MINNEHAHA CREEK
WATERSHED DISTRICT
QUALITY OF WATER, QUALITY OF LIFE

Meeting: Board Meeting
Meeting date: 11/3/2022
Agenda Item #: 10.1
Item type: Permit requiring approval

Title: Regional Stormwater Agreement & Permit 22-436

Prepared by: Name: Will Roach
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Recommendation:

The Board of Managers is asked to take two separate actions, in the following order:

1) Approval of Regional Stormwater Management Agreement for Downtown West Victoria Development – A proposed resolution is presented in the meeting packet for the Board's consideration.
2) Approval of MCWD Permit 22-436, The Marco McLane Development
    a. Condition of Approval including the installation of a pre-treatment BMP and recording of Maintenance declaration for pre-treatment BMP.
    b. Approval also rests on City of Victoria construction of Filtration Pond 1 in conjunction with Permit 22-436 permit term.

Introduction:

This report summarizes two separate requests that the Board of Managers is asked to consider and approve. The first request is the consideration and approval of a new Regional Stormwater Management Agreement between the City of Victoria and the Minnehaha Creek Watershed District. The second item requested for consideration and approval is permit application #22-436, the Marco McLane multi-family residential development in Victoria.

The City of Victoria is proposing the redevelopment of a 13.5-acre parcel owned by the city, in the downtown area and adjacent to the intersection of Victoria Drive and Highway 5. This redevelopment will comprise mixed use of multi-family residential and commercial space that will be constructed over multiple phases.

The City of Victoria will be constructing several filtration ponds as part of a regional treatment plan to provide stormwater management for the site. The city is asking to enter into a regional treatment facility agreement with the MCWD for this proposed development, as provided for by section 7 of the Stormwater Management rule. In addition to the stormwater facilities, the City will also be constructing public infrastructure like the roads, and the commercial aspects of the redevelopment will be built by private developers through partnership agreements with the City of Victoria.

Marco McLane LLC is proposing a multi-family residential building located within the Phase 1 area of the Downtown West Redevelopment under Permit #22-436. The present application is for the proposed private development only. The City will apply separately for a permit for the proposed road and other public infrastructure.

Background:

The City of Victoria is proposing the redevelopment of a 13.5-acre parcel located in the downtown area and near the intersection of County Road 11/ Victoria Drive and Trunk Highway 5/Arboretum Boulevard. The redevelopment will result in 8.87 acres of new impervious on site and will be done in at least two phases. The first phase is proposed to start

construction in April 2023 and to be completed by October 2023 and will result in a total of 3.27-acres of impervious on the 13.5-acre site. The second phase of the development will be constructed at a future time and will create an additional 4.47-acres of impervious surface. As part of the public infrastructure side of the proposed development, the City will be constructing several stormwater filtration ponds to capture and treat runoff from the future impervious surface. Filtration pond 1 will be constructed under the first phase of the development, pond 2 was built under a recent road reconstruction permit (22-212) and, pond 3 will be constructed in conjunction with the second phase of redevelopment. The City is looking to enter a Regional Stormwater Management Agreement for the proposed development and associated Best Management Practices (BMPs).

Marco McLane LLC is proposing a multi-family residential building that will be located within the first phase of the Downtown West Development. The multi-family building will be located along the Eastern portion of the 13.5-acre parcel and will be North of Steiger Lake Lane. Marco McLane will be purchasing the project area from the City and the project specific parcel will be subdivided out from the main parcel. This project, under Permit #22-436, would increase the total amount of impervious on site from 0.09 acres to 1.56 acres and would disturb approximately 2.1 acres of the 13.5-acre parcel. A recommended condition of the permit is that applicant install an on-site, pre-treatment BMP to aid in stormwater treatment prior to discharging to the off-site filtration ponds.

Downtown West Victoria Regional Stormwater Agreement

Staff seeks the approval of an agreement between the District and the City of Victoria regarding the City's installation of three filtration ponds to serve as a new regional treatment facility to provide rate, volume, and phosphorus treatment for 13.5 acres in downtown Victoria. The agreement as outlined will constitute a regional stormwater management plan pursuant to section 7 of the District's stormwater management rule.

The City anticipates both public and private development within the 13.5 acre with a total of about 8.9 acres of impervious surface to be constructed under two phases. Pond 1 will be built as part of the first phase of development, pond 2 was established with a previously approved road reconstruction project (permit #22-212), and pond 3 will be constructed as part of a future phase of development. Under this agreement, the City is fully responsible for the design and construction of the project while the District is providing technical review and support.

Under this agreement, the City will provide 90% design plans in November of 2022 that District staff will review to concur that it is a satisfactory design to provide for retention and abstraction of stormwater within the meaning of the District's stormwater management rule and the filtration requirements in Appendix A. During construction, the City will notify the District of any change from the final plans and the City and the District will cooperate with respect to any inspection or Facility document review undertaken by District staff during the course of construction. On substantial completion of a Facility, the City will provide as-built plans signed by a professional engineer or surveyor.

Section 7 of the District's stormwater management rule outlines the criteria for regional treatment facilities and sites that seek to utilize them. District staff and the District engineer have reviewed the proposed stormwater facilities and have determined that the design provides the required water quality, rate, and volume treatment under subsection 7(a) of the rule. District staff and the District engineer have reviewed the proposed regional treatment and, in accordance with subsection 7(b), do not find that the plan would cause impact to local groundwater or natural resources, however in accordance with subsections 7(b) and 7(c), individual project sites within the 13.5 acre area will be required to include stormwater best management practices on-site to address any local impact identified during application review. Private developers that intend to use the regional treatment facilities also will need to document permission from the City to use the necessary portion of facility capacity, as outlined in subsection 7(d) of the rule.

It is the recommendation of District staff that the Board of Managers approve the Regional Stormwater Management Agreement between the City of Victoria and the District for the proposed development.

District Rule Analysis for Permit # 22-436

Marco McLane LLC is proposing the construction of a multi-family residential building (Permit 22-436) located within the first phase of the redevelopment. The rules triggered by the Marco McLane development are the Erosion Control and Stormwater Management rules.

Erosion Control

The District's Erosion Control Rule is applicable to projects proposing at least 5,000 square feet of land disturbance or 50 cubic yards of fill, grading, excavation, or stockpiling. As the applicant proposes to disturb approximately 2.1 acres of the parcel and engage in 2,612 cubic yards of excavation/fill the District's Erosion Control rule is triggered.

The applicant has submitted a Stormwater Pollution Prevention Plan (SWPPP) and Erosion Control plan to meet District requirements. Silt fence will be established around all disturbed areas to provide perimeter control, stormwater inlet protection is to be provided to prevent illicit discharges to existing storm sewer infrastructure, and a rock construction entrance is provided to prevent sediment tracking on public roads. Final site stabilization will take place through the establishment of sod.

As a result, the proposed project meets the criteria of this rule.

Stormwater Management

The District's Stormwater Management rule applies to land disturbance that creates new or replaces existing impervious surface or alters the contours of a parcel in a way that affects the direction, peak rate, volume, or water quality of runoff.

As described in the Introduction and Background sections of this report, the project proposes to redevelop a 13.5-acre parcel to include several commercial and multi-family residential buildings. The proposed Marco McLane multi-family building under permit 22-436 would result in the creation of 1.56-acres of the 3.27 total acres impervious surface associated with the first phase of development. As the work associated with permit application #22-436 consists of redeveloping a parcel over 1-acre in size, would disturb less than 40% of the total parcel, and result in an increase in over 50% impervious surface on site the applicant is required to provide rate, volume, and water quality treatment for the entire site's impervious surface. As previously noted, the City will be installing several filtration stormwater ponds to serve as regional stormwater facilities, due to soils on site not being suitable for infiltration, the City has opted for the filtration design for the ponds. Per Appendix A of the District's stormwater rule, filtration ponds only count towards 50% of the volume abstraction credit of infiltration practices, which requires the ponds to provide double the treatment volume. The Marco McLane development would tie into these ponds to serve as their primary BMP and the applicant has received approval from the City to do so, as is required under section 7(d) of the Stormwater Management rule. Pursuant to Section 7(b) of the District's Stormwater rule the applicant will also be installing an on-site, pre-treatment BMP to aid with the removal of sediment and other materials before discharging to the filtration ponds.

Site Phase	Existing Impervious (ac)	Proposed Impervious (ac)	Required Water Quality Volume (cu ft)	Required Filtration Volume Credit (cu ft)
Phase 1	0.09	3.27	11,870	23,740

Table 1. Phase 1 Proposed Impervious and Required Filtration

BMP	Location	Impervious Routed (ac)	Water Quality Volume Provided (cu ft)	Filtration Volume Provided (cu ft)
Pond 1	Phase 1 & Future	3.14	12,113	24,225
Pond 2	Phase 1	0.99	2,147	4,295
Pond 3	Future	4.74	18,000	36,000
Total		**8.87**	**32,260**	**64,520**

Table 2. Filtration Credit Summary

Table 1 summarizes the proposed total amount of impervious surface associated with the first phase of development and the required amount of abstraction that would need to be provided.

Table 2 summarizes the amount of impervious surface being routed to each of the BMPs associated with the redevelopment and the amount of filtration credit provided by each pond. To meet the District's stormwater requirements, the first phase of development needs to include stormwater facilities that provide 23,740 cubic feet of abstraction. Permit 22-436 requires water quality volume for just 1.56 acres of the planned total Phase 1 impervious surface of 3.27 acres, and so the construction of Pond 1 in conjunction with the permitted development necessarily will be sufficient. As the BMPs proposed provide 28, 520 cubic feet of abstraction it is the determination of District staff and the District engineer that the proposed filtration ponds meet the volume and water quality requirements of the Stormwater rule .

Drainage Outfall	1-year Storm (cfs)		10-year Storm (cfs)		100-year Storm (cfs)	
	Exist.	Prop.	Exist.	Prop.	Exist.	Prop.
North	11.1	7.5	25.3	17.3	50.6	34.7
South	4.8	3.2	8.5	7.4	12.1	11.2
Southwest	6.0	3.4	14.8	9.3	31.3	30.9
West	3.5	2.4	8.4	5.8	17.4	12.1

Table 3. Phase 1 Rate Control Summary

Table 3 summarizes the rate control of the site under the existing and proposed conditions. Per the Stormwater rule, activities subject to this rule shall not result in increases in peak runoff rates for the 1-,10-, or 100-yr rainfall events. As the proposed conditions show reduction in runoff rates under all rainfall events, the proposed filtration ponds meet the rate control requirements of the Stormwater Management rule.

As the filtration ponds proposed by the City of Victoria have met the criteria of providing rate, volume, and water quality control, it is the determination of District staff and the District engineer that the requirements of the Stormwater Management rule have been met. Additionally, as Permit 22-436, the first part of the phase 1 development, will be using the ponds to provide treatment to their site, along with a pre-treatment BMP, it is the determination of District staff and the District engineer that there will be no local water quality, flooding or other local water resource impact associated with the use of an off-site facility for compliance, and that applicant has satisfied the Stormwater Management rule requirements.

Summary & Recommendation

The City of Victoria is proposing the redevelopment of a 13.5-acre lot into mixed-use comprising multi-family residential, commercial, and public spaces. The City will install three regional stormwater filtration ponds to provide stormwater treatment for the two phases of development. The City will be responsible for the construction of public improvements such as roadways and the stormwater ponds and private developers would be developing the commercial and residential spaces through partnership with the City. The construction of public improvements associated with the first phase of development would begin in Spring of 2023 and conclude in October of 2023 per a timeline provided by the City. The City of Victoria has requested that the District enter into a Regional Stormwater Management Agreement with City for the proposed ponds. District staff and the District engineer have reviewed the proposed filtration ponds and have determined that the filtration ponds meet the design requirements of the Stormwater rule.

The Marco McLane development proposed under Permit 22-436 would be the first private development to begin work within the first phase of development. This project would utilize the filtration ponds to provide treatment for runoff from their site and will also include a pre-treatment BMP to remove sediment from stormwater runoff, prior to discharging to the filtration ponds. District staff and the engineer have determined that Permit 22-436 meets the Erosion Control and Stormwater Management rules.

Supporting documents (list attachments):

1) Downtown West Victoria Stormwater Report
2) Permit 22-436 Stormwater Memo
3) Statement from City regarding Permit 22-436 & use of regional facilities
4) Regional Stormwater Management Agreement for Downtown West Victoria

Kimley»Horn

MEMORANDUM

To: City of Victoria, Minnehaha Creek Watershed District

From: Adam Tjaden, PE

Ron Leaf, PE

Date: September 16th, 2022

Subject: City of Victoria - Downtown West Regional Stormwater Management

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The Downtown West Infrastructure Improvements in the City of Victoria is a 13.5-acre redevelopment site is located in the northeast quadrant of the intersection of Trunk Highway 5/Arboretum Boulevard and County Road 11/Victoria Drive. The proposed improvements will be constructed in at least two phases. Phase 1 is proposed to be constructed in 2023, the schedule for future downtown west phases is still to be determined. This memo describes the regulatory requirements and proposed stormwater management approach within each phase of the development to meet those regulatory requirements. The proposed stormwater management approach described in this memo, meets the requirements of the Minnehaha Creek Watershed District (MCWD) stormwater management rule.

Regulatory Criteria

The development of the project site will result in the creation of approximately 8.86 acres of new impervious surface based on the site plan for all phases. The project will trigger the MCWD stormwater management requirements for new development by increasing the impervious surface to greater than 20% of the site's total area. The site must meet the following design requirements of Table 2 of MCWD's Stormwater Management Rules:

1. Phosphorus Control
    a. No net increase in phosphorus loading from existing conditions.
2. Rate Control
    a. No net increase in peak runoff rates for the 1-, 10-, and 100-year, 24-hour design storms where stormwater discharges across the downgradient site boundary compared to existing conditions.
3. Volume Control
    a. Provide abstraction for 1 inch of rainfall from the site's impervious surface.

Site Drainage

The site is mostly undeveloped with existing drainage generally flowing in three directions: north into Three Rivers Park, south west into the north ditch of TH 5 (Arboretum Boulevard), and south into an existing MnDOT stormwater management facility south of Stieger Lake Lane. The 2022 Stieger Lake

Lane Reconstruction project will include construction of a filtration basin on the north side of existing Stieger Lake Lane which then outlets to the existing MnDOT stormwater management facility.

The proposed design includes the construction of three regional stormwater management facilities for regional treatment throughout the Downtown West Redevelopment. The first facility (BMP 1) is an aboveground stormwater basin near the center of the site. The second facility (BMP 2) is the stormwater basin constructed as part of the 2022 Stieger Lake Reconstruction project. The third facility (BMP 3) is located within the future phase portion of the site and would initially be constructed as an aboveground basin that would be converted to underground BMP as future development converts the area to parking lot and buildings. The proposed grading will maximize drainage to the three regional stormwater management facilities. However, additional structural BMPs will likely be needed to capture portions of the site that are not able to drain to the regional BMPs.

Downtown West (Phase 1)

The following sections summarize the regulatory criteria and proposed stormwater management compliance with MCWD rules for the first phase of Downtown West to be constructed in 2023. Phase 1 includes realignment and extension of Stieger Lake Lane, construction of the central green, and a proposed development east of the central green. Phase 1 will include construction of BMP 1, and modifications to BMP 2 due to the realignment of Stieger Lake Lane and associated grading.

Phosphorus Control (Phase 1)

A P8 analysis was completed for the existing condition and proposed phase 1 improvements to analyze the existing and proposed phosphorus loadings. The proposed regional stormwater management facilities described above will provide necessary water quality treatment to meet the MCWD regulation of no net increase in phosphorus loading from existing conditions. Table 1 summarizes the phosphorus loading in the pre and post development conditions.

Table 1. Phosphorous Control Summary (Phase 1)

	Impervious Area (acres)	Pervious Area (acres)	Total Area (acres)	TP Load Generated (Annual) (lbs.)	TP Load Effluent (Annual) (lbs.)
Existing Conditions	1.54	15.12	16.66	6.9	6.9
Proposed Conditions	4.28	12.38	16.66	12.3	4.5

Rate Control (Phase 1)

Discharge rate requirements from the site will be met with the onsite regional stormwater BMPs. HydroCAD models for existing and proposed conditions phase 1 were prepared to evaluate the existing and proposed discharge rates from the project area. Table 2 summarizes the rate control results of the pre and post development conditions.

Table 2. Rate Control Summary (Phase 1)				
Location \ Event	**1-year (cfs)**	**2-year (cfs)**	**10-year (cfs)**	**100-year (cfs)**
North – Ex.	11.1	14.0	25.3	50.6
North – Pr.	7.5	9.5	17.3	34.7
*South – Ex. SLL	4.8	5.8	8.5	12.1
South – Ex.	1.7	2.9	7.4	11.9
South – Pr.	3.2	3.3	7.4	11.2
South West – Ex.	6.0	7.8	14.8	31.3
South West – Pr.	3.4	5.2	9.3	30.9
West – Ex.	3.5	4.5	8.4	17.4
West – Pr.	2.4	3.1	5.8	12.1

** Existing discharge rates prior to construction of BMP 2 as part of Stieger Lake Lane reconstruction project in 2022, per MCWD permit 22-212.*

Volume Control (Phase 1)

With the post-development impervious area as 3.27 acres, the MCWD volume control 1-inch requirement is 11,870 cubic feet. Filtration is assumed due to poor onsite soils. MCWD regulates filtration BMPs at 50% volume control credit. The filtration volume credit requirement is 23,740 cubic feet. The regional stormwater BMPs in phase 1 (BMP 1, 2) provide a total of 28,520 cubic feet of filtration volume which equates to 14,260 cubic feet of volume control, which meets MCWD rules. Table 4 summarizes the volume control requirements and proposed volume credits of the proposed improvements in phase 1.

Table 3. Impervious Area Summary (Phase 1)				
Site Phase	**Existing Impervious Area (ac.)**	**Proposed Regulatory Impervious Area (ac.)**	**Water Quality Volume Required (1 in. over regulatory impervious) (cu ft.)**	**Filtration Volume Required (50% Volume Credit) (cu ft.)**
Phase 1	-	3.27	11,870	23,740

Table 4. Volume Control Summary (Phase 1)				
BMP	**Location**	**Impervious Routed (ac.)**	**Water Quality Volume Provided (cu ft.)**	**Filtration Volume Provided (cu ft.)**
1	Phase 1	2.51	12,11318	24,225
2	Phase 1	0.99	2,147	4,295
Total		**3.50**	**14,260**	**28,520**

Downtown West (Phase 1 & Future Phases)

The following sections summarize the regulatory criteria and proposed stormwater management compliance with MCWD rules for the full buildout of Downtown West including future phase. BMP 3 is proposed in future phase to meet requirements for water quality, volume control, and rate control of the additional redevelopment.

Phosphorus Control (Phase 1 & Future Phases)

A P8 analysis was completed for the existing condition and proposed improvements to analyze the existing and proposed phosphorus loadings. The proposed regional stormwater management facilities described above will provide necessary water quality treatment to meet the MCWD regulation of no net increase in phosphorus loading from existing conditions. Table 5 summarizes the rate control results of the pre and post development conditions.

Table 5. Phosphorous Control Summary (All Phases)

	Impervious Area (acres)	Pervious Area (acres)	Total Area (acres)	TP Load Generated (Annual) (lbs.)	TP Load Effluent (Annual) (lbs.)
Existing Conditions	1.54	15.12	16.66	6.9	6.9
Proposed Conditions	9.88	6.78	16.66	23.5	6.0

Rate Control (Phase 1 & Future Phases)

Discharge rate requirements from the site will be met with the onsite regional stormwater BMPs. HydroCAD models for existing and proposed conditions were prepared to evaluate the existing and proposed discharge rates from the project area in both phase 1 and future phases. Table 6 summarizes the rate control results of the pre and post development conditions.

Table 6. Rate Control Summary (All Phases)

Location \ Event	1-year (cfs)	2-year (cfs)	10-year (cfs)	100-year (cfs)
North – Ex.	11.1	14.0	25.3	50.6
North – Pr.	1.0	1.4	2.6	5.7
*South – Ex. SLL	4.8	5.8	8.5	12.1
South – Ex.	1.7	2.9	7.4	11.9
South – Pr.	3.8	4.4	7.9	11.9
South West – Ex.	6.0	7.8	14.8	31.3
South West – Pr.	1.4	5.2	10.7	30.1
West – Ex.	3.5	4.5	8.4	17.4
West – Pr.	2.0	3.1	4.5	9.0

** Existing discharge rates prior to construction of BMP 2 as part of Stieger Lake Lane reconstruction project in 2022, per MCWD permit 22-212.*

Volume Control (Phase 1 & Future Phases)

With the post-development impervious area as 8.87 acres, the MCWD volume control 1-inch requirement is 32,198 cubic feet. Filtration is assumed due to poor onsite soils. MCWD regulates filtration BMPs at 50% volume control credit. The filtration volume credit requirement is 64,396 cubic feet. The regional stormwater BMPs throughout the site (all phases) provide a total of 64,520 cubic feet of filtration volume which equates to 32,260 cubic feet for volume control, which meets MCWD rules. Table 8 summarizes the volume control requirements and proposed volume credits of the proposed improvements.

Table 7. Impervious Area Summary (All Phases)

Site Phase	Existing Impervious Area (ac.)	Proposed Regulatory Impervious Area (ac.)	Water Quality Volume Required (1 in. over regulatory impervious) (cu ft.)	Filtration Volume Required (50% Volume Credit) (cu ft.)
Phase 1	-	3.27	11,870	23,740
Future	-	5.60	20,328	40,656
Total	**-**	**8.87**	**32,198**	**64,396**

Table 8. Impervious Area Summary (All Phases)

BMP	Location	Impervious Routed (ac.)	Water Quality Volume Provided (cu ft.)	Filtration Volume Provided (cu ft.)
1	Phase 1 & Future	3.14	12,113	24,225
2	Phase 1	0.99	2,147	4,295
3	Future	4.74	18,000	36,000
Total		**8.87**	**32,260**	**64,520**

Table 9. Water Quality Drawdown Calculations

BMP	Water Quality Volume (CF)	BMP Bottom Area (SF)	Depth (Volume/Bottom Area) (LF)	48 Hour Drawdown Rate (IN/HR)	Design Filtration Rate (IN/HR)
1	24,225	10,410	2.33	0.58	0.8
2	4,295	1,400	3.07	0.77	0.8
3	36,000	21,390	1.68	0.42	0.8

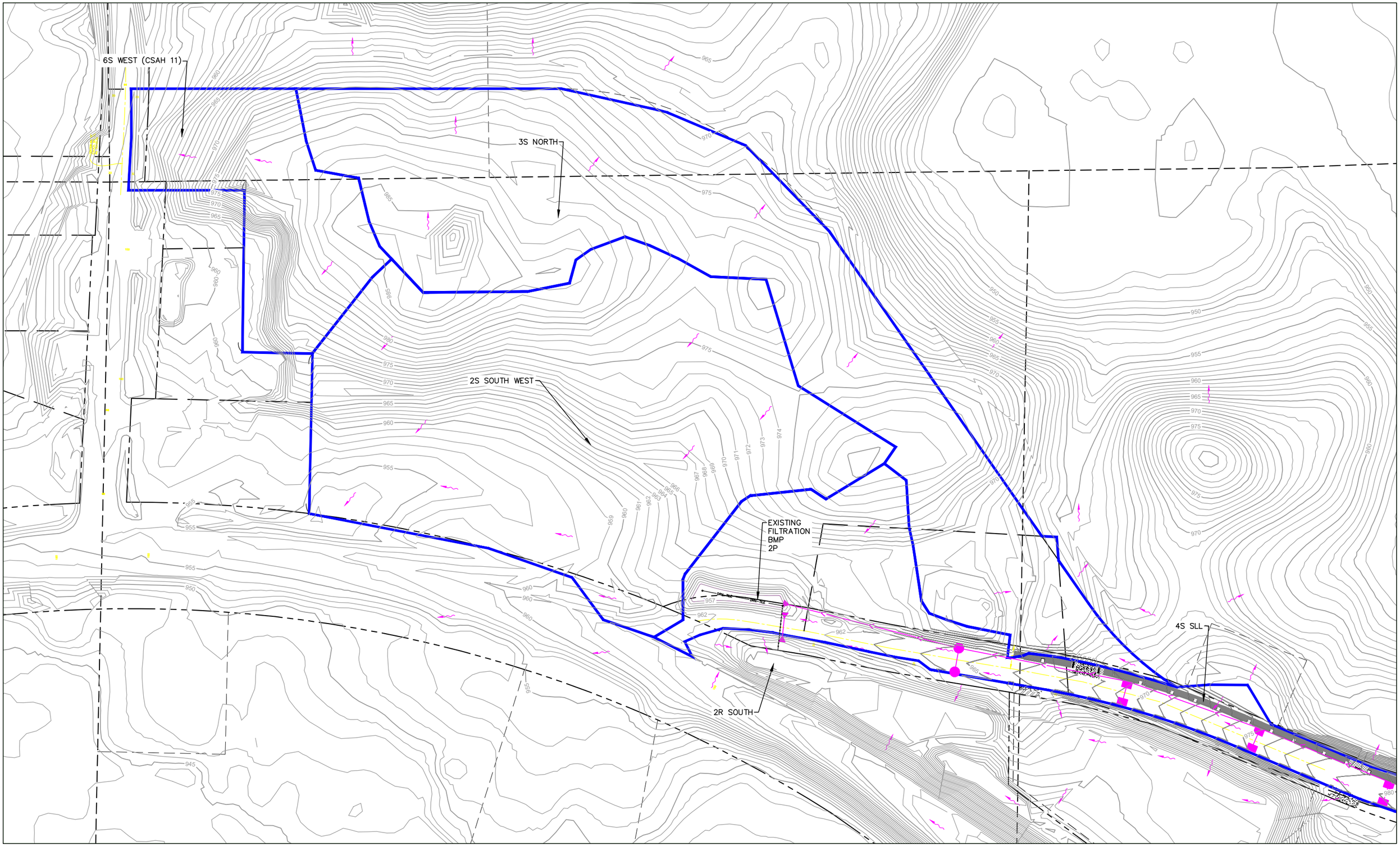
Table 10. BMP Volume Accounting				
BMP	Construction Phase	Total Filtration Volume Credits (CF)	Phase 1 Volume Credits (cu-ft)	Future Projects Volume Credits (cu-ft)
1	Phase 1	24,225	18,223	6,002
2	Phase 1	4,295	4,295	0
3	Future	36,000	0	36,000
Total		64,520	22,518	42,002

Conclusion

The proposed regional stormwater management design above meets the requirements of MCWD's Stormwater Management Rule. The proposed improvements will be constructed in at least two phases. Phase 1 is proposed to be constructed in 2023, the schedule for future downtown west phases is still to be determined.

Attachments

A. Existing Stormwater System Exhibit
B. Proposed Phase 1 Stormwater System Exhibit
C. Proposed Full Buildout Stormwater System Exhibit
D. Existing HydroCAD Model Summary
E. Proposed Phase 1 HydroCAD Model Summary
F. Proposed Full Buildout HydroCAD Model Summary
G. Geotechnical Report
H. Stantec Memo titled “Downtown West Infrastructure Improvements Stormwater Management” dated October 17, 2017



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Kimley»Horn

CITY OF VICTORIA

DOWNTOWN WEST INFRASTRUCTURE IMPROVEMENTS

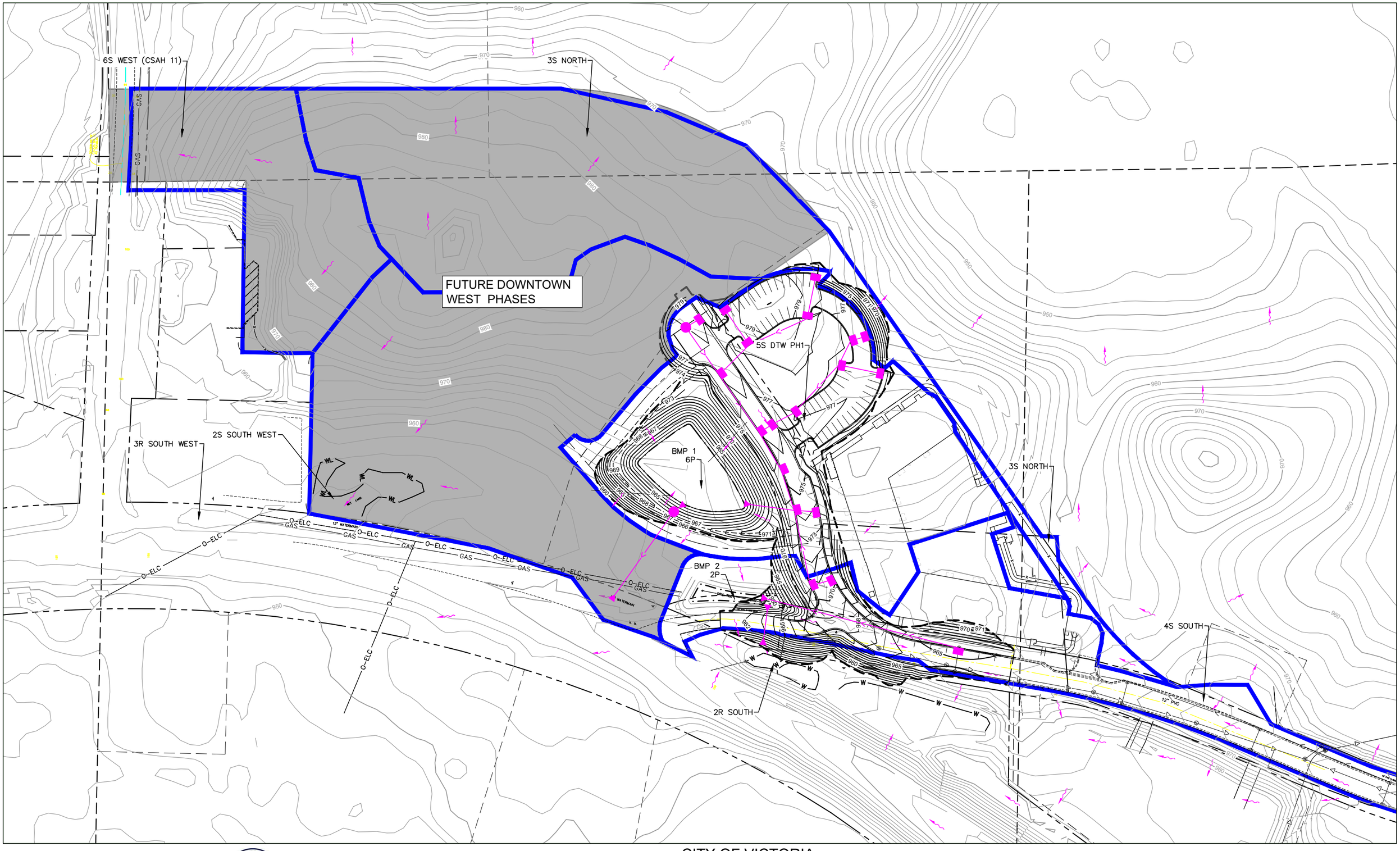
EXISTING STORMWATER SYSTEM

SEPTEMBER 16, 2022

NORTH

0 60 120

HORIZONTAL SCALE IN FEET



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CITY OF VICTORIA

DOWNTOWN WEST INFRASTRUCTURE IMPROVEMENTS

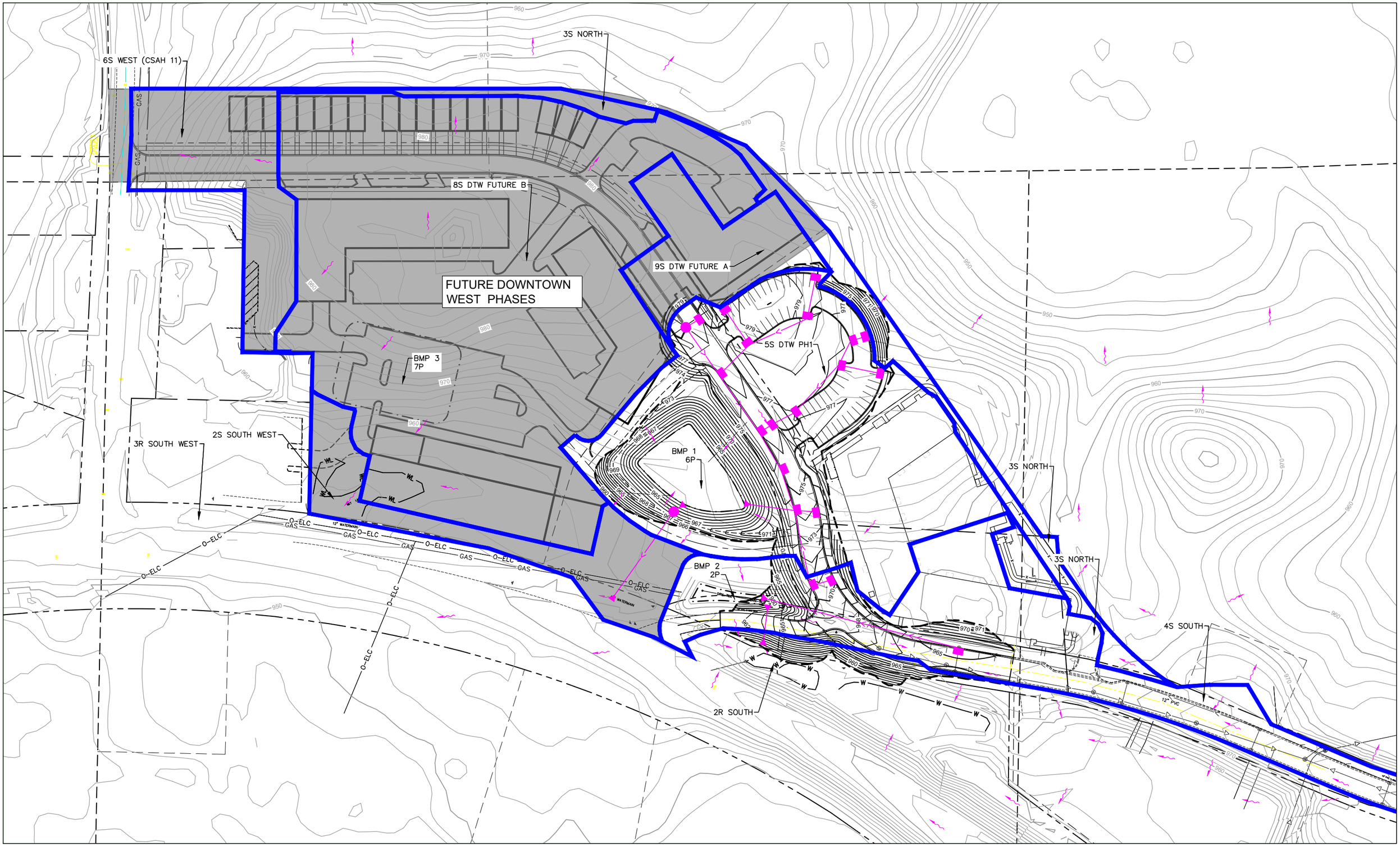
PHASE 1 STORMWATER SYSTEM

SEPTEMBER 16, 2022

NORTH

0 60 120

HORIZONTAL SCALE IN FEET



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CITY OF VICTORIA

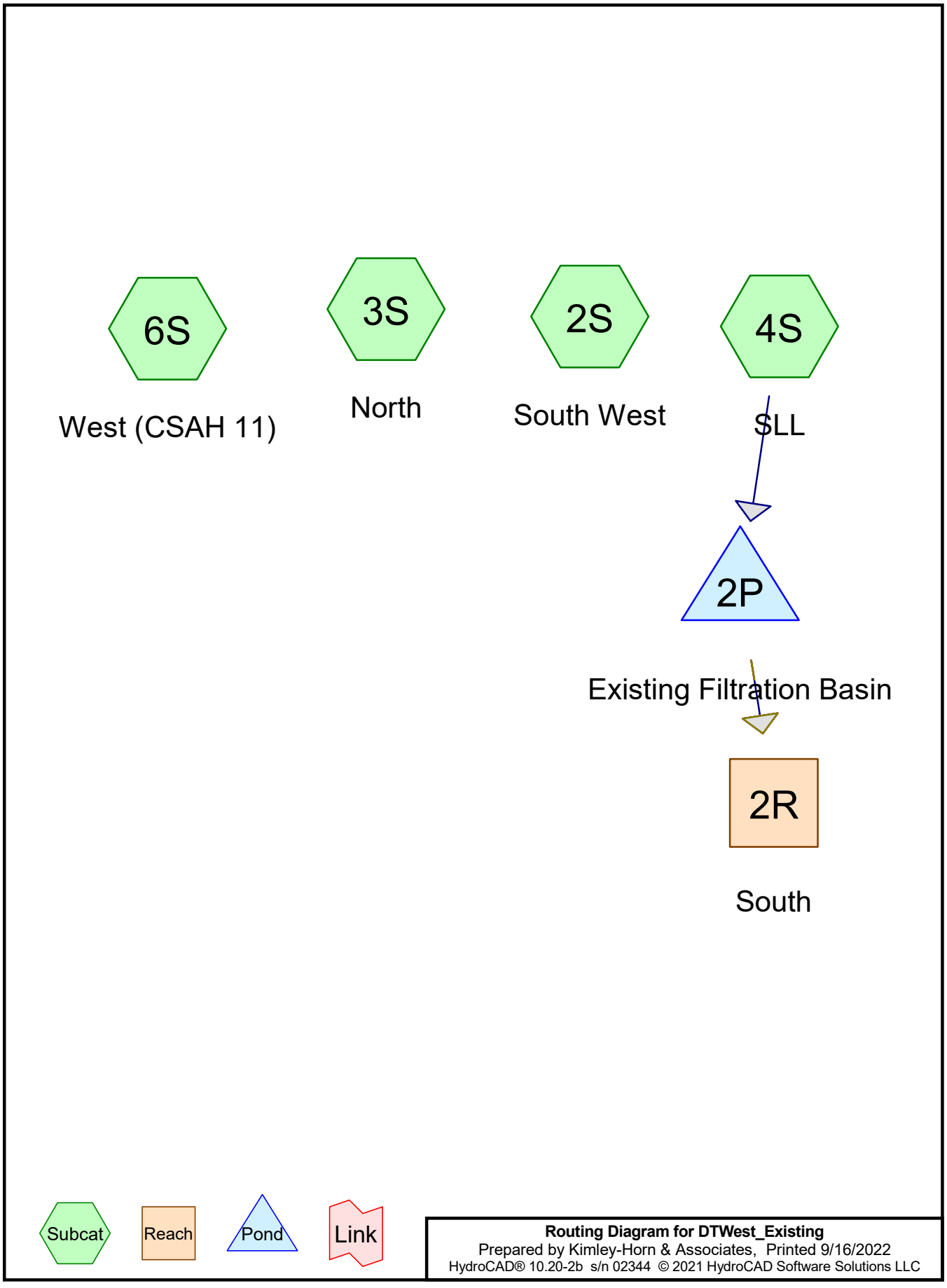
DOWNTOWN WEST INFRASTRUCTURE IMPROVEMENTS
FUTURE PHASES STORMWATER SYSTEM

SEPTEMBER 16, 2022

NORTH

0 60 120

HORIZONTAL SCALE IN FEET



Routing Diagram for DTWest_Existing
Prepared by Kimley-Horn & Associates, Printed 9/16/2022
HydroCAD® 10.20-2b s/n 02344 © 2021 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-Year	MSE 24-hr	3	Default	24.00	1	2.47	2
2	10-Year	MSE 24-hr	3	Default	24.00	1	4.20	2
3	100-Year	MSE 24-hr	3	Default	24.00	1	7.18	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
5.638	84	50-75% Grass cover, Fair, HSG D (3S)
1.063	98	Paved roads w/curbs & sewers, HSG D (4S)
0.476	98	Unconnected pavement, HSG D (2S, 3S, 4S)
9.485	82	Woods/grass comb., Fair, HSG D (2S, 4S, 6S)
16.662	**84**	**TOTAL AREA**

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: South West Runoff Area=6.316 ac 0.71% Impervious Runoff Depth=0.99"
Flow Length=935' Tc=25.4 min CN=82/98 Runoff=5.96 cfs 0.518 af

Subcatchment 3S: North Runoff Area=5.736 ac 1.71% Impervious Runoff Depth=1.11"
Tc=7.0 min CN=84/98 Runoff=11.06 cfs 0.532 af

Subcatchment 4S: SLL Runoff Area=2.899 ac 48.15% Impervious Runoff Depth=1.59"
Tc=7.0 min CN=82/98 Runoff=7.30 cfs 0.383 af

Subcatchment 6S: West (CSAH 11) Runoff Area=1.711 ac 0.00% Impervious Runoff Depth=0.98"
Tc=0.0 min CN=82/0 Runoff=3.50 cfs 0.139 af

Reach 2R: South Inflow=1.75 cfs 0.383 af
Outflow=1.75 cfs 0.383 af

Pond 2P: Existing Filtration Basin Peak Elev=959.59' Storage=0.190 af Inflow=7.30 cfs 0.383 af
Primary=1.67 cfs 0.162 af Secondary=0.08 cfs 0.221 af Tertiary=0.00 cfs 0.000 af Outflow=1.75 cfs 0.383 af

Total Runoff Area = 16.662 ac Runoff Volume = 1.572 af Average Runoff Depth = 1.13"
90.76% Pervious = 15.123 ac 9.24% Impervious = 1.539 ac

Summary for Subcatchment 2S: South West

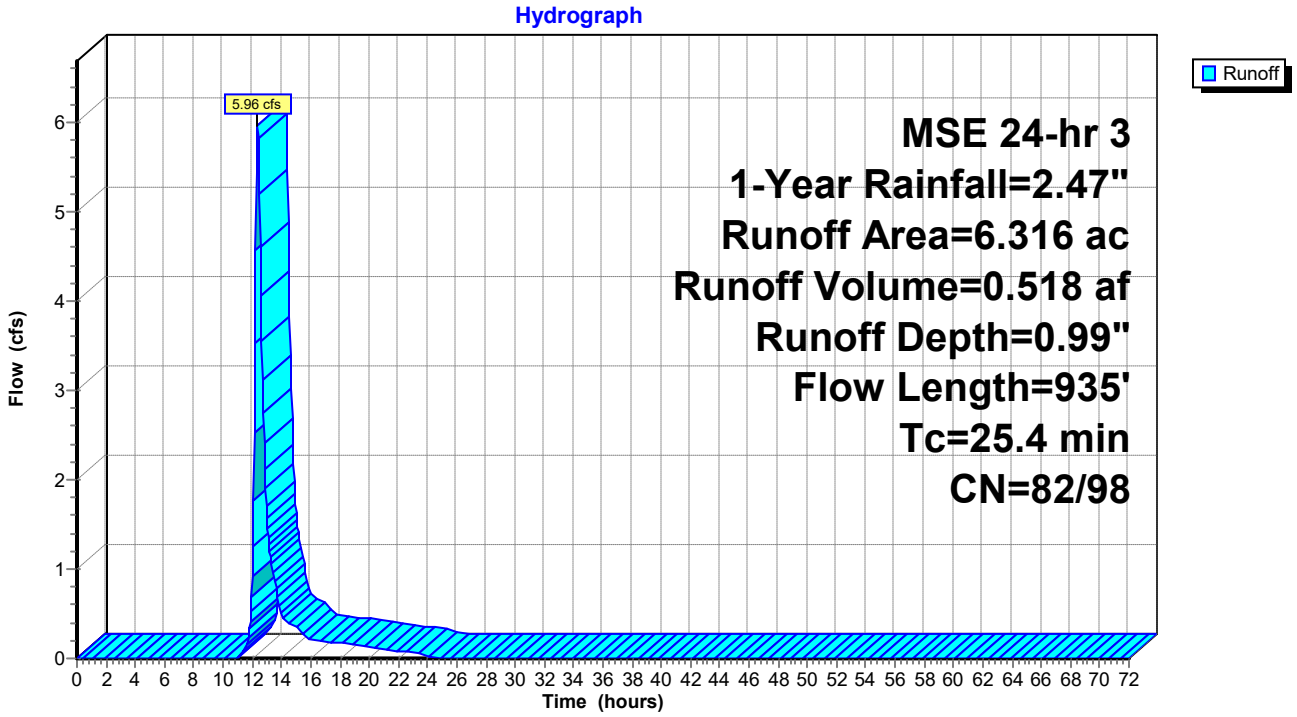
Runoff = 5.96 cfs @ 12.38 hrs, Volume= 0.518 af, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

Area (ac)	CN	Description
6.271	82	Woods/grass comb., Fair, HSG D
0.045	98	Unconnected pavement, HSG D
6.316	82	Weighted Average
6.271	82	99.29% Pervious Area
0.045	98	0.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	80	0.0700	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.80"
3.0	250	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	110	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.7	45	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	90	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.0	220	0.0150	0.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.7	140	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
25.4	935	Total			

Subcatchment 2S: South West



Summary for Subcatchment 3S: North

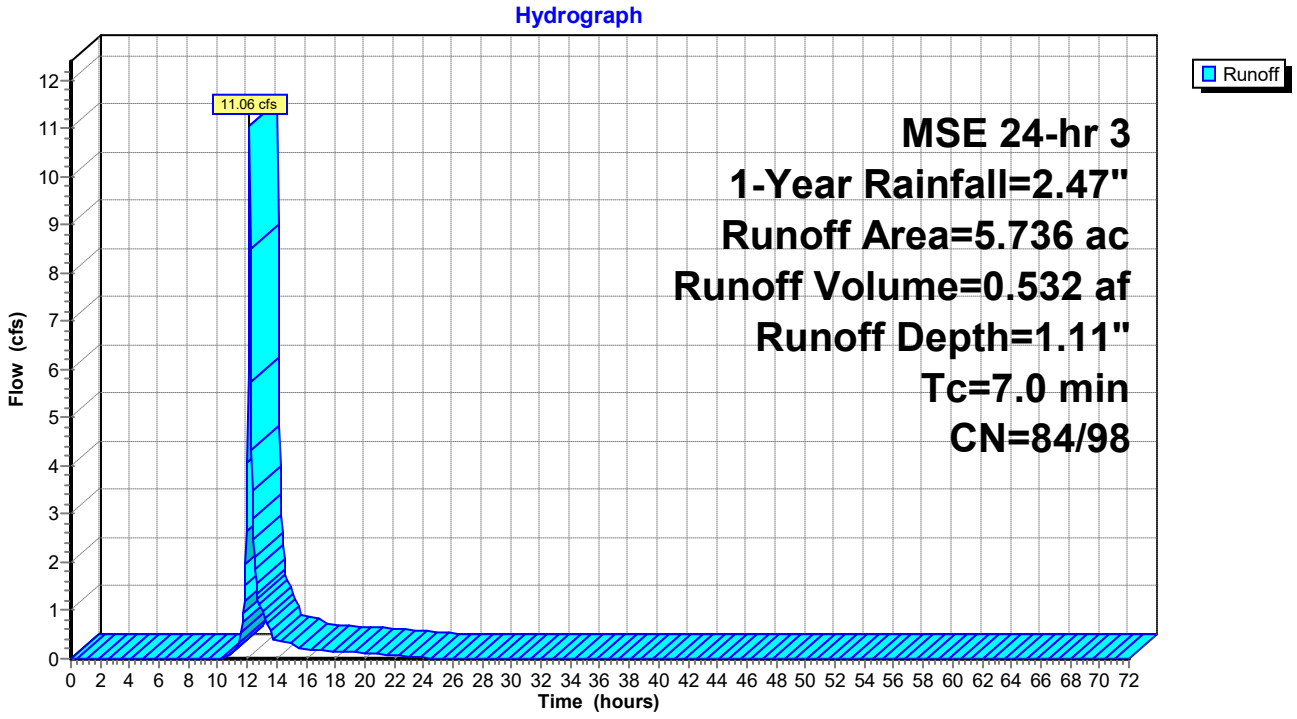
Runoff = 11.06 cfs @ 12.15 hrs, Volume= 0.532 af, Depth= 1.11"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

	Area (ac)	CN	Description
*	5.638	84	50-75% Grass cover, Fair, HSG D
*	0.098	98	Unconnected pavement, HSG D
	5.736	84	Weighted Average
	5.638	84	98.29% Pervious Area
	0.098	98	1.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 3S: North



Summary for Subcatchment 4S: SLL

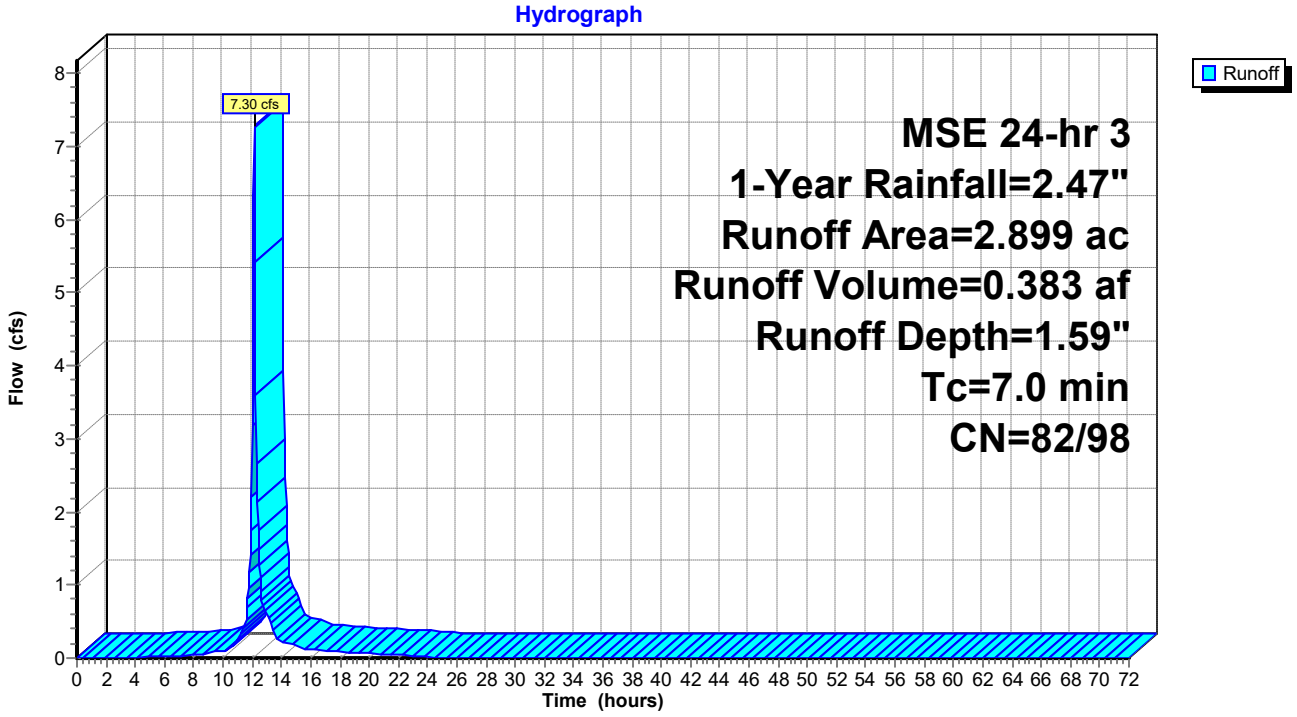
Runoff = 7.30 cfs @ 12.14 hrs, Volume= 0.383 af, Depth= 1.59"
Routed to Pond 2P : Existing Filtration Basin

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

Area (ac)	CN	Description
1.063	98	Paved roads w/curbs & sewers, HSG D
0.220	98	Unconnected pavement, HSG D
0.113	98	Unconnected pavement, HSG D
1.503	82	Woods/grass comb., Fair, HSG D
2.899	90	Weighted Average
1.503	82	51.85% Pervious Area
1.396	98	48.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 4S: SLL



Summary for Subcatchment 6S: West (CSAH 11)

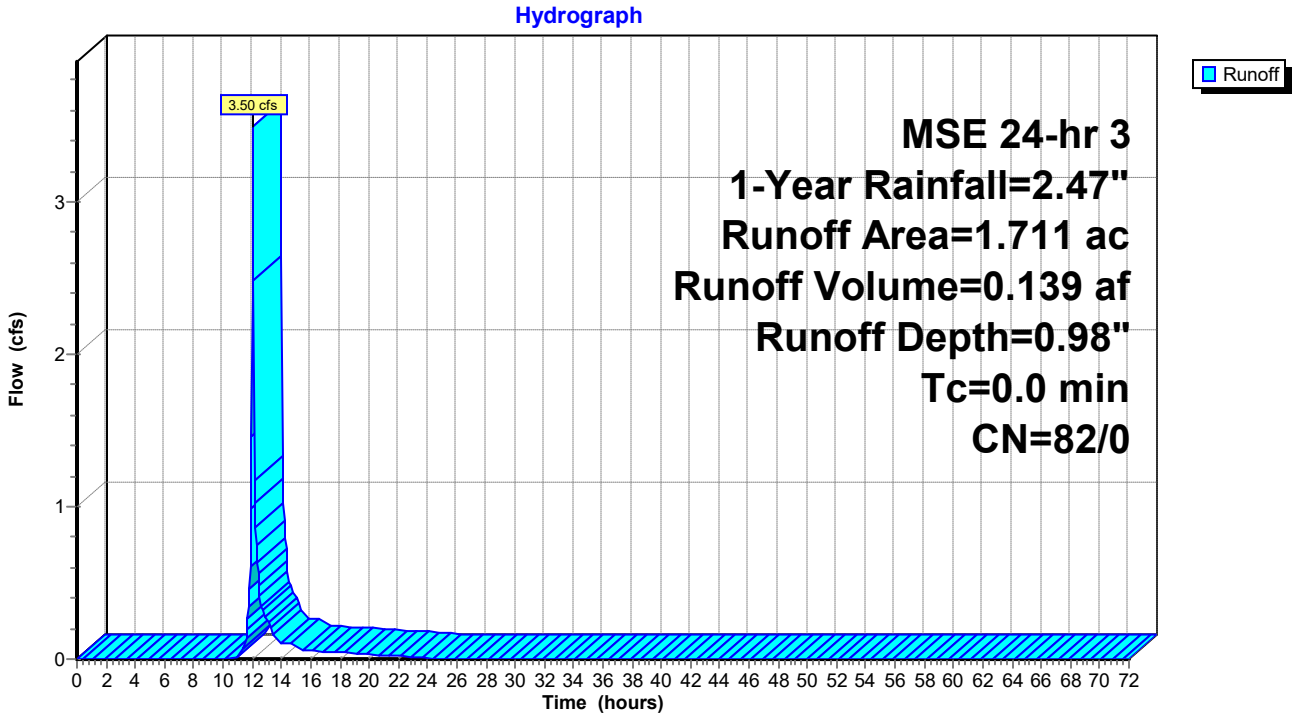
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 3.50 cfs @ 12.05 hrs, Volume= 0.139 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

Area (ac)	CN	Description
1.711	82	Woods/grass comb., Fair, HSG D
1.711	82	100.00% Pervious Area

Subcatchment 6S: West (CSAH 11)



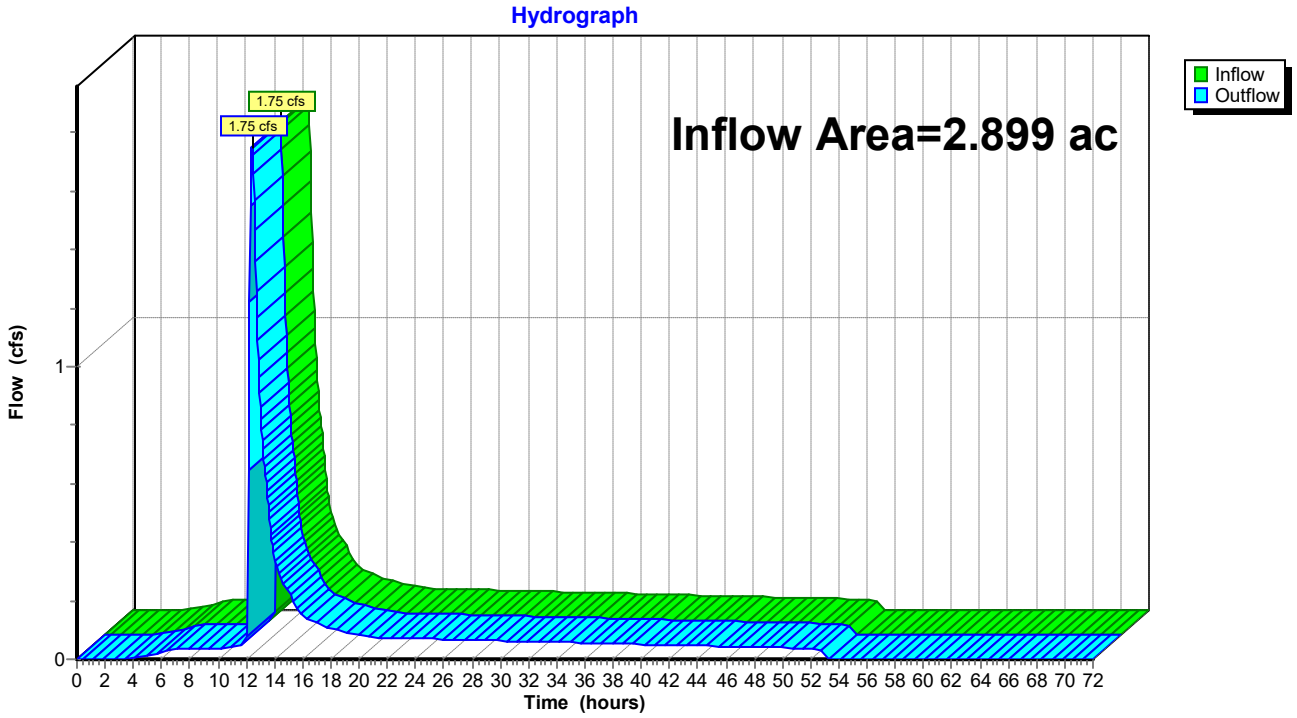
Summary for Reach 2R: South

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.899 ac, 48.15% Impervious, Inflow Depth = 1.59" for 1-Year event
Inflow = 1.75 cfs @ 12.41 hrs, Volume= 0.383 af
Outflow = 1.75 cfs @ 12.41 hrs, Volume= 0.383 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 2R: South



Summary for Pond 2P: Existing Filtration Basin

Inflow Area = 2.899 ac, 48.15% Impervious, Inflow Depth = 1.59" for 1-Year event
Inflow = 7.30 cfs @ 12.14 hrs, Volume= 0.383 af
Outflow = 1.75 cfs @ 12.41 hrs, Volume= 0.383 af, Atten= 76%, Lag= 15.8 min
Primary = 1.67 cfs @ 12.41 hrs, Volume= 0.162 af
Routed to Reach 2R : South
Secondary = 0.08 cfs @ 12.41 hrs, Volume= 0.221 af
Routed to Reach 2R : South
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 2R : South

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 959.59' @ 12.41 hrs Surf.Area= 0.105 ac Storage= 0.190 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 531.1 min (1,308.4 - 777.3)

Volume	Invert	Avail.Storage	Storage Description
#1	957.00'	0.821 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
957.00	0.044	0.000	0.000
958.00	0.066	0.055	0.055
959.00	0.089	0.078	0.133
960.00	0.117	0.103	0.236
961.00	0.148	0.132	0.368
962.00	0.232	0.190	0.558
963.00	0.295	0.263	0.821

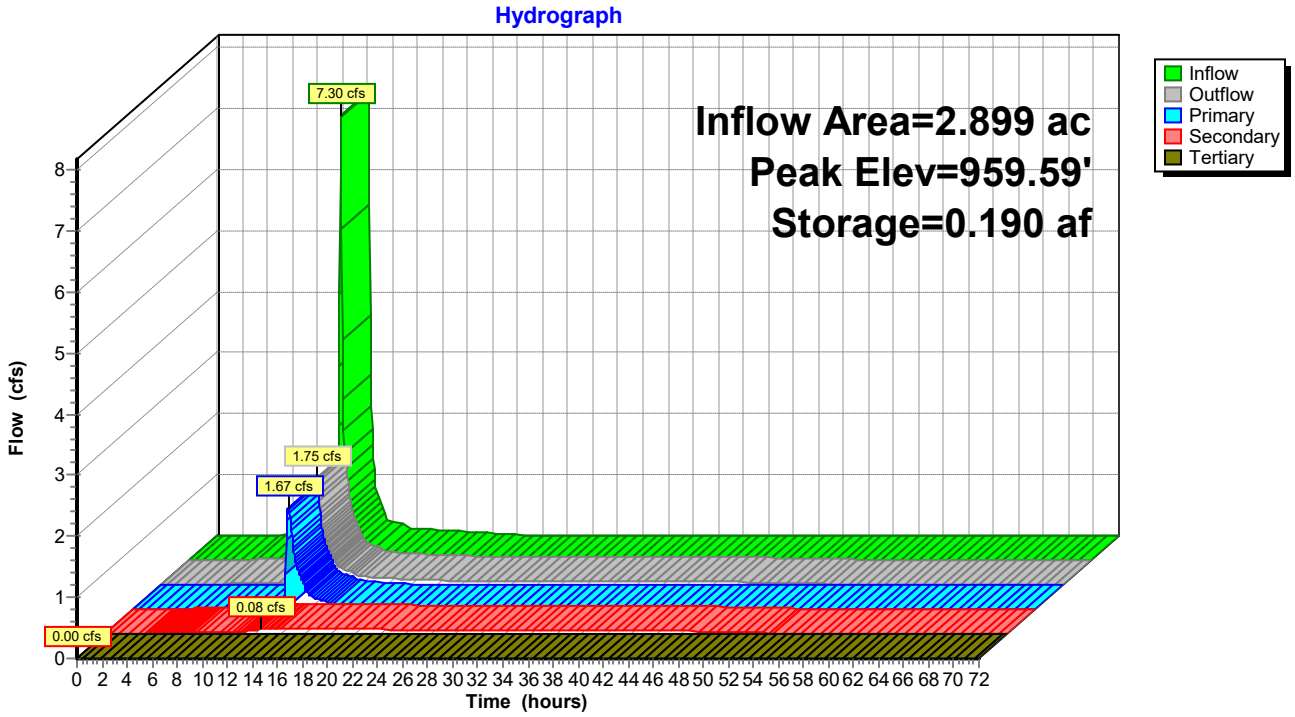
Device	Routing	Invert	Outlet Devices
#1	Device 2	957.00'	**0.800 in/hr Exfiltration over Surface area**
#2	Secondary	955.00'	**6.0" Vert. Draintile** C= 0.600 Limited to weir flow at low heads
#3	Tertiary	961.70'	**50.0' long SLL Overtop** Cv= 2.62 (C= 3.28)
#4	Primary	959.00'	**18.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 959.00' / 957.51' S= 0.0392 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=1.66 cfs @ 12.41 hrs HW=959.59' TW=0.00' (Dynamic Tailwater)
└**4=Culvert** (Inlet Controls 1.66 cfs @ 2.61 fps)

Secondary OutFlow Max=0.08 cfs @ 12.41 hrs HW=959.59' TW=0.00' (Dynamic Tailwater)
└**2=Draintile** (Passes 0.08 cfs of 1.97 cfs potential flow)
└**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=957.00' TW=0.00' (Dynamic Tailwater)
└**3=SLL Overtop** (Controls 0.00 cfs)

Pond 2P: Existing Filtration Basin



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: South West Runoff Area=6.316 ac 0.71% Impervious Runoff Depth=2.39"
Flow Length=935' Tc=25.4 min CN=82/98 Runoff=14.78 cfs 1.256 af

Subcatchment 3S: North Runoff Area=5.736 ac 1.71% Impervious Runoff Depth=2.57"
Tc=7.0 min CN=84/98 Runoff=25.24 cfs 1.230 af

Subcatchment 4S: SLL Runoff Area=2.899 ac 48.15% Impervious Runoff Depth=3.14"
Tc=7.0 min CN=82/98 Runoff=14.36 cfs 0.759 af

Subcatchment 6S: West (CSAH 11) Runoff Area=1.711 ac 0.00% Impervious Runoff Depth=2.37"
Tc=0.0 min CN=82/0 Runoff=8.42 cfs 0.339 af

Reach 2R: South Inflow=7.41 cfs 0.759 af
Outflow=7.41 cfs 0.759 af

Pond 2P: Existing Filtration Basin Peak Elev=960.48' Storage=0.295 af Inflow=14.36 cfs 0.759 af
Primary=7.30 cfs 0.519 af Secondary=0.11 cfs 0.240 af Tertiary=0.00 cfs 0.000 af Outflow=7.41 cfs 0.759 af

Total Runoff Area = 16.662 ac Runoff Volume = 3.583 af Average Runoff Depth = 2.58"
90.76% Pervious = 15.123 ac 9.24% Impervious = 1.539 ac

Summary for Subcatchment 2S: South West

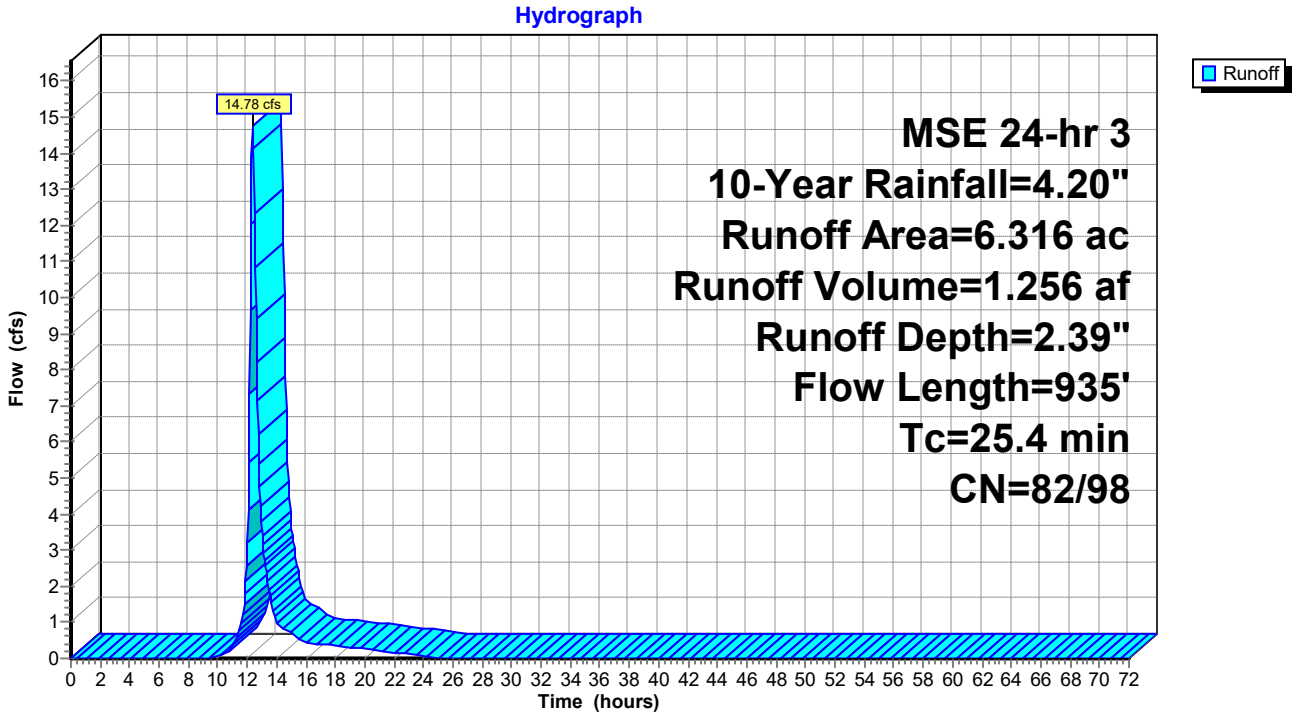
Runoff = 14.78 cfs @ 12.37 hrs, Volume= 1.256 af, Depth= 2.39"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

Area (ac)	CN	Description
6.271	82	Woods/grass comb., Fair, HSG D
0.045	98	Unconnected pavement, HSG D
6.316	82	Weighted Average
6.271	82	99.29% Pervious Area
0.045	98	0.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	80	0.0700	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.80"
3.0	250	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	110	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.7	45	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	90	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.0	220	0.0150	0.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.7	140	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
25.4	935	Total			

Subcatchment 2S: South West



Summary for Subcatchment 3S: North

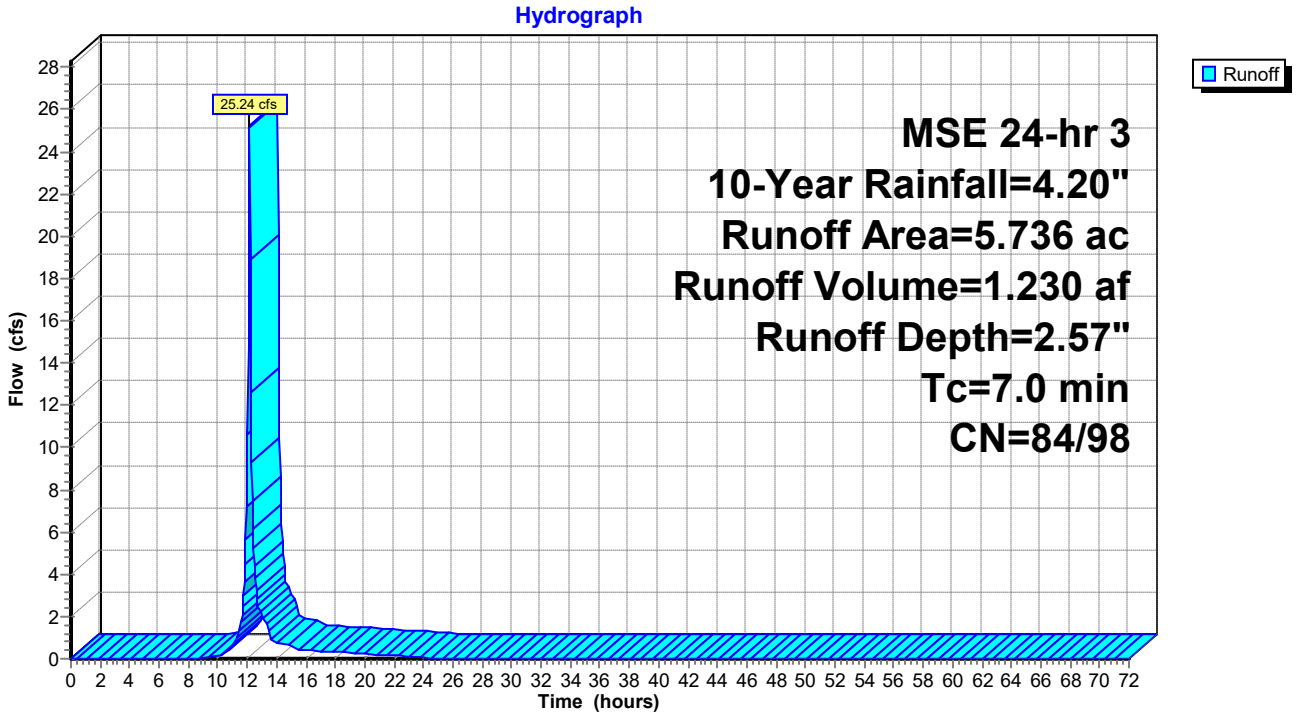
Runoff = 25.24 cfs @ 12.14 hrs, Volume= 1.230 af, Depth= 2.57"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (ac)	CN	Description
*	5.638	84	50-75% Grass cover, Fair, HSG D
*	0.098	98	Unconnected pavement, HSG D
	5.736	84	Weighted Average
	5.638	84	98.29% Pervious Area
	0.098	98	1.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 3S: North



Summary for Subcatchment 4S: SLL

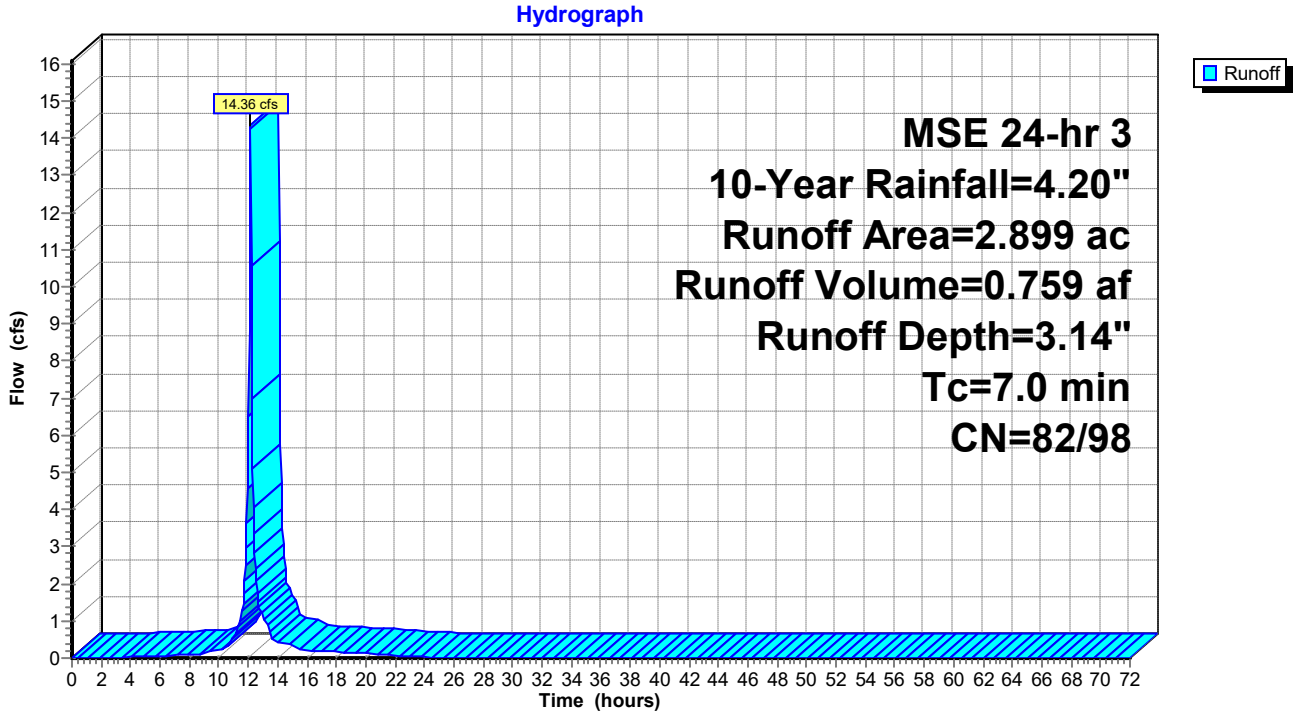
Runoff = 14.36 cfs @ 12.14 hrs, Volume= 0.759 af, Depth= 3.14"
Routed to Pond 2P : Existing Filtration Basin

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

Area (ac)	CN	Description
1.063	98	Paved roads w/curbs & sewers, HSG D
0.220	98	Unconnected pavement, HSG D
0.113	98	Unconnected pavement, HSG D
1.503	82	Woods/grass comb., Fair, HSG D
2.899	90	Weighted Average
1.503	82	51.85% Pervious Area
1.396	98	48.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 4S: SLL



Summary for Subcatchment 6S: West (CSAH 11)

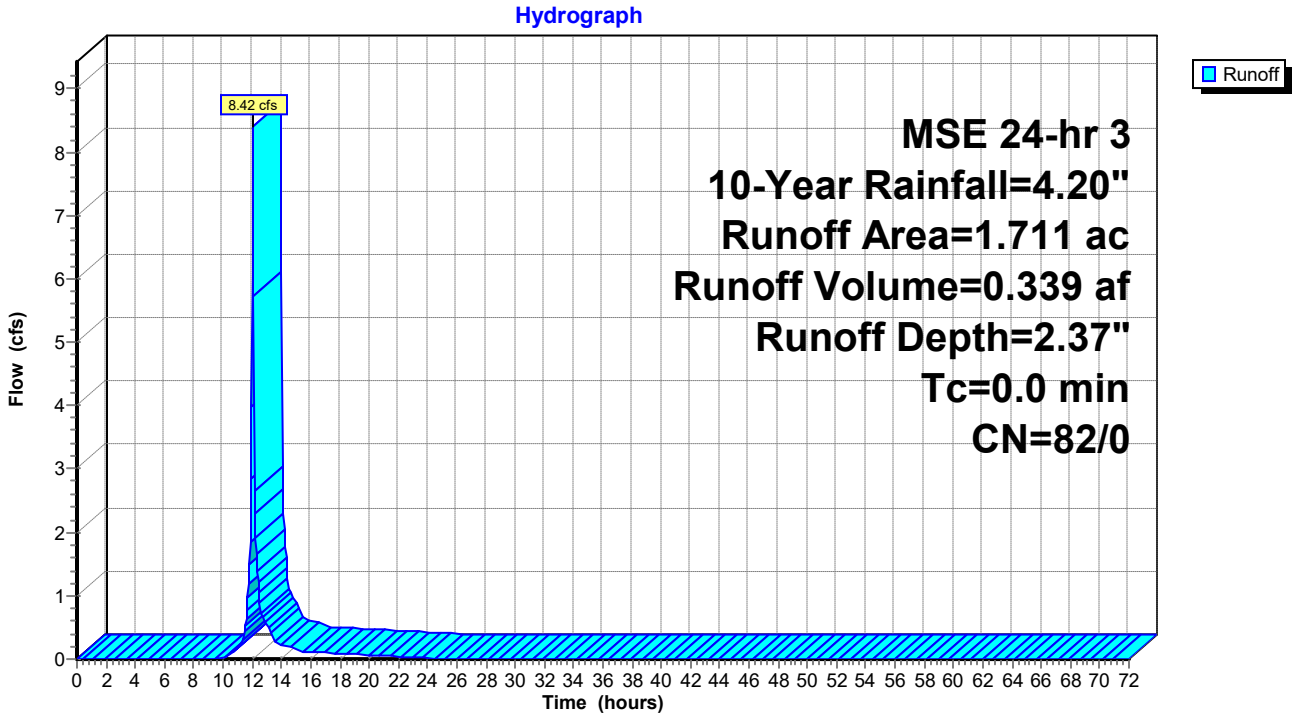
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 8.42 cfs @ 12.05 hrs, Volume= 0.339 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

Area (ac)	CN	Description
1.711	82	Woods/grass comb., Fair, HSG D
1.711	82	100.00% Pervious Area

Subcatchment 6S: West (CSAH 11)



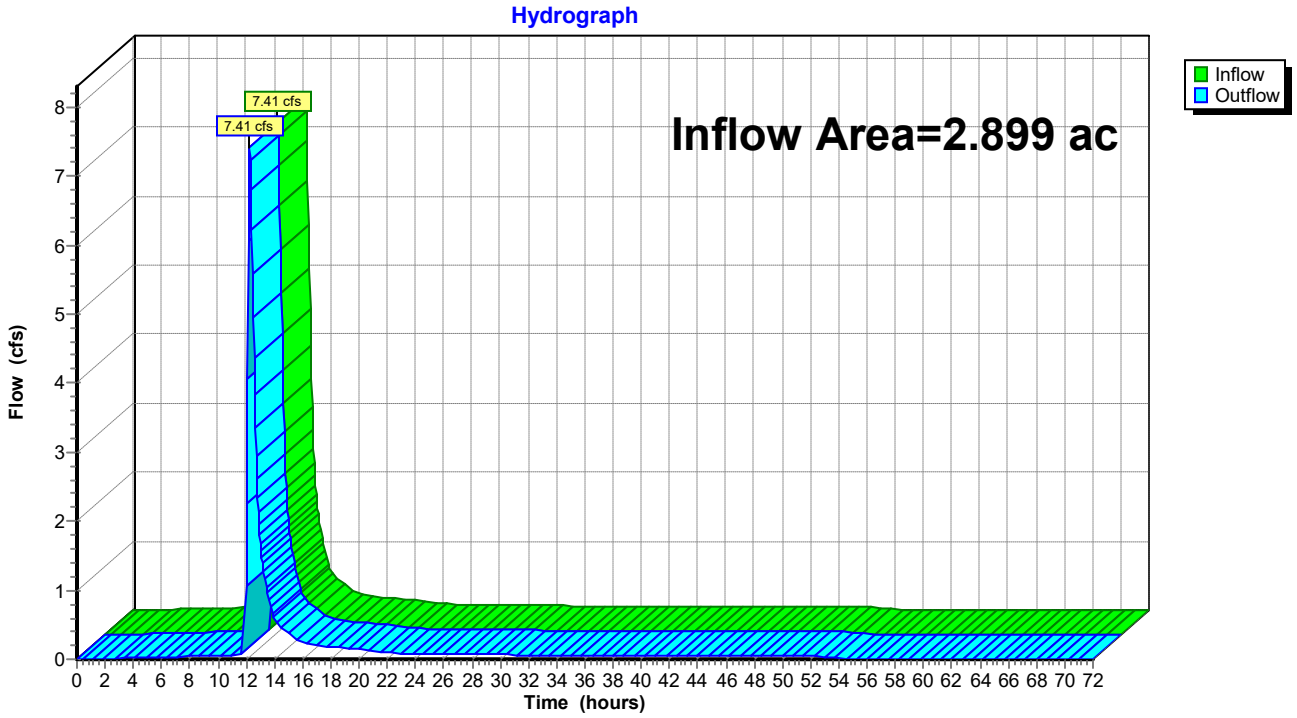
Summary for Reach 2R: South

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.899 ac, 48.15% Impervious, Inflow Depth = 3.14" for 10-Year event
Inflow = 7.41 cfs @ 12.25 hrs, Volume= 0.759 af
Outflow = 7.41 cfs @ 12.25 hrs, Volume= 0.759 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 2R: South



Summary for Pond 2P: Existing Filtration Basin

Inflow Area = 2.899 ac, 48.15% Impervious, Inflow Depth = 3.14" for 10-Year event
Inflow = 14.36 cfs @ 12.14 hrs, Volume= 0.759 af
Outflow = 7.41 cfs @ 12.25 hrs, Volume= 0.759 af, Atten= 48%, Lag= 6.7 min
Primary = 7.30 cfs @ 12.25 hrs, Volume= 0.519 af
Routed to Reach 2R : South
Secondary = 0.11 cfs @ 12.25 hrs, Volume= 0.240 af
Routed to Reach 2R : South
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 2R : South

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 960.48' @ 12.25 hrs Surf.Area= 0.132 ac Storage= 0.295 af

Plug-Flow detention time= 301.0 min calculated for 0.758 af (100% of inflow)
Center-of-Mass det. time= 302.1 min (1,071.5 - 769.4)

Volume	Invert	Avail.Storage	Storage Description
#1	957.00'	0.821 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
957.00	0.044	0.000	0.000
958.00	0.066	0.055	0.055
959.00	0.089	0.078	0.133
960.00	0.117	0.103	0.236
961.00	0.148	0.132	0.368
962.00	0.232	0.190	0.558
963.00	0.295	0.263	0.821

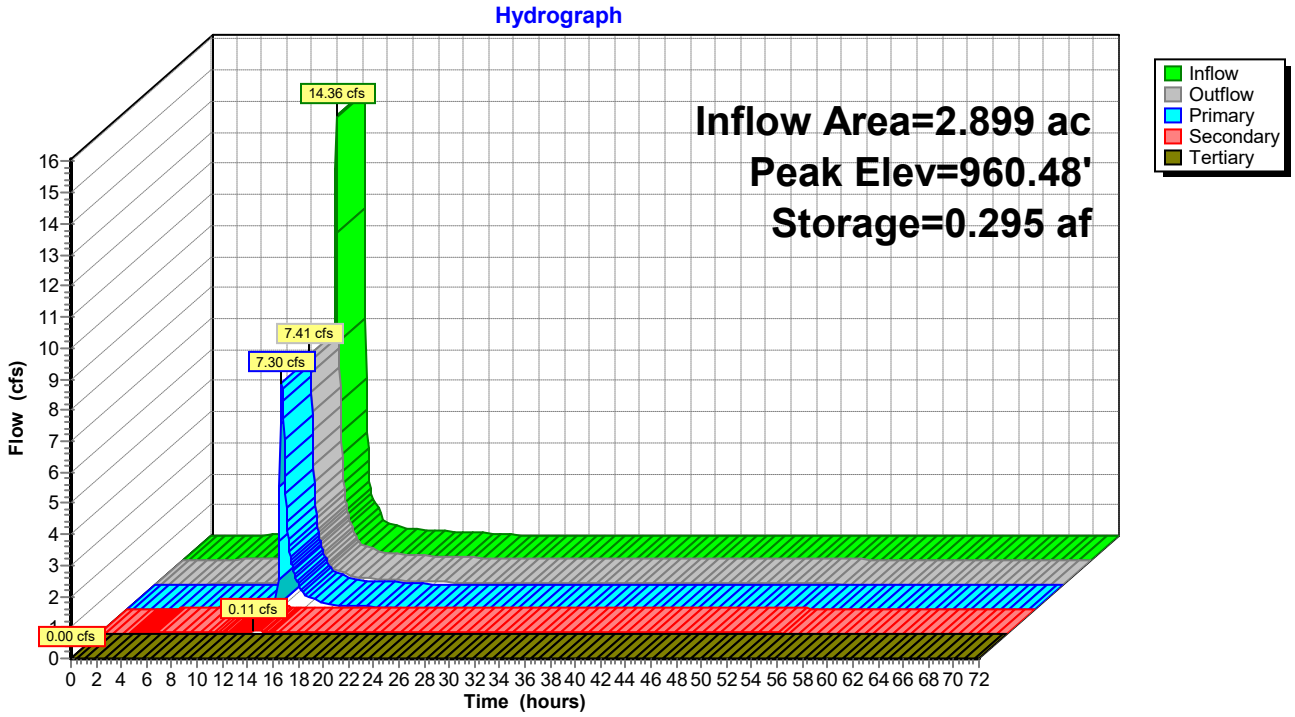
Device	Routing	Invert	Outlet Devices
#1	Device 2	957.00'	**0.800 in/hr Exfiltration over Surface area**
#2	Secondary	955.00'	**6.0" Vert. Draintile** C= 0.600 Limited to weir flow at low heads
#3	Tertiary	961.70'	**50.0' long SLL Overtop** Cv= 2.62 (C= 3.28)
#4	Primary	959.00'	**18.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 959.00' / 957.51' S= 0.0392 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=7.30 cfs @ 12.25 hrs HW=960.48' TW=0.00' (Dynamic Tailwater)
└**4=Culvert** (Inlet Controls 7.30 cfs @ 4.14 fps)

Secondary OutFlow Max=0.11 cfs @ 12.25 hrs HW=960.48' TW=0.00' (Dynamic Tailwater)
└**2=Draintile** (Passes 0.11 cfs of 2.16 cfs potential flow)
└**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=957.00' TW=0.00' (Dynamic Tailwater)
└**3=SLL Overtop** (Controls 0.00 cfs)

Pond 2P: Existing Filtration Basin



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: South West Runoff Area=6.316 ac 0.71% Impervious Runoff Depth=5.10"
Flow Length=935' Tc=25.4 min CN=82/98 Runoff=31.13 cfs 2.683 af

Subcatchment 3S: North Runoff Area=5.736 ac 1.71% Impervious Runoff Depth=5.34"
Tc=7.0 min CN=84/98 Runoff=50.59 cfs 2.552 af

Subcatchment 4S: SLL Runoff Area=2.899 ac 48.15% Impervious Runoff Depth=5.98"
Tc=7.0 min CN=82/98 Runoff=26.87 cfs 1.444 af

Subcatchment 6S: West (CSAH 11) Runoff Area=1.711 ac 0.00% Impervious Runoff Depth=5.09"
Tc=0.0 min CN=82/0 Runoff=17.36 cfs 0.725 af

Reach 2R: South Inflow=11.90 cfs 1.444 af
Outflow=11.90 cfs 1.444 af

Pond 2P: Existing Filtration Basin Peak Elev=961.65' Storage=0.482 af Inflow=26.87 cfs 1.444 af
Primary=11.74 cfs 1.186 af Secondary=0.16 cfs 0.258 af Tertiary=0.00 cfs 0.000 af Outflow=11.90 cfs 1.444 af

Total Runoff Area = 16.662 ac Runoff Volume = 7.405 af Average Runoff Depth = 5.33"
90.76% Pervious = 15.123 ac 9.24% Impervious = 1.539 ac

Summary for Subcatchment 2S: South West

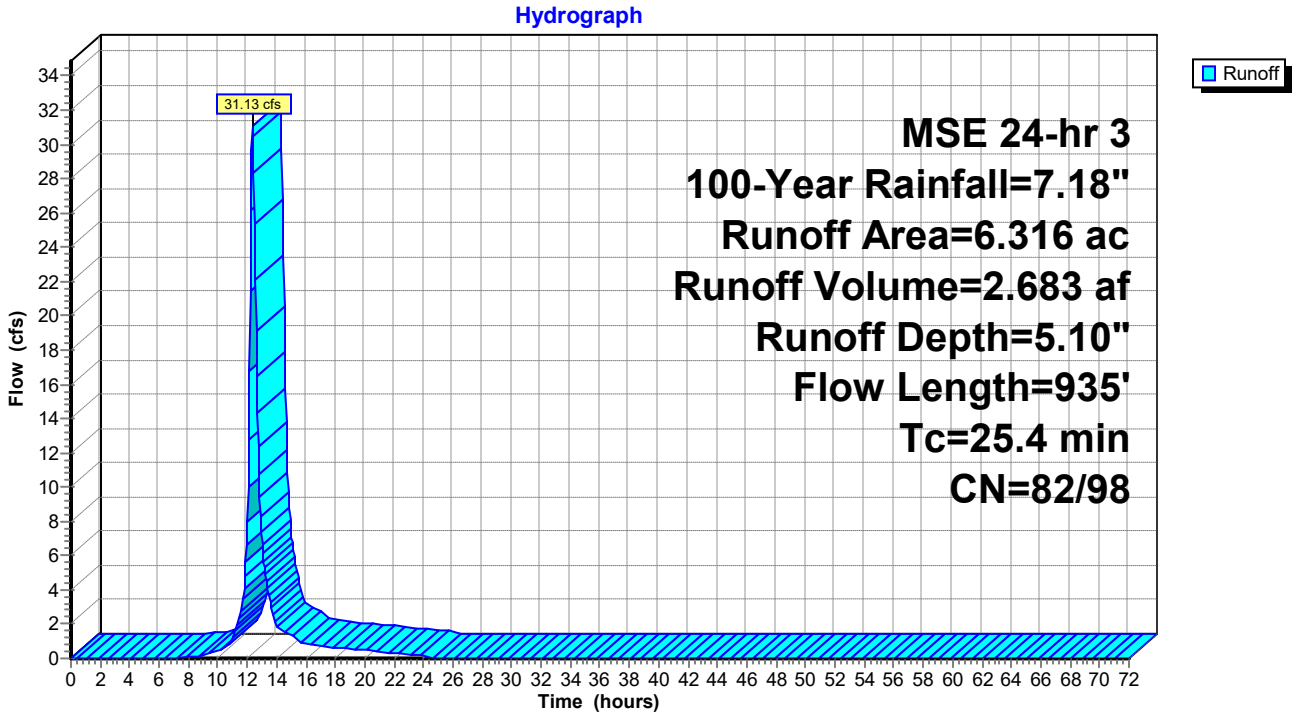
Runoff = 31.13 cfs @ 12.36 hrs, Volume= 2.683 af, Depth= 5.10"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

Area (ac)	CN	Description
6.271	82	Woods/grass comb., Fair, HSG D
0.045	98	Unconnected pavement, HSG D
6.316	82	Weighted Average
6.271	82	99.29% Pervious Area
0.045	98	0.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	80	0.0700	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.80"
3.0	250	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	110	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.7	45	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	90	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.0	220	0.0150	0.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.7	140	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
25.4	935	Total			

Subcatchment 2S: South West



Summary for Subcatchment 3S: North

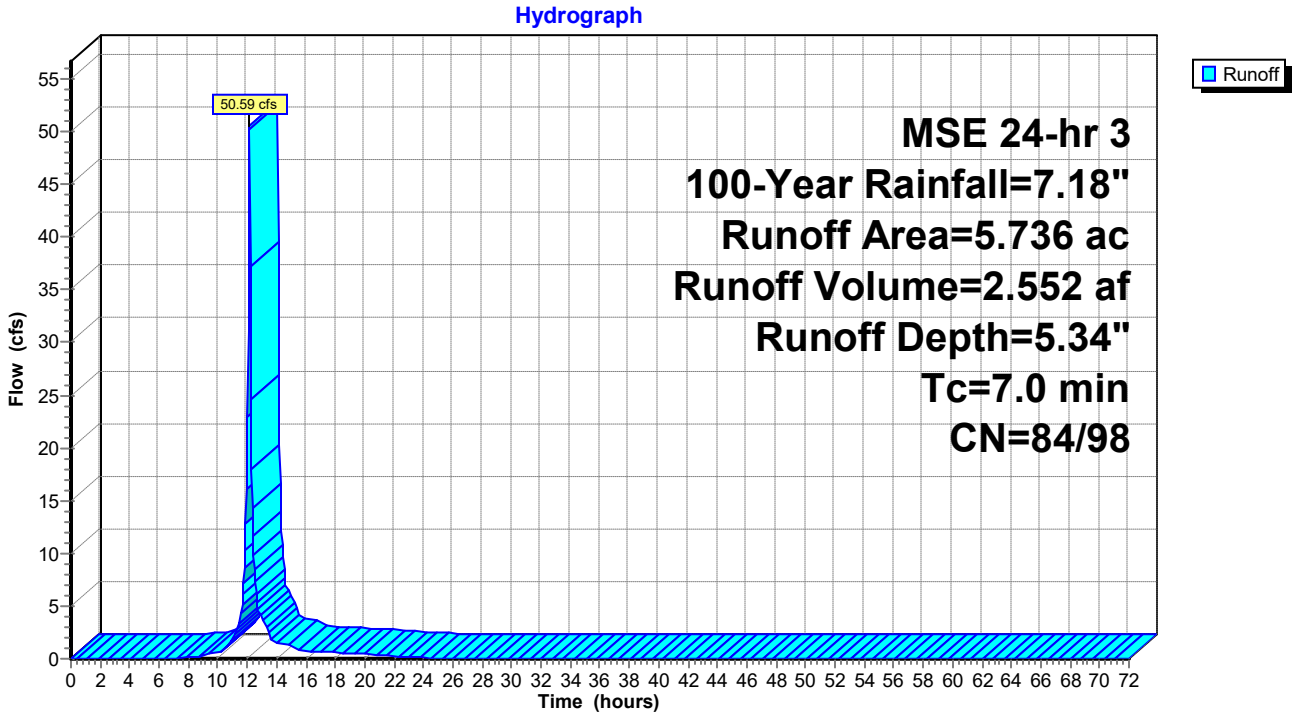
Runoff = 50.59 cfs @ 12.14 hrs, Volume= 2.552 af, Depth= 5.34"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

	Area (ac)	CN	Description
*	5.638	84	50-75% Grass cover, Fair, HSG D
*	0.098	98	Unconnected pavement, HSG D
	5.736	84	Weighted Average
	5.638	84	98.29% Pervious Area
	0.098	98	1.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 3S: North



Summary for Subcatchment 4S: SLL

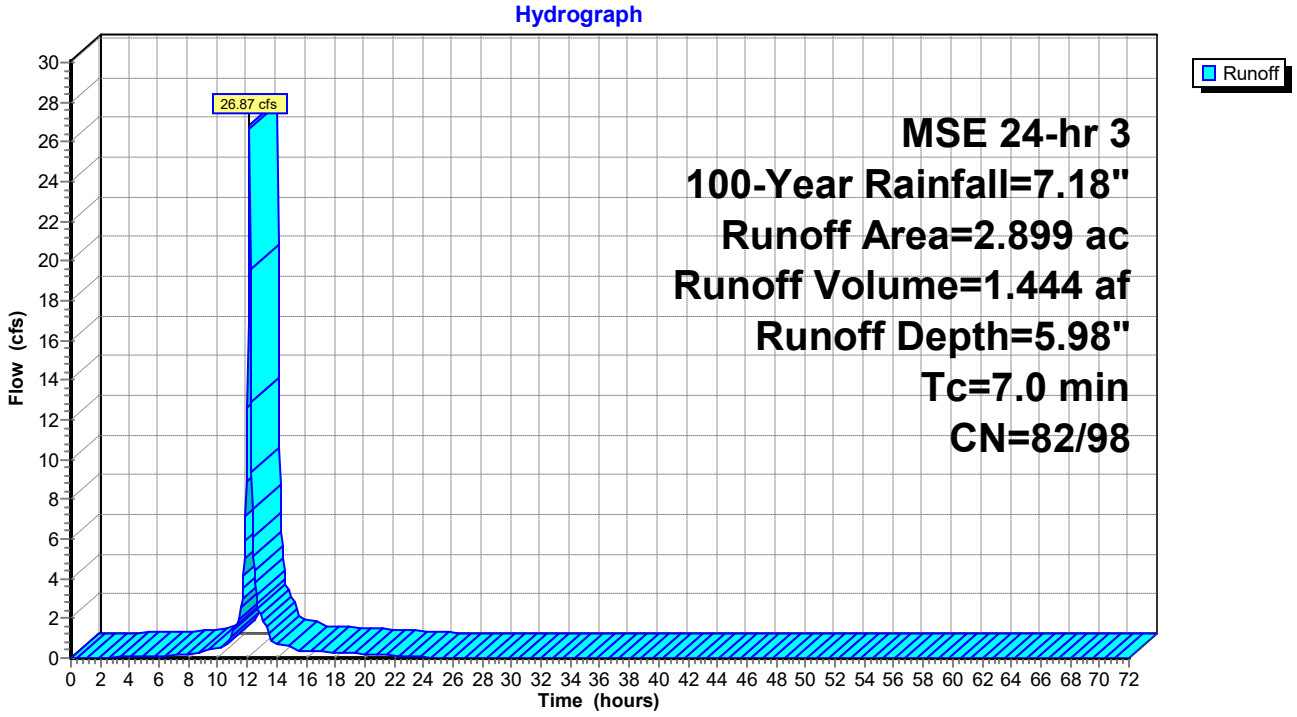
Runoff = 26.87 cfs @ 12.14 hrs, Volume= 1.444 af, Depth= 5.98"
Routed to Pond 2P : Existing Filtration Basin

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

Area (ac)	CN	Description
1.063	98	Paved roads w/curbs & sewers, HSG D
0.220	98	Unconnected pavement, HSG D
0.113	98	Unconnected pavement, HSG D
1.503	82	Woods/grass comb., Fair, HSG D
2.899	90	Weighted Average
1.503	82	51.85% Pervious Area
1.396	98	48.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 4S: SLL



Summary for Subcatchment 6S: West (CSAH 11)

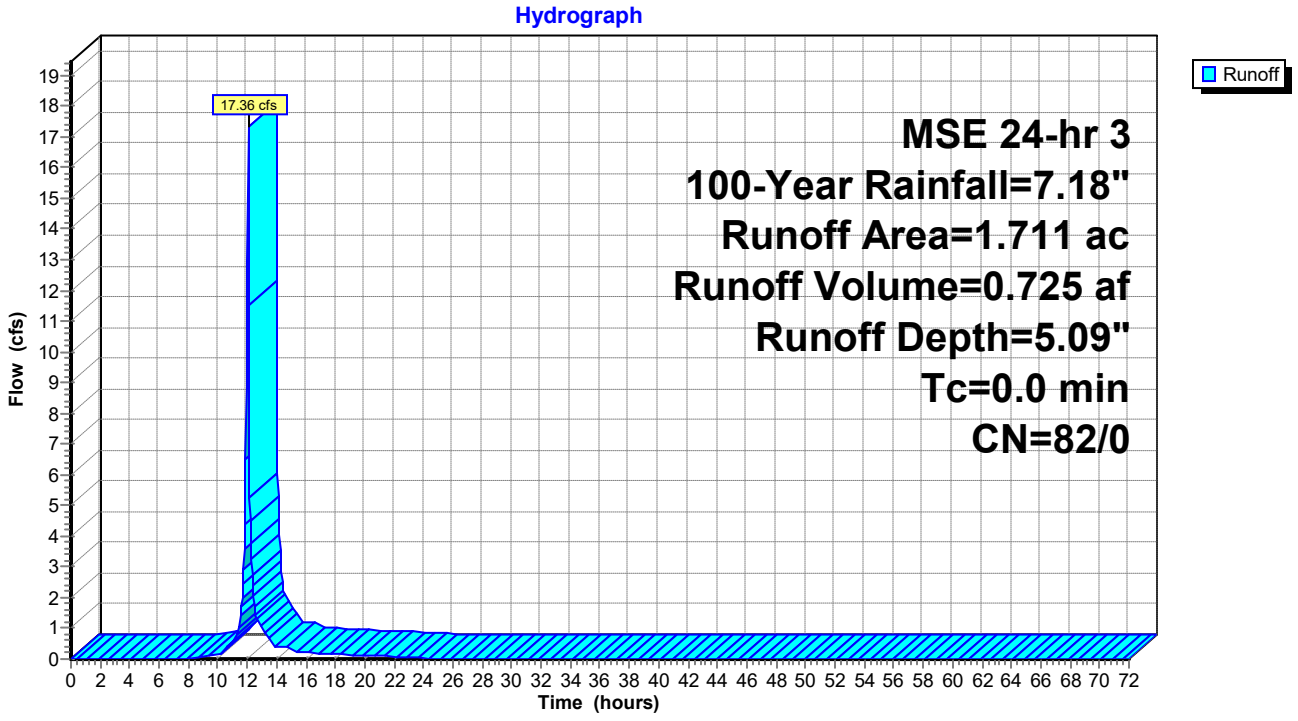
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 17.36 cfs @ 12.05 hrs, Volume= 0.725 af, Depth= 5.09"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

Area (ac)	CN	Description
1.711	82	Woods/grass comb., Fair, HSG D
1.711	82	100.00% Pervious Area

Subcatchment 6S: West (CSAH 11)



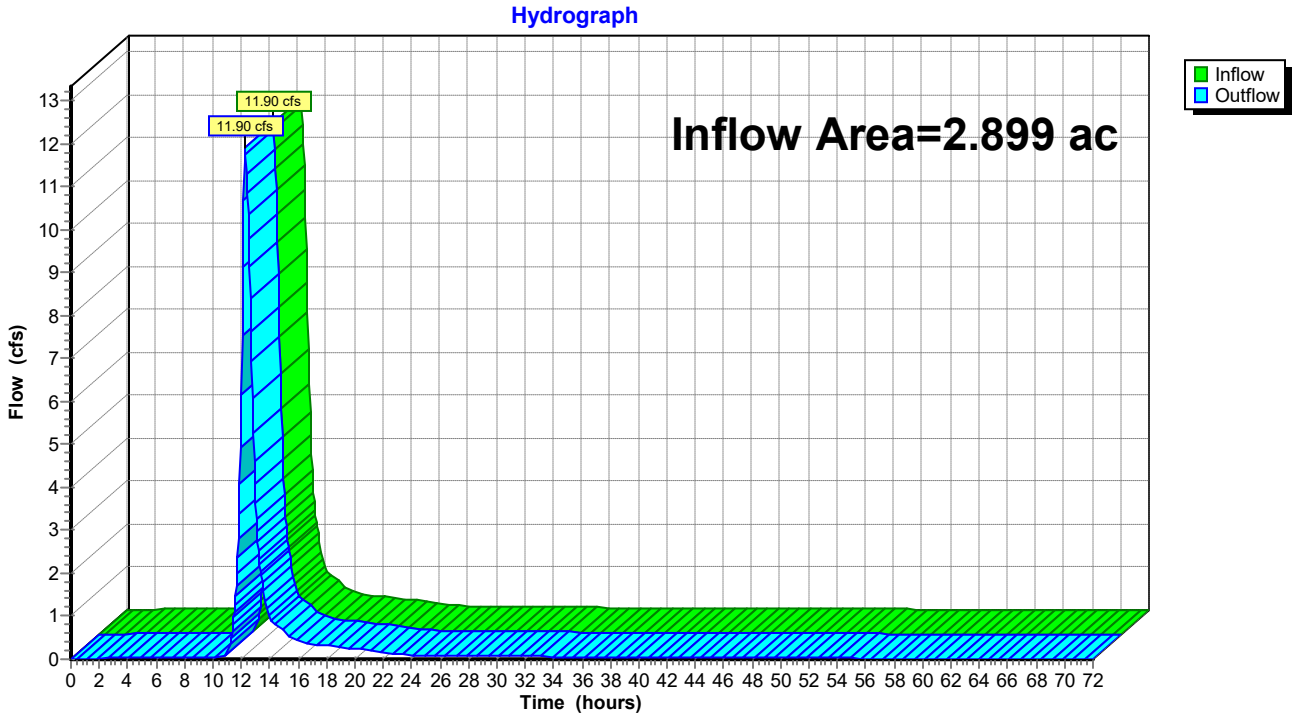
Summary for Reach 2R: South

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.899 ac, 48.15% Impervious, Inflow Depth = 5.98" for 100-Year event
Inflow = 11.90 cfs @ 12.27 hrs, Volume= 1.444 af
Outflow = 11.90 cfs @ 12.27 hrs, Volume= 1.444 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 2R: South



Summary for Pond 2P: Existing Filtration Basin

Inflow Area = 2.899 ac, 48.15% Impervious, Inflow Depth = 5.98" for 100-Year event
Inflow = 26.87 cfs @ 12.14 hrs, Volume= 1.444 af
Outflow = 11.90 cfs @ 12.27 hrs, Volume= 1.444 af, Atten= 56%, Lag= 7.7 min
Primary = 11.74 cfs @ 12.27 hrs, Volume= 1.186 af
Routed to Reach 2R : South
Secondary = 0.16 cfs @ 12.27 hrs, Volume= 0.258 af
Routed to Reach 2R : South
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 2R : South

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 961.65' @ 12.27 hrs Surf.Area= 0.202 ac Storage= 0.482 af

Plug-Flow detention time= 180.9 min calculated for 1.443 af (100% of inflow)
Center-of-Mass det. time= 182.1 min (943.6 - 761.5)

Volume	Invert	Avail.Storage	Storage Description
#1	957.00'	0.821 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
957.00	0.044	0.000	0.000
958.00	0.066	0.055	0.055
959.00	0.089	0.078	0.133
960.00	0.117	0.103	0.236
961.00	0.148	0.132	0.368
962.00	0.232	0.190	0.558
963.00	0.295	0.263	0.821

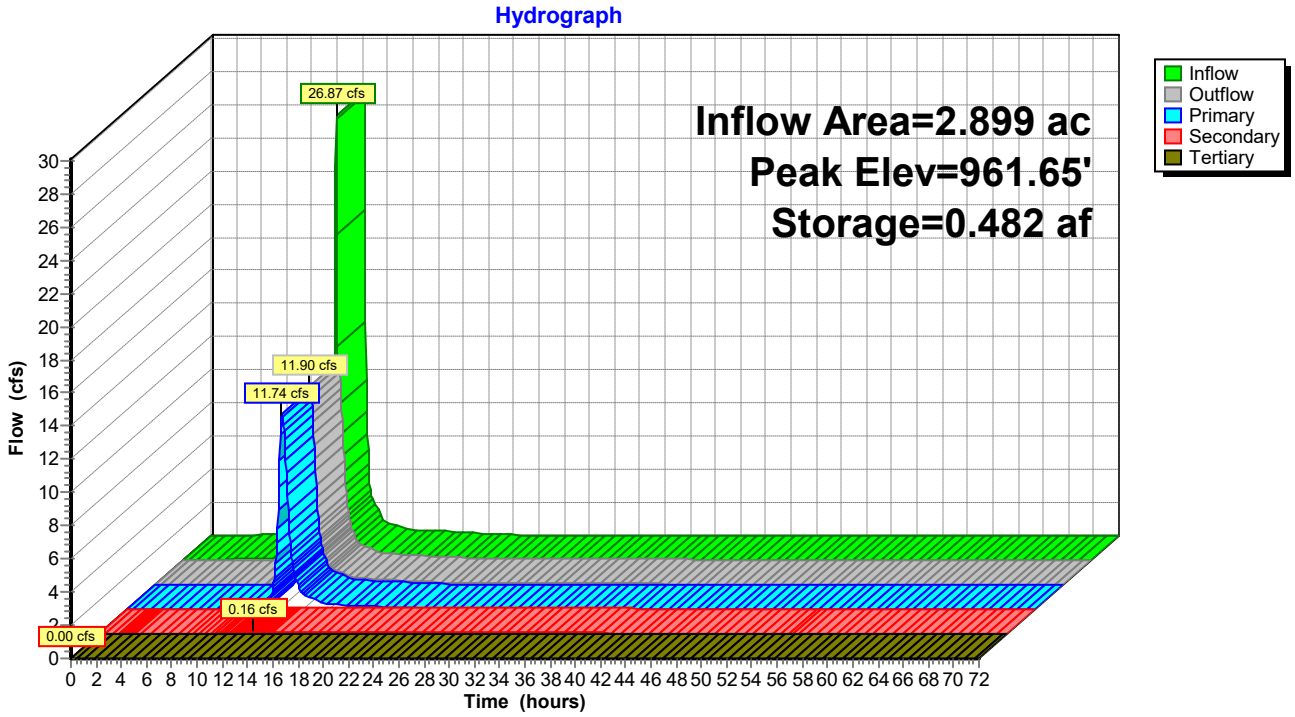
Device	Routing	Invert	Outlet Devices
#1	Device 2	957.00'	**0.800 in/hr Exfiltration over Surface area**
#2	Secondary	955.00'	**6.0" Vert. Draintile** C= 0.600 Limited to weir flow at low heads
#3	Tertiary	961.70'	**50.0' long SLL Overtop** Cv= 2.62 (C= 3.28)
#4	Primary	959.00'	**18.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 959.00' / 957.51' S= 0.0392 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

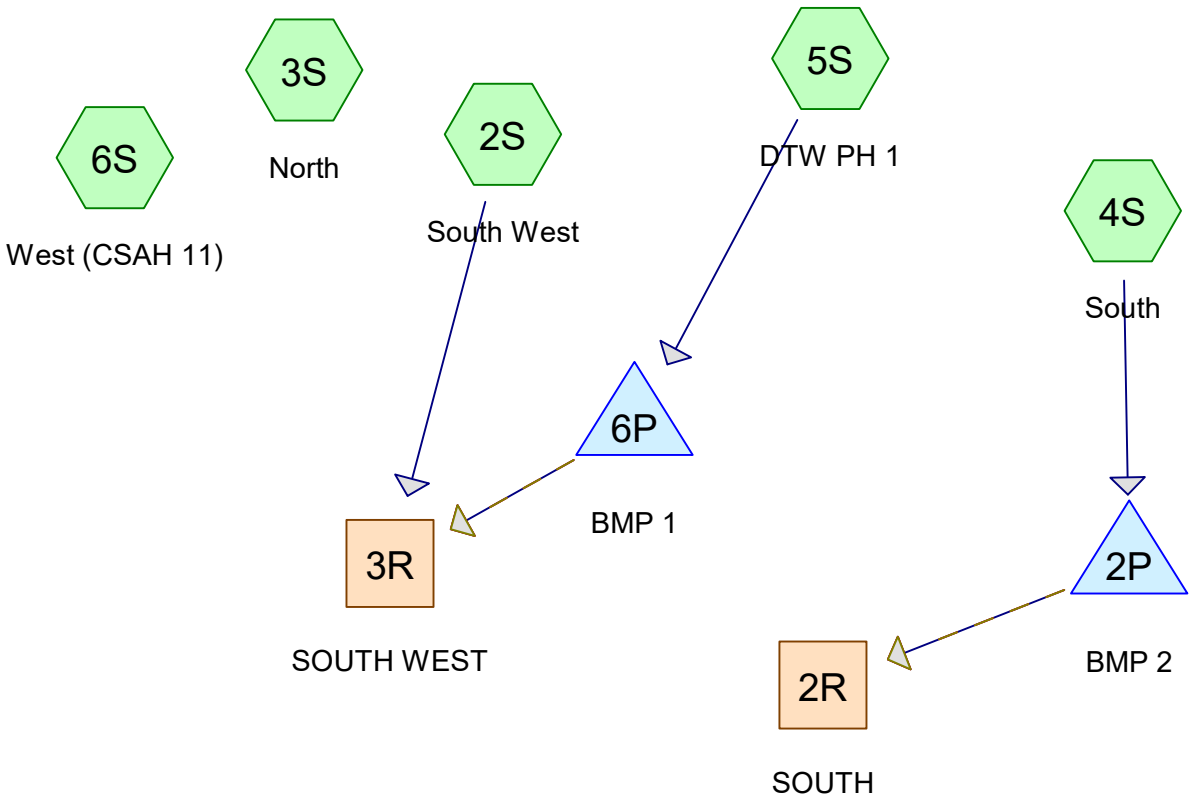
Primary OutFlow Max=11.70 cfs @ 12.27 hrs HW=961.64' TW=0.00' (Dynamic Tailwater)
└**4=Culvert** (Inlet Controls 11.70 cfs @ 6.62 fps)

Secondary OutFlow Max=0.16 cfs @ 12.27 hrs HW=961.64' TW=0.00' (Dynamic Tailwater)
└**2=Draintile** (Passes 0.16 cfs of 2.39 cfs potential flow)
└**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=957.00' TW=0.00' (Dynamic Tailwater)
└**3=SLL Overtop** (Controls 0.00 cfs)

Pond 2P: Existing Filtration Basin





Subcat Reach Pond Link

Routing Diagram for DTWest_Proposed-Phase1
Prepared by Kimley-Horn & Associates, Printed 9/16/2022
HydroCAD® 10.20-2b s/n 02344 © 2021 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-Year	MSE 24-hr	3	Default	24.00	1	2.47	2
2	10-Year	MSE 24-hr	3	Default	24.00	1	4.20	2
3	100-Year	MSE 24-hr	3	Default	24.00	1	7.18	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.943	84	50-75% Grass cover, Fair, HSG D (3S)
6.725	80	>75% Grass cover, Good, HSG D (2S, 4S, 5S)
1.018	98	Existing Stieger Lake Lane (4S)
1.456	98	Marco McLane Development (4S, 5S)
1.437	98	Paved roads w/curbs & sewers, HSG D (5S)
0.371	98	Proposed Stieger Lake Lane (4S)
1.710	82	Woods/grass comb., Fair, HSG D (6S)
16.660	**86**	**TOTAL AREA**

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: South West Runoff Area=3.843 ac 0.00% Impervious Runoff Depth=0.87"
Flow Length=935' Tc=25.4 min CN=80/0 Runoff=3.15 cfs 0.278 af

Subcatchment 3S: North Runoff Area=3.943 ac 0.00% Impervious Runoff Depth=1.09"
Tc=7.0 min CN=84/0 Runoff=7.51 cfs 0.359 af

Subcatchment 4S: South Runoff Area=2.573 ac 68.99% Impervious Runoff Depth=1.82"
Tc=12.0 min CN=80/98 Runoff=6.03 cfs 0.389 af

Subcatchment 5S: DTW PH 1 Runoff Area=4.591 ac 54.61% Impervious Runoff Depth=1.62"
Tc=12.0 min CN=80/98 Runoff=9.66 cfs 0.619 af

Subcatchment 6S: West (CSAH 11) Runoff Area=1.710 ac 0.00% Impervious Runoff Depth=0.98"
Tc=12.0 min CN=82/0 Runoff=2.36 cfs 0.139 af

Reach 2R: SOUTH Inflow=3.16 cfs 0.389 af
Outflow=3.16 cfs 0.389 af

Reach 3R: SOUTH WEST Inflow=3.38 cfs 0.897 af
Outflow=3.38 cfs 0.897 af

Pond 2P: BMP 2 Peak Elev=959.83' Storage=0.167 af Inflow=6.03 cfs 0.389 af
Primary=3.08 cfs 0.217 af Secondary=0.08 cfs 0.172 af Tertiary=0.00 cfs 0.000 af Outflow=3.16 cfs 0.389 af

Pond 6P: BMP 1 Peak Elev=963.52' Storage=0.408 af Inflow=9.66 cfs 0.619 af
Primary=0.24 cfs 0.619 af Secondary=0.00 cfs 0.000 af Outflow=0.24 cfs 0.619 af

Total Runoff Area = 16.660 ac Runoff Volume = 1.784 af Average Runoff Depth = 1.29"
74.30% Pervious = 12.378 ac 25.70% Impervious = 4.282 ac

Summary for Subcatchment 2S: South West

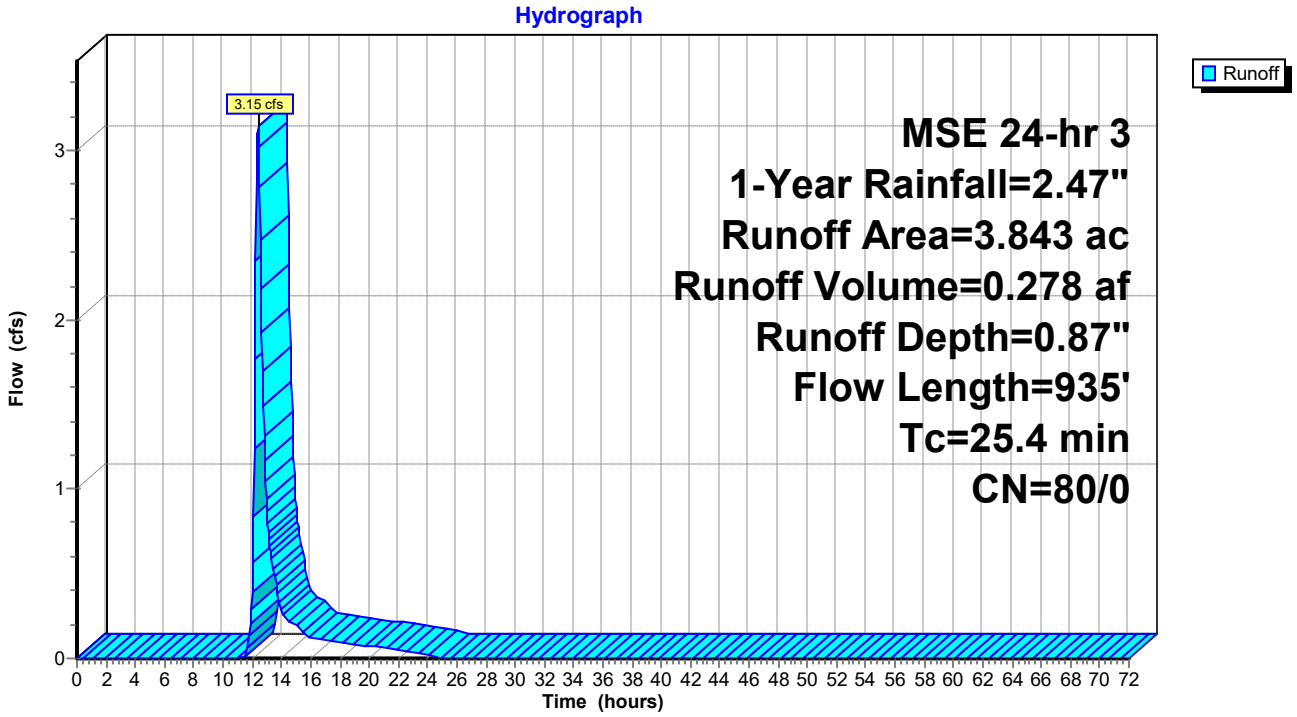
Runoff = 3.15 cfs @ 12.39 hrs, Volume= 0.278 af, Depth= 0.87"
Routed to Reach 3R : SOUTH WEST

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

Area (ac)	CN	Description
3.843	80	>75% Grass cover, Good, HSG D
3.843	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	80	0.0700	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.80"
3.0	250	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	110	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.7	45	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	90	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.0	220	0.0150	0.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.7	140	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
25.4	935	Total			

Subcatchment 2S: South West



Summary for Subcatchment 3S: North

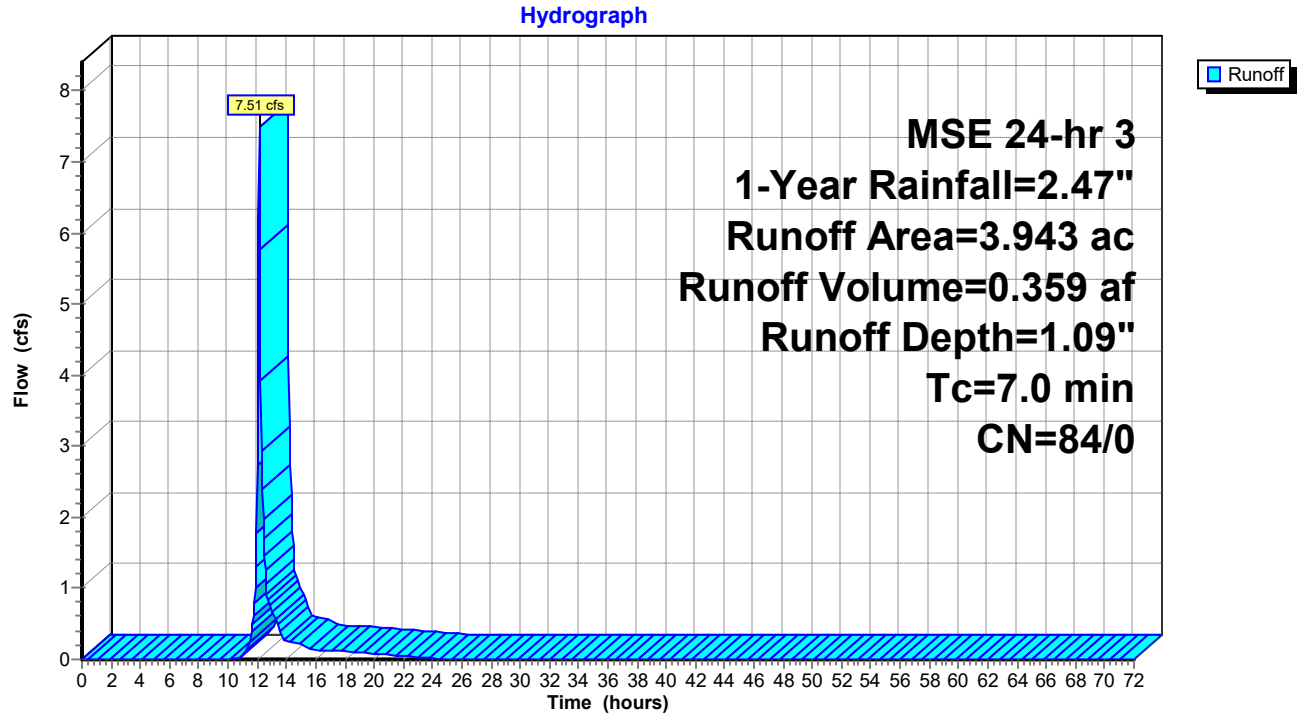
Runoff = 7.51 cfs @ 12.15 hrs, Volume= 0.359 af, Depth= 1.09"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

	Area (ac)	CN	Description
*	3.943	84	50-75% Grass cover, Fair, HSG D
	3.943	84	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 3S: North



Summary for Subcatchment 4S: South

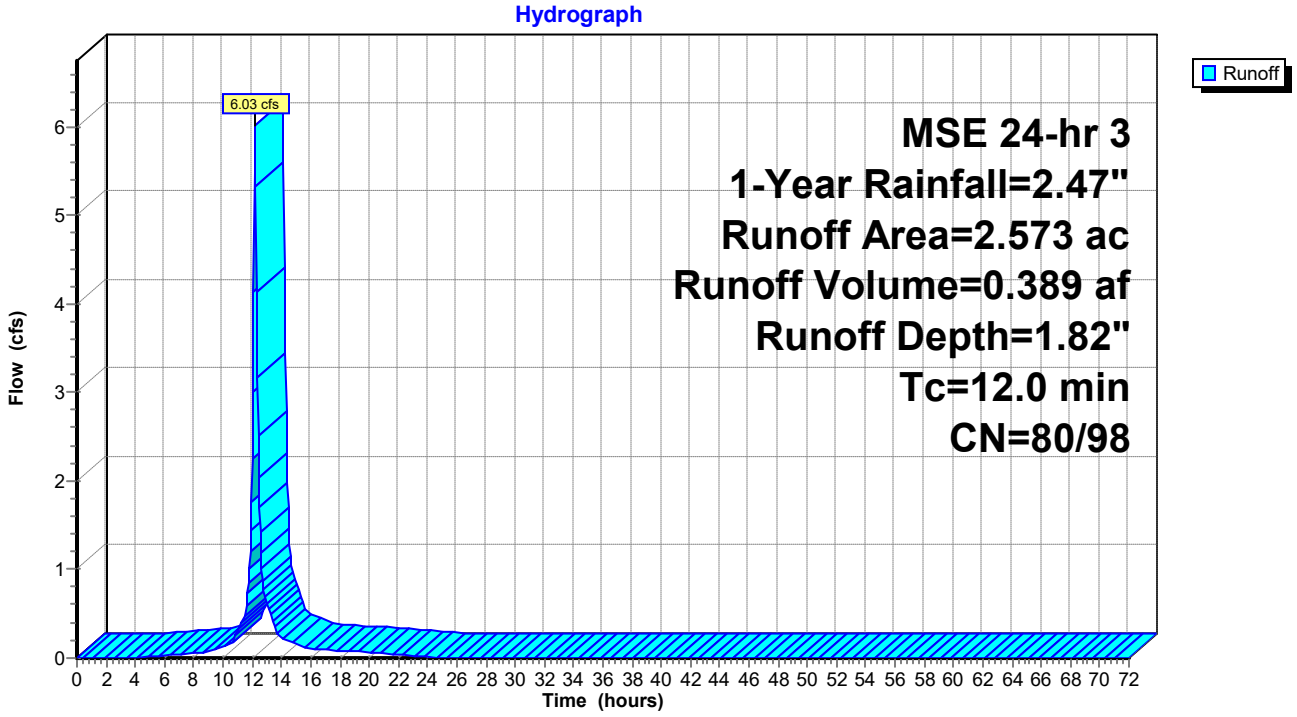
Runoff = 6.03 cfs @ 12.20 hrs, Volume= 0.389 af, Depth= 1.82"
Routed to Pond 2P : BMP 2

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

	Area (ac)	CN	Description
*	0.371	98	Proposed Stieger Lake Lane
	0.798	80	>75% Grass cover, Good, HSG D
*	1.018	98	Existing Stieger Lake Lane
*	0.386	98	Marco McLane Development
	2.573	92	Weighted Average
	0.798	80	31.01% Pervious Area
	1.775	98	68.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry, Roof Drain**

Subcatchment 4S: South



Summary for Subcatchment 5S: DTW PH 1

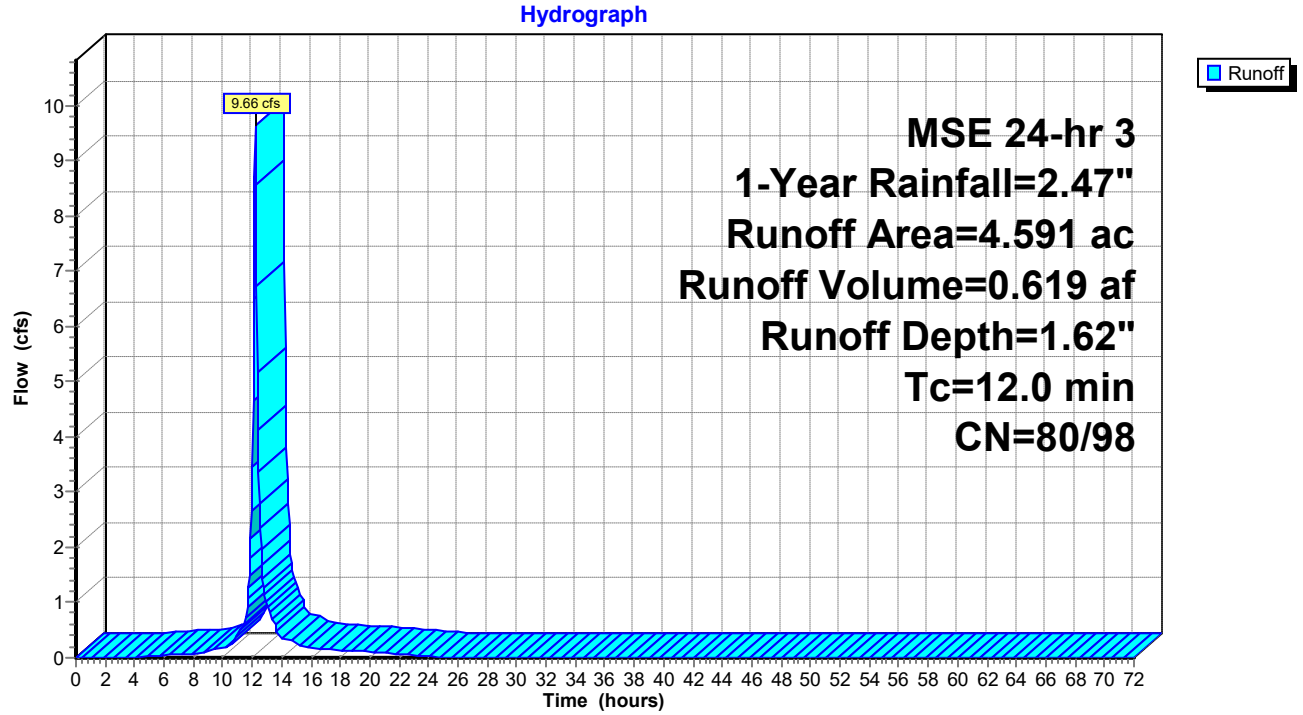
Runoff = 9.66 cfs @ 12.20 hrs, Volume= 0.619 af, Depth= 1.62"
Routed to Pond 6P : BMP 1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

	Area (ac)	CN	Description
	1.437	98	Paved roads w/curbs & sewers, HSG D
	2.084	80	>75% Grass cover, Good, HSG D
*	1.070	98	Marco McLane Development
	4.591	90	Weighted Average
	2.084	80	45.39% Pervious Area
	2.507	98	54.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry, Roof Drain**

Subcatchment 5S: DTW PH 1



Summary for Subcatchment 6S: West (CSAH 11)

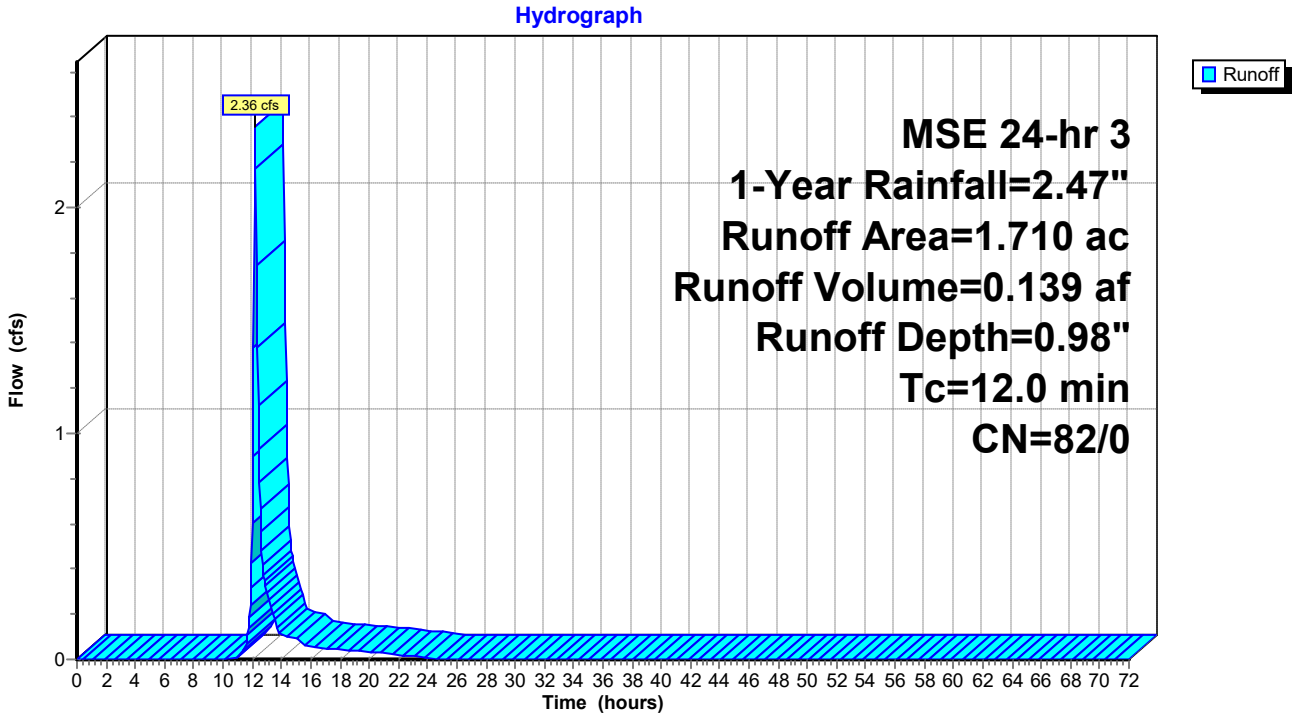
Runoff = 2.36 cfs @ 12.21 hrs, Volume= 0.139 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

Area (ac)	CN	Description
1.710	82	Woods/grass comb., Fair, HSG D
1.710	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry,**

Subcatchment 6S: West (CSAH 11)



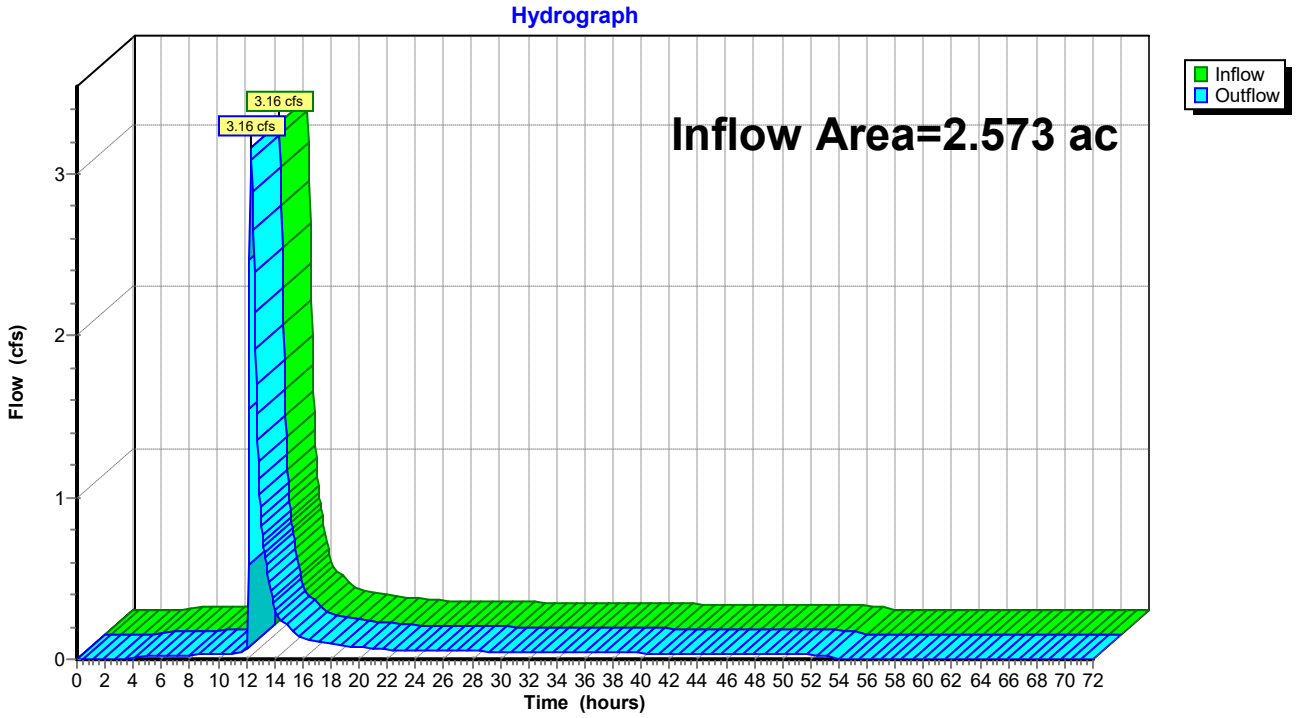
Summary for Reach 2R: SOUTH

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.573 ac, 68.99% Impervious, Inflow Depth = 1.82" for 1-Year event
Inflow = 3.16 cfs @ 12.36 hrs, Volume= 0.389 af
Outflow = 3.16 cfs @ 12.36 hrs, Volume= 0.389 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 2R: SOUTH



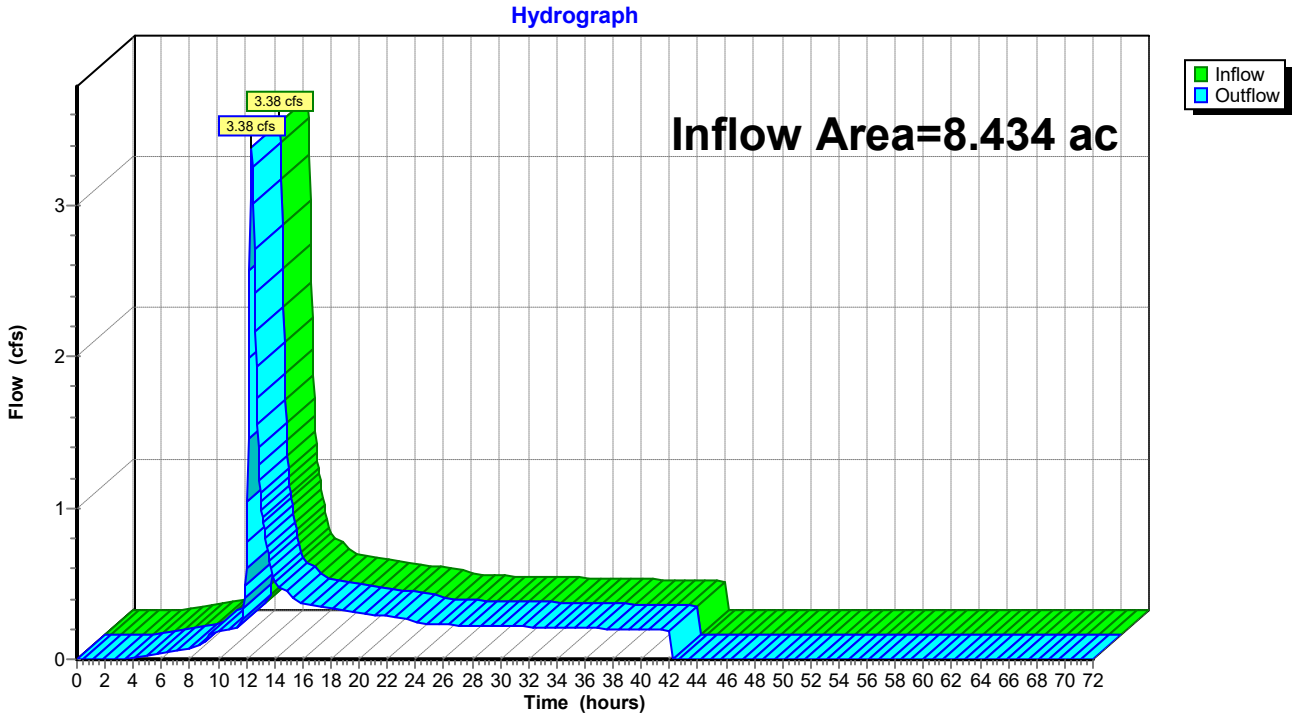
Summary for Reach 3R: SOUTH WEST

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.434 ac, 29.72% Impervious, Inflow Depth = 1.28" for 1-Year event
Inflow = 3.38 cfs @ 12.39 hrs, Volume= 0.897 af
Outflow = 3.38 cfs @ 12.39 hrs, Volume= 0.897 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 3R: SOUTH WEST



Summary for Pond 2P: BMP 2

Inflow Area = 2.573 ac, 68.99% Impervious, Inflow Depth = 1.82" for 1-Year event
Inflow = 6.03 cfs @ 12.20 hrs, Volume= 0.389 af
Outflow = 3.16 cfs @ 12.36 hrs, Volume= 0.389 af, Atten= 48%, Lag= 9.7 min
Primary = 3.08 cfs @ 12.36 hrs, Volume= 0.217 af
Routed to Reach 2R : SOUTH
Secondary = 0.08 cfs @ 12.36 hrs, Volume= 0.172 af
Routed to Reach 2R : SOUTH
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 2R : SOUTH

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 959.83' @ 12.36 hrs Surf.Area= 0.098 ac Storage= 0.167 af

Plug-Flow detention time= 402.4 min calculated for 0.389 af (100% of inflow)
Center-of-Mass det. time= 403.4 min (1,175.4 - 772.0)

Volume	Invert	Avail.Storage	Storage Description
#1	957.00'	0.634 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
957.00	0.032	0.000	0.000
958.00	0.049	0.040	0.040
959.00	0.068	0.058	0.099
960.00	0.105	0.086	0.185
961.00	0.140	0.123	0.308
962.00	0.171	0.156	0.463
963.00	0.171	0.171	0.634

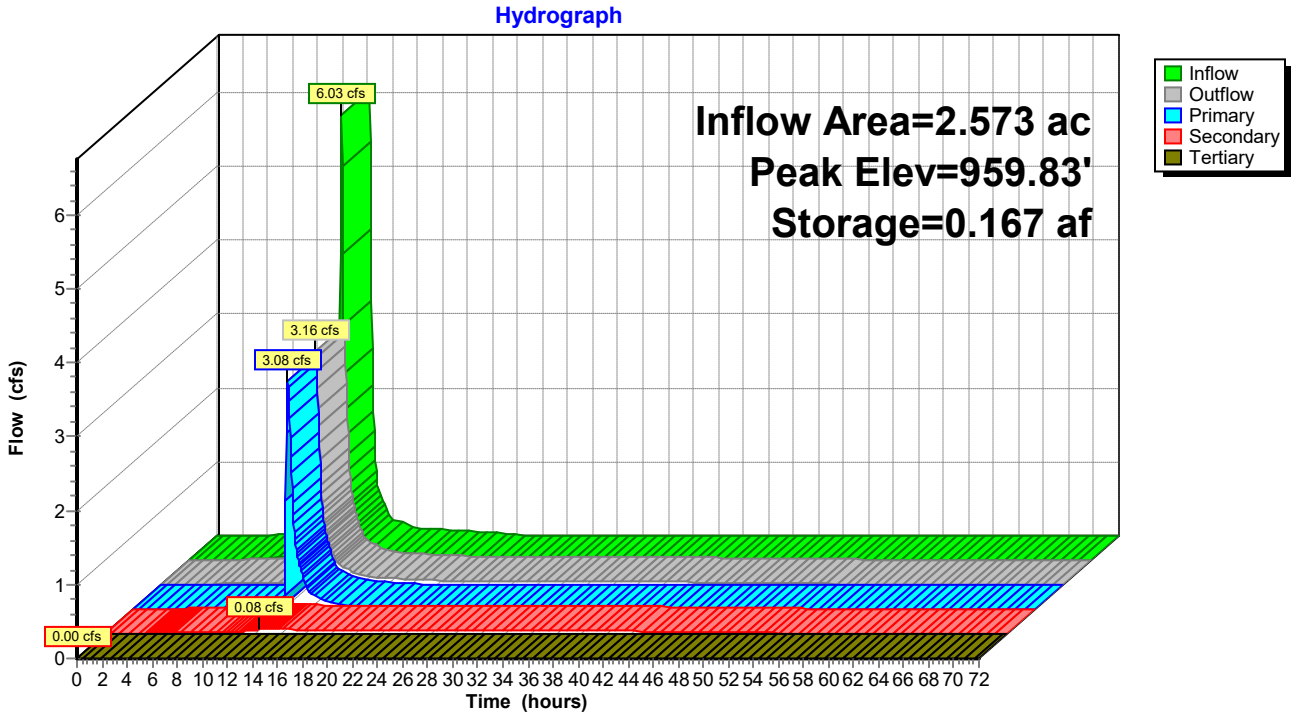
Device	Routing	Invert	Outlet Devices
#1	Device 2	957.00'	**0.800 in/hr Exfiltration over Surface area**
#2	Secondary	955.00'	**6.0" Vert. Draintile** C= 0.600 Limited to weir flow at low heads
#3	Tertiary	962.00'	**50.0' long SLL Overtop** Cv= 2.62 (C= 3.28)
#4	Primary	959.00'	**18.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 959.00' / 957.50' S= 0.0395 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=3.06 cfs @ 12.36 hrs HW=959.82' TW=0.00' (Dynamic Tailwater)
└**4=Culvert** (Inlet Controls 3.06 cfs @ 3.09 fps)

Secondary OutFlow Max=0.08 cfs @ 12.36 hrs HW=959.82' TW=0.00' (Dynamic Tailwater)
└**2=Draintile** (Passes 0.08 cfs of 2.02 cfs potential flow)
└**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=957.00' TW=0.00' (Dynamic Tailwater)
└**3=SLL Overtop** (Controls 0.00 cfs)

Pond 2P: BMP 2


Hydrograph
Inflow Area=2.573 ac
Peak Elev=959.83'
Storage=0.167 af
6.03 cfs
3.16 cfs
3.08 cfs
0.08 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Tertiary
Flow (cfs)
0 1 2 3 4 5 6
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Pond 6P: BMP 1

Inflow Area = 4.591 ac, 54.61% Impervious, Inflow Depth = 1.62" for 1-Year event
Inflow = 9.66 cfs @ 12.20 hrs, Volume= 0.619 af
Outflow = 0.24 cfs @ 15.19 hrs, Volume= 0.619 af, Atten= 98%, Lag= 179.6 min
Primary = 0.24 cfs @ 15.19 hrs, Volume= 0.619 af
Routed to Reach 3R : SOUTH WEST
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 3R : SOUTH WEST

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 963.52' @ 15.19 hrs Surf.Area= 0.299 ac Storage= 0.408 af

Plug-Flow detention time= 703.5 min calculated for 0.619 af (100% of inflow)
Center-of-Mass det. time= 704.0 min (1,482.6 - 778.6)

Volume	Invert	Avail.Storage	Storage Description
#1	962.00'	4.222 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

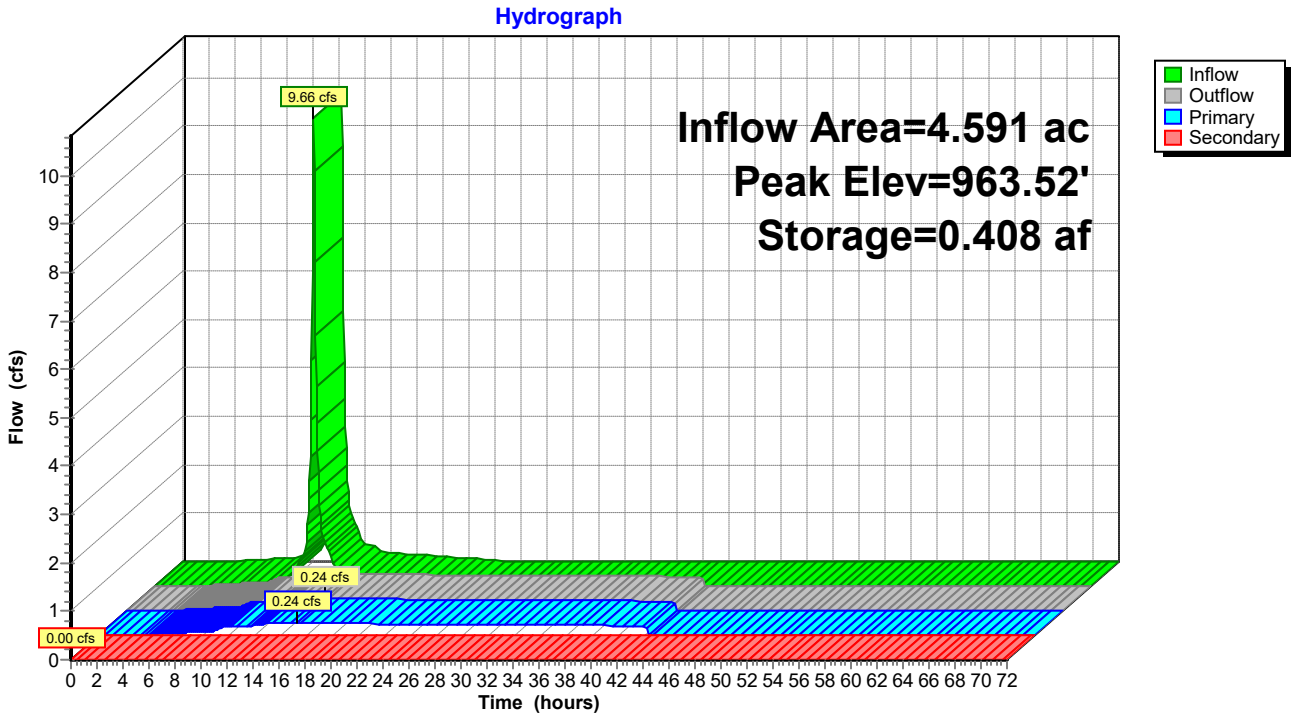
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
962.00	0.239	0.000	0.000
963.00	0.277	0.258	0.258
964.00	0.319	0.298	0.556
965.00	0.362	0.340	0.897
966.00	0.408	0.385	1.282
967.00	0.456	0.432	1.714
968.00	0.456	0.456	2.170
969.00	0.456	0.456	2.626
970.00	0.456	0.456	3.082
971.00	0.456	0.456	3.538
972.00	0.456	0.456	3.994
972.50	0.456	0.228	4.222

Device	Routing	Invert	Outlet Devices
#1	Device 2	962.00'	**0.800 in/hr Exfiltration over Surface area**
#2	Device 4	960.00'	**6.0" Vert. Draintile** C= 0.600 Limited to weir flow at low heads
#3	Secondary	967.30'	**50.0' long Road B** Cv= 2.62 (C= 3.28)
#4	Primary	960.00'	**15.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 960.00' / 959.81' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#5	Device 4	964.00'	**5.0' long x 0.8' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.74 2.78 2.86 3.00 3.11 3.18 3.25 3.29 3.32 3.31 3.32

Primary OutFlow Max=0.24 cfs @ 15.19 hrs HW=963.52' TW=0.00' (Dynamic Tailwater)
└─**4=Culvert** (Passes 0.24 cfs of 10.00 cfs potential flow)
  └─**2=Draintile** (Passes 0.24 cfs of 1.71 cfs potential flow)
    └─**1=Exfiltration** (Exfiltration Controls 0.24 cfs)
  └─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=962.00' TW=0.00' (Dynamic Tailwater)
└─**3=Road B** (Controls 0.00 cfs)

Pond 6P: BMP 1



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: South West Runoff Area=3.843 ac 0.00% Impervious Runoff Depth=2.21"
Flow Length=935' Tc=25.4 min CN=80/0 Runoff=8.32 cfs 0.707 af

Subcatchment 3S: North Runoff Area=3.943 ac 0.00% Impervious Runoff Depth=2.55"
Tc=7.0 min CN=84/0 Runoff=17.25 cfs 0.837 af

Subcatchment 4S: South Runoff Area=2.573 ac 68.99% Impervious Runoff Depth=3.42"
Tc=12.0 min CN=80/98 Runoff=11.24 cfs 0.733 af

Subcatchment 5S: DTW PH 1 Runoff Area=4.591 ac 54.61% Impervious Runoff Depth=3.17"
Tc=12.0 min CN=80/98 Runoff=18.89 cfs 1.212 af

Subcatchment 6S: West (CSAH 11) Runoff Area=1.710 ac 0.00% Impervious Runoff Depth=2.37"
Tc=12.0 min CN=82/0 Runoff=5.78 cfs 0.338 af

Reach 2R: SOUTH Inflow=7.36 cfs 0.733 af
Outflow=7.36 cfs 0.733 af

Reach 3R: SOUTH WEST Inflow=9.87 cfs 1.919 af
Outflow=9.87 cfs 1.919 af

Pond 2P: BMP 2 Peak Elev=960.47' Storage=0.238 af Inflow=11.24 cfs 0.733 af
Primary=7.26 cfs 0.547 af Secondary=0.10 cfs 0.187 af Tertiary=0.00 cfs 0.000 af Outflow=7.36 cfs 0.733 af

Pond 6P: BMP 1 Peak Elev=964.35' Storage=0.670 af Inflow=18.89 cfs 1.212 af
Primary=3.14 cfs 1.212 af Secondary=0.00 cfs 0.000 af Outflow=3.14 cfs 1.212 af

Total Runoff Area = 16.660 ac Runoff Volume = 3.828 af Average Runoff Depth = 2.76"
74.30% Pervious = 12.378 ac 25.70% Impervious = 4.282 ac

Summary for Subcatchment 2S: South West

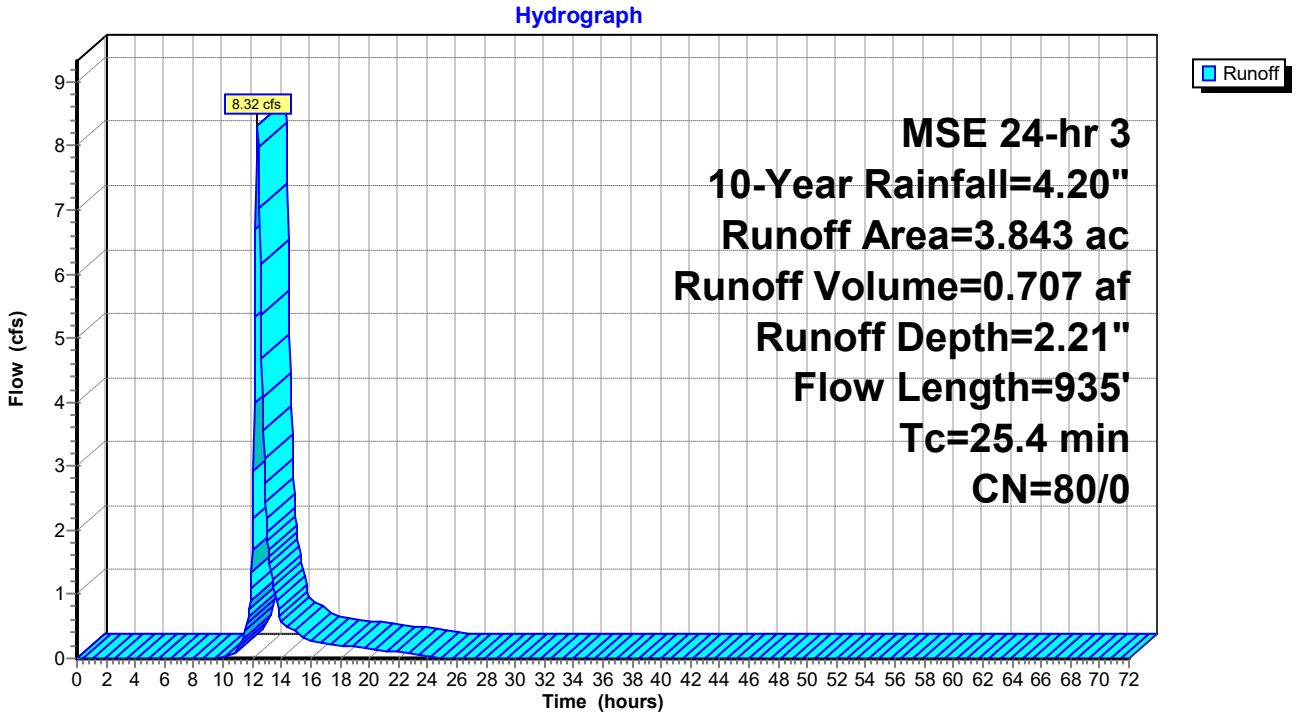
Runoff = 8.32 cfs @ 12.37 hrs, Volume= 0.707 af, Depth= 2.21"
Routed to Reach 3R : SOUTH WEST

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

Area (ac)	CN	Description
3.843	80	>75% Grass cover, Good, HSG D
3.843	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	80	0.0700	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.80"
3.0	250	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	110	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.7	45	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	90	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.0	220	0.0150	0.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.7	140	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
25.4	935	Total			

Subcatchment 2S: South West



Summary for Subcatchment 3S: North

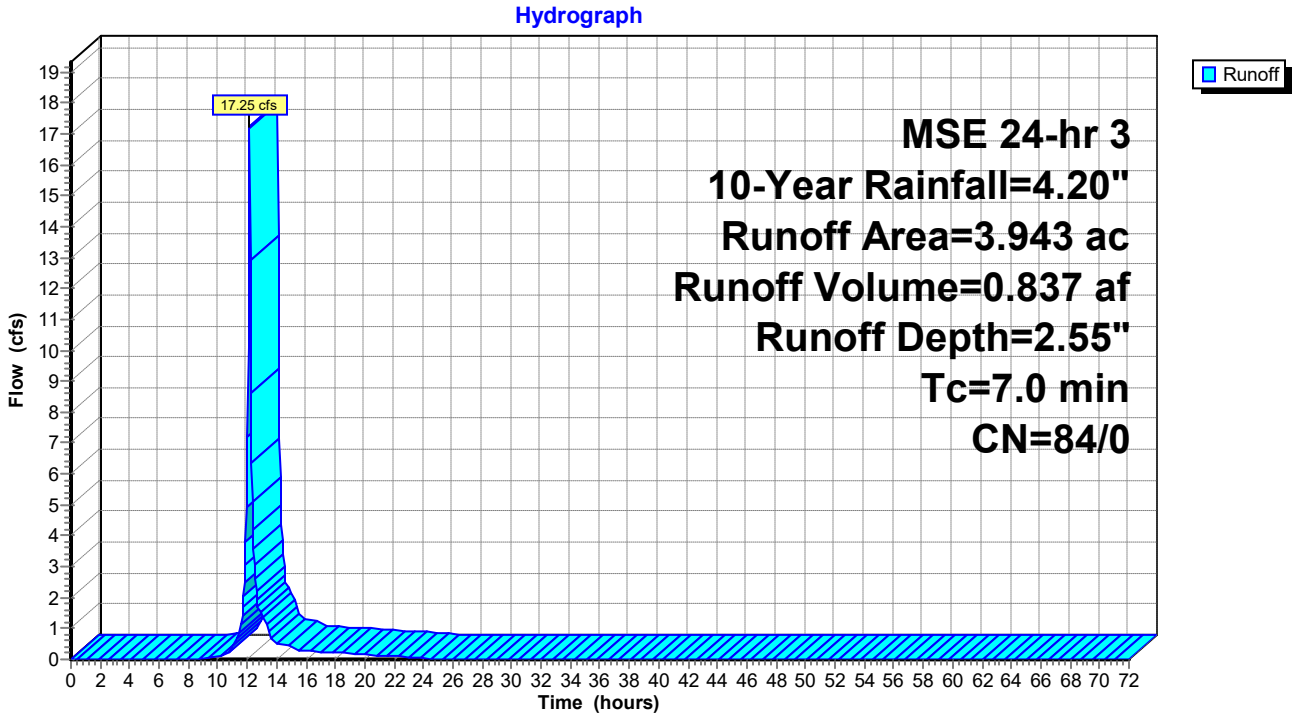
Runoff = 17.25 cfs @ 12.14 hrs, Volume= 0.837 af, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (ac)	CN	Description
*	3.943	84	50-75% Grass cover, Fair, HSG D
	3.943	84	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 3S: North



Summary for Subcatchment 4S: South

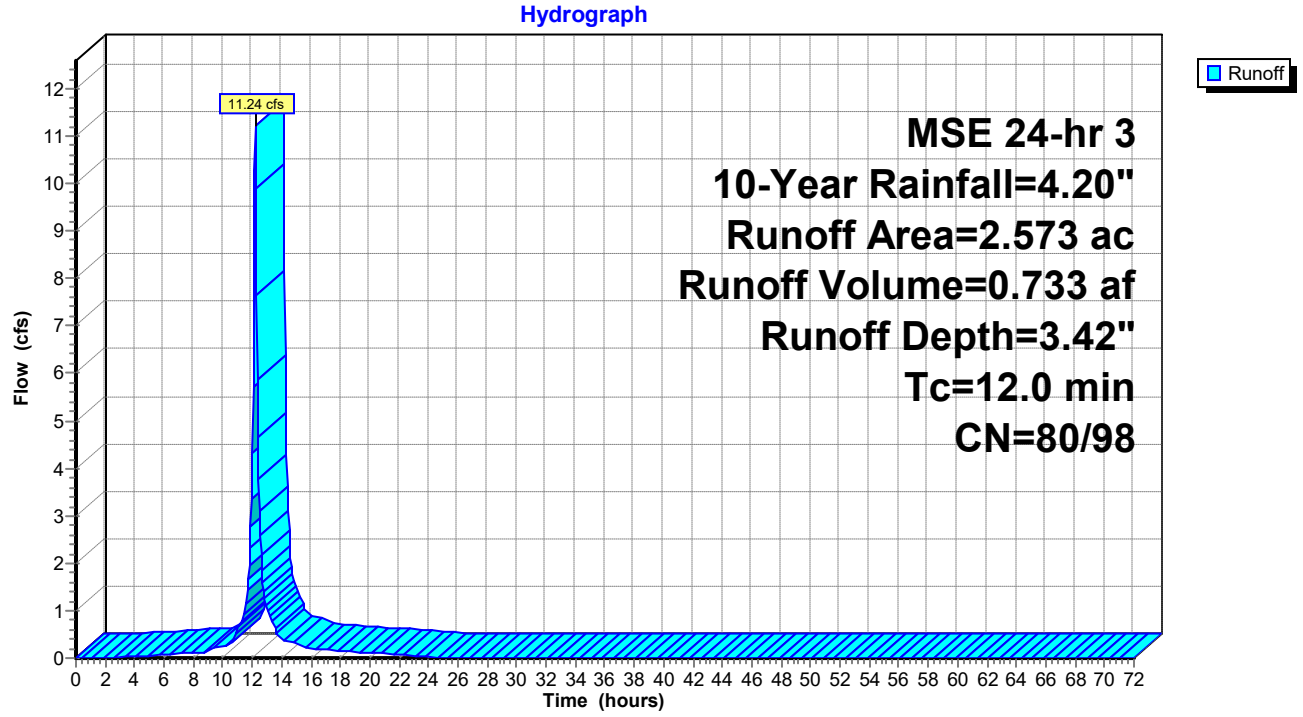
Runoff = 11.24 cfs @ 12.20 hrs, Volume= 0.733 af, Depth= 3.42"
Routed to Pond 2P : BMP 2

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (ac)	CN	Description
*	0.371	98	Proposed Stieger Lake Lane
	0.798	80	>75% Grass cover, Good, HSG D
*	1.018	98	Existing Stieger Lake Lane
*	0.386	98	Marco McLane Development
	2.573	92	Weighted Average
	0.798	80	31.01% Pervious Area
	1.775	98	68.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry, Roof Drain**

Subcatchment 4S: South



Summary for Subcatchment 5S: DTW PH 1

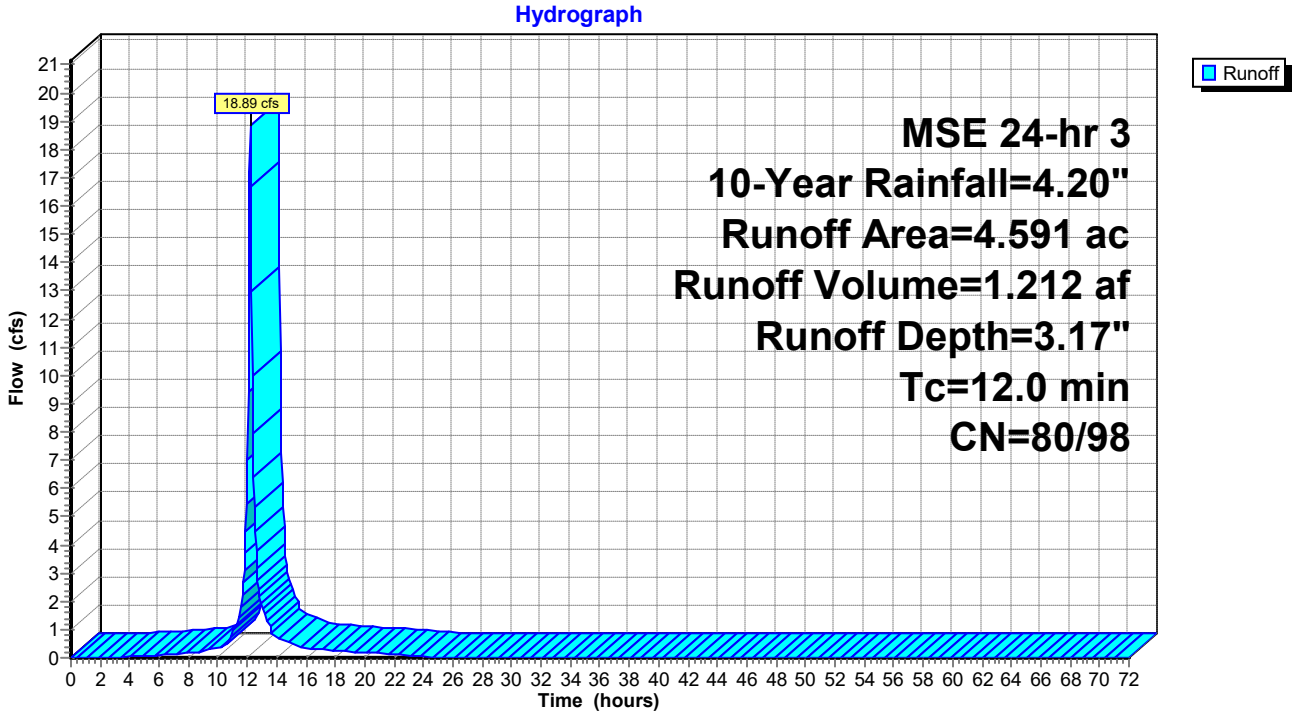
Runoff = 18.89 cfs @ 12.20 hrs, Volume= 1.212 af, Depth= 3.17"
Routed to Pond 6P : BMP 1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (ac)	CN	Description
	1.437	98	Paved roads w/curbs & sewers, HSG D
	2.084	80	>75% Grass cover, Good, HSG D
*	1.070	98	Marco McLane Development
	4.591	90	Weighted Average
	2.084	80	45.39% Pervious Area
	2.507	98	54.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry, Roof Drain**

Subcatchment 5S: DTW PH 1



Summary for Subcatchment 6S: West (CSAH 11)

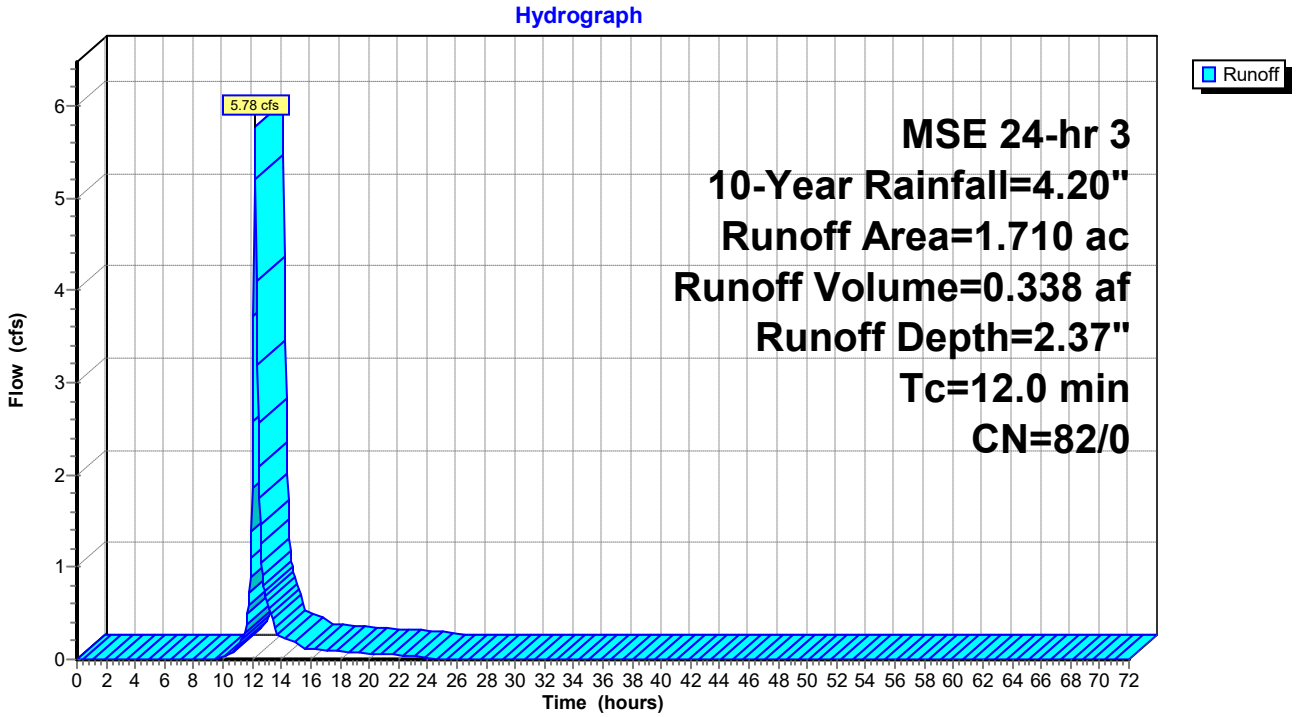
Runoff = 5.78 cfs @ 12.20 hrs, Volume= 0.338 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

Area (ac)	CN	Description
1.710	82	Woods/grass comb., Fair, HSG D
1.710	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry,**

Subcatchment 6S: West (CSAH 11)



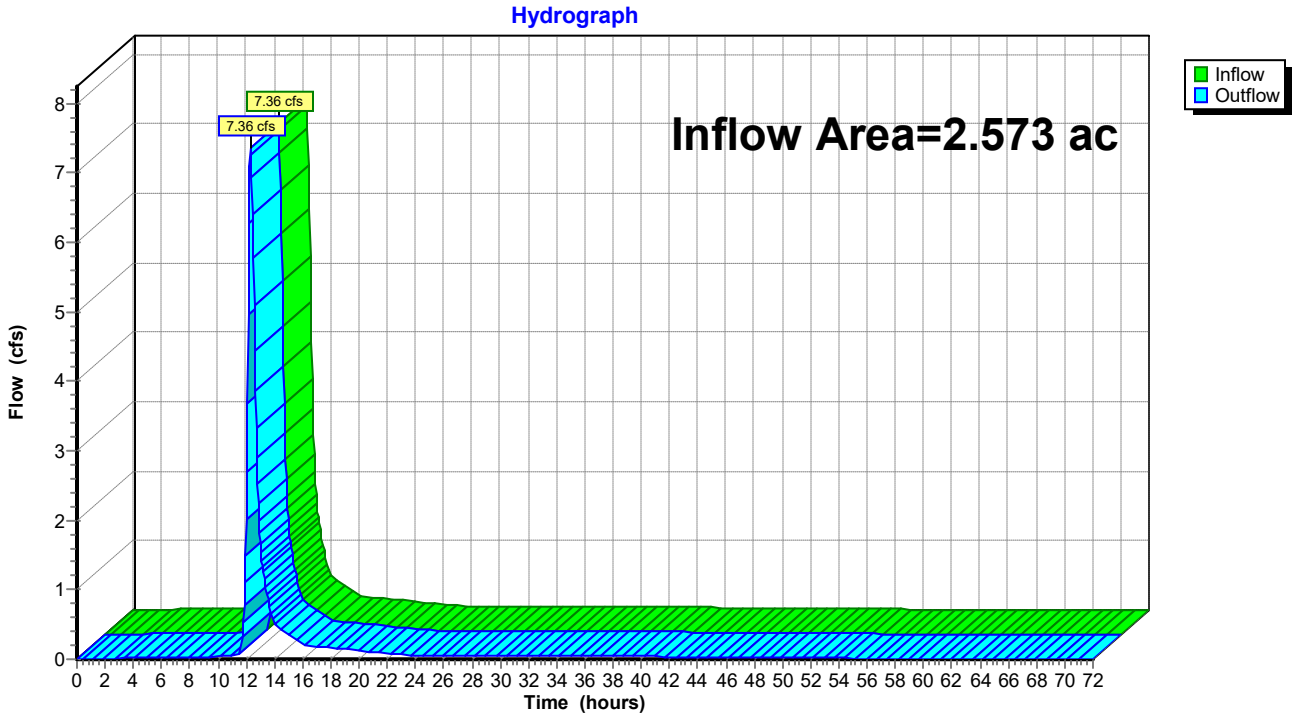
Summary for Reach 2R: SOUTH

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.573 ac, 68.99% Impervious, Inflow Depth = 3.42" for 10-Year event
Inflow = 7.36 cfs @ 12.31 hrs, Volume= 0.733 af
Outflow = 7.36 cfs @ 12.31 hrs, Volume= 0.733 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 2R: SOUTH



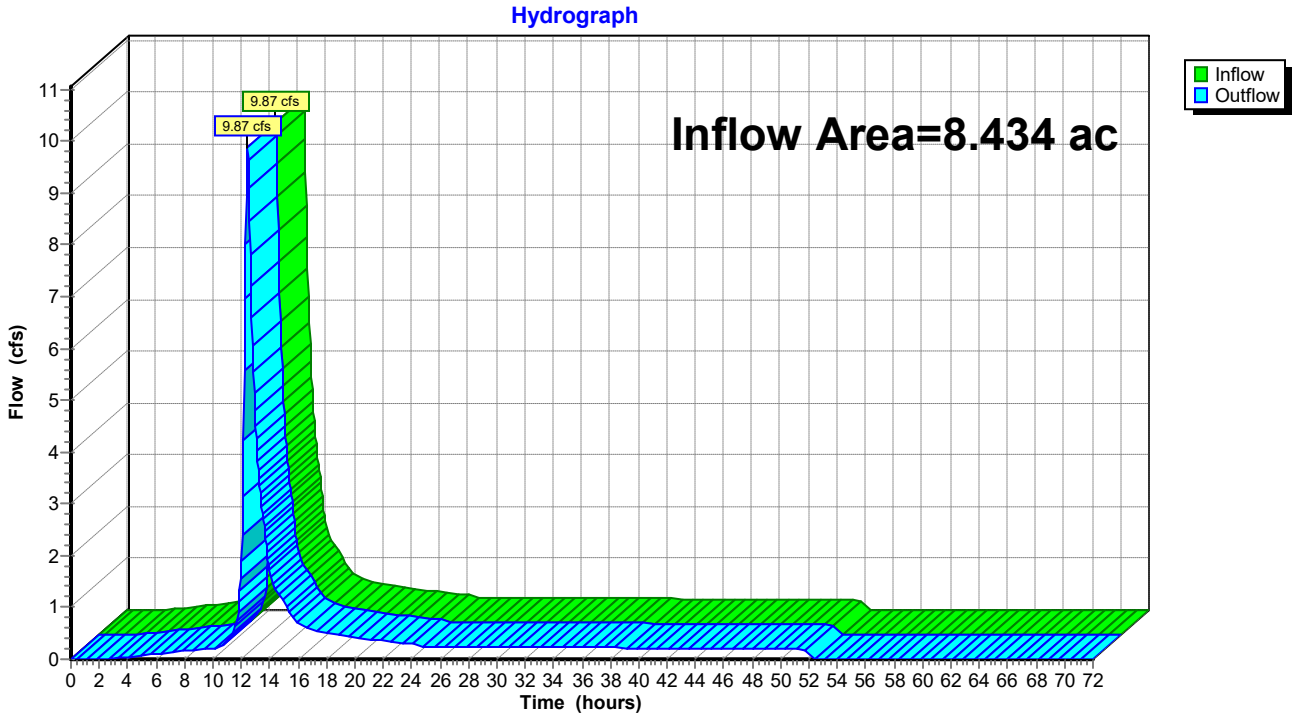
Summary for Reach 3R: SOUTH WEST

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.434 ac, 29.72% Impervious, Inflow Depth = 2.73" for 10-Year event
Inflow = 9.87 cfs @ 12.45 hrs, Volume= 1.919 af
Outflow = 9.87 cfs @ 12.45 hrs, Volume= 1.919 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 3R: SOUTH WEST



Summary for Pond 2P: BMP 2

Inflow Area = 2.573 ac, 68.99% Impervious, Inflow Depth = 3.42" for 10-Year event
Inflow = 11.24 cfs @ 12.20 hrs, Volume= 0.733 af
Outflow = 7.36 cfs @ 12.31 hrs, Volume= 0.733 af, Atten= 34%, Lag= 7.0 min
Primary = 7.26 cfs @ 12.31 hrs, Volume= 0.547 af
Routed to Reach 2R : SOUTH
Secondary = 0.10 cfs @ 12.31 hrs, Volume= 0.187 af
Routed to Reach 2R : SOUTH
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 2R : SOUTH

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 960.47' @ 12.31 hrs Surf.Area= 0.122 ac Storage= 0.238 af

Plug-Flow detention time= 240.7 min calculated for 0.733 af (100% of inflow)
Center-of-Mass det. time= 241.8 min (1,006.5 - 764.7)

Volume	Invert	Avail.Storage	Storage Description
#1	957.00'	0.634 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
957.00	0.032	0.000	0.000
958.00	0.049	0.040	0.040
959.00	0.068	0.058	0.099
960.00	0.105	0.086	0.185
961.00	0.140	0.123	0.308
962.00	0.171	0.156	0.463
963.00	0.171	0.171	0.634

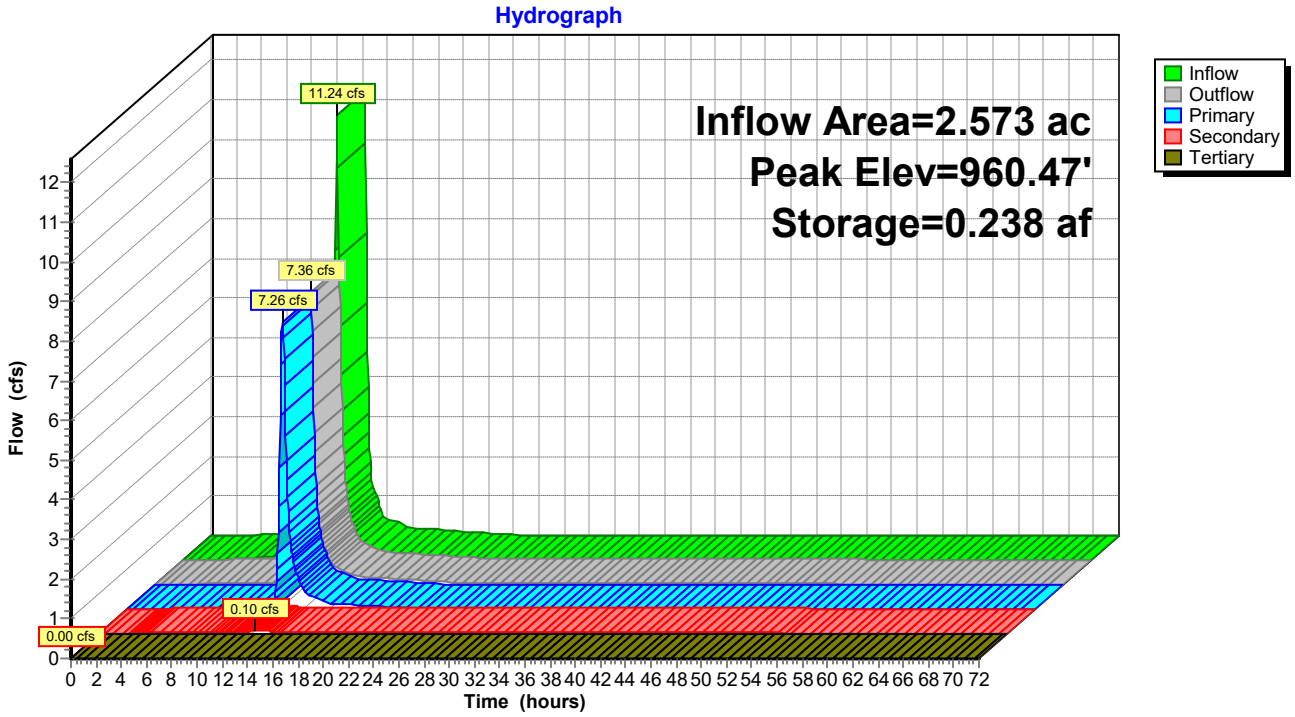
Device	Routing	Invert	Outlet Devices
#1	Device 2	957.00'	**0.800 in/hr Exfiltration over Surface area**
#2	Secondary	955.00'	**6.0" Vert. Draintile** C= 0.600 Limited to weir flow at low heads
#3	Tertiary	962.00'	**50.0' long SLL Overtop** Cv= 2.62 (C= 3.28)
#4	Primary	959.00'	**18.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 959.00' / 957.50' S= 0.0395 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=7.23 cfs @ 12.31 hrs HW=960.46' TW=0.00' (Dynamic Tailwater)
└**4=Culvert** (Inlet Controls 7.23 cfs @ 4.12 fps)

Secondary OutFlow Max=0.10 cfs @ 12.31 hrs HW=960.46' TW=0.00' (Dynamic Tailwater)
└**2=Draintile** (Passes 0.10 cfs of 2.16 cfs potential flow)
└**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=957.00' TW=0.00' (Dynamic Tailwater)
└**3=SLL Overtop** (Controls 0.00 cfs)

Pond 2P: BMP 2


Hydrograph
Inflow Area=2.573 ac
Peak Elev=960.47'
Storage=0.238 af
11.24 cfs
7.36 cfs
7.26 cfs
0.10 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Tertiary
Flow (cfs)
Time (hours)

Summary for Pond 6P: BMP 1

Inflow Area = 4.591 ac, 54.61% Impervious, Inflow Depth = 3.17" for 10-Year event
Inflow = 18.89 cfs @ 12.20 hrs, Volume= 1.212 af
Outflow = 3.14 cfs @ 12.66 hrs, Volume= 1.212 af, Atten= 83%, Lag= 27.6 min
Primary = 3.14 cfs @ 12.66 hrs, Volume= 1.212 af
Routed to Reach 3R : SOUTH WEST
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 3R : SOUTH WEST

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 964.35' @ 12.66 hrs Surf.Area= 0.334 ac Storage= 0.670 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 680.2 min (1,451.5 - 771.3)

Volume	Invert	Avail.Storage	Storage Description
#1	962.00'	4.222 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

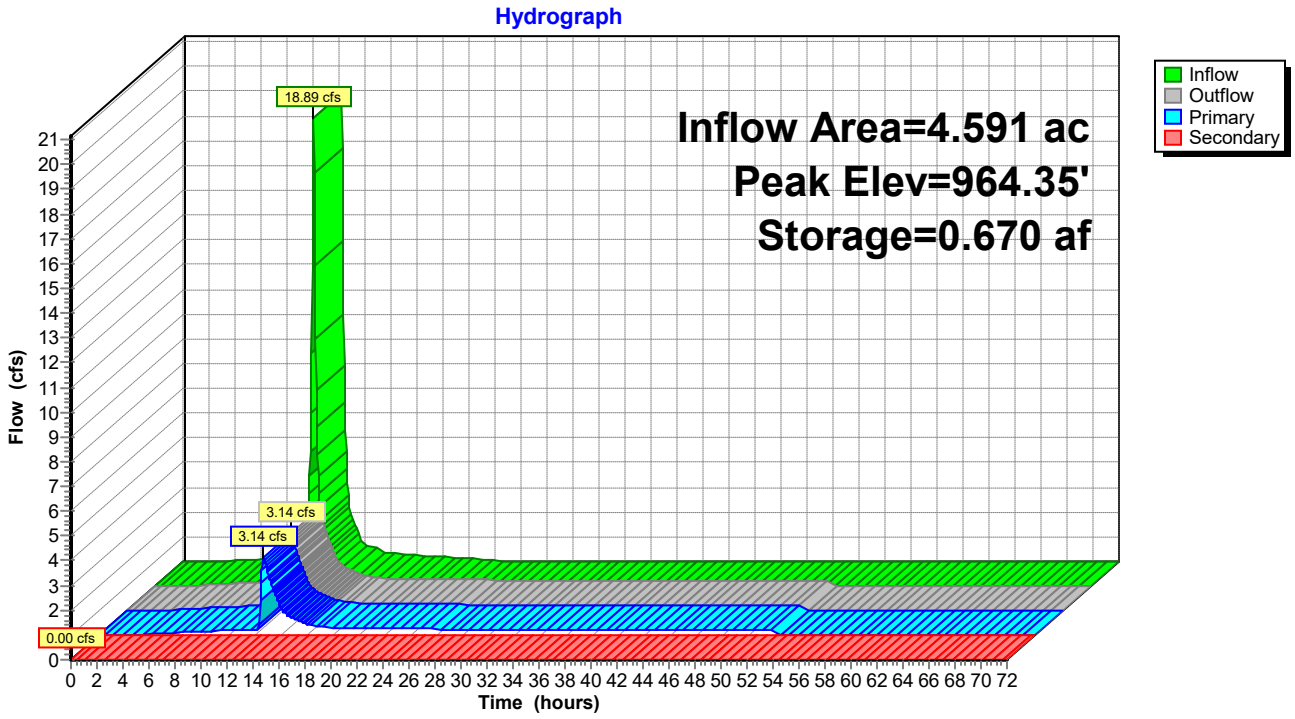
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
962.00	0.239	0.000	0.000
963.00	0.277	0.258	0.258
964.00	0.319	0.298	0.556
965.00	0.362	0.340	0.897
966.00	0.408	0.385	1.282
967.00	0.456	0.432	1.714
968.00	0.456	0.456	2.170
969.00	0.456	0.456	2.626
970.00	0.456	0.456	3.082
971.00	0.456	0.456	3.538
972.00	0.456	0.456	3.994
972.50	0.456	0.228	4.222

Device	Routing	Invert	Outlet Devices
#1	Device 2	962.00'	**0.800 in/hr Exfiltration over Surface area**
#2	Device 4	960.00'	**6.0" Vert. Draintile** C= 0.600 Limited to weir flow at low heads
#3	Secondary	967.30'	**50.0' long Road B** Cv= 2.62 (C= 3.28)
#4	Primary	960.00'	**15.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 960.00' / 959.81' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#5	Device 4	964.00'	**5.0' long x 0.8' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.74 2.78 2.86 3.00 3.11 3.18 3.25 3.29 3.32 3.31 3.32

Primary OutFlow Max=3.14 cfs @ 12.66 hrs HW=964.35' TW=0.00' (Dynamic Tailwater)
└─**4=Culvert** (Passes 3.14 cfs of 11.40 cfs potential flow)
  ├─**2=Draintile** (Passes 0.27 cfs of 1.91 cfs potential flow)
  │ └─**1=Exfiltration** (Exfiltration Controls 0.27 cfs)
  └─**5=Broad-Crested Rectangular Weir** (Weir Controls 2.87 cfs @ 1.64 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=962.00' TW=0.00' (Dynamic Tailwater)
└─**3=Road B** (Controls 0.00 cfs)

Pond 6P: BMP 1



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: South West Runoff Area=3.843 ac 0.00% Impervious Runoff Depth=4.86"
Flow Length=935' Tc=25.4 min CN=80/0 Runoff=18.18 cfs 1.557 af

Subcatchment 3S: North Runoff Area=3.943 ac 0.00% Impervious Runoff Depth=5.31"
Tc=7.0 min CN=84/0 Runoff=34.69 cfs 1.745 af

Subcatchment 4S: South Runoff Area=2.573 ac 68.99% Impervious Runoff Depth=6.30"
Tc=12.0 min CN=80/98 Runoff=20.44 cfs 1.350 af

Subcatchment 5S: DTW PH 1 Runoff Area=4.591 ac 54.61% Impervious Runoff Depth=6.00"
Tc=12.0 min CN=80/98 Runoff=35.38 cfs 2.294 af

Subcatchment 6S: West (CSAH 11) Runoff Area=1.710 ac 0.00% Impervious Runoff Depth=5.09"
Tc=12.0 min CN=82/0 Runoff=12.09 cfs 0.725 af

Reach 2R: SOUTH Inflow=11.21 cfs 1.350 af
Outflow=11.21 cfs 1.350 af

Reach 3R: SOUTH WEST Inflow=31.00 cfs 3.851 af
Outflow=31.00 cfs 3.851 af

Pond 2P: BMP 2 Peak Elev=961.45' Storage=0.374 af Inflow=20.44 cfs 1.350 af
Primary=11.09 cfs 1.149 af Secondary=0.12 cfs 0.201 af Tertiary=0.00 cfs 0.000 af Outflow=11.21 cfs 1.350 af

Pond 6P: BMP 1 Peak Elev=965.36' Storage=1.031 af Inflow=35.38 cfs 2.294 af
Primary=12.86 cfs 2.294 af Secondary=0.00 cfs 0.000 af Outflow=12.86 cfs 2.294 af

Total Runoff Area = 16.660 ac Runoff Volume = 7.671 af Average Runoff Depth = 5.53"
74.30% Pervious = 12.378 ac 25.70% Impervious = 4.282 ac

Summary for Subcatchment 2S: South West

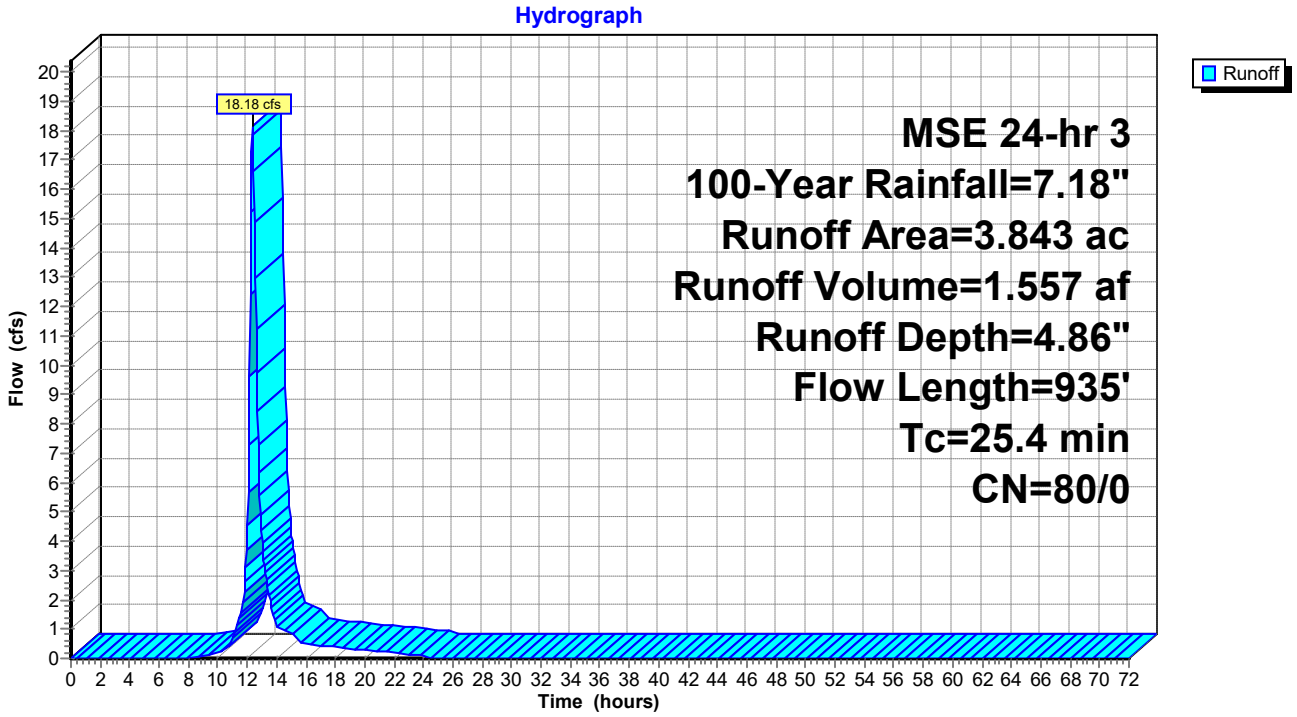
Runoff = 18.18 cfs @ 12.36 hrs, Volume= 1.557 af, Depth= 4.86"
Routed to Reach 3R : SOUTH WEST

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

Area (ac)	CN	Description
3.843	80	>75% Grass cover, Good, HSG D
3.843	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	80	0.0700	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.80"
3.0	250	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	110	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.7	45	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	90	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.0	220	0.0150	0.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.7	140	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
25.4	935	Total			

Subcatchment 2S: South West



Summary for Subcatchment 3S: North

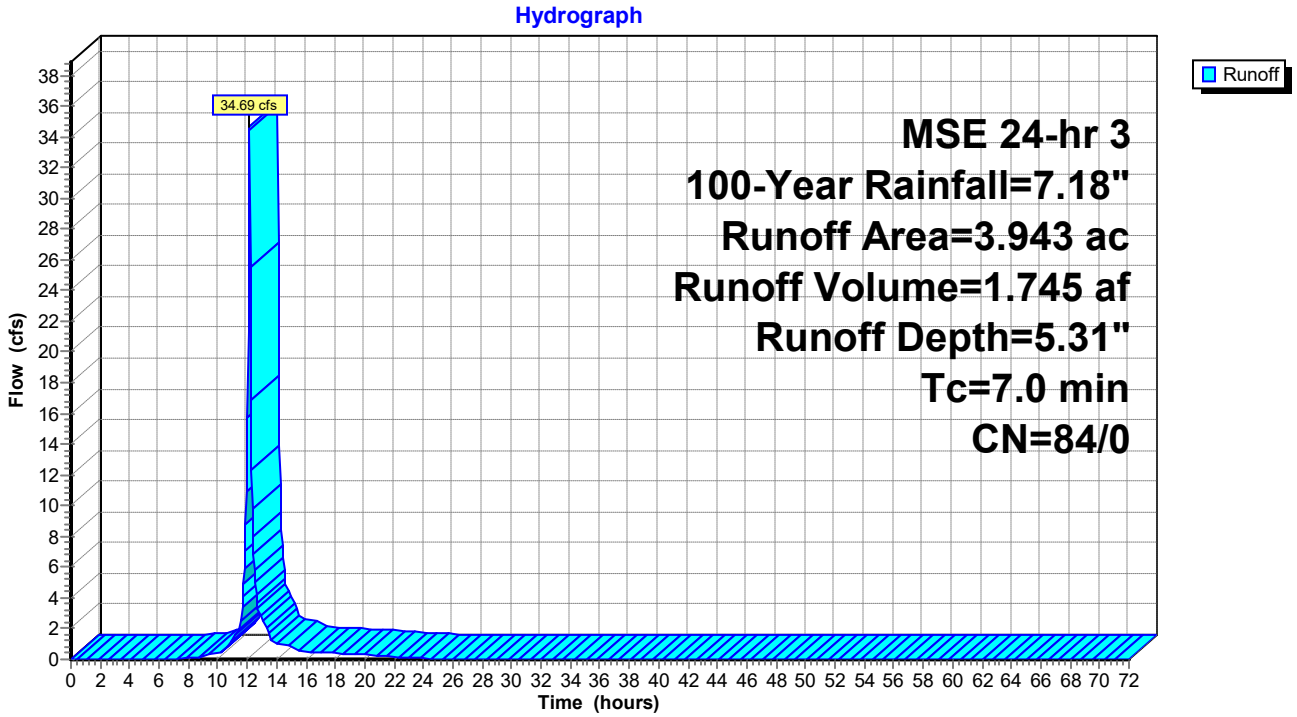
Runoff = 34.69 cfs @ 12.14 hrs, Volume= 1.745 af, Depth= 5.31"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

	Area (ac)	CN	Description
*	3.943	84	50-75% Grass cover, Fair, HSG D
	3.943	84	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 3S: North



Summary for Subcatchment 4S: South

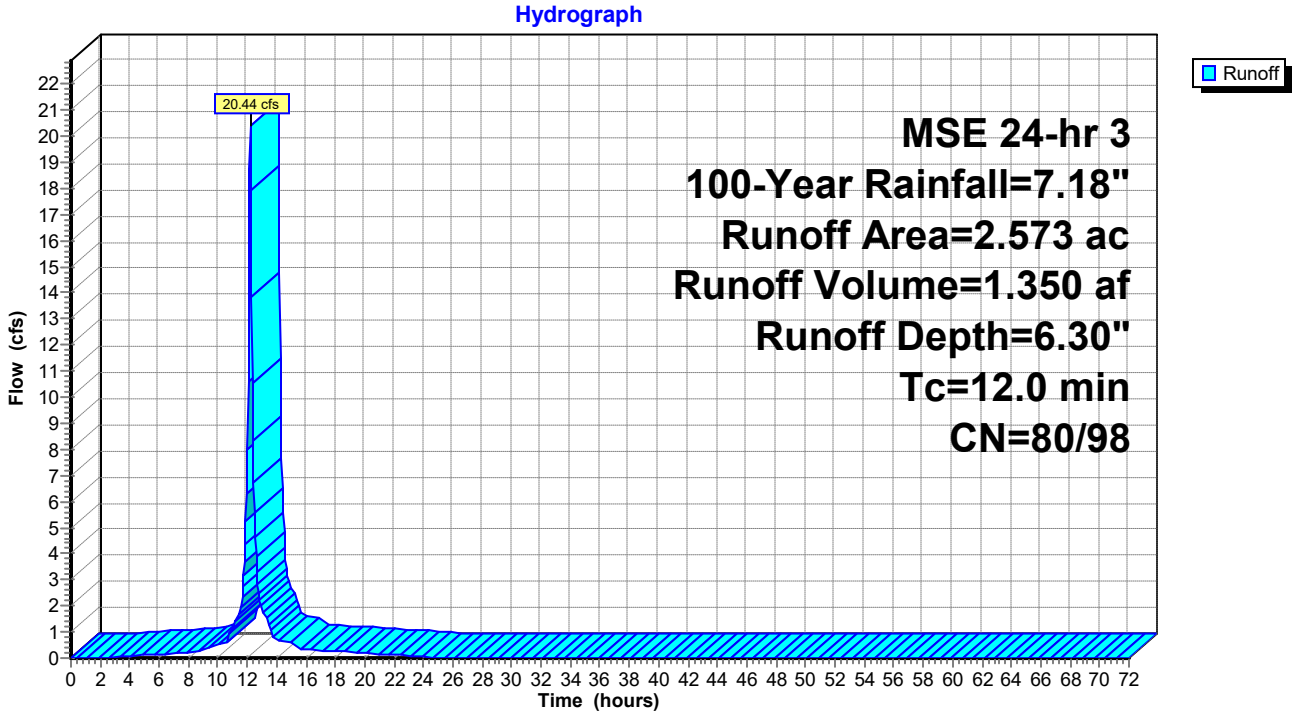
Runoff = 20.44 cfs @ 12.19 hrs, Volume= 1.350 af, Depth= 6.30"
Routed to Pond 2P : BMP 2

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

	Area (ac)	CN	Description
*	0.371	98	Proposed Stieger Lake Lane
	0.798	80	>75% Grass cover, Good, HSG D
*	1.018	98	Existing Stieger Lake Lane
*	0.386	98	Marco McLane Development
	2.573	92	Weighted Average
	0.798	80	31.01% Pervious Area
	1.775	98	68.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry, Roof Drain**

Subcatchment 4S: South



Summary for Subcatchment 5S: DTW PH 1

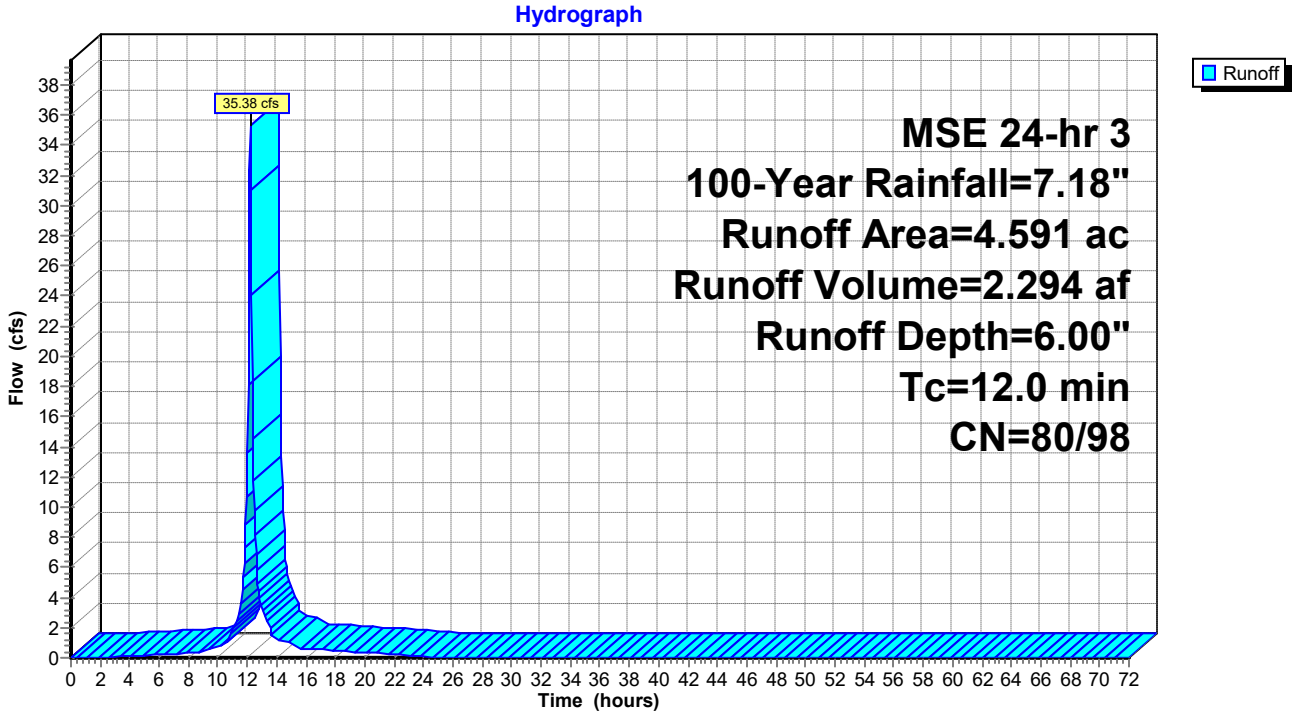
Runoff = 35.38 cfs @ 12.20 hrs, Volume= 2.294 af, Depth= 6.00"
Routed to Pond 6P : BMP 1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

	Area (ac)	CN	Description
	1.437	98	Paved roads w/curbs & sewers, HSG D
	2.084	80	>75% Grass cover, Good, HSG D
*	1.070	98	Marco McLane Development
	4.591	90	Weighted Average
	2.084	80	45.39% Pervious Area
	2.507	98	54.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry, Roof Drain**

Subcatchment 5S: DTW PH 1



Summary for Subcatchment 6S: West (CSAH 11)

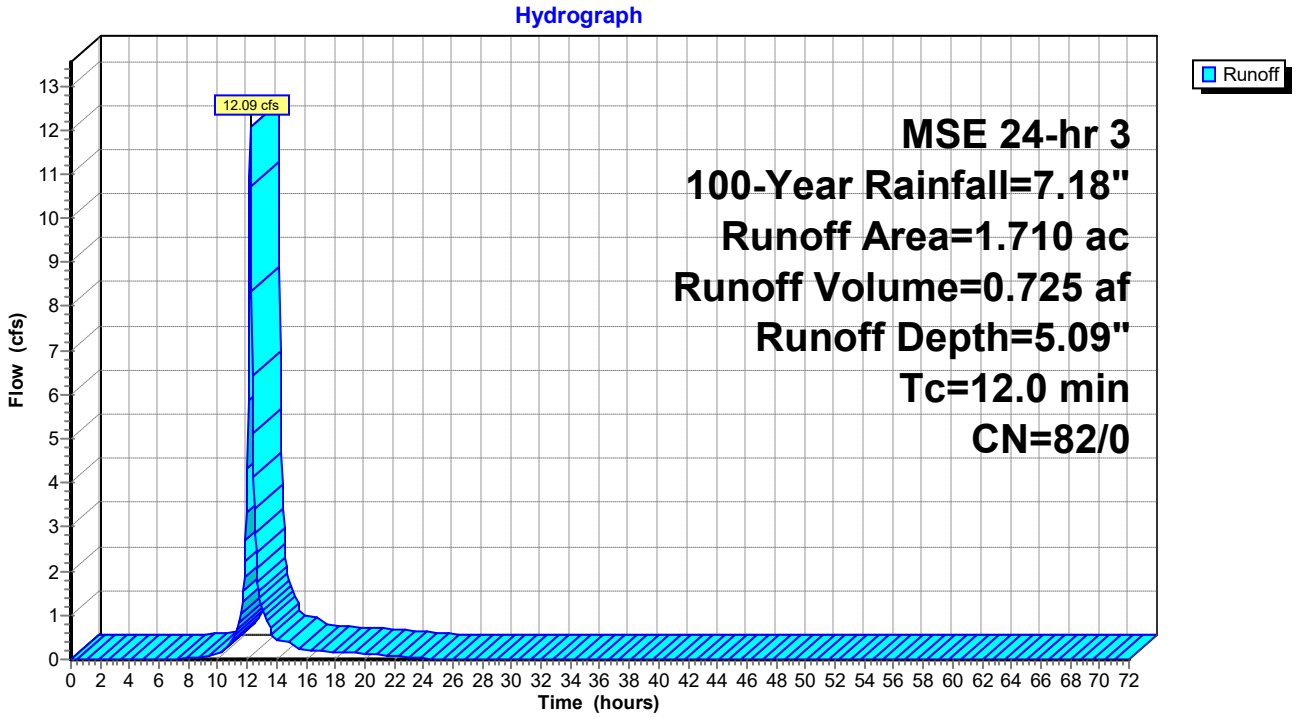
Runoff = 12.09 cfs @ 12.20 hrs, Volume= 0.725 af, Depth= 5.09"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

Area (ac)	CN	Description
1.710	82	Woods/grass comb., Fair, HSG D
1.710	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry,**

Subcatchment 6S: West (CSAH 11)



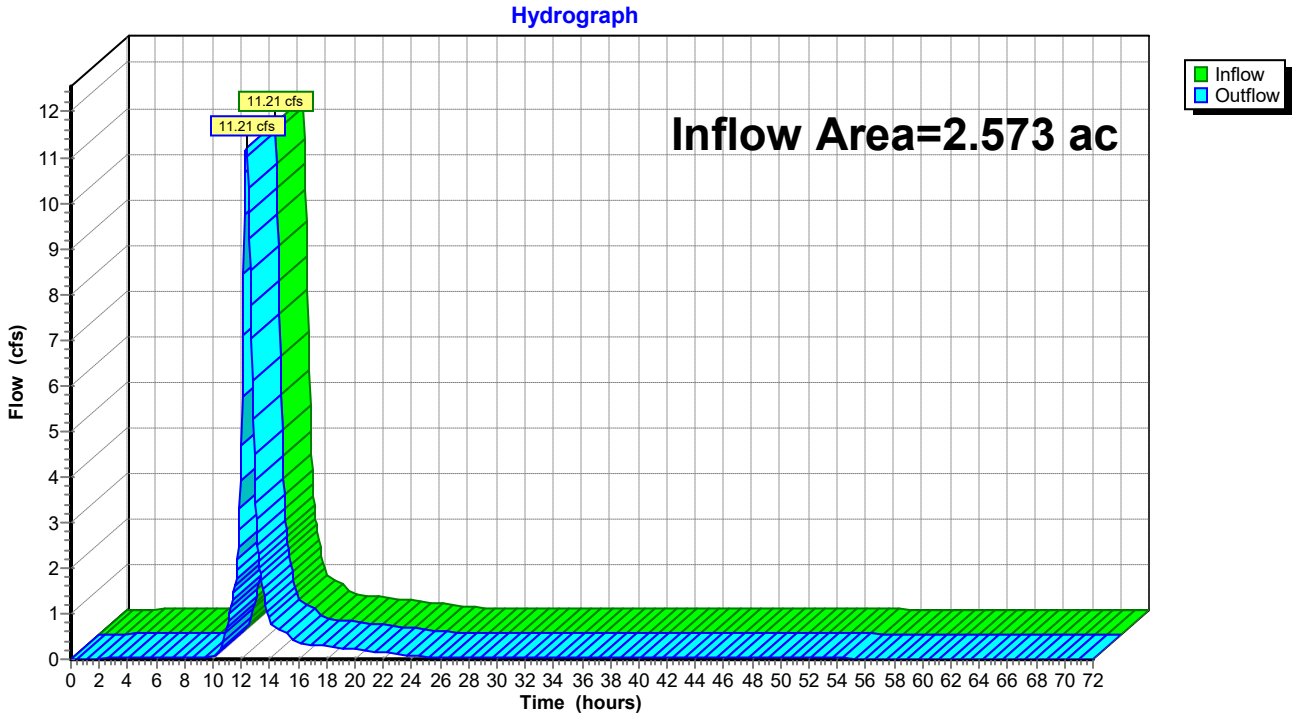
Summary for Reach 2R: SOUTH

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.573 ac, 68.99% Impervious, Inflow Depth = 6.30" for 100-Year event
Inflow = 11.21 cfs @ 12.34 hrs, Volume= 1.350 af
Outflow = 11.21 cfs @ 12.34 hrs, Volume= 1.350 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 2R: SOUTH



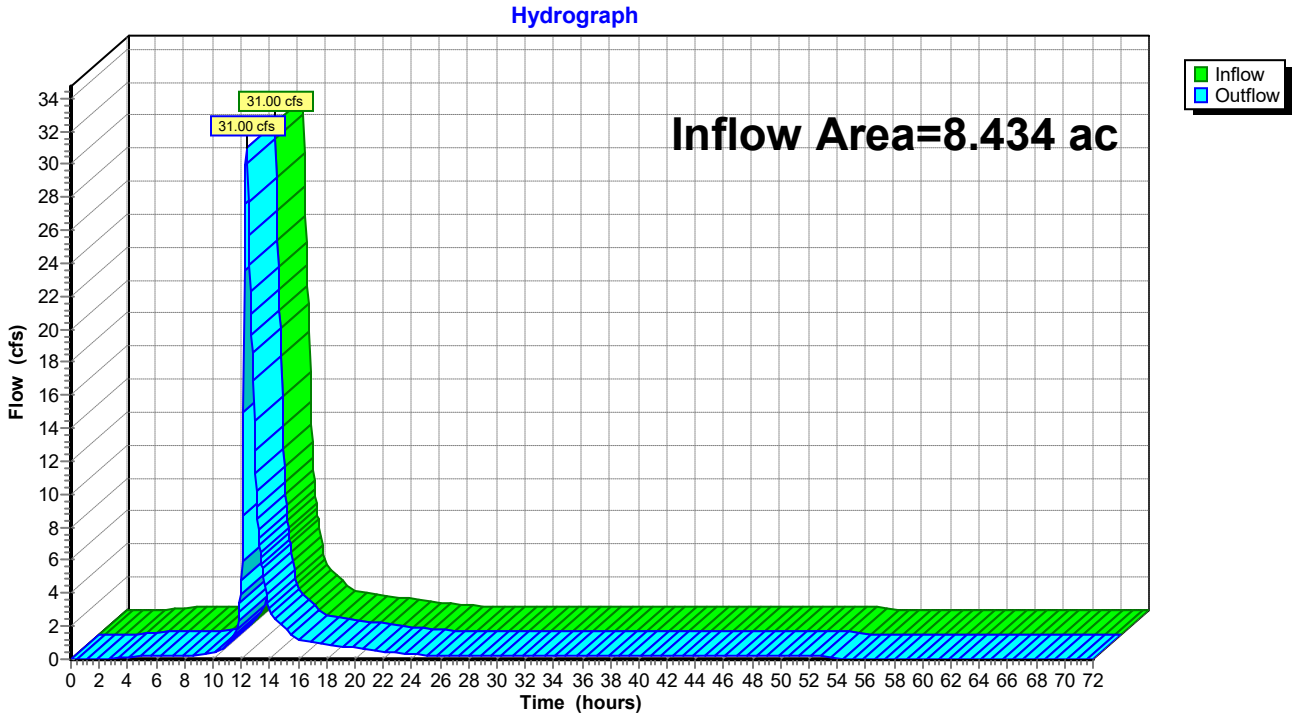
Summary for Reach 3R: SOUTH WEST

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.434 ac, 29.72% Impervious, Inflow Depth = 5.48" for 100-Year event
Inflow = 31.00 cfs @ 12.36 hrs, Volume= 3.851 af
Outflow = 31.00 cfs @ 12.36 hrs, Volume= 3.851 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 3R: SOUTH WEST



Summary for Pond 2P: BMP 2

Inflow Area = 2.573 ac, 68.99% Impervious, Inflow Depth = 6.30" for 100-Year event
Inflow = 20.44 cfs @ 12.19 hrs, Volume= 1.350 af
Outflow = 11.21 cfs @ 12.34 hrs, Volume= 1.350 af, Atten= 45%, Lag= 9.0 min
Primary = 11.09 cfs @ 12.34 hrs, Volume= 1.149 af
Routed to Reach 2R : SOUTH
Secondary = 0.12 cfs @ 12.34 hrs, Volume= 0.201 af
Routed to Reach 2R : SOUTH
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 2R : SOUTH

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 961.45' @ 12.34 hrs Surf.Area= 0.154 ac Storage= 0.374 af

Plug-Flow detention time= 150.3 min calculated for 1.349 af (100% of inflow)
Center-of-Mass det. time= 151.5 min (909.4 - 757.9)

Volume	Invert	Avail.Storage	Storage Description
#1	957.00'	0.634 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
957.00	0.032	0.000	0.000
958.00	0.049	0.040	0.040
959.00	0.068	0.058	0.099
960.00	0.105	0.086	0.185
961.00	0.140	0.123	0.308
962.00	0.171	0.156	0.463
963.00	0.171	0.171	0.634

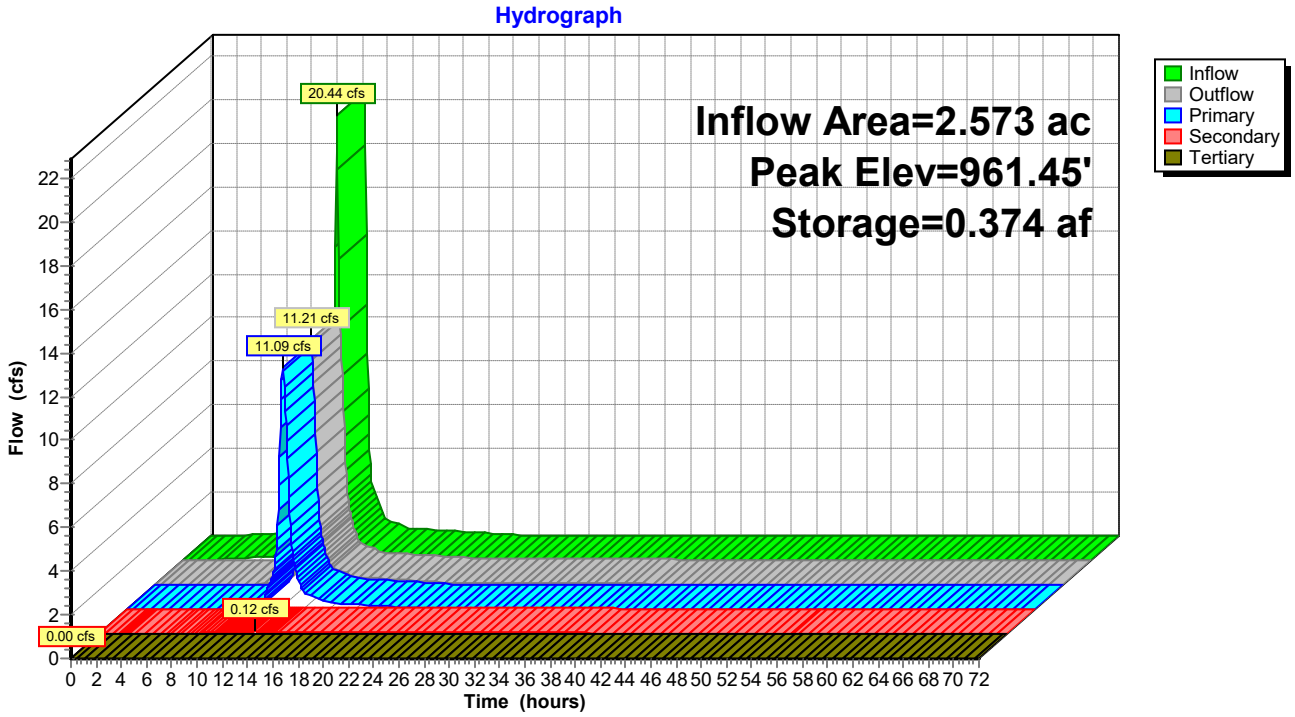
Device	Routing	Invert	Outlet Devices
#1	Device 2	957.00'	**0.800 in/hr Exfiltration over Surface area**
#2	Secondary	955.00'	**6.0" Vert. Draintile** C= 0.600 Limited to weir flow at low heads
#3	Tertiary	962.00'	**50.0' long SLL Overtop** Cv= 2.62 (C= 3.28)
#4	Primary	959.00'	**18.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 959.00' / 957.50' S= 0.0395 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=11.07 cfs @ 12.34 hrs HW=961.44' TW=0.00' (Dynamic Tailwater)
└**4=Culvert** (Inlet Controls 11.07 cfs @ 6.27 fps)

Secondary OutFlow Max=0.12 cfs @ 12.34 hrs HW=961.44' TW=0.00' (Dynamic Tailwater)
└**2=Draintile** (Passes 0.12 cfs of 2.35 cfs potential flow)
└**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=957.00' TW=0.00' (Dynamic Tailwater)
└**3=SLL Overtop** (Controls 0.00 cfs)

Pond 2P: BMP 2


Hydrograph
Inflow Area=2.573 ac
Peak Elev=961.45'
Storage=0.374 af
20.44 cfs
11.21 cfs
11.09 cfs
0.12 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Tertiary
Flow (cfs)
Time (hours)

Summary for Pond 6P: BMP 1

Inflow Area = 4.591 ac, 54.61% Impervious, Inflow Depth = 6.00" for 100-Year event
Inflow = 35.38 cfs @ 12.20 hrs, Volume= 2.294 af
Outflow = 12.86 cfs @ 12.43 hrs, Volume= 2.294 af, Atten= 64%, Lag= 14.2 min
Primary = 12.86 cfs @ 12.43 hrs, Volume= 2.294 af
Routed to Reach 3R : SOUTH WEST
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 3R : SOUTH WEST

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 965.36' @ 12.43 hrs Surf.Area= 0.379 ac Storage= 1.031 af

Plug-Flow detention time= 402.0 min calculated for 2.293 af (100% of inflow)
Center-of-Mass det. time= 403.0 min (1,167.1 - 764.1)

Volume	Invert	Avail.Storage	Storage Description
#1	962.00'	4.222 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

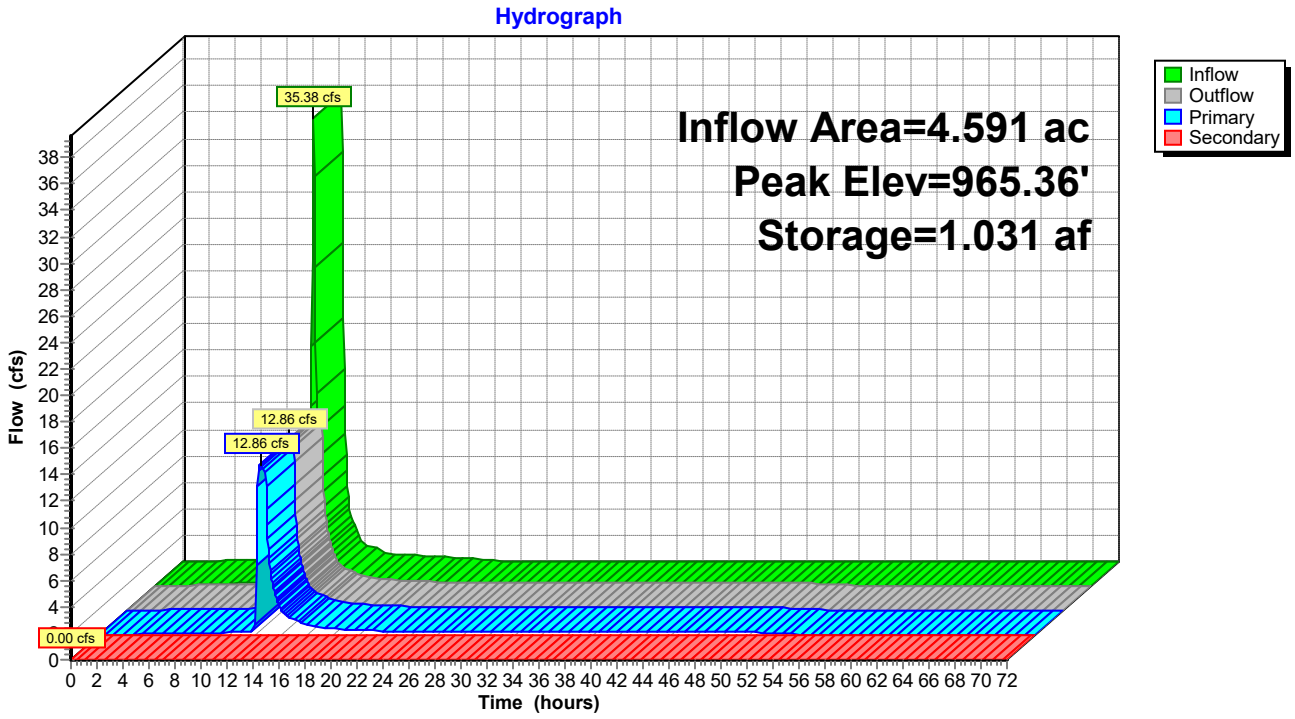
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
962.00	0.239	0.000	0.000
963.00	0.277	0.258	0.258
964.00	0.319	0.298	0.556
965.00	0.362	0.340	0.897
966.00	0.408	0.385	1.282
967.00	0.456	0.432	1.714
968.00	0.456	0.456	2.170
969.00	0.456	0.456	2.626
970.00	0.456	0.456	3.082
971.00	0.456	0.456	3.538
972.00	0.456	0.456	3.994
972.50	0.456	0.228	4.222

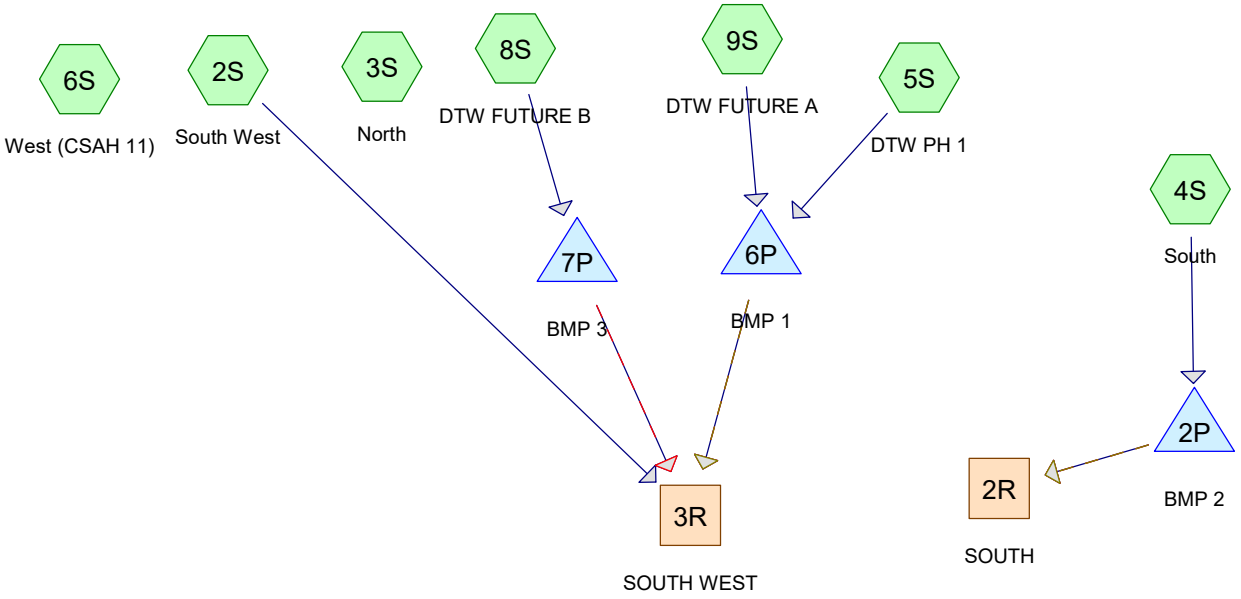
Device	Routing	Invert	Outlet Devices
#1	Device 2	962.00'	**0.800 in/hr Exfiltration over Surface area**
#2	Device 4	960.00'	**6.0" Vert. Draintile** C= 0.600 Limited to weir flow at low heads
#3	Secondary	967.30'	**50.0' long Road B** Cv= 2.62 (C= 3.28)
#4	Primary	960.00'	**15.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 960.00' / 959.81' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#5	Device 4	964.00'	**5.0' long x 0.8' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.74 2.78 2.86 3.00 3.11 3.18 3.25 3.29 3.32 3.31 3.32

Primary OutFlow Max=12.86 cfs @ 12.43 hrs HW=965.36' TW=0.00' (Dynamic Tailwater)
└─**4=Culvert** (Inlet Controls 12.86 cfs @ 10.48 fps)
  └─**2=Draintile** (Passes < 2.14 cfs potential flow)
    └─**1=Exfiltration** (Passes < 0.31 cfs potential flow)
  └─**5=Broad-Crested Rectangular Weir** (Passes < 25.63 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=962.00' TW=0.00' (Dynamic Tailwater)
└─**3=Road B** (Controls 0.00 cfs)

Pond 6P: BMP 1





Subcat Reach Pond Link

Routing Diagram for DTWest_Proposed-Future
Prepared by Kimley-Horn & Associates, Printed 9/16/2022

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-Year	MSE 24-hr	3	Default	24.00	1	2.47	2
2	10-Year	MSE 24-hr	3	Default	24.00	1	4.20	2
3	100-Year	MSE 24-hr	3	Default	24.00	1	7.18	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.383	98	(8S)
6.784	80	>75% Grass cover, Good, HSG D (2S, 3S, 4S, 5S, 6S, 8S, 9S)
1.018	98	Existing Stieger Lake Lane (4S)
1.456	98	Marco McLane Development (4S, 5S)
5.648	98	Paved roads w/curbs & sewers, HSG D (5S, 6S, 8S, 9S)
0.371	98	Proposed Stieger Lake Lane (4S)
16.660	**91**	**TOTAL AREA**

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: South West Runoff Area=0.885 ac 0.00% Impervious Runoff Depth=0.87"
Flow Length=935' Tc=25.4 min CN=80/0 Runoff=0.73 cfs 0.064 af

Subcatchment 3S: North Runoff Area=0.688 ac 0.00% Impervious Runoff Depth=0.87"
Tc=7.0 min CN=80/0 Runoff=1.03 cfs 0.050 af

Subcatchment 4S: South Runoff Area=2.573 ac 68.99% Impervious Runoff Depth=1.82"
Tc=12.0 min CN=80/98 Runoff=6.03 cfs 0.389 af

Subcatchment 5S: DTW PH 1 Runoff Area=4.591 ac 54.61% Impervious Runoff Depth=1.62"
Tc=7.0 min CN=80/98 Runoff=11.65 cfs 0.619 af

Subcatchment 6S: West (CSAH 11) Runoff Area=1.045 ac 21.34% Impervious Runoff Depth=1.16"
Tc=7.0 min CN=80/98 Runoff=1.99 cfs 0.101 af

Subcatchment 8S: DTW FUTURE B Runoff Area=5.496 ac 86.26% Impervious Runoff Depth=2.05"
Tc=7.0 min CN=80/98 Runoff=17.29 cfs 0.940 af

Subcatchment 9S: DTW FUTURE A Runoff Area=1.382 ac 45.59% Impervious Runoff Depth=1.49"
Tc=7.0 min CN=80/98 Runoff=3.27 cfs 0.172 af

Reach 2R: SOUTH Inflow=3.15 cfs 0.389 af
Outflow=3.15 cfs 0.389 af

Reach 3R: SOUTH WEST Inflow=1.36 cfs 1.796 af
Outflow=1.36 cfs 1.796 af

Pond 2P: BMP 2 Peak Elev=959.82' Storage=0.168 af Inflow=6.03 cfs 0.389 af
Primary=3.07 cfs 0.216 af Secondary=0.08 cfs 0.173 af Tertiary=0.00 cfs 0.000 af Outflow=3.15 cfs 0.389 af

Pond 6P: BMP 1 Peak Elev=963.97' Storage=0.545 af Inflow=14.91 cfs 0.791 af
Primary=0.26 cfs 0.791 af Secondary=0.00 cfs 0.000 af Outflow=0.26 cfs 0.791 af

Pond 7P: BMP 3 Peak Elev=963.48' Storage=0.596 af Inflow=17.29 cfs 0.940 af
Outflow=0.40 cfs 0.941 af

Total Runoff Area = 16.660 ac Runoff Volume = 2.335 af Average Runoff Depth = 1.68"
40.72% Pervious = 6.784 ac 59.28% Impervious = 9.876 ac

Summary for Subcatchment 2S: South West

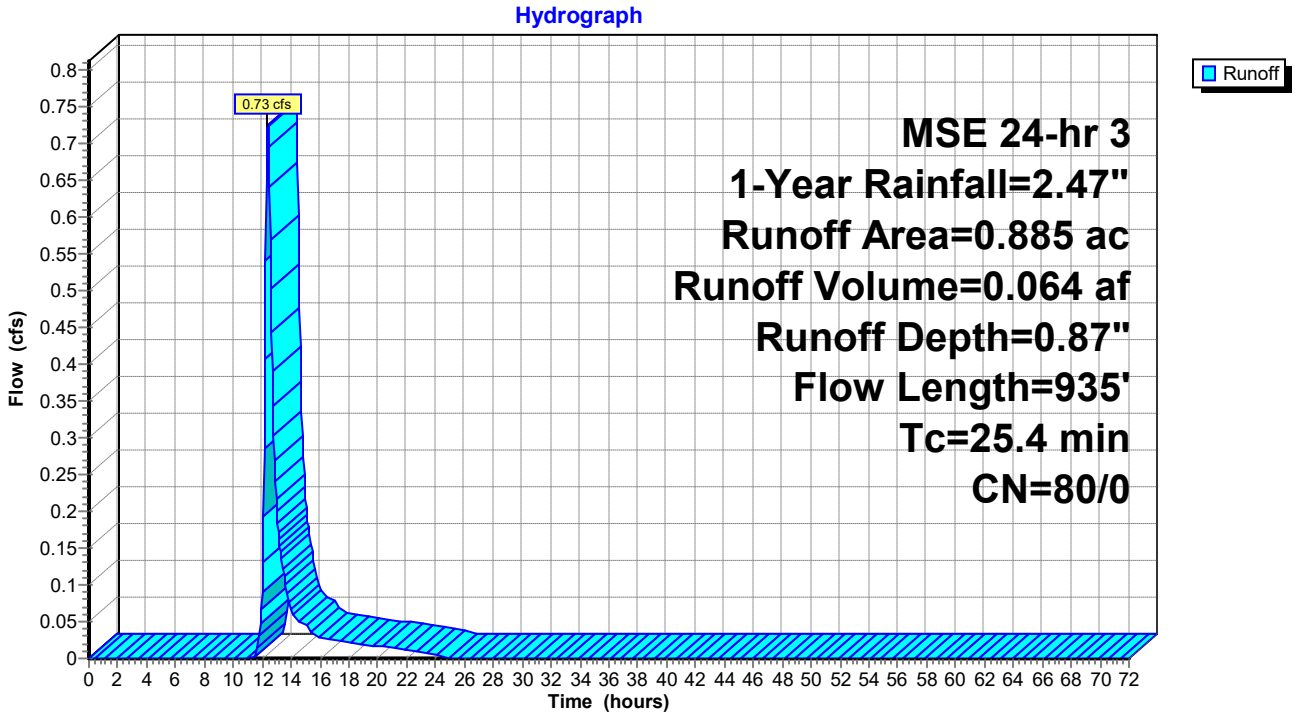
Runoff = 0.73 cfs @ 12.39 hrs, Volume= 0.064 af, Depth= 0.87"
Routed to Reach 3R : SOUTH WEST

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

Area (ac)	CN	Description
0.885	80	>75% Grass cover, Good, HSG D
0.885	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	80	0.0700	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.80"
3.0	250	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	110	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.7	45	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	90	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.0	220	0.0150	0.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.7	140	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
25.4	935	Total			

Subcatchment 2S: South West



Summary for Subcatchment 3S: North

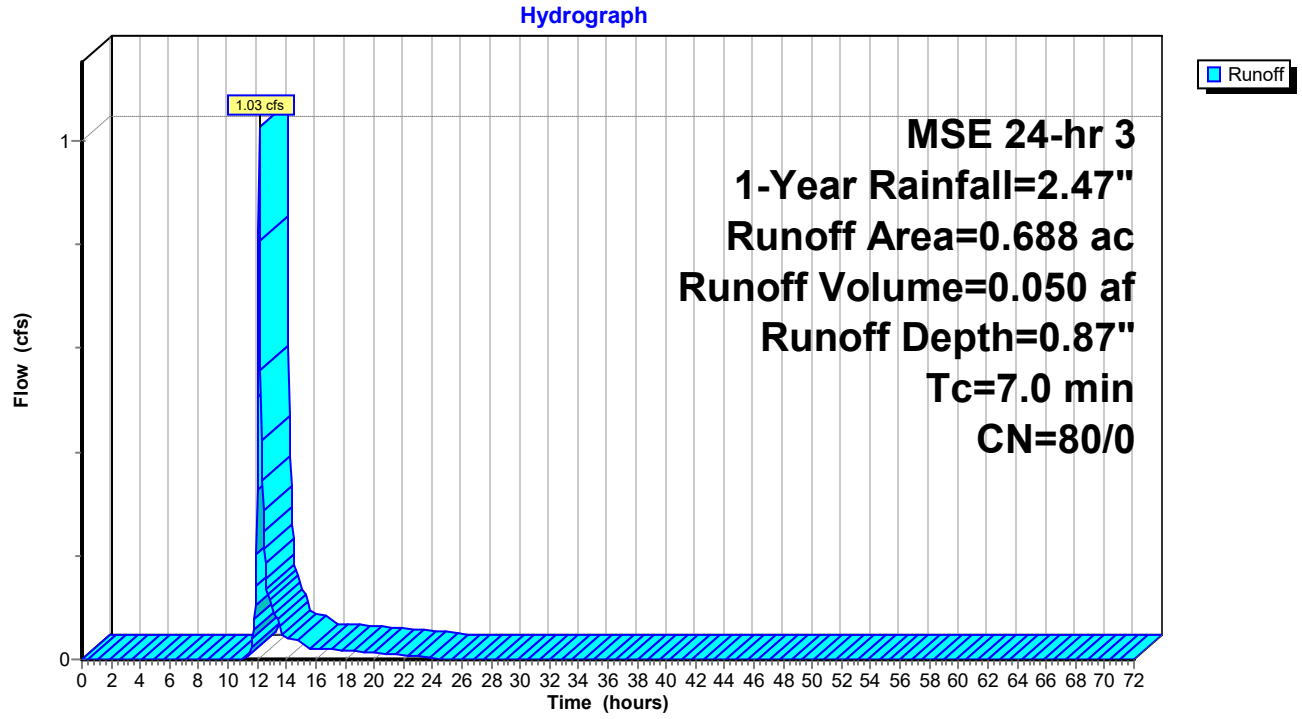
Runoff = 1.03 cfs @ 12.15 hrs, Volume= 0.050 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

Area (ac)	CN	Description
0.688	80	>75% Grass cover, Good, HSG D
0.688	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 3S: North



Summary for Subcatchment 4S: South

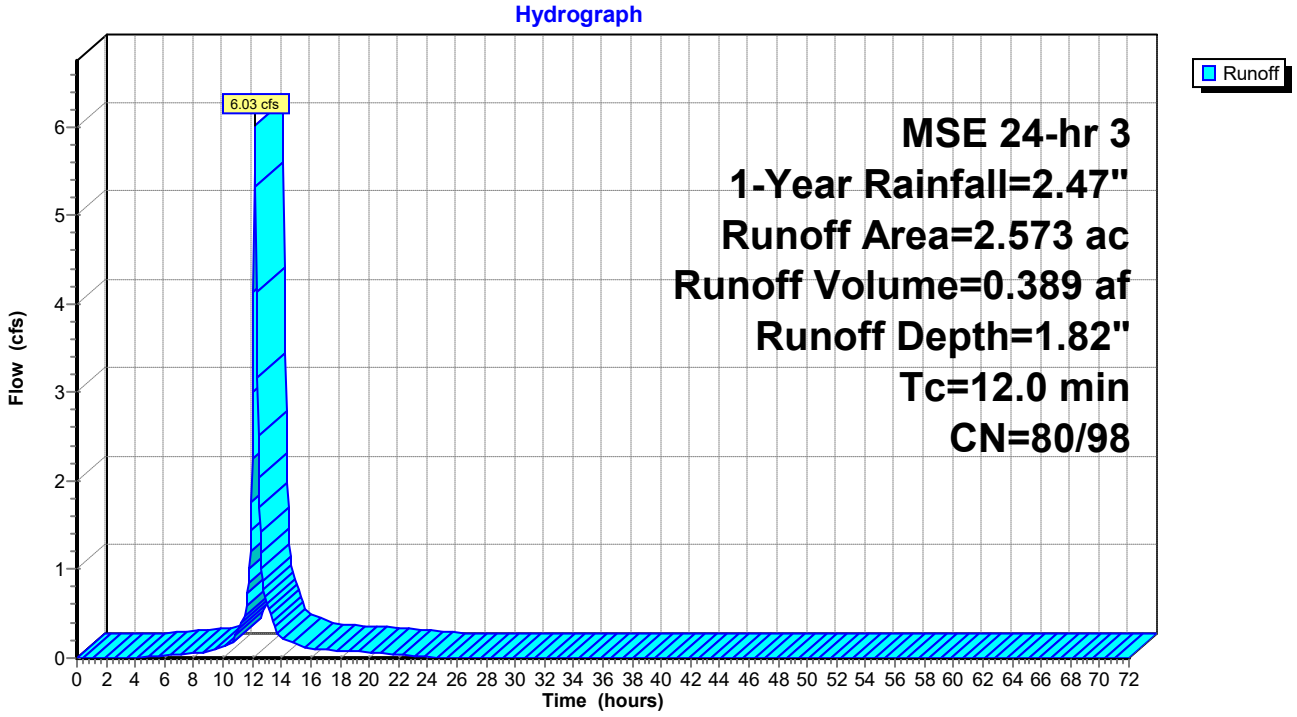
Runoff = 6.03 cfs @ 12.20 hrs, Volume= 0.389 af, Depth= 1.82"
Routed to Pond 2P : BMP 2

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

	Area (ac)	CN	Description
*	0.371	98	Proposed Stieger Lake Lane
	0.798	80	>75% Grass cover, Good, HSG D
*	1.018	98	Existing Stieger Lake Lane
*	0.386	98	Marco McLane Development
	2.573	92	Weighted Average
	0.798	80	31.01% Pervious Area
	1.775	98	68.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry, Roof Drain**

Subcatchment 4S: South



Summary for Subcatchment 5S: DTW PH 1

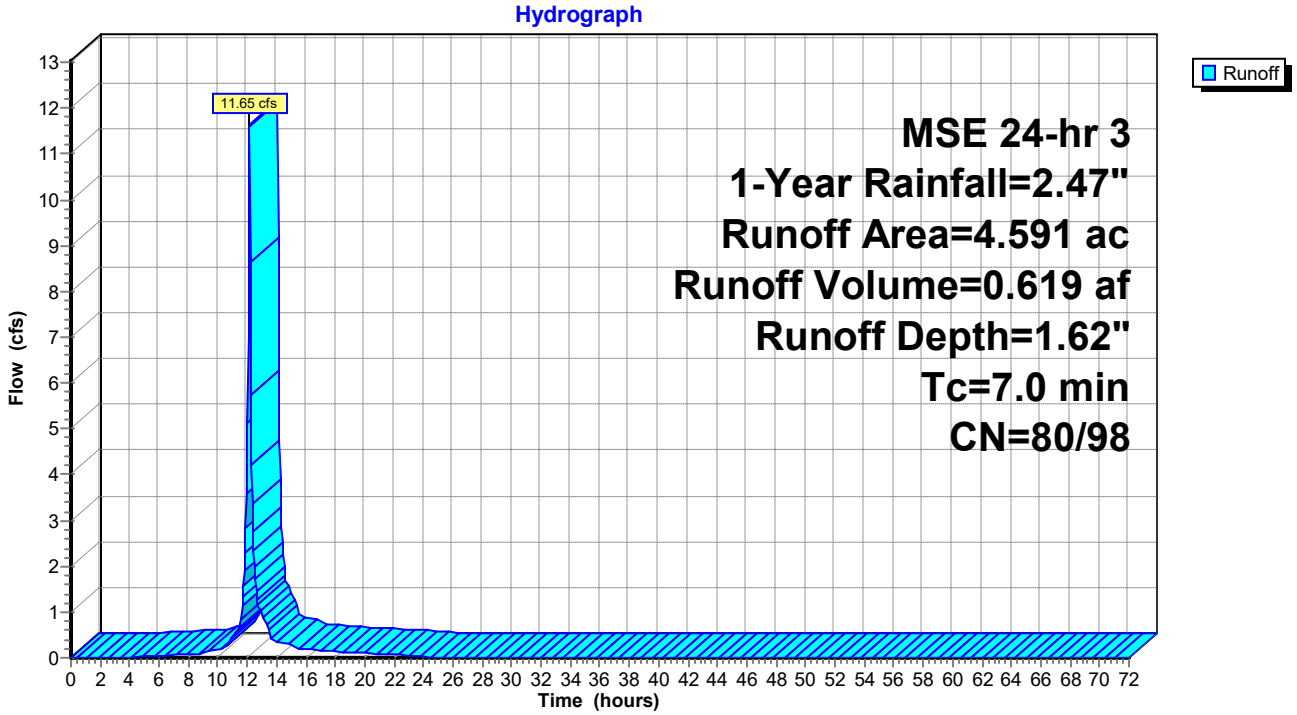
Runoff = 11.65 cfs @ 12.14 hrs, Volume= 0.619 af, Depth= 1.62"
Routed to Pond 6P : BMP 1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

	Area (ac)	CN	Description
	1.437	98	Paved roads w/curbs & sewers, HSG D
	2.084	80	>75% Grass cover, Good, HSG D
*	1.070	98	Marco McLane Development
	4.591	90	Weighted Average
	2.084	80	45.39% Pervious Area
	2.507	98	54.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 5S: DTW PH 1



Summary for Subcatchment 6S: West (CSAH 11)

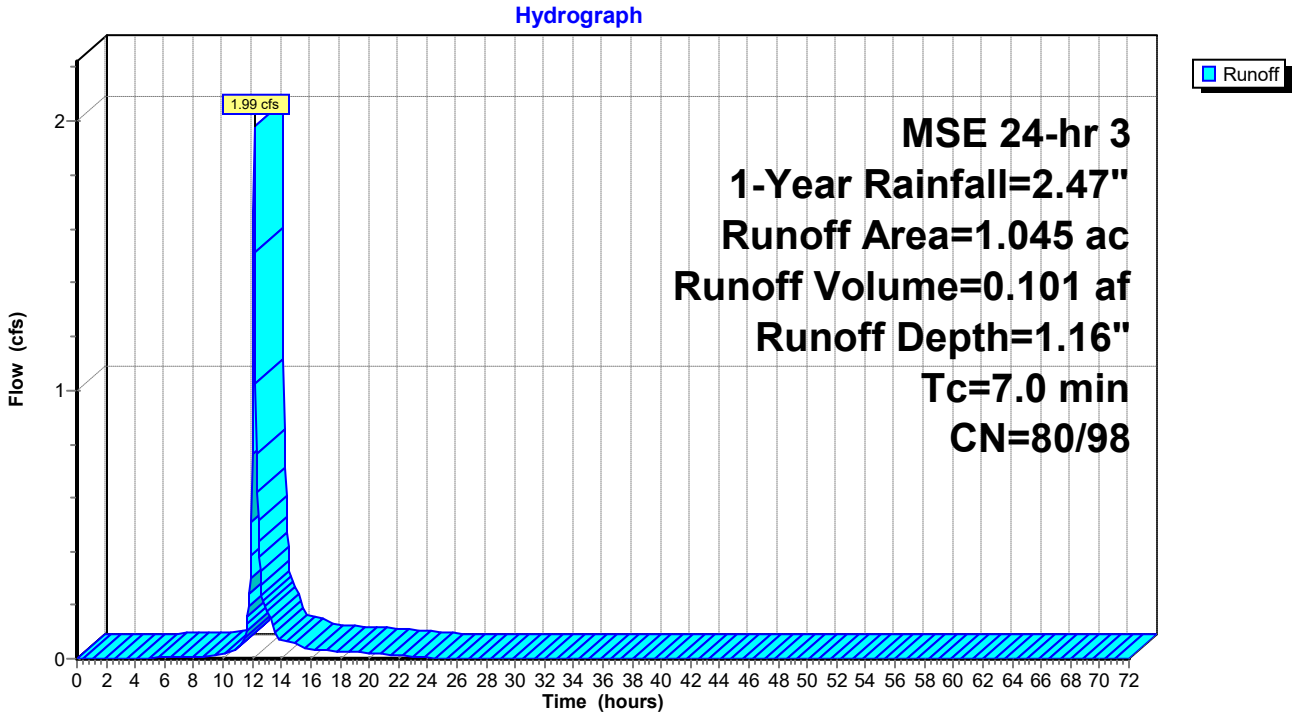
Runoff = 1.99 cfs @ 12.15 hrs, Volume= 0.101 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

Area (ac)	CN	Description
0.223	98	Paved roads w/curbs & sewers, HSG D
0.822	80	>75% Grass cover, Good, HSG D
1.045	84	Weighted Average
0.822	80	78.66% Pervious Area
0.223	98	21.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 6S: West (CSAH 11)



Summary for Subcatchment 8S: DTW FUTURE B

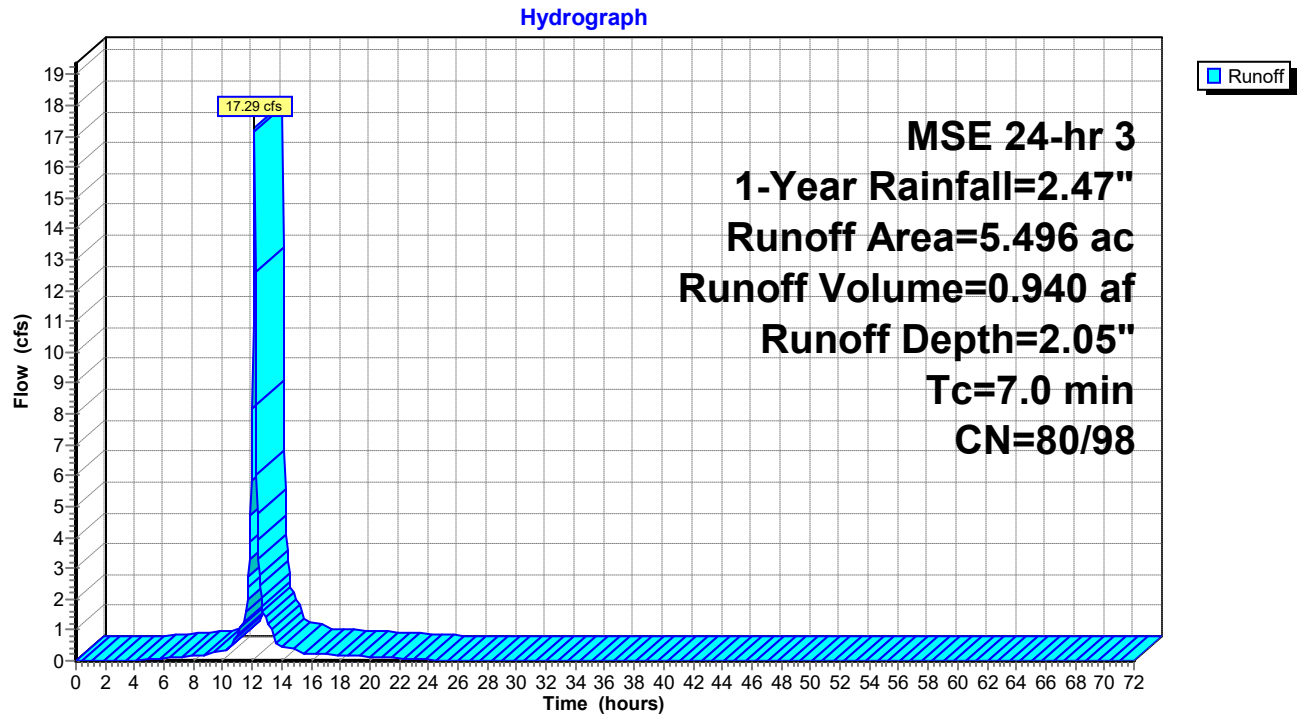
Runoff = 17.29 cfs @ 12.14 hrs, Volume= 0.940 af, Depth= 2.05"
Routed to Pond 7P : BMP 3

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

	Area (ac)	CN	Description
	3.358	98	Paved roads w/curbs & sewers, HSG D
	0.755	80	>75% Grass cover, Good, HSG D
*	1.383	98	
	5.496	96	Weighted Average
	0.755	80	13.74% Pervious Area
	4.741	98	86.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 8S: DTW FUTURE B



Summary for Subcatchment 9S: DTW FUTURE A

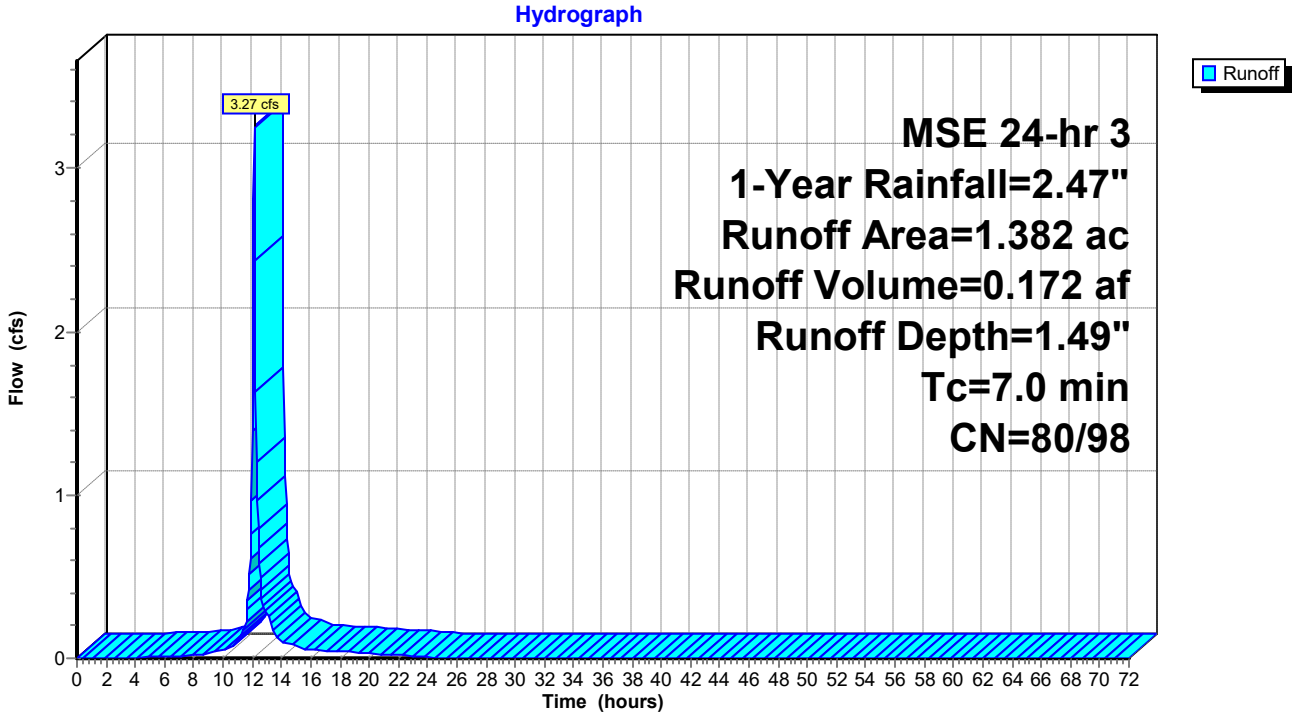
Runoff = 3.27 cfs @ 12.14 hrs, Volume= 0.172 af, Depth= 1.49"
Routed to Pond 6P : BMP 1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.47"

Area (ac)	CN	Description
0.630	98	Paved roads w/curbs & sewers, HSG D
0.752	80	>75% Grass cover, Good, HSG D
1.382	88	Weighted Average
0.752	80	54.41% Pervious Area
0.630	98	45.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 9S: DTW FUTURE A



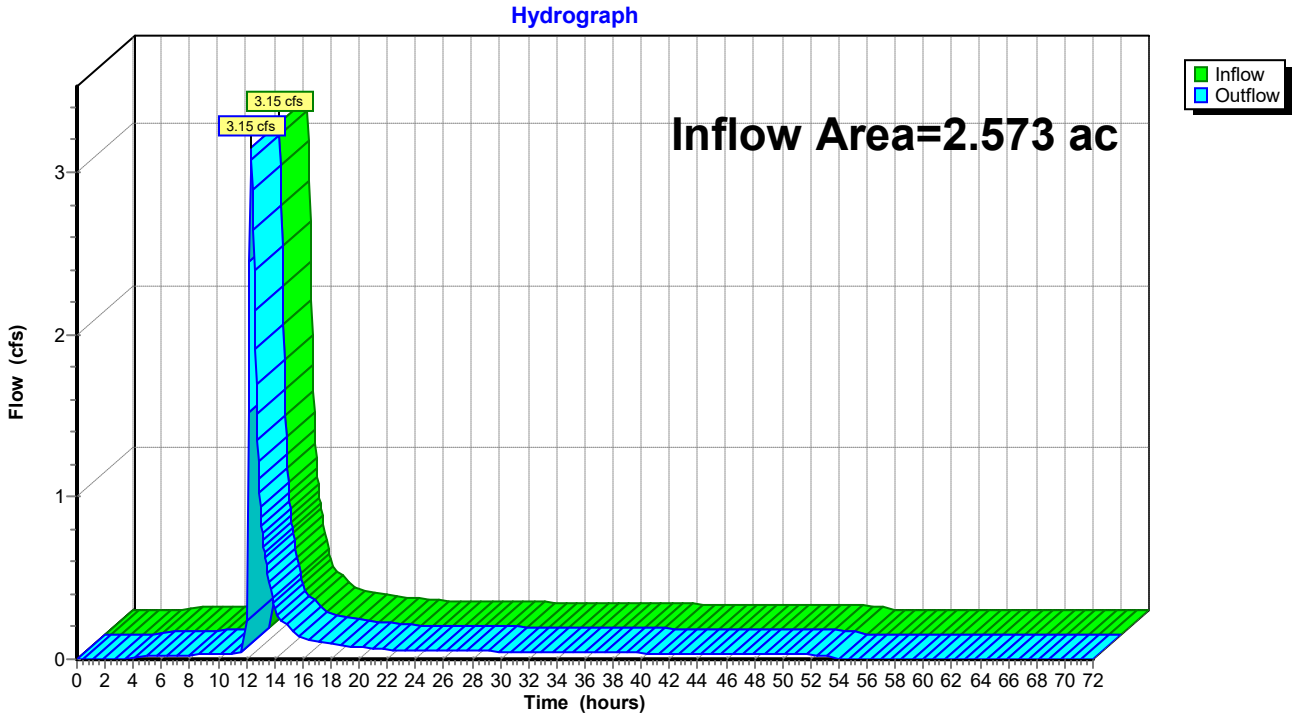
Summary for Reach 2R: SOUTH

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.573 ac, 68.99% Impervious, Inflow Depth = 1.82" for 1-Year event
Inflow = 3.15 cfs @ 12.36 hrs, Volume= 0.389 af
Outflow = 3.15 cfs @ 12.36 hrs, Volume= 0.389 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 2R: SOUTH



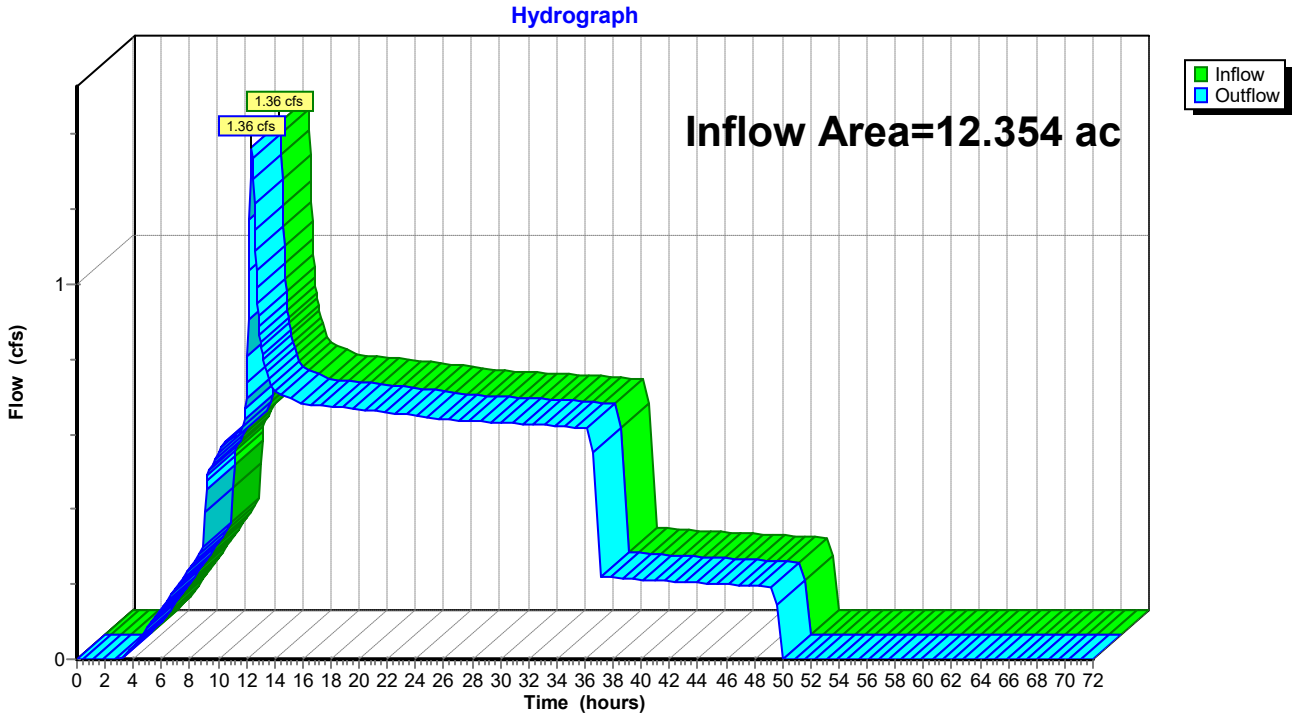
Summary for Reach 3R: SOUTH WEST

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 12.354 ac, 63.77% Impervious, Inflow Depth = 1.74" for 1-Year event
Inflow = 1.36 cfs @ 12.39 hrs, Volume= 1.796 af
Outflow = 1.36 cfs @ 12.39 hrs, Volume= 1.796 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 3R: SOUTH WEST



Summary for Pond 2P: BMP 2

Inflow Area = 2.573 ac, 68.99% Impervious, Inflow Depth = 1.82" for 1-Year event
Inflow = 6.03 cfs @ 12.20 hrs, Volume= 0.389 af
Outflow = 3.15 cfs @ 12.36 hrs, Volume= 0.389 af, Atten= 48%, Lag= 9.8 min
Primary = 3.07 cfs @ 12.36 hrs, Volume= 0.216 af
Routed to Reach 2R : SOUTH
Secondary = 0.08 cfs @ 12.36 hrs, Volume= 0.173 af
Routed to Reach 2R : SOUTH
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 2R : SOUTH

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 959.82' @ 12.36 hrs Surf.Area= 0.098 ac Storage= 0.168 af

Plug-Flow detention time= 403.6 min calculated for 0.389 af (100% of inflow)
Center-of-Mass det. time= 404.7 min (1,176.7 - 772.0)

Volume	Invert	Avail.Storage	Storage Description
#1	957.00'	0.635 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
957.00	0.032	0.000	0.000
958.00	0.049	0.040	0.040
959.00	0.068	0.059	0.099
960.00	0.105	0.087	0.186
961.00	0.140	0.123	0.308
962.00	0.171	0.156	0.464
963.00	0.171	0.171	0.635

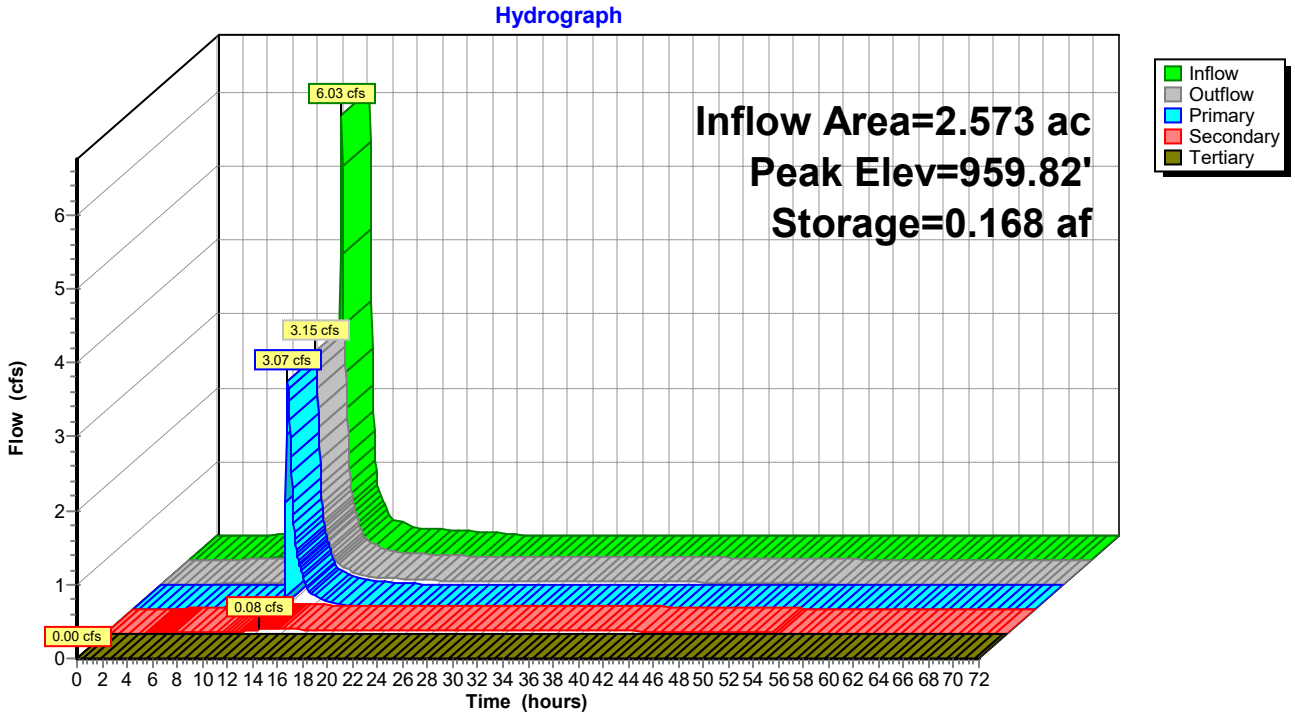
Device	Routing	Invert	Outlet Devices
#1	Device 2	957.00'	**0.800 in/hr Exfiltration over Surface area**
#2	Secondary	955.00'	**6.0" Vert. Draintile** C= 0.600 Limited to weir flow at low heads
#3	Tertiary	962.00'	**50.0' long SLL Overtop** Cv= 2.62 (C= 3.28)
#4	Primary	959.00'	**18.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 959.00' / 957.50' S= 0.0395 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=3.05 cfs @ 12.36 hrs HW=959.82' TW=0.00' (Dynamic Tailwater)
└**4=Culvert** (Inlet Controls 3.05 cfs @ 3.08 fps)

Secondary OutFlow Max=0.08 cfs @ 12.36 hrs HW=959.82' TW=0.00' (Dynamic Tailwater)
└**2=Draintile** (Passes 0.08 cfs of 2.02 cfs potential flow)
└**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=957.00' TW=0.00' (Dynamic Tailwater)
└**3=SLL Overtop** (Controls 0.00 cfs)

Pond 2P: BMP 2


Hydrograph
Inflow Area=2.573 ac
Peak Elev=959.82'
Storage=0.168 af
Inflow
Outflow
Primary
Secondary
Tertiary
6.03 cfs
3.15 cfs
3.07 cfs
0.08 cfs
0.00 cfs
Flow (cfs)
Time (hours)

Summary for Pond 6P: BMP 1

Inflow Area = 5.973 ac, 52.52% Impervious, Inflow Depth = 1.59" for 1-Year event
Inflow = 14.91 cfs @ 12.14 hrs, Volume= 0.791 af
Outflow = 0.26 cfs @ 15.22 hrs, Volume= 0.791 af, Atten= 98%, Lag= 184.5 min
Primary = 0.26 cfs @ 15.22 hrs, Volume= 0.791 af
Routed to Reach 3R : SOUTH WEST
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 3R : SOUTH WEST

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 963.97' @ 15.22 hrs Surf.Area= 0.317 ac Storage= 0.545 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 902.3 min (1,677.3 - 775.0)

Volume	Invert	Avail.Storage	Storage Description
#1	962.00'	4.222 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

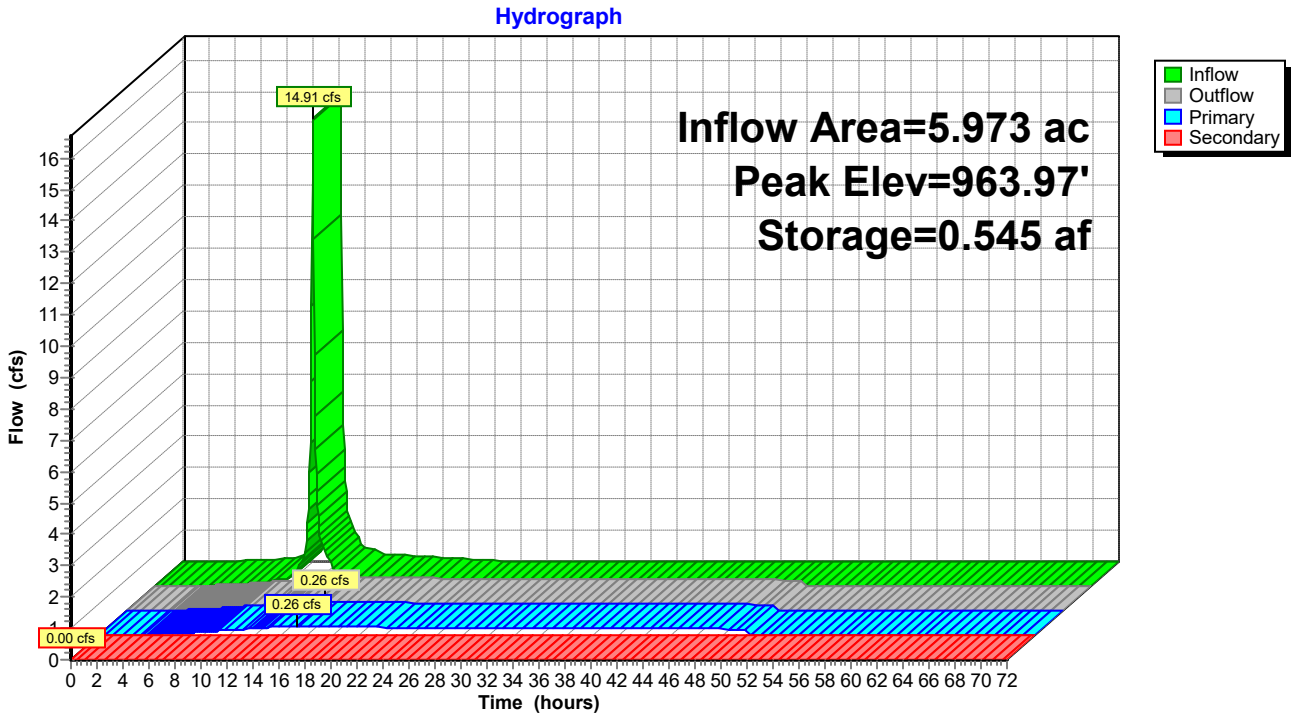
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
962.00	0.239	0.000	0.000
963.00	0.277	0.258	0.258
964.00	0.319	0.298	0.556
965.00	0.362	0.340	0.897
966.00	0.408	0.385	1.282
967.00	0.456	0.432	1.714
968.00	0.456	0.456	2.170
969.00	0.456	0.456	2.626
970.00	0.456	0.456	3.082
971.00	0.456	0.456	3.538
972.00	0.456	0.456	3.994
972.50	0.456	0.228	4.222

Device	Routing	Invert	Outlet Devices
#1	Device 2	962.00'	**0.800 in/hr Exfiltration over Surface area**
#2	Device 4	960.00'	**6.0" Vert. Draintile** C= 0.600 Limited to weir flow at low heads
#3	Secondary	967.30'	**50.0' long Road B** Cv= 2.62 (C= 3.28)
#4	Primary	960.00'	**15.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 960.00' / 959.62' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#5	Device 4	964.00'	**5.0' long x 0.8' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.74 2.78 2.86 3.00 3.11 3.18 3.25 3.29 3.32 3.31 3.32

Primary OutFlow Max=0.26 cfs @ 15.22 hrs HW=963.97' TW=0.00' (Dynamic Tailwater)
└─**4=Culvert** (Passes 0.26 cfs of 10.80 cfs potential flow)
  ├─**2=Draintile** (Passes 0.26 cfs of 1.82 cfs potential flow)
  │ └─**1=Exfiltration** (Exfiltration Controls 0.26 cfs)
  └─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=962.00' TW=0.00' (Dynamic Tailwater)
└─**3=Road B** (Controls 0.00 cfs)

Pond 6P: BMP 1



Summary for Pond 7P: BMP 3

Inflow Area = 5.496 ac, 86.26% Impervious, Inflow Depth = 2.05" for 1-Year event
Inflow = 17.29 cfs @ 12.14 hrs, Volume= 0.940 af
Outflow = 0.40 cfs @ 11.00 hrs, Volume= 0.941 af, Atten= 98%, Lag= 0.0 min
Primary = 0.40 cfs @ 11.00 hrs, Volume= 0.941 af
Routed to Reach 3R : SOUTH WEST

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 963.48' @ 15.04 hrs Surf.Area= 0.491 ac Storage= 0.596 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 576.0 min (1,337.2 - 761.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	961.50'	0.571 af	**138.00'W x 155.00'L x 5.00'H Field A** 2.455 af Overall - 1.028 af Embedded = 1.427 af x 40.0% Voids
#2A	962.00'	1.028 af	**CMP Round 48** x 161 Inside #1 Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf Overall Size= 48.0"W x 48.0"H x 20.00'L Row Length Adjustment= +9.00' x 12.57 sf x 23 rows 136.00' Header x 12.57 sf x 1 = 1,709.0 cf Inside
		1.599 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 3	959.50'	**6.0" Vert. Tile** X 3 rows with 8.0" cc spacing C= 0.600 Limited to weir flow at low heads
#2	Device 1	961.50'	**0.800 in/hr Filtration over Surface area**
#3	Primary	960.50'	**15.0" Round Culvert** L= 100.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 959.50' / 960.50' S= -0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#4	Device 3	964.10'	**5.0' long x 0.8' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.74 2.78 2.86 3.00 3.11 3.18 3.25 3.29 3.32 3.31 3.32

Primary OutFlow Max=0.40 cfs @ 11.00 hrs HW=961.55' TW=0.00' (Dynamic Tailwater)
- **3=Culvert** (Passes 0.40 cfs of 3.85 cfs potential flow)
  - **1=Tile** (Passes 0.40 cfs of 2.59 cfs potential flow)
    - **2=Filtration** (Exfiltration Controls 0.40 cfs)
  - **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 7P: BMP 3 - Chamber Wizard Field A

Chamber Model = CMP Round 48 (Round Corrugated Metal Pipe)
Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
Overall Size= 48.0"W x 48.0"H x 20.00'L
Row Length Adjustment= +9.00' x 12.57 sf x 23 rows

48.0" Wide + 24.0" Spacing = 72.0" C-C Row Spacing

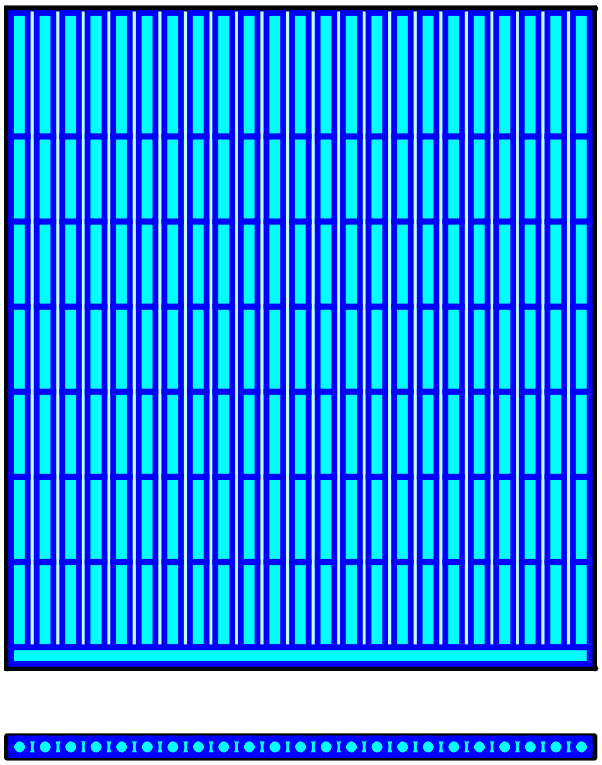
7 Chambers/Row x 20.00' Long +9.00' Row Adjustment +4.00' Header x 1 = 153.00' Row Length +12.0" End Stone x 2 = 155.00' Base Length
23 Rows x 48.0" Wide + 24.0" Spacing x 22 + 12.0" Side Stone x 2 = 138.00' Base Width
6.0" Stone Base + 48.0" Chamber Height + 6.0" Stone Cover = 5.00' Field Height

161 Chambers x 251.3 cf +9.00' Row Adjustment x 12.57 sf x 23 Rows + 136.00' Header x 12.57 sf = 44,774.0 cf Chamber Storage

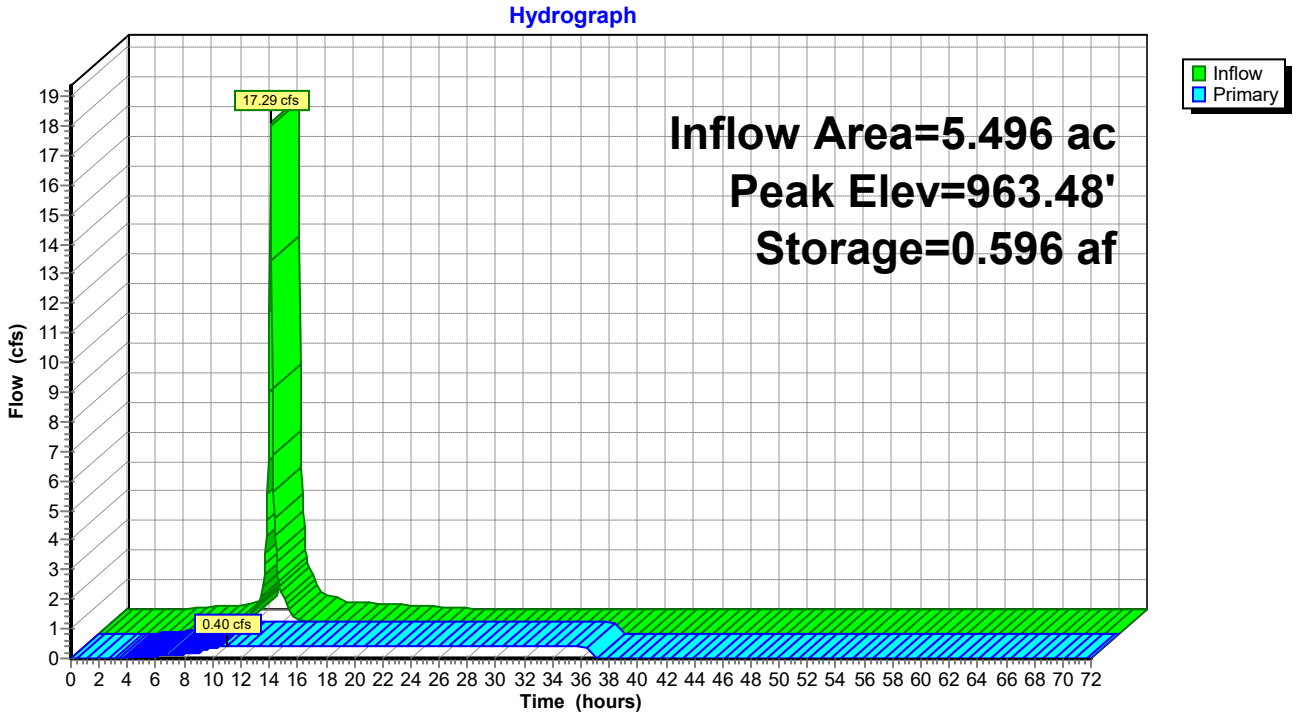
106,950.0 cf Field - 44,774.0 cf Chambers = 62,176.0 cf Stone x 40.0% Voids = 24,870.4 cf Stone Storage

Chamber Storage + Stone Storage = 69,644.4 cf = 1.599 af
Overall Storage Efficiency = 65.1%
Overall System Size = 155.00' x 138.00' x 5.00'

161 Chambers
3,961.1 cy Field
2,302.8 cy Stone



Pond 7P: BMP 3


Hydrograph
Inflow
Primary
17.29 cfs
0.40 cfs
Inflow Area=5.496 ac
Peak Elev=963.48'
Storage=0.596 af
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: South West Runoff Area=0.885 ac 0.00% Impervious Runoff Depth=2.21"
Flow Length=935' Tc=25.4 min CN=80/0 Runoff=1.92 cfs 0.163 af

Subcatchment 3S: North Runoff Area=0.688 ac 0.00% Impervious Runoff Depth=2.21"
Tc=7.0 min CN=80/0 Runoff=2.64 cfs 0.127 af

Subcatchment 4S: South Runoff Area=2.573 ac 68.99% Impervious Runoff Depth=3.42"
Tc=12.0 min CN=80/98 Runoff=11.24 cfs 0.733 af

Subcatchment 5S: DTW PH 1 Runoff Area=4.591 ac 54.61% Impervious Runoff Depth=3.17"
Tc=7.0 min CN=80/98 Runoff=22.70 cfs 1.212 af

Subcatchment 6S: West (CSAH 11) Runoff Area=1.045 ac 21.34% Impervious Runoff Depth=2.58"
Tc=7.0 min CN=80/98 Runoff=4.46 cfs 0.225 af

Subcatchment 8S: DTW FUTURE B Runoff Area=5.496 ac 86.26% Impervious Runoff Depth=3.72"
Tc=7.0 min CN=80/98 Runoff=30.72 cfs 1.705 af

Subcatchment 9S: DTW FUTURE A Runoff Area=1.382 ac 45.59% Impervious Runoff Depth=3.01"
Tc=7.0 min CN=80/98 Runoff=6.58 cfs 0.347 af

Reach 2R: SOUTH Inflow=7.36 cfs 0.733 af
Outflow=7.36 cfs 0.733 af

Reach 3R: SOUTH WEST Inflow=11.63 cfs 3.427 af
Outflow=11.63 cfs 3.427 af

Pond 2P: BMP 2 Peak Elev=960.47' Storage=0.239 af Inflow=11.24 cfs 0.733 af
Primary=7.26 cfs 0.546 af Secondary=0.10 cfs 0.187 af Tertiary=0.00 cfs 0.000 af Outflow=7.36 cfs 0.733 af

Pond 6P: BMP 1 Peak Elev=964.64' Storage=0.768 af Inflow=29.27 cfs 1.558 af
Primary=7.64 cfs 1.558 af Secondary=0.00 cfs 0.000 af Outflow=7.64 cfs 1.558 af

Pond 7P: BMP 3 Peak Elev=964.44' Storage=0.973 af Inflow=30.72 cfs 1.705 af
Outflow=3.18 cfs 1.705 af

Total Runoff Area = 16.660 ac Runoff Volume = 4.511 af Average Runoff Depth = 3.25"
40.72% Pervious = 6.784 ac 59.28% Impervious = 9.876 ac

Summary for Subcatchment 2S: South West

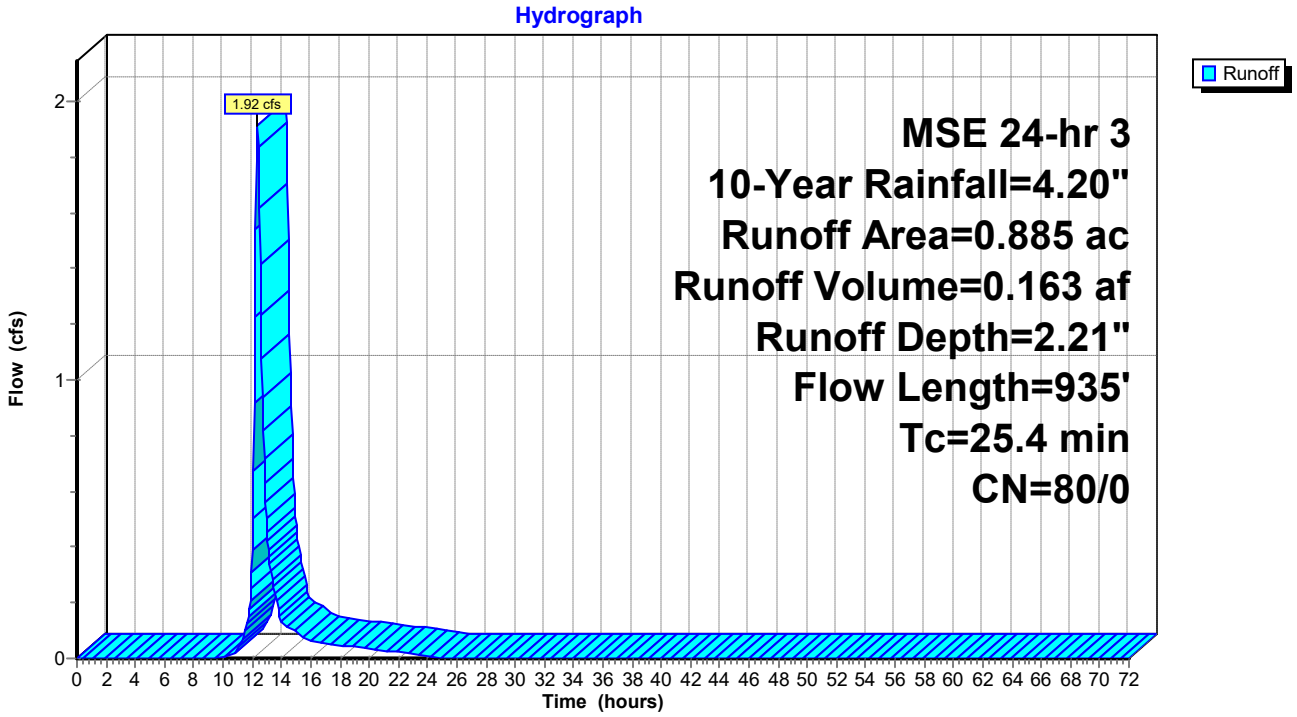
Runoff = 1.92 cfs @ 12.37 hrs, Volume= 0.163 af, Depth= 2.21"
Routed to Reach 3R : SOUTH WEST

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

Area (ac)	CN	Description
0.885	80	>75% Grass cover, Good, HSG D
0.885	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	80	0.0700	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.80"
3.0	250	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	110	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.7	45	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	90	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.0	220	0.0150	0.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.7	140	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
25.4	935	Total			

Subcatchment 2S: South West



Summary for Subcatchment 3S: North

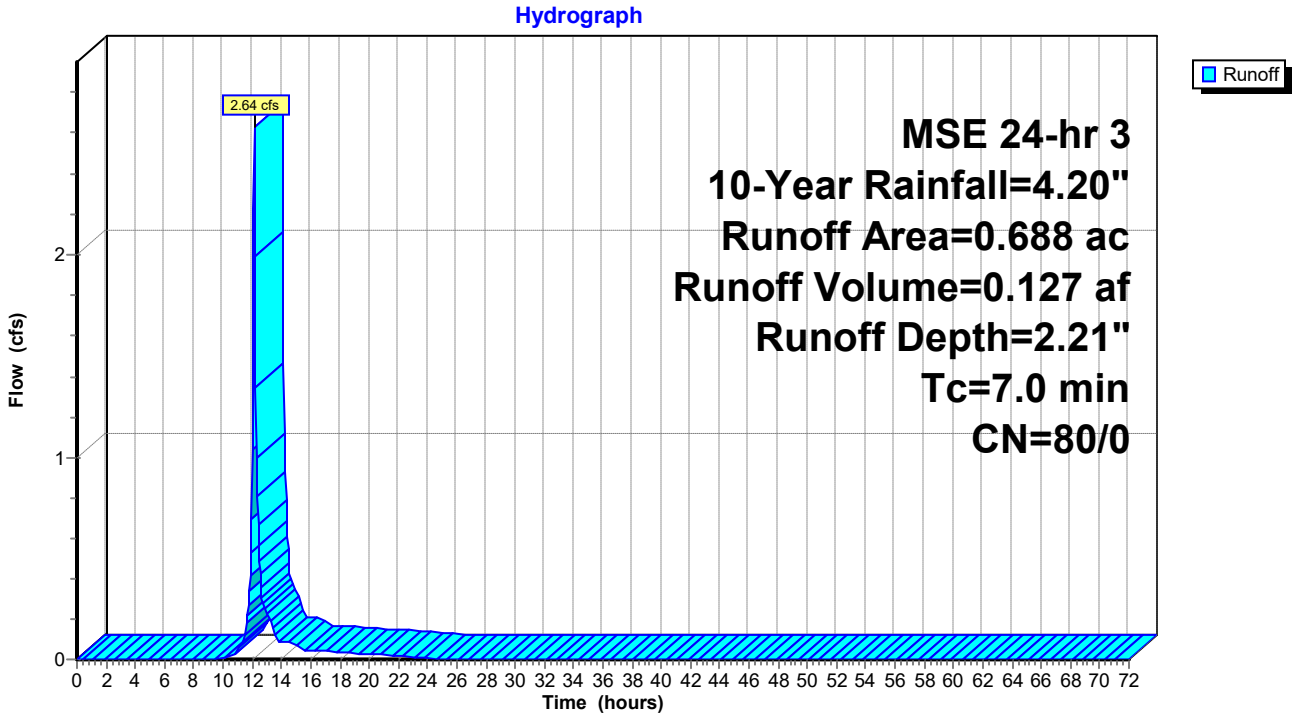
Runoff = 2.64 cfs @ 12.14 hrs, Volume= 0.127 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

Area (ac)	CN	Description
0.688	80	>75% Grass cover, Good, HSG D
0.688	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 3S: North



Summary for Subcatchment 4S: South

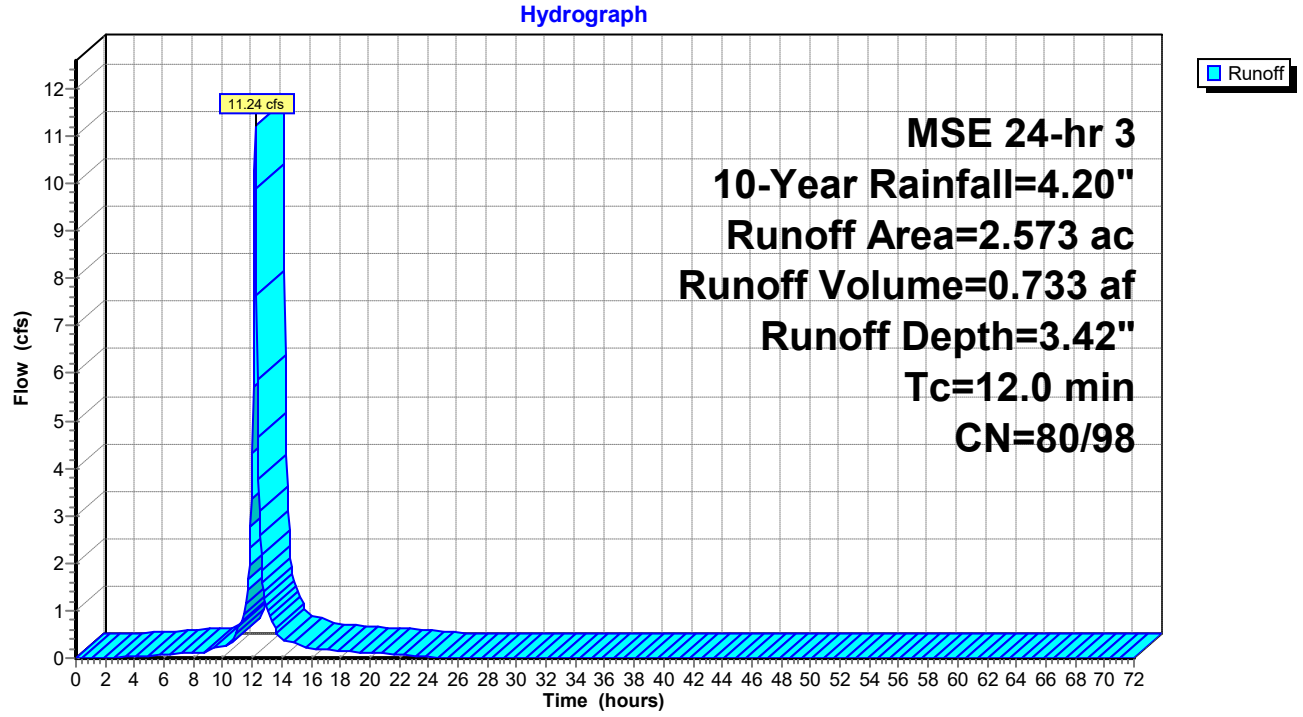
Runoff = 11.24 cfs @ 12.20 hrs, Volume= 0.733 af, Depth= 3.42"
Routed to Pond 2P : BMP 2

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (ac)	CN	Description
*	0.371	98	Proposed Stieger Lake Lane
	0.798	80	>75% Grass cover, Good, HSG D
*	1.018	98	Existing Stieger Lake Lane
*	0.386	98	Marco McLane Development
	2.573	92	Weighted Average
	0.798	80	31.01% Pervious Area
	1.775	98	68.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry, Roof Drain**

Subcatchment 4S: South



Summary for Subcatchment 5S: DTW PH 1

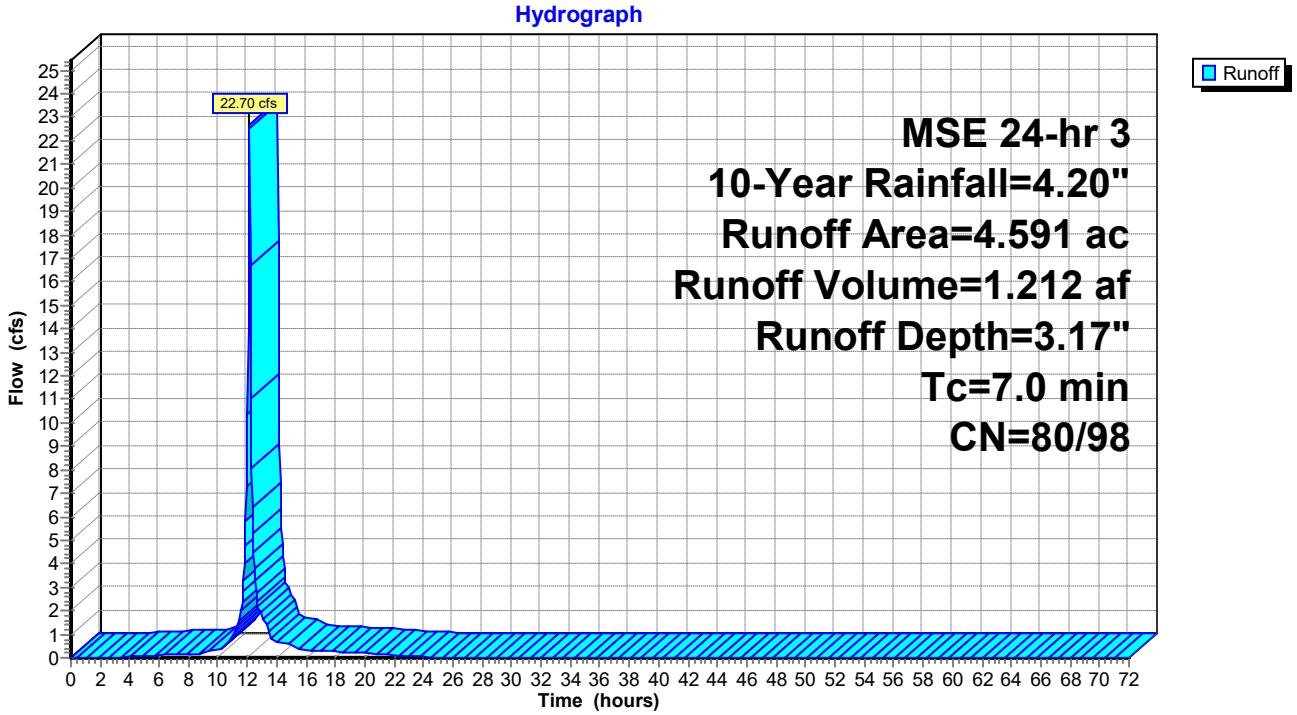
Runoff = 22.70 cfs @ 12.14 hrs, Volume= 1.212 af, Depth= 3.17"
Routed to Pond 6P : BMP 1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (ac)	CN	Description
	1.437	98	Paved roads w/curbs & sewers, HSG D
	2.084	80	>75% Grass cover, Good, HSG D
*	1.070	98	Marco McLane Development
	4.591	90	Weighted Average
	2.084	80	45.39% Pervious Area
	2.507	98	54.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 5S: DTW PH 1



Summary for Subcatchment 6S: West (CSAH 11)

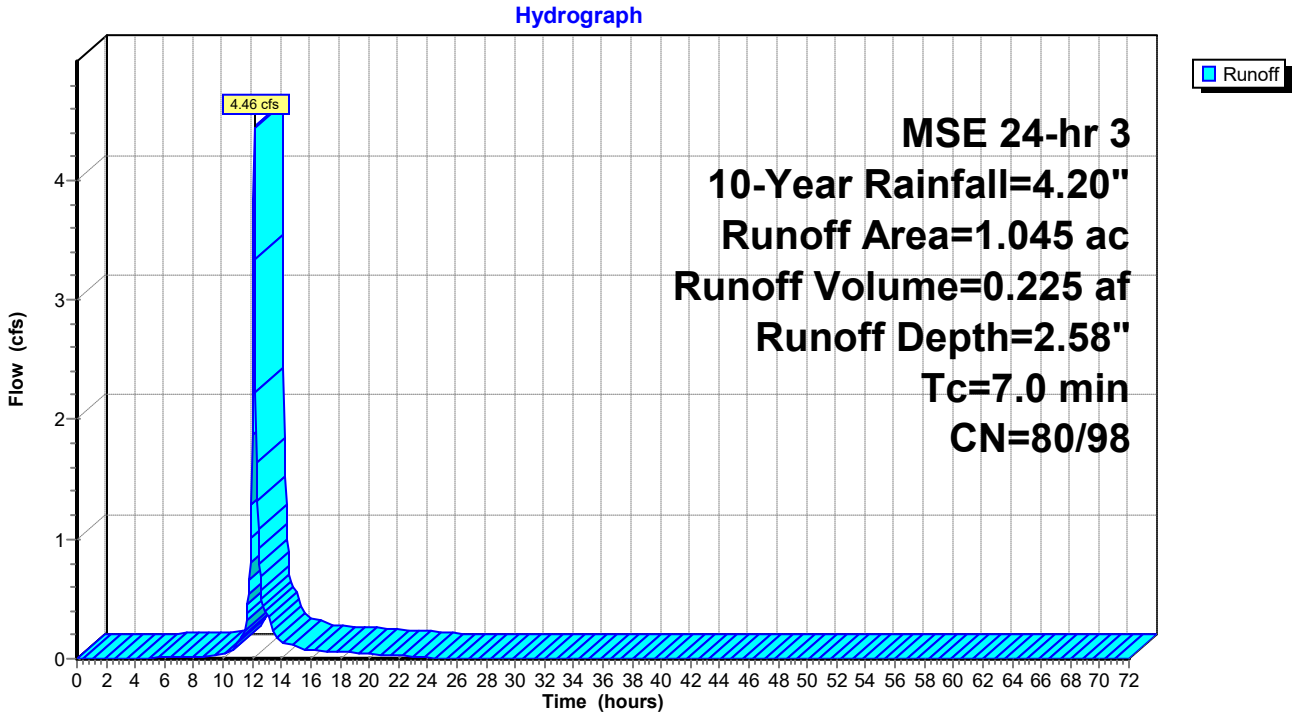
Runoff = 4.46 cfs @ 12.14 hrs, Volume= 0.225 af, Depth= 2.58"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

Area (ac)	CN	Description
0.223	98	Paved roads w/curbs & sewers, HSG D
0.822	80	>75% Grass cover, Good, HSG D
1.045	84	Weighted Average
0.822	80	78.66% Pervious Area
0.223	98	21.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 6S: West (CSAH 11)



Summary for Subcatchment 8S: DTW FUTURE B

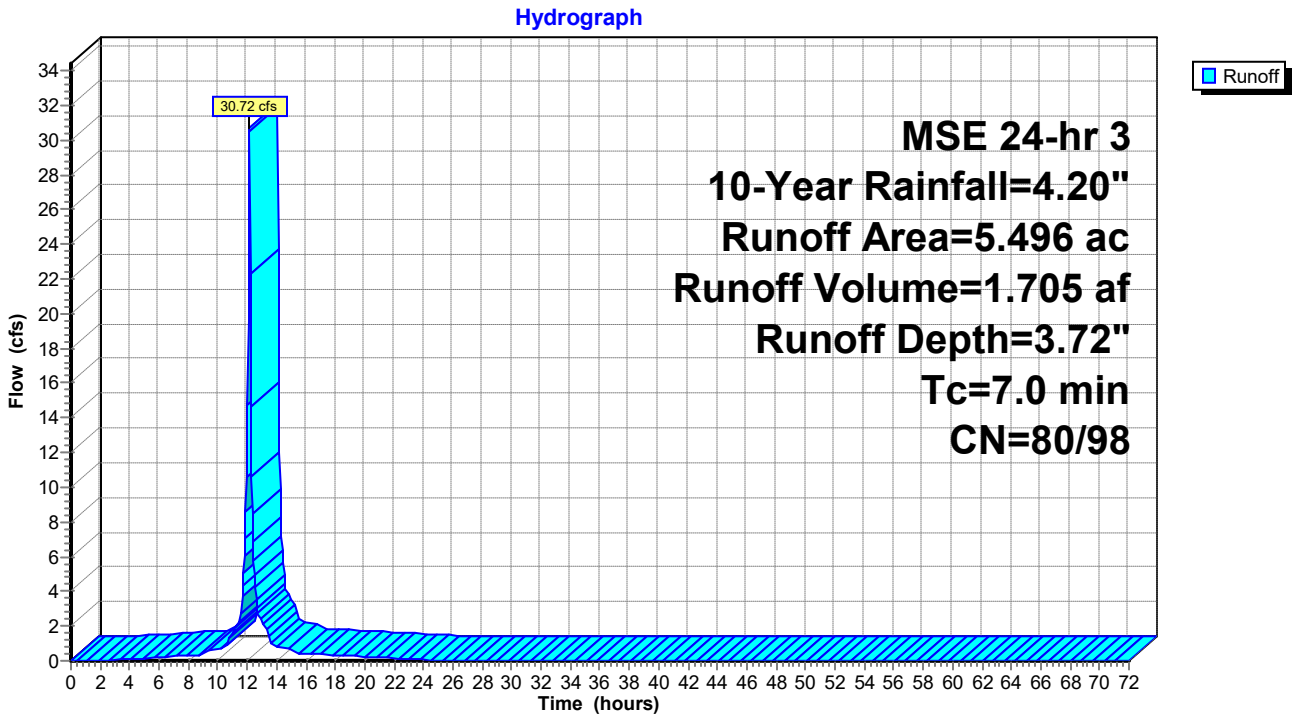
Runoff = 30.72 cfs @ 12.14 hrs, Volume= 1.705 af, Depth= 3.72"
Routed to Pond 7P : BMP 3

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (ac)	CN	Description
	3.358	98	Paved roads w/curbs & sewers, HSG D
	0.755	80	>75% Grass cover, Good, HSG D
*	1.383	98	
	5.496	96	Weighted Average
	0.755	80	13.74% Pervious Area
	4.741	98	86.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 8S: DTW FUTURE B



Summary for Subcatchment 9S: DTW FUTURE A

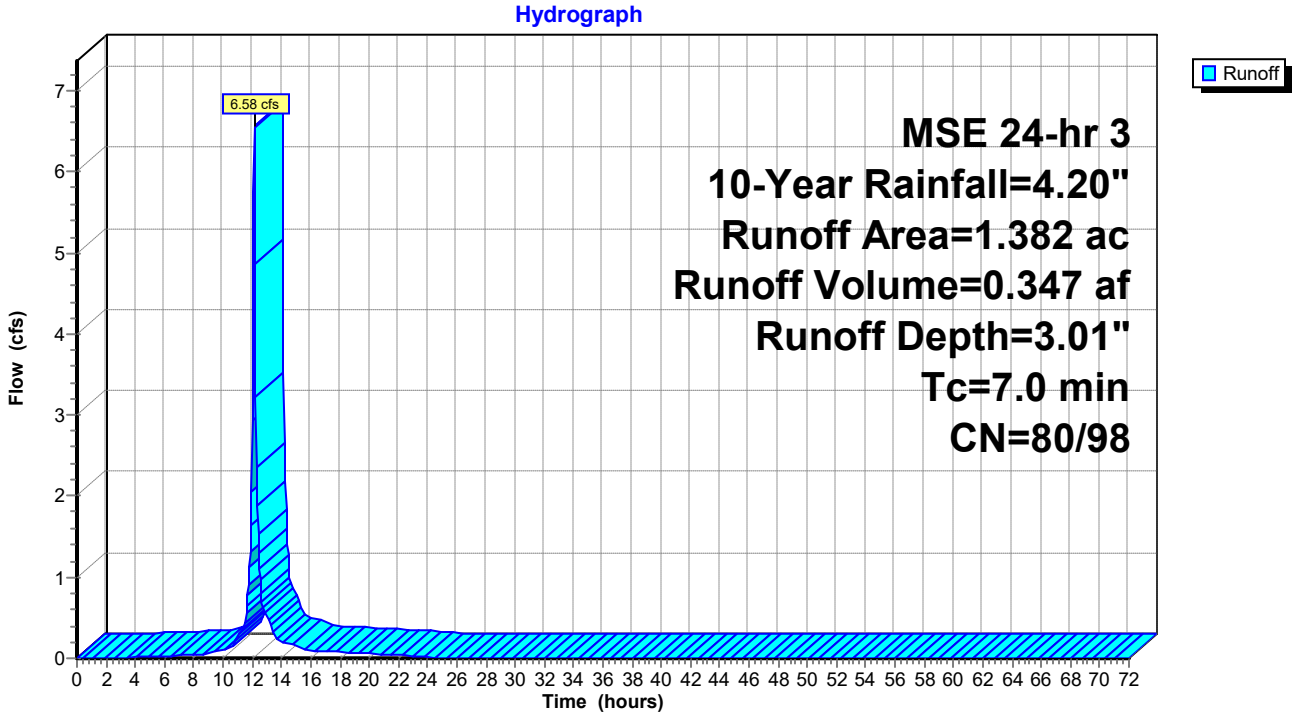
Runoff = 6.58 cfs @ 12.14 hrs, Volume= 0.347 af, Depth= 3.01"
Routed to Pond 6P : BMP 1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

Area (ac)	CN	Description
0.630	98	Paved roads w/curbs & sewers, HSG D
0.752	80	>75% Grass cover, Good, HSG D
1.382	88	Weighted Average
0.752	80	54.41% Pervious Area
0.630	98	45.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 9S: DTW FUTURE A



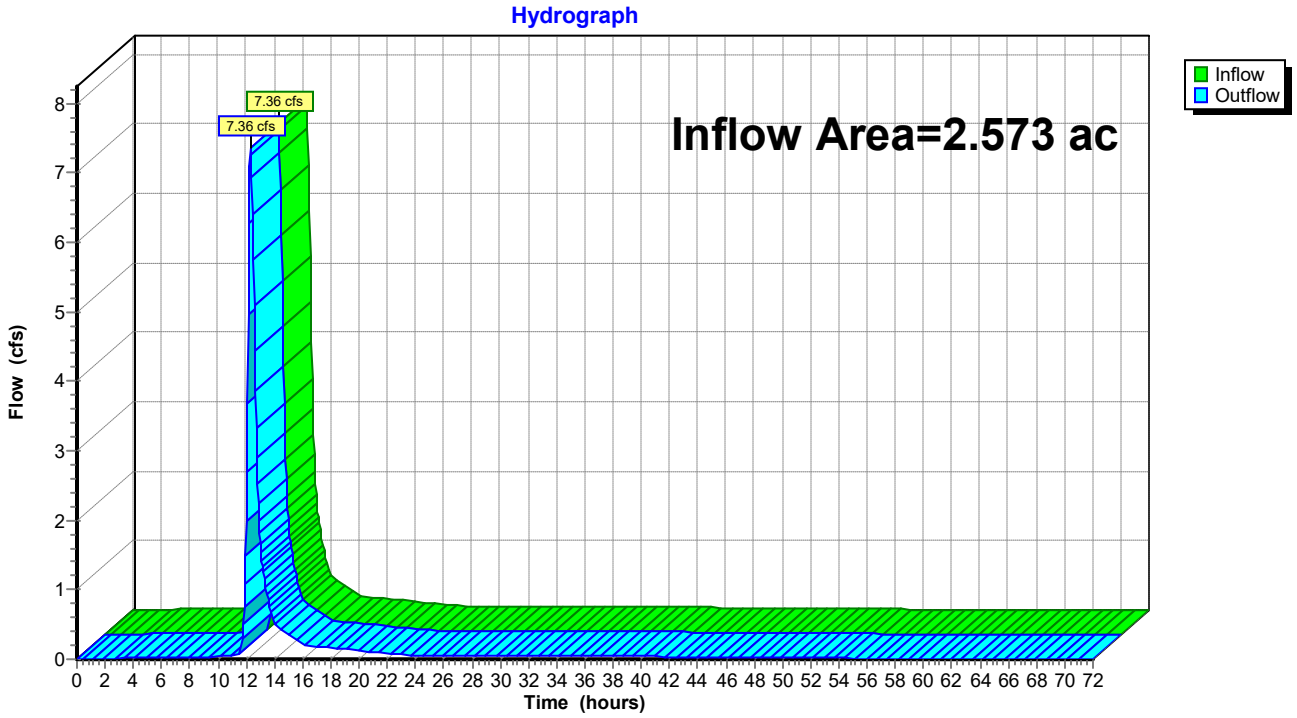
Summary for Reach 2R: SOUTH

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.573 ac, 68.99% Impervious, Inflow Depth = 3.42" for 10-Year event
Inflow = 7.36 cfs @ 12.31 hrs, Volume= 0.733 af
Outflow = 7.36 cfs @ 12.31 hrs, Volume= 0.733 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 2R: SOUTH



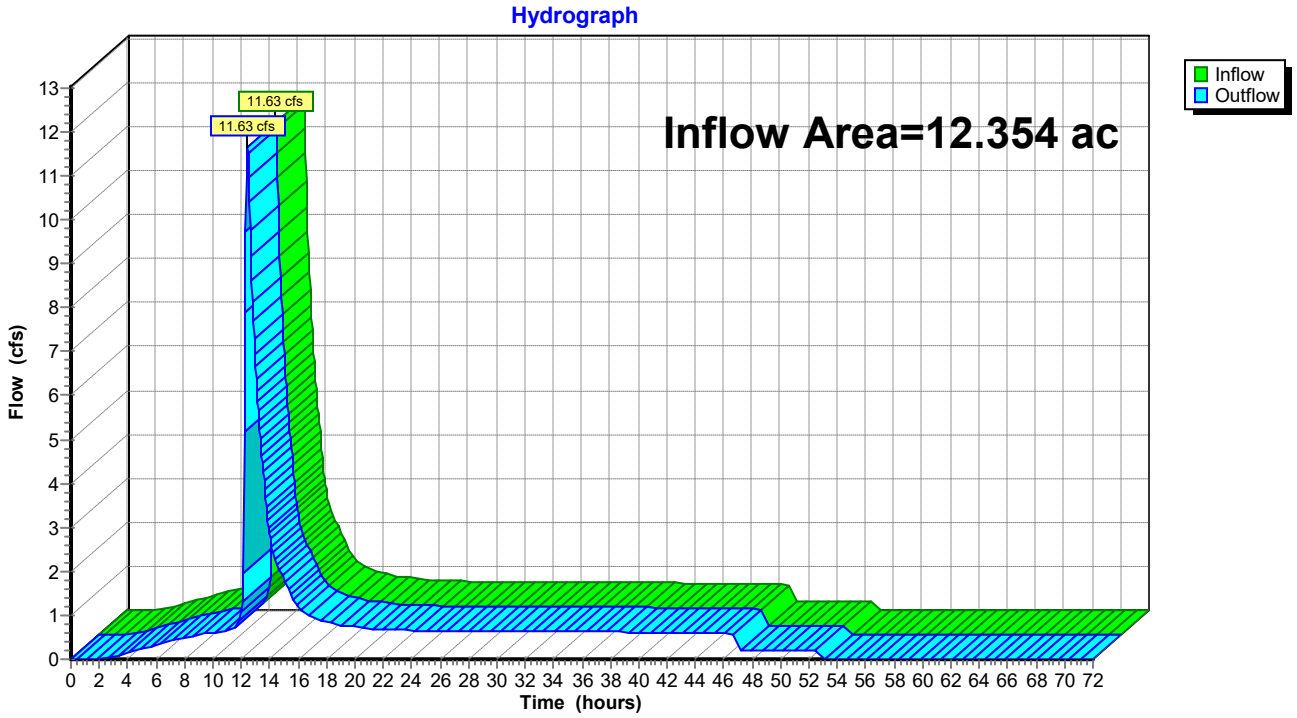
Summary for Reach 3R: SOUTH WEST

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 12.354 ac, 63.77% Impervious, Inflow Depth = 3.33" for 10-Year event
Inflow = 11.63 cfs @ 12.44 hrs, Volume= 3.427 af
Outflow = 11.63 cfs @ 12.44 hrs, Volume= 3.427 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 3R: SOUTH WEST



Summary for Pond 2P: BMP 2

Inflow Area = 2.573 ac, 68.99% Impervious, Inflow Depth = 3.42" for 10-Year event
Inflow = 11.24 cfs @ 12.20 hrs, Volume= 0.733 af
Outflow = 7.36 cfs @ 12.31 hrs, Volume= 0.733 af, Atten= 35%, Lag= 7.0 min
Primary = 7.26 cfs @ 12.31 hrs, Volume= 0.546 af
Routed to Reach 2R : SOUTH
Secondary = 0.10 cfs @ 12.31 hrs, Volume= 0.187 af
Routed to Reach 2R : SOUTH
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 2R : SOUTH

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 960.47' @ 12.31 hrs Surf.Area= 0.121 ac Storage= 0.239 af

Plug-Flow detention time= 241.4 min calculated for 0.733 af (100% of inflow)
Center-of-Mass det. time= 242.6 min (1,007.3 - 764.7)

Volume	Invert	Avail.Storage	Storage Description
#1	957.00'	0.635 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
957.00	0.032	0.000	0.000
958.00	0.049	0.040	0.040
959.00	0.068	0.059	0.099
960.00	0.105	0.087	0.186
961.00	0.140	0.123	0.308
962.00	0.171	0.156	0.464
963.00	0.171	0.171	0.635

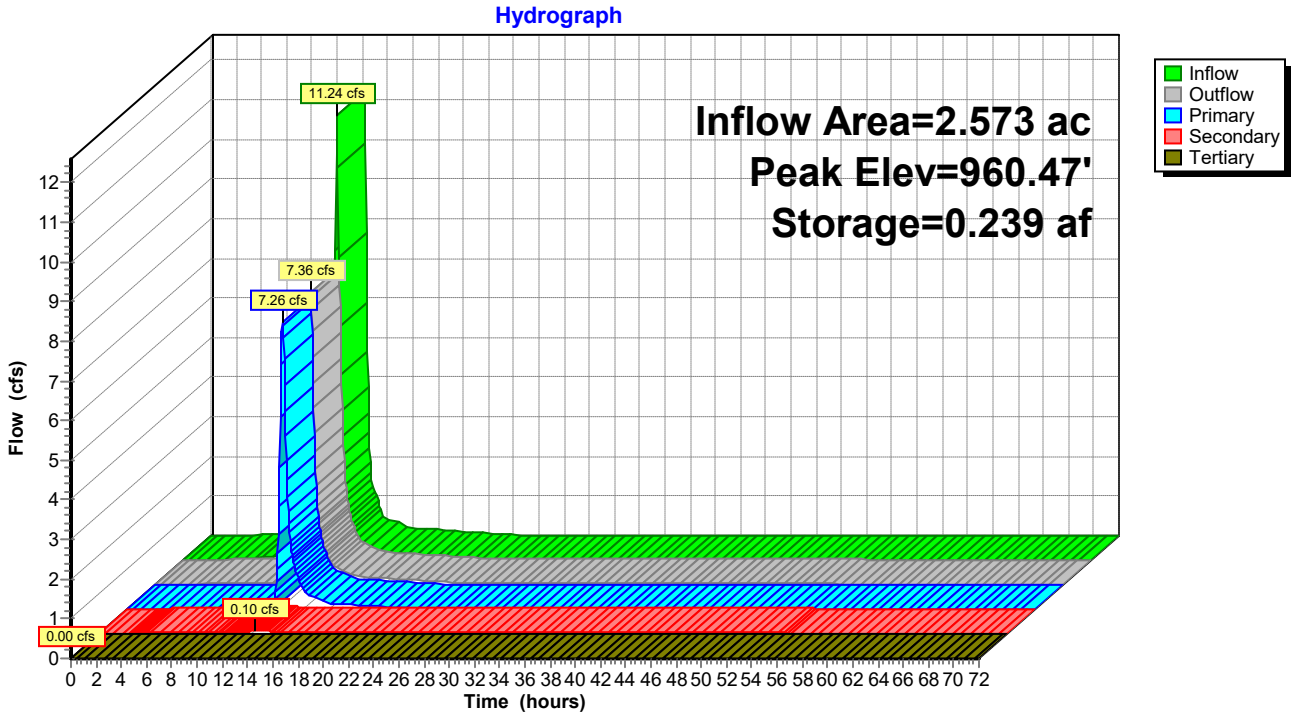
Device	Routing	Invert	Outlet Devices
#1	Device 2	957.00'	**0.800 in/hr Exfiltration over Surface area**
#2	Secondary	955.00'	**6.0" Vert. Draintile** C= 0.600 Limited to weir flow at low heads
#3	Tertiary	962.00'	**50.0' long SLL Overtop** Cv= 2.62 (C= 3.28)
#4	Primary	959.00'	**18.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 959.00' / 957.50' S= 0.0395 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=7.23 cfs @ 12.31 hrs HW=960.46' TW=0.00' (Dynamic Tailwater)
└**4=Culvert** (Inlet Controls 7.23 cfs @ 4.12 fps)

Secondary OutFlow Max=0.10 cfs @ 12.31 hrs HW=960.46' TW=0.00' (Dynamic Tailwater)
└**2=Draintile** (Passes 0.10 cfs of 2.16 cfs potential flow)
└**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=957.00' TW=0.00' (Dynamic Tailwater)
└**3=SLL Overtop** (Controls 0.00 cfs)

Pond 2P: BMP 2


Hydrograph
Inflow Area=2.573 ac
Peak Elev=960.47'
Storage=0.239 af
11.24 cfs
7.36 cfs
7.26 cfs
0.10 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Tertiary
Flow (cfs)
Time (hours)

Summary for Pond 6P: BMP 1

Inflow Area = 5.973 ac, 52.52% Impervious, Inflow Depth = 3.13" for 10-Year event
Inflow = 29.27 cfs @ 12.14 hrs, Volume= 1.558 af
Outflow = 7.64 cfs @ 12.37 hrs, Volume= 1.558 af, Atten= 74%, Lag= 14.0 min
Primary = 7.64 cfs @ 12.37 hrs, Volume= 1.558 af
Routed to Reach 3R : SOUTH WEST
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 3R : SOUTH WEST

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 964.64' @ 12.37 hrs Surf.Area= 0.346 ac Storage= 0.768 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 554.6 min (1,322.3 - 767.7)

Volume	Invert	Avail.Storage	Storage Description
#1	962.00'	4.222 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

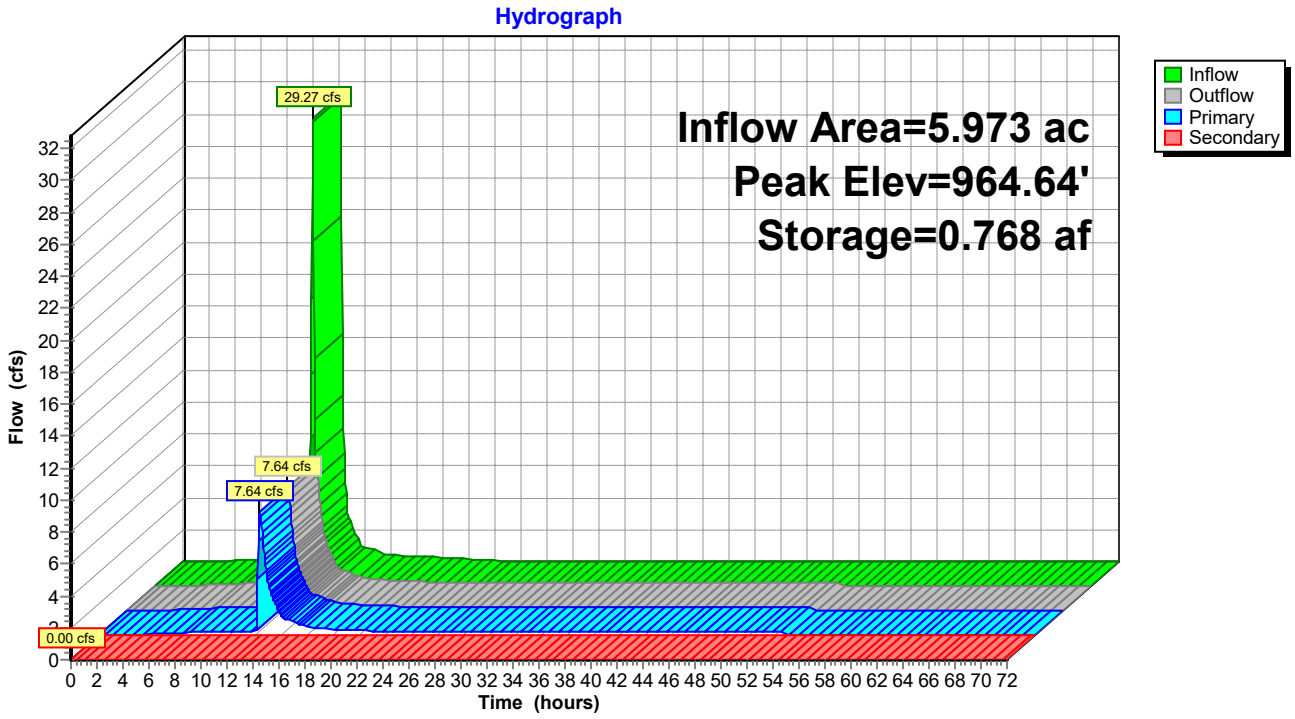
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
962.00	0.239	0.000	0.000
963.00	0.277	0.258	0.258
964.00	0.319	0.298	0.556
965.00	0.362	0.340	0.897
966.00	0.408	0.385	1.282
967.00	0.456	0.432	1.714
968.00	0.456	0.456	2.170
969.00	0.456	0.456	2.626
970.00	0.456	0.456	3.082
971.00	0.456	0.456	3.538
972.00	0.456	0.456	3.994
972.50	0.456	0.228	4.222

Device	Routing	Invert	Outlet Devices
#1	Device 2	962.00'	**0.800 in/hr Exfiltration over Surface area**
#2	Device 4	960.00'	**6.0" Vert. Draintile** C= 0.600 Limited to weir flow at low heads
#3	Secondary	967.30'	**50.0' long Road B** Cv= 2.62 (C= 3.28)
#4	Primary	960.00'	**15.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 960.00' / 959.62' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#5	Device 4	964.00'	**5.0' long x 0.8' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.74 2.78 2.86 3.00 3.11 3.18 3.25 3.29 3.32 3.31 3.32

Primary OutFlow Max=7.58 cfs @ 12.37 hrs HW=964.64' TW=0.00' (Dynamic Tailwater)
└─**4=Culvert** (Passes 7.58 cfs of 11.83 cfs potential flow)
  └─**2=Draintile** (Passes 0.28 cfs of 1.98 cfs potential flow)
    └─**1=Exfiltration** (Exfiltration Controls 0.28 cfs)
  └─**5=Broad-Crested Rectangular Weir** (Weir Controls 7.30 cfs @ 2.30 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=962.00' TW=0.00' (Dynamic Tailwater)
└─**3=Road B** (Controls 0.00 cfs)

Pond 6P: BMP 1



Summary for Pond 7P: BMP 3

Inflow Area = 5.496 ac, 86.26% Impervious, Inflow Depth = 3.72" for 10-Year event
Inflow = 30.72 cfs @ 12.14 hrs, Volume= 1.705 af
Outflow = 3.18 cfs @ 12.64 hrs, Volume= 1.705 af, Atten= 90%, Lag= 30.3 min
Primary = 3.18 cfs @ 12.64 hrs, Volume= 1.705 af
Routed to Reach 3R : SOUTH WEST

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 964.44' @ 12.64 hrs Surf.Area= 0.491 ac Storage= 0.973 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 660.5 min (1,413.7 - 753.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	961.50'	0.571 af	**138.00'W x 155.00'L x 5.00'H Field A** 2.455 af Overall - 1.028 af Embedded = 1.427 af x 40.0% Voids
#2A	962.00'	1.028 af	**CMP Round 48** x 161 Inside #1 Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf Overall Size= 48.0"W x 48.0"H x 20.00'L Row Length Adjustment= +9.00' x 12.57 sf x 23 rows 136.00' Header x 12.57 sf x 1 = 1,709.0 cf Inside
		1.599 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 3	959.50'	**6.0" Vert. Tile** X 3 rows with 8.0" cc spacing C= 0.600 Limited to weir flow at low heads
#2	Device 1	961.50'	**0.800 in/hr Filtration over Surface area**
#3	Primary	960.50'	**15.0" Round Culvert** L= 100.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 959.50' / 960.50' S= -0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#4	Device 3	964.10'	**5.0' long x 0.8' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.74 2.78 2.86 3.00 3.11 3.18 3.25 3.29 3.32 3.31 3.32

Primary OutFlow Max=3.18 cfs @ 12.64 hrs HW=964.44' TW=0.00' (Dynamic Tailwater)
- **3=Culvert** (Passes 3.18 cfs of 10.14 cfs potential flow)
  - **1=Tile** (Passes 0.40 cfs of 5.49 cfs potential flow)
    - **2=Filtration** (Exfiltration Controls 0.40 cfs)
  - **4=Broad-Crested Rectangular Weir** (Weir Controls 2.78 cfs @ 1.62 fps)

Pond 7P: BMP 3 - Chamber Wizard Field A

Chamber Model = CMP Round 48 (Round Corrugated Metal Pipe)
Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
Overall Size= 48.0"W x 48.0"H x 20.00'L
Row Length Adjustment= +9.00' x 12.57 sf x 23 rows

48.0" Wide + 24.0" Spacing = 72.0" C-C Row Spacing

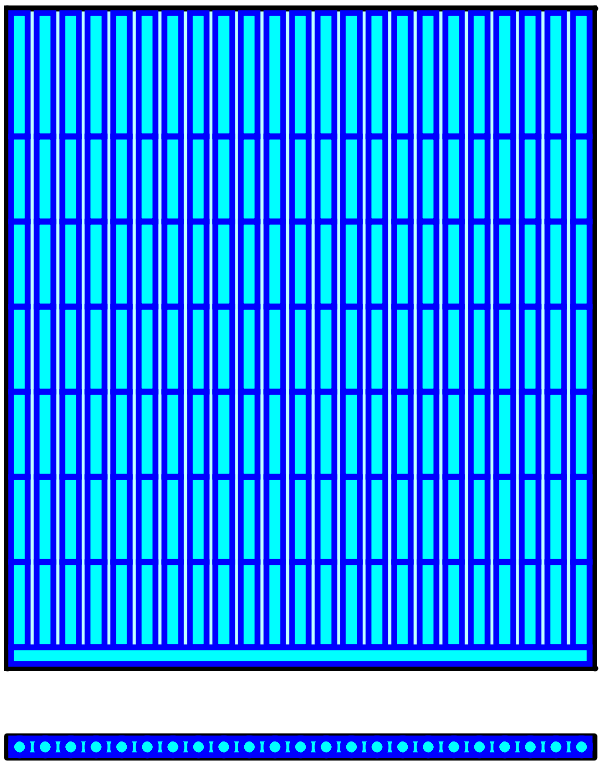
7 Chambers/Row x 20.00' Long +9.00' Row Adjustment +4.00' Header x 1 = 153.00' Row Length +12.0" End Stone x 2 = 155.00' Base Length
23 Rows x 48.0" Wide + 24.0" Spacing x 22 + 12.0" Side Stone x 2 = 138.00' Base Width
6.0" Stone Base + 48.0" Chamber Height + 6.0" Stone Cover = 5.00' Field Height

161 Chambers x 251.3 cf +9.00' Row Adjustment x 12.57 sf x 23 Rows + 136.00' Header x 12.57 sf = 44,774.0 cf Chamber Storage

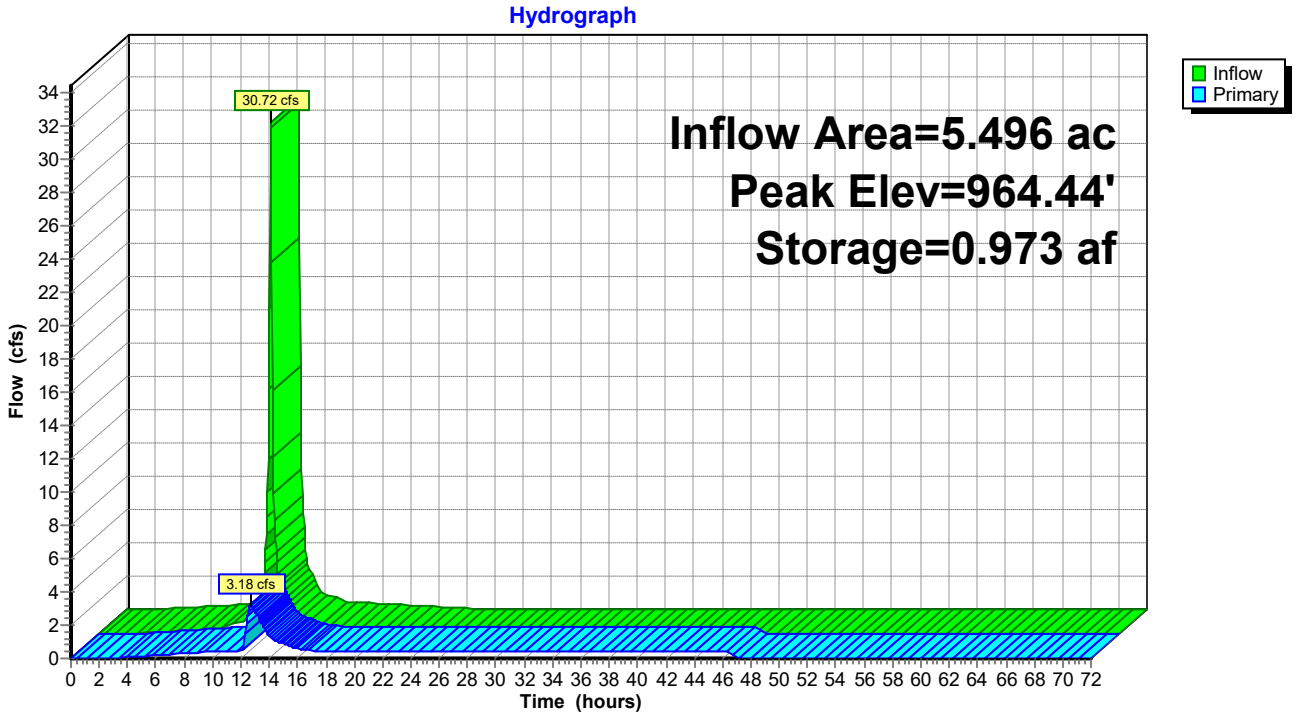
106,950.0 cf Field - 44,774.0 cf Chambers = 62,176.0 cf Stone x 40.0% Voids = 24,870.4 cf Stone Storage

Chamber Storage + Stone Storage = 69,644.4 cf = 1.599 af
Overall Storage Efficiency = 65.1%
Overall System Size = 155.00' x 138.00' x 5.00'

161 Chambers
3,961.1 cy Field
2,302.8 cy Stone



Pond 7P: BMP 3


Hydrograph
Inflow
Primary
30.72 cfs
3.18 cfs
Inflow Area=5.496 ac
Peak Elev=964.44'
Storage=0.973 af
Flow (cfs)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: South West Runoff Area=0.885 ac 0.00% Impervious Runoff Depth=4.86"
Flow Length=935' Tc=25.4 min CN=80/0 Runoff=4.19 cfs 0.358 af

Subcatchment 3S: North Runoff Area=0.688 ac 0.00% Impervious Runoff Depth=4.86"
Tc=7.0 min CN=80/0 Runoff=5.65 cfs 0.279 af

Subcatchment 4S: South Runoff Area=2.573 ac 68.99% Impervious Runoff Depth=6.30"
Tc=12.0 min CN=80/98 Runoff=20.44 cfs 1.350 af

Subcatchment 5S: DTW PH 1 Runoff Area=4.591 ac 54.61% Impervious Runoff Depth=6.00"
Tc=7.0 min CN=80/98 Runoff=42.39 cfs 2.294 af

Subcatchment 6S: West (CSAH 11) Runoff Area=1.045 ac 21.34% Impervious Runoff Depth=5.30"
Tc=7.0 min CN=80/98 Runoff=9.00 cfs 0.462 af

Subcatchment 8S: DTW FUTURE B Runoff Area=5.496 ac 86.26% Impervious Runoff Depth=6.66"
Tc=7.0 min CN=80/98 Runoff=54.01 cfs 3.048 af

Subcatchment 9S: DTW FUTURE A Runoff Area=1.382 ac 45.59% Impervious Runoff Depth=5.81"
Tc=7.0 min CN=80/98 Runoff=12.53 cfs 0.669 af

Reach 2R: SOUTH Inflow=11.22 cfs 1.350 af
Outflow=11.22 cfs 1.350 af

Reach 3R: SOUTH WEST Inflow=30.35 cfs 6.370 af
Outflow=30.35 cfs 6.370 af

Pond 2P: BMP 2 Peak Elev=961.45' Storage=0.374 af Inflow=20.44 cfs 1.350 af
Primary=11.09 cfs 1.148 af Secondary=0.12 cfs 0.202 af Tertiary=0.00 cfs 0.000 af Outflow=11.22 cfs 1.350 af

Pond 6P: BMP 1 Peak Elev=966.22' Storage=1.372 af Inflow=54.92 cfs 2.963 af
Primary=13.97 cfs 2.963 af Secondary=0.00 cfs 0.000 af Outflow=13.97 cfs 2.963 af

Pond 7P: BMP 3 Peak Elev=966.10' Storage=1.520 af Inflow=54.01 cfs 3.048 af
Outflow=12.20 cfs 3.048 af

Total Runoff Area = 16.660 ac Runoff Volume = 8.460 af Average Runoff Depth = 6.09"
40.72% Pervious = 6.784 ac 59.28% Impervious = 9.876 ac

Summary for Subcatchment 2S: South West

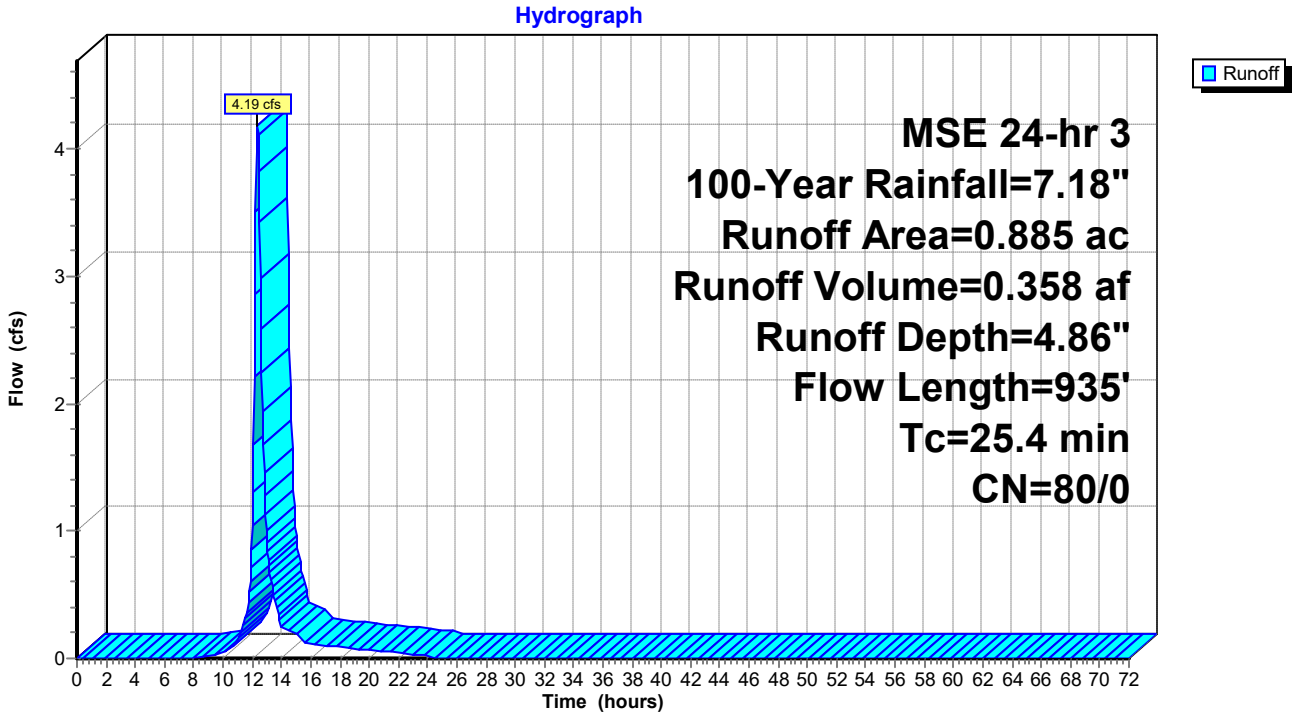
Runoff = 4.19 cfs @ 12.36 hrs, Volume= 0.358 af, Depth= 4.86"
Routed to Reach 3R : SOUTH WEST

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

Area (ac)	CN	Description
0.885	80	>75% Grass cover, Good, HSG D
0.885	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	80	0.0700	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.80"
3.0	250	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	110	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.7	45	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	90	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.0	220	0.0150	0.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.7	140	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
25.4	935	Total			

Subcatchment 2S: South West



Summary for Subcatchment 3S: North

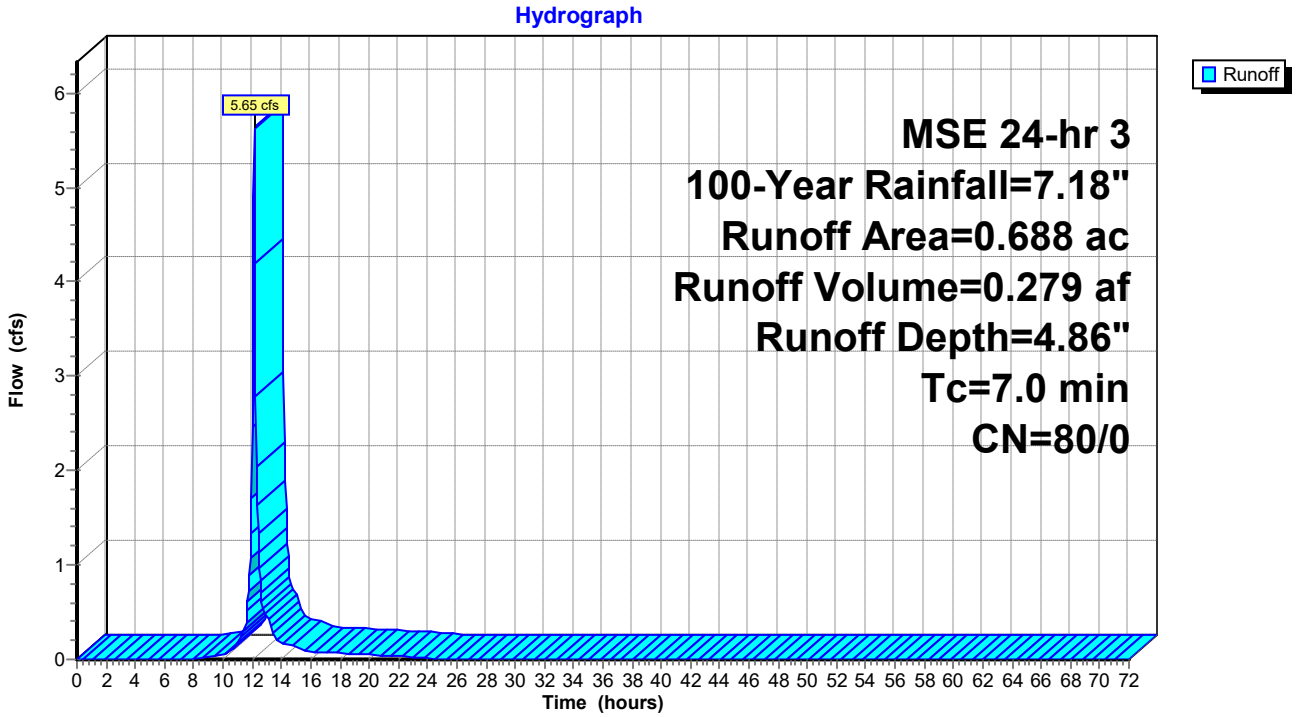
Runoff = 5.65 cfs @ 12.14 hrs, Volume= 0.279 af, Depth= 4.86"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

Area (ac)	CN	Description
0.688	80	>75% Grass cover, Good, HSG D
0.688	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 3S: North



Summary for Subcatchment 4S: South

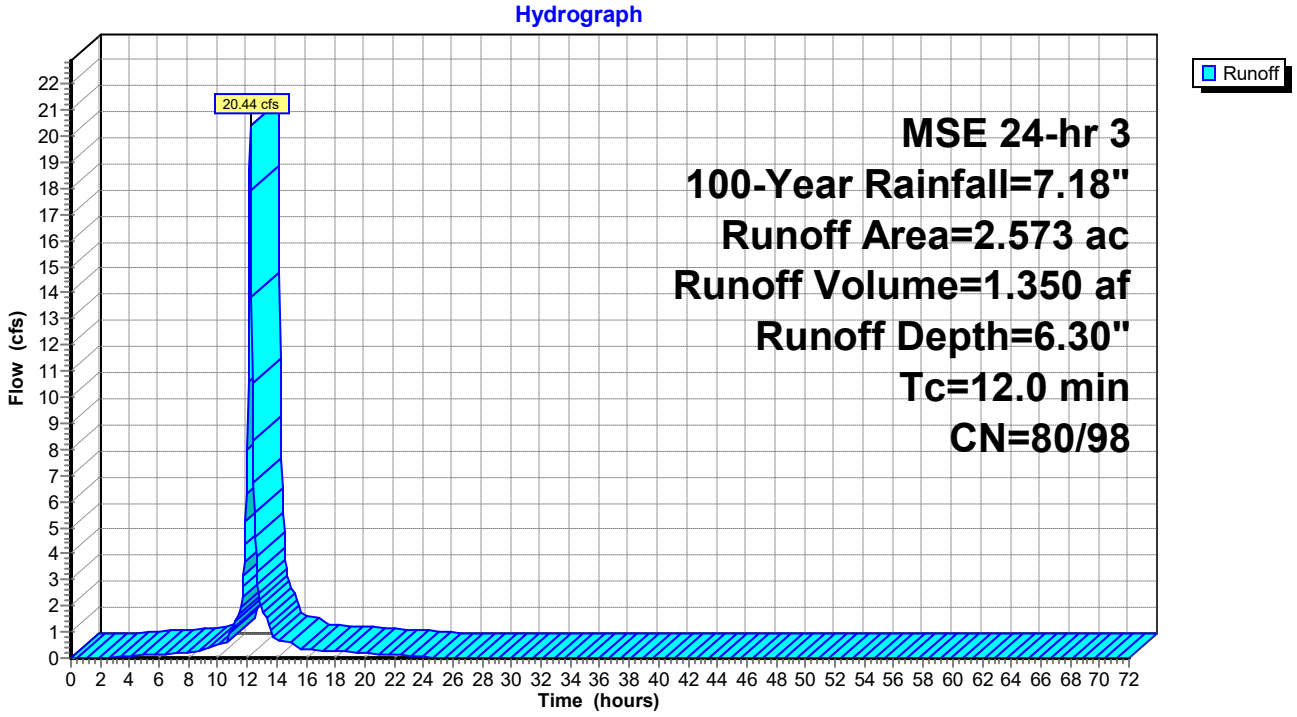
Runoff = 20.44 cfs @ 12.19 hrs, Volume= 1.350 af, Depth= 6.30"
Routed to Pond 2P : BMP 2

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

	Area (ac)	CN	Description
*	0.371	98	Proposed Stieger Lake Lane
	0.798	80	>75% Grass cover, Good, HSG D
*	1.018	98	Existing Stieger Lake Lane
*	0.386	98	Marco McLane Development
	2.573	92	Weighted Average
	0.798	80	31.01% Pervious Area
	1.775	98	68.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry, Roof Drain**

Subcatchment 4S: South



Summary for Subcatchment 5S: DTW PH 1

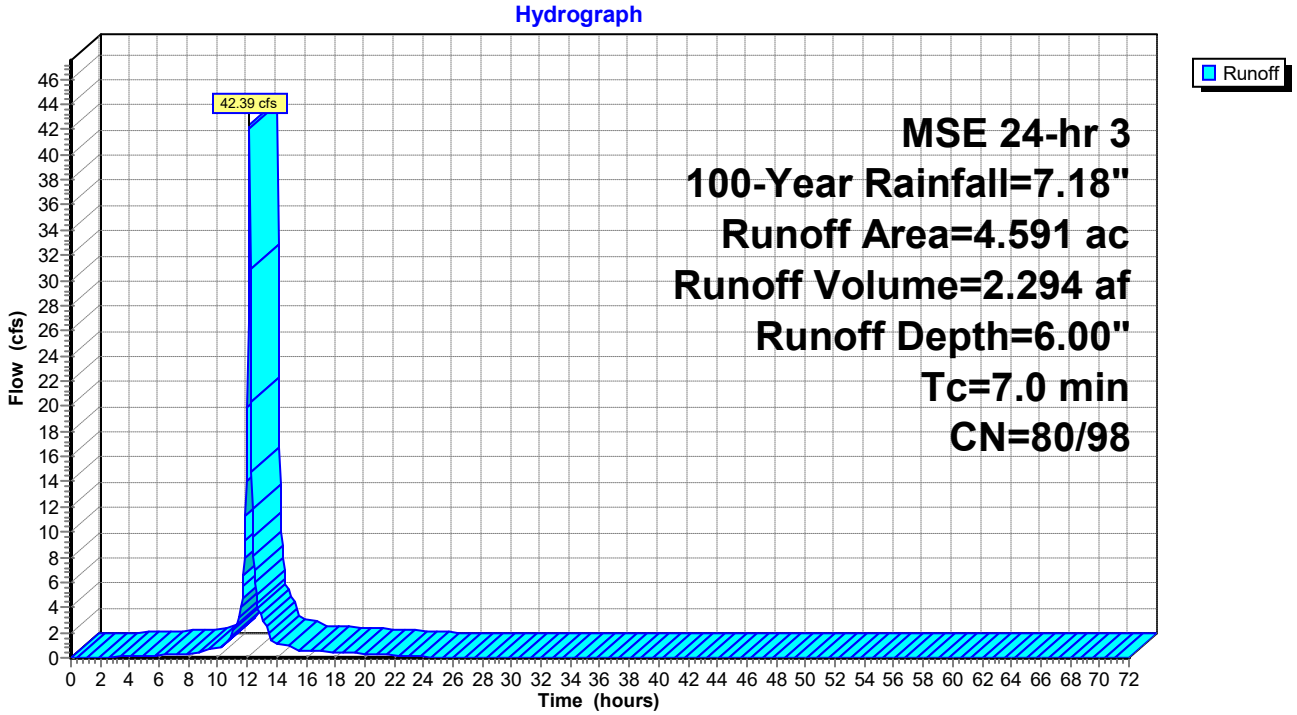
Runoff = 42.39 cfs @ 12.14 hrs, Volume= 2.294 af, Depth= 6.00"
Routed to Pond 6P : BMP 1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

	Area (ac)	CN	Description
	1.437	98	Paved roads w/curbs & sewers, HSG D
	2.084	80	>75% Grass cover, Good, HSG D
*	1.070	98	Marco McLane Development
	4.591	90	Weighted Average
	2.084	80	45.39% Pervious Area
	2.507	98	54.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 5S: DTW PH 1



Summary for Subcatchment 6S: West (CSAH 11)

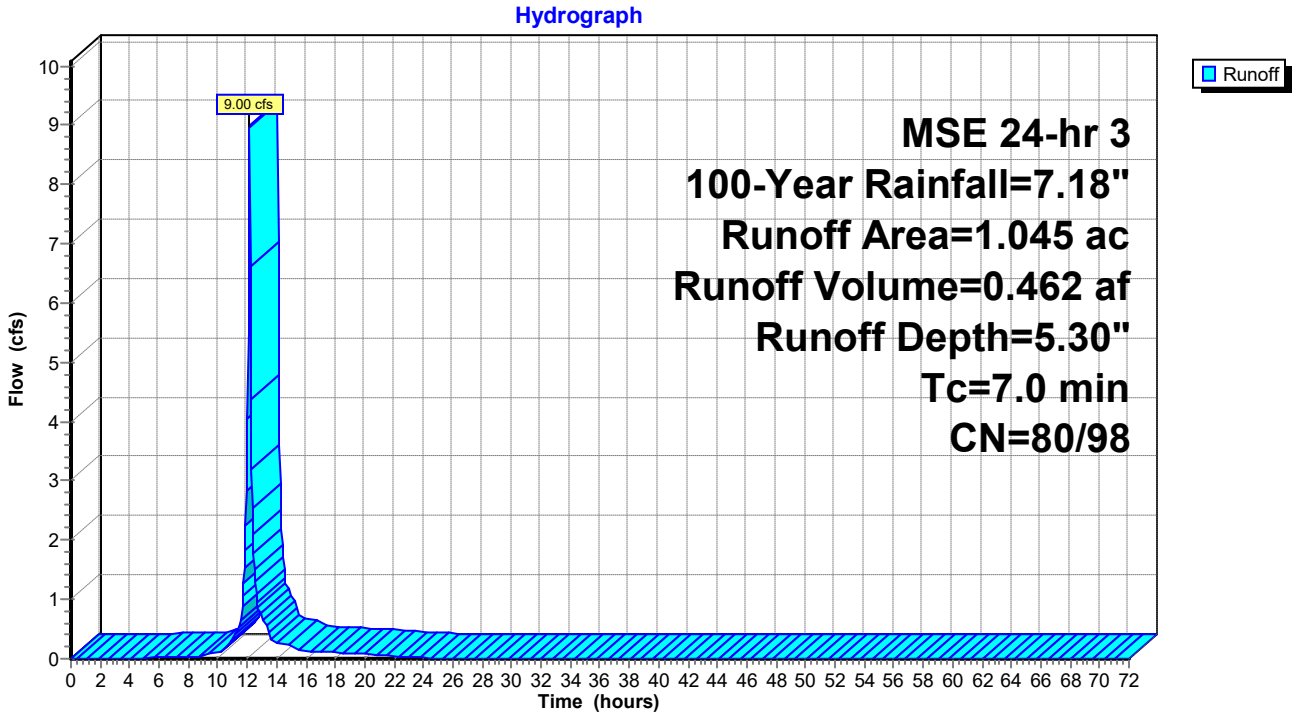
Runoff = 9.00 cfs @ 12.14 hrs, Volume= 0.462 af, Depth= 5.30"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

Area (ac)	CN	Description
0.223	98	Paved roads w/curbs & sewers, HSG D
0.822	80	>75% Grass cover, Good, HSG D
1.045	84	Weighted Average
0.822	80	78.66% Pervious Area
0.223	98	21.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 6S: West (CSAH 11)



Summary for Subcatchment 8S: DTW FUTURE B

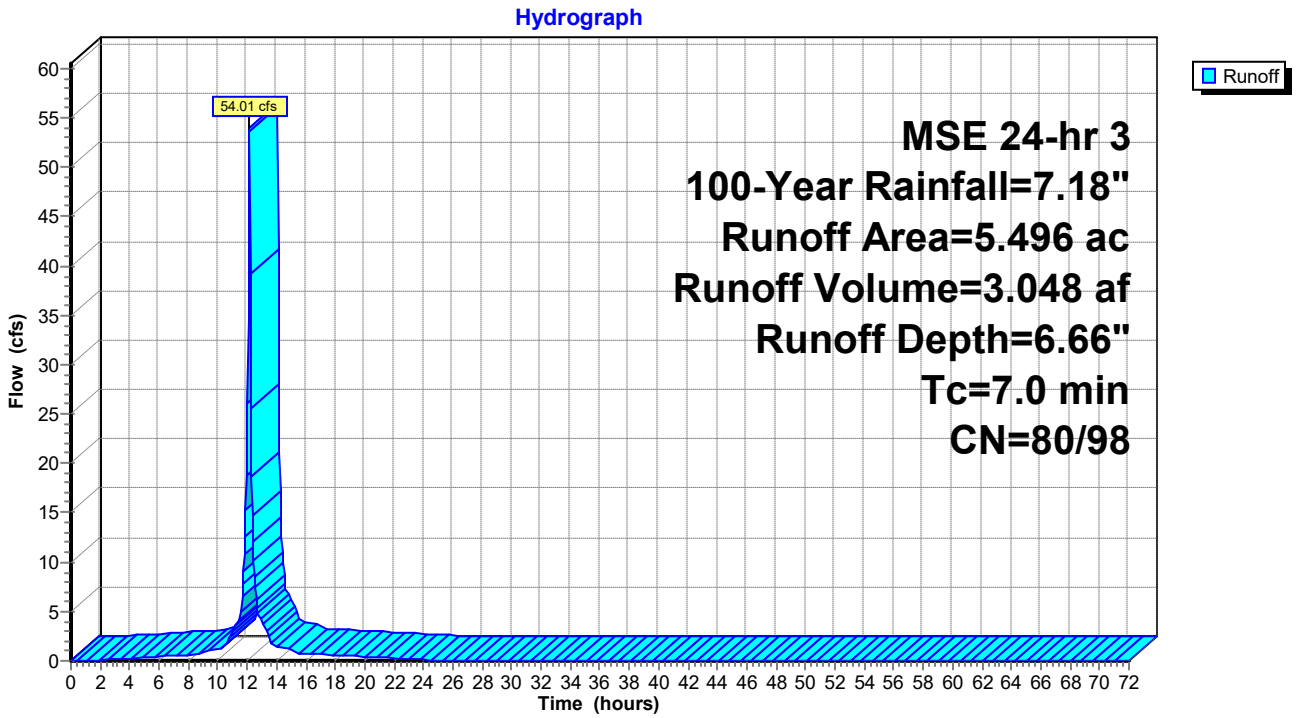
Runoff = 54.01 cfs @ 12.14 hrs, Volume= 3.048 af, Depth= 6.66"
Routed to Pond 7P : BMP 3

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

	Area (ac)	CN	Description
	3.358	98	Paved roads w/curbs & sewers, HSG D
	0.755	80	>75% Grass cover, Good, HSG D
*	1.383	98	
	5.496	96	Weighted Average
	0.755	80	13.74% Pervious Area
	4.741	98	86.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 8S: DTW FUTURE B



Summary for Subcatchment 9S: DTW FUTURE A

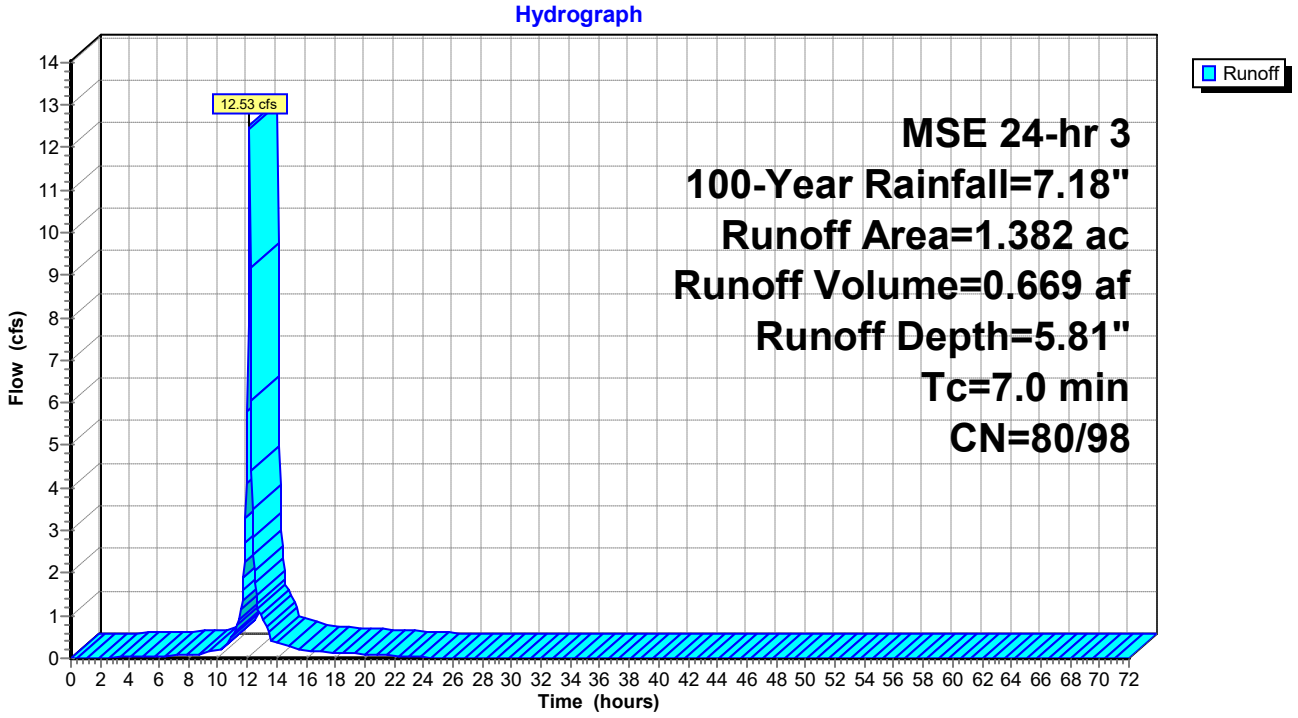
Runoff = 12.53 cfs @ 12.14 hrs, Volume= 0.669 af, Depth= 5.81"
Routed to Pond 6P : BMP 1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.18"

Area (ac)	CN	Description
0.630	98	Paved roads w/curbs & sewers, HSG D
0.752	80	>75% Grass cover, Good, HSG D
1.382	88	Weighted Average
0.752	80	54.41% Pervious Area
0.630	98	45.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment 9S: DTW FUTURE A



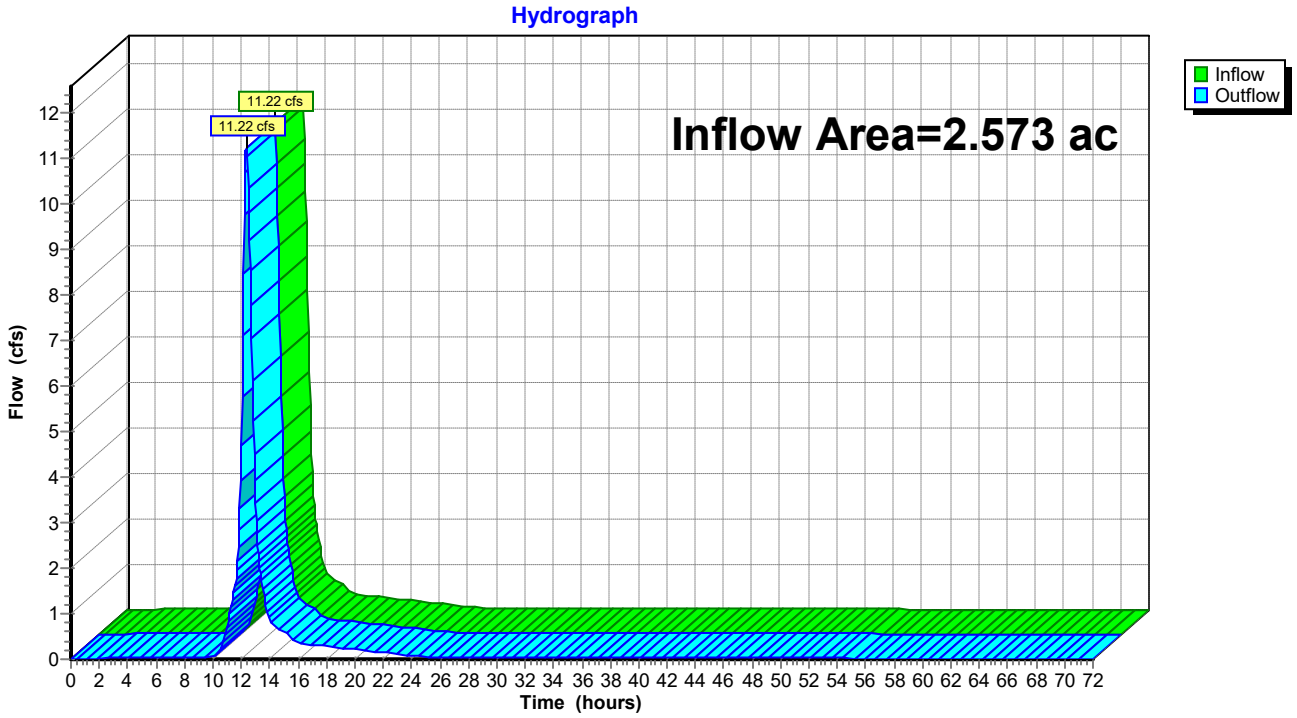
Summary for Reach 2R: SOUTH

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.573 ac, 68.99% Impervious, Inflow Depth = 6.30" for 100-Year event
Inflow = 11.22 cfs @ 12.34 hrs, Volume= 1.350 af
Outflow = 11.22 cfs @ 12.34 hrs, Volume= 1.350 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 2R: SOUTH



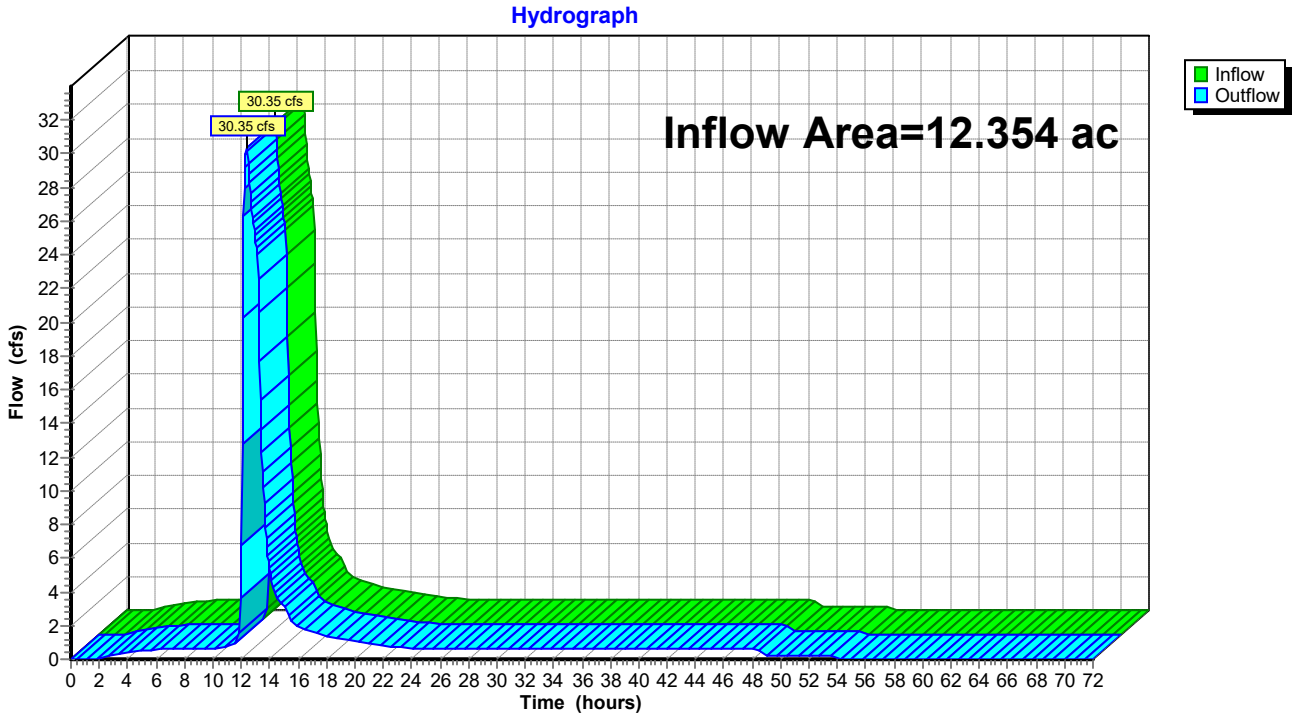
Summary for Reach 3R: SOUTH WEST

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 12.354 ac, 63.77% Impervious, Inflow Depth = 6.19" for 100-Year event
Inflow = 30.35 cfs @ 12.37 hrs, Volume= 6.370 af
Outflow = 30.35 cfs @ 12.37 hrs, Volume= 6.370 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 3R: SOUTH WEST



Summary for Pond 2P: BMP 2

Inflow Area = 2.573 ac, 68.99% Impervious, Inflow Depth = 6.30" for 100-Year event
Inflow = 20.44 cfs @ 12.19 hrs, Volume= 1.350 af
Outflow = 11.22 cfs @ 12.34 hrs, Volume= 1.350 af, Atten= 45%, Lag= 8.9 min
Primary = 11.09 cfs @ 12.34 hrs, Volume= 1.148 af
Routed to Reach 2R : SOUTH
Secondary = 0.12 cfs @ 12.34 hrs, Volume= 0.202 af
Routed to Reach 2R : SOUTH
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 2R : SOUTH

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 961.45' @ 12.34 hrs Surf.Area= 0.154 ac Storage= 0.374 af

Plug-Flow detention time= 150.7 min calculated for 1.349 af (100% of inflow)
Center-of-Mass det. time= 151.9 min (909.8 - 757.9)

Volume	Invert	Avail.Storage	Storage Description
#1	957.00'	0.635 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
957.00	0.032	0.000	0.000
958.00	0.049	0.040	0.040
959.00	0.068	0.059	0.099
960.00	0.105	0.087	0.186
961.00	0.140	0.123	0.308
962.00	0.171	0.156	0.464
963.00	0.171	0.171	0.635

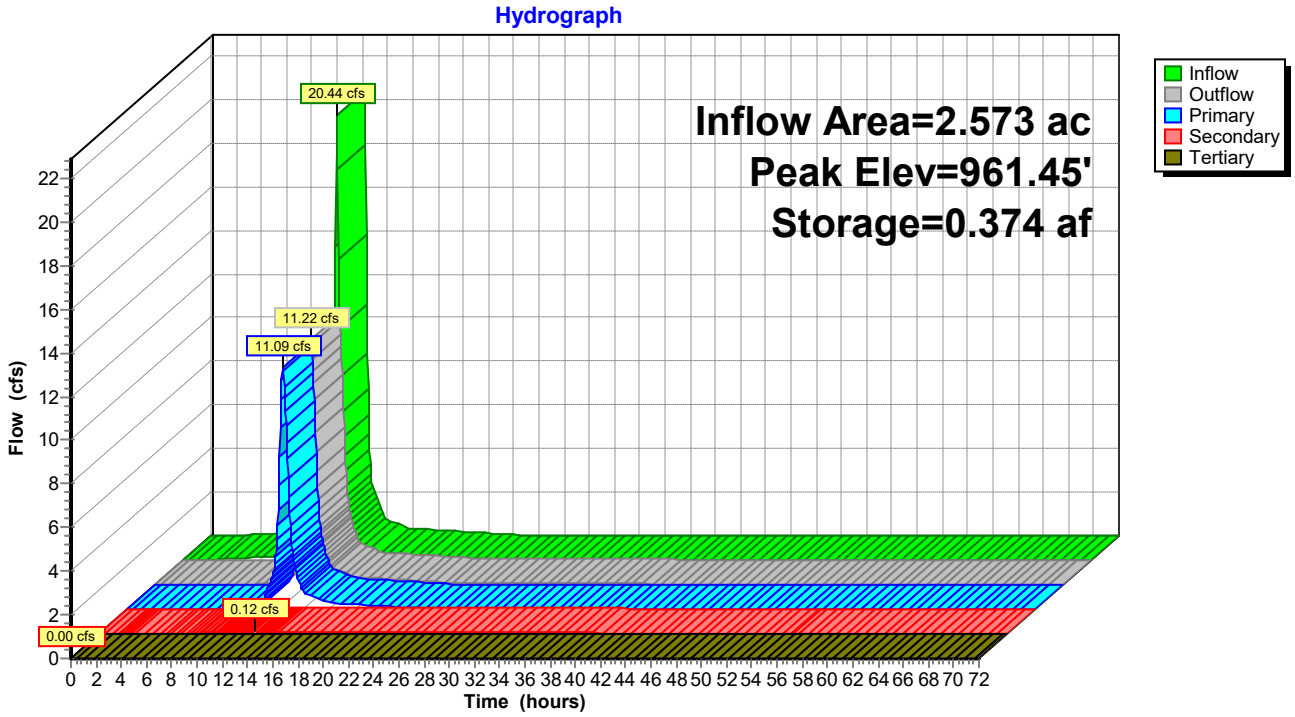
Device	Routing	Invert	Outlet Devices
#1	Device 2	957.00'	**0.800 in/hr Exfiltration over Surface area**
#2	Secondary	955.00'	**6.0" Vert. Draintile** C= 0.600 Limited to weir flow at low heads
#3	Tertiary	962.00'	**50.0' long SLL Overtop** Cv= 2.62 (C= 3.28)
#4	Primary	959.00'	**18.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 959.00' / 957.50' S= 0.0395 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=11.08 cfs @ 12.34 hrs HW=961.45' TW=0.00' (Dynamic Tailwater)
└**4=Culvert** (Inlet Controls 11.08 cfs @ 6.27 fps)

Secondary OutFlow Max=0.12 cfs @ 12.34 hrs HW=961.45' TW=0.00' (Dynamic Tailwater)
└**2=Draintile** (Passes 0.12 cfs of 2.35 cfs potential flow)
└**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=957.00' TW=0.00' (Dynamic Tailwater)
└**3=SLL Overtop** (Controls 0.00 cfs)

Pond 2P: BMP 2


Hydrograph
Inflow Area=2.573 ac
Peak Elev=961.45'
Storage=0.374 af
20.44 cfs
11.22 cfs
11.09 cfs
0.12 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Tertiary
Flow (cfs)
Time (hours)

Summary for Pond 6P: BMP 1

Inflow Area = 5.973 ac, 52.52% Impervious, Inflow Depth = 5.95" for 100-Year event
Inflow = 54.92 cfs @ 12.14 hrs, Volume= 2.963 af
Outflow = 13.97 cfs @ 12.37 hrs, Volume= 2.963 af, Atten= 75%, Lag= 14.0 min
Primary = 13.97 cfs @ 12.37 hrs, Volume= 2.963 af
Routed to Reach 3R : SOUTH WEST
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 3R : SOUTH WEST

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 966.22' @ 12.37 hrs Surf.Area= 0.418 ac Storage= 1.372 af

Plug-Flow detention time= 329.8 min calculated for 2.961 af (100% of inflow)
Center-of-Mass det. time= 330.8 min (1,091.2 - 760.4)

Volume	Invert	Avail.Storage	Storage Description
#1	962.00'	4.222 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

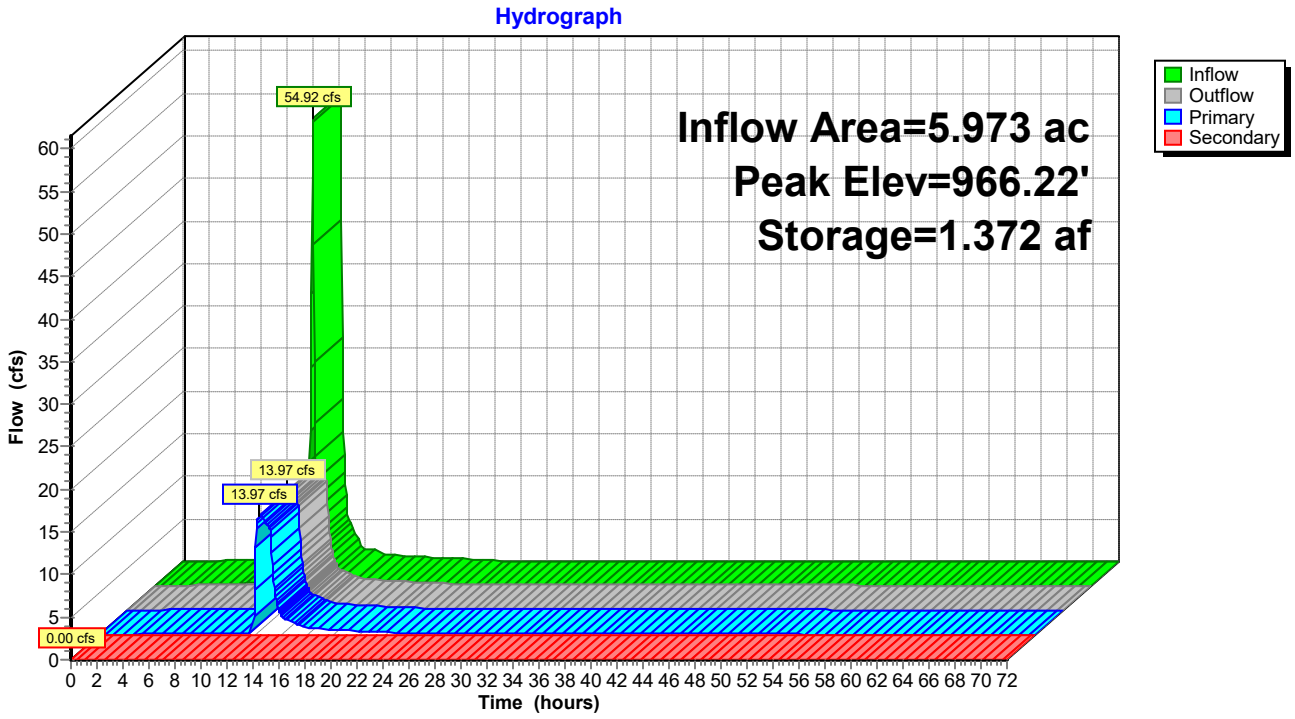
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
962.00	0.239	0.000	0.000
963.00	0.277	0.258	0.258
964.00	0.319	0.298	0.556
965.00	0.362	0.340	0.897
966.00	0.408	0.385	1.282
967.00	0.456	0.432	1.714
968.00	0.456	0.456	2.170
969.00	0.456	0.456	2.626
970.00	0.456	0.456	3.082
971.00	0.456	0.456	3.538
972.00	0.456	0.456	3.994
972.50	0.456	0.228	4.222

Device	Routing	Invert	Outlet Devices
#1	Device 2	962.00'	**0.800 in/hr Exfiltration over Surface area**
#2	Device 4	960.00'	**6.0" Vert. Draintile** C= 0.600 Limited to weir flow at low heads
#3	Secondary	967.30'	**50.0' long Road B** Cv= 2.62 (C= 3.28)
#4	Primary	960.00'	**15.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 960.00' / 959.62' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#5	Device 4	964.00'	**5.0' long x 0.8' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.74 2.78 2.86 3.00 3.11 3.18 3.25 3.29 3.32 3.31 3.32

Primary OutFlow Max=13.97 cfs @ 12.37 hrs HW=966.21' TW=0.00' (Dynamic Tailwater)
└─**4=Culvert** (Inlet Controls 13.97 cfs @ 11.38 fps)
  ├─**2=Draintile** (Passes < 2.31 cfs potential flow)
  │ └─**1=Exfiltration** (Passes < 0.34 cfs potential flow)
  └─**5=Broad-Crested Rectangular Weir** (Passes < 54.60 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=962.00' TW=0.00' (Dynamic Tailwater)
└─**3=Road B** (Controls 0.00 cfs)

Pond 6P: BMP 1



Summary for Pond 7P: BMP 3

Inflow Area = 5.496 ac, 86.26% Impervious, Inflow Depth = 6.66" for 100-Year event
Inflow = 54.01 cfs @ 12.14 hrs, Volume= 3.048 af
Outflow = 12.20 cfs @ 12.40 hrs, Volume= 3.048 af, Atten= 77%, Lag= 15.7 min
Primary = 12.20 cfs @ 12.40 hrs, Volume= 3.048 af
Routed to Reach 3R : SOUTH WEST

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 966.10' @ 12.40 hrs Surf.Area= 0.491 ac Storage= 1.520 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 423.9 min (1,170.4 - 746.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	961.50'	0.571 af	**138.00'W x 155.00'L x 5.00'H Field A** 2.455 af Overall - 1.028 af Embedded = 1.427 af x 40.0% Voids
#2A	962.00'	1.028 af	**CMP Round 48** x 161 Inside #1 Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf Overall Size= 48.0"W x 48.0"H x 20.00'L Row Length Adjustment= +9.00' x 12.57 sf x 23 rows 136.00' Header x 12.57 sf x 1 = 1,709.0 cf Inside
		1.599 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 3	959.50'	**6.0" Vert. Tile** X 3 rows with 8.0" cc spacing C= 0.600 Limited to weir flow at low heads
#2	Device 1	961.50'	**0.800 in/hr Filtration over Surface area**
#3	Primary	960.50'	**15.0" Round Culvert** L= 100.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 959.50' / 960.50' S= -0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#4	Device 3	964.10'	**5.0' long x 0.8' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.74 2.78 2.86 3.00 3.11 3.18 3.25 3.29 3.32 3.31 3.32

Primary OutFlow Max=12.20 cfs @ 12.40 hrs HW=966.10' TW=0.00' (Dynamic Tailwater)
└─**3=Culvert** (Barrel Controls 12.20 cfs @ 9.94 fps)
  ├─**1=Tile** (Passes < 6.59 cfs potential flow)
  │ └─**2=Filtration** (Passes < 0.40 cfs potential flow)
  └─**4=Broad-Crested Rectangular Weir** (Passes < 46.72 cfs potential flow)

Pond 7P: BMP 3 - Chamber Wizard Field A

Chamber Model = CMP Round 48 (Round Corrugated Metal Pipe)
Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
Overall Size= 48.0"W x 48.0"H x 20.00'L
Row Length Adjustment= +9.00' x 12.57 sf x 23 rows

48.0" Wide + 24.0" Spacing = 72.0" C-C Row Spacing

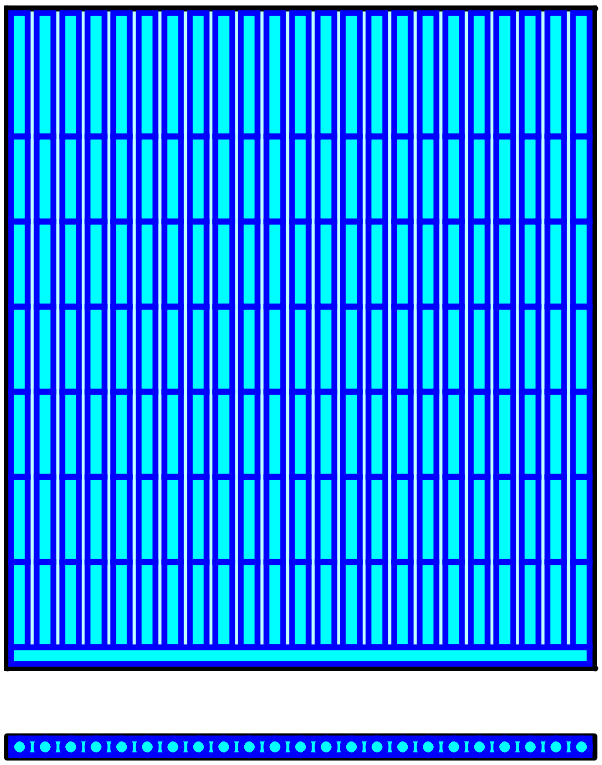
7 Chambers/Row x 20.00' Long +9.00' Row Adjustment +4.00' Header x 1 = 153.00' Row Length +12.0" End Stone x 2 = 155.00' Base Length
23 Rows x 48.0" Wide + 24.0" Spacing x 22 + 12.0" Side Stone x 2 = 138.00' Base Width
6.0" Stone Base + 48.0" Chamber Height + 6.0" Stone Cover = 5.00' Field Height

161 Chambers x 251.3 cf +9.00' Row Adjustment x 12.57 sf x 23 Rows + 136.00' Header x 12.57 sf = 44,774.0 cf Chamber Storage

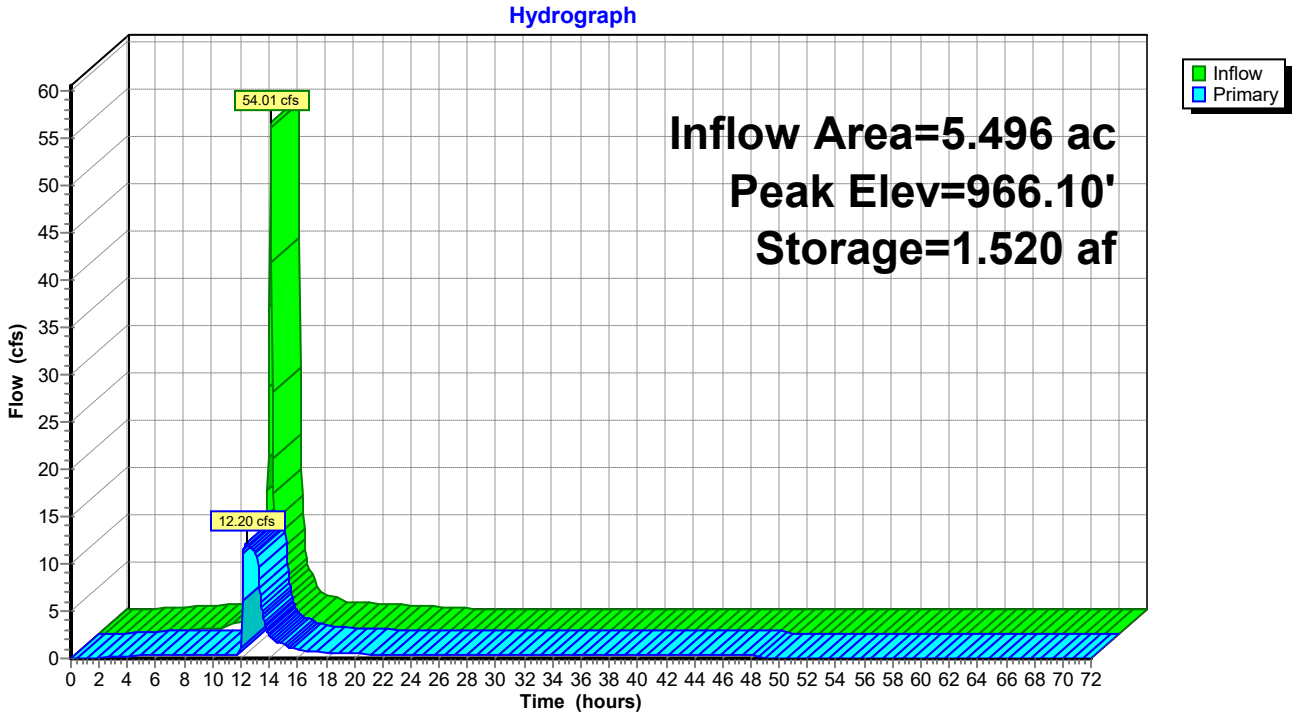
106,950.0 cf Field - 44,774.0 cf Chambers = 62,176.0 cf Stone x 40.0% Voids = 24,870.4 cf Stone Storage

Chamber Storage + Stone Storage = 69,644.4 cf = 1.599 af
Overall Storage Efficiency = 65.1%
Overall System Size = 155.00' x 138.00' x 5.00'

161 Chambers
3,961.1 cy Field
2,302.8 cy Stone



Pond 7P: BMP 3


Hydrograph
Inflow
Primary
54.01 cfs
12.20 cfs
Inflow Area=5.496 ac
Peak Elev=966.10'
Storage=1.520 af
Flow (cfs)
Time (hours)
0 5 10 15 20 25 30 35 40 45 50 55 60
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

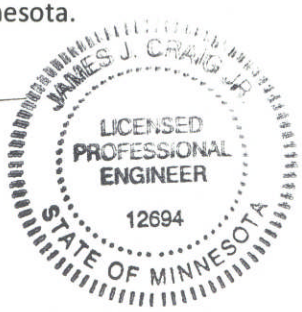
Preliminary Geotechnical Evaluation Report

Vacant Parcel
NE Quadrant Co Rd 11 and Highway 5
Victoria, Minnesota

Prepared for

City of Victoria

Professional Certification:
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.



James J. Craig, Jr., PE
Senior Engineer
License Number: 12694
July 14, 2011

Project BL-10-07515

Braun Intertec Corporation

BRAUN INTERTEC

Braun Intertec Corporation
11001 Hampshire Avenue S
Minneapolis, MN 55438

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Fax: 952.995.2020
Web: braunintertec.com

July 14, 2011

Project BL-10-07515

Ms. Holly Kreft
City of Victoria
7951 Rose Street, Box 36
Victoria, MN 55386-9681

Re: Preliminary Geotechnical Evaluation
Vacant Parcel
NE Quadrant Co Rd 11 and Highway 5
Victoria, Minnesota

Dear Ms. Kreft:

We are pleased to present this Preliminary Geotechnical Evaluation Report for the vacant property. A summary of our results and recommendations are presented below. More detailed information and recommendations follow.

Summary of Results

The borings mostly encountered lean clay with sand and sandy lean clay glacial till. The soils generally varied from rather soft to stiff.

Most of the borings did not encounter groundwater at the time of the borings. Borings ST-5, ST-8, and ST-15 encountered water at 3, 4, and 8 feet, respectively.

Summary of Recommendations

Generally, the soils encountered in the borings are suitable for foundation and floor slab support of light to moderately loaded structures. Depending on design grades, some areas such as ST-5, corrective earthwork will be needed for structure support. Allowable bearing pressures of 2,000 to 4,000 pounds per square foot (psf) may be used depending on location and elevation.

Remarks

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please call Jim Craig at 952.995.2372 or Greg Bialon at 952.995.2380.

Sincerely,

BRAUN INTERTEC CORPORATION

James J. Craig, Jr., PE
Senior Engineer

Gregory J. Bialon, PE
Principal Engineer

Geo Rpt-Vacant Parcel

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Appendix

A. Introduction

A.1. Project Description

We understand a mixed use development is proposed for this site. At this time there are no details as to what the development might be. We have assumed light to moderately loaded one and two story structures. There would also be driveways and parking areas.

A.2. Purpose

The purpose of this geotechnical evaluation was to characterize the soil and groundwater conditions at the boring locations with regard to possible future development.

A.3. Site Conditions

The site is relatively open and is high in the middle and slopes down in all directions.

A.4. Scope of Services

Our scope of services for this project was originally submitted as a Proposal to Ms. Holly Kreft of the City of Victoria. We received authorization to proceed from on May 19, 2011. Tasks performed in accordance with our authorized scope of services included:

- Performing a reconnaissance of the site to evaluate equipment access to exploration locations.
- Staking exploration locations and arranging the clearing of underground utilities.
- Performing 15 penetration test borings to a depth of 15 feet.
- Performing laboratory tests on selected penetration test samples.
- Preparing this report containing a CAD sketch, exploration logs, a summary of the geologic materials encountered, results of laboratory tests, and preliminary recommendations for structure subgrade preparation and the geotechnical design of foundations and pavements.

Exploration locations and surface elevations at the exploration locations were determined using GPS (Global Positioning System) technology that utilizes the Minnesota Department of Transportation's permanent GPS Virtual Reference Network (VRN).

Our scope of services was performed under the terms of our June 15, 2006, General Conditions.

B. Results

B.1. Exploration Logs

B.1.a. Log of Boring Sheets

Log of Boring sheets for our penetration test borings are included in the Appendix. The logs identify and describe the geologic materials that were penetrated, and present the results of penetration resistance, laboratory tests, and groundwater measurements.

Strata boundaries were inferred from changes in the penetration test samples and the auger cuttings. Because sampling was not performed continuously, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may also occur as gradual rather than abrupt transitions.

B.1.b. Geologic Origins

Geologic origins assigned to the materials shown on the logs and referenced within this report were based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.

B.2. Geologic Profile

B.2.a. Geologic Materials

Generally the borings encountered 1/2 to 2 feet of topsoil over sandy lean clay, lean clay with sand and clayey sand glacial till. Boring ST-3 encountered a stratum of silty sand till below the topsoil. The clay till

soils generally extended to the termination depth except at borings ST-2 and ST-5 where outwash poorly graded sand was encountered at depth.

The penetration resistance varied from 4 to 38 blows per foot (BPF) but was generally 6 to 10 BPF in the upper 10 feet and 10 to 15 BPF below 10 feet.

B.2.b. Groundwater

Groundwater was not observed in most of the borings as they were advanced. Groundwater was encountered in borings ST-5, ST-8, ST-15 at depths of 3, 4, and 8 feet, respectively. Given the cohesive nature of the geologic materials encountered, however, it is likely that insufficient time was available for groundwater to seep into the borehole and rise to its hydrostatic level. Piezometers or monitoring wells would be required to further evaluate if groundwater was present within the depths explored. Seasonal and annual fluctuations of groundwater should also be anticipated.

B.3. Laboratory Test Results

Laboratory test results are shown on the Log of Boring sheets adjacent to the sample tested. The moisture content of the samples tested varied from approximately 15 to 32 percent, indicating that the soil was over its probable optimum moisture content. The liquid limit determined for one sample was 33 with a plastic limit of 16.

C. Basis for Recommendations

C.1. Design Details

C.1.a. Building Structure Loads

Light to moderately loaded, slab-on-grade commercial buildings will likely be built on this site. Specific building loads were not available at the time of this evaluation. We have assumed that wall loads will be about 4,000 pounds per linear foot (plf) and column loads will be 75,000 to 150,000 pounds.

C.1.b. Pavements and Traffic Loads

Light-duty pavement areas will have a bituminous section. We have assumed that light-duty pavements will be subjected to no more than 50,000 equivalent 18-kip single axle loads (ESALs) over an assumed design life of 20 years.

Medium-duty pavement areas will have a bituminous section. We have assumed that medium-duty pavements will be subjected to no more than 100,000 ESALs over an assumed design life of 20 years.

C.1.c. Anticipated Grade Changes

We anticipate grade changes will be made to develop this site. The amount of cut or fill may have a significant impact on foundation design. We should review the development plans to evaluate the effect of grade changes on the development.

C.1.d. Precautions Regarding Changed Information

We have attempted to describe our understanding of the proposed construction to the extent it was reported to us by others. Depending on the extent of available information, assumptions may have been made based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, we should be notified. New or changed information could require additional evaluation, analyses and/or recommendations.

C.2. Design Considerations

Spread footing foundation support is feasible over most of the site for light to moderately loaded structures. Depending on final grades, some soil correction work will likely be needed in some areas to provide foundation support.

C.3. Construction Considerations

From a construction perspective, the project team should also be aware that:

- The on-site clay soils will need to be dried to facilitate compaction. The thickness of clay placed in an excavation will also have to be restricted to limit the amount of post-construction settlement that occurs from the backfill compressing under its own weight.

- Because there are limited resources on the site, sands or gravels will have to be imported to backfill the balance of deep excavations that can only be partially backfilled with clay, and facilitate drainage behind below-grade walls and below pavements.

- Subgrades for haul roads and staging areas will be particularly sensitive to disturbance and strength loss. Subexcavation and recompaction or replacement of subgrade soils can be limited if these traffic areas are protected with crushed rock.

D. Recommendations

D.1. Building and Pavement Subgrade Preparation

D.1.a. Excavations

The amount of excavation below proposed foundation level will vary depending on building loads and elevation. For example, at boring ST-5, we recommend removing the upper 4 feet from below foundations. Since boring ST-5 is near the highest site elevation, it may be cut down several feet as part of the general site grading and no further subcuts would be needed.

At boring ST-9, the general site grade will likely be raised. If boring ST-9 is below a structure, the topsoil and soft clays, if encountered, should be removed prior to raising the grade.

Thus, it will be important to review the proposed development plan and provide specific recommendations for the various components of the plan. Additional borings may be recommended.

To provide lateral support to replacement backfill, additional required fill and the structural loads they will support, we recommend oversizing (widening) the excavations 1 foot horizontally beyond the outer edges of the building perimeter footings, or pavement limits, for each foot the excavations extend below bottom-of-footing or pavement subgrade elevations.

If grade changes will result in the placement of more than 10 feet of fill, a construction delay may be needed. We should evaluate the need to allow time for consolidation of the fill and/or the underlying soils where fill depths exceed 10 feet.

D.1.b. Excavation Dewatering

Based on the boring results, we anticipate limited groundwater will be encountered. However, localized perched water may be encountered and groundwater may be encountered in the lower portions of the site. Additional evaluation of groundwater levels could be done by installing piezometers and monitoring them for a period of time.

We recommend removing any groundwater from the excavations. Sumps and pumps can be considered for excavations in low-permeability silt- and clay-rich soils, or where groundwater can be drawn down 2 feet below the bottoms of excavations in more permeable sands. In large excavations, or where groundwater must be drawn down more than 2 feet, a well contractor should review our logs to

determine if wells are required, how many will be required, and to what depths they will need to be installed.

In sands, we do not recommend attempting to dewater from within an excavation. Upward seepage will loosen and disturb the excavation bottom. Rather, groundwater should be drawn down at least 2 feet below the anticipated excavation bottom in advance of excavation.

D.1.c. Selecting Excavation Backfill and Additional Required Fill

We initially recommend backfilling over wet or submerged excavation bottoms with at least 2 feet of coarse sand having less than 50 percent of the particles by weight passing a #40 sieve, and less than 5 percent of the particles passing a #200 sieve. We anticipate that this material will need to be imported.

On-site soils free of organic soil and debris can be considered for reuse as backfill and fill. The clay soils will be more difficult to compact if wet or allowed to become wet, or if spread and compacted over wet surfaces.

We recommend that granular subbase material for pavement support consist of sand having less than 12 percent of the particles by weight passing a #200 sieve. We anticipate that this material will need to be imported.

Imported material needed to replace excavation spoils or to balance cut and fill quantities, may consist of sand, silty sand, clayey sand, sandy lean clay or lean clay. We recommend, however, that the plasticity index of these materials not exceed 15.

D.1.d. Placement and Compaction of Backfill and Fill

We recommend spreading backfill and fill in loose lifts of approximately 8 inches. We generally recommend compacting backfill and fill to a minimum of 95 to 98 percent standard Proctor density (ASTM D698) depending on what type of structures will be constructed. The clay soil needs to be placed with moisture contents between 1 percentage point below to 3 percentage points above the optimum moisture content. Actual compaction specifications should be determined based on development design requirements.

D.2. Spread Footings

D.2.a. Embedment Depth

For frost protection, we recommend embedding perimeter footings 42 inches below the lowest exterior grade. Interior footings may be placed directly below floor slabs. We recommend embedding building footings not heated during winter construction, and other unheated footings associated with canopies, stoops or sidewalks 60 inches below the lowest exterior grade.

D.2.b. Net Allowable Bearing Pressure

Based on the borings, it is our opinion the site is suitable for foundations designed with net allowable bearing pressures ranging from 2,000 to 4,000 pounds per square foot (psf). This value includes a safety factor of at least 3.0 with regard to bearing capacity failure. The net allowable bearing pressure can be increased by one-third its value for occasional transient loads, but not for repetitive loads due to traffic, or for other live loads from snow or occupancy. Actual recommended bearing pressures will depend on the structures proposed and final grades.

D.2.c. Settlement

The recommended bearing pressure will be designed to limit total settlement to less than 1 inch.

D.3. Interior Slabs

D.3.a. Subgrade Modulus

We recommend using a modulus of subgrade reaction, k, of 100 pounds per square inch per inch of deflection (pci) to design the slabs with a clay subgrade.

D.3.b. Moisture Vapor Protection

If floor coverings or coatings less permeable than the concrete slab will be used, we recommend that a vapor retarder or vapor barrier be place immediately beneath the slab. Some contractors prefer to bury the vapor retarder or barrier beneath a layer of sand to reduce curling and shrinkage, but this practice risks trapping water between the slab and vapor retarder or barrier.

Regardless of where the vapor retarder or barrier is placed, we recommend consulting with floor covering manufacturers regarding the appropriate type, use and installation of the vapor retarder or barrier to preserve warranty assurances.

D.4. Exterior Slabs

Exterior slabs will be underlain with sandy lean clay to clayey sand, which are considered moderately to highly frost susceptible. If these soils become saturated and freeze, unfavorable amounts of heaving could occur. Grading to direct surface drainage away from buildings helps limit the potential for saturation and subsequent heaving to occur. Still, even limited amounts of movement can create tripping hazards to building residents, employees and guests. One way to help limit the potential for heaving to occur is to remove frost-susceptible soils present below the overlying slab "footprints" down to bottom-of-footing grades or to a maximum depth of 5 feet below subgrade elevation, whichever is least, and replace them with non frost-susceptible (NFS) backfill consisting of sand having less than 5 percent of the particles by weight passing a #200 sieve. This material was not encountered in our borings and would likely need to be imported.

If the banks of excavations to remove frost-susceptible soils from below exterior slabs are not sloped, abrupt transitions between frost-susceptible and NFS backfill will exist along which unfavorable amounts of differential heaving may still occur. Such transitions could exist between exterior slabs and pavements, between slabs and sidewalks, and along the slabs themselves should excavations be confined only to the building entrances. NSF backfill is also likely to be more permeable than the soils it replaces, and so can also trap infiltrating surface drainage and groundwater that can contribute to heaving at transitions. To address these issues, we recommend:

- Sloping the banks of excavations to remove frost-susceptible soils at a 3:1 (horizontal:vertical) or flatter gradient.

- Sloping the bottoms of the excavations to drain away from the building.

- Installing perforated drainpipes along the bottom outer edges of the excavations to collect and dispose of surface drainage and groundwater that could otherwise accumulate within the backfill and contribute to heaving.

One alternative for reducing frost-related heave is to place at least 2 inches of extruded polystyrene foam insulation below the slabs and extend it approximately 4 feet beyond the outer edges of the slabs. The insulation may have to be buried below a cushion of sand or gravel to protect it during construction. Another alternative is to support the slabs on frost-depth footings, and suspending the slabs at least 4 inches above the underlying subgrade soils to accommodate heaving without it affecting the slabs.

D.5. Pavements

D.5.a. Subgrade Proof-Roll

Prior to placing aggregate base material, we recommend proof-rolling pavement subgrades to determine if the subgrade materials are loose, soft or weak, and in need of further stabilization, compaction or subexcavation and recompaction or replacement. A second proof-roll should be performed after the aggregate base material is in place, and prior to placing bituminous or concrete pavement.

D.5.b. Design Sections

Laboratory tests to determine an R-value for pavement design were not included in the scope of this project. Based on our experience with similar projects in the area, however, it is our opinion that an R-value of 12 can be assumed for design purposes with a clay subgrade.

Based upon the aforementioned traffic loads and an R-value of 12, we recommend a light-duty pavement section that includes 3-inches of bituminous pavement over 8-inches of aggregate base material. For medium-duty areas, we recommend 4-inches of bituminous pavement over 10 inches of aggregate base material.

The above pavement designs are based upon a 20-year performance life. This is the amount of time before major reconstruction is anticipated. This performance life assumes maintenance, such as seal coating and crack sealing, is routinely performed. The actual pavement life will vary depending on variations in weather, traffic conditions and maintenance.

D.5.c. Materials and Compaction

We recommend specifying crushed aggregate base meeting the requirements of Minnesota Department of Transportation (Mn/DOT) Specification 3138 for Class 5. We recommend that the bituminous wear and base courses meet the requirements of Specifications 2360.

We recommend that the aggregate base be compacted to a minimum of 100 percent of its maximum standard Proctor dry density. We recommend that the bituminous pavement be compacted to at least 92 percent of the maximum theoretical Rice density.

D.5.d. Subgrade Drainage

We recommend installing perforated drainpipes throughout pavement areas at low points and about catch basins. The drainpipes should be placed in small trenches extended at least 6 inches below the granular subbase layer – or aggregate base material where no subbase is present.

D.6. Utilities

D.6.a. Subgrade Stabilization

We anticipate that utilities can be installed per manufacturer bedding requirements.

D.6.b. Selection, Placement and Compaction of Backfill

The compaction requirements for utility backfill will vary depending on location of the utility and the surface use requirements.

D.7. Construction Quality Control

D.7.a. Excavation Observations

We recommend having a geotechnical engineer observe all excavations related to subgrade preparation and spread footing, slab-on-grade and pavement construction. The purpose of the observations is to evaluate the competence of the geologic materials exposed in the excavations, and the adequacy of required excavation oversizing.

D.7.b. Materials Testing

We recommend density tests be taken in excavation backfill and additional required fill placed below spread footings, slab-on-grade construction, beside foundation walls, behind basement walls, and below pavements.

We recommend Marshall tests on bituminous mixes to evaluate strength and air voids, and density tests to evaluate compaction.

We also recommend slump, air content and strength tests of Portland cement concrete.

D.7.c. Pavement Subgrade Proof-Roll

We recommend that proof-rolling of the pavement subgrades be observed by a geotechnical engineer to determine if the results of the procedure meet project specifications, or delineate the extent of additional pavement subgrade preparation work.

D.7.d. Cold Weather Precautions

If site grading and construction is anticipated during cold weather, all snow and ice should be removed from cut and fill areas prior to additional grading. No fill should be placed on frozen subgrades. No frozen soils should be used as fill.

Concrete delivered to the site should meet the temperature requirements of ASTM C 94. Concrete should not be placed on frozen subgrades. Concrete should be protected from freezing until the necessary strength is attained. Frost should not be permitted to penetrate below footings.

E. Procedures

E.1. Penetration Test Borings

The penetration test borings were drilled with a flotation tired carrier-mounted core and auger drill equipped with hollow-stem auger and automatic hammer. The borings were performed in accordance with ASTM D 1586. Penetration test samples were taken at 2 1/2- or 5-foot intervals. Actual sample intervals and corresponding depths are shown on the boring logs.

Penetration test boreholes that met the Minnesota Department of Health (MDH) Environmental Borehole criteria were sealed with an MDH-approved grout. A sealing record for those boreholes will be forwarded to the Minnesota Department of Health Well Management Section.

E.2. Material Classification and Testing

E.2.a. Visual and Manual Classification

The geologic materials encountered were visually and manually classified in accordance with ASTM Standard Practice D 2488. A chart explaining the classification system is attached. Samples were placed in jars or bags and returned to our facility for review and storage.

E.2.b. Laboratory Testing

The results of the laboratory tests performed on geologic material samples are noted on or follow the appropriate attached exploration logs. The tests were performed in accordance with ASTM or AASHTO procedures.

E.3. Groundwater Measurements

The drillers checked for groundwater as the penetration test borings were advanced, and again after auger withdrawal. The boreholes were then backfilled or allowed to remain open for an extended period of observation as noted on the boring logs.

F. Qualifications

F.1. Variations in Subsurface Conditions

F.1.a. Material Strata

Our evaluation, analyses and recommendations were developed from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth, and therefore strata boundaries and thicknesses must be inferred to some extent. Strata boundaries may also be gradual transitions, and can be expected to vary in depth, elevation and thickness away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until additional exploration work is completed, or construction commences. If any such variations are revealed, our recommendations should be re-evaluated. Such variations could increase construction costs, and a contingency should be provided to accommodate them.

F.1.b. Groundwater Levels

Groundwater measurements were made under the conditions reported herein and shown on the exploration logs, and interpreted in the text of this report. It should be noted that the observation periods were relatively short, and groundwater can be expected to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

F.2. Continuity of Professional Responsibility

F.2.a. Plan Review

This report is based on a limited amount of information, and a number of assumptions were necessary to help us develop our recommendations. It is recommended that our firm review the geotechnical aspects of the designs and specifications, and evaluate whether the design is as expected, if any design changes have affected the validity of our recommendations, and if our recommendations have been correctly interpreted and implemented in the designs and specifications.

F.2.b. Construction Observations and Testing

It is recommended that we be retained to perform observations and tests during construction. This will allow correlation of the subsurface conditions encountered during construction with those encountered by the borings, and provide continuity of professional responsibility.

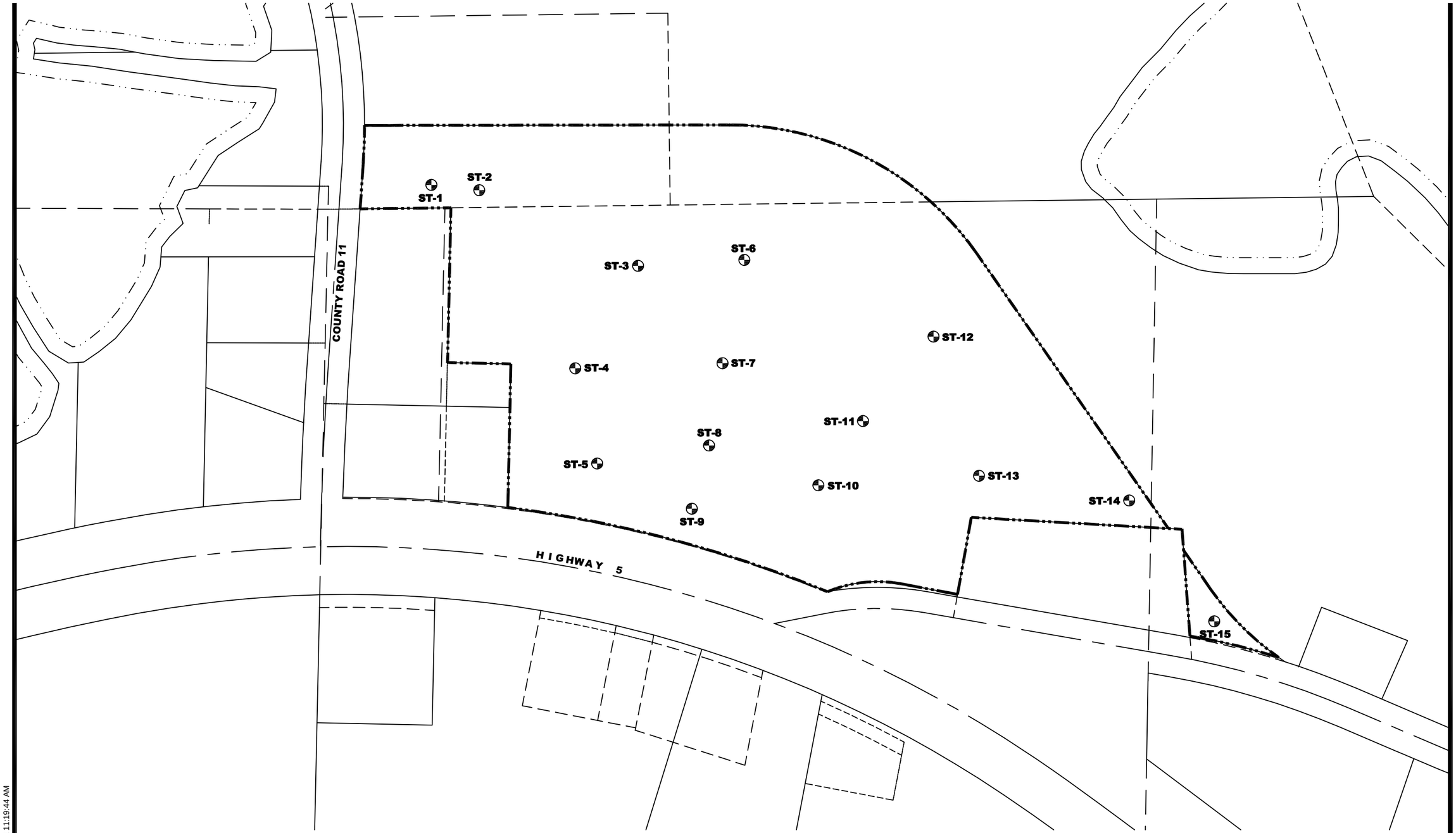
F.3. Use of Report

This report is for the exclusive use of the parties to which it has been addressed. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

F.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix



DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

N

75' 0 150'

SCALE: 1"= 150'

BRAUN INTERTEC

11001 Hampshire Avenue So.
Minneapolis, MN 55438
PH. (952) 995-2000
FAX (952) 995-2020

Base Dwg Provided By:
TKDA

SOIL BORING LOCATION SKETCH

GEOTECHNICAL EVALUATION
VACANT PARCEL
NE OF COUNTY ROAD 11 AND HIGHWAY 5
VICTORIA, MINNESOTA

Project No:	BL1007515
Drawing No:	BL1007515
Scale:	1"= 150'
Drawn By:	JAG
Date Drawn:	5/24/11
Checked By:	GJB
Last Modified:	6/3/11
Sheet:	of
Fig:	

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LOG OF BORING

Braun Project BL-10-07515
GEOTECHNICAL EVALUATION
Vacant Parcel
NE Quadrant Co Rd 11 & Hwy 5
Victoria, Minnesota

BORING: **ST-1**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/27/11** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
978.4	0.0					
977.6	0.8	CL	LEAN CLAY, with roots, dark gray, wet. (Topsoil)			
		CL	SANDY LEAN CLAY, with a trace of Gravel, brown, wet, medium to rather stiff. (Glacial Till)	6		
				11		
971.4	7.0	SC	CLAYEY SAND, fine-grained, with a trace of Gravel, brown, moist to wet, rather stiff to stiff. (Glacial Till)	12		
				12		
				12		
962.4	16.0			14		
			END OF BORING.			
			Water not observed with 14 1/2 feet of hollow-stem auger in the ground.			
			Water not observed to cave-in depth of 6 feet immediately after withdrawal of auger.			
			Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project BL-10-07515
GEOTECHNICAL EVALUATION
Vacant Parcel
NE Quadrant Co Rd 11 & Hwy 5
Victoria, Minnesota

BORING: **ST-2**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/27/11** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
981.3	0.0						
980.4	0.9	CL	LEAN CLAY, dark brown, wet. (Topsoil)				
		CL	SANDY LEAN CLAY, brown, wet, rather soft. (Glacial Till)	5		26	
977.3	4.0						
		SC	CLAYEY SAND, with a trace of Gravel, brown, moist to wet, medium. (Glacial Till)	8		18	
974.3	7.0						
		CL	SANDY LEAN CLAY, with a trace of Gravel, brown, wet, stiff. (Glacial Till)	13		25	
971.3	10.0						
		SC	CLAYEY SAND, brown, moist to wet, rather stiff. (Glacial Till)	11			
				10			
967.3	14.0						
		SP	POORLY GRADED SAND, fine- to medium-grained, with a trace of Gravel, brown, moist, medium dense. (Glacial Outwash)	13			
965.3	16.0						
			END OF BORING.				
			Water not observed with 14 1/2 feet of hollow-stem auger in the ground.				
			Water not observed to cave-in depth of 13 feet immediately after withdrawal of auger.				
			Boring immediately backfilled.				

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Braun Project BL-10-07515
GEOTECHNICAL EVALUATION
Vacant Parcel
NE Quadrant Co Rd 11 & Hwy 5
Victoria, Minnesota

BORING: **ST-3**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/27/11** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
985.5	0.0						
985.0	0.5	SC/SM	CLAYEY SAND, fine-grained, black, wet. (Topsoil)				
			SILTY SAND, fine- to medium-grained, with a trace of Gravel, brown, moist, loose. (Glacial Till)	5			
980.5	5.0	CL	SANDY LEAN CLAY, with a trace of Gravel, brown, wet, medium to stiff. (Glacial Till)	6		22	
			With Poorly Graded Sand lenses at 8 feet.	9			
				12			
				12			
969.5	16.0			14			
			END OF BORING. Water not observed with 15 feet of hollow-stem auger in the ground. Water not observed to cave-in depth of 13 feet immediately after withdrawal of auger. Boring immediately backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project BL-10-07515
GEOTECHNICAL EVALUATION
Vacant Parcel
NE Quadrant Co Rd 11 & Hwy 5
Victoria, Minnesota

BORING: **ST-4**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/27/11** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
975.6	0.0					
974.7	0.9	CL	LEAN CLAY, dark brown, wet. (Topsoil)			
		CL	LEAN CLAY with SAND, with a trace of Gravel, brown, wet, medium to rather stiff. (Glacial Till)	6		
				9		
968.6	7.0	CL	SANDY LEAN CLAY, with a trace of Gravel, brown, wet, medium to stiff. (Glacial Till)	7		
			With Sand seams at 10 feet.	9		
				11		
959.6	16.0			15		
			END OF BORING. Water not observed with 14 1/2 feet of hollow-stem auger in the ground. Water not observed to cave-in depth of 14 feet immediately after withdrawal of auger. Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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LOG OF BORING

Braun Project BL-10-07515
GEOTECHNICAL EVALUATION
Vacant Parcel
NE Quadrant Co Rd 11 & Hwy 5
Victoria, Minnesota

BORING: **ST-5**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/27/11** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
954.6	0.0	CL	LEAN CLAY, dark gray, wet. (Topsoil)				
952.6	2.0	CL	LEAN CLAY, dark gray, wet, rather soft. (Lacustrine Deposit)	4	▽	24	OC=2 1/2%
950.6	4.0	CL	LEAN CLAY, with a trace of root holes, with seams of Sand, dark gray, wet, medium to rather stiff. (Glacial Till)	9		30	An open triangle in the water level (WL) column indicates the depth at which groundwater was observed while drilling. Groundwater levels fluctuate.
				8		32	
944.6	10.0	SM	SILTY SAND, fine-grained, brown, waterbearing to wet, loose. (Glacial Outwash)	5			No sample recovery.
941.6	13.0	SP-SM	POORLY GRADED SAND with SILT, fine- to coarse-grained, with a little Gravel, brown, waterbearing, loose to medium dense. (Glacial Outwash)	7			
938.6	16.0			12			
			END OF BORING.				

Water observed at 7 1/2 feet while drilling.

Water observed at 13 feet with 14 1/2 feet of hollow-stem auger in the ground.

Water observed at 3 feet with a cave-in depth of 12 1/2 feet immediately after withdrawal of auger.

Boring immediately backfilled.

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project BL-10-07515
GEOTECHNICAL EVALUATION
Vacant Parcel
NE Quadrant Co Rd 11 & Hwy 5
Victoria, Minnesota

BORING: **ST-6**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/27/11** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
982.8	0.0					
982.1	0.7	ML	SANDY SILT, dark brown, wet. (Topsoil)			
		CL	LEAN CLAY with SAND, brown, wet, rather soft. (Glacial Till)	5		
976.8	6.0			5		
		CL	SANDY LEAN CLAY, with a trace of Gravel, brown and rust, wet, rather stiff to very stiff. (Glacial Till)	11		
				12		
				23		
966.8	16.0			20		
			END OF BORING.			
			Water not observed with 14 1/2 feet of hollow-stem auger in the ground.			
			Water not observed to cave-in depth of 13 feet immediately after withdrawal of auger.			
			Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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LOG OF BORING

Braun Project BL-10-07515
GEOTECHNICAL EVALUATION
Vacant Parcel
NE Quadrant Co Rd 11 & Hwy 5
Victoria, Minnesota

BORING: **ST-7**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/27/11** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
974.4	0.0					
973.4	1.0	CL	LEAN CLAY, with a trace of roots. (Topsoil)			
		CL	LEAN CLAY with SAND, with seams of Sand at 3 feet, gray to brown, wet, medium. (Glacial Till)	8		
968.4	6.0			8		
		CL	SANDY LEAN CLAY, with a trace of Gravel, brown, wet, rather stiff. (Glacial Till)	12		
965.4	9.0					
		CL	LEAN CLAY with SAND, with a trace of Gravel, brown to grayish brown, wet, rather stiff to stiff. (Glacial Till)	11		
				16		
958.4	16.0			19		
			END OF BORING. Water not observed with 14 1/2 feet of hollow-stem auger in the ground. Water not observed to cave-in depth of 14 feet immediately after withdrawal of auger. Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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LOG OF BORING

Braun Project BL-10-07515
GEOTECHNICAL EVALUATION
Vacant Parcel
NE Quadrant Co Rd 11 & Hwy 5
Victoria, Minnesota

BORING: **ST-8**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/27/11** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
960.1	0.0	CL	LEAN CLAY, brown, wet. (Topsoil)				
958.1	2.0	CL	SANDY LEAN CLAY, with a trace of Gravel, brown and gray mottled with rust, wet, medium. (Glacial Till)	7	▽		No sample recovery.
				8		32	
953.1	7.0	SC	CLAYEY SAND, fine- to medium-grained, with a little Gravel, dark brown, wet, rather soft. (Glacial Till)	5		28	
				5			
948.1	12.0	CL	SANDY LEAN CLAY, with a trace of Gravel, brown and gray, wet, rather stiff to stiff. (Glacial Till)	11			
				13			
944.1	16.0		END OF BORING.				

Water observed at 7 1/2 feet while drilling.

Water observed at 13 1/2 feet with 14 1/2 feet of hollow-stem auger in the ground.

Water observed at 4 feet with a cave-in depth of 13 feet immediately after withdrawal of auger.

Boring immediately backfilled.

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\MINNEAPOLIS\2010\07515.GPJ BRAUN_V8_CURRENT.GDT 7/13/11 15:30

BRAUN INTERTEC

LOG OF BORING

Braun Project BL-10-07515
GEOTECHNICAL EVALUATION
Vacant Parcel
NE Quadrant Co Rd 11 & Hwy 5
Victoria, Minnesota

BORING: **ST-9**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/27/11** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
956.6	0.0	CL	SANDY LEAN CLAY, dark brown, wet. (Topsoil)				
954.6	2.0	CL	SANDY LEAN CLAY, brown and gray, wet, rather stiff. (Glacial Till)	9		32	
952.6	4.0	CL	SANDY LEAN CLAY, with a trace of Gravel, brown and gray, wet, rather stiff. (Glacial Till)	9		18	
949.6	7.0	CL	SANDY LEAN CLAY, with a trace of Gravel, brown mottled with rust, wet, rather stiff to very stiff. (Glacial Till)	14			
				12			
943.6	13.0			18			No sample recovery.
940.6	16.0	CL	SANDY LEAN CLAY, with a trace of Gravel, gray, wet, very stiff. (Glacial Till)	25			
			END OF BORING. Water not observed with 14 1/2 feet of hollow-stem auger in the ground. Water not observed to cave-in depth of 13 feet immediately after withdrawal of auger. Boring immediately backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\MINNEAPOLIS\2010\07515.GPJ BRAUN_V8_CURRENT.GDT 7/13/11 15:30

BRAUN INTERTEC

LOG OF BORING

Braun Project BL-10-07515
GEOTECHNICAL EVALUATION
Vacant Parcel
NE Quadrant Co Rd 11 & Hwy 5
Victoria, Minnesota

BORING: **ST-10**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/27/11** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
961.6	0.0					
960.9	0.7	CL	LEAN CLAY, dark brown, wet. (Topsoil)			
		CL	LEAN CLAY, brown, wet, rather stiff. (Glacial Till)	10		
957.6	4.0	CL	SANDY LEAN CLAY, with a trace of Gravel, brown and gray, wet, stiff to very stiff. (Glacial Till)	14		
				19		
				15		
				17		
945.6	16.0			19		
			END OF BORING.			

Water not observed with 14 1/2 feet of hollow-stem auger in the ground.

Water not observed to cave-in depth of 13 1/2 feet immediately after withdrawal of auger.

Boring immediately backfilled.

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project BL-10-07515
GEOTECHNICAL EVALUATION
Vacant Parcel
NE Quadrant Co Rd 11 & Hwy 5
Victoria, Minnesota

BORING: **ST-11**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/27/11** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
968.7	0.0						
967.8	0.9	CL	LEAN CLAY, dark brown, wet. (Topsoil)				
		CL	SANDY LEAN CLAY, with a trace of Gravel, dark brown, wet, medium. (Glacial Till)	7			
964.7	4.0	CL	SANDY LEAN CLAY, with a trace of Gravel, brown, wet, rather stiff to stiff. (Glacial Till)	9		21	LL=33, PI=17
				16			
				15			
956.7	12.0	CL	SANDY LEAN CLAY, with a trace of Gravel, gray, wet, very stiff. (Glacial Till)	20			
				19			
952.7	16.0		END OF BORING.				
			Water not observed with 14 1/2 feet of hollow-stem auger in the ground.				
			Water not observed to cave-in depth of 13 feet immediately after withdrawal of auger.				
			Boring immediately backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\MINNEAPOLIS\2010\07515.GPJ BRAUN_V8_CURRENT.GDT 7/13/11 15:30

BRAUN INTERTEC

LOG OF BORING

Braun Project BL-10-07515
GEOTECHNICAL EVALUATION
Vacant Parcel
NE Quadrant Co Rd 11 & Hwy 5
Victoria, Minnesota

BORING: **ST-12**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/27/11** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
979.2	0.0					
978.7	0.5	CL	LEAN CLAY, dark brown, wet. (Topsoil)			
		CL	LEAN CLAY with SAND, with a trace of Gravel, brown, wet, medium. (Glacial Till)	7		
975.2	4.0					
		CL	SANDY LEAN CLAY, with a trace of Gravel, brown mottled with rust, wet, stiff to very stiff. (Glacial Till)	16		
				18		
970.2	9.0					
		SC	CLAYEY SAND, fine-grained, with a trace of Gravel, brown, wet, very stiff. (Glacial Till)	18		
				19		
				20		
963.2	16.0					
			END OF BORING.			
			Water not observed with 14 1/2 feet of hollow-stem auger in the ground.			
			Water not observed to cave-in depth of 12 feet immediately after withdrawal of auger.			
			Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project BL-10-07515
GEOTECHNICAL EVALUATION
Vacant Parcel
NE Quadrant Co Rd 11 & Hwy 5
Victoria, Minnesota

BORING: **ST-13**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/27/11** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
978.9	0.0					
978.4	0.5	CL	LEAN CLAY, dark brown, wet.			
		CL	(Topsoil)			
			LEAN CLAY with SAND, with a trace of Gravel, brown, wet, medium to rather stiff. (Glacial Till)	8		
				12		
971.9	7.0					
		CL	SANDY LEAN CLAY, with a trace of Gravel, brown to grayish brown, wet, rather stiff to stiff. (Glacial Till)	12		
			Mottled with rust at 10 feet.	13		
				14		
				13		
962.9	16.0					
			END OF BORING.			
			Water not observed with 14 1/2 feet of hollow-stem auger in the ground.			
			Water not observed to cave-in depth of 14 feet immediately after withdrawal of auger.			
			Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project BL-10-07515
GEOTECHNICAL EVALUATION
Vacant Parcel
NE Quadrant Co Rd 11 & Hwy 5
Victoria, Minnesota

BORING: **ST-14**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/27/11** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
967.2	0.0					
966.7	0.5	CL	LEAN CLAY, dark brown, wet.			
		CL	(rather soft,)			
			LEAN CLAY with SAND, with a trace of Gravel, brown, wet, rather stiff. (Glacial Till)	9		
				12		
960.2	7.0	CL	SANDY LEAN CLAY, with a trace of Gravel, brownish gray, wet, very stiff. (Glacial Till)	18		
956.2	11.0		Mottled with rust at 10 feet.	18		
		CL	LEAN CLAY with SAND, with a trace of Gravel, brown, wet, hard. (Glacial Till)	38		
953.2	14.0	CL	SANDY LEAN CLAY, with a trace of Gravel, with seams of Sand, grayish brown, wet, very stiff. (Glacial Till)	20		
951.2	16.0		END OF BORING.			
			Water not observed with 14 1/2 feet of hollow-stem auger in the ground.			
			Water not observed to cave-in depth of 12 feet immediately after withdrawal of auger.			
			Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\MINNEAPOLIS\2010\07515.GPJ BRAUN_V8_CURRENT.GDT 7/13/11 15:30

BRAUN INTERTEC

LOG OF BORING

Braun Project BL-10-07515
GEOTECHNICAL EVALUATION
Vacant Parcel
NE Quadrant Co Rd 11 & Hwy 5
Victoria, Minnesota

BORING: **ST-15**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/27/11** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
965.6	0.0					
965.0	0.6	CL	LEAN CLAY, fine-grained, with a trace of roots, brown. (Topsoil)			
		CL	LEAN CLAY with SAND, with a trace of Gravel, brown, wet, rather stiff to very stiff. (Glacial Till)	11		
				14		qp=4 tsf
				17	▽	
956.6	9.0					
		CL-ML	CLAYEY SILT, with seams of Poorly Graded Sand, gray, wet, stiff to very stiff. (Glacial Till)	15		
				20		
951.6	14.0					
		CL	LEAN CLAY, with lenses of Sand, grayish brown, wet, stiff. (Glacial Till)	13		
949.6	16.0					
			END OF BORING.			
			Water observed at 13 feet with 14 1/2 feet of hollow-stem auger in the ground.			
			Water observed at 8 feet with a cave-in depth of 9 1/2 feet immediately after withdrawal of auger.			
			Boring immediately backfilled.			

LOG OF BORING N:\GINT\PROJECTS\MINNEAPOLIS\2010\07515.GPJ BRAUN_V8_CURRENT.GDT 7/13/11 15:30

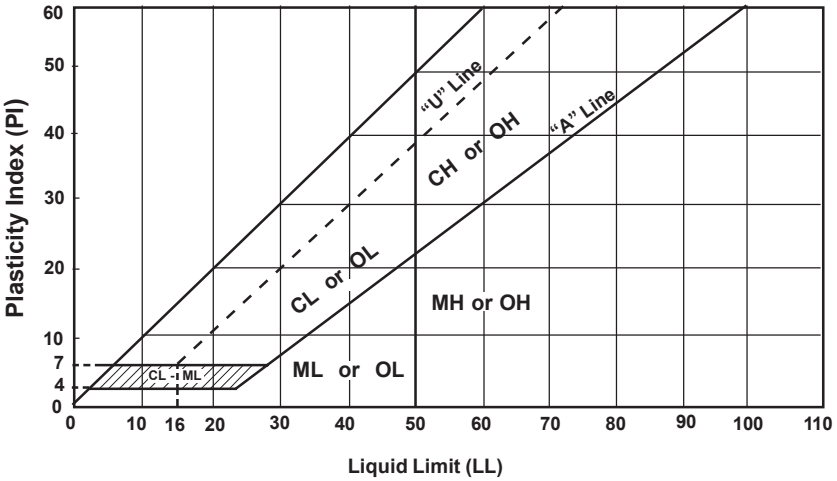
BRAUN INTERTEC

Descriptive Terminology of Soil

Standard D 2487 - 00
Classification of Soils for Engineering Purposes
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [a]				Soils Classification	
				Group Symbol	Group Name [b]
Coarse-grained Soils more than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels 5% or less fines [e]	$C_u \geq 4$ and $1 \leq C_c \leq 3$ [c]	GW	Well-graded gravel [d]
			$C_u < 4$ and/or $1 > C_c > 3$ [c]	GP	Poorly graded gravel [d]
		Gravels with Fines More than 12% fines [e]	Fines classify as ML or MH	GM	Silty gravel [d f g]
			Fines classify as CL or CH	GC	Clayey gravel [d f g]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands 5% or less fines [i]	$C_u \geq 6$ and $1 \leq C_c \leq 3$ [c]	SW	Well-graded sand [h]
			$C_u < 6$ and/or $1 > C_c > 3$ [c]	SP	Poorly graded sand [h]
		Sands with Fines More than 12% [i]	Fines classify as ML or MH	SM	Silty sand [f g h]
			Fines classify as CL or CH	SC	Clayey sand [f g h]
Fine-grained Soils 50% or more passed the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line [j]	CL	Lean clay [k l m]
			PI < 4 or plots below "A" line [j]	ML	Silt [k l m]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [k l m n]
				OL	Organic silt [k l m o]
	Silts and clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay [k l m]
			PI plots below "A" line	MH	Elastic silt [k l m]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [k l m p]
				OH	Organic silt [k l m q]
Highly Organic Soils		Primarily organic matter, dark in color and organic odor		PT	Peat

a. Based on the material passing the 3-in (75mm) sieve.
b. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders or both" to group name.
c. $C_u = D_{60} / D_{10}$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
d. If soil contains ≥15% sand, add "with sand" to group name.
e. Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
f. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
g. If fines are organic, add "with organic fines" to group name.
h. If soil contains ≥ 15% gravel, add "with gravel" to group name.
i. Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
j. If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
k. If soil contains 10 to 29% plus No. 200, add "with sand" or "with gravel" whichever is predominant.
l. If soil contains ≥30% plus No. 200, predominantly sand, add "sandy" to group name.
m. If soil contains ≥ 30% plus No. 200 predominantly gravel, add "gravelly" to group name.
n. PI ≥ 4 and plots on or above "A" line.
o. PI < 4 or plots below "A" line.
p. PI plots on or above "A" line.
q. PI plots below "A" line.



Laboratory Tests

DD	Dry density, pcf	**OC**	Organic content, %
WD	Wet density, pcf	**S**	Percent of saturation, %
MC	Natural moisture content, %	**SG**	Specific gravity
LL	Liqiuid limit, %	**C**	Cohesion, psf
PL	Plastic limit, %	∅	Angle of internal friction
PI	Plasticity index, %	**qu**	Unconfined compressive strength, psf
P200	% passing 200 sieve	**qp**	Pocket penetrometer strength, tsf

Particle Size Identification

Boulders	over 12"
Cobbles	3" to 12"
Gravel	
Coarse	3/4" to 3"
Fine	No. 4 to 3/4"
Sand	
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Silt	< No. 200, PI < 4 or below "A" line
Clay	< No. 200, PI ≥ 4 and on or above "A" line

Relative Density of Cohesionless Soils

Very loose	0 to 4 BPF
Loose	5 to 10 BPF
Medium dense	11 to 30 BPF
Dense	31 to 50 BPF
Very dense	over 50 BPF

Consistency of Cohesive Soils

Very soft	0 to 1 BPF
Soft	2 to 3 BPF
Rather soft	4 to 5 BPF
Medium	6 to 8 BPF
Rather stiff	9 to 12 BPF
Stiff	13 to 16 BPF
Very stiff	17 to 30 BPF
Hard	over 30 BPF

Drilling Notes

Standard penetration test borings were advanced by 3 1/4" or 6 1/4" ID hollow-stem augers unless noted otherwise, Jetting water was used to clean out auger prior to sampling only where indicated on logs. Standard penetration test borings are designated by the prefix "ST" (Split Tube). All samples were taken with the standard 2" OD split-tube sampler, except where noted.

Power auger borings were advanced by 4" or 6" diameter continuous-flight, solid-stem augers. Soil classifications and strata depths were inferred from disturbed samples augered to the surface and are, therefore, somewhat approximate. Power auger borings are designated by the prefix "B."

Hand auger borings were advanced manually with a 1 1/2" or 3 1/4" diameter auger and were limited to the depth from which the auger could be manually withdrawn. Hand auger borings are indicated by the prefix "H."

BPF: Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6" into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6" increments and added to get BPF. Where they differed significantly, they are reported in the following form: 2/12 for the second and third 6" increments, respectively.

WH: WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WR: WR indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

TW indicates thin-walled (undisturbed) tube sample.

Note: All tests were run in general accordance with applicable ASTM standards.

Stantec

Memo

To:	Eric Lembke St. Paul MN Office	From:	Peter Allen St. Paul MN Office
File:	193803714	Date:	October 11, 2017

Reference: Downtown West Infrastructure Improvements Stormwater Management

The following is a summary of the stormwater analysis for the Downtown West Infrastructure Improvements project in the City of Victoria. The design presented in the memo meets Minnehaha Creek Watershed District's (MCWD) stormwater management rules.

DESIGN CRITERIA

The project site is approximately 16.5 acres of new development and will result in more than 20% in land disturbance and the impervious surface will increase from 0.9 acres to 9.8 acres; therefore, the site must meet the design requirements of Table 2 of MCWD Stormwater Management Rules, as follows:

- Rate Control:
    - MCWD: No increase in peak flow rates for the 1-, 10-, and 100-year, 24-hour rain events. MCWD defines rainfall depths for these event as follows:
        - 1-year = 2.4"
        - 10-year = 4.1"
        - 100-year = 5.9"
- Volume Control:
    - MCWD: Abstraction of the first 1" of rainfall from the site's impervious surface.
- Water Quality:
    - MCWD: Phosphorus loading cannot increase from existing conditions.

DESIGN INPUTS AND ASSUMPTIONS

The following summarizes specific design inputs used for the stormwater analysis:

- Hydrologic Soil Group D was used for this site.
- Time of concentration was set to a minimum of 10 minutes.
- Infiltration Rate for filtration features = 0.45 in/hr

SITE DRAINAGE

The existing drainage of the 16.5-acre project area, which includes the realignment of Steiger Lake Road, generally flows in three directions: to the existing on-site wetland, to CSAH 11, and to Steiger Lake. The majority of the existing project area is undeveloped land with the only impervious surface being Steiger Lake Road. Figure 1 shows the drainage area boundaries for existing conditions.

Reference: Downtown West Infrastructure Improvements Stormwater Management

The proposed design provides regional stormwater management of the project site (see Figure 2). This includes two ponds that would be constructed prior to development and four other stormwater features that would be installed at the time of development. The two ponds constructed prior to development would be install by the City. These wet ponds each include a filtration bench to provide water quality and volume control treatment. The remaining four treatment features include an underground storage system with filtration, bioretention (filtration) swale, bioretention (filtration) basin, and a structural treatment device to be installed in-line with the storm sewer system. The majority of the stormwater runoff will be routed to the southwest through the two wet ponds. A smaller portion of the site will be routed to the northwest corner of the site near CSAH 11. This area will be treated with the in-line structural system due to limited area for a surface system.

RATE CONTROL

The discharge rate from the site will be controlled by the various best management practices (BMPs) used on-site. The proposed design meets the MCWD rate control requirements. The results are summarized in Table 1 below, and HydroCAD outputs are attached.

Table 1 – Summary of Peak Rates

Storm Event	Existing Conditions (cfs)	Proposed Conditions (cfs)
1-yr	19	3.1
10-yr	51	8.4
100-yr	88	15

VOLUME CONTROL

The site has a post-development impervious surface of 9.84 acres, which results in a volume control requirement of 35,719 ft^3. Filtration is proposed due to the presence of clayey soils on-site. To meet MCWD volume control requirements using filtration, the standard volume control requirements must be doubled. Therefore, the sites volume control requirement is 71,438 ft^3. The volume control requirement is achieved using a series of filtration BMPs. Appendix A of the MCWD Stormwater Management Rule was used as the primary guidance for volume abstraction credits. Table 2 below summarizes volume control credit for each BMP.

Reference: Downtown West Infrastructure Improvements Stormwater Management

Table 2 – Summary of Volume Control Provided by Each BMP

City BMPs	HydroCAD Node	Direct Drainage Area (ac)	Impervious Area (ac)	WQV (cu.ft)	Design Volume (cu.ft.)	Net Diff. (cu. ft.)
Pond w/ filtration bench	1P	6.08	3.25	23,595	25,580	1,985
Pond w/ filtration bench	4P	2.37	0.68	4,937	8,079	3,142
In-line Structural Treatment	2P	0.91	0.46	3,340	0	-3,340
City Subtotals		*9.36*	*4.39*	*31,871*	*33,659*	*3,142*

Development BMPs	HydroCAD Node	Direct Drainage Area (ac)	Impervious Area (ac)	WQV (cu.ft)	Design Volume (cu.ft.)	Net Diff. (cu. ft.)
Underground Filtration	3P	3.32	3.02	21,925	23,266	1341
Filtration basin	5P	1.52	1.01	7,333	7,500	167
Filtration swale	6P	2.08	1.42	10,309	7,028	-3,281
Development Subtotals		*6.92*	*5.45*	*39,567*	*37,794*	*-1,773*
Totals		**16.28**	**9.84**	**71,438**	**71,453**	**15**

WATER QUALITY

A P8 analysis was used for water quality calculations. All the BMPs listed in the volume control credit summary table will provide water quality treatment. In addition to this list, a structural stormwater filtration device (e.g., Jellyfish filter, StormFilter, or equivalent) will be used to provide additional treatment at the northwest corner of the site. Based on manufacturer's literature, these devices can achieve a TP removal rate of approximately 60%. Table 3 below summarizes the water quality modeling. P8 output data is included as an attachment.

Reference: Downtown West Infrastructure Improvements Stormwater Management

Table 3 – Summary of TP Flowing Off-Site

Condition	TP Outflow (lbs/yr)
Existing	6.4
Proposed	5.1*

*Includes 60% TP removal rate of in-line structural treatment of drainage area P02. P02 creates 1.1 lbs/yr of TP, therefore 0.7 lbs/yr are removed by the in-line treatment device. P8 output shows a TP outflow of 5.8 lbs/yr, so subtracting the 0.7 lbs/yr removed by the in-line treatment results in an outflow of 5.1 lbs/yr.

CONCLUSION

The design presented in this memo meets the requirements of MCWD's Stormwater Management Rule. As part of this design, the City will construct two wet ponds with filtration benches. The remaining BMPs will be installed by developers at the time of development. The development BMPs directly treat 6.92 ac of drainage area and 5.45 ac of impervious surface. These BMPs should provide water quality volumes equal to or greater than 37,794 ft^3 (0.87 ac-ft). This water quality volume is slightly less than the required water quality volume to treat 5.45 ac of impervious surface. To accommodate this, the wet ponds have been oversized to account for additional treatment. Therefore, the system in its entirety meets the MCWD's requirements.

There are several types of stormwater treatment features and devices that can be used to help meet stormwater requirements. Other than those listed in the memo they include, but are not limited to

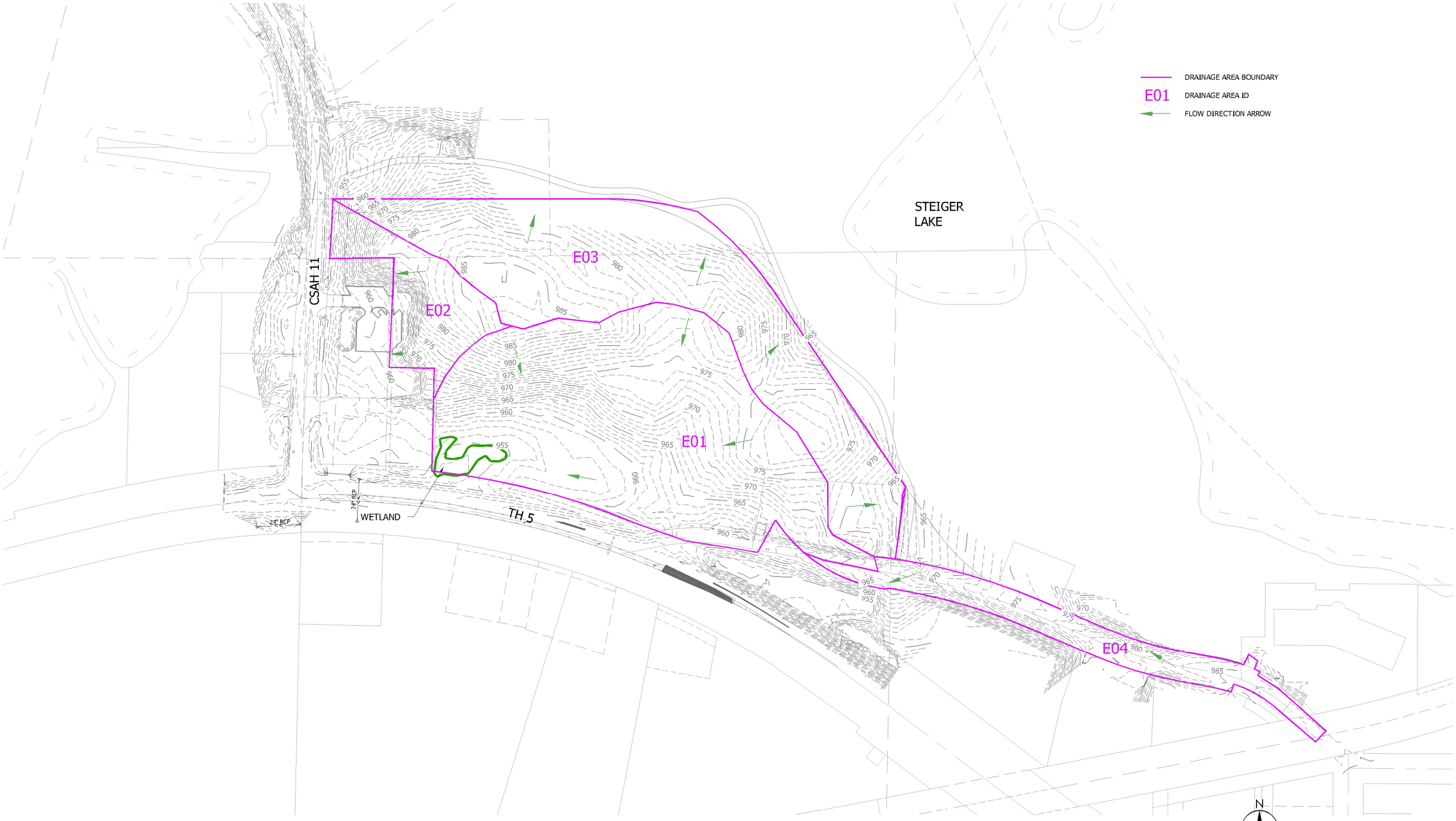
- Tree trenches or tree boxes
- Stormwater reuse/irrigation
- Soil amendments

Please contact me if you have questions or comments about our analysis or results.

STANTEC CONSULTING SERVICES INC.

Peter Allen
Water Resources Engineer
Phone: (651) 604-4801
Peter.Allen@stantec.com

Attachments: Drainage Area Maps
HydroCAD Outputs
P8 Output



DRAINAGE AREA MAP - EXISTING CONDITIONS

CITY OF VICTORIA

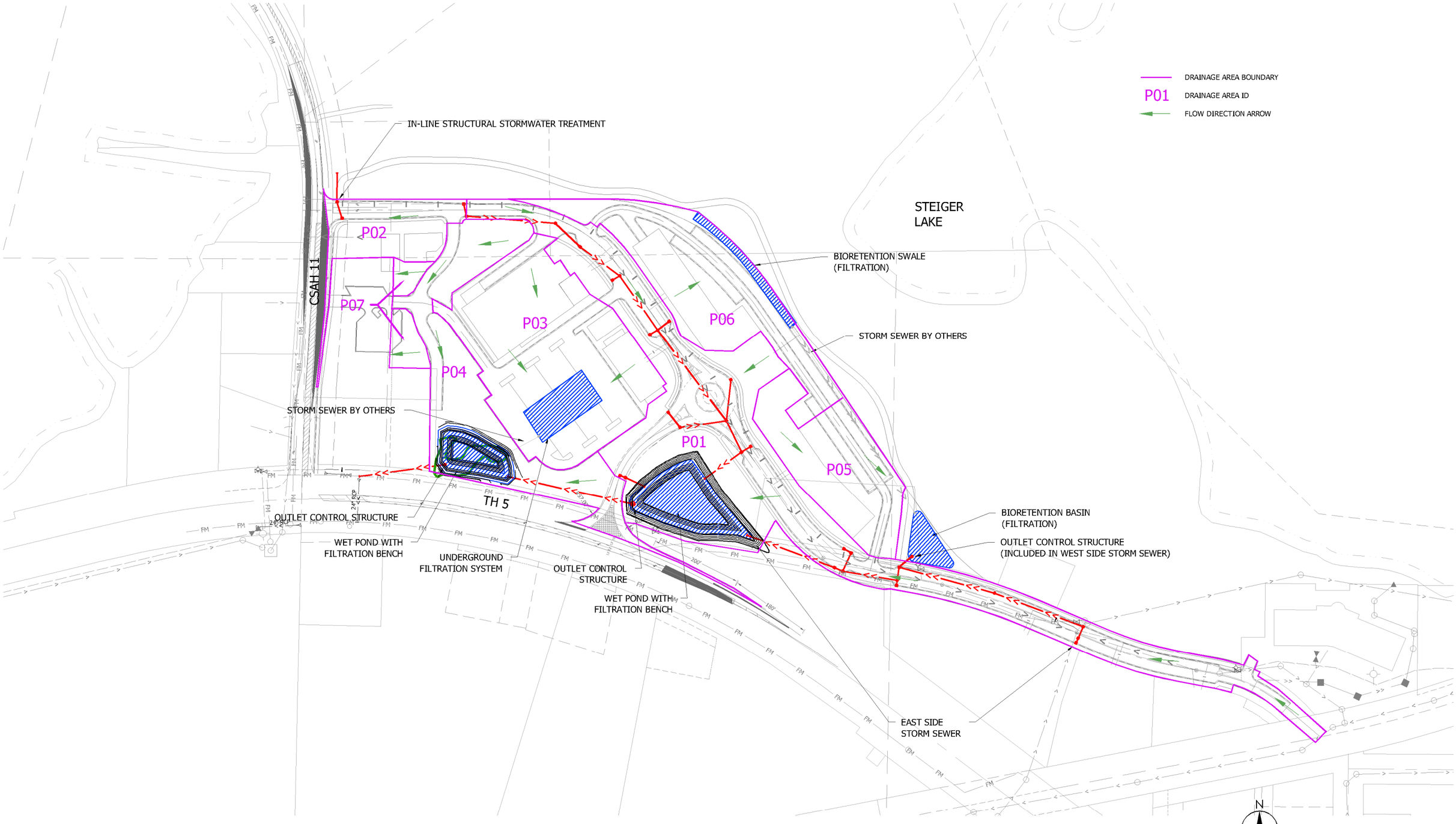
2017 DOWNTOWN WEST SIDE DEVELOPMENT

FIGURE 1

DATE: 10/10/2017 PROJ. NO.: 193803714

Stantec
2335 Highway 36 W
St. Paul, MN 55113
www.stantec.com

Plot Date: 10/10/2017 - 4:39pm
Drawing name: V:\1938\active\193803714\CAD\Dwg\193803714-Drainage_Existing.dwg
Xrefs: 193803714-ASAP, 193803714-ASNO, 193803714-ASPL, 193803714-ASST, 193803714-ASXT, Tree_GPS



DRAINAGE AREA MAP - PROPOSED CONDITIONS

CITY OF VICTORIA

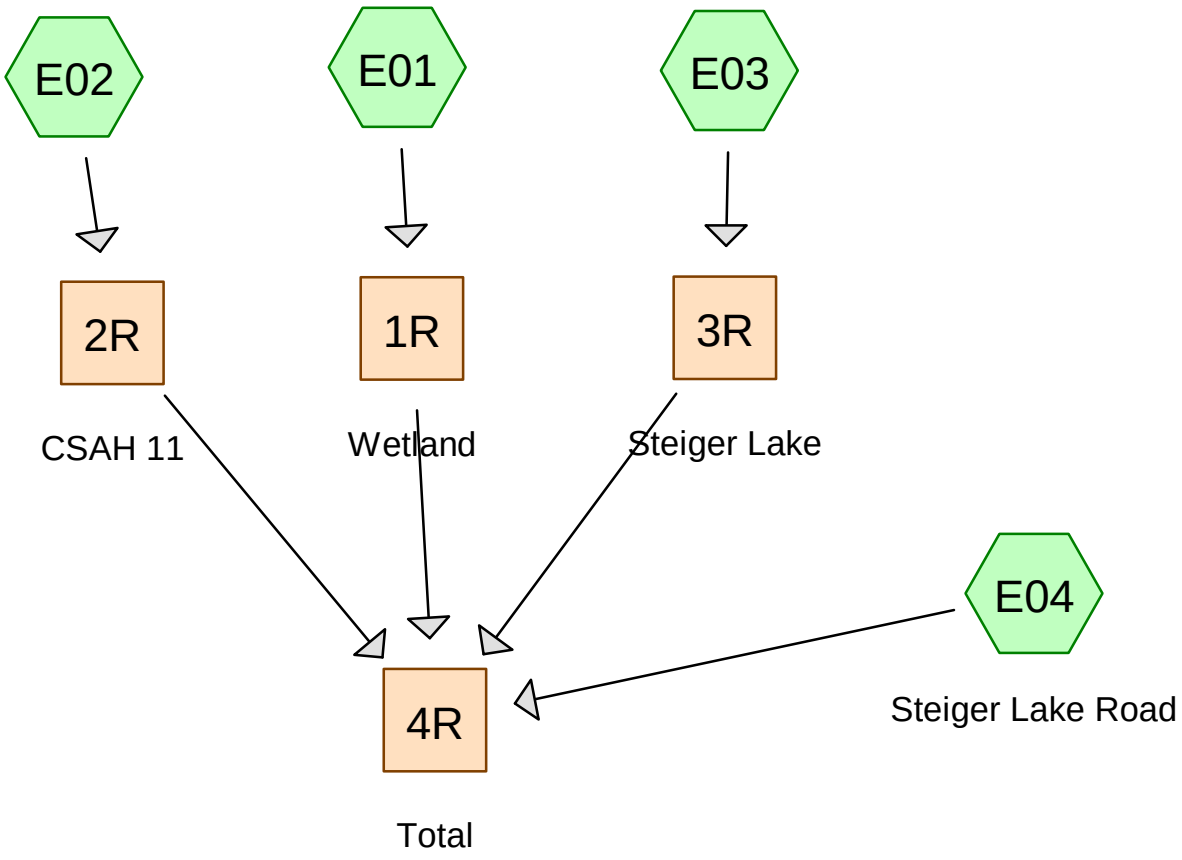
2017 DOWNTOWN WEST SIDE DEVELOPMENT

FIGURE 2

DATE: 10/10/2017 PROJ. NO.: 193803714

Stantec
2335 Highway 36 W
St. Paul MN 55113
www.stantec.com

Plot Date: 10/11/2017 - 11:55am
Drawing name: V:\1938\active\193803714\CAD\Dwg\193803714-Drainage_Proposed.dwg
Xrefs: 193803714-XSAP, 193803714-XSNO, 193803714-XSPL, 193803714-XSST, 193803714-XSX, Trees_GPS



Subcat Reach Pond Link

Routing Diagram for DTWest_Victoria_Existing
Prepared by Stantec Consulting Ltd., Printed 10/11/2017

Summary for Subcatchment E01:

Runoff = 7.94 cfs @ 12.03 hrs, Volume= 0.452 af, Depth= 0.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1yr Rainfall=2.40"

Area (ac)	CN	Description
7.500	78	Meadow, non-grazed, HSG D
7.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment E02:

Runoff = 1.48 cfs @ 12.03 hrs, Volume= 0.084 af, Depth= 0.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1yr Rainfall=2.40"

Area (ac)	CN	Description
1.400	78	Meadow, non-grazed, HSG D
1.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment E03:

Runoff = 6.35 cfs @ 12.03 hrs, Volume= 0.362 af, Depth= 0.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1yr Rainfall=2.40"

Area (ac)	CN	Description
6.000	78	Meadow, non-grazed, HSG D
6.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment E04: Steiger Lake Road

Runoff = 3.25 cfs @ 12.01 hrs, Volume= 0.180 af, Depth= 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1yr Rainfall=2.40"

Area (ac)	CN	Description
0.880	98	Paved roads w/curbs & sewers, HSG D
0.620	78	Meadow, non-grazed, HSG D
1.500	90	Weighted Average
0.620		41.33% Pervious Area
0.880		58.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Reach 1R: Wetland

Inflow Area = 7.500 ac, 0.00% Impervious, Inflow Depth = 0.72" for 1yr event
Inflow = 7.94 cfs @ 12.03 hrs, Volume= 0.452 af
Outflow = 7.94 cfs @ 12.03 hrs, Volume= 0.452 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach 2R: CSAH 11

Inflow Area = 1.400 ac, 0.00% Impervious, Inflow Depth = 0.72" for 1yr event
Inflow = 1.48 cfs @ 12.03 hrs, Volume= 0.084 af
Outflow = 1.48 cfs @ 12.03 hrs, Volume= 0.084 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach 3R: Steiger Lake

Inflow Area = 6.000 ac, 0.00% Impervious, Inflow Depth = 0.72" for 1yr event
Inflow = 6.35 cfs @ 12.03 hrs, Volume= 0.362 af
Outflow = 6.35 cfs @ 12.03 hrs, Volume= 0.362 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach 4R: Total

Inflow Area = 16.400 ac, 5.37% Impervious, Inflow Depth = 0.79" for 1yr event
Inflow = 18.98 cfs @ 12.02 hrs, Volume= 1.079 af
Outflow = 18.98 cfs @ 12.02 hrs, Volume= 1.079 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Subcatchment E01:

Runoff = 22.35 cfs @ 12.02 hrs, Volume= 1.229 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=4.10"

Area (ac)	CN	Description
7.500	78	Meadow, non-grazed, HSG D
7.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment E02:

Runoff = 4.17 cfs @ 12.02 hrs, Volume= 0.229 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=4.10"

Area (ac)	CN	Description
1.400	78	Meadow, non-grazed, HSG D
1.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment E03:

Runoff = 17.88 cfs @ 12.02 hrs, Volume= 0.983 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=4.10"

Area (ac)	CN	Description
6.000	78	Meadow, non-grazed, HSG D
6.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment E04: Steiger Lake Road

Runoff = 6.59 cfs @ 12.01 hrs, Volume= 0.377 af, Depth= 3.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=4.10"

Area (ac)	CN	Description
0.880	98	Paved roads w/curbs & sewers, HSG D
0.620	78	Meadow, non-grazed, HSG D
1.500	90	Weighted Average
0.620		41.33% Pervious Area
0.880		58.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Reach 1R: Wetland

Inflow Area = 7.500 ac, 0.00% Impervious, Inflow Depth = 1.97" for 10yr event
Inflow = 22.35 cfs @ 12.02 hrs, Volume= 1.229 af
Outflow = 22.35 cfs @ 12.02 hrs, Volume= 1.229 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach 2R: CSAH 11

Inflow Area = 1.400 ac, 0.00% Impervious, Inflow Depth = 1.97" for 10yr event
Inflow = 4.17 cfs @ 12.02 hrs, Volume= 0.229 af
Outflow = 4.17 cfs @ 12.02 hrs, Volume= 0.229 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach 3R: Steiger Lake

Inflow Area = 6.000 ac, 0.00% Impervious, Inflow Depth = 1.97" for 10yr event
Inflow = 17.88 cfs @ 12.02 hrs, Volume= 0.983 af
Outflow = 17.88 cfs @ 12.02 hrs, Volume= 0.983 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach 4R: Total

Inflow Area = 16.400 ac, 5.37% Impervious, Inflow Depth = 2.06" for 10yr event
Inflow = 50.98 cfs @ 12.02 hrs, Volume= 2.819 af
Outflow = 50.98 cfs @ 12.02 hrs, Volume= 2.819 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Subcatchment E01:

Runoff = 39.40 cfs @ 12.01 hrs, Volume= 2.182 af, Depth= 3.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=5.90"

Area (ac)	CN	Description
7.500	78	Meadow, non-grazed, HSG D
7.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment E02:

Runoff = 7.35 cfs @ 12.01 hrs, Volume= 0.407 af, Depth= 3.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=5.90"

Area (ac)	CN	Description
1.400	78	Meadow, non-grazed, HSG D
1.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment E03:

Runoff = 31.52 cfs @ 12.01 hrs, Volume= 1.745 af, Depth= 3.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=5.90"

Area (ac)	CN	Description
6.000	78	Meadow, non-grazed, HSG D
6.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment E04: Steiger Lake Road

Runoff = 10.12 cfs @ 12.01 hrs, Volume= 0.594 af, Depth= 4.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=5.90"

Area (ac)	CN	Description
0.880	98	Paved roads w/curbs & sewers, HSG D
0.620	78	Meadow, non-grazed, HSG D
1.500	90	Weighted Average
0.620		41.33% Pervious Area
0.880		58.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Reach 1R: Wetland

Inflow Area = 7.500 ac, 0.00% Impervious, Inflow Depth = 3.49" for 100yr event
Inflow = 39.40 cfs @ 12.01 hrs, Volume= 2.182 af
Outflow = 39.40 cfs @ 12.01 hrs, Volume= 2.182 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach 2R: CSAH 11

Inflow Area = 1.400 ac, 0.00% Impervious, Inflow Depth = 3.49" for 100yr event
Inflow = 7.35 cfs @ 12.01 hrs, Volume= 0.407 af
Outflow = 7.35 cfs @ 12.01 hrs, Volume= 0.407 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach 3R: Steiger Lake

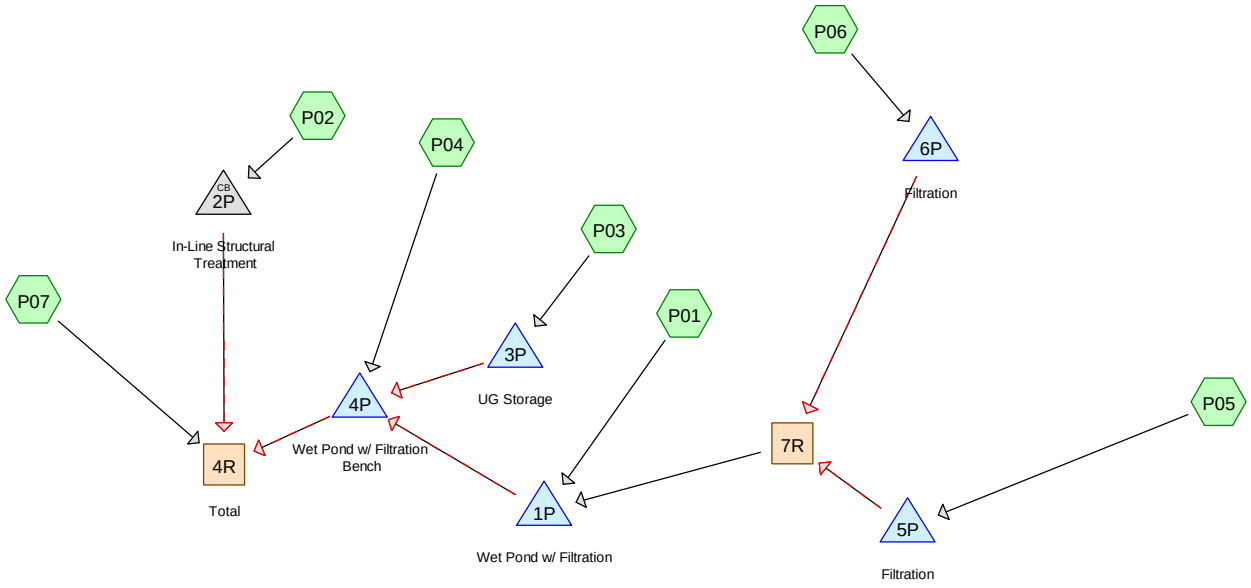
Inflow Area = 6.000 ac, 0.00% Impervious, Inflow Depth = 3.49" for 100yr event
Inflow = 31.52 cfs @ 12.01 hrs, Volume= 1.745 af
Outflow = 31.52 cfs @ 12.01 hrs, Volume= 1.745 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach 4R: Total

Inflow Area = 16.400 ac, 5.37% Impervious, Inflow Depth = 3.61" for 100yr event
Inflow = 88.37 cfs @ 12.01 hrs, Volume= 4.928 af
Outflow = 88.37 cfs @ 12.01 hrs, Volume= 4.928 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs



Subcat Reach Pond Link

Routing Diagram for DTWest_Victoria_Proposed_171011
Prepared by Stantec Consulting Ltd., Printed 10/11/2017

Summary for Subcatchment P01:

Runoff = 13.18 cfs @ 12.01 hrs, Volume= 0.731 af, Depth= 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1yr Rainfall=2.40"

Area (ac)	CN	Description
2.830	80	>75% Grass cover, Good, HSG D
3.250	98	Paved parking, HSG D
6.080	90	Weighted Average
2.830		46.55% Pervious Area
3.250		53.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P02:

Runoff = 1.88 cfs @ 12.01 hrs, Volume= 0.104 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1yr Rainfall=2.40"

Area (ac)	CN	Description
0.450	80	>75% Grass cover, Good, HSG D
0.460	98	Paved parking, HSG D
0.910	89	Weighted Average
0.450		49.45% Pervious Area
0.460		50.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P03:

Runoff = 9.20 cfs @ 12.01 hrs, Volume= 0.543 af, Depth= 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1yr Rainfall=2.40"

Area (ac)	CN	Description
0.300	80	>75% Grass cover, Good, HSG D
3.020	98	Paved parking, HSG D
3.320	96	Weighted Average
0.300		9.04% Pervious Area
3.020		90.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P04:

Runoff = 3.95 cfs @ 12.02 hrs, Volume= 0.217 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1yr Rainfall=2.40"

Area (ac)	CN	Description
1.690	80	>75% Grass cover, Good, HSG D
0.680	98	Paved parking, HSG D
2.370	85	Weighted Average
1.690		71.31% Pervious Area
0.680		28.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P05:

Runoff = 3.61 cfs @ 12.01 hrs, Volume= 0.203 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1yr Rainfall=2.40"

Area (ac)	CN	Description
0.510	80	>75% Grass cover, Good, HSG D
1.010	98	Paved parking, HSG D
1.520	92	Weighted Average
0.510		33.55% Pervious Area
1.010		66.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P06:

Runoff = 4.94 cfs @ 12.01 hrs, Volume= 0.277 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1yr Rainfall=2.40"

Area (ac)	CN	Description
0.660	80	>75% Grass cover, Good, HSG D
1.420	98	Paved parking, HSG D
2.080	92	Weighted Average
0.660		31.73% Pervious Area
1.420		68.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P07:

Runoff = 0.38 cfs @ 12.02 hrs, Volume= 0.021 af, Depth= 0.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1yr Rainfall=2.40"

Area (ac)	CN	Description
0.310	80	>75% Grass cover, Good, HSG D
0.310		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Reach 4R: Total

Inflow Area = 16.590 ac, 59.31% Impervious, Inflow Depth > 1.53" for 1yr event
Inflow = 3.05 cfs @ 12.04 hrs, Volume= 2.117 af
Outflow = 3.05 cfs @ 12.04 hrs, Volume= 2.117 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

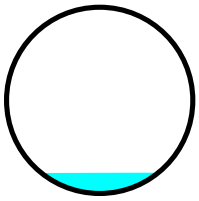
Summary for Reach 7R:

Inflow Area = 3.600 ac, 67.50% Impervious, Inflow Depth = 1.60" for 1yr event
Inflow = 0.29 cfs @ 13.44 hrs, Volume= 0.480 af
Outflow = 0.29 cfs @ 13.51 hrs, Volume= 0.480 af, Atten= 0%, Lag= 4.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.60 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 1.74 fps, Avg. Travel Time= 3.4 min

Peak Storage= 40 cf @ 13.47 hrs
Average Depth at Peak Storage= 0.17'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 10.50 cfs

18.0" Round Pipe
n= 0.013
Length= 360.0' Slope= 0.0100 '/'
Inlet Invert= 958.60', Outlet Invert= 955.00'



Summary for Pond 1P: Wet Pond w/ Filtration

Inflow Area = 9.680 ac, 58.68% Impervious, Inflow Depth = 1.50" for 1yr event
Inflow = 13.27 cfs @ 12.01 hrs, Volume= 1.211 af
Outflow = 1.26 cfs @ 12.64 hrs, Volume= 1.243 af, Atten= 90%, Lag= 37.5 min
Primary = 1.18 cfs @ 12.64 hrs, Volume= 0.802 af
Secondary = 0.09 cfs @ 12.64 hrs, Volume= 0.441 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Starting Elev= 956.20' Surf.Area= 24,387 sf Storage= 83,204 cf
Peak Elev= 956.81' @ 12.64 hrs Surf.Area= 25,778 sf Storage= 98,501 cf (15,297 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 326.0 min (1,575.0 - 1,249.0)

Volume	Invert	Avail.Storage	Storage Description
#1	951.00'	226,527 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
951.00	11,247	0	0
955.00	17,565	57,624	57,624
956.00	23,931	20,748	78,372
961.00	35,331	148,155	226,527

Device	Routing	Invert	Outlet Devices
#1	Primary	956.20'	**12.0" Round Culvert** L= 350.0' Ke= 0.500 Inlet / Outlet Invert= 956.20' / 954.00' S= 0.0063 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Secondary	955.00'	**0.450 in/hr Exfiltration over Surface area above 955.00'** Conductivity to Groundwater Elevation = 1.00' Excluded Surface area = 17,565 sf

Primary OutFlow Max=1.18 cfs @ 12.64 hrs HW=956.81' (Free Discharge)
1=Culvert (Barrel Controls 1.18 cfs @ 3.36 fps)

Secondary OutFlow Max=0.09 cfs @ 12.64 hrs HW=956.81' (Free Discharge)
2=Exfiltration (Controls 0.09 cfs)

Summary for Pond 2P: In-Line Structural Treatment

Inflow Area = 0.910 ac, 50.55% Impervious, Inflow Depth = 1.37" for 1yr event
Inflow = 1.88 cfs @ 12.01 hrs, Volume= 0.104 af
Outflow = 1.88 cfs @ 12.01 hrs, Volume= 0.104 af, Atten= 0%, Lag= 0.0 min
Primary = 1.88 cfs @ 12.01 hrs, Volume= 0.104 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 954.75' @ 12.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	954.00'	**12.0" Round Culvert** L= 100.0' Ke= 0.500 Inlet / Outlet Invert= 954.00' / 953.00' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.83 cfs @ 12.01 hrs HW=954.74' (Free Discharge)
1=Culvert (Inlet Controls 1.83 cfs @ 2.93 fps)

Summary for Pond 3P: UG Storage

Inflow Area = 3.320 ac, 90.96% Impervious, Inflow Depth = 1.96" for 1yr event
Inflow = 9.20 cfs @ 12.01 hrs, Volume= 0.543 af
Outflow = 0.11 cfs @ 19.55 hrs, Volume= 0.543 af, Atten= 99%, Lag= 452.7 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Secondary = 0.11 cfs @ 19.55 hrs, Volume= 0.543 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 967.23' @ 19.55 hrs Surf.Area= 10,872 sf Storage= 16,830 cf

Plug-Flow detention time= 1,355.8 min calculated for 0.543 af (100% of inflow)
Center-of-Mass det. time= 1,356.6 min (2,139.6 - 783.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	965.00'	15,003 cf	**72.92'W x 149.10'L x 5.50'H Field A** 59,795 cf Overall - 22,288 cf Embedded = 37,507 cf x 40.0% Voids
#2A	965.75'	22,288 cf	**ADS_StormTech MC-3500 d +Cap** x 200 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 10 Rows of 20 Chambers Cap Storage= +14.9 cf x 2 x 10 rows = 298.0 cf
		37,291 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	955.50'	**12.0" Round Culvert** L= 75.0' Ke= 0.500 Inlet / Outlet Invert= 955.50' / 954.00' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	968.00'	**12.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 968.00' / 967.90' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

#3 Secondary 965.00' **0.450 in/hr Exfiltration over Surface area**
Conductivity to Groundwater Elevation = 1.00'

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=965.00' (Free Discharge)
└**1=Culvert** (Passes 0.00 cfs of 10.15 cfs potential flow)
└**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.11 cfs @ 19.55 hrs HW=967.23' (Free Discharge)
└**3=Exfiltration** (Controls 0.11 cfs)

Summary for Pond 4P: Wet Pond w/ Filtration Bench

Inflow Area = 15.370 ac, 61.03% Impervious, Inflow Depth > 1.56" for 1yr event
Inflow = 4.61 cfs @ 12.03 hrs, Volume= 2.003 af
Outflow = 1.69 cfs @ 12.79 hrs, Volume= 1.992 af, Atten= 63%, Lag= 45.7 min
Primary = 1.69 cfs @ 12.79 hrs, Volume= 1.992 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Starting Elev= 954.00' Surf.Area= 10,016 sf Storage= 25,555 cf
Peak Elev= 954.58' @ 12.79 hrs Surf.Area= 10,774 sf Storage= 31,558 cf (6,003 cf above start)

Plug-Flow detention time= 1,065.6 min calculated for 1.404 af (70% of inflow)
Center-of-Mass det. time= 83.7 min (1,732.2 - 1,648.5)

Volume	Invert	Avail.Storage	Storage Description
#1	949.00'	48,211 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
949.00	2,597	0	0
953.00	6,141	17,476	17,476
954.00	10,016	8,079	25,555
956.00	12,640	22,656	48,211

Device	Routing	Invert	Outlet Devices
#1	Primary	954.00'	**24.0" Round Culvert** L= 190.0' Ke= 0.500 Inlet / Outlet Invert= 954.00' / 953.00' S= 0.0053 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Primary	953.00'	**0.800 in/hr Exfiltration over Surface area above 953.00'** Conductivity to Groundwater Elevation = 0.00' Excluded Surface area = 6,141 sf

Primary OutFlow Max=1.69 cfs @ 12.79 hrs HW=954.58' (Free Discharge)
└**1=Culvert** (Barrel Controls 1.60 cfs @ 3.20 fps)
└**2=Exfiltration** (Controls 0.09 cfs)

Summary for Pond 5P: Filtration

Inflow Area = 1.520 ac, 66.45% Impervious, Inflow Depth = 1.60" for 1yr event
Inflow = 3.61 cfs @ 12.01 hrs, Volume= 0.203 af
Outflow = 0.06 cfs @ 18.64 hrs, Volume= 0.203 af, Atten= 98%, Lag= 397.6 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Secondary = 0.06 cfs @ 18.64 hrs, Volume= 0.203 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 966.25' @ 18.64 hrs Surf.Area= 5,400 sf Storage= 6,123 cf

Plug-Flow detention time= 1,106.6 min calculated for 0.203 af (100% of inflow)
Center-of-Mass det. time= 1,107.3 min (1,916.5 - 809.2)

Volume	Invert	Avail.Storage	Storage Description
#1	965.00'	16,575 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
965.00	4,400	0	0
966.50	5,600	7,500	7,500
968.00	6,500	9,075	16,575

Device	Routing	Invert	Outlet Devices
#1	Primary	962.50'	**12.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 962.50' / 962.20' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	966.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	965.00'	**0.450 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 1.00'

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=965.00' (Free Discharge)
↑—**1=Culvert** (Passes 0.00 cfs of 5.35 cfs potential flow)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.06 cfs @ 18.64 hrs HW=966.25' (Free Discharge)
↑—**3=Exfiltration** (Controls 0.06 cfs)

Summary for Pond 6P: Filtration

Inflow Area = 2.080 ac, 68.27% Impervious, Inflow Depth = 1.60" for 1yr event
Inflow = 4.94 cfs @ 12.01 hrs, Volume= 0.277 af
Outflow = 0.24 cfs @ 13.44 hrs, Volume= 0.277 af, Atten= 95%, Lag= 85.7 min
Primary = 0.18 cfs @ 13.44 hrs, Volume= 0.045 af
Secondary = 0.06 cfs @ 13.44 hrs, Volume= 0.233 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 966.57' @ 13.44 hrs Surf.Area= 5,886 sf Storage= 7,409 cf

Plug-Flow detention time= 1,074.8 min calculated for 0.277 af (100% of inflow)
Center-of-Mass det. time= 1,074.7 min (1,883.9 - 809.2)

Volume	Invert	Avail.Storage	Storage Description
#1	965.00'	18,765 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
965.00	3,670	0	0
966.50	5,700	7,028	7,028
968.00	9,950	11,738	18,765

Device	Routing	Invert	Outlet Devices
#1	Primary	962.50'	**12.0" Round Culvert** L= 550.0' Ke= 0.500 Inlet / Outlet Invert= 962.50' / 959.70' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	966.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	965.00'	**0.450 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 1.00'

Primary OutFlow Max=0.17 cfs @ 13.44 hrs HW=966.57' (Free Discharge)
↑—**1=Culvert** (Passes 0.17 cfs of 3.52 cfs potential flow)
↑—**2=Orifice/Grate** (Weir Controls 0.17 cfs @ 0.84 fps)

Secondary OutFlow Max=0.06 cfs @ 13.44 hrs HW=966.57' (Free Discharge)
↑—**3=Exfiltration** (Controls 0.06 cfs)

Summary for Subcatchment P01:

Runoff = 26.72 cfs @ 12.01 hrs, Volume= 1.527 af, Depth= 3.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=4.10"

Area (ac)	CN	Description
2.830	80	>75% Grass cover, Good, HSG D
3.250	98	Paved parking, HSG D
6.080	90	Weighted Average
2.830		46.55% Pervious Area
3.250		53.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P02:

Runoff = 3.90 cfs @ 12.01 hrs, Volume= 0.221 af, Depth= 2.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=4.10"

Area (ac)	CN	Description
0.450	80	>75% Grass cover, Good, HSG D
0.460	98	Paved parking, HSG D
0.910	89	Weighted Average
0.450		49.45% Pervious Area
0.460		50.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P03:

Runoff = 16.44 cfs @ 12.01 hrs, Volume= 1.007 af, Depth= 3.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=4.10"

Area (ac)	CN	Description
0.300	80	>75% Grass cover, Good, HSG D
3.020	98	Paved parking, HSG D
3.320	96	Weighted Average
0.300		9.04% Pervious Area
3.020		90.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P04:

Runoff = 9.04 cfs @ 12.01 hrs, Volume= 0.503 af, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=4.10"

Area (ac)	CN	Description
1.690	80	>75% Grass cover, Good, HSG D
0.680	98	Paved parking, HSG D
2.370	85	Weighted Average
1.690		71.31% Pervious Area
0.680		28.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P05:

Runoff = 7.00 cfs @ 12.01 hrs, Volume= 0.407 af, Depth= 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=4.10"

Area (ac)	CN	Description
0.510	80	>75% Grass cover, Good, HSG D
1.010	98	Paved parking, HSG D
1.520	92	Weighted Average
0.510		33.55% Pervious Area
1.010		66.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P06:

Runoff = 9.58 cfs @ 12.01 hrs, Volume= 0.557 af, Depth= 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=4.10"

Area (ac)	CN	Description
0.660	80	>75% Grass cover, Good, HSG D
1.420	98	Paved parking, HSG D
2.080	92	Weighted Average
0.660		31.73% Pervious Area
1.420		68.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P07:

Runoff = 1.00 cfs @ 12.02 hrs, Volume= 0.055 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=4.10"

Area (ac)	CN	Description
0.310	80	>75% Grass cover, Good, HSG D
0.310		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Reach 4R: Total

Inflow Area = 16.590 ac, 59.31% Impervious, Inflow Depth > 3.00" for 10yr event
Inflow = 8.37 cfs @ 12.05 hrs, Volume= 4.145 af
Outflow = 8.37 cfs @ 12.05 hrs, Volume= 4.145 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

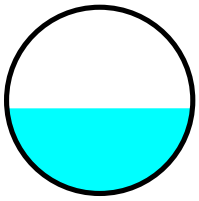
Summary for Reach 7R:

Inflow Area = 3.600 ac, 67.50% Impervious, Inflow Depth = 3.21" for 10yr event
Inflow = 4.56 cfs @ 12.23 hrs, Volume= 0.964 af
Outflow = 4.55 cfs @ 12.27 hrs, Volume= 0.964 af, Atten= 0%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.73 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.93 fps, Avg. Travel Time= 3.1 min

Peak Storage= 286 cf @ 12.25 hrs
Average Depth at Peak Storage= 0.69'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 10.50 cfs

18.0" Round Pipe
n= 0.013
Length= 360.0' Slope= 0.0100 '/'
Inlet Invert= 958.60', Outlet Invert= 955.00'



Summary for Pond 1P: Wet Pond w/ Filtration

Inflow Area = 9.680 ac, 58.68% Impervious, Inflow Depth = 3.09" for 10yr event
Inflow = 27.58 cfs @ 12.02 hrs, Volume= 2.491 af
Outflow = 3.13 cfs @ 13.01 hrs, Volume= 2.499 af, Atten= 89%, Lag= 59.5 min
Primary = 3.01 cfs @ 13.01 hrs, Volume= 2.045 af
Secondary = 0.11 cfs @ 13.01 hrs, Volume= 0.455 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Starting Elev= 956.20' Surf.Area= 24,387 sf Storage= 83,204 cf
Peak Elev= 957.86' @ 13.01 hrs Surf.Area= 28,165 sf Storage= 126,745 cf (43,541 cf above start)

Plug-Flow detention time= 1,802.9 min calculated for 0.589 af (24% of inflow)
Center-of-Mass det. time= 239.1 min (1,297.3 - 1,058.2)

Volume	Invert	Avail.Storage	Storage Description
#1	951.00'	226,527 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
951.00	11,247	0	0
955.00	17,565	57,624	57,624
956.00	23,931	20,748	78,372
961.00	35,331	148,155	226,527

Device	Routing	Invert	Outlet Devices
#1	Primary	956.20'	**12.0" Round Culvert** L= 350.0' Ke= 0.500 Inlet / Outlet Invert= 956.20' / 954.00' S= 0.0063 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Secondary	955.00'	**0.450 in/hr Exfiltration over Surface area above 955.00'** Conductivity to Groundwater Elevation = 1.00' Excluded Surface area = 17,565 sf

Primary OutFlow Max=3.01 cfs @ 13.01 hrs HW=957.86' (Free Discharge)
1=Culvert (Barrel Controls 3.01 cfs @ 3.84 fps)

Secondary OutFlow Max=0.11 cfs @ 13.01 hrs HW=957.86' (Free Discharge)
2=Exfiltration (Controls 0.11 cfs)

Summary for Pond 2P: In-Line Structural Treatment

Inflow Area = 0.910 ac, 50.55% Impervious, Inflow Depth = 2.92" for 10yr event
Inflow = 3.90 cfs @ 12.01 hrs, Volume= 0.221 af
Outflow = 3.90 cfs @ 12.01 hrs, Volume= 0.221 af, Atten= 0%, Lag= 0.0 min
Primary = 3.90 cfs @ 12.01 hrs, Volume= 0.221 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 955.77' @ 12.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	954.00'	**12.0" Round Culvert** L= 100.0' Ke= 0.500 Inlet / Outlet Invert= 954.00' / 953.00' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=3.82 cfs @ 12.01 hrs HW=955.71' (Free Discharge)
1=Culvert (Barrel Controls 3.82 cfs @ 4.87 fps)

Summary for Pond 3P: UG Storage

Inflow Area = 3.320 ac, 90.96% Impervious, Inflow Depth = 3.64" for 10yr event
Inflow = 16.44 cfs @ 12.01 hrs, Volume= 1.007 af
Outflow = 0.86 cfs @ 13.11 hrs, Volume= 0.902 af, Atten= 95%, Lag= 66.0 min
Primary = 0.75 cfs @ 13.11 hrs, Volume= 0.266 af
Secondary = 0.11 cfs @ 13.11 hrs, Volume= 0.637 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 968.50' @ 13.11 hrs Surf.Area= 10,872 sf Storage= 27,113 cf

Plug-Flow detention time= 1,176.6 min calculated for 0.902 af (90% of inflow)
Center-of-Mass det. time= 1,124.8 min (1,892.2 - 767.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	965.00'	15,003 cf	**72.92'W x 149.10'L x 5.50'H Field A** 59,795 cf Overall - 22,288 cf Embedded = 37,507 cf x 40.0% Voids
#2A	965.75'	22,288 cf	**ADS_StormTech MC-3500 d +Cap** x 200 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 10 Rows of 20 Chambers Cap Storage= +14.9 cf x 2 x 10 rows = 298.0 cf
		37,291 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	955.50'	**12.0" Round Culvert** L= 75.0' Ke= 0.500 Inlet / Outlet Invert= 955.50' / 954.00' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	968.00'	**12.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 968.00' / 967.90' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

#3 Secondary 965.00' **0.450 in/hr Exfiltration over Surface area**
Conductivity to Groundwater Elevation = 1.00'

Primary OutFlow Max=0.75 cfs @ 13.11 hrs HW=968.50' (Free Discharge)
└**1=Culvert** (Passes 0.75 cfs of 11.80 cfs potential flow)
└**2=Culvert** (Barrel Controls 0.75 cfs @ 2.76 fps)

Secondary OutFlow Max=0.11 cfs @ 13.11 hrs HW=968.50' (Free Discharge)
└**3=Exfiltration** (Controls 0.11 cfs)

Summary for Pond 4P: Wet Pond w/ Filtration Bench

Inflow Area = 15.370 ac, 61.03% Impervious, Inflow Depth > 3.05" for 10yr event
Inflow = 11.54 cfs @ 12.03 hrs, Volume= 3.905 af
Outflow = 5.23 cfs @ 12.26 hrs, Volume= 3.869 af, Atten= 55%, Lag= 14.0 min
Primary = 5.23 cfs @ 12.26 hrs, Volume= 3.869 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Starting Elev= 954.00' Surf.Area= 10,016 sf Storage= 25,555 cf
Peak Elev= 955.08' @ 12.26 hrs Surf.Area= 11,429 sf Storage= 37,103 cf (11,548 cf above start)

Plug-Flow detention time= 526.5 min calculated for 3.280 af (84% of inflow)
Center-of-Mass det. time= 43.0 min (1,415.8 - 1,372.7)

Volume	Invert	Avail.Storage	Storage Description
#1	949.00'	48,211 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
949.00	2,597	0	0
953.00	6,141	17,476	17,476
954.00	10,016	8,079	25,555
956.00	12,640	22,656	48,211

Device	Routing	Invert	Outlet Devices
#1	Primary	954.00'	**24.0" Round Culvert** L= 190.0' Ke= 0.500 Inlet / Outlet Invert= 954.00' / 953.00' S= 0.0053 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Primary	953.00'	**0.800 in/hr Exfiltration over Surface area above 953.00'** Conductivity to Groundwater Elevation = 0.00' Excluded Surface area = 6,141 sf

Primary OutFlow Max=5.23 cfs @ 12.26 hrs HW=955.08' (Free Discharge)
└**1=Culvert** (Barrel Controls 5.13 cfs @ 4.32 fps)
└**2=Exfiltration** (Controls 0.10 cfs)

Summary for Pond 5P: Filtration

Inflow Area = 1.520 ac, 66.45% Impervious, Inflow Depth = 3.21" for 10yr event
Inflow = 7.00 cfs @ 12.01 hrs, Volume= 0.407 af
Outflow = 1.50 cfs @ 12.26 hrs, Volume= 0.407 af, Atten= 79%, Lag= 14.8 min
Primary = 1.44 cfs @ 12.26 hrs, Volume= 0.153 af
Secondary = 0.06 cfs @ 12.26 hrs, Volume= 0.254 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 966.77' @ 12.26 hrs Surf.Area= 5,762 sf Storage= 9,035 cf

Plug-Flow detention time= 822.9 min calculated for 0.407 af (100% of inflow)
Center-of-Mass det. time= 822.8 min (1,612.4 - 789.6)

Volume	Invert	Avail.Storage	Storage Description
#1	965.00'	16,575 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
965.00	4,400	0	0
966.50	5,600	7,500	7,500
968.00	6,500	9,075	16,575

Device	Routing	Invert	Outlet Devices
#1	Primary	962.50'	**12.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 962.50' / 962.20' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	966.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	965.00'	**0.450 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 1.00'

Primary OutFlow Max=1.44 cfs @ 12.26 hrs HW=966.77' (Free Discharge)
↑—**1=Culvert** (Passes 1.44 cfs of 7.34 cfs potential flow)
↑—**2=Orifice/Grate** (Weir Controls 1.44 cfs @ 1.70 fps)

Secondary OutFlow Max=0.06 cfs @ 12.26 hrs HW=966.77' (Free Discharge)
↑—**3=Exfiltration** (Controls 0.06 cfs)

Summary for Pond 6P: Filtration

Inflow Area = 2.080 ac, 68.27% Impervious, Inflow Depth = 3.21" for 10yr event
Inflow = 9.58 cfs @ 12.01 hrs, Volume= 0.557 af
Outflow = 3.09 cfs @ 12.19 hrs, Volume= 0.557 af, Atten= 68%, Lag= 10.8 min
Primary = 3.01 cfs @ 12.19 hrs, Volume= 0.309 af
Secondary = 0.08 cfs @ 12.19 hrs, Volume= 0.248 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 967.13' @ 12.19 hrs Surf.Area= 7,499 sf Storage= 11,218 cf

Plug-Flow detention time= 570.5 min calculated for 0.557 af (100% of inflow)
Center-of-Mass det. time= 570.4 min (1,360.0 - 789.6)

Volume	Invert	Avail.Storage	Storage Description
#1	965.00'	18,765 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
965.00	3,670	0	0
966.50	5,700	7,028	7,028
968.00	9,950	11,738	18,765

Device	Routing	Invert	Outlet Devices
#1	Primary	962.50'	**12.0" Round Culvert** L= 550.0' Ke= 0.500 Inlet / Outlet Invert= 962.50' / 959.70' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	966.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	965.00'	**0.450 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 1.00'

Primary OutFlow Max=3.01 cfs @ 12.19 hrs HW=967.13' (Free Discharge)
└**1=Culvert** (Passes 3.01 cfs of 3.69 cfs potential flow)
└**2=Orifice/Grate** (Orifice Controls 3.01 cfs @ 3.83 fps)

Secondary OutFlow Max=0.08 cfs @ 12.19 hrs HW=967.13' (Free Discharge)
└**3=Exfiltration** (Controls 0.08 cfs)

Summary for Subcatchment P01:

Runoff = 41.01 cfs @ 12.01 hrs, Volume= 2.406 af, Depth= 4.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=5.90"

Area (ac)	CN	Description
2.830	80	>75% Grass cover, Good, HSG D
3.250	98	Paved parking, HSG D
6.080	90	Weighted Average
2.830		46.55% Pervious Area
3.250		53.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P02:

Runoff = 6.04 cfs @ 12.01 hrs, Volume= 0.352 af, Depth= 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=5.90"

Area (ac)	CN	Description
0.450	80	>75% Grass cover, Good, HSG D
0.460	98	Paved parking, HSG D
0.910	89	Weighted Average
0.450		49.45% Pervious Area
0.460		50.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P03:

Runoff = 24.00 cfs @ 12.01 hrs, Volume= 1.502 af, Depth= 5.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=5.90"

Area (ac)	CN	Description
0.300	80	>75% Grass cover, Good, HSG D
3.020	98	Paved parking, HSG D
3.320	96	Weighted Average
0.300		9.04% Pervious Area
3.020		90.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P04:

Runoff = 14.64 cfs @ 12.01 hrs, Volume= 0.831 af, Depth= 4.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=5.90"

Area (ac)	CN	Description
1.690	80	>75% Grass cover, Good, HSG D
0.680	98	Paved parking, HSG D
2.370	85	Weighted Average
1.690		71.31% Pervious Area
0.680		28.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P05:

Runoff = 10.54 cfs @ 12.01 hrs, Volume= 0.630 af, Depth= 4.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=5.90"

Area (ac)	CN	Description
0.510	80	>75% Grass cover, Good, HSG D
1.010	98	Paved parking, HSG D
1.520	92	Weighted Average
0.510		33.55% Pervious Area
1.010		66.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P06:

Runoff = 14.43 cfs @ 12.01 hrs, Volume= 0.862 af, Depth= 4.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=5.90"

Area (ac)	CN	Description
0.660	80	>75% Grass cover, Good, HSG D
1.420	98	Paved parking, HSG D
2.080	92	Weighted Average
0.660		31.73% Pervious Area
1.420		68.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Subcatchment P07:

Runoff = 1.71 cfs @ 12.01 hrs, Volume= 0.095 af, Depth= 3.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=5.90"

Area (ac)	CN	Description
0.310	80	>75% Grass cover, Good, HSG D
0.310		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Summary for Reach 4R: Total

Inflow Area = 16.590 ac, 59.31% Impervious, Inflow Depth > 4.73" for 100yr event
Inflow = 15.10 cfs @ 12.06 hrs, Volume= 6.537 af
Outflow = 15.10 cfs @ 12.06 hrs, Volume= 6.537 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

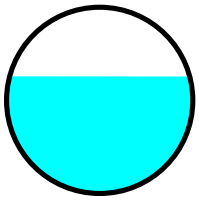
Summary for Reach 7R:

Inflow Area = 3.600 ac, 67.50% Impervious, Inflow Depth = 4.97" for 100yr event
Inflow = 7.59 cfs @ 12.18 hrs, Volume= 1.491 af
Outflow = 7.58 cfs @ 12.22 hrs, Volume= 1.491 af, Atten= 0%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.47 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 2.02 fps, Avg. Travel Time= 3.0 min

Peak Storage= 422 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.94'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 10.50 cfs

18.0" Round Pipe
n= 0.013
Length= 360.0' Slope= 0.0100 '/'
Inlet Invert= 958.60', Outlet Invert= 955.00'



Summary for Pond 1P: Wet Pond w/ Filtration

Inflow Area = 9.680 ac, 58.68% Impervious, Inflow Depth = 4.83" for 100yr event
Inflow = 46.39 cfs @ 12.02 hrs, Volume= 3.897 af
Outflow = 3.78 cfs @ 13.45 hrs, Volume= 3.903 af, Atten= 92%, Lag= 86.1 min
Primary = 3.64 cfs @ 13.45 hrs, Volume= 3.422 af
Secondary = 0.14 cfs @ 13.45 hrs, Volume= 0.482 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Starting Elev= 956.20' Surf.Area= 24,387 sf Storage= 83,204 cf
Peak Elev= 959.16' @ 13.45 hrs Surf.Area= 31,134 sf Storage= 165,352 cf (82,148 cf above start)

Plug-Flow detention time= 926.4 min calculated for 1.993 af (51% of inflow)
Center-of-Mass det. time= 281.8 min (1,242.6 - 960.9)

Volume	Invert	Avail.Storage	Storage Description
#1	951.00'	226,527 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
951.00	11,247	0	0
955.00	17,565	57,624	57,624
956.00	23,931	20,748	78,372
961.00	35,331	148,155	226,527

Device	Routing	Invert	Outlet Devices
#1	Primary	956.20'	**12.0" Round Culvert** L= 350.0' Ke= 0.500 Inlet / Outlet Invert= 956.20' / 954.00' S= 0.0063 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Secondary	955.00'	**0.450 in/hr Exfiltration over Surface area above 955.00'** Conductivity to Groundwater Elevation = 1.00' Excluded Surface area = 17,565 sf

Primary OutFlow Max=3.64 cfs @ 13.45 hrs HW=959.16' (Free Discharge)
1=Culvert (Barrel Controls 3.64 cfs @ 4.63 fps)

Secondary OutFlow Max=0.14 cfs @ 13.45 hrs HW=959.16' (Free Discharge)
2=Exfiltration (Controls 0.14 cfs)

Summary for Pond 2P: In-Line Structural Treatment

Inflow Area = 0.910 ac, 50.55% Impervious, Inflow Depth = 4.64" for 100yr event
Inflow = 6.04 cfs @ 12.01 hrs, Volume= 0.352 af
Outflow = 6.04 cfs @ 12.01 hrs, Volume= 0.352 af, Atten= 0%, Lag= 0.0 min
Primary = 6.04 cfs @ 12.01 hrs, Volume= 0.352 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 958.26' @ 12.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	954.00'	**12.0" Round Culvert** L= 100.0' Ke= 0.500 Inlet / Outlet Invert= 954.00' / 953.00' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=5.94 cfs @ 12.01 hrs HW=958.13' (Free Discharge)
1=Culvert (Barrel Controls 5.94 cfs @ 7.57 fps)

Summary for Pond 3P: UG Storage

Inflow Area = 3.320 ac, 90.96% Impervious, Inflow Depth = 5.43" for 100yr event
Inflow = 24.00 cfs @ 12.01 hrs, Volume= 1.502 af
Outflow = 4.87 cfs @ 12.26 hrs, Volume= 1.391 af, Atten= 80%, Lag= 15.1 min
Primary = 4.75 cfs @ 12.26 hrs, Volume= 0.742 af
Secondary = 0.11 cfs @ 12.26 hrs, Volume= 0.649 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 970.08' @ 12.26 hrs Surf.Area= 10,872 sf Storage= 35,458 cf

Plug-Flow detention time= 799.1 min calculated for 1.391 af (93% of inflow)
Center-of-Mass det. time= 757.7 min (1,516.1 - 758.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	965.00'	15,003 cf	**72.92'W x 149.10'L x 5.50'H Field A** 59,795 cf Overall - 22,288 cf Embedded = 37,507 cf x 40.0% Voids
#2A	965.75'	22,288 cf	**ADS_StormTech MC-3500 d +Cap** x 200 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 10 Rows of 20 Chambers Cap Storage= +14.9 cf x 2 x 10 rows = 298.0 cf
		37,291 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	955.50'	**12.0" Round Culvert** L= 75.0' Ke= 0.500 Inlet / Outlet Invert= 955.50' / 954.00' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	968.00'	**12.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 968.00' / 967.90' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

#3	Secondary	965.00'	**0.450 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 1.00'

Primary OutFlow Max=4.75 cfs @ 12.26 hrs HW=970.07' (Free Discharge)
└**1=Culvert** (Passes 4.75 cfs of 12.46 cfs potential flow)
└**2=Culvert** (Inlet Controls 4.75 cfs @ 6.04 fps)

Secondary OutFlow Max=0.11 cfs @ 12.26 hrs HW=970.07' (Free Discharge)
└**3=Exfiltration** (Controls 0.11 cfs)

Summary for Pond 4P: Wet Pond w/ Filtration Bench

Inflow Area = 15.370 ac, 61.03% Impervious, Inflow Depth > 4.78" for 100yr event
Inflow = 19.11 cfs @ 12.04 hrs, Volume= 6.125 af
Outflow = 10.75 cfs @ 12.32 hrs, Volume= 6.090 af, Atten= 44%, Lag= 16.7 min
Primary = 10.75 cfs @ 12.32 hrs, Volume= 6.090 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Starting Elev= 954.00' Surf.Area= 10,016 sf Storage= 25,555 cf
Peak Elev= 955.68' @ 12.32 hrs Surf.Area= 12,217 sf Storage= 44,200 cf (18,646 cf above start)

Plug-Flow detention time= 331.5 min calculated for 5.503 af (90% of inflow)
Center-of-Mass det. time= 37.7 min (1,282.7 - 1,244.9)

Volume	Invert	Avail.Storage	Storage Description
#1	949.00'	48,211 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
949.00	2,597	0	0
953.00	6,141	17,476	17,476
954.00	10,016	8,079	25,555
956.00	12,640	22,656	48,211

Device	Routing	Invert	Outlet Devices
#1	Primary	954.00'	**24.0" Round Culvert** L= 190.0' Ke= 0.500 Inlet / Outlet Invert= 954.00' / 953.00' S= 0.0053 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Primary	953.00'	**0.800 in/hr Exfiltration over Surface area above 953.00'** Conductivity to Groundwater Elevation = 0.00' Excluded Surface area = 6,141 sf

Primary OutFlow Max=10.74 cfs @ 12.32 hrs HW=955.68' (Free Discharge)
└**1=Culvert** (Barrel Controls 10.63 cfs @ 5.11 fps)
└**2=Exfiltration** (Controls 0.11 cfs)

Summary for Pond 5P: Filtration

Inflow Area = 1.520 ac, 66.45% Impervious, Inflow Depth = 4.97" for 100yr event
Inflow = 10.54 cfs @ 12.01 hrs, Volume= 0.630 af
Outflow = 3.61 cfs @ 12.18 hrs, Volume= 0.630 af, Atten= 66%, Lag= 10.2 min
Primary = 3.54 cfs @ 12.18 hrs, Volume= 0.367 af
Secondary = 0.06 cfs @ 12.18 hrs, Volume= 0.263 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 967.38' @ 12.18 hrs Surf.Area= 6,127 sf Storage= 12,645 cf

Plug-Flow detention time= 554.6 min calculated for 0.629 af (100% of inflow)
Center-of-Mass det. time= 555.9 min (1,333.9 - 777.9)

Volume	Invert	Avail.Storage	Storage Description
#1	965.00'	16,575 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
965.00	4,400	0	0
966.50	5,600	7,500	7,500
968.00	6,500	9,075	16,575

Device	Routing	Invert	Outlet Devices
#1	Primary	962.50'	**12.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 962.50' / 962.20' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	966.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	965.00'	**0.450 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 1.00'

Primary OutFlow Max=3.53 cfs @ 12.18 hrs HW=967.37' (Free Discharge)
↑—**1=Culvert** (Passes 3.53 cfs of 7.91 cfs potential flow)
↑—**2=Orifice/Grate** (Orifice Controls 3.53 cfs @ 4.50 fps)

Secondary OutFlow Max=0.06 cfs @ 12.18 hrs HW=967.37' (Free Discharge)
↑—**3=Exfiltration** (Controls 0.06 cfs)

Summary for Pond 6P: Filtration

Inflow Area = 2.080 ac, 68.27% Impervious, Inflow Depth = 4.97" for 100yr event
Inflow = 14.43 cfs @ 12.01 hrs, Volume= 0.862 af
Outflow = 3.98 cfs @ 12.21 hrs, Volume= 0.862 af, Atten= 72%, Lag= 12.1 min
Primary = 3.88 cfs @ 12.21 hrs, Volume= 0.604 af
Secondary = 0.10 cfs @ 12.21 hrs, Volume= 0.258 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 967.83' @ 12.21 hrs Surf.Area= 9,455 sf Storage= 17,070 cf

Plug-Flow detention time= 393.3 min calculated for 0.861 af (100% of inflow)
Center-of-Mass det. time= 394.8 min (1,172.7 - 777.9)

Volume	Invert	Avail.Storage	Storage Description
#1	965.00'	18,765 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
965.00	3,670	0	0
966.50	5,700	7,028	7,028
968.00	9,950	11,738	18,765

Device	Routing	Invert	Outlet Devices
#1	Primary	962.50'	**12.0" Round Culvert** L= 550.0' Ke= 0.500 Inlet / Outlet Invert= 962.50' / 959.70' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	966.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	965.00'	**0.450 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 1.00'

Primary OutFlow Max=3.88 cfs @ 12.21 hrs HW=967.82' (Free Discharge)
└**1=Culvert** (Barrel Controls 3.88 cfs @ 4.94 fps)
└**2=Orifice/Grate** (Passes 3.88 cfs of 4.35 cfs potential flow)

Secondary OutFlow Max=0.10 cfs @ 12.21 hrs HW=967.82' (Free Discharge)
└**3=Exfiltration** (Controls 0.10 cfs)

Existing - Input

P8 Urban Catchment Model, Version 3.4				Run Date	10/10/17
Case	DTVictoria_Existing_171010.p8c	FirstDate	01/02/49	Precip(in)	1110.1
Title	DT Victoria	LastDate	08/31/89	Rain(in)	954.73
PrecFile	msp_4989.pcp	Events	2851	Snow(in)	155.39
PartFile	nurp50.p8p	TotalHrs	356328	TotalYrs	40.65

Case Title	DT Victoria
Case Data File	DTVictoria_Existing_171010.p8c
Path	V:\1938\active\193803714\Design\Stormwater\P8\
Case Notes:	
Storm Data File	msp_4989.pcp
Particle File	nurp50.p8p
Air Temp File File	msp_4889.tmp

Time Steps Per Hour	4
Minimum Inter-Event Time (hrs)	10
Maximum Continuity Error %	2
Rainfall Breakpoint (inches)	0.8
Precipitation Scale Factor	1
Air Temp Offset (deg-F)	0
Loops Thru Storm File	1
Simulation Dates	
Start	1/2/1949
Keep	1/2/1949
Stop	8/31/1989

Max Snowfall Temperature (deg-f)	32.0
SnowMelt Temperature (deg-f)	32.0
Snowmelt Coef (in/degF-Day)	0.06
Soil Freeze Temp (deg-F)	32.0
Snowmelt Abstraction Factor	1.00
Evapo-Trans. Calibration Factor	1.00
Growing Season Start Month	5
Growing Season End Month	10

5-Day Antecedent Rainfall + Runoff (inches)		
CN Antecedent Moisture Condition	AMC-II	AMC-III
Growing Season	1.40	2.10
NonGrowing Season	0.50	1.10

Watershed Data						
Watershed Name	E01					
Runoff to Device	Total					
Infiltration to Device						
Watershed Area	16.4					
SCS Curve Number (Pervious)	78					
Scale Factor for Pervious Runoff Load	1					
Indirectly Connected Imperv Fraction	0					
UnSwept Impervious Fraction	0.0537					
UnSwept Depression Storage (inches)	0.02					
UnSwept Imperv. Runoff Coefficient	1					
UnSwept Scale Factor for Particle Loads	1					
Swept Impervious Fraction	0					
Swept Depression Storage (inches)	0.02					
Swept Imperv. Runoff Coefficient	1					
Swept Scale Factor for Particle Loads	1					
Sweeping Frequency	0					
Sweeping Efficiency	1					
Sweeping Start Date (MMDD)	101					
Sweeping Stop Date (MMDD)	1231					

Device Data						
Device Name	Total					
Device Type	PIPE					
Infiltration Outlet						
Normal Outlet						
Spillway Outlet						
Particle Removal Scale Factor						
Bottom Elevation (ft)						
Bottom Area (acres)						
Permanent Pool Area (acres)						
Permanent Pool Volume (ac-ft)						
Perm Pool Infilt Rate (in/hr)						
Flood Pool Area (acres)						
Flood Pool Volume (ac-ft)						
Flood Pool Infilt Rate (in/hr)						

Infilt Basin Void Fraction (%)							
Detention Pond Outlet Parameters							
Outlet Type							
Outlet Orifice Diameter (in)							
Orifice Discharge Coef							
Outlet Weir Length (ft)							
Weir Discharge Coef							
Perforated Riser Height (ft)							
Number of Holes in Riser							
Holes Diameter							
Flood Pool Drain Time (hrs)							
Swale Parameters							
Length of Flow Path (ft)							
Slope of Flow Path %							
Bottom Width (ft)							
Side Slope (ft-v/ft-h)							
Maximum Depth of Flow (ft)							
Mannings n Constant							
Hydraulic Model							
Pipe, Splitter, Aquifer Parameter							
Hydraulic Res. Time (hrs)	0						

Particle Data						
Particle File	nurp50.p8p					
Particle Class	P0%	P10%	P30%	P50%	P80%	
Filtration Efficiency (%)	90	100	100	100	100	
Settling Velocity (ft/hr)	0	0.03	0.3	1.5	15	
First Order Decay Rate (1/day)	0	0	0	0	0	
2nd Order Decay (1/day-ppm)	0	0	0	0	0	
Impervious Runoff Conc (ppm)	1	0	0	0	0	
Pervious Runoff Conc (ppm)	1	100	100	100	200	
Pervious Conc Exponent	0	1	1	1	1	
Accum. Rate (lbs-ac-day)	0	1.75	1.75	1.75	3.5	
Particle Removal Rate (1/day)	0	0.25	0.25	0.25	0.25	
Washoff Coefficient	0	20	20	20	20	
Washoff Exponent	0	2	2	2	2	
Sweeper Efficiency	0	0	0	5	15	

Water Quality Component Data							
Component Name	TSS	TP	TKN	CU	PB	ZN	HC
Water Quality Criteria (ppm)							
Level 1	5	0.025	2	2	0.02	5	0.1
Level 2	10	0.05	1	0.0048	0.014	0.0362	0.5
Level 3	20	0.1	0.5	0.02	0.15	0.38	1
Content Scale Factor	1	1	1	1	1	1	1
Particle Composition (mg/kg)							
P0%	0	99000	600000	13600	2000	640000	250000
P10%	1000000	3850	15000	340	180	1600	22500
P30%	1000000	3850	15000	340	180	1600	22500
P50%	1000000	3850	15000	340	180	1600	22500
P80%	1000000	0	0	340	180	0	22500

Existing - Output (TP)

P8 Urban Catchment Model, Version 3.4				Run Date	10/10/17
Case	DTVictoria_Existing_171010.p8c	FirstDate	01/02/49	Precip(in)	1110.1
Title	DT Victoria	LastDate	08/31/89	Rain(in)	954.73
PrecFile	msp_4989.pcp	Events	2851	Snow(in)	155.39
PartFile	nurp50.p8p	TotalHrs	356328	TotalYrs	40.65

Term	Flow ac-ft	Load lbs	Conc ppm	Flow cfs	Load lbs/yr
01 watershed inflows	264.4	259.4	0.4	0	6.4
06 normal outlet	264.4	259.4	0.4	0	6.4
09 total inflow	264.4	259.4	0.4	0	6.4
10 surface outflow	264.4	259.4	0.4	0	6.4
12 total outflow	264.4	259.4	0.4	0	6.4
Load Reduction %	0	0			
Mass Balance Error %	0	0			

Proposed - Input

P8 Urban Catchment Model, Version 3.4				Run Date	10/11/17
Case	DTVictoria_Proposed_171010.p8c	FirstDate	01/02/49	Precip(in)	1110.1
Title	DT Victoria	LastDate	08/31/89	Rain(in)	954.73
PrecFile	msp_4989.pcp	Events	2851	Snow(in)	155.39
PartFile	nurp50.p8p	TotalHrs	356328	TotalYrs	40.65

Case Title	DT Victoria
Case Data File	DTVictoria_Proposed_171010.p8c
Path	V:\1938\active\193803714\Design\Stormwater\P8\
Case Notes:	
Storm Data File	msp_4989.pcp
Particle File	nurp50.p8p
Air Temp File File	msp_4889.tmp

Time Steps Per Hour	4
Minimum Inter-Event Time (hrs)	10
Maximum Continuity Error %	2
Rainfall Breakpoint (inches)	0.8
Precipitation Scale Factor	1
Air Temp Offset (deg-F)	0
Loops Thru Storm File	1
Simulation Dates	
Start	1/2/1949
Keep	1/2/1949
Stop	8/31/1989

Max Snowfall Temperature (deg-f)	32.0
SnowMelt Temperature (deg-f)	32.0
Snowmelt Coef (in/degF-Day)	0.06
Soil Freeze Temp (deg-F)	32.0
Snowmelt Abstraction Factor	1.00
Evapo-Trans. Calibration Factor	1.00
Growing Season Start Month	5
Growing Season End Month	10

5-Day Antecedent Rainfall + Runoff (inches)		
CN Antecedent Moisture Condition	AMC-II	AMC-III
Growing Season	1.40	2.10
NonGrowing Season	0.50	1.10

Watershed Data

Watershed Name	P01	P02	P03	P04	P05	P06	P07
Runoff to Device	1 - Wet Pond w/ Filtration Bench	2 - Structural BMP	3 - Underground Filtration	4 - Wet Pond w/ Filtration	5 - Filtration	6 - Filtration	Total
Infiltration to Device							
Watershed Area	6.08	0.91	3.32	2.37	1.52	2.08	0.31
SCS Curve Number (Pervious)	80	80	80	80	80	80	80
Scale Factor for Pervious Runoff Load	1	1	1	1	1	1	1
Indirectly Connected Imperv Fraction	0	0	0	0	0	0	0
UnSwept Impervious Fraction	0.5345	0.5055	0.9096	0.2869	0.6645	0.6827	0
UnSwept Depression Storage (inches)	0.02	0.02	0.02	0.02	0.02	0.02	0.02
UnSwept Imperv. Runoff Coefficient	1	1	1	1	1	1	1
UnSwept Scale Factor for Particle Loads	1	1	1	1	1	1	1
Swept Impervious Fraction	0	0	0	0	0	0	0
Swept Depression Storage (inches)	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Swept Imperv. Runoff Coefficient	1	1	1	1	1	1	1
Swept Scale Factor for Particle Loads	1	1	1	1	1	1	1
Sweeping Frequency	0	0	0	0	0	0	0
Sweeping Efficiency	1	1	1	1	1	1	1
Sweeping Start Date (MMDD)	101	101	101	101	101	101	101
Sweeping Stop Date (MMDD)	1231	1231	1231	1231	1231	1231	1231

Device Data

Device Name	1 - Wet Pond w/ Filtration Bench	2 - Structural BMP	3 - Underground Filtration	4 - Wet Pond w/ Filtration	5 - Filtration	6 - Filtration	Total
Device Type	POND	PIPE	POND	POND	INF_BASIN	INF_BASIN	PIPE
Infiltration Outlet	4 - Wet Pond w/ Filtration		4 - Wet Pond w/ Filtration	Total	1 - Wet Pond w/ Filtration Bench	1 - Wet Pond w/ Filtration Bench	
Normal Outlet	4 - Wet Pond w/ Filtration		4 - Wet Pond w/ Filtration				
Spillway Outlet	4 - Wet Pond w/ Filtration		4 - Wet Pond w/ Filtration	Total	1 - Wet Pond w/ Filtration Bench	1 - Wet Pond w/ Filtration Bench	
Particle Removal Scale Factor	1		1	1	1	1	
Bottom Elevation (ft)	903.5		950	950	950	950	
Bottom Area (acres)	0.2582		0.2496	0.0596	0.101	0.0843	
Permanent Pool Area (acres)	0.4032		0.2496	0.141			
Permanent Pool Volume (ac-ft)	1.3229		0.5341	0.4012			
Perm Pool Infilt Rate (in/hr)	0		0.45	0			
Flood Pool Area (acres)	0.7081		0.2496	0.2757	0.1286	0.1309	
Flood Pool Volume (ac-ft)	1.9942		0.2553	0.3839	0.1722	0.2284	
Flood Pool Infilt Rate (in/hr)	0.45		0.45	0.45	0.45	0.45	
Infilt Basin Void Fraction (%)					100	100	
Detention Pond Outlet Parameters							
Outlet Type	ORIFICE		ORIFICE	ORIFICE			
Outlet Orifice Diameter (in)	12		12	24			
Orifice Discharge Coef	0.6		0.6	0.6			
Outlet Weir Length (ft)							
Weir Discharge Coef							
Perforated Riser Height (ft)							
Number of Holes in Riser							
Holes Diameter							
Flood Pool Drain Time (hrs)							
Swale Parameters							
Length of Flow Path (ft)							
Slope of Flow Path %							
Bottom Width (ft)							
Side Slope (ft-v/ft-h)							
Maximum Depth of Flow (ft)							
Mannings n Constant							
Hydraulic Model							
Pipe, Splitter, Aquifer Parameter							
Hydraulic Res. Time (hrs)		0					0

Particle Data					
Particle File	nurp50.p8p				
Particle Class	P0%	P10%	P30%	P50%	P80%
Filtration Efficiency (%)	90	100	100	100	100
Settling Velocity (ft/hr)	0	0.03	0.3	1.5	15
First Order Decay Rate (1/day)	0	0	0	0	0
2nd Order Decay (1/day-ppm)	0	0	0	0	0
Impervious Runoff Conc (ppm)	1	0	0	0	0
Pervious Runoff Conc (ppm)	1	100	100	100	200
Pervious Conc Exponent	0	1	1	1	1
Accum. Rate (lbs-ac-day)	0	1.75	1.75	1.75	3.5

Particle Removal Rate (1/day)	0	0.25	0.25	0.25	0.25
Washoff Coefficient	0	20	20	20	20
Washoff Exponent	0	2	2	2	2
Sweeper Efficiency	0	0	0	5	15

Water Quality Component Data								
Component Name	TSS	TP	TKN	CU	PB	ZN	HC	
Water Quality Criteria (ppm)								
Level 1	5	0.025	2	2	0.02	5	0.1	
Level 2	10	0.05	1	0.0048	0.014	0.0362	0.5	
Level 3	20	0.1	0.5	0.02	0.15	0.38	1	
Content Scale Factor	1	1	1	1	1	1	1	
Particle Composition (mg/kg)								
P0%	0	99000	600000	13600	2000	640000	250000	
P10%	1000000	3850	15000	340	180	1600	22500	
P30%	1000000	3850	15000	340	180	1600	22500	
P50%	1000000	3850	15000	340	180	1600	22500	
P80%	1000000	0	0	340	180	0	22500	

Proposed - Output (TP)

P8 Urban Catchment Model, Version 3.4				Run Date	10/11/17
Case	DTVictoria_Proposed_171010.p8c	FirstDate	01/02/49	Precip(in)	1110.1
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PrecFile	msp_4989.pcp	Events	2851	Snow(in)	155.39
PartFile	nurp50.p8p	TotalHrs	356328	TotalYrs	40.65

Term	Flow ac-ft	Load lbs	Conc ppm	Flow cfs	Load lbs/yr
01 watershed inflows	956.4	912.7	0.4	0	22.5
05 filtered	0	195.1		0	4.8
06 normal outlet	956.4	235	0.1	0	5.8
08 sedimen + decay	0	481.9		0	11.9
09 total inflow	956.4	912.7	0.4	0	22.5
10 surface outflow	956.4	235	0.1	0	5.8
12 total outflow	956.4	235	0.1	0	5.8
13 total trapped	0	677		0	16.7
14 storage increase	0	0.3		0	0
15 mass balance check	0	0.3		0	0
Load Reduction %	0	74.2			
Mass Balance Error %	0	0			

Kimley»Horn

STORMWATER MEMORANDUM

To: Minnehaha Creek Watershed District
Cc: City of Victoria

From: Katie Olson, PE

Date: September 12th, 2022

Subject: Victoria Multifamily Stormwater Management

Marco McLane Development is proposing to construct a ±38,100 square foot multifamily residential building located within the Downtown West Redevelopment project at the intersection of Trunk Highway 5/Arboretum Boulevard and County Road 11/Victoria Boulevard in Victoria, MN. This project will be constructed adjacent to the City of Victoria's Downtown West Phase 1 Redevelopment project. The City of Victoria's Downtown West Redevelopment project is proposing to construct regional stormwater treatment that the proposed Victoria Multifamily runoff will discharge to via private and public storm sewer conveyance systems within Steiger Lake Lane. The Victoria Multifamily private storm sewer network includes on-site structural pretreatment in the form of a The Preserver or approved equal to meet subsection C of section 7 of the MCWD Stormwater Management Rule prior to discharge to the regional treatment basin.

The City's regional treatment basin will provide the stormwater treatment necessary to meet the Minnehaha Creek Watershed District's (MCWD) stormwater management requirements for the Victoria Multifamily site. Refer to the City of Victoria Downtown West Stormwater Management Memorandum for details and calculations necessary to meet the MCWD stormwater management requirements. Because Victoria Multifamily is planning construction prior to the City's improvements, an agreement is in progress between the City of Victoria and the MCWD, which binds the city to constructing the regional treatment facility in a timely manner as it relates to the proposed private development. MCWD has determined that the agreement is acceptable to have in lieu of showing an on-site alternative for stormwater treatment for the Victoria Multifamily site.

The proposed civil improvements for the Victoria Multifamily Development are shown in a separate attachment. If you have any questions or should you like clarification on any portion of our evaluation or proposed improvements, please contact me at Katelyn.olson@kimley-horn.com or (507) 216-0362.

Sincerely,

Katie Olson, PE
Project Manager
Kimley-Horn and Associates, Inc.

The following document is supplemental stormwater information that was taken from the City of Victoria's 9/16/22 submittal package to MCWD for the Downtown West regional stormwater treatment.

Downtown West (Phase 1)

The following sections summarize the regulatory criteria and proposed stormwater management for compliance with MCWD rules for the first phase of Downtown West to be constructed in 2023. The City of Victoria's Downtown West Phase 1 includes the Victoria Multifamily development, construction of BMP 1, and modifications to BMP 2 due to the realignment of Stieger Lake Lane and associated grading.

Rate Control (Phase 1)

Discharge rate requirements from the site will be met with the onsite regional stormwater BMPs. HydroCAD models for existing and proposed conditions phase 1 were prepared to evaluate the existing and proposed discharge rates from the project area. Table 2 summarizes the rate control results of the pre and post development conditions.

Table 2. Rate Control Summary (Phase 1)

Location \ Event	1-year (cfs)	2-year (cfs)	10-year (cfs)	100-year (cfs)
North – Ex.	11.1	14.0	25.3	50.6
North – Pr.	7.5	9.5	17.3	34.7
***South – Ex. SLL**	4.8	5.8	8.5	12.1
South – Ex.	1.7	2.9	7.4	11.9
South – Pr.	3.2	3.3	7.4	11.2
South West – Ex.	6.0	7.8	14.8	31.3
South West – Pr.	3.4	5.2	9.3	30.9
West – Ex.	3.5	4.5	8.4	17.4
West – Pr.	2.4	3.1	5.8	12.1

** Existing discharge rates prior to construction of BMP 2 as part of Stieger Lake Lane reconstruction project in 2022, per MCWD permit 22-212.*

Volume Control (Phase 1)

With the post-development impervious area as 3.27 acres, the MCWD volume control 1-inch requirement is 11,870 cubic feet. Filtration is assumed due to poor onsite soils. MCWD regulates filtration BMPs at 50% volume control credit. The filtration volume credit requirement is 23,740 cubic feet. The regional stormwater BMPs in phase 1 (BMP 1, 2) provide a total of 28,520 cubic feet of filtration volume which equates to 14,260 cubic feet of volume control, which meets MCWD rules. Table 4 summarizes the volume control requirements and proposed volume credits of the proposed improvements in phase 1. Table 10 shows the regional BMP volume accounting for Phase 1 and Future phases of Downtown West.

Table 3. Impervious Area Summary (Phase 1)

Site Phase	Existing Impervious Area (ac.)	Proposed Regulatory Impervious Area (ac.)	Water Quality Volume Required (1 in. over regulatory impervious) (cu ft.)	Filtration Volume Required (50% Volume Credit) (cu ft.)
Phase 1	-	3.27	11,870	23,740

Table 4. Volume Control Summary (Phase 1)				
BMP	**Location**	**Impervious Routed (ac.)**	**Water Quality Volume Provided (cu ft.)**	**Filtration Volume Provided (cu ft.)**
1	Phase 1	2.51	12,113	24,225
2	Phase 1	0.99	2,147	4,295
Total		**3.50**	**14,260**	**28,520**

Table 10. BMP Volume Accounting				
BMP	Construction Phase	Total Filtration Volume Credits (CF)	Phase 1 Volume Credits (cu-ft)	Future Projects Volume Credits (cu-ft)
1	Phase 1	24,225	19,445	4,780
2	Phase 1	4,295	4,295	0
3	Future	36,000	-	36,000
Total		64,520	23,740	40,780

CITY OF VICTORIA

Victoria, MN *Est. 1915*

October 26, 2022

Mr. Will Roach
Permitting Assistant
Minnehaha Creek Watershed District
15320 Minnetonka Blvd
Minnetonka, MN 55345

Re: Downtown West First Addition
Regional Stormwater Facilities

Dear Mr. Roach:

On October 24, 2022, the City Council adopted a resolution approving the Final Plat for Downtown West First Addition and approved a Development Agreement with March McLane Development, LLC for the development a new 145-unit apartment building on Lot 1, Block 1. The approved development agreement includes provisions for the city to construct the stormwater management facilities outlined in the Regional Stormwater Management Agreement (also approved by the City Council on October 24, 2022) and allocate the required capacity to meet the MCWD requirements for the development of Lot 1, Block 1.

Should you have any questions or require additional information, please call me 651.300.4261.

Regards,

Cara L. Geheren, P.E.
City Engineer

cc: Dana Hardie, City Manager
Jenn Brewington, Community and Economic Development Director
Dave Shoger, Director of Public Works

REGIONAL STORMWATER MANAGEMENT AGREEMENT
City of Victoria and Minnehaha Creek Watershed District

[Downtown West Development- Filtration Practices 1, 2 & 3]

This Agreement is made by and between the Minnehaha Creek Watershed District, a watershed district with purposes and powers as set forth at Minnesota Statutes Chapters 103B and 103D ("District"), and the City of Victoria, a statutory city and political subdivision of the State of Minnesota ("City").

Recitals

A. The District, pursuant to Minnesota Statutes §103D.341, has adopted and implements rules and permit requirements for property owners engaging in land development to permanently manage stormwater generated by development to protect water quality, avoid flooding and otherwise limit development impacts on water resources. The District stormwater management rule is attached as Exhibit A to this Agreement.

B. Paragraph 7(a) of the District's stormwater management rule allows a permit applicant to meet rule requirements "by providing equal or greater phosphorus control, rate control, or volume control through a regional or subwatershed plan approved by the District."

C. The City anticipates public and private development within an area of about 13. 5 acres delineated on Attachment A to this Agreement ("Development Area"). It expects that the development will consist of about 8.9 acres of impervious surface, with about 3.3 acres under a first phase, and about 5.6 acres under a future phase.

D. To provide stormwater management for this development, the City intends to construct three filtration practices (together, the "Facilities"). Facilities 1, 2 and 3 are being designed, respectively, to receive runoff and provide volume control from 3.14 acres, 0.99 acres and 4.74 acres of impervious surface. The City intends to construct Facilities 1 and 2 initially, and Facility 3 for the purpose of the future development phase. The City intends that the Facilities also will provide for peak flow control for the development.

E. The City and District enter into this Agreement to specify terms for the City's construction, maintenance and use of the Facilities in accordance with section 7 of the District stormwater management rule.

Terms

THEREFORE the City and the District agree as follows, intending to be legally bound:

A. DESIGN and CONSTRUCTION

1. The City is preparing a 90 percent design of the Facilities that it intends to complete in November 2022. The District will review the 90 percent design to concur that it is a satisfactory design to provide for retention and abstraction of stormwater within the meaning of the District

stormwater management rule, paragraph 3(c)(1) and Appendix A ("Filtration"). The City will complete design plans in accordance with the 90-percent plans, and construct the Facilities. The City and District will cooperate with respect to any inspection or Facility document review undertaken by District staff during the course of construction. During construction, the City will notify the District of any change from the final plans before it is approved by the City, except for field changes, of which the District may be notified promptly after approval.

2. On substantial completion, the City will supply Facility as-built plans to the District, signed by a professional engineer or surveyor. On the basis of the as-built and technical specifications, the District will determine the Facility phosphorus removal, rate and volume control capacities for the purpose of its use for stormwater management under the District rule. The City will notify the District in writing when a Facility is functional and on-line to receive and treat stormwater in accordance with its design, and will transmit to the District a copy of the engineer's certificate of completion.

B. FACILITY USE for REGULATORY COMPLIANCE

1. The capacity that the District determines under paragraph A.2, above, will be available to the City for the purpose of compliance with the District stormwater management rule with respect to land disturbance within the Development Area. The City may use the capacity for its own projects, and may make capacity available to third parties, on such terms as the City may decide. The City and District will maintain and share records of the use of Facility capacity and remaining capacity available for use.

2. An application that proposes to use a Facility for compliance purposes will be processed and evaluated by the District in the ordinary course. Except as specifically stated in this Agreement, District rules and regulatory procedures will apply as in effect at the time an application is considered. To recognize a third party claim to any part of Facility capacity, the District will require that the applicant conform to paragraph 7(d) of the District rule, including written concurrence from the City and confirmation of current maintenance per paragraph C.1, below.

3. In accordance with paragraphs 7(b) and (c) of the District rule, the City or a third party using a Facility for rule compliance will be required to provide an on-site practice to address any local stormwater impact and otherwise achieve an adequate measure of on-site stormwater management.

4. The District stormwater management rule requires that stormwater management facilities be operational concurrent with the creation or replacement of the impervious surface for which they are to provide treatment. The City recognizes that delay in Facility construction may affect the City's, or a third party's, ability to use the Facility to meet District rule requirements.

5. At any time, the City may reserve remaining Facility capacity for Total Maximum Daily Load or anti-degradation compliance, prospective City projects, or any other purpose. The parties will memorialize this decision in writing, and the dedicated capacity no longer will be available under paragraph B.1, above.

6. If at a future time the City is exercising sole authority for stormwater management

permitting pursuant to District approval of the City's local water plan under Minnesota Statutes §103B.235, the parties will cooperate so that the District may confirm that permitting accords with the terms of this section B.

C. MAINTENANCE

1. The City will maintain the Facilities in accordance with the terms of the Programmatic Maintenance Agreement between the parties dated January 29, 2014, Attachment B hereto, Incorporated herein (PMA). This maintenance obligation will extend in accordance with the terms of the PMA.

2. If at any time there is evidence that a Facility is not performing to design, the City, in consultation with the District, will perform reasonable investigation to assess performance and determine the cause of inadequate performance, and will take feasible actions to improve performance. A feasible action is one that is technically attainable at a cost not grossly disproportionate to the performance benefit it is capable of achieving.

D. GENERAL

1. The purpose of this Agreement is to establish a framework for the City's use of the Facilities for compliance with District permitting rules. The City is responsible for all costs of Facility design, construction and maintenance.

2. The Agreement is not a joint powers agreement within the meaning of Minnesota Statutes §471.59. Neither party agrees to be responsible for the acts or omissions of the other within the meaning of subdivision 1a(a) of that statute. The District has no authority to select, or role in selecting, the design, means, method or manner of constructing the Facilities or the person or firm who will perform the work. This Agreement creates no right in, and waives no immunity, defense or liability limit with respect to, any third party or the other party to this Agreement. Only contractual remedies are available for the failure of a party to fulfill the terms of this Agreement.

3. Each notification required by this Agreement must be made to the project representative. The project representatives of the parties are:

Kayla Westerlund, Manager-Permitting Department
Minnehaha Creek Watershed District
15320 Minnehaha Boulevard
Minnetonka, MN 55345
(952) 471-0590

_____, _____
City of Victoria
1670 Stieger Lake Lane
Victoria, MN 55386
(952) 443-4210

Contact information will be kept current. Either contact may be changed by a party by written notification to the other party.

4. An amendment to this Agreement must be in writing and will not be effective until it has been executed and approved by the parties. A party to this Agreement may not assign or transfer any right or obligation hereunder without an assignment agreement executed by the parties and the assignee.

5. A party's failure to enforce a provision of this Agreement does not waive the provision or that party's right to enforce it subsequently.

6. The above Recitals are incorporated into this Agreement.

7. This Agreement is effective when executed by both parties, will remain in force for a five-year term thereafter, and will renew automatically for subsequent five-year terms unless and until terminated by written agreement of the parties.

IN TESTIMONY WHEREOF the parties have executed this Agreement by their authorized officers.

CITY OF VICTORIA

By_____ Date:
Its Mayor

By_____ Date:
Its City Manager

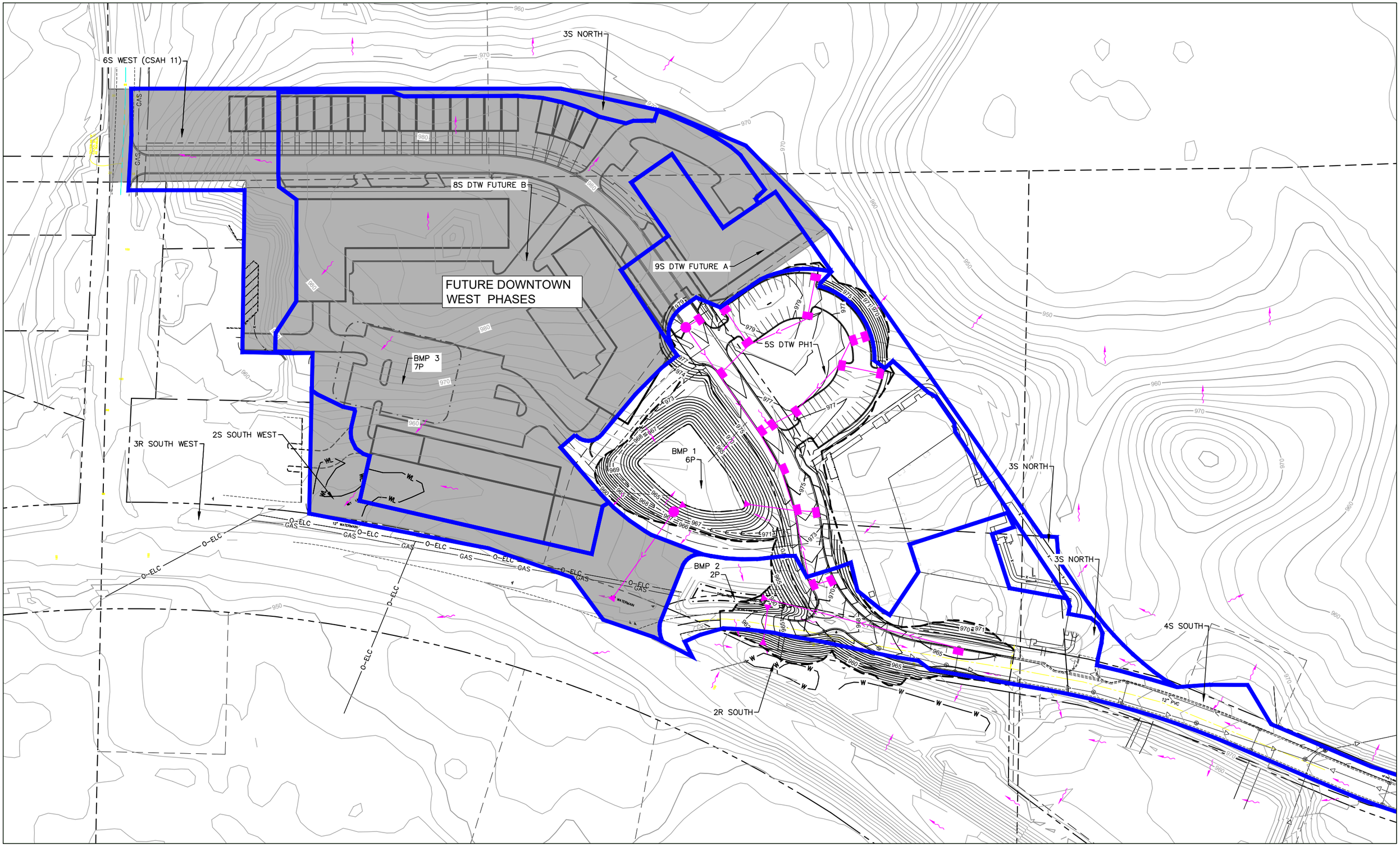
Approved for form and execution:

_____
MCWD Counsel

MINNEHAHA CREEK WATERSHED DISTRICT

By_____ Date:
Its President

Exhibit A
Development Area



K:\TWC_Civil\City\VICTORIA\STIEGER LAKE LANE IMPROVEMENTS\CAD\Plan Sheets\Exhibits\DOWNTOWN WEST\220916-DTWest_PropFutureStormwaterSystem.dwg September 16, 2022 - 4:27pm

Kimley»Horn

CITY OF VICTORIA

DOWNTOWN WEST INFRASTRUCTURE IMPROVEMENTS
FUTURE PHASES STORMWATER SYSTEM

SEPTEMBER 16, 2022

NORTH

0 60 120

HORIZONTAL SCALE IN FEET

Exhibit B
City of Victoria Programmatic Maintenance Agreement

PROGRAMMATIC MAINTENANCE AGREEMENT
Stormwater Management Facilities, Waterbody Crossings & Structures, Wetland Buffers and Shoreline & Streambank Stabilizations

Between the Minnehaha Creek Watershed District and the City of Victoria

This Maintenance Agreement (Agreement) is made by and between the Minnehaha Creek Watershed District, a watershed district with purposes and powers set forth at Minnesota Statutes chapters 103B and 103D (MCWD), and the City of Victoria, an incorporated municipality and political subdivision of the State of Minnesota (CITY).

Recitals and Statement of Purpose

WHEREAS pursuant to Minnesota Statutes § 103D.345, the MCWD has adopted and implements the Stormwater Management Rule, Wetland Protection Rule, the Waterbody Crossings & Structures Rule and the Shoreline & Streambank Stabilization Rule;

WHEREAS under the Stormwater Management Rule, certain land development activity triggers the requirement that the landowner record a declaration establishing the landowner's perpetual obligation to inspect and maintain stormwater-management facilities;

WHEREAS in each case, a public landowner, as an alternative to a recorded instrument, may meet the maintenance requirement by documenting its obligations in an unrecorded written agreement with the MCWD;

WHEREAS CITY from time to time is subject to stormwater management, wetland buffer, waterbody crossings and structures and shoreline & streambank stabilization maintenance requirements pursuant to the terms of an MCWD permit; and

WHEREAS the parties concur that it is clearer and procedurally more efficient for the MCWD and CITY to agree at this time on standard requirements for stormwater management, wetland buffer protection, waterbody crossings and structures maintenance and shoreline & streambank stabilizations, so that this Agreement may be incorporated into future permits as applicable.

THEREFORE IT IS AGREED as follows:

1. All features requiring maintenance under an MCWD permit shall be maintained in perpetuity in accordance with Attachment A, Maintenance Plan & Schedule.

2. MCWD permits for specific projects may contain additional maintenance conditions in accordance with MCWD rules, as they may be amended from time to time.

3. CITY will submit a copy of the Storm Water Pollution Prevention Plan annual report prepared under its Municipal Separate Storm Sewer System permit to the MCWD each year.

4. If CITY conveys into private ownership a fee interest in any property that has become subject to this Agreement, it shall require as a condition of sale, and enforce: (a) that the purchaser record a declaration on the property incorporating the maintenance requirements of this Agreement; and (b) that recordation occur either before any other encumbrance is recorded on the property or, if after, only as accompanied by a subordination and consent executed by the encumbrance holder

ensuring that the declaration will run with the land in perpetuity. If CITY conveys into public ownership a fee interest in any property that has become subject to this Agreement, it shall require as a condition of the purchase and sale agreement that the purchaser accept an assignment of all obligations vested under this Agreement.

5. This Agreement may be amended only in a writing signed by the parties.

6. This Agreement is in force for five years from the date on which it has been fully executed and will renew automatically for five year terms unless terminated. Either party may terminate the Agreement on 30 days' written notice to the other. Any obligations vested in CITY through incorporation into an issued permit before the effective date of termination will survive expiration.

7. The recitals are incorporated as a part of this Agreement.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement.

MINNEHAHA CREEK WATERSHED DISTRICT

By Sherry Davis White Date: 1-29-14
President, Board of Managers

APPROVED AS TO FORM and EXECUTION

By _____ ~~Date:~~
Its Attorney

CITY OF CITY

By: Tom Campbell Date:
Its Mayor

By: Don Ollman Date:
Its Administrator

APPROVED AS TO FORM and EXECUTION

By: _____ Date:
City Attorney

ATTACHMENT A

MAINTENANCE PLAN & SCHEDULE

1. WETLAND BUFFER AREAS

    a. Buffer vegetation will not be cultivated, cropped, pastured, mowed, fertilized, subject to the placement of mulch or yard waste, or otherwise disturbed, except for periodic cutting or burning that promotes the health of the buffer, actions to address disease or invasive species, mowing for purposes of public safety, temporary disturbance for placement or repair of buried utilities, or other actions to maintain or improve buffer quality, Pesticides and herbicides may be used in accordance with Minnesota Department of Agriculture rules and guidelines. No new structure or hard surface will be placed within a buffer, except that construction of a trail or path of no more than 4 feet in width to provide riparian access through the buffer is acceptable. No fill, debris or other material will be excavated from or placed within a buffer.

    b. Permanent wetland buffer monuments will be maintained in the locations shown on the approved site plan. Language shall indicate the purpose of the buffer, restrictions, and the name and phone number of the Minnehaha Creek Watershed District.

2. SHORELINE & STREAMBANK STABILIZATIONS

    a. The project area will be inspected at least annually and any erosion or structural problems observed will be corrected within 30 days of inspection to establish and maintain a naturalized, ecologically healthy [shoreline/streambank] that is structurally stable and resistant to erosion. [Shoreline/Streambank] plantings will be replaced and seeded areas will be reseeded as necessary in the spring and fall of each year in accordance with the approved plan to maintain the ecological health and function of the shoreline. Removal of invasive species will occur on an ongoing basis. Weeds will be hand pulled or spot treated with aquatic formulations of herbicide according to instructions on the herbicide label. All planted and seeded areas will be maintained in perpetuity free from mowing or other vegetative disturbance, fertilizer application, yard or other waste disposal, the placement of structures or any other alteration that impedes the function of the shoreline in protecting water quality, shading the riparian edge, moderating flow into any adjacent wetland or waterbody, or providing wildlife habitat.

3. WATERBODY CROSSINGS & STRUCTURES

a. Crossings and structures in contact with the bed or bank of a waterbody will be inspected at least once a year and maintained in good repair in perpetuity to ensure continuing adequate hydraulic and navigational capacity is retained in accordance with approved plans, to ensure no net increase in the flood stage beyond that achieved by the approved plans, to prevent adverse effects on water quality, changes to the existing flowline/gradient and increased scour, erosion or sedimentation, and to minimize the potential for obstruction of the waterbody.

4. STORMWATER FACILITIES

a. **Stormwater retention and treatment basin(s).** Stormwater retention and treatment basin(s) must be inspected at least once a year to determine if the basin's retention and treatment characteristics are adequate and continue to perform per design. Culverts and outfall structures must be inspected at least annually and kept clear of any obstructions or sediment accumulation. Sediment accumulation must be measured by a method accurate to within one vertical foot. A storage treatment basin will be considered inadequate if sediment has decreased the wet storage volume by 50 percent of its original design volume. Based on this inspection, if the stormwater basin(s) is identified for sediment cleanout, the basin(s) will be restored to its original design contours and vegetation in disturbed areas restored within one year of the inspection date.

b. **Raingardens, infiltration basins and filtration basins**. Raingardens, infiltration basins and filtration basins will be inspected annually to ensure continued live storage capacity at or above the design volume. Invasive vegetation, excess sediment and debris will be removed as needed and healthy plant growth will be maintained to ensure that the facilities continue to perform per design.

c. **Vegetated swales.** Vegetated swales will remain free from mowing or other vegetative disturbance, fertilizer application, yard or other waste disposal, the placement of structures or any other alteration that impedes the function of the vegetated swale.

d. **Pervious pavement**. Pervious pavement will be inspected after at least one major storm per year and otherwise annually to ensure continuing performance per design. Surface openings will be vacuumed in dry weather to remove dry, encrusted sediment as necessary. Broken units that impair the structural integrity of the surface will be replaced. If water stands for an extended period of time, the base materials will be removed and replaced.

e. **Underground storage facilities.** Underground storage facilities will be inspected at least annually to ensure continuing performance per design. Capacity will be considered inadequate if sediment has decreased the storage volume by 50 percent of the original design volume. Accumulated debris and sediment will be

removed, and inlet and outlet structures will be kept clear of any flow impediments.

f. **Grit chambers, sump catch basins and sump manholes.** Grit chambers, sump catch basins and sump manholes will be inspected in the spring, summer and fall of each year. All sediment and debris will be removed as needed such that the stormwater facilities operate as designed and permitted.

g. **Proprietary stormwater facilities.** Proprietary stormwater facilities will be inspected at least annually and maintained as specified or recommended by the manufacturer and/or installer

h. **Reporting.** The Declarant will submit to the MCWD annually a brief written report that describes stormwater facility maintenance activities performed under this declaration, including dates, locations of inspections and the maintenance activities performed.