Elora Battery Energy Storage System

Stormwater Management Report

Stantec

Prepared for:
Aypa Power

April 4, 2025

Prepared by:
Stantec Consulting Ltd.

Project/File:
160901104.902

Stantec Consulting Ltd.

Revision Schedule

Revision	Description	Author	Date	Quality Check	Date	Independent Review	Date
0	Draft	DW	2025-Mar 18	MS	2025-Mar 18	MS	2025-Mar 18
1	FINAL	DW	2025-Apr 1	MS	2025-Apr 1	MS	2025-Apr 1

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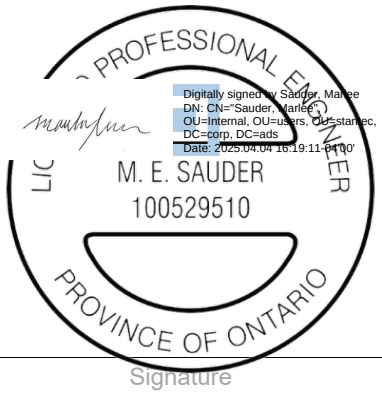

Signature

Marlee Sauder, P.Eng., CAN-CISEC

Printed Name

Approved by:

David Williams
2025.04.04
16:22:08 -04'00'

Signature

Dave Williams, P.Eng.

Printed Name

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1 Introduction

This report has been prepared to document detail the stormwater management (SWM) design for the Elora Battery Energy Storage System (BESS), located northeast of the town of Jarvis in Haldimand County, Ontario. This report summarizes the water quantity, water quality and erosion and sediment control for the site to mitigate impacts of surface water runoff to downstream receivers.

The subject site is located southeast of the Town of Fergus and is bounded by 2 Line to the northwest, Grand River Natural Stone (Commercial Property) to the east and agricultural lands to the south and west. The proposed development is a 211 MW BESS facility complete with batteries, access road, substation, screening berm and a SWM facility.

1.1 Reference Documents

The following data sources, background reports and technical guidelines were referenced while preparing this report and should be read in conjunction with this report.

- *Detailed On-Site Groundwater Assessment, 6235 Guelph Road, Centre Wellington ON*, Egis Canada Ltd., December 2024.
- *Engineering Consulting Services Geotechnical Investigation Report 6234 Guelph Road, Centre Wellington, ON.,* Egis Canada Ltd., December 2024.
- *Aypa Power Elora Battery Energy Storage System Project – Natural Heritage Memo*, Stantec Consulting Ltd., October 2024.
- *Centre Wellington Development Manual*, Township of Centre Wellington, June 2024.
- *Runoff Volume Control Targets for Ontario*, Aquafor Beech & Earthfx, 2016.
- *Stormwater Management Planning and Design Manual (SWMPD),* Ministry of the Environment, Conservation and Parks (MECP), March 2003.
- *MTO Drainage Management Manual*, MTO, 1997.

2 Stormwater Management Criteria

The proposed facility must meet the requirements of the Centre Wellington Development Manual. The following stormwater management criteria are required for the site:

Water Quality – Enhanced level of water quality control (80% total suspended solids removal).

Water Quantity – Control post-development peak flow rates to pre-development flow rates for the 2-year through 100-year storm events.

Oil Containment – Provide sufficient containment for the oil within the transformer and the runoff volume from a 100-year storm.

Erosion and Sediment Control – Provide an erosion and sediment control plan to mitigate migration of sediment to downstream receivers during construction.

Runoff Control – On-site retention controls are recommended through the use of low-impact development (LID) features, to meet the recommendations made in the Runoff Volume Control Targets for Ontario report (Aquafor Beech & Earthfx, 2016).

3 Existing Drainage Conditions

Under existing conditions, the property consists of undeveloped cultivated agricultural lands with surface water draining overland in a westerly direction towards Municipal Drain 2 west of the site. Municipal Drain 2 is tributary to Swan Creek and is considered a Class D Drain (coldwater permanent flow regime). Delineation of the drainage catchments under existing conditions are illustrated in **Figure 1**. A summary of the individual catchments that compromise the site in existing conditions are as follows:

Catchment 110 – 3.00 ha of cultivated lands draining west towards 2 Line Roadside Ditch and ultimately Municipal Drain 2 west of the site.

Catchment 120 – 5.89 ha of cultivated lands draining as overland flow across an adjacent agricultural field towards Municipal Drain 2.

3.1 Existing Geotechnical Conditions

Based on the results of the geotechnical investigation prepared by Egis Canada Ltd. in 2024, site soils consisted of topsoil underlain by a fill soil layer and Sandy Silty Clay Till. The topsoil / ploughed soil layer has an approximate thickness of 0.2 to 0.8 m. The fill soil layer was generally compromised of sandy silt ranging from 0.7-2.2 m in thickness. The Sandy Silty Clay Till underlying the fill was encountered at depths ranging from 0.9-2.7 m below ground surface (mbgs).

3.2 Existing Hydrogeological Conditions

The hydrogeological investigation prepared by Egis Canada Ltd. in 2024, noted three monitoring wells were installed onsite. On November 18th, 2024, groundwater was measured at 3.26 and 4.19 mbgs. The report notes the elevation of the groundwater table is likely to vary throughout the year depending on the amount of precipitation, runoff, evaporation, and percolation in the area.

4 Proposed Drainage Conditions

Under proposed conditions most of the site is proposed to be covered in granular material. Surface water will be conveyed via overland sheet flow to a grassed swale on the southwest edge of the site. The swale forms the inlet to a Stormwater Management wet-pond facility adjacent to 2 Line. Delineation of the proposed conditions drainage catchments are illustrated in **Figure 2**. A summary of the individual catchments that compromise the site in proposed conditions are as follows:

Catchment 210 – 6.75 ha of BESS facility and cultivated lands draining southwest towards a grassed swale and ultimately the proposed SWMF.

Catchment 220 – 2.14 ha of substation area draining to an oil containment pit, prior to discharging to the grassed swale on the southwest edge of the site and ultimately the proposed SWMF.

5 Hydrological Model

Visual OTTHYMO (VO) hydrological modelling software was used to model the existing and proposed drainage conditions. The Intensity-Duration-Frequency parameters for rainfall data from the *Centre Wellington Development Manual* (2015) were used and are summarized in **Table 1** below. The Chicago design storm distribution, 3-hour duration and time of peak ration of 0.48 were used. VO modelling results are provided in **Appendix A.**

Table 1: Rainfall Events – Centre Wellington

Storm Event/ Return Period	A	B	Total Depth
25-mm			25
2-yr	25.39	-0.682	36.0
5-yr	32.79	-0.686	46.3
10-yr	37.71	-0.687	53.2
25-yr	43.85	-0.690	61.6
50-yr	48.46	-0.691	68.0
100-yr	52.97	-0.691	74.4

A summary of the modelling parameters used are summarized in **Appendix B**.

6 Stormwater Management Strategy

The proposed SWM strategy has been designed to meet the SWM objectives outlined by reviewing agencies and relevant technical guidelines. Due to no known legal outlet at the south of the site, a reduction of flows to the south is expected. Water quantity controls are provided to reduce proposed site discharge rates to the 2 Line roadside ditch to, at or below, existing conditions discharge rates. The proceeding sections demonstrate the functionality and effectiveness of the SWM strategy to mitigate impacts to the downstream systems.

6.1 Grassed Swale

A grassed swale runs along the southwest edge of the site and has been designed to collect and convey runoff to the proposed SWMF adjacent to the 2 Line roadside ditch. Detailed design of the swale is summarized in the table below:

Table 2: SWMF Design Characteristics

Parameter	Swale Characteristics	Units
Bottom Width	2.5	m
Depth	0.9	m
Side Slopes (H:V)	3:1	
Top Width	7.9	m
Slope	0.5	%

The maximum velocities within the swale are approximately 1.28 m/s during a 100-year event. Check dams have been provided within the swale to mitigate erosion and promote settling of suspended solids within the swale.

6.2 Stormwater Management Facility

The proposed wet pond facility is designed to provide quantity control for 2-yr through to 100-yr events, an enhanced level of quality control (80% TSS Removal) and erosion control (i.e. detain runoff from 25 mm rainfall event for at least 24 hours). Drainage will enter the SWMF via the previously described grassed swale. A forebay has been provided to promote settling of suspended solids in a localized area to facilitate easy cleanout in the future. A planting plan is to be developed to aid in thermal mitigation. The SWMF is proposed to have a total depth of 2.20 m with 3:1 side slopes, providing a total volume of approximately 4000 m^3. The bottom of the SWMF is proposed as 409.50 masl, with the permanent pool at 410.40 masl and provides minimum 0.3 m of freeboard above the 100-year design storm event storage volume elevation. The outlet structure for low flows is proposed to be an 80 mm diameter orifice and discharging to the existing municipal roadside ditch west of the site. A second orifice with a diameter of 600 mm and a landscaped weir are proposed to be constructed along the western edge of the SWMF

with a depth of 0.5 m, bottom width of 10 m and side slopes of 5% to provide maintenance access to the outlet structure. A riprap apron is proposed to be installed at the outlet to the 2 line ditch to mitigate the potential for erosion. The proposed SWMF and operating characteristics are detailed in **Table 3** and **Table 4**, respectively, below. The stage storge discharge curve and supporting stormwater management design calculations are provided in **Appendix B.**

Table 3: SWMF Design Characteristics

Parameter	SWMF Characteristics	Units
Total Contributing Drainage Area	8.89	ha
Imperviousness (Total Area to SWMF)	56	%
Bottom Elevation of SWMF	409.50	m
Top Elevation of SWMF	411.70	m
High Water Level (100-year Storm Event)	411.23	m
Freeboard Provided Above the High-Water Level	0.47	m
Water Quality Control		
Forebay Settling Length Required / Provided	4.5 / 39.2	m
Forebay Scour Length Required / Provided	39.2 / 39.2	m
Forebay Sediment Storage Volume	107	m^3
Forebay Cleanout Frequency	7.7	yrs
Extended Detention Volume Required ($40m^3$/ha) / Provided	356 / 1138	m^3
Permanent Pool Volume Required ($143m^3$/ha) / Provided	1300 / 1362	m^3
Outlet Details		
Low Flow Orifice Diameter / Elevation	80 / 410.40	mm / m
High Flow Orifice Diameter / Elevation	600 / 410.75	mm / m
Spillway Width / Elevation	10 / 411.20	m / m

Table 4: SWMF Routing Performance Summary

Design Storm	Peak Inflow (m^3/s)	Peak Outflow (m^3/s)	Max. Live Storage Volume (m^3)	Max. WSE (m)	Drawdown Time (hrs.)
25-mm	0.411	0.001	1,138	410.43	27.9
2-year	1.095	0.013	1,839	410.70	80.0
5-year	1.600	0.074	2,410	410.90	87.4
10-year	1.958	0.124	2,662	410.98	88.2
25-year	2.431	0.195	2,977	411.08	88.8
50-year	2.795	0.265	3,219	411.15	88.9
100-year	3.156	0.341	3,479	411.23	89.1

6.2.1 Shut-off Valve

A shut-off valve has been provided at the outlet of the SWMF, prior to discharge to the 2 Line ditch. The shutoff valve can be closed in the event of a spill on site, to mitigate the potential for any deleterious substances from migrating downstream. In the event that the shutoff valve has been closed, the pond can contain 3,370 m^3 of runoff before discharging through the emergency overflow weir. This volume is approximately equivalent of the runoff from a 50-year event. Runoff from the transformer is accounted for within the SWM design.

6.3 Transformer Containment Pit

The transformer containment pit (designed by others) has been designed to contain the volume of oil in the proposed transformer and the runoff from a 100-year storm event. The containment pit has been lined with a Sorbweb™ membrane to prevent oils from migrating downstream in the event of a leak. The containment pit is filled with quenching stone to mitigate the risk of a fire. Detailed design calculations are provided under separate cover.

6.4 Water Quantity Controls

A comparison of the existing and proposed peak flow rates for the 2- through 100-yr design storm is provided in **Table 5,** below.

Table 5: Discharge Rates to 2 Line Roadside Ditch

	Flow Rate to 2 Line Ditch (m^3/s)					
Design Event	**2-year**	**5-year**	**10-year**	**25-year**	**50-year**	**100-year**
Existing Conditions	0.21	0.33	0.41	0.53	0.61	0.70
Proposed Conditions	0.01	0.07	0.12	0.20	0.27	0.34

Based on the above, the proposed SWMF provides sufficient volume to meet the pre-development flow rates for the 2- through 100-year design storm events.

Retention of the 90th percentile of rainfall events, equivalent to the first 28-29 mm, is provided through the granular material used throughout the site. Granular material has a depth of 150 mm, with a porosity of 0.4, this is equivalent to 60 mm, surpassing the runoff control target for the site.

6.5 Water Quality Controls

Water quality controls are provided through the provision of a permanent pool in the wet pond stormwater management facility. The pond has been designed to provide 80% TSS removal per the *Stormwater Management Planning and Design Manual* (2003). In addition to the provision of the wet pond facility additional water quality controls provided on-site include:

- Additional filtration of sediments will be provided in vegetated conveyance swales.
- Site traffic and use will be limited to maintenance and routine inspections, which minimize the opportunity for sediment build-up and wash off cycles.
- The conversion of lands from agricultural land with repeatedly disturbed soil, to a BESS yard stabilized by granular materials will improve the site's ability to mitigate erosion and retain site soils in-situ.
- The transformer containment pit has been designed with a Sorbweb^{TM} membrane to capture any oil leaks prior to migrating to the downstream system

7 Erosion and Sediment Control (ESC)

Construction activities required to develop the site include excavation, grading, infrastructure installation and general construction traffic. These activities will result in disturbance of surface soils, exposure of underlying soils and the potential for erosion and sediment transport. In all instances where the potential for erosion is identified, a series of control measures should be implemented, including, but not limited to:

- Prior to commencing site grading activities, erect silt fences downslope of the area to be graded to protect downstream areas from potential sediment transport caused by entrainment in overland flows.
- Direct runoff through swales and erosion control berms (where necessary) to sediment control measures, minimizing risk of untreated runoff from discharged from the site.
- Install temporary rock check dams, sediment traps, straw bale barriers and/or filter cloth barriers in swales (where appropriate) to help attenuate flows, reduce erosive velocities, and encourage sediment deposition.
- Stockpile materials in designated areas.
- Provide a construction entrance "mud mat" feature at the site construction entrance.
- Stabilize all disturbed areas not subject to construction activities within 30 days, per Ontario Provincial Standard Specification 804.

In order to ensure the effectiveness of the various erosion and sediment control measures, a routine program should be implemented which includes the inspection of the erosion and sediment controls after each significant rainfall event or weekly, whichever is more frequent, and immediate repair of any deficiencies.

A detailed ESC plan including notes, details, implementation schedule and monitoring/maintenance requirements will be developed concurrently with the detailed grading design of the site. The ESC plan will be consistent with the guidelines provided in the *Erosion and Sediment Control Guide for Urban Construction* (Toronto and Region Conservation Authority, 2019)

8 Operational Monitoring

A robust monitoring and maintenance program is essential to the long-term effectiveness of the stormwater management strategy. The sections below outline maintenance requirements for each SWM feature onsite.

8.1 Grassed Conveyance Swale

- Routine observations as to the presence of trash/debris within the swale that could be conveyed downstream and/or affect the conveyance capacity of the system and removal of same as needed.
- A semi-annual walking inspection should be completed to identify areas of bare soil and/or the formation of erosive gullies within or downstream of site facilities. Remediative efforts would typically involve re-grading the area and/or re-vegetating with sod or appropriate seed mix, with fertilizer and water applied as necessary to ensure germination and stabilization.
- Concurrent with the walking inspections, a visual assessment of any areas of isolated ponding or sediment build-up should be identified. Minor areas of ponding can be resolved with re-grading / re-stabilization if the magnitude of associated nuisance warrants such action. From a stormwater management perspective, there are no functional concerns associated with ponding and, therefore, remediation is not strictly required. Excessive sedimentation is an issue requiring attention if it remains in a non-vegetated condition and is, therefore, prone to re-suspension and transport downstream, if it creates an isolated ponding area as described above, or if it occurs to an extent that it impacts on the conveyance capacity of the swale or retention volumes in the pond (reduction of 10% of cross sectional area). If any such condition occurs, the sediment should be removed and the area re-stabilized.
- Vegetation management is not a strict requirement in that excess growth will serve to improve water quality treatment benefits. If the density of vegetation reaches a level where conveyance capacity is impacted, a cutting operation should be undertaken. A minimum vegetation height of 0.15 m (6”) should be maintained.

8.2 Wet Pond Stormwater Management Facility

Long-term operation and maintenance responsibilities at SWM facilities include regular facility inspections and the implementation of associated remediation actions. Inspections should be undertaken following each significant rainfall event (>15 mm depth, minimum 4 inspections / year) to gain confidence that the facilities are functioning as designed. Inspections include:

- Permanent pool elevations. If regular pond levels are higher than expected, this could be indication of an outlet blockage by trash or sediment; visual inspection should be completed to confirm.

- Within a 'wet' SWM facility, pond levels should be assessed to determine if they are lower than the normal permanent pool elevation. Such a condition could be indicative of a blockage of the inlet or leakage through the pond's invert; visual inspection of inlet should be completed to confirm clear passage. Weather conditions in the days and weeks leading up to the inspection should also be considered as evaporative losses during a hot, dry spell could be significant.
- Visual inspection of facility structures including headwalls, pipes, berms, maintenance accesses, etc. Maintenance requirements in this regard should be performed on an as-required basis.
- Visual characteristics of water (i.e., oily sheen, froth, colour, etc.) Issues in this regard could be indicative of an upstream spill and the need for cleanup.
- Vegetation conditions around the facilities. Lack of vegetation, particularly around the water's edge, increase attractiveness and use by waterfowl, often leading to degradation in effluent water quality (i.e., increased bacteria loadings). Replanting should be undertaken to ensure sufficient vegetation densities.
- Annual measurements of sediment accumulation within the sediment forebay. Sediment depth can be measured with a graduated pole at a standardized location (can be identified with a marker that is left in the facilities). Sediment should be removed when the permanent pool depth is reduced to 1.0 m within the forebay area. Owing to the increased sediment loadings anticipated during construction, the clean-out frequencies estimated during the design process might be reduced during the interval prior to complete stabilization of the upstream contributing drainage areas. In any event, the removal and disposal of sediment from all facilities should be completed by a qualified party and/or licensed contractor.
- Visual inspection for erosion around outlet structures or downstream areas that may require stabilization. All noticeable erosion and damage within and immediately outside the basin should be repaired and stabilized as quickly as possible.

8.2.1 Water Quality Grab Sampling

The following water quality grab sampling program has been developed to confirm the site stormwater management features are performing as intended. Grab sampling will consist of samples taken at the mid point of the grassed swale, the inlet of the pond and the outlet of the pond. Samples will be tested for and analyzed against the following parameters and targets:

Parameter	Exceedance Target
TSS	80% Removal
Oil and Grease	15 mg/L
Phenols	20 µg/L
pH	6.5-8.5
Temperature	<20˚C

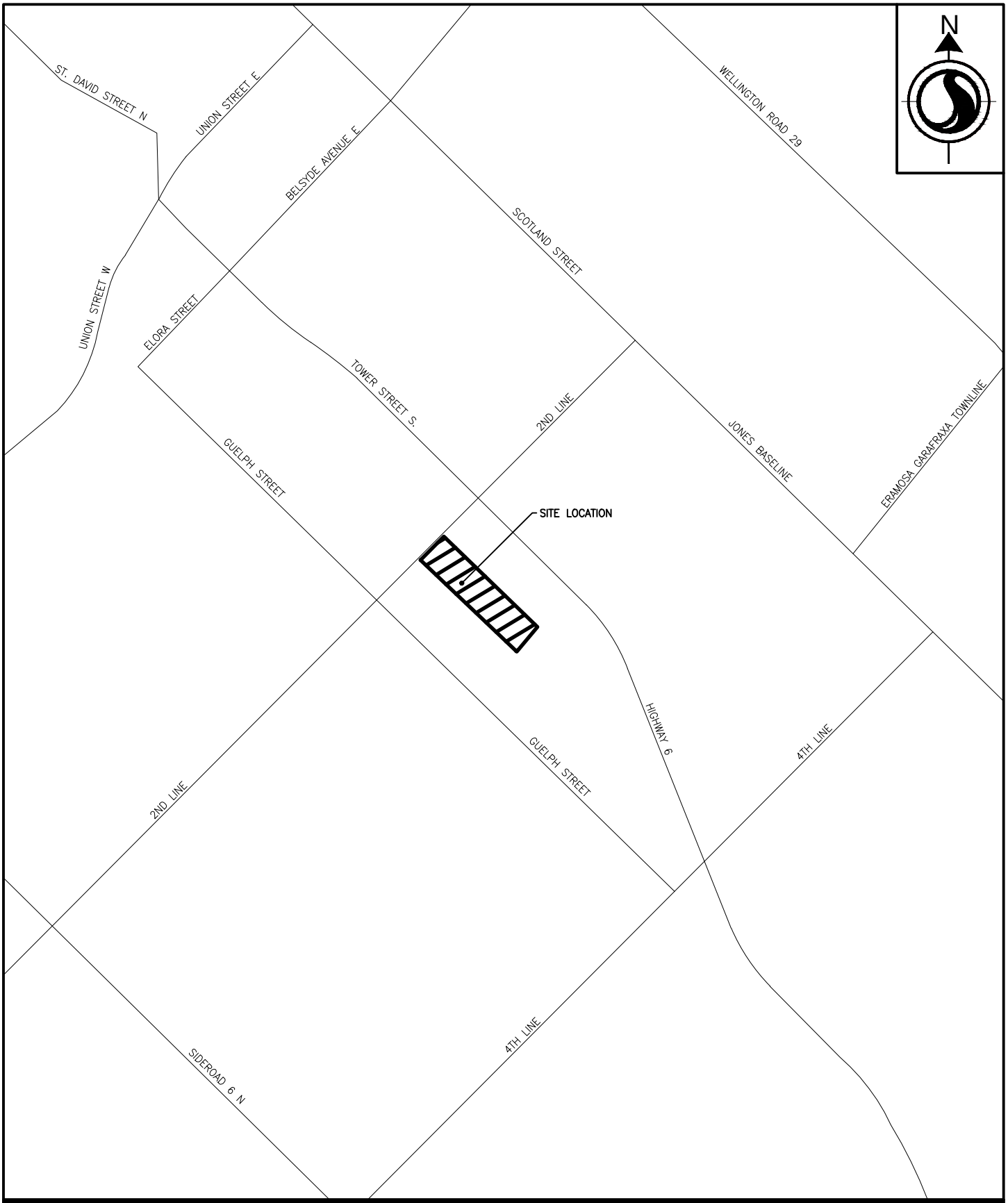
Grab sampling will be completed quarterly following the construction of the SWMF. Grab sampling should be completed quarterly after a significant rainfall event (10-15 mm in 24 hours) to ensure sufficient flows to sample. Of the of the quarterly samples should be completed during the spring freshet if possible. Following three years of monitoring a request can be made to the MECP to reduce the required frequency of grab samples.

9 Conclusions

Based on the preceding report the following conclusions can be drawn:

- The proposed Stormwater Management Strategy provides sufficient water quality and water quantity controls for the Elora BESS facility.
- A containment pit will be provided to prevent oil discharge to the downstream system
- Erosion and sediment controls will be implemented during construction to mitigate the migration of sediment offsite
- A monitoring program has been established to ensure the long-term effectiveness of the stormwater management facility and confirm that the facility is functioning as intended.

Figures



Stantec

Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo ON N2L 0A4
Tel: (519) 579-4410
www.stantec.com

Client/Project
AYPA POWER CANADA DEVELOPMENT LP

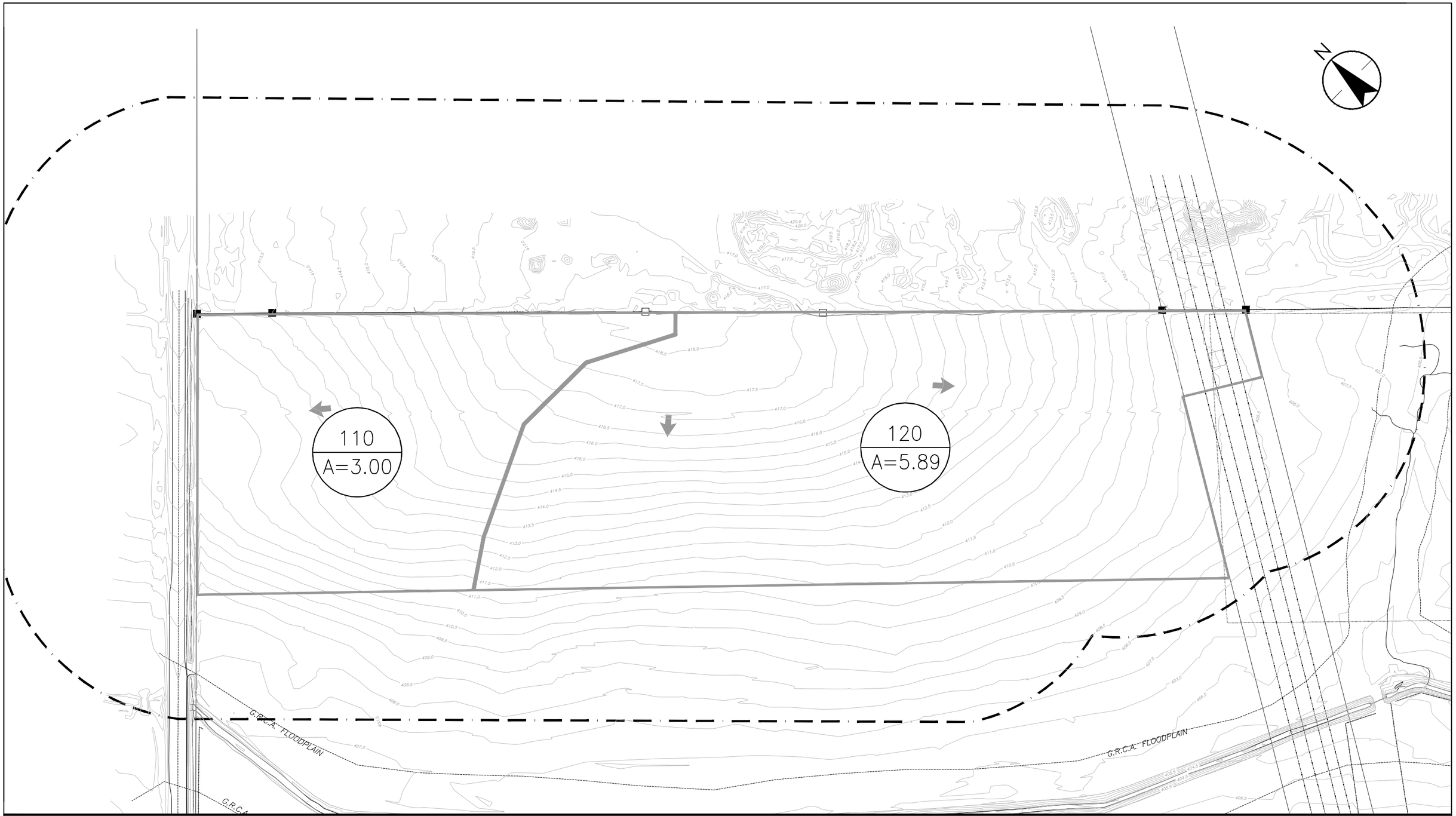
PROPOSED BATTERY STORAGE SITE

Project No.
160901104

Title
ELORA SITE LOCATION PLAN
GUELPH, ON

Date
2025.03.19

Figure No.
1.0



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100-300 Hagey Boulevard
Waterloo ON N2L 0A4
Tel: (519) 579-4410
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Legend

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MAJOR OVERLAND FLOW ROUTE

DRAINAGE BOUNDARY

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EXISTING CONTOURS

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Client/Project
AYPA POWER CANADA DEVELOPMENT

GUELPH, ON CANADA

Project No.
160901104

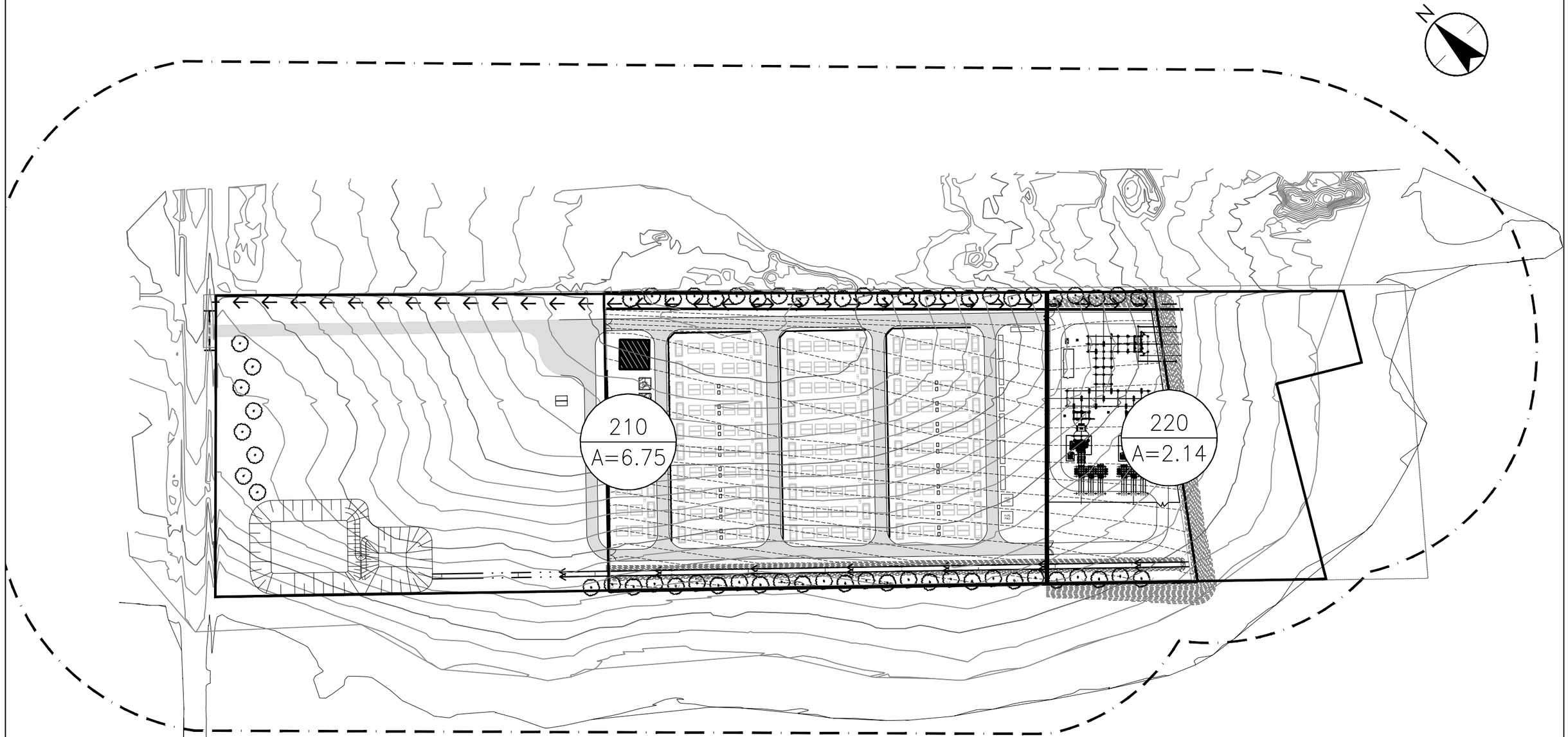
ELORA PRE-DEVELOPMENT CATCHMENT PLAN

Revision

Date
2025.03.20

Reference Sheet

Figure No.
2.0



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Tel: (519) 579-4410
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DRAINAGE BOUNDARY

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EXISTING CONTOURS

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Client/Project
AYPA POWER CANADA DEVELOPMENT

GUELPH, ON CANADA

Project No.
160901104

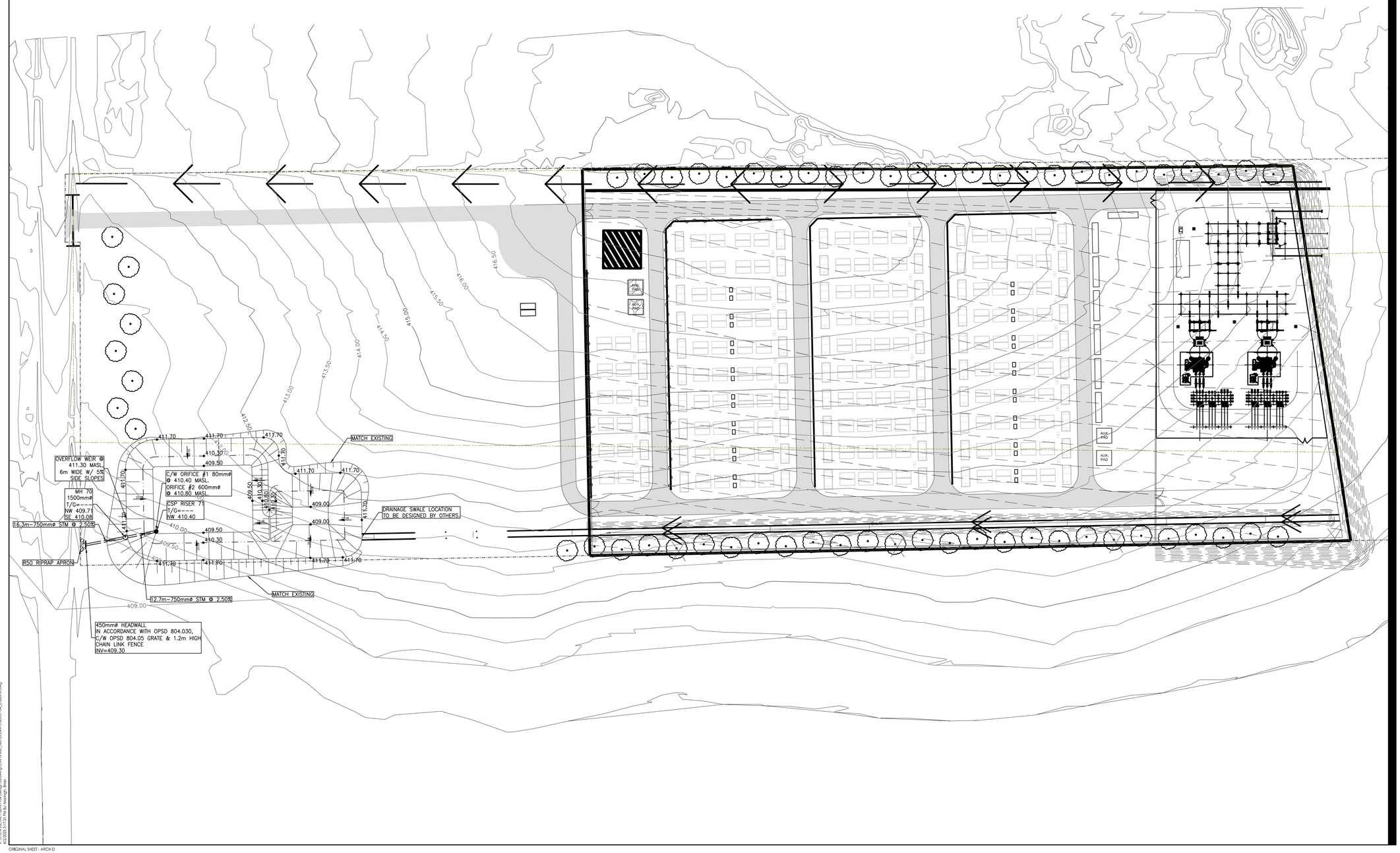
ELORA POST-DEVELOPMENT CATCHMENT PLAN

Revision

Date
2025.04.04

Reference Sheet

Figure No.
3.0



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Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo ON N2L 0A4
Tel: (519) 579-4410
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Notes

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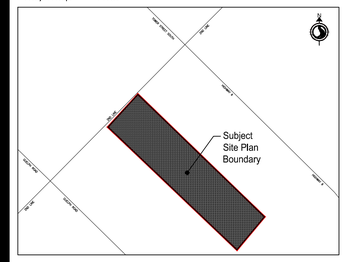
2. SITE PLAN PREPARED BY XXX, DATED XXX.
3. CALCULATED PLAN PREPARED BY XXX, DATED XXX.
4. TOPOGRAPHICAL SURVEY PREPARED BY XXX, DATED XXX.

Key Map NTS.



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- 349.00 EXISTING CONTOUR
- PROPOSED STORM MANHOLE
- PROPOSED SLOPE (3:1 UNLESS NOTED OTHERWISE)

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Revision	By	Appd	YYYY.MM.DD
File Name: 160901104_C-800HX	BWM	BWM	JL 2025.04.02
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Permit-Seal

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Client/Project
AYPA POWER CANADA DEVELOPMENT LP

PROPOSED BATTERY STORAGE SITE

ELORA, ON

Title
STORM WATER MANAGEMNT FACILITY PLAN

Project No. 160901104
Scale 1:750 (0 7.5 22.5 37.5m)
Revision 0
Sheet of
Drawing No. C-800

Appendix A VO Modelling Output

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DATE: 04/02/2025                          TIME: 04:34:30

USER:



COMMENTS: _____________________________________________________________


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  **********************************************

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| Ptotal= 24.98 mm |                          B=   6.000
--------------------                          C=   0.762
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used in: INTENSITY = A / (t + B)^C

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Storm time step = 10.00 min
Time to peak ratio = 0.48

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	1.67	1.00	3.24	2.00	15.68	3.00	2.58
0.17	1.80	1.17	3.94	2.17	7.91	3.17	2.31
0.33	1.97	1.33	5.11	2.33	5.43	3.33	2.09
0.50	2.17	1.50	7.49	2.50	4.19	3.50	1.92
0.67	2.43	1.67	15.23	2.67	3.45	3.67	1.77
0.83	2.77	1.83	50.10	2.83	2.95	3.83	1.65

CALIB			
NASHYD (0110)	Area (ha)=	3.00	Curve Number (CN)= 86.0
ID= 1 DT=10.0 min	Ia (mm)=	4.10	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)=	0.11	

Unit Hyd Qpeak (cms)= 1.042

PEAK FLOW (cms)= 0.084 (i)
TIME TO PEAK (hrs)= 2.000
RUNOFF VOLUME (mm)= 5.724
TOTAL RAINFALL (mm)= 24.976
RUNOFF COEFFICIENT = 0.229

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

CALIB			
NASHYD (0120)	Area (ha)=	5.89	Curve Number (CN)= 86.0
ID= 1 DT=10.0 min	Ia (mm)=	4.10	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)=	0.16	

Unit Hyd Qpeak (cms)= 1.406

PEAK FLOW (cms)= 0.144 (i)
TIME TO PEAK (hrs)= 2.000
RUNOFF VOLUME (mm)= 6.607
TOTAL RAINFALL (mm)= 24.976
RUNOFF COEFFICIENT = 0.265

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

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--------------------
| ADD HYD  (  0001)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0110):     3.00   0.084     2.00     5.72
      + ID2= 2 (  0120):     5.89   0.144     2.00     6.61
        ================================================
        ID = 3 (  0001):     8.89   0.228     2.00     6.31

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\9b37
3b03-0977-4ef7-b764-16ef4801d0dc\scen
  Summary filename:
C:\Users\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\9b37
3b03-0977-4ef7-b764-16ef4801d0dc\scen


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  **********************************************
  ** SIMULATION : 2                           **
  **********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 414.345
| Ptotal= 36.01 mm |                          B=   0.000
--------------------                          C=   0.682
```

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

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.48

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	4.03	0.83	7.93	1.67	10.99	2.50	4.65
0.17	4.42	1.00	10.56	1.83	8.30	2.67	4.24
0.33	4.91	1.17	17.81	2.00	6.81	2.83	3.92
0.50	5.57	1.33	86.17	2.17	5.85		
0.67	6.50	1.50	18.21	2.33	5.16		

CALIB NASHYD (0110) ID= 1 DT=10.0 min	Area (ha)= 3.00	Curve Number (CN)= 86.0
	Ia (mm)= 4.10	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.11	

Unit Hyd Qpeak (cms)= 1.042

PEAK FLOW (cms)= 0.206 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 11.357
TOTAL RAINFALL (mm)= 36.006
RUNOFF COEFFICIENT = 0.315

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

CALIB NASHYD (0120) ID= 1 DT=10.0 min	Area (ha)= 5.89	Curve Number (CN)= 86.0
	Ia (mm)= 4.10	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.16	

Unit Hyd Qpeak (cms)= 1.406

PEAK FLOW (cms)= 0.350 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 13.110
TOTAL RAINFALL (mm)= 36.006
RUNOFF COEFFICIENT = 0.364

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

```
--------------------
| ADD HYD  (  0001)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0110):     3.00   0.206     1.50    11.36
      + ID2= 2 (  0120):     5.89   0.350     1.50    13.11
        ================================================
        ID = 3 (  0001):     8.89   0.556     1.50    12.52

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\19ab
a361-6ab4-4461-87bc-c10841f7e6be\scen
  Summary filename:
C:\Users\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\19ab
a361-6ab4-4461-87bc-c10841f7e6be\scen


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  ********************************************
  ** SIMULATION : 3                          **
  ********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 543.943
| Ptotal= 46.30 mm |                          B=   0.000
--------------------                          C=   0.686
```

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

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.48

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	5.12	0.83	10.11	1.67	14.04	2.50	5.91
0.17	5.62	1.00	13.48	1.83	10.59	2.67	5.39
0.33	6.25	1.17	22.82	2.00	8.68	2.83	4.97
0.50	7.09	1.33	112.09	2.17	7.44		
0.67	8.27	1.50	23.34	2.33	6.57		

CALIB NASHYD (0110) ID= 1 DT=10.0 min	Area (ha)= 3.00	Curve Number (CN)= 86.0
	Ia (mm)= 4.10	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.11	

Unit Hyd Qpeak (cms)= 1.042

PEAK FLOW (cms)= 0.326 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 17.418
TOTAL RAINFALL (mm)= 46.296
RUNOFF COEFFICIENT = 0.376

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

CALIB NASHYD (0120) ID= 1 DT=10.0 min	Area (ha)= 5.89	Curve Number (CN)= 86.0
	Ia (mm)= 4.10	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.16	

Unit Hyd Qpeak (cms)= 1.406

PEAK FLOW (cms)= 0.557 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 20.105
TOTAL RAINFALL (mm)= 46.296
RUNOFF COEFFICIENT = 0.434

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

```
--------------------
| ADD HYD  (  0001)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0110):     3.00   0.326     1.50    17.42
      + ID2= 2 (  0120):     5.89   0.557     1.50    20.11
        ================================================
        ID = 3 (  0001):     8.89   0.883     1.50    19.20

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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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  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat

  Output  filename:
C:\Users\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\0508
9ddf-e3e5-4173-88ec-84e33af51dce\scen
  Summary filename:
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9ddf-e3e5-4173-88ec-84e33af51dce\scen


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  ********************************************
  ** SIMULATION : 4                          **
  ********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 628.126
| Ptotal= 53.18 mm |                          B=   0.000
--------------------                          C=   0.687
```

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

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.48

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	5.86	0.83	11.59	1.67	16.11	2.50	6.77
0.17	6.43	1.00	15.46	1.83	12.14	2.67	6.18
0.33	7.15	1.17	26.19	2.00	9.95	2.83	5.70
0.50	8.12	1.33	129.14	2.17	8.53		
0.67	9.48	1.50	26.79	2.33	7.52		

CALIB NASHYD (0110) ID= 1 DT=10.0 min	Area (ha)= 3.00	Curve Number (CN)= 86.0
	Ia (mm)= 4.10	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.11	

Unit Hyd Qpeak (cms)= 1.042

PEAK FLOW (cms)= 0.412 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 21.773
TOTAL RAINFALL (mm)= 53.184
RUNOFF COEFFICIENT = 0.409

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

CALIB NASHYD (0120) ID= 1 DT=10.0 min	Area (ha)= 5.89	Curve Number (CN)= 86.0
	Ia (mm)= 4.10	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.16	

Unit Hyd Qpeak (cms)= 1.406

PEAK FLOW (cms)= 0.706 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 25.133
TOTAL RAINFALL (mm)= 53.184
RUNOFF COEFFICIENT = 0.473

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

```
--------------------
| ADD HYD  (  0001)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0110):     3.00   0.412     1.50    21.77
      + ID2= 2 (  0120):     5.89   0.706     1.50    25.13
        ================================================
        ID = 3 (  0001):     8.89   1.118     1.50    24.00

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\5266
ee63-1cc8-44c0-95c8-158c2d50b310\scen
  Summary filename:
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ee63-1cc8-44c0-95c8-158c2d50b310\scen


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  ********************************************
  ** SIMULATION : 5                          **
  ********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 739.425
| Ptotal= 61.64 mm |                          B=   0.000
--------------------                          C=   0.690
```

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

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.48

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	6.73	0.83	13.35	1.67	18.57	2.50	7.78
0.17	7.39	1.00	17.83	1.83	13.98	2.67	7.09
0.33	8.22	1.17	30.27	2.00	11.45	2.83	6.54
0.50	9.33	1.33	150.97	2.17	9.81		
0.67	10.91	1.50	30.97	2.33	8.65		

CALIB					
NASHYD (0110)	Area (ha)=	3.00	Curve Number (CN)=	86.0	
ID= 1 DT=10.0 min	Ia (mm)=	4.10	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	0.11			

Unit Hyd Qpeak (cms)= 1.042

PEAK FLOW (cms)= 0.526 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 27.363
TOTAL RAINFALL (mm)= 61.640
RUNOFF COEFFICIENT = 0.444

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

CALIB					
NASHYD (0120)	Area (ha)=	5.89	Curve Number (CN)=	86.0	
ID= 1 DT=10.0 min	Ia (mm)=	4.10	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	0.16			

Unit Hyd Qpeak (cms)= 1.406

PEAK FLOW (cms)= 0.902 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 31.585
TOTAL RAINFALL (mm)= 61.640
RUNOFF COEFFICIENT = 0.512

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

```
--------------------
| ADD HYD  (  0001)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0110):     3.00   0.526     1.50    27.36
      + ID2= 2 (  0120):     5.89   0.902     1.50    31.58
        ================================================
        ID = 3 (  0001):     8.89   1.428     1.50    30.16

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\e452
92c8-17dd-46ce-b19d-bb8ede1cb01b\scen
  Summary filename:
C:\Users\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\e452
92c8-17dd-46ce-b19d-bb8ede1cb01b\scen


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  ********************************************
  ** SIMULATION : 6                          **
  ********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 820.514
| Ptotal= 68.05 mm |                          B=   0.000
--------------------                          C=   0.691
```

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

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.48

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	7.41	0.83	14.71	1.67	20.47	2.50	8.56
0.17	8.13	1.00	19.65	1.83	15.40	2.67	7.80
0.33	9.05	1.17	33.39	2.00	12.61	2.83	7.19
0.50	10.28	1.33	167.14	2.17	10.80		
0.67	12.01	1.50	34.16	2.33	9.52		

CALIB NASHYD (0110) ID= 1 DT=10.0 min	Area (ha)= 3.00	Curve Number (CN)= 86.0
	Ia (mm)= 4.10	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.11	

Unit Hyd Qpeak (cms)= 1.042

PEAK FLOW (cms)= 0.614 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 31.738
TOTAL RAINFALL (mm)= 68.045
RUNOFF COEFFICIENT = 0.466

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

CALIB NASHYD (0120) ID= 1 DT=10.0 min	Area (ha)= 5.89	Curve Number (CN)= 86.0
	Ia (mm)= 4.10	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.16	

Unit Hyd Qpeak (cms)= 1.406

PEAK FLOW (cms)= 1.055 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 36.635
TOTAL RAINFALL (mm)= 68.045
RUNOFF COEFFICIENT = 0.538

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

```
--------------------
| ADD HYD  (  0001)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0110):     3.00   0.614     1.50    31.74
      + ID2= 2 (  0120):     5.89   1.055     1.50    36.64
        ================================================
        ID = 3 (  0001):     8.89   1.669     1.50    34.98

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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:
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3327-f071-4f83-a127-2639727a0565\scen
  Summary filename:
C:\Users\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\8c80
3327-f071-4f83-a127-2639727a0565\scen


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  ********************************************
  ** SIMULATION : 7                          **
  ********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 896.876
| Ptotal= 74.38 mm |                          B=   0.000
--------------------                          C=   0.691
```

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

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.48

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	8.10	0.83	16.08	1.67	22.38	2.50	9.36
0.17	8.89	1.00	21.48	1.83	16.83	2.67	8.53
0.33	9.89	1.17	36.49	2.00	13.78	2.83	7.86
0.50	11.23	1.33	182.70	2.17	11.81		
0.67	13.13	1.50	37.33	2.33	10.41		

CALIB NASHYD (0110) ID= 1 DT=10.0 min	Area (ha)= 3.00	Curve Number (CN)= 86.0
	Ia (mm)= 4.10	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.11	

Unit Hyd Qpeak (cms)= 1.042

PEAK FLOW (cms)= 0.701 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 36.161
TOTAL RAINFALL (mm)= 74.378
RUNOFF COEFFICIENT = 0.486

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

CALIB NASHYD (0120) ID= 1 DT=10.0 min	Area (ha)= 5.89	Curve Number (CN)= 86.0
	Ia (mm)= 4.10	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.16	

Unit Hyd Qpeak (cms)= 1.406

PEAK FLOW (cms)= 1.207 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 41.740
TOTAL RAINFALL (mm)= 74.378
RUNOFF COEFFICIENT = 0.561

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

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--------------------
| ADD HYD  (  0001)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0110):     3.00   0.701     1.50    36.16
      + ID2= 2 (  0120):     5.89   1.207     1.50    41.74
        ================================================
        ID = 3 (  0001):     8.89   1.908     1.50    39.86

     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 6.2.2017)
       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 *****


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26e3-1ba4-486b-a73f-f7dc738b8de4\scen


DATE: 04/02/2025                          TIME: 04:44:20

USER:



COMMENTS: _____________________________________________________________


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  ********************************************
  ** SIMULATION : 1                          **
  ********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 414.345
| Ptotal= 24.98 mm |                          B=   6.000
--------------------                          C=   0.762
```

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

Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.48

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	1.67	1.00	3.24	2.00	15.68	3.00	2.58
0.17	1.80	1.17	3.94	2.17	7.91	3.17	2.31
0.33	1.97	1.33	5.11	2.33	5.43	3.33	2.09
0.50	2.17	1.50	7.49	2.50	4.19	3.50	1.92
0.67	2.43	1.67	15.23	2.67	3.45	3.67	1.77
0.83	2.77	1.83	50.10	2.83	2.95	3.83	1.65

CALIB STANDHYD (0210) ID= 1 DT=10.0 min	Area (ha)= 6.75 Total Imp(%)= 50.00 Dir. Conn.(%)= 20.00

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	3.37	3.37	
Dep. Storage	(mm)=	2.00	1.50	
Average Slope	(%)=	0.50	0.50	
Length	(m)=	20.00	20.00	
Mannings n	=	0.015	0.250	
Max.Eff.Inten.(mm/hr)	=	50.10	21.87	
over (min)		10.00	20.00	
Storage Coeff. (min)	=	1.72 (ii)	14.68 (ii)	
Unit Hyd. Tpeak (min)	=	10.00	20.00	
Unit Hyd. peak (cms)	=	0.17	0.07	
				TOTALS
PEAK FLOW	(cms)=	0.19	0.15	0.272 (iii)
TIME TO PEAK	(hrs)=	2.00	2.17	2.00
RUNOFF VOLUME	(mm)=	22.98	9.07	11.85
TOTAL RAINFALL	(mm)=	24.98	24.98	24.98
RUNOFF COEFFICIENT	=	0.92	0.36	0.47

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 80.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0220)|   Area    (ha)=   2.14
|ID= 1 DT=10.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  35.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.61         0.54
     Dep. Storage     (mm)=       2.00         1.50
     Average Slope     (%)=       1.00         1.00
     Length            (m)=      40.00        30.00
     Mannings n             =     0.015        0.250

     Max.Eff.Inten.(mm/hr)=      50.10        69.46
               over (min)        10.00        20.00
     Storage Coeff.  (min)=       2.12 (ii)   10.58 (ii)
     Unit Hyd. Tpeak (min)=      10.00        20.00
     Unit Hyd. peak  (cms)=       0.17         0.08
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.10         0.06          0.140 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.17           2.00
     RUNOFF VOLUME    (mm)=      22.98        12.19          15.96
     TOTAL RAINFALL   (mm)=      24.98        24.98          24.98
     RUNOFF COEFFICIENT   =       0.92         0.49           0.64

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0004)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0210):     6.75   0.272     2.00    11.85
      + ID2= 2 (  0220):     2.14   0.140     2.00    15.96
        ================================================
        ID = 3 (  0004):     8.89   0.411     2.00    12.84

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0007)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
```

DT= 10.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0520	0.3731	0.2280
	0.0017	0.0600	0.8784	0.2770
	0.0110	0.1040	1.7045	0.3030
	0.0441	0.1420	2.2579	0.3160
	0.1705	0.1830	4.5036	0.3580

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0004)	8.890	0.411	2.00	12.84
OUTFLOW: ID= 1 (0007)	8.890	0.013	4.17	6.86

PEAK FLOW REDUCTION [Qout/Qin](%)= 3.21
TIME SHIFT OF PEAK FLOW (min)=130.00
MAXIMUM STORAGE USED (ha.m.)= 0.1066

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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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 *****


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C:\Users\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\8c80
1637-133c-4e1f-85c2-1cdf7651e98e\scen


DATE: 04/02/2025                          TIME: 04:44:19

USER:



COMMENTS: _____________________________________________________________


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  **********************************************
  ** SIMULATION : 2                           **
  **********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 414.345
| Ptotal= 36.01 mm |                          B=   0.000
--------------------                          C=   0.682
```

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

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.48

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	4.03	0.83	7.93	1.67	10.99	2.50	4.65
0.17	4.42	1.00	10.56	1.83	8.30	2.67	4.24
0.33	4.91	1.17	17.81	2.00	6.81	2.83	3.92
0.50	5.57	1.33	86.17	2.17	5.85		
0.67	6.50	1.50	18.21	2.33	5.16		

CALIB STANDHYD (0210) ID= 1 DT=10.0 min	Area (ha)= 6.75 Total Imp(%)= 50.00 Dir. Conn.(%)= 20.00

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	3.37	3.37	
Dep. Storage	(mm)=	2.00	1.50	
Average Slope	(%)=	0.50	0.50	
Length	(m)=	20.00	20.00	
Mannings n	=	0.015	0.250	
Max.Eff.Inten.(mm/hr)	=	86.17	68.02	
over (min)		10.00	10.00	
Storage Coeff.	(min)=	1.38 (ii)	9.62 (ii)	
Unit Hyd. Tpeak	(min)=	10.00	10.00	
Unit Hyd. peak	(cms)=	0.17	0.11	
				TOTALS
PEAK FLOW	(cms)=	0.32	0.43	0.757 (iii)
TIME TO PEAK	(hrs)=	1.50	1.50	1.50
RUNOFF VOLUME	(mm)=	34.01	16.45	19.96
TOTAL RAINFALL	(mm)=	36.01	36.01	36.01
RUNOFF COEFFICIENT	=	0.94	0.46	0.55

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 80.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0220)|   Area    (ha)=   2.14
|ID= 1 DT=10.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  35.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.61         0.54
     Dep. Storage     (mm)=       2.00         1.50
     Average Slope     (%)=       1.00         1.00
     Length            (m)=      40.00        30.00
     Mannings n             =     0.015        0.250

     Max.Eff.Inten.(mm/hr)=      86.17       143.31
               over (min)        10.00        10.00
     Storage Coeff.  (min)=       1.70 (ii)    8.04 (ii)
     Unit Hyd. Tpeak (min)=      10.00        10.00
     Unit Hyd. peak  (cms)=       0.17         0.12
                                                        *TOTALS*
     PEAK FLOW       (cms)=       0.18         0.16          0.338 (iii)
     TIME TO PEAK    (hrs)=       1.50         1.50           1.50
     RUNOFF VOLUME    (mm)=      34.01        20.97          25.53
     TOTAL RAINFALL   (mm)=      36.01        36.01          36.01
     RUNOFF COEFFICIENT   =       0.94         0.58           0.71

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0004)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0210):     6.75   0.757     1.50    19.96
      + ID2= 2 (  0220):     2.14   0.338     1.50    25.53
        ================================================
        ID = 3 (  0004):     8.89   1.095     1.50    21.30

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0007)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 10.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
```

----------	(cms)	(ha.m.)	(cms)	(ha.m.)
	0.0000	0.0520	0.3731	0.2280
	0.0017	0.0600	0.8784	0.2770
	0.0110	0.1040	1.7045	0.3030
	0.0441	0.1420	2.2579	0.3160
	0.1705	0.1830	4.5036	0.3580

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0004)	8.890	1.095	1.50	21.30
OUTFLOW: ID= 1 (0007)	8.890	0.084	2.83	15.32

PEAK FLOW REDUCTION [Qout/Qin](%)= 7.67
TIME SHIFT OF PEAK FLOW (min)= 80.00
MAXIMUM STORAGE USED (ha.m.)= 0.1550

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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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 *****


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C:\Users\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\4865
ae4a-ff21-4f93-87ba-a0fff3b8a16e\scen


DATE: 04/02/2025                          TIME: 04:44:19

USER:



COMMENTS: _____________________________________________________________


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  ********************************************
  ** SIMULATION : 3                          **
  ********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 543.943
| Ptotal= 46.30 mm |                          B=   0.000
--------------------                          C=   0.686
```

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

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.48

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	5.12	0.83	10.11	1.67	14.04	2.50	5.91
0.17	5.62	1.00	13.48	1.83	10.59	2.67	5.39
0.33	6.25	1.17	22.82	2.00	8.68	2.83	4.97
0.50	7.09	1.33	112.09	2.17	7.44		
0.67	8.27	1.50	23.34	2.33	6.57		

CALIB STANDHYD (0210) ID= 1 DT=10.0 min	Area (ha)= 6.75 Total Imp(%)= 50.00 Dir. Conn.(%)= 20.00

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	3.37	3.37	
Dep. Storage	(mm)=	2.00	1.50	
Average Slope	(%)=	0.50	0.50	
Length	(m)=	20.00	20.00	
Mannings n	=	0.015	0.250	
Max.Eff.Inten.(mm/hr)=		112.09	102.16	
over (min)		10.00	10.00	
Storage Coeff. (min)=		1.25 (ii)	8.24 (ii)	
Unit Hyd. Tpeak (min)=		10.00	10.00	
Unit Hyd. peak (cms)=		0.17	0.12	
				TOTALS
PEAK FLOW	(cms)=	0.42	0.70	1.124 (iii)
TIME TO PEAK	(hrs)=	1.50	1.50	1.50
RUNOFF VOLUME	(mm)=	44.30	24.19	28.21
TOTAL RAINFALL	(mm)=	46.30	46.30	46.30
RUNOFF COEFFICIENT	=	0.96	0.52	0.61

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 80.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0220)|   Area    (ha)=   2.14
|ID= 1 DT=10.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  35.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.61         0.54
     Dep. Storage     (mm)=       2.00         1.50
     Average Slope     (%)=       1.00         1.00
     Length            (m)=      40.00        30.00
     Mannings n           =      0.015        0.250

     Max.Eff.Inten.(mm/hr)=     112.09       206.94
               over (min)       10.00        10.00
     Storage Coeff.  (min)=       1.53 (ii)    7.00 (ii)
     Unit Hyd. Tpeak (min)=      10.00        10.00
     Unit Hyd. peak  (cms)=       0.17         0.13
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.23         0.24          0.476 (iii)
     TIME TO PEAK    (hrs)=       1.50         1.50           1.50
     RUNOFF VOLUME    (mm)=      44.30        29.80          34.87
     TOTAL RAINFALL   (mm)=      46.30        46.30          46.30
     RUNOFF COEFFICIENT   =       0.96         0.64           0.75

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0004)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0210):     6.75   1.124     1.50    28.21
      + ID2= 2 (  0220):     2.14   0.476     1.50    34.87
        ================================================
        ID = 3 (  0004):     8.89   1.600     1.50    29.81

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0007)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 10.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
```

----------	(cms)	(ha.m.)	(cms)	(ha.m.)
	0.0000	0.0520	0.3731	0.2280
	0.0017	0.0600	0.8784	0.2770
	0.0110	0.1040	1.7045	0.3030
	0.0441	0.1420	2.2579	0.3160
	0.1705	0.1830	4.5036	0.3580

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0004)	8.890	1.600	1.50	29.81
OUTFLOW: ID= 1 (0007)	8.890	0.190	2.17	23.83

PEAK FLOW REDUCTION [Qout/Qin](%)= 11.88
TIME SHIFT OF PEAK FLOW (min)= 40.00
MAXIMUM STORAGE USED (ha.m.)= 0.1875

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================================================================================
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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\5437
52a7-2cb3-4bd6-9021-6cc030925621\scen
  Summary filename:
C:\Users\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\5437
52a7-2cb3-4bd6-9021-6cc030925621\scen


DATE: 04/02/2025                          TIME: 04:44:20

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COMMENTS: _____________________________________________________________


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  ********************************************
  ** SIMULATION : 4                          **
  ********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 628.126
| Ptotal= 53.18 mm |                          B=   0.000
--------------------                          C=   0.687
```

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

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.48

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	5.86	0.83	11.59	1.67	16.11	2.50	6.77
0.17	6.43	1.00	15.46	1.83	12.14	2.67	6.18
0.33	7.15	1.17	26.19	2.00	9.95	2.83	5.70
0.50	8.12	1.33	129.14	2.17	8.53		
0.67	9.48	1.50	26.79	2.33	7.52		

CALIB STANDHYD (0210) ID= 1 DT=10.0 min	Area (ha)= 6.75 Total Imp(%)= 50.00 Dir. Conn.(%)= 20.00

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	3.37	3.37	
Dep. Storage	(mm)=	2.00	1.50	
Average Slope	(%)=	0.50	0.50	
Length	(m)=	20.00	20.00	
Mannings n	=	0.015	0.250	
Max.Eff.Inten.(mm/hr)	=	129.14	126.31	
over (min)		10.00	10.00	
Storage Coeff.	(min)=	1.18 (ii)	7.61 (ii)	
Unit Hyd. Tpeak	(min)=	10.00	10.00	
Unit Hyd. peak	(cms)=	0.17	0.12	
				TOTALS
PEAK FLOW	(cms)=	0.48	0.90	1.386 (iii)
TIME TO PEAK	(hrs)=	1.50	1.50	1.50
RUNOFF VOLUME	(mm)=	51.18	29.69	33.99
TOTAL RAINFALL	(mm)=	53.18	53.18	53.18
RUNOFF COEFFICIENT	=	0.96	0.56	0.64

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 80.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0220)|   Area    (ha)=   2.14
|ID= 1 DT=10.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  35.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.61         0.54
     Dep. Storage     (mm)=       2.00         1.50
     Average Slope     (%)=       1.00         1.00
     Length            (m)=      40.00        30.00
     Mannings n             =     0.015        0.250

     Max.Eff.Inten.(mm/hr)=     129.14       250.53
               over (min)       10.00        10.00
     Storage Coeff.  (min)=      1.45 (ii)    6.51 (ii)
     Unit Hyd. Tpeak (min)=     10.00        10.00
     Unit Hyd. peak  (cms)=      0.17         0.13
                                                        *TOTALS*
     PEAK FLOW       (cms)=      0.27         0.30          0.571 (iii)
     TIME TO PEAK    (hrs)=      1.50         1.50           1.50
     RUNOFF VOLUME    (mm)=     51.18        35.93          41.27
     TOTAL RAINFALL   (mm)=     53.18        53.18          53.18
     RUNOFF COEFFICIENT   =      0.96         0.68           0.78

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0004)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0210):     6.75   1.386     1.50    33.99
      + ID2= 2 (  0220):     2.14   0.571     1.50    41.27
        ================================================
        ID = 3 (  0004):     8.89   1.958     1.50    35.74

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0007)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 10.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
```

----------	(cms)	(ha.m.)	(cms)	(ha.m.)
	0.0000	0.0520	0.3731	0.2280
	0.0017	0.0600	0.8784	0.2770
	0.0110	0.1040	1.7045	0.3030
	0.0441	0.1420	2.2579	0.3160
	0.1705	0.1830	4.5036	0.3580

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0004)	8.890	1.958	1.50	35.74
OUTFLOW: ID= 1 (0007)	8.890	0.295	2.00	29.76

PEAK FLOW REDUCTION [Qout/Qin](%)= 15.06
TIME SHIFT OF PEAK FLOW (min)= 30.00
MAXIMUM STORAGE USED (ha.m.)= 0.2107

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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\7dc2
1fbb-3ba6-4018-b706-ca1a5497be4c\scen
  Summary filename:
C:\Users\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\7dc2
1fbb-3ba6-4018-b706-ca1a5497be4c\scen


DATE: 04/02/2025                          TIME: 04:44:20

USER:



COMMENTS: _____________________________________________________________


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  ********************************************
  ** SIMULATION : 5                          **
  ********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 739.425
| Ptotal= 61.64 mm |                          B=   0.000
--------------------                          C=   0.690
```

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

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.48

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	6.73	0.83	13.35	1.67	18.57	2.50	7.78
0.17	7.39	1.00	17.83	1.83	13.98	2.67	7.09
0.33	8.22	1.17	30.27	2.00	11.45	2.83	6.54
0.50	9.33	1.33	150.97	2.17	9.81		
0.67	10.91	1.50	30.97	2.33	8.65		

CALIB
STANDHYD (0210)
ID= 1 DT=10.0 min

Area (ha)= 6.75
Total Imp(%)= 50.00 Dir. Conn.(%)= 20.00

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	3.37	3.37	
Dep. Storage	(mm)=	2.00	1.50	
Average Slope	(%)=	0.50	0.50	
Length	(m)=	20.00	20.00	
Mannings n	=	0.015	0.250	
Max.Eff.Inten.(mm/hr)	=	150.97	158.07	
over (min)		10.00	10.00	
Storage Coeff.	(min)=	1.11 (ii)	6.98 (ii)	
Unit Hyd. Tpeak	(min)=	10.00	10.00	
Unit Hyd. peak	(cms)=	0.17	0.13	
				TOTALS
PEAK FLOW	(cms)=	0.57	1.17	1.736 (iii)
TIME TO PEAK	(hrs)=	1.50	1.50	1.50
RUNOFF VOLUME	(mm)=	59.64	36.70	41.29
TOTAL RAINFALL	(mm)=	61.64	61.64	61.64
RUNOFF COEFFICIENT	=	0.97	0.60	0.67

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 80.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0220)|   Area    (ha)=   2.14
|ID= 1 DT=10.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  35.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.61         0.54
     Dep. Storage     (mm)=       2.00         1.50
     Average Slope     (%)=       1.00         1.00
     Length            (m)=      40.00        30.00
     Mannings n             =     0.015        0.250

     Max.Eff.Inten.(mm/hr)=     150.97       306.84
               over (min)       10.00        10.00
     Storage Coeff.  (min)=      1.36 (ii)    6.03 (ii)
     Unit Hyd. Tpeak (min)=     10.00        10.00
     Unit Hyd. peak  (cms)=      0.17         0.14
                                                        *TOTALS*
     PEAK FLOW       (cms)=      0.31         0.38          0.695 (iii)
     TIME TO PEAK    (hrs)=      1.50         1.50           1.50
     RUNOFF VOLUME    (mm)=     59.64        43.62          49.22
     TOTAL RAINFALL   (mm)=     61.64        61.64          61.64
     RUNOFF COEFFICIENT   =      0.97         0.71           0.80

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0004)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0210):     6.75   1.736     1.50    41.29
      + ID2= 2 (  0220):     2.14   0.695     1.50    49.22
        ================================================
        ID = 3 (  0004):     8.89   2.431     1.50    43.20

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0007)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 10.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
```

----------	(cms)	(ha.m.)	(cms)	(ha.m.)
	0.0000	0.0520	0.3731	0.2280
	0.0017	0.0600	0.8784	0.2770
	0.0110	0.1040	1.7045	0.3030
	0.0441	0.1420	2.2579	0.3160
	0.1705	0.1830	4.5036	0.3580

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0004)	8.890	2.431	1.50	43.20
OUTFLOW: ID= 1 (0007)	8.890	0.491	1.83	37.22

PEAK FLOW REDUCTION [Qout/Qin](%)= 20.18
TIME SHIFT OF PEAK FLOW (min)= 20.00
MAXIMUM STORAGE USED (ha.m.)= 0.2394

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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\f0bf
8003-f8f5-4534-87be-9636ca11f6b1\scen
  Summary filename:
C:\Users\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\f0bf
8003-f8f5-4534-87be-9636ca11f6b1\scen


DATE: 04/02/2025                          TIME: 04:44:20

USER:



COMMENTS: _____________________________________________________________


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  ********************************************
  ** SIMULATION : 6                          **
  ********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 820.514
| Ptotal= 68.05 mm |                          B=   0.000
--------------------                          C=   0.691
```

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

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.48

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	7.41	0.83	14.71	1.67	20.47	2.50	8.56
0.17	8.13	1.00	19.65	1.83	15.40	2.67	7.80
0.33	9.05	1.17	33.39	2.00	12.61	2.83	7.19
0.50	10.28	1.33	167.14	2.17	10.80		
0.67	12.01	1.50	34.16	2.33	9.52		

CALIB STANDHYD (0210) ID= 1 DT=10.0 min	Area (ha)= 6.75 Total Imp(%)= 50.00 Dir. Conn.(%)= 20.00

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	3.37	3.37	
Dep. Storage	(mm)=	2.00	1.50	
Average Slope	(%)=	0.50	0.50	
Length	(m)=	20.00	20.00	
Mannings n	=	0.015	0.250	
Max.Eff.Inten.(mm/hr)	=	167.14	182.48	
over (min)		10.00	10.00	
Storage Coeff.	(min)=	1.06 (ii)	6.61 (ii)	
Unit Hyd. Tpeak	(min)=	10.00	10.00	
Unit Hyd. peak	(cms)=	0.17	0.13	
				TOTALS
PEAK FLOW	(cms)=	0.63	1.38	2.007 (iii)
TIME TO PEAK	(hrs)=	1.50	1.50	1.50
RUNOFF VOLUME	(mm)=	66.05	42.17	46.94
TOTAL RAINFALL	(mm)=	68.05	68.05	68.05
RUNOFF COEFFICIENT	=	0.97	0.62	0.69

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 80.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0220)|   Area    (ha)=   2.14
|ID= 1 DT=10.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  35.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.61         0.54
     Dep. Storage     (mm)=       2.00         1.50
     Average Slope     (%)=       1.00         1.00
     Length            (m)=      40.00        30.00
     Mannings n             =     0.015        0.250

     Max.Eff.Inten.(mm/hr)=     167.14       349.33
               over (min)       10.00        10.00
     Storage Coeff.  (min)=      1.31 (ii)    5.74 (ii)
     Unit Hyd. Tpeak (min)=     10.00        10.00
     Unit Hyd. peak  (cms)=      0.17         0.14
                                                        *TOTALS*
     PEAK FLOW       (cms)=      0.35         0.44          0.789 (iii)
     TIME TO PEAK    (hrs)=      1.50         1.50           1.50
     RUNOFF VOLUME    (mm)=     66.05        49.54          55.31
     TOTAL RAINFALL   (mm)=     68.05        68.05          68.05
     RUNOFF COEFFICIENT   =      0.97         0.73           0.81

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0004)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0210):     6.75   2.007     1.50    46.94
      + ID2= 2 (  0220):     2.14   0.789     1.50    55.31
        ================================================
        ID = 3 (  0004):     8.89   2.795     1.50    48.96

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0007)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 10.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
```

----------	(cms)	(ha.m.)	(cms)	(ha.m.)
	0.0000	0.0520	0.3731	0.2280
	0.0017	0.0600	0.8784	0.2770
	0.0110	0.1040	1.7045	0.3030
	0.0441	0.1420	2.2579	0.3160
	0.1705	0.1830	4.5036	0.3580

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0004)	8.890	2.795	1.50	48.96
OUTFLOW: ID= 1 (0007)	8.890	0.671	1.83	42.98

PEAK FLOW REDUCTION [Qout/Qin](%)= 24.01
TIME SHIFT OF PEAK FLOW (min)= 20.00
MAXIMUM STORAGE USED (ha.m.)= 0.2608

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================================================================================
========================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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:
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  Summary filename:
C:\Users\msauder\AppData\Local\Civica\VH5\66c87b4e-6def-4eb5-ad6f-2a14809f2e40\c6ee
ffb4-62ad-453f-a165-a44762a1fa6e\scen


DATE: 04/02/2025                          TIME: 04:44:20

USER:



COMMENTS: _____________________________________________________________


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  ********************************************
  ** SIMULATION : 7                          **
  ********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 896.876
| Ptotal= 74.38 mm |                          B=   0.000
--------------------                          C=   0.691
```

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

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.48

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	8.10	0.83	16.08	1.67	22.38	2.50	9.36
0.17	8.89	1.00	21.48	1.83	16.83	2.67	8.53
0.33	9.89	1.17	36.49	2.00	13.78	2.83	7.86
0.50	11.23	1.33	182.70	2.17	11.81		
0.67	13.13	1.50	37.33	2.33	10.41		

CALIB STANDHYD (0210) ID= 1 DT=10.0 min	Area (ha)= 6.75 Total Imp(%)= 50.00 Dir. Conn.(%)= 20.00

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	3.37	3.37	
Dep. Storage	(mm)=	2.00	1.50	
Average Slope	(%)=	0.50	0.50	
Length	(m)=	20.00	20.00	
Mannings n	=	0.015	0.250	
Max.Eff.Inten.(mm/hr)	=	182.70	206.60	
over (min)		10.00	10.00	
Storage Coeff.	(min)=	1.03 (ii)	6.31 (ii)	
Unit Hyd. Tpeak	(min)=	10.00	10.00	
Unit Hyd. peak	(cms)=	0.17	0.14	
				TOTALS
PEAK FLOW	(cms)=	0.69	1.59	2.276 (iii)
TIME TO PEAK	(hrs)=	1.50	1.50	1.50
RUNOFF VOLUME	(mm)=	72.38	47.68	52.62
TOTAL RAINFALL	(mm)=	74.38	74.38	74.38
RUNOFF COEFFICIENT	=	0.97	0.64	0.71

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 80.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0220)|   Area    (ha)=   2.14
|ID= 1 DT=10.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  35.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.61         0.54
     Dep. Storage     (mm)=       2.00         1.50
     Average Slope     (%)=       1.00         1.00
     Length            (m)=      40.00        30.00
     Mannings n             =     0.015        0.250

     Max.Eff.Inten.(mm/hr)=     182.70       390.75
               over (min)       10.00        10.00
     Storage Coeff.  (min)=      1.26 (ii)    5.50 (ii)
     Unit Hyd. Tpeak (min)=     10.00        10.00
     Unit Hyd. peak  (cms)=      0.17         0.14
                                                        *TOTALS*
     PEAK FLOW       (cms)=      0.38         0.50          0.880 (iii)
     TIME TO PEAK    (hrs)=      1.50         1.50           1.50
     RUNOFF VOLUME    (mm)=     72.38        55.45          61.37
     TOTAL RAINFALL   (mm)=     74.38        74.38          74.38
     RUNOFF COEFFICIENT   =      0.97         0.75           0.83

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0004)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0210):     6.75   2.276     1.50    52.62
      + ID2= 2 (  0220):     2.14   0.880     1.50    61.37
        ================================================
        ID = 3 (  0004):     8.89   3.156     1.50    54.72

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0007)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 10.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
```

```
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           0.0000      0.0520   |    0.3731      0.2280
                           0.0017      0.0600   |    0.8784      0.2770
                           0.0110      0.1040   |    1.7045      0.3030
                           0.0441      0.1420   |    2.2579      0.3160
                           0.1705      0.1830   |    4.5036      0.3580

                                    AREA     QPEAK     TPEAK       R.V.
                                    (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0004)      8.890      3.156      1.50      54.72
   OUTFLOW: ID= 1 (  0007)      8.890      0.837      1.83      48.74

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 26.53
                  TIME SHIFT OF PEAK FLOW         (min)= 20.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.2804

--------------------------------------------------------------------------------

 FINISH
================================================================================
========================
```

Appendix B Stormwater Management Calculations

NRCS (SCS) CURVE NUMBER DELINEATION

STORMWATER MANAGEMENT REPORT
ELORA BESS
CENTRE WELLINGTON, ONTARIO

Pre-Development Conditions

TABLE OF CURVE NUMBERS (CN's)

Land Use		Hydrologic Soil Type A	AB	B	BC	C	CD	D	Manning's 'n'
Meadow	"Good"	30	44	58	64.5	71	74.5	78	0.40
Woodlot	"Fair"	36	48	60	66.5	73	76	79	0.40
Gravel		76	80.5	85	87	89	90	91	0.30
Lawns	"Good"	39	50	61	67.5	74	77	80	0.25
Pasture/Range		58	61.5	65	70.5	76	78.5	81	0.17
Crop		66	70	74	78	82	84	86	0.13
Fallow (Bare)		77	82	86	89	91	93	94	0.05
Impervious		98	98	98	98	98	98	98	0.01

Notes:
1. MTO Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
2. Chin (2000), Water-Resources Engineering, Table 6.13-Curve Numbers for Various Urban Land Uses

HYDROLOGIC SOIL TYPE (%)

Catchment	Hydrologic Soil Type A	AB	B	BC	C	CD	D	TOTAL
Internal Catchments								
110							100.0	100
120							100.0	100

LAND USE (%)

Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Impervious (see note)	Total
Internal Catchments									
110						100		0	100
120						100		0	100

CURVE NUMBER (CN)

Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Impervious	Weighted CN	Pervious CN
Internal Catchments										
110	0.0	0.0	0.0	0.0	0.0	86.0	0.0	0.0	86	86
120	0.0	0.0	0.0	0.0	0.0	86.0	0.0	0.0	86	86

Notes:
1. AMC II assumed
2. Hydrological Soil Group taken from MTO Drainage Manual for each soil type

NRCS (SCS) CURVE NUMBER DELINEATION

STORMWATER MANAGEMENT REPORT
ELORA BESS
CENTRE WELLINGTON, ONTARIO

TABLE OF CURVE NUMBERS (CN's)

Land Use		Hydrologic Soil Type A	AB	B	BC	C	CD	D	Manning's 'n'
Meadow	"Good"	30	44	58	64.5	71	74.5	78	0.40
Woodlot	"Fair"	36	48	60	66.5	73	76	79	0.40
Gravel		76	80.5	85	87	89	90	91	0.30
Lawns	"Good"	39	50	61	67.5	74	77	80	0.25
Pasture/Range		58	61.5	65	70.5	76	78.5	81	0.17
Crop		66	70	74	78	82	84	86	0.13
Fallow (Bare)		77	82	86	89	91	93	94	0.05
Impervious		98	98	98	98	98	98	98	0.01

Notes:
1. MTO Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
2. Chin (2000), Water-Resources Engineering, Table 6.13-Curve Numbers for Various Urban Land Uses

HYDROLOGIC SOIL TYPE (%)

Catchment	Hydrologic Soil Type A	AB	B	BC	C	CD	D	TOTAL
Internal Catchments								
210							100.0	100
220							100.0	100

LAND USE (%)

Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Impervious (see note)	Total
Internal Catchments									
210				25				75	100
220				25				75	100

CURVE NUMBER (CN)

Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Impervious	Weighted CN	Pervious CN
Internal Catchments										
210	0.0	0.0	0.0	20.0	0.0	0.0	0.0	73.5	94	80
220	0.0	0.0	0.0	20.0	0.0	0.0	0.0	73.5	94	80

Notes:
1. AMC II assumed
2. Hydrological Soil Group taken from MTO Drainage Manual for each soil type

VISUAL OTTHYMO CATCHMENT PARAMETER SUMMARY
PRE-DEVELOPMENT

STORMWATER MANAGEMENT REPORT
ELORA BESS
CENTRE WELLINGTON, ONTARIO

Pre-Development Conditions

NasHyd

Area Description	Catchment ID	Area (ha)	CN	Length (m)	IA (mm)	TP (hrs)
Internal						
External Catchment - Agricultural land, draining east	110	3.00	86	122	4.10	0.11
External Catchment - Agricultural land, draining east	120	5.89	86	168	4.10	0.16
Internal Total		**8.89**				
Total		**8.89**				

Notes:

TIMP → *Total percent impervious*

XIMP → *Percent impervious directly connected*

Time of Concentration calculated using the Airport Method
(For areas less than 100 ha, and RC less than 0.4) →

$Tc = [\ 3.26\ (1.1\text{-}C)\ L^{0.5}\ ] / S^{0.33}$

Where: *C = Runoff Coefficient according to MTO Design chart 1.07 for 'cultivated' on silt loam/loam soil*
L = Length of Overland Flow (m)
S = Slope (%)

Time of Concentration calculated using the Bransby Williams Method
(For areas less than 100 ha, and RC greater than 0.4) →

$Tc = 0.057*L/[(Sw^{0.2})*(A^{0.1})]$

Where: *tc = time of concentration, minutes*
L = catchment or watershed length, m
Sw = catchment or watershed slope, %
A = catchment or watershed area, ha

Time to Peak (hr) → *Tp = 0.6Tc (StandHyd), Tp = Flow Length/0.3 (NasHyd)*

Storage → $S = (25400 / CN) - 254$

Initial Abstractions → $IA = 0.1\ S$ *(from Visual Otthymo User's Manual Section 1.1.2)*

VISUAL OTTHYMO CATCHMENT PARAMETER SUMMARY
POST-DEVELOPMENT

STORMWATER MANAGEMENT REPORT
ELORA BESS
CENTRE WELLINGTON, ONTARIO

Visual OTTHYMO Parameters

Post-Development Conditions

StandHyd

Area Description	Catchment ID		Area (ha)	CN	TIMP	XIMP	Slope (%)	Length (m)	R.C	Tc (hrs)	Tp (hrs)
Internal											
BESS facility	210	Y	6.75	94	0.50	0.20	0.50	20.0	0.53	0.02	0.01
BESS facility	220	Y	2.14	94	0.75	0.35	1.00	30.0	0.71	0.03	0.02

	Area	Imperviousness
Internal Total	8.89	
Total	8.89	
Total Area to SWM Pond	8.89	0.56

Notes:

TIMP ..... *Total percent impervious*

XIMP ..... *Percent impervious directly connected*

Time of Concentration calculated using the Airport Method ..... $Tc = [\ 3.26\ (1.1-C)\ L^{0.5}\ ] / S^{0.33}$
(For areas less than 100 ha, and RC less than 0.4)

Where:
C = Runoff Coefficient according to MTO Design chart 1.07 for 'cultivated' on silt loam/loam soil
L = Length of Overland Flow (m)
S = Slope (%)

Time of Concentration calculated using the Bransby Williams Method .....
(For areas less than 100 ha, and RC greater than 0.4)

$Tc = 0.057*L/[(Sw^{0.2})*(A^{0.1})]$
Where:
tc = time of concentration, minutes
L = catchment or watershed length, m
Sw = catchment or watershed slope, %
A = catchment or watershed area, ha

Time to Peak (hr) ..... *Tp = 0.6Tc (StandHyd), Tp = Flow Length/0.3 (NasHyd)*

Storage ..... $S = (25400 / CN) - 254$

Initial Abstractions ..... $IA = 0.1\ S$ *(from Visual Otthymo User's Manual Section 1.1.2)*

STORMWATER MANAGEMENT POND DESIGN
STAGE STORAGE DISCHARGE CURVE

STORMWATER MANAGEMENT REPORT
ELORA BESS
CENTRE WELLINGTON, ONTARIO

160901104 - Elora BESS
Stage Storage Discharge Curve

Bottom of the Pond	409.50	m
Permanent Pool	410.40	m

			Storage		Discharge				
Elevation (m)	Depth (m)	Footprint Area (m^2)	Total Storage Volume (m^3)	Live Storage (m^3)	Orifice 1 (m^3/s)	Orifice 2 (m^3/s)	Weir 1 (m^3/s)	Total Flow (m^3/s)	Drawdown Time (h)
409.50	0.00	0	0						
409.70	0.20	1,527	153						
409.90	0.40	1,753	481						
410.10	0.60	1,872	843						
410.25	0.75	2,124	1,143						
410.35	0.85	2,268	1,362						
410.40	0.90	2,389	1,479	1,068	0.000			0.0000	0.0
410.45	0.95	2,389	1,598	1,188	0.001			0.0014	47.9
410.55	1.05	2,513	1,843	1,433	0.005			0.0047	70.4
410.80	1.30	2,908	2,521	2,111	0.008	0.010		0.0188	86.5
411.05	1.55	3,154	3,279	2,868	0.011	0.153		0.1637	88.8
411.30	1.80	3,537	4,115	3,705	0.013	0.395	0.608	1.0158	89.2
411.50	2.00	3,802	4,849	4,439	0.014	0.529	3.994	4.5379	89.3
411.60	2.10	3,937	5,236	4,826	0.015	0.585	6.791	7.3913	89.3
411.70	2.20	4,074	5,636	5,226	0.016	0.636	10.387	11.0393	89.3

Orifice 1 Flow	$Q_{orif} = C \times A \times (2gH)^{1/2}$	
Crest Elevation	410.40	m
Crown Elevation	410.48	m
Diameter	0.080	m
Area	0.005	m^2
Cd	0.63	
Cw	0.003	
Orifice 2 Flow	$Q_{orif} = C \times A \times (2gH)^{1/2}$	
Crest Elevation	410.75	m
Crown Elevation	411.35	m
Diameter	0.600	m
Area	0.283	m^2
Cd	0.63	
Cw	0.432	
Emergency Spillway 1	$Q_{weir} = C \times L \times H^{3/2} + C_s \times S \times H^{5/2}$	
Elevation	411.20	m
Length	10.00	m
Discharge Coeff.	1.670	
Discharge Coeff.	1.268	
Height	0.5	m
Side Slopes	20	m/m

Notes:

Orifice Flow Calculations: $Q_{orif} = C \times A \times (2gH)^{1/2}$
where
C = orifice coefficient
A = area of orifice
g = acceleration due to gravity
H = head above centreline of orifice
Note: used when water elevation is above 3/4 of the orifice diameter

Sharp crested semi-circular weir equation: $Q = C_w \times (H/D)^{1.5}$
where
C_w = sharp-crested weir coefficient
D = diameter of orifice
H = head above orifice invert
Note: used when water elevation is below 3/4 of the orifice diameter

Broad Crested Weir Equation: $Q_{weir} = C \times L \times H^{3/2} + C_s \times S \times H^{5/2}$
where
C = rectangular weir coefficient
C_s = triangular weir coefficient
L = bottom width of spillway
H = head above weir invert
S = side slopes (ratio H:W)

PROPOSED STORMWATER MANAGEMENT POND
WATER QUALITY CALCULATIONS

STORMWATER MANAGEMENT REPORT
ELORA BESS
CENTRE WELLINGTON, ONTARIO

SWM Pond		
Required protection level:	Enhanced	
Contributing drainage area:	8.89	ha
Impervious level:	56	%
Total required water quality storage volume per hectare:	186	m^3/ha
Required permanent pool volume per hectare:	146	m^3/ha
Required extended detention storage volume per hectare:	40	m^3/ha
Required permanent pool volume:	1,300	m^3
Provided permanent pool volume:	1,362	m^3
Required extended detention storage volume:	356	m^3
Provided extended detention volume during water quality event:	1,138	m^3

MOE SWM Design Manual Table 3.2

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	*55%*	*70%*	*85%*
Enhanced (80% long-term S.S. removal)	Infiltration	25	30	35	40
	Wetlands	80	105	120	140
	Hybrid Wet Pond/Wetland	110	150	175	195
	Wet Pond	140	190	225	250
Normal (70% long-term S.S. removal)	Infiltration	20	20	25	30
	Wetlands	60	70	80	90
	Hybrid Wet Pond/Wetland	75	90	105	120
	Wet Pond	90	110	130	150
Basic (60% long-term S.S. removal)	Infiltration	20	20	20	20
	Wetlands	60	60	60	60
	Hybrid Wet Pond/Wetland	60	70	75	80
	Wet Pond	60	75	85	95
	Dry Pond (Continuous Flow)	90	150	200	240

PROPOSED STORMWATER MANAGEMENT POND
FOREBAY CALCULATIONS

STORMWATER MANAGEMENT REPORT
ELORA BESS
CENTRE WELLINGTON, ONTARIO

Using MOE - Stormwater Management Planning and Design Manual (2003)

STORMWATER MANAGEMENT FACILITY

Settling

Dist = sqrt(r*Q_p/v_s)
= **4.5** **m**

r : 1 = l to w ratio — r = 3
Q_p = peak SWM outflow during quality storm — Q_p = 0.002 — Note 1.
v_s = settling velocity for 0.15 mm particles (m/s) — v_s = 0.0003

Dispersion Length

Dist = 8Q/dv
= **39.2** **m**

y_d = total depth of sediment in forebay (m) — y_d = 0.5
Q = 10 yr inlet flow (m^3/s) — Q = 1.958 — Note 2.
d = depth of perm pool in forebay (m) — d = 0.8
v_f = desired vel in forebay (m/s) — v_f = 0.5

Velocity

v = Q/A
= **0.06** **m/s**

y = total depth of forebay from perm. pool (m) — y = 1.3
b = bottom width (avg) of forebay (m) — b = 20
Q = 10 yr inlet flow (m^3/s) — Q = 1.958 — Note 2.
A = cross-sectional area (m^2) — A = 32.77
Target velocity = 0.15 — V_{targ} = 0.15

Therefore, **Velocity Target Satisfied**

Cleanout Frequency

Table 6.3 MOE SWMPD Manual

Water Quality Level — Enhanced
A_{sew} = Contributing Sewer Area (ha) — A_{sew} = 8.89
cleanout = Vol/(load*A_{sew}*effic) — Imp = Percent Impervious (%) — Imp = 56%
= **7.7** **years** — load = Sediment Loading (m^3/ha) — load = 2.0 — Note 3.
effic = Removal Efficiency (%) - Enhanced Level — effic = 80%
Targ = Cleanout Frequency Target (years) — Targ = 7
Vol = Sediment volume (m^3) — Vol = 107 — Note 4.

Therefore, **Cleanout Frequency Satisfied**

Surface Area Check[5]

SA_f/SA_{pp} = **25.9%**

SA_f = Forebay Surface Area (m^2) — SA_f = 619
SA_{pp} = Total Permanent Pool Surface Area (m^2) — SA_{pp} = 2389
Targ = Forebay size (as % of Permanent Pool Area) — Targ = 33%

Therefore, **The forebay size is OK!**

Notes:
1. Assume 2 times the 24 hour extended detention peak flow as worst case quality storm outflow
2. 10 year peak inlet flow to SWM facility based on Visual OTTHYMO Modelling
3. Interpolated based on percent impervious
4. Volume of bottom 0.5 m depth, the maximum sediment accumulation depth

Appendix C FlowMaster Modelling Output

Trapezoidal Channel - Elora

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.005 m/m
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	2.50 m
Discharge	3,156.00 L/s

Results	
Normal Depth	581.5 mm
Flow Area	2.5 m²
Wetted Perimeter	6.2 m
Hydraulic Radius	399.6 mm
Top Width	5.99 m
Critical Depth	452.0 mm
Critical Slope	0.013 m/m
Velocity	1.28 m/s
Velocity Head	0.08 m
Specific Energy	0.66 m
Froude Number	0.636
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 mm
Length	0.0 m
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Downstream Velocity	0.00 m/s
Upstream Velocity	0.00 m/s
Normal Depth	581.5 mm
Critical Depth	452.0 mm
Channel Slope	0.005 m/m
Critical Slope	0.013 m/m

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Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo ON N2L 0A4
stantec.com