	2.14	11.500	12.83	17.500	2.40	23.50	1.60
5.583	2.14	11.583	55.57	17.583	2.40	23.58	1.60
5.667	2.14	11.667	55.58	17.667	2.40	23.67	1.60
5.750	2.14	11.750	55.58	17.750	2.40	23.75	1.60
5.833	2.14	11.833	147.48	17.833	2.40	23.83	1.60
5.917	2.14	11.917	147.49	17.917	2.40	23.92	1.60
6.000	2.14	12.000	147.49	18.000	2.40	24.00	1.60

Max.Eff.Inten.(mm/hr)=	147.49	152.98

over (min)		5.00	10.00	
Storage Coeff. (min)=		5.28 (ii)	9.62 (ii)	
Unit Hyd. Tpeak (min)=		5.00	10.00	
Unit Hyd. peak (cms)=		0.21	0.11	
				TOTALS
PEAK FLOW	(cms)=	7.35	2.70	10.052 (iii)
TIME TO PEAK	(hrs)=	12.00	12.00	12.00
RUNOFF VOLUME	(mm)=	132.60	102.66	122.42
TOTAL RAINFALL	(mm)=	133.60	133.60	133.60
RUNOFF COEFFICIENT	=	0.99	0.77	0.92

(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.

RESERVOIR(0175)	OVERFLOW IS OFF
IN= 2---> OUT= 1	
DT= 5.0 min	

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.4810	1.4680
0.0470	0.8600	0.6580	1.7540
0.1860	0.9300	0.7990	1.9670
0.3530	1.2390	0.9460	2.1790

		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0171)		28.250	10.052	12.00	122.42
OUTFLOW: ID= 1 (0175)		28.250	0.945	12.67	120.45

PEAK FLOW REDUCTION [Qout/Qin](%)= 9.40
TIME SHIFT OF PEAK FLOW (min)= 40.00
MAXIMUM STORAGE USED (ha.m.)= 2.1782

MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\2b7bf0a5-557e-4a78-9392-0a739a5df2b5\06dbffa2
Ptotal=106.50 mm	Comments: SCS II 6H_100YR

Duration of storm = 6.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	4.26	1.75	10.65	3.25	23.43	4.75	6.39
0.50	4.26	2.00	10.65	3.50	23.43	5.00	6.39
0.75	6.39	2.25	12.78	3.75	10.65	5.25	4.26
1.00	6.39	2.50	12.78	4.00	10.65	5.50	4.26
1.25	6.39	2.75	63.90	4.25	8.52	5.75	4.26
1.50	6.39	3.00	166.14	4.50	8.52	6.00	4.26

CALIB	
STANDHYD (0172)	Area (ha)= 28.25
ID= 1 DT= 5.0 min	Total Imp(%)= 71.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	20.06	8.19
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	433.97	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	4.26	1.583	10.65	3.083	23.43	4.58	6.39
0.167	4.26	1.667	10.65	3.167	23.43	4.67	6.39
0.250	4.26	1.750	10.65	3.250	23.43	4.75	6.39
0.333	4.26	1.833	10.65	3.333	23.43	4.83	6.39
0.417	4.26	1.917	10.65	3.417	23.43	4.92	6.39
0.500	4.26	2.000	10.65	3.500	23.43	5.00	6.39
0.583	6.39	2.083	12.78	3.583	10.65	5.08	4.26
0.667	6.39	2.167	12.78	3.667	10.65	5.17	4.26
0.750	6.39	2.250	12.78	3.750	10.65	5.25	4.26
0.833	6.39	2.333	12.78	3.833	10.65	5.33	4.26
0.917	6.39	2.417	12.78	3.917	10.65	5.42	4.26
1.000	6.39	2.500	12.78	4.000	10.65	5.50	4.26
1.083	6.39	2.583	63.90	4.083	8.52	5.58	4.26
1.167	6.39	2.667	63.90	4.167	8.52	5.67	4.26
1.250	6.39	2.750	63.90	4.250	8.52	5.75	4.26
1.333	6.39	2.833	166.14	4.333	8.52	5.83	4.26
1.417	6.39	2.917	166.14	4.417	8.52	5.92	4.26
1.500	6.39	3.000	166.14	4.500	8.52	6.00	4.26

Max.Eff.Inten.(mm/hr)=		166.14	166.26	
over (min)		5.00	10.00	
Storage Coeff. (min)=		5.03 (ii)	9.18 (ii)	
Unit Hyd. Tpeak (min)=		5.00	10.00	
Unit Hyd. peak (cms)=		0.21	0.12	
				TOTALS
PEAK FLOW	(cms)=	8.33	2.91	11.237 (iii)
TIME TO PEAK	(hrs)=	3.00	3.00	3.00
RUNOFF VOLUME	(mm)=	105.50	77.18	95.87
TOTAL RAINFALL	(mm)=	106.50	106.50	106.50
RUNOFF COEFFICIENT	=	0.99	0.72	0.90

(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.

RESERVOIR(0176)	OVERFLOW IS OFF
IN= 2---> OUT= 1	
DT= 5.0 min	

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.4260	1.3670
0.0470	0.8600	0.6000	1.6350
0.1480	0.8780	0.7400	1.8350
0.3040	1.1570	0.8880	2.0360

		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0172)		28.250	11.237	3.00	95.87
OUTFLOW: ID= 1 (0176)		28.250	0.887	3.83	94.36

PEAK FLOW REDUCTION [Qout/Qin](%)= 7.90
TIME SHIFT OF PEAK FLOW (min)= 50.00

MAXIMUM STORAGE USED (ha.m.)= 2.0350

MASS STORM	Filename: C:\Users\hliu\AppData\Local\Temp\2b7bf0a5-557e-4a78-9392-0a739a5df2b5\b2dbabe9
Ptotal=112.50 mm	Comments: SCS II 12H_100YR

Duration of storm = 12.00 hrs
Mass curve time step = 15.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	2.81	3.25	4.50	6.25	20.25	9.25	3.94
0.50	2.81	3.50	4.50	6.50	20.25	9.50	3.94
0.75	2.81	3.75	4.50	6.75	9.00	9.75	3.94
1.00	2.81	4.00	4.50	7.00	9.00	10.00	3.94
1.25	2.81	4.25	6.75	7.25	6.75	10.25	2.25
1.50	2.81	4.50	6.75	7.50	6.75	10.50	2.25
1.75	2.81	4.75	9.00	7.75	6.75	10.75	2.25
2.00	2.81	5.00	9.00	8.00	6.75	11.00	2.25
2.25	3.38	5.25	13.50	8.25	3.94	11.25	2.25
2.50	3.37	5.50	13.50	8.50	3.94	11.50	2.25
2.75	3.38	5.75	54.00	8.75	3.94	11.75	2.25
3.00	3.38	6.00	148.50	9.00	3.94	12.00	2.25

CALIB STANDHYD (0173) ID= 1 DT= 5.0 min	Area (ha)= 28.25 Total Imp(%)= 71.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	20.06	8.19
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	433.97	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.81	3.083	4.50	6.083	20.25	9.08	3.94
0.167	2.81	3.167	4.50	6.167	20.25	9.17	3.94
0.250	2.81	3.250	4.50	6.250	20.25	9.25	3.94
0.333	2.81	3.333	4.50	6.333	20.25	9.33	3.94
0.417	2.81	3.417	4.50	6.417	20.25	9.42	3.94
0.500	2.81	3.500	4.50	6.500	20.25	9.50	3.94
0.583	2.81	3.583	4.50	6.583	9.00	9.58	3.94
0.667	2.81	3.667	4.50	6.667	9.00	9.67	3.94
0.750	2.81	3.750	4.50	6.750	9.00	9.75	3.94
0.833	2.81	3.833	4.50	6.833	9.00	9.83	3.94
0.917	2.81	3.917	4.50	6.917	9.00	9.92	3.94
1.000	2.81	4.000	4.50	7.000	9.00	10.00	3.94
1.083	2.81	4.083	6.75	7.083	6.75	10.08	2.25
1.167	2.81	4.167	6.75	7.167	6.75	10.17	2.25
1.250	2.81	4.250	6.75	7.250	6.75	10.25	2.25
1.333	2.81	4.333	6.75	7.333	6.75	10.33	2.25
1.417	2.81	4.417	6.75	7.417	6.75	10.42	2.25
1.500	2.81	4.500	6.75	7.500	6.75	10.50	2.25
1.583	2.81	4.583	9.00	7.583	6.75	10.58	2.25
1.667	2.81	4.667	9.00	7.667	6.75	10.67	2.25
1.750	2.81	4.750	9.00	7.750	6.75	10.75	2.25
1.833	2.81	4.833	9.00	7.833	6.75	10.83	2.25
1.917	2.81	4.917	9.00	7.917	6.75	10.92	2.25
2.000	2.81	5.000	9.00	8.000	6.75	11.00	2.25
2.083	3.38	5.083	13.50	8.083	3.94	11.08	2.25
2.167	3.38	5.167	13.50	8.167	3.94	11.17	2.25
2.250	3.38	5.250	13.50	8.250	3.94	11.25	2.25
2.333	3.37	5.333	13.50	8.333	3.94	11.33	2.25
2.417	3.37	5.417	13.50	8.417	3.94	11.42	2.25
2.500	3.37	5.500	13.50	8.500	3.94	11.50	2.25
2.583	3.37	5.583	54.00	8.583	3.94	11.58	2.25
2.667	3.38	5.667	54.00	8.667	3.94	11.67	2.25
2.750	3.38	5.750	54.00	8.750	3.94	11.75	2.25
2.833	3.37	5.833	148.50	8.833	3.94	11.83	2.25
2.917	3.38	5.917	148.50	8.917	3.94	11.92	2.25
3.000	3.38	6.000	148.50	9.000	3.94	12.00	2.25

Max.Eff.Inten.(mm/hr)=	148.50	149.92		
over (min)	5.00	10.00		
Storage Coeff. (min)=	5.26 (ii)	9.60 (ii)		
Unit Hyd. Tpeak (min)=	5.00	10.00		
Unit Hyd. peak (cms)=	0.21	0.11		
				TOTALS
PEAK FLOW (cms)=	7.40	2.60		10.005 (iii)
TIME TO PEAK (hrs)=	6.00	6.00		6.00
RUNOFF VOLUME (mm)=	111.50	82.77		101.73
TOTAL RAINFALL (mm)=	112.50	112.50		112.50
RUNOFF COEFFICIENT =	0.99	0.74		0.90

(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.

RESERVOIR(0177) IN= 2---> OUT= 1 DT= 5.0 min	OVERFLOW IS OFF

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.4210	1.3480
0.0470	0.8600	0.5820	1.6080
0.1580	0.8880	0.7120	1.8060
0.3050	1.1460	0.8460	1.9980

		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2	(0173)	28.250	10.005	6.00	101.73
OUTFLOW: ID= 1	(0177)	28.250	0.845	6.75	100.10

PEAK FLOW REDUCTION [Qout/Qin](%)= 8.45
TIME SHIFT OF PEAK FLOW (min)= 45.00
MAXIMUM STORAGE USED (ha.m.)= 1.9970

CHICAGO STORM Ptotal= 87.58 mm	IDF curve parameters: A=1426.408 B= 5.273 C= 0.759

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

Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.17	6.41	1.17	45.22	2.17	14.50	3.17	7.56
0.33	7.29	1.33	180.15	2.33	12.44	3.33	7.04
0.50	8.52	1.50	58.54	2.50	10.94	3.50	6.60
0.67	10.36	1.67	31.96	2.67	9.80	3.67	6.22
0.83	13.45	1.83	22.45	2.83	8.90	3.83	5.89
1.00	19.96	2.00	17.52	3.00	8.16	4.00	5.59

CALIB
STANDHYD (0174)
ID= 1 DT= 5.0 min

Area (ha)= 28.25
Total Imp(%)= 71.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	20.06	8.19
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	433.97	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	6.41	1.083	45.22	2.083	14.50	3.08	7.56
0.167	6.41	1.167	45.22	2.167	14.50	3.17	7.56
0.250	7.29	1.250	180.15	2.250	12.44	3.25	7.04
0.333	7.29	1.333	180.15	2.333	12.44	3.33	7.04
0.417	8.52	1.417	58.54	2.417	10.94	3.42	6.60
0.500	8.52	1.500	58.54	2.500	10.94	3.50	6.60
0.583	10.36	1.583	31.96	2.583	9.80	3.58	6.22
0.667	10.36	1.667	31.96	2.667	9.80	3.67	6.22
0.750	13.45	1.750	22.45	2.750	8.90	3.75	5.89
0.833	13.45	1.833	22.45	2.833	8.90	3.83	5.89
0.917	19.96	1.917	17.52	2.917	8.16	3.92	5.59
1.000	19.96	2.000	17.52	3.000	8.16	4.00	5.59

Max.Eff.Inten.	(mm/hr)=	180.15	146.15	
over	(min)	5.00	10.00	
Storage Coeff.	(min)=	4.87 (ii)	8.88 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	10.00	
Unit Hyd. peak	(cms)=	0.22	0.12	
				TOTALS
PEAK FLOW	(cms)=	8.41	2.23	10.320 (iii)
TIME TO PEAK	(hrs)=	1.33	1.42	1.33
RUNOFF VOLUME	(mm)=	86.58	59.81	77.48
TOTAL RAINFALL	(mm)=	87.58	87.58	87.58
RUNOFF COEFFICIENT	=	0.99	0.68	0.88

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

(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.

RESERVOIR(0178)

OVERFLOW IS OFF

IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.2810	1.2030
	0.0470	0.8600	0.3960	1.4090
	0.1020	0.8601	0.4840	1.5570
	0.2010	1.0400	0.5830	1.7020

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0174)	28.250	10.320	1.33	77.48
OUTFLOW: ID= 1 (0178)	28.250	0.583	3.17	76.00

PEAK FLOW REDUCTION [Qout/Qin](%)= 5.64
TIME SHIFT OF PEAK FLOW (min)=110.00
MAXIMUM STORAGE USED (ha.m.)= 1.7014

Quality and Volume Control Calculations

Barrie Annex Lands
WATER QUALITY REQUIREMENT CALCULATIONS
SWM Pond C

SCHAEFFERS CONSULTING ENGINEERS

Table: Water Quality Storage Requirements Based on Receiving Waters

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level					
		0%	35%	55%	70%	85%	100%
Level 1	Wet Pond	53	140	190	225	250	275

* For wet ponds, all of the storage, except for 40 m^3/ha represents the permanent pool volume.
The 40 m^3/ha represents extended detention storage.

Pond C

Input:

Estimated Imperviousness =	71%			
Area =	28.25	ha		
Level of Protection:	1			
SWMP Type :	Wet Pond			

Calculation:

Total Storage Volume Required =	227	m^3/ha →	6,422	m^3
Permanent Pool Volume =	187	m^3/ha →	5,292	m^3
Active Storage Volume =	40	m^3/ha →	1,130	m^3

Project No.: 5184
Project Name: Watersand Construction
Location: City of Barrie

SCHAEFFERS
CONSULTING ENGINEERS

Volume Control Requirement Calculation

SWM Pond C - Infiltration Cell

Information:

Estimated Imperviousness =	66%		
Area* =	16.80	ha	*Area excludes School + Rec Centre
Retained Storm Event =	25	mm	
Infiltration Rate** =	38	mm/hr	***Value resused from Watersand Phase 1, subject to change*
Safety Factor =	2.5		
Available Infil. Footprint Area =	2400	m^2	

Calculation:

Volumetric Control Requirement =	2501	m^3
Infiltration Flux =	36.48	m^3/hr
Infiltration Rate =	0.01	m^3/s
Drawdown Time =	68.56	hours

PROJECT NO: WATERSAND CONSTRUCTION
DESCRIPTION: SWM Pond C
DATE: 19-May-22 PREPARED BY: Howie Liu

SCHAEFFERS
CONSULTING ENGINEERS

FOREBAY

FOREBAY SETTLING LENGTH

ref: SWM Planning & Design Manual (MOE, March 2003)

$Dist = (rQ_p / V_s)^{1/2}$, where

Dist = forebay length (m)
r = Length to width ratio of forebay (>2:1)
Q_p = peak flowrate from the pond during design quality storm (m^3/s)
V_s = settling velocity in the forebay (m/s)

r =	2.0		(2:1)
Q_p =	0.047	m^3/s	(required erosion outflow rate)
V_s =	0.0003	m/s	(based on 150μm particles)

Dist = 18 metres

DISPERSION LENGTH

ref: SWM Planning & Design Manual (MOE, March 2003)

$D = 8Q / dV_f$, where

D = length of dispersion (m)
Q = 10 year inlet flowrate (m^3/s)
d = depth of permanent pool in forebay (m)
V_f = desired velocity in the forebay (m/s)

Q =	6.779	m^3/s	(from hydrologic model)
d =	2.00	m	
V_f =	0.5	m/s	(MOEE empirical value)

D = 54 m

Forebay Length Required: 54 metres
Forebay Length Provided: 90 metres

Water Balance Calculations

Project 5184: Watersand Phase 2 - Barrie

TABLE 1: WATER BUDGET - PRE DEVELOPMENT
WATER BALANCE/WATER BUDGET ASSESSMENT

Catchment Designation	**Site**	Total
Area (m^2)	273200	273200
Pervious Area (m^2)	273200	273200
Impervious Area (m^2)	0	0
Infiltration Factors		
Topography Infiltration Factor (Rolling Land)*	0.25	
Soil Infiltration Factor (Silty to Sandy Glacial Till)*	0.3	
Land Cover Infiltration Factor (Cultivated Land)*	0.1	
MOE Infiltration Factor	0.65	
Inputs (per unit area)		
Precipitation (mm/year)**	933	**933**
Total Inputs (mm/year)	933	**933**
Outputs (mm/year)		
Precipitation Surplus	336	336
Net Surplus	336	336
Downspout Disconnection Retention	0	0
Evapotranspiration**	597	597
Roof Evapotranspiration	0	0
Rooftop Runoff Lawn Evaporation	0	0
Total Evapotranspiration	**597**	**597**
Infiltration	218	218
Rooftop Infiltration	0	0
Total Infiltration	**218**	**218**
Runoff Pervious Area	118	118
Runoff Impervious Area	0	0
Total Runoff	**118**	**118**
Total Outputs	**933**	933
Difference (Inputs - Outputs)	0	0
Input (Volumes - m^3/year)		
Precipitation	254896	254896
Total Inputs	**254896**	**254896**
Outputs (Volumes - m^3/year)		
Precipitation Surplus	91795	91795
Net Surplus	91795	91795
Downspout Disconnection Retention	0	0
Evapotranspiration	163100	163100
Roof Evapotranspiration	0	0
Rooftop Runoff Lawn Evaporation	0	0
Total Evapotranspiration	163100	**163100**
Infiltration	59667	59667
Rooftop Infiltration	0	0
Total Infiltration	**59667**	**59667**
Runoff Pervious Area	32128	32128
Runoff Impervious Area	0	0
Total Runoff	**32128**	**32128**
Total Outputs	**254896**	**254896**
Difference (Inputs - Outputs)	0	0

*Data based on MOE

**Precipitation and Evapotranspiration data based on Environment Canada-Barrie WPCC Station (1978-2006)

TABLE 2: WATER BUDGET - POST-DEVELOPMENT WITHOUT MITIGATION -SWM POND C

WATER BALANCE/WATER BUDGET ASSESSMENT

	Site													
Catchment Designation	**Front Lawn**	**Backyard**	**Roofs**	**Front Porch**	**Rec. Centre (79% Impervious)**	**Rec. Centre (21% Pervious)**	**Pond (50% Impervious)**	**Pond (50% Pervious)**	**Elementary School (79% Impervious)**	**Elementary School (21% Pervious)**	**ROW (79% Impervious)**	**ROW (21% Pervious)**	**Driveways**	**Total**
Area (m^2)	14589	20830	48241	650	63990	17010	13900	13900	19118	5082	39737	10563	5590	273200
Pervious Area (m^2)	14589	20830	0	0	0	17010	0	13900	0	5082	0	10563	0	81974
Impervious Area (m^2)	0	0	48241	650	63990	0	13900	0	19118	0	39737	0	5590	191226
Infiltration Factors														
Topography Infiltration Factor (Rolling to Flat Land)*	0.25	0.25	N/A	N/A	N/A	0.25	N/A	0.25	N/A	0.25	N/A	0.25	N/A	
Soil Infiltration Factor (Sandy loam)*	0.3	0.3	N/A	N/A	N/A	0.3	N/A	0.3	N/A	0.3	N/A	0.3	N/A	
Land Cover Infiltration Factor (Cultivated Land)*	0.1	0.1	N/A	N/A	N/A	0.1	N/A	0.1	N/A	0.1	N/A	0.1	N/A	
MOE Infiltration Factor	0.65	0.65	N/A	N/A	N/A	0.65	N/A	0.65	N/A	0.65	N/A	0.65	N/A	
Inputs (per unit area)														
Precipitation (mm/year)**	933	933	933	933	933	933	933	933	933	933	933	933	933	933
Total Inputs (m^3/year)	933	933	933	933	933	933	933	933	933	933	933	933	933	933
Outputs (per unit area)														
Precipitation Surplus (mm/year)	336	336	840	840	840	336	840	336	840	336	840	336	840	689
Net Surplus (mm/year)	336	336	840	840	840	336	840	336	840	336	840	336	840	689
Downspout Disconnection Retention	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Evapotranspiration (mm/year)	597	597	0	93	93	597	93	597	93	597	93	597	93	228
Roof Evapotranspiration (mm/year)	0	0	93	0	0	0	0	0	0	0	0	0	0	16
Rooftop Runoff Lawn Evaporation (mm/year)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Evapotranspiration (mm/yr)	**597**	**597**	**93**	**93**	**93**	**597**	**93**	**597**	**93**	**597**	**93**	**597**	**93**	244
Infiltration (mm/year)	218	218	0	0	0	218	0	218	0	218	0	218	0	66
Rooftop Infiltration (mm/year)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Topsoil Amendment Mitigation Infiltration	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Infiltration (mm/year)	**218**	**218**	**0**	**0**	**0**	**218**	**0**	**218**	**0**	**218**	**0**	**218**	**0**	66
Runoff Pervious Area (mm/year)	118	118	0	0	0	118	0	118	0	118	0	118	0	35
Runoff Impervious Area (mm/year)	0	0	840	840	840	0	840	0	840	0	840	0	840	588
Total Runoff (mm/year)	**118**	**118**	**840**	**840**	**840**	**118**	**840**	**118**	**840**	**118**	**840**	**118**	**840**	623
Total Outputs (mm/year)	**933**	**933**	**933**	**933**	**933**	**933**	**933**	**933**	**933**	**933**	**933**	**933**	**933**	933
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Input Volumes														
Precipitation (m^3/year)	13611	19434	45008	607	59703	15870	12969	12969	17837	4742	37075	9855	5216	**254896**
Total Inputs (m^3/year)	**13611**	**19434**	**45008**	**607**	**59703**	**15870**	**12969**	**12969**	**17837**	**4742**	**37075**	**9855**	**5216**	**254896**
Outputs (Volumes)														
Precipitation Surplus (m^3/year)	4902	6999	40508	546	53732	5715	11672	4670	16053	1708	33367	3549	4694	188116
Net Surplus (m^3/year)	4902	6999	40508	546	53732	5715	11672	4670	16053	1708	33367	3549	4694	188116
Downspout Disconnection Retention (m^3/year)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Evapotranspiration (m^3/year)	8710	12436	0	61	5970	10155	1297	8298	1784	3034	3707	6306	522	62279
Roof Evapotranspiration (m^3/year)	0	0	4501	0	0	0	0	0	0	0	0	0	0	4501
Rooftop Runoff Lawn Evaporation (m^3/year)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Evapotranspiration (m^3/year)	**8710**	**12436**	**4501**	**61**	**5970**	**10155**	**1297**	**8298**	**1784**	**3034**	**3707**	**6306**	**522**	**66780**
Infiltration (m^3/year)	3186	4549	0	0	0	3715	0	3036	0	1110	0	2307	0	17903
Rooftop Infiltration (m^3/year)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Topsoil Amendment Mitigation Infiltration (m^3/year)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Infiltration (m^3/year)	**3186**	**4549**	**0**	**0**	**0**	**3715**	**0**	**3036**	**0**	**1110**	**0**	**2307**	**0**	**17903**
Runoff Pervious Area (m^3/year)	1716	2450	0	0	0	2000	0	1635	0	598	0	1242	0	9640
Runoff Impervious Area (m^3/year)	0	0	40508	546	53732	0	11672	0	16053	0	33367	0	4694	160573
Total Runoff (m^3/year)	**1716**	**2450**	**40508**	**546**	**53732**	**2000**	**11672**	**1635**	**16053**	**598**	**33367**	**1242**	**4694**	**170213**
Total Outputs (m^3/year)	**13611**	**19434**	**45008**	**607**	**59703**	**15870**	**12969**	**12969**	**17837**	**4742**	**37075**	**9855**	**5216**	**254896**
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**

* Data based on R.J. Burnside & Associate Ltd.'s Hydrogeology Assessment Repor
** Precipitation data from Environment Canada, located at Barrie WPCC
*** Thornwaite (1948) method used to calcuate Evapotranspiratior

TABLE 3: WATER BUDGET - POST-DEVELOPMENT WITH MITIGATION -SWM POND C

WATER BALANCE/WATER BUDGET ASSESSMENT

	Site													
Catchment Designation	**Front Lawn**	**Backyard**	**Roofs**	**Front Porch**	**Rec. Centre (79% Impervious)**	**Rec. Centre (21% Pervious)**	**Pond (50% Impervious)**	**Pond (50% Pervious)**	**Elementary School (79% Impervious)**	**Elementary School (21% Pervious)**	**ROW (79% Impervious)**	**ROW (21% Pervious)**	**Driveways**	**Total**
Area (m^2)	14589	20830	48241	650	63990	17010	13900	13900	19118	5082	39737	10563	5590	273200
Pervious Area (m^2)	14589	20830	0	0	0	17010	0	13900	0	5082	0	10563	0	81974
Impervious Area (m^2)	0	0	48241	650	63990	0	13900	0	19118	0	39737	0	5590	191226
Infiltration Factors														
Topography Infiltration Factor (Rolling to Flat Land)*	0.25	0.25	N/A	N/A	N/A	0.25	N/A	0.25	N/A	0.25	N/A	0.25	N/A	
Soil Infiltration Factor (Sandy loam)*	0.3	0.3	N/A	N/A	N/A	0.3	N/A	0.3	N/A	0.3	N/A	0.3	N/A	
Land Cover Infiltration Factor (Cultivated Land)*	0.1	0.1	N/A	N/A	N/A	0.1	N/A	0.1	N/A	0.1	N/A	0.1	N/A	
MOE Infiltration Factor	0.65	0.65	N/A	N/A	N/A	0.65	N/A	0.65	N/A	0.65	N/A	0.65	N/A	
Inputs (per unit area)														
Precipitation (mm/year)**	933	933	933	933	933	933	933	933	933	933	933	933	933	933
Total Inputs (m^3/year)	933	933	933	933	933	933	933	933	933	933	933	933	933	933
Outputs (per unit area)														
Precipitation Surplus (mm/year)	336	336	840	840	840	336	840	336	840	336	840	336	840	689
Net Surplus (mm/year)	336	336	840	840	840	336	840	336	840	336	840	336	840	689
Downspout Disconnection Retention	0	0	168	0	0	0	0	0	0	0	0	0	0	30
Evapotranspiration (mm/year)***	597	597	0	93	93	597	93	597	93	597	93	597	93	228
Roof Evapotranspiration (mm/year)	0	0	93	0	0	0	0	0	0	0	0	0	0	16
Rooftop Runoff Lawn Evaporation (mm/year)	0	0	123	0	0	0	0	0	0	0	0	0	0	22
Total Evapotranspiration (mm/yr)	**597**	**597**	**216**	**93**	**93**	**597**	**93**	**597**	**93**	**597**	**93**	**597**	**93**	266
Infiltration (mm/year)	218	218	0	0	0	218	0	218	0	218	0	218	0	66
Rooftop Infiltration (mm/year)	0	0	45	0	0	0	0	0	0	0	0	0	0	8
Mitigation Infiltration	117	117	125	125	220	118	125	118	220	118	125	118	125	152
Additional Topsoil	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Infiltration (mm/year)	**335**	**335**	**170**	**125**	**220**	**336**	**125**	**336**	**220**	**336**	**125**	**336**	**125**	225
Runoff Pervious Area (mm/year)	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Runoff Impervious Area (mm/year)	0	0	547	715	620	0	715	0	620	0	715	0	715	442
Total Runoff (mm/year)	**1**	**1**	**547**	**715**	**620**	**0**	**715**	**0**	**620**	**0**	**715**	**0**	**715**	442
Total Outputs (mm/year)	**933**	**933**	**933**	**933**	**933**	**933**	**933**	**933**	**933**	**933**	**933**	**933**	**933**	933
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Input Volumes														
Precipitation (m^3/year)	13611	19434	45008	607	59703	15870	12969	12969	17837	4742	37075	9855	5216	**254896**
Total Inputs (m^3/year)	**13611**	**19434**	**45008**	**607**	**59703**	**15870**	**12969**	**12969**	**17837**	**4742**	**37075**	**9855**	**5216**	**254896**
Outputs (Volumes)														
Precipitation Surplus (m^3/year)	4902	6999	40508	546	53732	5715	11672	4670	16053	1708	33367	3549	4694	188116
Net Surplus (m^3/year)	4902	6999	40508	546	53732	5715	11672	4670	16053	1708	33367	3549	4694	188116
Downspout Disconnection Retention (m^3/year)	0	0	8102	0	0	0	0	0	0	0	0	0	0	8102
Evapotranspiration (m^3/year)	8710	12436	0	61	5970	10155	1297	8298	1784	3034	3707	6306	522	62279
Roof Evapotranspiration (m^3/year)	0	0	4501	0	0	0	0	0	0	0	0	0	0	4501
Rooftop Runoff Lawn Evaporation (m^3/year)	0	0	5932	0	0	0	0	0	0	0	0	0	0	5932
Total Evapotranspiration (m^3/year)	**8710**	**12436**	**10432**	**61**	**5970**	**10155**	**1297**	**8298**	**1784**	**3034**	**3707**	**6306**	**522**	**72711**
Infiltration (m^3/year)	3186	4549	0	0	0	3715	0	3036	0	1110	0	2307	0	17903
Rooftop Infiltration (m^3/year)	0	0	2170	0	0	0	0	0	0	0	0	0	0	2170
Mitigation Infiltration (m^3/year)	1707	2437	6030	81	14078	2000	1738	1635	4206	598	4967	1242	699	41417
Additonal Topsoil	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Infiltration (m^3/year)	**4893**	**6986**	**8200**	**81**	**14078**	**5715**	**1738**	**4670**	**4206**	**1708**	**4967**	**3549**	**699**	**61490**
Runoff Pervious Area (m^3/year)	9	12	0	0	0	0	0	0	0	0	0	0	0	21
Runoff Impervious Area (m^3/year)	0	0	26376	465	39655	0	9934	0	11847	0	28400	0	3995	120673
Total Runoff (m^3/year)	**9**	**12**	**26376**	**465**	**39655**	**0**	**9934**	**0**	**11847**	**0**	**28400**	**0**	**3995**	**120694**
Total Outputs (m^3/year)	**13611**	**19434**	**45008**	**607**	**59703**	**15870**	**12969**	**12969**	**17837**	**4742**	**37075**	**9855**	**5216**	**254896**
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**

* Data based on R.J. Burnside & Associate Ltd.'s Hydrogeology Assessment Repor
** Precipitation data from Environment Canada, located at Barrie WPCC
*** Thornwaite (1948) method used to calcuate Evapotranspiratior

Water Balance Mitigation Calculations

Pre Development Infiltration =	**59,667**	**m^3/year**
Post Development Infiltration =	**17,903**	**m^3/year**
Post to Pre Deficit =	**41,764**	**m^3/year**
On-site Infiltration (School Block) =	**4,804**	**m^3/year**
On-site Infiltration (Recreation Centre) =	**16,078**	**m^3/year**
Infiltration Cell Underneath SWM Pond C =	**20,882**	**m^3/year**
Mitigation Volume Provided =	**41,764**	**m^3/year**
Deficit =	**0**	**m^3/year**

On-site Infiltration (School Block) =

2.42 ha x Annual Precipitation Depth = **4259** **m^3/year**

Required Annual Precpitation Depth to meet deficit = **176** **mm/year**

A precipitation analysis (rainfall & snowfall) was conducted to estimate an event with sufficient precipitation that produces an annual runoff volume of 4260 m^3/year (or a total depth of annual rainfall equal to 176mm)

The analysis was performed on daily precipitation data collected from Barrie WPCC Station from 1978 to 2006 by Environment Canada. The data was then arranged into four categories for each year: Total Annual Depth of Precipitation from events less than or equal to 5mm, 10mm, 15mm, 20mm, 25mm & 50mm. This yearly data was then used to determine an average annua precipitation depth. The results of the analysis are summarized in Table A and Figure A

Based on this analysis, it is concluded that precipitation events of depth less than or equal to 5.00 mm will produce an annual amount of precipitation equal to **220 mm/year**

The total On-Site Infiltration at School Block require a volume of 5 mm x 2.42 ha x10 = **121 m^3** 5.00 mm

On-site Infiltration (Recreation Centre) =

8.10 ha x Annual Precipitation Depth = **12781** **m^3/year**

Required Annual Precpitation Depth to meet deficit = **158** **mm/year**

A precipitation analysis (rainfall & snowfall) was conducted to estimate an event with sufficient precipitation that produces an annual runoff volume of 12782 m^3/year (or a total depth of annual rainfall equal to 158mm

The analysis was performed on daily precipitation data collected from Barrie WPCC Station from 1978 to 2006 by Environment Canada. The data was then arranged into four categories for each year: Total Annual Depth of Precipitatio from events less than or equal to 5mm, 10mm, 15mm, 20mm, 25mm & 50mm. This yearly data was then used to determine an average annua precipitation depth. The results of the analysis are summarized in Table A and Figure A

Based on this analysis, it is concluded that precipitation events of depth less than or equal to 5.00 mm will produce an annual amount of precipitation equal to **220 mm/year**

The total required Atlantis Infiltraton Cell within boulevard would require a volume of 5 mm x 8.1 ha x 10 = **405 m^3** 5.00 mm

Infiltration Cell Underneath SWM Pond C =

16.80 ha x Annual Precipitation Depth = **20882** **m^3/year**

Required Annual Precpitation Depth to meet deficit = **124** **mm/year**

A precipitation analysis (rainfall & snowfall) was conducted to estimate an event with sufficient precipitation that produces an annual runoff volume of 20883 m^3/year (or a total depth of annual rainfall equal to 125mm

The analysis was performed on daily precipitation data collected from Barrie WPCC Station from 1978 to 2006 by Environment Canada. The data was then arranged into four categories for each year: Total Annual Depth of Precipitatio from events less than or equal to 5mm, 10mm, 15mm, 20mm, 25mm & 50mm. This yearly data was then used to determine an average annua precipitation depth. The results of the analysis are summarized in Table A and Figure A

Based on this analysis, it is concluded that precipitation events of depth less than or equal to 2.60 mm will produce an annual amount of precipitation equal to **124 mm/year**

The total required Infiltration Tank would require a volume of 2.6 mm x 16.8 ha x10 = **437 m^3** 2.60 mm

Phosphorus Mitigation Calculations

Development Export Summary

Development :5184

Pre-Development Phosphorus Export

DEVELOPMENT : 5184

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Agricultural				
Cropland	Cropland	16.80		2.71
	Agricultural Land use Class Total :	**16.80**		**2.71**
	Development Total :	**16.80**		**2.71**

Cropland Site Sediment & Phosphorus Pre-Development Export

DEVELOPMENT : 5184

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea : Cropland

Slope Area (ha)	16.80	R (rainfall / runoff for Lake Simcoe)	120.00
Surface Slope Gradient (%)	0.40	K (soil errodability factor)	0.29
Length of Slope (m)	377.20	NN (determined by slope)	0.20
Cropt Type Factor)	0.02	LS (slope length gradient factor)	0.15
Tillage Type Factor	0.25	C (crop management factor)	0.01
		P (prevention + capture)	0.37
		Soil Loss (kg/year)	0.01
		Phosphorus export (kg/ha/yr)	0.16
		Phosphorus load (kg/yr)	2.71

PRE Developed Area (ha) : **16.80**

Phosphorus export (kg/ha/yr) : **0.16**

Phosphorus load (kg/yr) : **2.71**

Updated : Sept 2014

Post-Development Phosphorus Export

DEVELOPMENT : 5184

Landuse	Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Natural Heritage			
Open Water	2.78	0.26	0.72
Natural Heritage Land use Class Total :	**2.78**		**0.72**
Urban			
Residential	1.06	0.41	0.43
Residential	7.93	0.41	3.25
Transportation	5.03	0.50	2.52
Urban Land use Class Total :	**14.02**		**6.20**
Development Total :	**16.80**		**6.92**

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Post-Development Export

DEVELOPMENT : 5184

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea :

Slope Area (ha)
Surface Slope Gradient (%)
Length of Slope (m)

Cropt Type Factor)
Tillage Type Factor

R (rainfall / runoff for Lake Simcoe)
K (soil errodability factor)
NN (determined by slope)

LS (slope length gradient factor)
C (crop management factor)
P (prevention + capture)
Soil Loss (kg/year)
Phosphorus export (kg/ha/yr)
Phosphorus load (kg/yr)

PRE Developed Area (ha) :

Phosphorus export (kg/ha/yr) :

Phosphorus load (kg/yr) :

Updated : Sept 2014

Post Dev BMP

Area (ha)	Treated Area %	P coefficient	P coefficient	P Load Reduction (kg/yr)	Rationale
Best Management Practices (BMP) Applied (and Rationale)					
Residential					
7.93	100	0.41	92 %	2.99	92% of 7.93 ha area of Residential Detached House drain to the SWM Pond (63%) and Infiltration cell (60%)
User Entry					
Residential					
1.06	100	0.41	92 %	0.40	92% of 1.06 ha area of Residential Townhouse drain to the SWM Pond (63%) and infiltration cell (60%)
User Entry					
Transportation					
5.03	100	0.50	92 %	2.31	92% of 5.03 ha area of ROW drain to the SWM Pond (63%) and infiltration cell (60%)
User Entry					
Open Water					
2.78	100	0.26	92 %	0.66	92% of 2.78 ha area of SWM Pond C (63%) and infiltration cell (60%)
User Entry					

Updated : Sept 2014

Development Area P and BMP Summary

Total PreDevelopment Area (ha):	16.80
PreDevelopment Area excluding Wetlands (ha):	16.80
Total PostDevelopment Area (ha):	16.80
Total Area treated by BMP's (ha):	16.80
Treated Area total:	16.80
Total PreDevelopment Load (kg/yr):	2.71
Total PostDevelopment Load (kg/yr):	6.92
Total P Load Reduction with BMP's (kg/yr):	6.36
Minimum P Load Reduction Required:	4.21
Total PostDevelopment Load with BMP's (kg/yr)	0.56

Conclusion : No Net Increase in P Load.

Updated : Sept 2014

Post Dev Construction

APPENDIX C: SANITARY SERVICING CALCULATIONS

SCHAEFFERS
Consulting Engineers
SCHAEFFER & ASSOCIATES LTD.

6 Ronrose Dr
Concord, Ontario
L4K 4R3
Phone: (905) 738-6100
Fax: (905) 738-6875
design@schaeffers.com

Project No: 5184
Project Desc: Watersand Phase 2 Residential
Designed by: S.K
Checked by: S.K
Date: 2022-05-02

Sanitary and Water Servicing Calculation Sheet

Average Daily Generation Rate	225 L/cap/day	Refer to the City of Barrie Design Criteria (2017) for all
Infiltration Allowance	0.1 L/s/ha	design criteria

Residential Population Estimates

	Density (pp/unit)	Units	Population
Singel Detached	3.13	211	661
Townhouses	2.34	55	129
Semi-detached	1.67	0	0
Total Residential			**790**

Non-Residential Population Estimates

	Generation rate [cum/ha/day]	Area (ha)	Average Flow [cum/day]	Population Equivalent*
Commercial	28	10.520	294.56	1310
Industrial	35	0.000	0.00	0
Total Non-Ressidential				**1310**

* Population equivalent is used only for determination of an appropriate peaking factor

Sanitary Sewage Flow Summary

Location	Population	Average Flow [L/s]	Harmon Peaking Factor	Peak Daily Flow [L/s]	Area [ha]	Infiltration [L/s]	Total Daily Peak [L/s]
Subject Lands	2100	5.47	3.57	19.52	26.54	2.65	**22.17**

APPENDIX D: WATER SUPPLY

SCHAEFFERS
Consulting Engineers
SCHAEFFER & ASSOCIATES LTD.
6 Ronrose Dr
Concord, Ontario
L4K 4R3
Phone: (905)738-6100
Fax: (905)738-6875
design@schaeffers.com

Project No: 5184
Project Desc: Watersand Phase 2 Residential
Designed by: S.K
Checked by: S.K
Date: 2022-05-02

Water Servicing Calculation Sheet

Residential Population Estimates

	Density (pp/unit)	Units	Population
Singel Detached	3.13	211	661
Townhouses	2.34	55	129
Semi-detached	1.67	0	0
Total Residential			**790**

Non-Residential Population Estimates

	Generation rate [cum/ha/day]	Area (ha)	Average Flow [cum/day]	Population Equivalent*
Commercial	28	10.520	294.56	1310
Industrial	35	0.000	0.00	0
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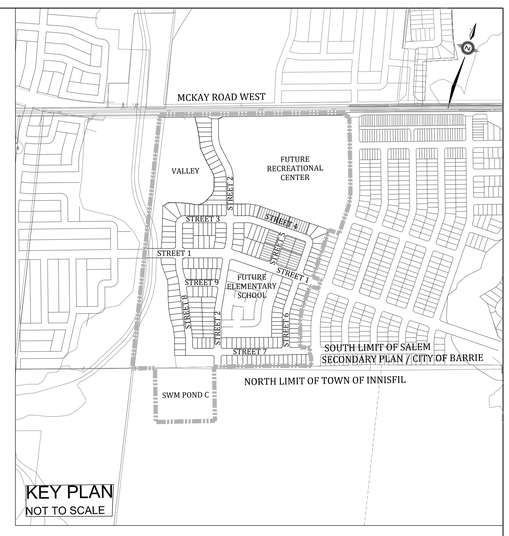
Water Supply Demand Peaking Factors

Max Day Demand	2.5
Peak Hour Demand	3.75
Minimum Hour Demand	0.45

Water Supply Demand Scenarios

Location	Average Day [L/s]	Max Day [L/s]	Peak Hour [L/s]	Minimum Hour [L/s]	Fire Flow [L/s]	Max Day + Fire Flow [L/s]
Subject Lands	5.47	13.67	20.50	2.46	283.00	296.67

APPENDIX E: ENGINEERING DRAWINGS



ULTIMATE GRADES ON McKAY ROAD WEST

LIMIT OF SUBDIVISION

McKAY ROAD WEST

ULTIMATE GRADES ON McKAY ROAD WEST

McKAY ROAD WEST

FUTURE WATERMAIN TRUNK

BLOCK 217

BLOCK 218 (0.30 RESERVE)

BLOCK 219 (0.30 RESERVE)

STREET 2

BLOCK 215 VALLEY

LIMIT OF SUBDIVISION

FUTURE DEVELOPMENT AREA BLOCK 214 RECREATIONAL CENTRE

BOCUS LANE

NORA STREET

CROWN AVENUE

OWL LAKE DRIVE

WINN DRIVE

CULFORD DRIVE

LISBON AVENUE

MOOSEWOOD STREET

WALKER STREET

PALOMINO STREET

STREET 3

STREET 4

STREET 5

STREET 6

STREET 7

STREET 8

STREET 9

STREET 1

BLOCK 185 (TH 8 UNITS)

BL-184 (TH 4 UNITS)

BLOCK 183 (TH 8 UNITS)

BL-201 (TH 5 UNITS)

BL-195 (TH 5 UNITS)

BL-192 (TH 5 UNITS)

BL-202 (TH 5 UNITS)

BL-194 (TH 6 UNITS)

BL-193 (TH 6 UNITS)

PROPOSED ENGINEERED CHANNEL

BEAR CREEK

FUTURE SUBDIVISION

BLOCK 220 (0.30 RESERVE)

PROPOSED 50.5m x 3.66m x 1.52m CONSPAN BOX CULVERT @ 1.22%

INV.308.18

INV.307.56

BLOCK 216 VALLEY

DRYING AREA 1000m²

FOREBAY

INFILTRATION CELL 1900m²

WET CELL

ORIGINAL LIMIT OF DEVELOPMENT

BLOCK 212 SWM POND

BLOCK 221 (0.30 RESERVE)

FUTURE DEVELOPMENT AREA BLOCK 213 ELEMENTARY SCHOOL

NOTE: SWM POND DETAILS AND SECTIONS
REFER TO PLAN DRAWING SWM-C-1 FOR SWM POND DRAWING. REFER TO POND SECTION DRAWING SWM-C-2 FOR SECTIONS 1-1 & 2-2 THROUGH SWM POND.

NOTE: WATERSAND RESIDENTIAL SUBDIVISION PHASE 1 SALEM SECONDARY PLAN AREA
REFER TO PROJECT 2017-4610 "WATERSAND RESIDENTIAL SUBDIVISION PHASE 1 SALEM SECONDARY PLAN AREA" BY SCHAEFFERS CONSULTING ENGINEERS

LEGEND

- PROPOSED STORM MANHOLE
- PROPOSED SANITARY MANHOLE
- PROPOSED STORM SEWER
- PROPOSED SANITARY SEWER
- 200ø WM — PROPOSED WATERMAIN
- 246 — EXISTING CONTOUR AND ELEVATION
- LIMIT OF SUBDIVISION
- OVERLAND FLOW ROUTE
- × 309.60 — EXISTING ELEVATION
- × 278.60 — PROPOSED ELEVATION
- N 270.85 SE 270.50 — SANITARY SEWER OBVERT
- N 270.80 W 270.30 E 270.70 — STORM SEWER OBVERT
- BL-184 (TH 4 UNITS) — BLOCK NUMBER AND DESCRIPTION
- 48 — LOT NUMBER
- DENOTES AREA TO BE CONSTRUCTED A PART OF WATERSAND RESIDENTIAL SUBDIVISION PHASE 1
- NATURAL HERITAGE SYSTEM
- NATURAL HERITAGE SYSTEM BUFFER

REFER TO DWG. No. GRSS-2

BENCH MARKS — U.T.M. COORDINATES: ZONE 17 NAD 83

MNR No: 03120110004 – BENCH MARK No: 03120110004 – COMBINED CONTROL MONUMENT RECORD
LOCATED APPROXIMATELY 465m SOUTH OF McKAY ROAD WEST AND COUNTY ROAD # 27 INTERSECTION ON THE WEST SIDE OF THE COUNTY ROAD # 27 BOULEVARD.

MNR No: 03120110011 – BENCH MARK No: 03120110011 – COMBINED CONTROL MONUMENT RECORD
LOCATED ON McKAY ROAD EAST ON THE SOUTH SIDE OF THE BOULEVARD, APPROXIMATELY 565m EAST OF HIGHWAY 400.

MNR No: 03120110007 – BENCH MARK No: 03120110007 – COMBINED CONTROL MONUMENT RECORD
LOCATED ON McKAY ROAD WEST ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 705m WEST OF THE McKAY ROAD WEST AND VETERAN'S DRIVE INTERSECTION, ELEVATION ARE RELATED TO GEODETIC DATUM AND ARE DERIVED FROM THE CITY OF BARRIE BENCH MARK No 03120110007 HAVING A PUBLISHED ELEVATION OF 310.796 METRES.

MNR No: 03120110008 – BENCH MARK No: 03120110008 – COMBINED CONTROL MONUMENT RECORD
LOCATED APPROXIMATELY 150m WEST OF THE McKAY ROAD WEST AND VETERAN'S DRIVE INTERSECTION ON THE NORTH SIDE OF THE McKAY ROAD WEST BOULEVARD, ELEVATION ARE RELATED TO GEODETIC DATUM AND ARE DERIVED FROM THE CITY OF BARRIE BENCH MARK No 03120110008 HAVING A PUBLISHED ELEVATION OF 311.503 METRES.

NOTE: A PROTECTIVE WATER VALVE COVER HAS BEEN PLACED OVER MONUMENTS CAP.

LEGAL INFORMATION:
CALCULATED MPLAN WAS PREPARED BY HOLDING JONES VANDERVEEN INC.
PROJECT No.: 04-1575-MPLAN 1, DATED JANUARY 14, 2020

NO.	REVISIONS	DATE	APPROVED

SCHAEFFERS CONSULTING ENGINEERS
SCHAEFFER & ASSOCIATES LTD.
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100
Fax: (905) 738-6875
E-mail: design@schaeffers.com

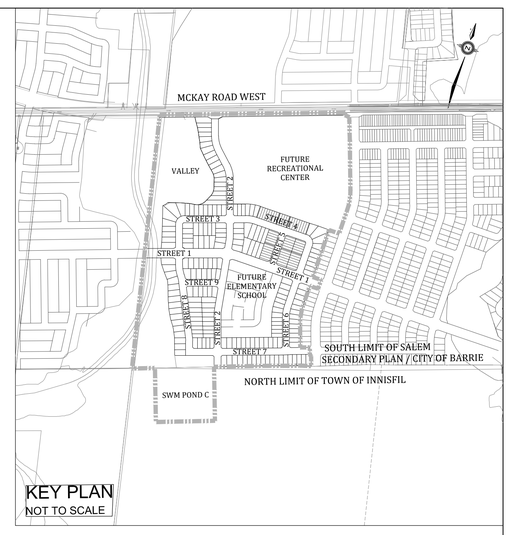
LICENSED PROFESSIONAL ENGINEER Z. LI Jun. 30, 2022 PROVINCE OF ONTARIO

WATERSAND RESIDENTIAL SUBDIVISION PHASE 2 SALEM SECONDARY PLAN AREA

PRELIMINARY GRADING AND SERVICING PLAN

Barrie
ENGINEERING DEPARTMENT

SCALE HOR. 1:1000	VERT. n/a	PROJECT NO.	2022-5184
DESIGN A.C.	DRAWN B.P.	SHEET NO.	GRSS-1
CHECKED Z.L.			



KEY PLAN
NOT TO SCALE

McKAY ROAD WEST

ULTIMATE GRADES ON McKAY ROAD WEST

McKAY ROAD WEST

LIMIT OF SUBDIVISION

BOCUS LANE

BOCUS LANE

LISBON AVENUE

NORA STREET

NORA STREET

STARSCAPE CRESCENT

FUTURE DEVELOPMENT AREA BLOCK 214
RECREATIONAL CENTRE

CROWN AVENUE

OWL LAKE DRIVE

WINN DRIVE

CULFORD DRIVE

LISBON AVENUE

AMARONE LANE

LALO MEWS

STARSCAPE CRESCENT

OPEN SPACE

VALLEY

ELEMANNA CRESCENT

EVERETT CRESCENT

SAPPHIRE HEIGHTS

MOOSEWOOD STREET

MOOSEWOOD STREET

BL-184 (TH 4 UNITS)

BLOCK 183 (TH 8 UNITS)

BL-195 (TH 5 UNITS)

BL-192 (TH 5 UNITS)

BL-194 (TH 6 UNITS)

BL-193 (TH 4 UNITS)

STREET 4

STREET 6

CROWN AVENUE

OWL LAKE DRIVE

WINN DRIVE

CULFORD DRIVE

LISBON AVENUE

WALKER STREET

WALKER STREET

LIMIT OF SUBDIVISION

MELODY WAY

EVERETT CRESCENT

SANZO ROAD

SANZO ROAD

NOTE: WATERSAND RESIDENTIAL SUBDIVISION PHASE 1 SALEM SECONDARY PLAN AREA
REFER TO PROJECT 2017-4610 "WATERSAND RESIDENTIAL SUBDIVISION PHASE 1 SALEM SECONDARY PLAN AREA" BY SCHAEFFERS CONSULTING ENGINEERS

CONNECT TO PROPOSED TRUNK SAN EAST INV.: 301.66m

WALKER STREET

49.3m-250mmø TRUNK SAN @ 0.40%

49.3m-200mmø LOCAL SAN @ 2.00%

PALOMINO STREET

LIMIT OF SUBDIVISION

5.0m WIDE ACCESS ROAD

REFER TO DWG. No. GRSS-1

LEGEND

- PROPOSED STORM MANHOLE
- PROPOSED SANITARY MANHOLE
- PROPOSED STORM SEWER
- PROPOSED SANITARY SEWER
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NOTE: A PROTECTIVE WATER VALVE COVER HAS BEEN PLACED OVER MONUMENTS CAP.

LEGAL INFORMATION:
CALCULATED MPLAN WAS PREPARED BY HOLDING JONES VANDERVEEN INC.
PROJECT No.: 04-1575-MPLAN 1, DATED JANUARY 14, 2020

NO.	REVISIONS	DATE	APPROVED

SCHAEFFERS
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SCHAEFFER & ASSOCIATES LTD.
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100
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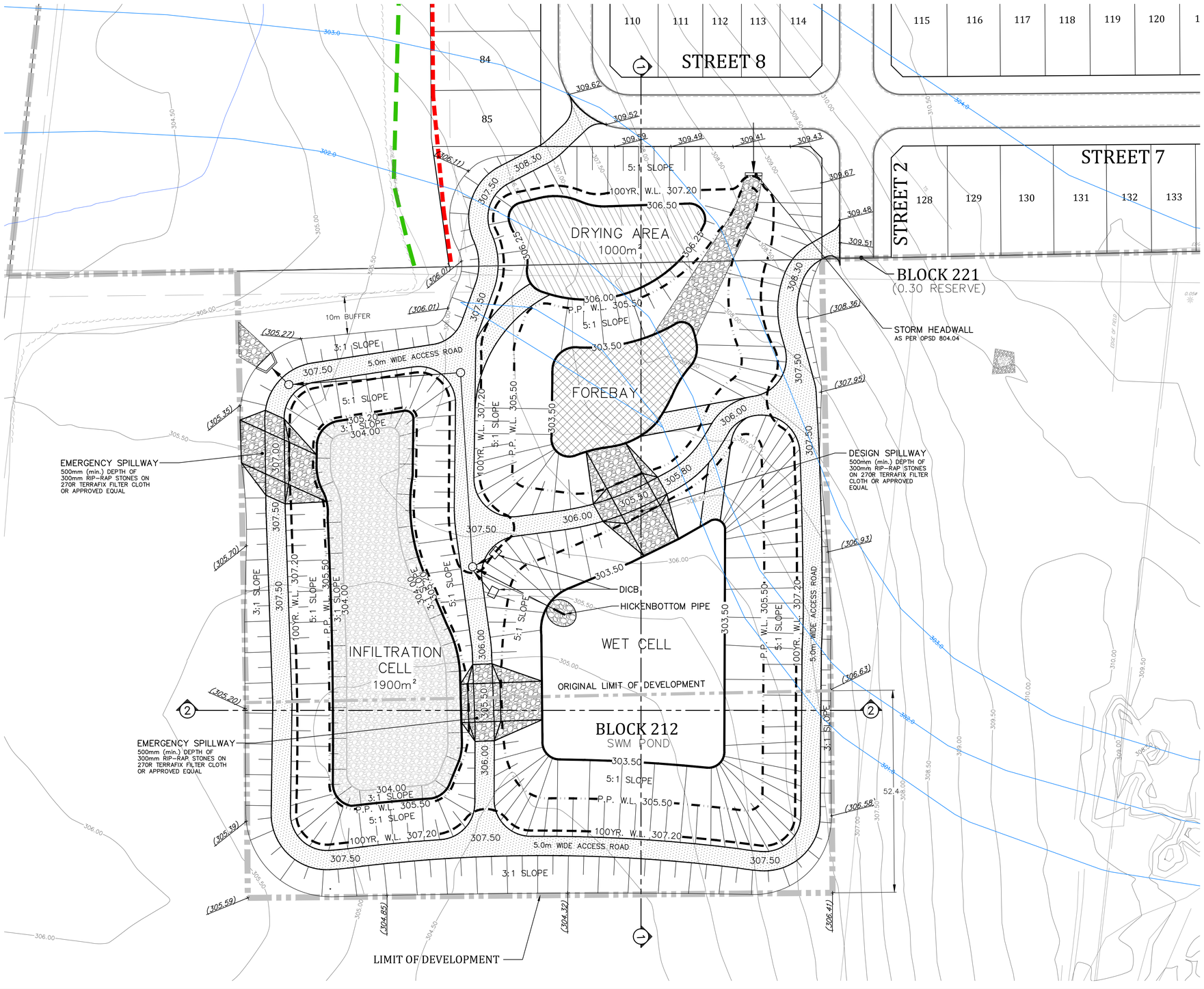
LICENSED PROFESSIONAL ENGINEER
Z. LI
sept. 30, 2022
PROVINCE OF ONTARIO

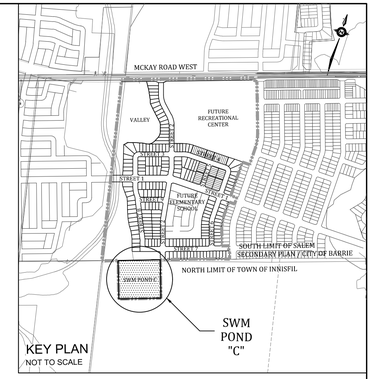
WATERSAND RESIDENTIAL SUBDIVISION PHASE 2 SALEM SECONDARY PLAN AREA

PRELIMINARY GRADING AND SERVICING PLAN

Barrie
ENGINEERING DEPARTMENT

SCALE HOR. 1:1000	VERT. n/a	PROJECT NO.	2022-5184
DESIGN A.C.	DRAWN B.P.	SHEET NO.	GRSS-2
CHECKED Z.L.			





LEGEND

- 4.0m WIDE MAINTENANCE ACCESS ROAD 300mm DEPTH OF 50mm CRUSHER-RUN LIMESTONE
- RIP-RAP STONE WASHED IN WITH TOPSOIL AND SEEDED. PLACED ON TOP OF 270R TERRAFIX FILTER CLOTH OR APPROVED EQUAL.
- RIP-RAP STONE (500mm MIN.) ON TOP OF 270R TERRAFIX FILTER CLOTH OR APPROVED EQUAL
- DENOTES INFILTRATION AREA
- DENOTES LIMIT OF DEVELOPMENT
- 306.93 — DENOTES PROPOSED GRADE
- (210.07) — DENOTES EXISTING GRADE
- 210.0 — DENOTES GROUND WATER CONTOUR LINE
- 210.0 — DENOTES EXISTING CONTOUR LINE
- DENOTES PROP. SWM POND BOTTOM
- DENOTES NORMAL WATER LEVEL (PERMANENT POOL)
- DENOTES 100 YR. W.L. CONTOUR LINE

SWM POND C

DEPTH	ELEVATIONS	AREA (m^2)	VOLUME PROVIDED (m^3)	VOLUME REQUIRED (m^3)
2.00m	303.50 (BOTTOM)	3,360 m^2	–	–
0.75m	305.50 (PERM. POOL EL.)	7,708 m^2	9,960 m^3	5,292 m^3
0.95m	306.25 (EROSION POOL EL.)	–	9,300 m^3	8,625 m^3
	307.20 (100 YR POOL EL.)	18,313 m^2	22,660 m^3	21,790 m^3

MISCELLANEOUS

ELEVATIONS	AREA PROVIDED (m^2)	AREA REQUIRED (m^2)
INFILTRATION PERM. POOL (EL.305.50)	3,040 m^2	1,800 m^2
DRYING AREA (EL.306.00–EL.306.50)	1,000 m^2	950 m^2

INFILTRATION CELL

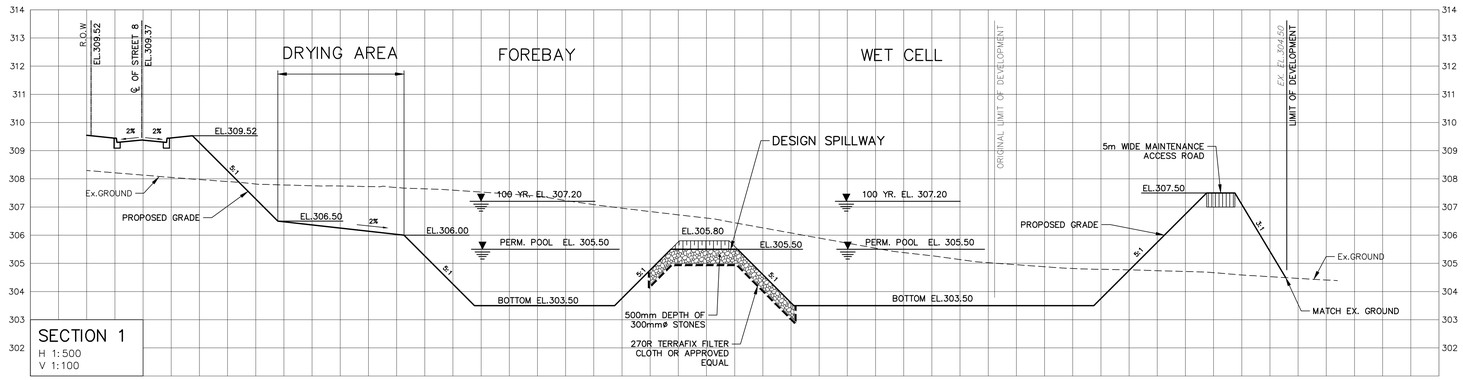
DESCRIPTION	AREA	PROVIDED STORAGE	REQUIRED STORAGE
BOTTOM OF FILTER EL.304.00	1,900m^2	–	–
TOP OF FILTER EL.304.00–EL.305.20	2,790m^2	1,013m^3	–
PERMANENT POOL EL.305.20–EL.305.50	3,040m^2	787m^3	–
TOP OF INFILTRATION CELL EL.305.50–EL.305.72	–	801m^3	–
TOTAL INFILTRATION CELL VOLUME EL.304.00–EL.305.72	–	2,600m^3	2,501m^3

WATERSAND RESIDENTIAL SUBDIVISION
PHASE 2 SALEM SECONDARY PLAN AREA
SALEM LANDOWNERS GROUP
SWM POND "C" PLAN

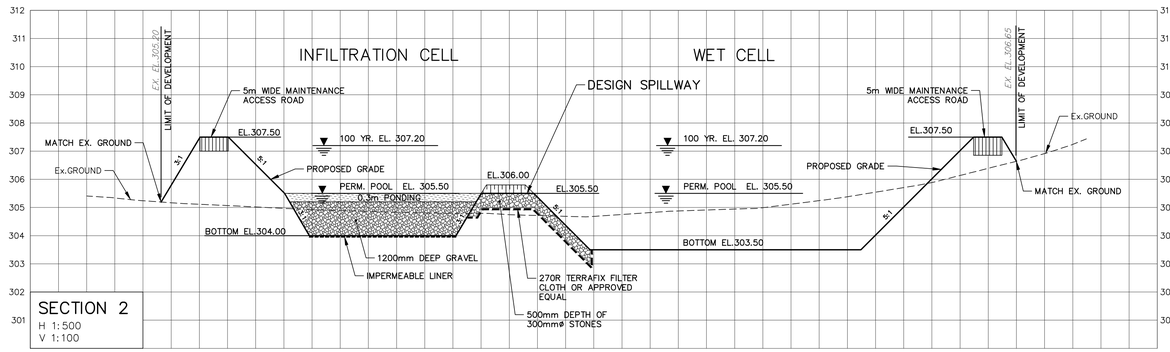
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CONSULTING ENGINEERS
SCHAEFFER & ASSOCIATES LTD.
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100
Fax: (905) 738-6875
E-mail: design@schaeffers.com

Barrie
ENGINEERING DEPARTMENT

SCALE 1:500		PROJECT NO.	2022-5184
DESIGN T.O	DRAWN B.P	SHEET NO.	SWM-C-1
CHECKED T.O			



SECTION 1
H 1:500
V 1:100



SECTION 2
H 1:500
V 1:100

WATERSAND RESIDENTIAL SUBDIVISION
PHASE 2 SALEM SECONDARY PLAN AREA

SALEM LANDOWNERS GROUP

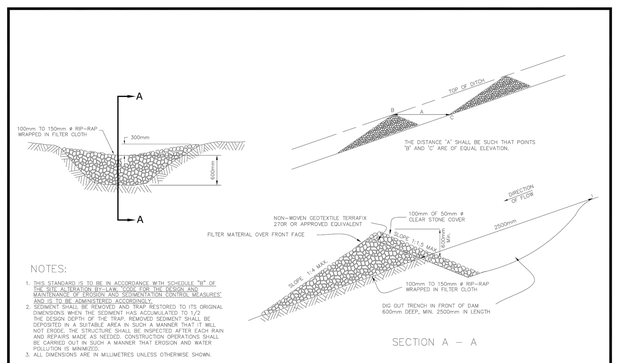
SWM POND "C" SECTIONS

SCHAEFFERS
CONSULTING ENGINEERS
SCHAEFFER & ASSOCIATES LTD.
6 Ronrose Drive, Concord,
Ontario L4K 4R3
Tel: (905) 738-6100
Fax: (905) 738-6875
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Barrie
ENGINEERING DEPARTMENT

SCALE	1:500			PROJECT NO. 2022-5184
DESIGN	T.O	DRAWN	B.P	SHEET NO. SWM-C-2
CHECKED	T.O			

APPENDIX F: ESC PLAN



NOTES:

1. THIS STANDARD IS TO BE IN ACCORDANCE WITH SCHEDULE "B" OF THE SITE ALTERATION BY-LAW, "CODE FOR THE DESIGN AND MAINTENANCE OF EROSION AND SEDIMENTATION CONTROL MEASURES" AND IS TO BE ADMINISTERED ACCORDINGLY.
2. SEDIMENT SHALL BE REMOVED AND TRAP RESTORED TO ITS ORIGINAL DIMENSIONS WHEN THE SEDIMENT HAS ACCUMULATED TO 1/2 THE DEPTH OF THE TRAP. ALL SEDIMENT REMOVED SHALL BE DEPOSITED IN A SUITABLE AREA IN SUCH A MANNER THAT IT WILL NOT ERODE. THE STRUCTURE SHALL BE INSPECTED AFTER EACH RAIN AND REPAIRS MADE AS NEEDED. CONSTRUCTION OPERATIONS SHALL BE CARRIED OUT IN SUCH A MANNER THAT EROSION AND WATER POLLUTION IS MINIMIZED.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.

CITY OF BARRIE STANDARD

TYPICAL GRANULAR EROSION CONTROL DEVICE

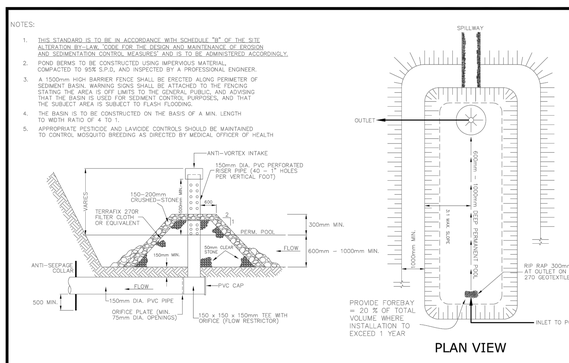
NO.	REVISION	APR'D	DATE
2	MODIFICATIONS BY ENV. SER.		2004.04.06
1	TRENCH ADDED AND FABRIC EXTENDED INTO IT	B.R.	2003.02.19

APR'D: R.G.N. DATE: 04.03.16
DRAWN: L.A.J. SCALE: N.T.S.

BSD-23B

NOTES:

1. THIS STANDARD IS TO BE IN ACCORDANCE WITH SCHEDULE "B" OF THE SITE ALTERATION BY-LAW, "CODE FOR THE DESIGN AND MAINTENANCE OF EROSION AND SEDIMENT CONTROL MEASURES" AND IS TO BE ADMINISTERED ACCORDINGLY.
2. POND BERMS TO BE CONSTRUCTED USING IMPERVIOUS MATERIAL, COMPACTED TO 95% S.P.D. AND INSPECTED BY A PROFESSIONAL ENGINEER.
3. A 1500mm HIGH BARRIER FENCE SHALL BE ERECTED ALONG PERIMETER OF SEDIMENT BASIN. WARNING SIGNS SHALL BE ATTACHED TO THE FENCING STATING THE AREA IS OFF LIMITS TO THE GENERAL PUBLIC, AND ADVISING THAT THE BASIN IS USED FOR SEDIMENT CONTROL PURPOSES, AND THAT THE SUBJECT AREA IS SUBJECT TO FLASH FLOODING.
4. THE BASIN IS TO BE CONSTRUCTED ON THE BASIS OF A MIN. LENGTH TO WIDTH RATIO OF 4 TO 1.
5. APPROPRIATE PESTICIDE AND LARVICIDE CONTROLS SHOULD BE MAINTAINED TO CONTROL MOSQUITO BREEDING AS DIRECTED BY MEDICAL OFFICER OF HEALTH



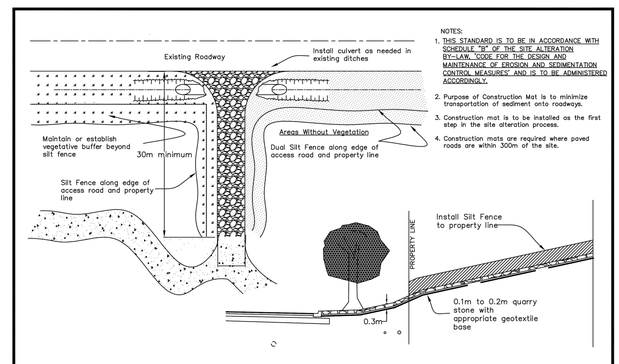
CITY OF BARRIE STANDARD

TEMPORARY SEDIMENT BASIN AND OUTLET DETAILS

NO.	REVISION	APR'D	DATE
1	MODIFICATIONS BY ENV. SER.		04.04.05

APR'D: R.G.N. DATE: 03.08.29
DRAWN: A.S.C SCALE: N.T.S

BSD-23C



NOTES:

1. THIS STANDARD IS TO BE IN ACCORDANCE WITH SCHEDULE "B" OF THE SITE ALTERATION BY–LAW, "CODE FOR THE DESIGN AND MAINTENANCE OF EROSION AND SEDIMENT CONTROL MEASURES" AND IS TO BE ADMINISTERED ACCORDINGLY.
2. Purpose of Construction Mat is to minimize transportation of sediment onto roadways.
3. Construction mat is to be installed as the first step in the site alteration process.
4. Construction mats are required where paved roads are within 300m of the site.

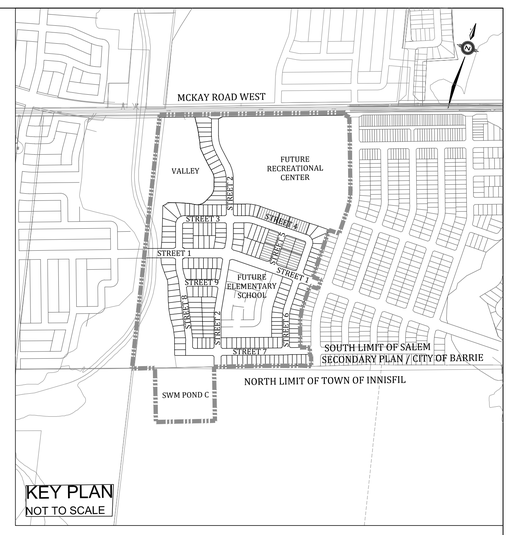
CITY OF BARRIE STANDARD

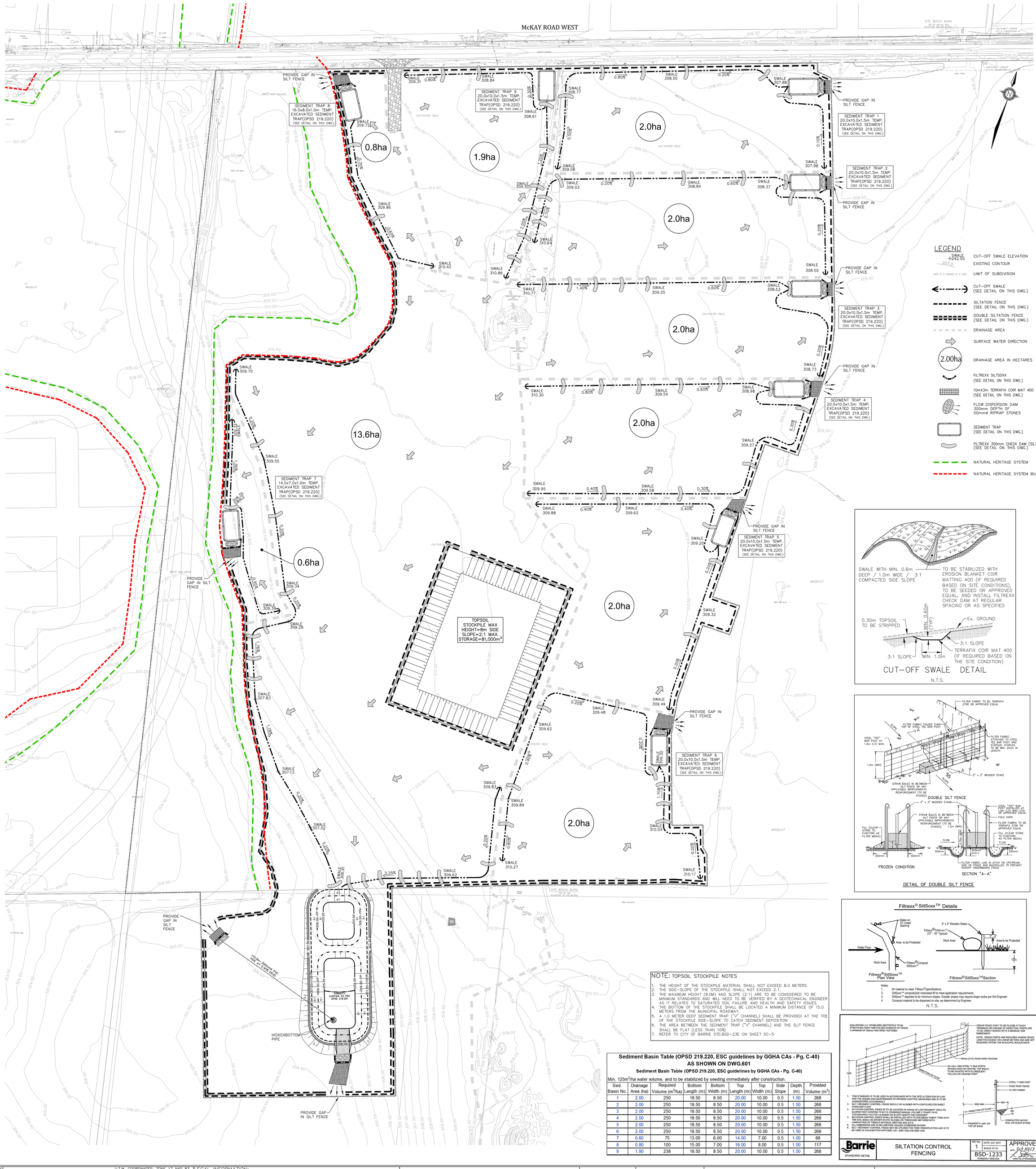
CONSTRUCTION ENTRANCE MAT

NO.	REVISION	APR'D	DATE
1.	Standardized Dimension Text	J.S.	05.10.28

APR'D: R.G.N. DATE: 04.03.16
DRAWN: A.S.C SCALE: N.T.S

BSD-23D





CUT–OFF SWALE DETAIL

N.T.S.

DETAIL OF DOUBLE SILT FENCE

NOTE: TOPSOIL STOCKPILE NOTES

1. THE HEIGHT OF THE STOCKPILE MATERIAL SHALL NOT EXCEED 8.0 METERS.
2. THE SIDE–SLOPE OF THE STOCKPILE SHALL NOT EXCEED 2:1.
3. THE MAXIMUM HEIGHT (8.0M) AND SLOPE (2:1) ARE TO BE CONSIDERED TO BE MINIMUM STANDARDS AND WILL NEED TO BE VERIFIED BY A GEOTECHNICAL ENGINEER AS IT RELATES TO SATURATED SOIL FAILURE AND HEALTH AND SAFETY ISSUES.
4. THE BOTTOM OF THE STOCKPILE SHALL BE LOCATED A MINIMUM DISTANCE OF 15.0 METERS FROM THE MUNICIPAL ROADWAY.
5. A 1.0 METER DEEP SEDIMENT TRAP ("V" CHANNEL) SHALL BE PROVIDED AT THE TOE OF THE STOCKPILE SIDE–SLOPE TO CATCH SEDIMENT DEPOSITION.
6. THE AREA BETWEEN THE SEDIMENT TRAP ("V" CHANNEL) AND THE SLIT FENCE SHALL BE FLAT (LESS THAN 10%)
7. REFER TO CITY OF BARRIE STD.BSD–23E ON SHEET SC–5

Sediment Basin Table (OPSD 219.220, ESC guidelines by GGHA CAs - Pg. C-40) AS SHOWN ON DWG.601

Sediment Basin Table (OPSD 219.220, ESC guidelines by GGHA CAs - Pg. C-40)

Min. 125m³/ha water volume, and to be stabilized by seeding immediately after construction.

Sed. Basin No.	Drainage Area (ha)	Required Volume (m³/ha)	Bottom Length (m)	Bottom Width (m)	Top Length (m)	Top Width (m)	Side Slope	Depth (m)	Provided Volume (m³)
1	2.00	250	18.50	8.50	20.00	10.00	0.5	1.50	268
2	2.00	250	18.50	8.50	20.00	10.00	0.5	1.50	268
3	2.00	250	18.50	8.50	20.00	10.00	0.5	1.50	268
4	2.00	250	18.50	8.50	20.00	10.00	0.5	1.50	268
5	2.00	250	18.50	8.50	20.00	10.00	0.5	1.50	268
6	2.00	250	18.50	8.50	20.00	10.00	0.5	1.50	268
7	0.60	75	13.00	6.00	14.00	7.00	0.5	1.00	88
8	0.80	100	15.00	7.00	16.00	8.00	0.5	1.00	117
9	1.90	238	18.50	8.50	20.00	10.00	0.5	1.50	268

1. THIS STANDARD IS TO BE USED IN ACCORDANCE WITH THE SITE ALTERATION BY-LAW FOR THE DESIGN AND MAINTENANCE OF EROSION CONTROL MEASURES AND IS TO BE ADMINISTERED ACCORDINGLY
2. SILT FENCE EROSION CONTROL FENCE SHOULD BE ALIGNED WITH CONTOURS FOR SHEET OVERLAND FLOW.
3. SILTATION CONTROL FENCE IS TO BE LOCATED IN AREAS OF LOW SEDIMENT YIELD ON SLOPES THAT CONFIRM TO M.T.O. DRAINAGE MANUAL VOLUME 2 "CHART FA-3C TOPOGRAPHIC FACTOR LS BASED ON SLOPE LENGTH AND GRADIENT"
4. SILTATION CONTROL FENCE SHALL BE INSTALLED WITH FILTER MEDIA FABRIC TOED INTO THE SOIL 300mm IN EITHER STATIC SLICING OR TRENCHING METHODS WITH SUFFICIENT EXCESS FABRIC TO ALLOW FOR SAGGING.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
6. SILT / SEDIMENT CONTROL FENCE MAY BE UTILIZED FOR TREE PRESERVATION AND IS TO BE USED IN CONJUNCTION WITH BSD-1231, BSD-1232 AND BSD-1236

DETAIL OF DOUBLE SILT FENCE

Barrie STANDARD DETAIL

SILTATION CONTROL FENCING

REV No. 1 DATE: OCT 2017 SCALE: N.T.S.

BSD-1233 FORMERLY BSD-23A

APPROVED DATE: Oct 19/17 DIRECTOR OF ENGINEERING

BENCH MARKS U.T.M. COORDINATES: ZONE 17 NAD 83

MNR No: 03120110004 – BENCH MARK No: 03120110004 – COMBINED CONTROL MONUMENT RECORD
LOCATED APPROXIMATELY 465m SOUTH OF McKAY ROAD WEST AND COUNTY ROAD # 27 INTERSECTION ON THE WEST SIDE OF THE COUNTY ROAD # 27 BOULEVARD.

MNR No: 03120110011 – BENCH MARK No: 03120110011 – COMBINED CONTROL MONUMENT RECORD
LOCATED ON McKAY ROAD EAST ON THE SOUTH SIDE OF THE BOULEVARD, APPROXIMATELY 565m EAST OF HIGHWAY 400.

MNR No: 03120110007 – BENCH MARK No: 03120110007 – COMBINED CONTROL MONUMENT RECORD
LOCATED ON McKAY ROAD WEST ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 705m WEST OF THE McKAY ROAD WEST AND VETERAN'S DRIVE INTERSECTION, ELEVATION ARE RELATED TO GEODETIC DATUM AND ARE DERIVED FROM THE CITY OF BARRIE BENCH MARK No 03120110007 HAVING A PUBLISHED ELEVATION OF 310.796 METRES.

MNR No: 03120110008 – BENCH MARK No: 03120110008 – COMBINED CONTROL MONUMENT RECORD
LOCATED APPROXIMATELY 150m WEST OF THE McKAY ROAD WEST AND VETERAN'S DRIVE INTERSECTION ON THE NORTH SIDE OF THE McKAY ROAD WEST BOULEVARD, ELEVATION ARE RELATED TO GEODETIC DATUM AND ARE DERIVED FROM THE CITY OF BARRIE BENCH MARK No 03120110008 HAVING A PUBLISHED ELEVATION OF 311.503 METRES.

NOTE: A PROTECTIVE WATER VALVE COVER HAS BEEN PLACED OVER MONUMENTS CAP

LEGAL INFORMATION:
CALCULATED MPLAN WAS PREPARED BY HOLDING JONES VANDERVEEN INC.
PROJECT No.: 04–1575–MPLAN 1, DATED JANUARY 14, 2020

NO.	REVISIONS	DATE	APPROVED

SCHAEFFERS CONSULTING ENGINEERS
SCHAEFFER & ASSOCIATES LTD.

6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100
Fax: (905) 738-6875
E-mail: design@schaeffers.com

LICENSED PROFESSIONAL ENGINEER Z. LI Jun. 30, 2022 PROVINCE OF ONTARIO

WATERSAND RESIDENTIAL SUBDIVISION PHASE 2 SALEM SECONDARY PLAN AREA

STAGE 1: TOPSOIL STRIPPING

Barrie ENGINEERING DEPARTMENT

SCALE HOR. 1:1000	VERT. n/a	PROJECT NO.	2022–5184
DESIGN A.C.	DRAWN B.P.	SHEET NO.	SC–1
CHECKED Z.L.			