Memo

Date:	Friday, March 07, 2025
Project:	Lee's Summit, Missouri Water Utility Facility Expansion
To:	City of Lee's Summit
From:	Mitch Wiebelhaus PE - HDR
Subject:	Stormwater Memo



General Information

HDR was retained by the City of Lee's Summit Water Utilities Department to analyze stormwater impacts of proposed improvements to the Lee's Summit Water Utilities Facility (WUF). The WUF is located at 1200 SE Hamblen Road, Lee's Summit, Missouri on the southwest corner of SE Hamblen Road and SE Browning Street (Refer to Figure 1). This facility is fully developed and operational. The 9.76 acre property includes 42,500 square foot field services building at the center of the lot, a detention pond at the northeast corner, access roads, parking surrounding the south & east sides of the building, and a paved maintenance yard west of the facility. The proposed site improvements will add parking stalls along the access road in the southwest section of the property, and a future building expansion along the northern face of the existing building.

FIGURE 1 – LEE'S SUMMIT WATER UTILITIES FACILITY AERIAL



hdrinc.com

10450 Holmes Road, Suite 600, Kansas City, MO 64131-3471 (816) 360-2700



Methodology:

A previous storm study by HDR was approved in 2014 when the site was initially developed (Refer to Attachment 1). This memorandum is intended to highlight any changes to the proposed land use with the mentioned improvements. These changes will be evaluated against the previously developed H&H models to determine if additional stormwater improvements will be needed to maintain target release rates provided by the previous report.

Hydraflow Hydrographs stormwater modeling program was utilized in determining the drainage characteristics for pre, post and future development conditions. The program uses the composite curve number (CN) and time of concentration (Tc) to analyze peak discharge rates for the 2-year, 10-year, and 100-year 24-hour storm events. The Tc was calculated based on TR-55 outlines that include flow types, flow path lengths, surface types, slopes, and flow velocities.

Existing Conditions:

The study area's hydrological soil group (HSG) is Soil Type C (Refer to Attachment 2). The entirety of the study area lies outside of the FEMA Flood Hazard Zone as shown in the FEMA FIRM Panel for this project (Refer to Attachment 3).

The site has previously been developed with the initial WUF building and its necessary parking and driveway improvements. Prior to this the majority of the site was a green field. The analysis of peak flow increases will be compared to pre-development conditions as outlined in a previous stormwater report (Lee's Summit Water Utilities - Stormwater Study, 2014). The summary for pre-development discharge rate targets is outlined below in Table 1-1.

Table 1-1	 Pre-Development Pea 	k Discharge	Targets
-----------	---	-------------	---------

2-Year Storm	10-Year Storm	100-Year Storm
Peak Flow (cfs)	Peak Flow (cfs)	Peak Flow (cfs)
29.4	48.9	73.1

Proposed Conditions:

The proposed site improvements are located at the cul-de-sac in the southwest corner of the facility with the addition of 11 parking stalls. This will add approximately 2,301 square feet of impervious area to the site. The current drainage patterns will be maintained with the proposed improvements. This area travels east to curb inlets, where it is routed to the detention pond at the northeast corner of the property. Stormwater is then discharged to a culvert going under Hamblen Road, ultimately discharges to Big Creek. Adjustments will be made to the CN and Tc for the added impervious area (Refer to Attachment 4).

In addition to the proposed parking expansion, the Water Utility Department would also like to include future improvements to this study. These improvements include two phases of building expansions (north), 4 visitor parking stalls (southwest), 9 maintenance parking (northwest), and additional paved storage bins (west). The total area of impervious surface added with these



future improvements is approximately 12,000 square feet. These improvements will not be constructed as part of this initial phase (Refer to Attachment 4). The drainage areas of the site are defined in Figures 1-2 & 1-3 of the previous storm report (Lee's Summit Water Utilities – Stormwater Study, 2014). The site improvements will not impact the current drainage areas of the site.

For a summary of the land use of the pre, post, and future development conditions, refer to **Table 2-1** below.

Condition	Impervious Area (ac)	Pervious Area (ac)	Weighted CN
Pre-Development	0	9.23	74*
Post-Development	5.66	3.57	89*
Future-Development	5.93	3.30	89*

Т	able	2-1	– Land	Use	Summary
---	------	-----	--------	-----	---------

*Hydraflow Hydrographs rounds CN Values to the nearest integer

Conclusion:

The proposed improvements to the site will utilize the existing detention pond constructed at the northwest corner of the site to manage discharge rates of the site. **Table 3-1** summarizes the release rates of the detention basin compared to pre-development condition below.

Table 3-1	– Summary	of Onsite	Discharge	Rates
			0	

Storm Event	Pre-Development Peak Flow Target (cfs)	Post- Development Peak Flow (cfs)	Post Development Basin Water Surface Elevation (ft)	Future Development Peak Flow (cfs)	Future Development Basin Water Surface Elevation (ft)
2-Year, 24-Hour	29.4	23.8	1018.26	23.8	1018.26
10-Year, 24-Hour	48.9	44.3	1018.88	44.3	1018.88
100-Year, 24-Hour	73.1	68.8	1019.38	68.8	1019.38

As shown by **Table 3-1**, the post and future development will not increase peak discharges from the site beyond pre-development conditions for all regulatory storm events. No additional improvements are anticipated to the detention pond or other onsite storm infrastructure.



City of Lee's Summit | LMSO WUF Expansion Stormwater Memo

Attachments:

- Attachment 1 2014 Lee's Summit Water Utilities Stormwater Study By HDR
- Attachment 2 USDA Soil Map
- Attachment 3 FEMA Firm Panel
- Attachment 4 Impervious Area Map
- Attachment 5 Hydraflow Hydrographs Post Condition Report
- Attachment 6 Hydraflow Hydrographs Future Condition Report

FSS



2014 Lee's Summit Water Utilities - Stormwater Study – By HDR

hdrinc.com 10450 Holmes Road, Suite 600, Kansas City, MO 64131-3471 (816) 360-2700

Stormwater Study

Lee's Summit Water Utilities

Water Utilities Facility - SE Hamblen Road

Lee's Summit, Missouri

October 24, 2014

HDR Engineering, Inc. 3741 NE Troon Dr Lee's Summit, MO 64064 (816) 347-1100

Table of Contents

1	Introduction and Analysis Criteria	1
2	Proposed Conditions	5
3	Summary	8

Figures

Figure 1-1 – Vicinity Map	1
Figure 1-2 – Stormwater Drainage Map	3
Figure 1-3 – Stormwater Drainage Map (No Aerial Image)	4

Tables

- Table 1-1 Allowable Discharge Rates
- Table 1-2 Water Quality Volumes
- Table 2-1 Site Pre-Development Discharge Rates
- Table 2-2 Site Post-Development Discharge Rates (no controls)
- Table 2-3 Offsite Diversion Peak Discharge Rates
- Table 2-4 Modified Pre-Development Discharge Rate Targets
- Table 2-5 Detention Basin Stage Storage
- Table 3-1 Summary of Onsite Discharge Rates

Appendix

Hydraflow Hydrographs Schematic Hydraflow Hydrographs TR-55 Time of Concentration Calculations Hydraflow Hydrographs Pond Routing Water Quality Drawdown Calculations

1 Introduction and Analysis Criteria

HDR Engineering, Inc. was retained by the City of Lee's Summit Water Utilities Department to perform a Stormwater Study for the proposed Water Utilities Facility off of SE Hamblen Road in Lee's Summit, MO. The new facility will be located west of Hamblen Road, north of Bailey Road, and south of Highway 50, as shown in the Vicinity Map below.



Figure 0-1 – Vicinity Map

The 9.76 acre site, of which approximately 0.54 acres will be dedicated as public street right-of-way, will contain a 42,500 square foot field services building and a paved storage area to support Water Utilities activities. **Figure 1-2**, at the end of this Section, shows the watershed areas and stormwater discharge locations. **Figure 1-3** shows the same features, without the aerial map background.

The City of Lee's Summit currently follows the comprehensive control strategy for development, in accordance with Kansas City Metropolitan Chapter American Public Works Association Section 5600. Comprehensive control limits the post-development peak discharge rates on a per acre basis for the 50%, 10%, and 1% storm events and also requires extended detention for the local 90% mean annual event. Peak discharge rates from the site are limited to 0.5, 2.0, and 3.0 cfs per site acre for the 50%, 10%, and 1% storm events, respectively. Forty-hour extended detention from the local 90% mean annual event, a 1.37-inch rainfall during a 24-hour storm event, is required for water quality.

The site currently receives offsite runoff from the west and southwest. These subwatersheds contain large areas of paved parking, not currently utilized, which drain onto the site before discharging to the north or northeast. An offsite south watershed discharges to a swale in Hamblen road right-of-way, on the east side of the project site. Allowable site discharges for regulatory storm events for the project site are summarized below in **Table 1-1**.

Subwatershed	<u>Drainage</u>	Allowable	Allowable	Allowable
	<u>Area</u>	50% Storm Peak	10% Storm Peak	<u>1% Storm Peak</u>
	(Ac)	Flow (cfs)	Flow (cfs)	<u>Flow (cfs)</u>
Onsite	9.23	4.6	18.5	27.7

Table 1-1 – Allowable Discharge Rates

The extended detention volume from the local 90% mean annual event correlates to the percentage of impervious area. The impervious area, including the permanent pool for the proposed stormwater pond, is 57 percent of the site. The calculations utilize an impervious area of 60 percent, to allow for additions to impervious area in the future. The Mid-America Regional Council and American Public Works Association Manual of Best Management Practices for Stormwater Quality, October 2012 edition, includes methodology for determining the water quality volume. Utilizing the shortcut method, WQv (Water Quality Volume, inches) = P (Rainfall event, inches) x Rv (Volumetric runoff coefficient), with 1.37-inches of precipitation and 60 percent impervious area, results in 0.81-inches of runoff to be treated over the site. The water quality volumes for the Water Utilities Facility are summarized below in Table 1-2.

Subwatershed	<u>Drainage</u>	Water Quality Volume	Water Quality Volume
	Area (Ac)	(cf)	(ac-ft)
Onsite	9.23	27,082	0.62





Stormwater Drainage Map

Lee's Summit Water Utilities Stormwater Study

| DATE

FIGURE

Oct 2014



2 Proposed Conditions

Hydraflow Hydrographs stormwater modeling program was used to determine the drainage characteristics for the pre and post-development conditions. Hydraflow Hydrographs uses the composite curve number (CN) and time of concentration (Tc) to generate peak discharge rates and volumes for the 50%, 10%, and 1% 24-hour storm events. The software includes Technical Release 55 (TR-55) calculations to calculate the CN based on user inputs of categorized area values, which for this study is based upon both pre and post-development conditions. The Tc is calculated with TR-55 based on inputs of flow types, flow path lengths, surface types, slopes, and flow velocities. Pre and Post-development site discharges for the varying storm events, without stormwater management controls for the post-development condition, are presented below in **Tables 2-1** and **2-2**.

Subwatershed	<u>Drainage</u>	50% Storm Peak	10% Storm Peak	<u>1% Storm Peak</u>
	Area (Ac)	Flow (cfs)	Flow (cfs)	Flow (cfs)
Onsite	9.23	16.2	34.7	61.9

Tabla	24	Cito	Dro Dovo	lonmont	Diacharga	Dataa
lable	Z-I -	Sile	Pre-Deve	aobment	Discharge	Rates

Table 2-2 – Site Post-Develo	oment Discharge Rat	tes (without controls)
	pinion Dioonargo ria	

Subwatershed	<u>Drainage</u>	50% Storm Peak	<u>10% Storm Peak</u>	<u>1% Storm Peak</u>
	<u>Area (Ac)</u>	Flow (cfs)	Flow (cfs)	Flow (cfs)
Onsite	9.23	32.8	55.7	86.0

The proposed Water Utilities Facility is located on an undeveloped parcel, but it surrounded by improvements on all sides. Many of the surrounding improvements contain a very high percentage of impervious area, contributing significantly to peak discharge rates at SE Hamblen Road during large storm events. It is understood that the comprehensive strategy for stormwater management is geared toward greenfield development and development at this site might be considered redevelopment to a degree. Providing detention for the largest storm events to the comprehensive level requires significant storage volume and can restrict the total onsite impervious area. Therefore an exception to the maximum allowable release rates is sought for the 50%, 10%, and 1% storm events. The post-development discharge rates for the regulatory storm events will be restricted to pre-development rates, to maintain existing conditions. Extended 40-hour detention will be provided for water quality.

A stormwater pond, with a permanent pool, is proposed near the NE Hamblen Road frontage at the northeast corner of the site. In an effort to maintain the permanent pool elevation during relatively dry periods with minimal rainfall, a portion of the offsite southwest drainage area runoff will be intercepted by the onsite stormwater infrastructure and routed to the pond. The swale diversion structure that intercepts a fraction of the offsite flow consists of a double grate inlet that is depressed 6-inches below the flowline of the conveyance swale. The sump capacity of the grate opening regulates flow entering the onsite system, while allowing excess flow to continue to bypass the site via a perimeter swale to SE Hamblen Road right-of-way swales. The diversion flows into the site and the modified allowable pre-development discharge rates, for regulatory storm events, are presented on the following page in **Tables 2-3** and **2-4**.

Table 2-3 – Offsite Diversion	Peak Discharge Rates
-------------------------------	----------------------

Subwatershed	50% Storm Peak	10% Storm Peak	<u>1% Storm Peak</u>
	Flow (cfs)	Flow (cfs)	Flow (cfs)
Offsite Southwest, Diversion to Onsite	13.2	14.2	11.2*

*Enclosed pipe system HGL during 1% storm, with pond elevation at 1% storm elevation, will further limit flow into the collection system. Excess flow will continue to be diverted to the right-of-way swale.

Table 2-4 – Modified Pre-Development Discharge Rate Targets

Subwatershed	50% Storm Peak	10% Storm Peak	<u>1% Storm Peak</u>	
	Flow (cfs)	Flow (cfs)	Flow (cfs)	
Onsite, with Diversion from Offsite Southwest	29.4	48.9	73.1	

A retaining wall is incorporated into the interior face of the pond, to improve the aesthetics and increase the available storage volume above the permanent pool. The required water quality volume is provided above the permanent pool elevation and drawn down over a 40-hour period. An outfall structure is incorporated into the face of the retaining wall to regulate discharges to pre-development rates as described above. The additional runoff rate from the diversion swale is passed through the outfall structure, via rectangular openings on the sides. An emergency spillway is provided near the north side of the basin in the event back to back 1% storms occur or the primary outlet becomes clogged. The design detention basin stage storage table is provided below as **Table 2-5**.

			Avg.		Incremental	Cumulative	Cumulative	
Elevation	Area	Area	Area	Depth	Volume	Volume	Volume	
(ft)	(ft^2)	(ac)	(ft^2)	(ft)	(ft^3)	(ft ³)	(ac-ft)	Notes
1008.0	12,653	0.291			0	0	0	Bottom of Pond
			17,043	5.5				
1013.5	21,433	0.492			93,736	93,736	2.15	
			24,348	1.5				
1015.0	27,264	0.626			36,523	130,259	2.99	
			27,264	1				
1016.0	27,264	0.626			27,264	157,523	3.62	Permanent Pool Elev.
			27,264	1				
1017.0	27,264	0.626			27,264	184,787	4.24	
			27,264	0.25				
1017.25	27,264	0.626			6,816	191,603	4.40	Water Quality Elev.
			27,264	0.75				
1018.0	27,264	0.626			20,448	212,051	4.87	
			27,264	1				
1019.0	27,264	0.626			27,264	239,315	5.49	
			27,264	1				
1020.0	27,264	0.626			27,264	266,579	6.12	Emergency Spillway Elev.
			29,422	1				& Top of Retaining Wall
1021.0	31,581	0.725			29,422	296,001	6.80	
			32,975	1				
1022.0	34,369	0.789			32,975	328,976	7.55	Top of Bank

Table 2-5 – Detention Basin Stage Storage

In the existing condition, the offsite west subwatershed drains onto the site and discharges north via a swale to the existing detention basin located on the adjacent property (vacant Adessa property). In order to reduce the pass through flow in the proposed stormwater basin, this offsite area will continue to be bypassed around the site in the post-development condition. A stormwater swale will be located adjacent to the west property line and convey the flow to the concrete spillway into the adjacent detention basin.

Similarly most flow from the offsite southwest subwatershed will be routed east to the SE Hamblen Road right-of-way via a swale. Currently the properties frontage along SE Hamblen Road is not improved with curb and gutter and an enclosed storm sewer system. Curb will be installed along the frontage, but flumes will provide the drainage to the right-of-way swale. The swale will promote water quality while also increasing conveyance capacity during significant storm events.

Discharge from the southwest, south, and onsite areas currently discharge to an existing 36-inch CMP at the northeast corner of the water utilities facility parcel. Any surcharge that's experienced during large storm events likely ponds on the undeveloped land until the hydraulic grade lines subside. To improve regional stormwater hydraulics, a new outfall will be provided from the SE Hamblen Road right-of-way swale east across SE Hamblen Road to the downstream channel. Flow from the proposed stormwater basin will continue to flow to the existing outfall location, with a modification to the existing curb inlet structure sidewall to increase its depth to accept a larger pipe diameter.

3 Summary

The proposed stormwater basin will provide water quality treatment and detention to pre-development release rates for all regulatory storm events. Runoff from the site will be routed to the stormwater management facility and offsite flows will be diverted around the site. A new stormwater outfall location will be provided for the adjacent offsite drainage to improve hydraulic characteristics of the existing storm water system. The detention basin will limit release rates as summarized below in **Table 3-1**.

Storm	Comprehensive	Onsite Pre-	<u>Swale</u>	Modified Pre-	Maximum	<u>Basin</u>
Event	Allowable Peak	Development	Diversion	Development	Proposed Post-	<u>Water</u>
	Flow (cfs)	Peak Flow	Peak Flow	Peak Flow	Development	Surface
		<u>(cfs)</u>	<u>(cfs)</u>	larget (cfs)	Peak Flow (cfs)	Elevation (ft)
50%	4.6	16.2	13.2	29.4	25.5	1018.23
10%	18.5	34.7	14.2	48.9	43.4	1018.86
1%	27.7	61.9	11.2	73.1	67.8	1019.37

Table 2-1	Summon	(of	Oncito	Discharge	Datas
	Summary	/ 01	Unsile	Discharge	Rales

As shown by **Table 3-1**, the project will not increase peak discharges from the site from modified predevelopment conditions for all regulatory storm events.



Appendix

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
SCS Runoff	16.18	2	722	42,841				Onsite - Pre
SCS Runoff	32.77	2	718	76,012				Onsite - Post
SCS Runoff	38.43	2	718	100,787				Offsite Southwest
Diversion1	13.20	2	714	83,223	3			To Basin
Diversion2	25.23	2	718	17,564	3			To ROW
Combine	29.38	2	722	126,064	1, 4,			Target Release
Combine	45.97	2	718	159,235	2, 4,			Diverted to Basin
Reservoir	22.93	2	728	159,097	7	1018.23	60,714	Basin Discharge
WII Hvd Pood	Report 1	0-23-14		Return P	eriod: 2 Ye	ar	Friday Oct	24 2014
VU Hyd Pond	Report 1	0-23-14	.gpw	Return P	eriod: 2 Ye	ar	Friday, Oct	24, 2014
	Hydrograph type (origin) SCS Runoff SCS Runoff Diversion1 Diversion2 Combine Reservoir	Hydrograph type (origin)Peak flow (cfs)SCS Runoff16.18SCS Runoff32.77SCS Runoff38.43Diversion113.20Diversion225.23Combine45.97Reservoir22.93	Hydrograph type (origin)Peak flow (cfs)Time interval (min)SCS Runoff16.182SCS Runoff32.772SCS Runoff38.432Diversion113.202Diversion225.232Combine45.972Reservoir22.932	Hydrograph type (origin)Peak flow (cfs)Time interval (min)Time to Peak (min)SCS Runoff16.182722SCS Runoff32.772718SCS Runoff38.432714Diversion113.202718Combine29.382722Combine45.972718Reservoir22.932728	Hydrograph type (origin) Peak flow (cfs) Time interval (min) Time to Peak (min) Hyd. volume (cuft) SCS Runoff 16.18 2 722 42,841 SCS Runoff 32.77 2 718 76,012 SCS Runoff 38.43 2 718 100,787 Diversion1 13.20 2 714 83,223 Diversion2 25.23 2 718 17,564 Combine 29.38 2 722 126,064 Combine 45.97 2 718 159,235 Reservoir 22.93 2 728 159,097	Hydrograph type (origin) Peak (cfs) Time (min) Time to Peak (min) Hyd. (cuft) Inflow hyd(s) SCS Runoff 16.18 2 722 42.841 SCS Runoff 32.77 2 718 76.012 SCS Runoff 38.43 2 718 100.787 Diversion1 13.20 2 718 17.564 3 Combine 29.38 2 722 126.064 1.4. Combine 45.97 2 718 159.235 2.4. Reservoir 22.93 2 728 159.097 7	Hydrograph type origin Peak Ros Time ray (min) Pipek (min) Hyd., byd. Maximum elevation (ft) SCS Runoff 10.18 2 722 42.041 SCS Runoff 32.07 2 718 70.012 SCS Runoff 34.3 2 718 100.787 Diversion1 13.20 2 714 83.233 3 Diversion2 25.33 2 722 126.064 1.4.4 Combine 45.97 2 728 159.097 7 1018.23 Reservoir 22.93 2 728 159.097 7 1018.23	Hydrograph type (origin) Peak two (nt) Time two (nt) Time to (nt) Hydrograph (nt) Maximum elevation (nt) Total strge used (nt) SCS Runoff 10.18 2 722 42.841 SCS Runoff 32.77 2 718 70.12 SCS Runoff 32.77 2 718 100.77 SCS Runoff 32.77 2 718 107.97 Diversion1 13.20 2 718 17.564 1.4 Combine 45.97 2 728 159.097 7 1018.23 60.714 Reservoir 22.93 2 728 159.097 7 1018.23 60.714

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 1

Onsite - Pre

Hydrograph type	= SCS Runoff	Peak discharge	= 16.18 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 42,841 cuft
Drainage area	= 9.230 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.60 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.540 x 98) + (3.690 x 74)] / 9.230



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 1

Onsite - Pre

	<u>A</u>		D		2		<u>10(d15</u>
Sheet Flow Manning's n-value Flow length (ft) Two-year 24-hr precip. (in) Land slope (%)	= 0.150 = 100.0 = 3.50 = 2.00		0.011 0.0 0.00 0.00		0.011 0.0 0.00 0.00		
Travel Time (min)	= 9.37	+	0.00	+	0.00	=	9.37
Shallow Concentrated Flow Flow length (ft) Watercourse slope (%) Surface description Average velocity (ft/s)	= 320.00 = 3.00 = Unpaved =2.79	b	0.00 0.00 Paved 0.00		0.00 0.00 Paved 0.00		
Travel Time (min)	= 1.91	+	0.00	+	0.00	=	1.91
Channel Flow X sectional flow area (sqft) Wetted perimeter (ft) Channel slope (%) Manning's n-value Velocity (ft/s)	= 20.00 = 15.00 = 1.75 = 0.015 =15.93		0.00 0.00 0.00 0.015 0.00		0.00 0.00 0.00 0.015 0.00		
Flow length (ft)	({0})345.0		0.0		0.0		
Travel Time (min)	= 0.36	+	0.00	+	0.00	=	0.36
Total Travel Time, Tc							11.60 min

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 2

Onsite - Post

Hydrograph type	= SCS Runoff	Peak discharge	= 32.77 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 76,012 cuft
Drainage area	= 9.230 ac	Curve number	= 88
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.00 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 2

Onsite - Post

<u>Description</u>	<u>A</u>		<u>B</u>		<u>C</u>		<u>Totals</u>
Sheet Flow Manning's n-value Flow length (ft) Two-year 24-hr precip. (in) Land slope (%)	= 0.240 = 60.0 = 3.50 = 6.50		0.011 0.0 0.00 0.00		0.011 0.0 0.00 0.00		
Travel Time (min)	= 5.66	+	0.00	+	0.00	=	5.66
Shallow Concentrated Flow Flow length (ft) Watercourse slope (%) Surface description Average velocity (ft/s)	= 175.00 = 2.00 = Paved =2.87		0.00 0.00 Unpave 0.00	ed	0.00 0.00 Paved 0.00		
Travel Time (min)	= 1.01	+	0.00	+	0.00	=	1.01
Channel Flow X sectional flow area (sqft) Wetted perimeter (ft) Channel slope (%) Manning's n-value Velocity (ft/s)	= 3.14 = 6.28 = 1.50 = 0.015 =7.65		0.00 0.00 0.00 0.015 0.00		0.00 0.00 0.00 0.015 0.00		
Flow length (ft)	({0})590.0		0.0		0.0		
Travel Time (min)	= 1.29	+	0.00	+	0.00	=	1.29
Total Travel Time, Tc							8.00 min

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 3

Offsite Southwest

SCS Runoff	Peak discharge	= 38.43 cfs
2 yrs	Time to peak	= 11.97 hrs
2 min	Hyd. volume	= 100,787 cuft
8.500 ac	Curve number	= 98
0.0 %	Hydraulic length	= 0 ft
TR55	Time of conc. (Tc)	= 7.10 min
3.50 in	Distribution	= Type II
24 hrs	Shape factor	= 484
	SCS Runoff 2 yrs 2 min 8.500 ac 0.0 % TR55 3.50 in 24 hrs	SCS RunoffPeak discharge2 yrsTime to peak2 minHyd. volume8.500 acCurve number0.0 %Hydraulic lengthTR55Time of conc. (Tc)3.50 inDistribution24 hrsShape factor



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 3

Offsite Southwest

Description	A		<u>B</u>		<u>C</u>		<u>Totals</u>
Sheet Flow Manning's n-value Flow length (ft) Two-year 24-hr precip. (in) Land slope (%)	= 0.011 = 300.0 = 3.50 = 2.00		0.011 0.0 0.00 0.00		0.011 0.0 0.00 0.00		
Travel Time (min)	= 2.79	+	0.00	+	0.00	=	2.79
Shallow Concentrated Flow Flow length (ft) Watercourse slope (%) Surface description Average velocity (ft/s)	= 670.00 = 1.65 = Paved =2.61		0.00 0.00 Paved 0.00		0.00 0.00 Paved 0.00		
Travel Time (min)	= 4.28	+	0.00	+	0.00	=	4.28
Channel Flow X sectional flow area (sqft) Wetted perimeter (ft) Channel slope (%) Manning's n-value Velocity (ft/s)	= 0.00 = 0.00 = 0.015 =0.00		0.00 0.00 0.00 0.015 0.00		0.00 0.00 0.00 0.015 0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00
Total Travel Time, Tc							7.10 min

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 4

To Basin

= Diversion1	Peak discharge	= 13.20 cfs
= 2 yrs	Time to peak	= 11.90 hrs
= 2 min	Hyd. volume	= 83,223 cuft
= 3 - Offsite Southwest	2nd diverted hyd.	= 5
= Constant Q	Constant Q	= 13.20 cfs
	 Diversion1 2 yrs 2 min 3 - Offsite Southwest Constant Q 	= Diversion1Peak discharge= 2 yrsTime to peak= 2 minHyd. volume= 3 - Offsite Southwest2nd diverted hyd.= Constant QConstant Q



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Friday, Oct 24, 2014

Hyd. No. 5

To ROW

Hydrograph type	= Diversion2	Peak discharge	= 25.23 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 17,564 cuft
Inflow hydrograph	= 3 - Offsite Southwest	2nd diverted hyd.	= 4
Diversion method	= Constant Q	Constant Q	= 13.20 cfs



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 6

Target Release

Hydrograph type Storm frequency Time interval Inflow hyds.	 = Combine = 2 yrs = 2 min = 1, 4 	Peak discharge Time to peak Hyd. volume Contrib. drain. area	 = 29.38 cfs = 12.03 hrs = 126,064 cuft = 9.230 ac
Inflow nyds.	= 1, 4	Contrib. drain. area	= 9.230 ac



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 7

Diverted to Basin

Hydrograph type Storm frequency	= Combine = 2 vrs	Peak discharge Time to peak	= 45.97 cfs = 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 159,235 cuft
Inflow hyds.	= 2, 4	Contrib. drain. area	= 9.230 ac



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 8

Basin Discharge

Hydrograph type	= Reservoir	Peak discharge	= 22.93 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 159,097 cuft
Inflow hyd. No.	= 7 - Diverted to Basin	Max. Elevation	= 1018.23 ft
Reservoir name	 Detention Basin 	Max. Storage	= 60,714 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
SCS Runoff	34.68	2	720	90,035				Onsite - Pre
SCS Runoff	55.67	2	718	132,498				Onsite - Post
SCS Runoff	58.54	2	718	156,210				Offsite Southwest
Diversion1	14.20	2	710	120,579	3			To Basin
Diversion2	44.34	2	718	35,631	3			To ROW
Combine	48.88	2	720	210,615	1, 4,			Target Release
Combine	69.87	2	718	253,077	2, 4,			Diverted to Basin
Reservoir	43.39	2	726	252,933	7	1018.86	77,818	Basin Discharge
WILL Hvd Pond	Report 1	0-23-14		Return P	eriod: 10 Y		Friday Oct	24 2014
NU Hyd Pond	Report 1	0-23-14	.gpw	Return P	eriod: 10 Y	ear	Friday, Oct	24, 2014
	Hydrograph type (origin) SCS Runoff SCS Runoff Diversion1 Diversion2 Combine Reservoir	Hydrograph type (origin)Peak flow (cfs)SCS Runoff34.68SCS Runoff55.67SCS Runoff58.54Diversion114.20Diversion244.34Combine69.87Reservoir43.39	Hydrograph (origin)Peak flow (cfs)Time interval (min)SCS Runoff34.682SCS Runoff55.672SCS Runoff58.542Diversion114.202Diversion244.342Combine69.872Reservoir43.392	Hydrograph type (origin)Peak flow (cfs)Time interval (min)Time to Peak (min)SCS Runoff34.682720SCS Runoff55.672718SCS Runoff58.542718Diversion114.202710Diversion244.342718Combine69.872726Reservoir43.392726	Hydrograph type (origin) Peak flow (cfs) Time time with interval (min) Time to Peak (min) Hyd. volume (cut) SCS Runoff 34.68 2 720 90.035 SCS Runoff 55.67 2 718 132.498 SCS Runoff 58.54 2 718 132.498 SCS Runoff 58.54 2 718 156.210 Diversion1 14.20 2 718 35.631 Combine 48.88 2 720 210.615 Combine 69.87 2 718 253.077 Reservoir 43.39 2 726 252.933	Hydrograph type (origin) Peak flow (cfs) Time time volume (min) Hyd. Peak (min) Hyd. volume (cuft) Inflow hyd(s) SCS Runoff 34.68 2 720 90,035 SCS Runoff 55.67 2 718 132,498 SCS Runoff 58.54 2 718 156,210 Diversion1 14.20 2 710 120,579 3 Diversion2 44.34 2 718 35,631 3 Combine 69.87 2 718 253,077 2,4, Reservoir 43.39 2 726 252,933 7	Hydrograph type (origin) Peak (rs) Ime to (min) Ime to (min) Hyd (rs) Inflow (rs) Maximum elevation (rt) SCS Runoff 54.68 2 720 90.035 SCS Runoff 55.67 2 718 132.498 SCS Runoff 58.54 2 718 156.210 Diversion1 14.20 2 710 120.579 3 Diversion2 44.34 2 718 35.631 3 Combine 69.87 2 726 252.933 7 1018.86 Reservoir 43.39 2 726 252.933 7 1018.86	Hydrograph type (origin) Peak frow (rin) Time interval (rin) Time to (rin) Hyd. Volume (cutt) Inflow hyd(s) Maximum elevation (rin) Total strge used (cutt) SCS Runoff 34.68 2 720 90.035 SCS Runoff 55.67 2 718 132.498 Diversion1 14.20 2 718 135.631 3 Obversion2 44.34 2 718 258.077 2.4 Combine 69.87 2 726 252.933 7 1018.86 777.818 Reservoir 43.39 2 726 252.933 7 1018.86 778.18

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 1

Onsite - Pre

Hydrograph type	= SCS Runoff	Peak discharge	= 34.68 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 90,035 cuft
Drainage area	= 9.230 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.60 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.540 x 98) + (3.690 x 74)] / 9.230



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 2

Onsite - Post

Hydrograph type	= SCS Runoff	Peak discharge	= 55.67 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 132,498 cuft
Drainage area	= 9.230 ac	Curve number	= 88
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.00 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 3

Offsite Southwest

Hydrograph type =	SCS Runoff	Peak discharge	= 58.54 cfs
Storm frequency =	10 yrs	Time to peak	= 11.97 hrs
Time interval =	2 min	Hyd. volume	= 156,210 cuft
Drainage area =	8.500 ac	Curve number	= 98
Basin Slope =	0.0 %	Hydraulic length	= 0 ft
Tc method =	TR55	Time of conc. (Tc)	= 7.10 min
Total precip. =	5.30 in	Distribution	= Type II
Storm duration =	24 hrs	Shape factor	= 484



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 4

To Basin

Hydrograph type	= Diversion1	Peak discharge	= 14.20 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.83 hrs
Time interval	= 2 min	Hyd. volume	= 120,579 cuft
Inflow hydrograph	= 3 - Offsite Southwest	2nd diverted hyd.	= 5
Diversion method	= Constant Q	Constant Q	= 14.20 cfs



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Friday, Oct 24, 2014

Hyd. No. 5

To ROW

Hydrograph type	= Diversion2	Peak discharge	= 44.34 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 35,631 cuft
Inflow hydrograph	= 3 - Offsite Southwest	2nd diverted hyd.	= 4
Diversion method	= Constant Q	Constant Q	= 14.20 cfs



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 6

Target Release

Time to peak Hyd. volume Contrib. drain. area	= 40.00 Crs = 12.00 hrs = $210,615 \text{ cuft}$ = 9.230 ac
Contrib. drain. area	= 9.230 ac
	Time to peak Hyd. volume Contrib. drain. area


Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 7

Diverted to Basin

Hydrograph type Storm frequency	Combine10 yrs	Peak discharge Time to peak	= 69.87 cfs = 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 253,077 cuft
Inflow hyds.	= 2, 4	Contrib. drain. area	= 9.230 ac



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 8

Basin Discharge

Hydrograph type	= Reservoir	Peak discharge	= 43.39 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 252,933 cuft
Inflow hyd. No.	= 7 - Diverted to Basin	Max. Elevation	= 1018.86 ft
Reservoir name	 Detention Basin 	Max. Storage	= 77,818 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. Hy No.	ydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1 SC	CS Runoff	61.86	2	720	160,952				Onsite - Pre
2 SC	CS Runoff	85.98	2	718	210,249				Onsite - Post
3 SC	CS Runoff	85.26	2	718	230,190				Offsite Southwest
4 Div	version1	11.20	2	704	160,348	3			To Basin
5 Div	version2	74.06	2	718	69,843	3			To ROW
6 Co	ombine	73.06	2	720	321,300	1, 4,			Target Release
7 Co	ombine	97.18	2	718	370,596	2, 4,			Diverted to Basin
8 Re	eservoir	67.79	2	724	370,446	7	1019.37	91,697	Basin Discharge
	J Hvd Pond	Report 1	0-23-14	dDW.	Return P	eriod: 100	Year	Friday Oct	24 2014

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 1

Onsite - Pre

Hydrograph type	= SCS Runoff	Peak discharge	= 61.86 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 160,952 cuft
Drainage area	= 9.230 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.60 min
Total precip.	= 7.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.540 x 98) + (3.690 x 74)] / 9.230



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 2

Onsite - Post

Hydrograph type	= SCS Runoff	Peak discharge	= 85.98 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 210,249 cuft
Drainage area	= 9.230 ac	Curve number	= 88
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.00 min
Total precip.	= 7.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 3

Offsite Southwest

SCS Runoff	Peak discharge	= 85.26 cfs
= 100 yrs	Time to peak	= 11.97 hrs
= 2 min	Hyd. volume	= 230,190 cuft
= 8.500 ac	Curve number	= 98
= 0.0 %	Hydraulic length	= 0 ft
= TR55	Time of conc. (Tc)	= 7.10 min
= 7.70 in	Distribution	= Type II
= 24 hrs	Shape factor	= 484
	 SCS Runoff 100 yrs 2 min 8.500 ac 0.0 % TR55 7.70 in 24 hrs 	SCS RunoffPeak discharge100 yrsTime to peak2 minHyd. volume8.500 acCurve number0.0 %Hydraulic lengthTR55Time of conc. (Tc)7.70 inDistribution24 hrsShape factor



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 4

To Basin

Hydrograph type	= Diversion1	Peak discharge	= 11.20 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.73 hrs
Time interval	= 2 min	Hyd. volume	= 160,348 cuft
Inflow hydrograph	= 3 - Offsite Southwest	2nd diverted hyd.	= 5
Diversion method	= Constant Q	Constant Q	= 11.20 cfs



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Friday, Oct 24, 2014

Hyd. No. 5

To ROW

Hydrograph type	= Diversion2	Peak discharge	= 74.06 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 69,843 cuft
Inflow hydrograph	= 3 - Offsite Southwest	2nd diverted hyd.	= 4
Diversion method	= Constant Q	Constant Q	= 11.20 cfs



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 6

Target Release

Hydrograph type	= Combine	Peak discharge	= 73.06 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 321,300 cuft
Inflow hyds.	= 1, 4	Contrib. drain. area	= 9.230 ac
-			



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 7

Diverted to Basin

Hydrograph type	= Combine	Peak discharge	= 97.18 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 370,596 cuft
Inflow hyds.	= 2, 4	Contrib. drain. area	= 9.230 ac



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No. 8

Basin Discharge

Hydrograph type	= Reservoir	Peak discharge	= 67.79 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 370,446 cuft
Inflow hyd. No.	= 7 - Diverted to Basin	Max. Elevation	= 1019.37 ft
Reservoir name	 Detention Basin 	Max. Storage	= 91,697 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Pond No. 1 - Detention Basin

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1016.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1016.00	27,264	0	0
0.50	1016.50	27,264	13,631	13,631
1.00	1017.00	27,264	13,631	27,261
1.50	1017.50	27,264	13,631	40,892
2.00	1018.00	27,264	13,631	54,523
2.50	1018.50	27,264	13,631	68,153
3.00	1019.00	27,264	13,631	81,784
3.50	1019.50	27,264	13,631	95,414
4.00	1020.00	27,264	13,631	109,045
4.50	1020.50	29,423	14,167	123,212
5.00	1021.00	31,581	15,246	138,458
5.50	1021.50	32,975	16,136	154,594
6.00	1022.00	34,369	16,833	171,428

Culvert / Orifice Structures

Weir Structures

	[A]	[B]	[C]	[PrfRsr]		[A]	[B]	[C]	[D]
Rise (in)	= 48.00	Inactive	0.00	0.00	Crest Len (ft)	= 3.84	0.00	6.00	0.50
Span (in)	= 48.00	0.00	0.00	0.00	Crest El. (ft)	= 1017.25	1016.00	1019.00	1016.00
No. Barrels	= 1	1	0	0	Weir Coeff.	= 3.33	0.68	3.33	3.33
Invert El. (ft)	= 1012.25	0.00	0.00	0.00	Weir Type	= Rect	30 degV	Rect	Rect
Length (ft)	= 181.00	0.00	0.00	0.00	Multi-Stage	= Yes	Yes	Yes	Yes
Slope (%)	= 0.55	0.00	0.00	n/a					
N-Value	= .013	.013	.013	n/a					
Orifice Coeff.	= 0.60	0.66	0.60	0.60	Exfil.(in/hr)	= 0.000 (by	Wet area)		
Multi-Stage	= n/a	Yes	No	No	TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s). Stage / Storage / Discharge Table

•	•	•											
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	1016.00	0.00				0.00		0.00	0.00			0.000
0.50	13,631	1016.50	65.68 oc				0.00	0.12	0.00	0.59			0.709
1.00	27,261	1017.00	65.68 oc				0.00	0.68	0.00	1.66			2.346
1.50	40,892	1017.50	65.68 oc				1.60	1.88	0.00	3.06			6.534
2.00	54,523	1018.00	65.68 oc				8.31	3.85	0.00	4.71			16.87
2.50	68,153	1018.50	65.68 oc				17.87	6.73	0.00	6.58			31.18
3.00	81,784	1019.00	65.68 oc				29.60	10.62	0.00	8.65			48.87
3.50	95,414	1019.50	75.97 oc				43.16	15.16 s	7.06	10.59 s			75.97
4.00	109,045	1020.00	105.89 oc				55.72 s	18.74 s	19.98	11.46 s			105.89
4.50	123,212	1020.50	128.52 oc				59.89 s	20.93 s	36.33 s	11.37 s			128.52
5.00	138,458	1021.00	143.06 oc				62.07 s	22.94 s	46.84 s	11.22 s			143.06
5.50	154,594	1021.50	153.97 oc				63.61 s	24.93 s	54.33 s	11.08 s			153.97
6.00	171,428	1022.00	162.81 ic				64.74 s	26.90 s	60.20 s	10.96 s			162.80

OUTLET STRUCTURE DISCHARGE COMPUTATIONS FOR EXTENDED DETENTION BASINS

FLOWLINE ELEVATION	1016.00	V ANGLE:	30
AT BOTTOM OF BASIN:		TOP V ELEV:	1017.25
MAXIMUM PONDING ELEV. FOR EXTENDED DETENTION:	1020.00		

WATER	AVERAGE	AVERAGE	BOTTOM	NOTCH	WEIR	ORIFICE	ONTROLLING	DRAIN TIME	TOTAL
ELEVATION	AREA (SF)	VOL (CF)	WEIR	WEIR	DISCHARGE	DISCHARGE	DISCHARGE	(HOURS)	DISCHARGE
			LENGTH	LENGTH					
1020.00	27264.00	6816	0.50	0.67	101.59	23.500	23.50	0.081	160.434
1019.75	27264.00	6816	0.50	0.67	86.45	21.331	21.33	0.089	136.934
1019.50	27264.00	6816	0.50	0.67	72.76	19.234	19.23	0.098	115.603
1019.25	27264.00	6816	0.50	0.67	60.45	17.211	17.21	0.110	96.369
1019.00	27264.00	6816	0.50	0.67	49.49	15.264	15.26	0.124	79.158
1018.75	27264.00	6816	0.50	0.67	39.81	13.396	13.40	0.141	63.895
1018.50	27264.00	6816	0.50	0.67	31.37	11.611	11.61	0.163	50.499
1018.25	27264.00	6816	0.50	0.67	24.11	9.914	9.91	0.191	38.887
1018.00	27264.00	6816	0.50	0.67	17.96	8.308	8.31	0.228	28.973
1017.75	27264.00	6816	0.50	0.67	12.86	6.800	6.80	0.278	20.665
1017.50	27264.00	6816	0.50	0.67	8.75	5.396	5.40	0.351	13.865
1017.25	27264.00	6816	0.50	0.67	5.55	4.105	4.11	0.461	8.468
1017.00	27264.00	6816	0.50	0.54	2.84	2.702	2.70	0.701	4.363
1016.75	27264.00	6816	0.50	0.40	1.22	1.602	1.22	1.552	1.661
1016.50	27264.00	6816	0.50	0.27	0.38	0.789	0.38	4.936	0.441
1016.25	27264.00	6816	0.50	0.13	0.06	0.249	0.06	33.018	0.057
1016.00	27264.00	0	0.50	0.00	0.00	0.000	0.00	0.000	0.000
		109056							

TOTAL DRAIN TIME

42.5 hours

WATER QUALITY DRAIN TIME

40.7 hours

FX



Attachment 2 USDA Soil Map



USDA Natural Resources

Conservation Service





Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	С	4.4	100.0%
10180	Udarents-Urban land- Sampsel complex, 2 to 5 percent slopes	С	0.0	0.0%
Totals for Area of Intere	est	4.4	100.0%	

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition Component Percent Cutoff: None Specified Tie-break Rule: Higher



FX



Attachment 3 FEMA Firm Panel

hdrinc.com 10450 Holmes Road, Suite 600, Kansas City, MO 64131-3471 (816) 360-2700

National Flood Hazard Layer FIRMette



Legend



Basemap Imagery Source: USGS National Map 2023

FSS



Attachment 4 Impervious Area Map



CIVIL	M. WIEBELHAUS
ECTURAL	ERICA BUTTMAN
HANICAL	M. WARRICK
NUMBER	10417754

FC



Attachment 5

Hydraflow Hydrographs – Post Condition Report

hdrinc.com 10450 Holmes Road, Suite 600, Kansas City, MO 64131-3471 (816) 360-2700

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	16.18	2	722	42,841				Onsite - Pre
2	SCS Runoff	33.86	2	718	78,977				Onsite - Post
3	SCS Runoff	38.43	2	718	100,787				Offsite Southwest
4	Diversion1	13.20	2	714	83,223	3			To Basin
5	Diversion2	25.23	2	718	17,564	3			To ROW
6	Combine	29.38	2	722	126,064	1, 4,			Target Release
7	Combine	47.06	2	718	162,200	2, 4,			Diverted to Basin
8	Reservoir	23.84	2	728	162,062	7	1018.26	61,593	Basin Discharge
C·W	Jsers\rferquisc	n\OneDr	ive - HD	R Inc\W(faib 61/20X8		Y\$\$1834#894/\00	Δ.Χ.1Ι).«ν2θ25 ment αρω

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 1

Onsite - Pre

Hydrograph type =	SCS Runoff	Peak discharge	= 16.18 cfs
Storm frequency =	= 2 yrs	Time to peak	= 12.03 hrs
Time interval =	= 2 min	Hyd. volume	= 42,841 cuft
Drainage area =	= 9.230 ac	Curve number	= 74*
Basin Slope =	= 0.0 %	Hydraulic length	= 0 ft
Tc method =	= TR55	Time of conc. (Tc)	= 11.60 min
Total precip. =	= 3.50 in	Distribution	= Type II
Storm duration =	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(9.230 x 74)] / 9.230



3

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 1

Onsite - Pre

<u>Description</u>	A		<u>B</u>		<u>C</u>		<u>Totals</u>
Sheet Flow Manning's n-value Flow length (ft) Two-year 24-hr precip. (in) Land slope (%)	= 0.150 = 100.0 = 3.50 = 2.00		0.011 0.0 0.00 0.00		0.011 0.0 0.00 0.00		
Travel Time (min)	= 9.37	+	0.00	+	0.00	=	9.37
Shallow Concentrated Flow Flow length (ft) Watercourse slope (%) Surface description Average velocity (ft/s)	= 320.00 = 3.00 = Unpaved =2.79	d	0.00 0.00 Paved 0.00		0.00 0.00 Paved 0.00		
Travel Time (min)	= 1.91	+	0.00	+	0.00	=	1.91
Channel Flow X sectional flow area (sqft) Wetted perimeter (ft) Channel slope (%) Manning's n-value Velocity (ft/s)	= 20.00 = 15.00 = 1.75 = 0.015 =15.93		0.00 0.00 0.00 0.015 0.00		0.00 0.00 0.00 0.015 0.00		
Flow length (ft)	({0})345.0		0.0		0.0		
Travel Time (min)	= 0.36	+	0.00	+	0.00	=	0.36
Total Travel Time, Tc							11.60 min

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 2

Onsite - Post

Hydrograph type	= SCS Runoff	Peak discharge	= 33.86 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 78,977 cuft
Drainage area	= 9.230 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.00 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.660 x 98) + (3.570 x 74)] / 9.230



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 2

Onsite - Post

<u>Description</u>	<u>A</u>		<u>B</u>		<u>C</u>		<u>Totals</u>
Sheet Flow Manning's n-value Flow length (ft) Two-year 24-hr precip. (in) Land slope (%) Travel Time (min)	= 0.240 = 60.0 = 3.50 = 6.50 = 5.66	+	0.011 0.0 0.00 0.00 0.00	+	0.011 0.0 0.00 0.00 0.00	=	5.66
Shallow Concentrated Flow Flow length (ft) Watercourse slope (%) Surface description Average velocity (ft/s)	= 175.00 = 2.00 = Paved =2.87		0.00 0.00 Paved 0.00		0.00 0.00 Paved 0.00		
Travel Time (min)	= 1.01	+	0.00	+	0.00	=	1.01
Channel Flow X sectional flow area (sqft) Wetted perimeter (ft) Channel slope (%) Manning's n-value Velocity (ft/s)	= 3.14 = 6.28 = 1.50 = 0.015 =7.65		0.00 0.00 0.00 0.015 0.00		0.00 0.00 0.00 0.015 0.00		
Flow length (ft)	({0})590.0		0.0		0.0		
Travel Time (min)	= 1.29	+	0.00	+	0.00	=	1.29
Total Travel Time, Tc							8.00 min

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 3

Offsite Southwest

Hydrograph type	= SCS Runoff	Peak discharge	= 38.43 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 100,787 cuft
Drainage area	= 8.500 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.10 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



7

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 3

Offsite Southwest

Description	<u>A</u>		<u>B</u>		<u>C</u>		<u>Totals</u>
Sheet Flow Manning's n-value Flow length (ft) Two-year 24-hr precip. (in) Land slope (%)	= 0.011 = 300.0 = 3.50 = 2.00		0.011 0.0 0.00 0.00		0.011 0.0 0.00 0.00		0.70
Travel Time (min)	= 2.79	+	0.00	+	0.00	=	2.79
Shallow Concentrated Flow Flow length (ft) Watercourse slope (%) Surface description Average velocity (ft/s)	= 670.00 = 1.65 = Paved =2.61		0.00 0.00 Paved 0.00		0.00 0.00 Paved 0.00		
Travel Time (min)	= 4.28	+	0.00	+	0.00	=	4.28
Channel Flow							
X sectional flow area (sqft) Wetted perimeter (ft) Channel slope (%) Manning's n-value Velocity (ft/s)	= 0.00 = 0.00 = 0.00 = 0.015 =0.00		0.00 0.00 0.00 0.015 0.00		0.00 0.00 0.00 0.015		
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00
Total Travel Time, Tc		Total Travel Time. Tc					7.10 min

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 4

To Basin

Hydrograph type	= Diversion1	Peak discharge	= 13.20 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.90 hrs
Time interval	= 2 min	Hyd. volume	= 83,223 cuft
Inflow hydrograph	= 3 - Offsite Southwest	2nd diverted hyd.	= 5
Diversion method	= Constant Q	Constant Q	= 13.20 cfs



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 5

To ROW

Hydrograph type	= Diversion2	Peak discharge	= 25.23 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 17,564 cuft
Inflow hydrograph	= 3 - Offsite Southwest	2nd diverted hyd.	= 4
Diversion method	= Constant Q	Constant Q	= 13.20 cfs



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 6

Target Release

Hydrograph type	= Combine	Peak discharge	= 29.38 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 126,064 cuft
Inflow hyds.	= 1, 4	Contrib. drain. area	= 9.230 ac
y	,		



11

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 7

Diverted to Basin

Hydrograph type Storm frequency	= Combine = 2 vrs	Peak discharge Time to peak	= 47.06 cfs = 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 162,200 cuft
Inflow hyds.	= 2, 4	Contrib. drain. area	= 9.230 ac



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 8

Basin Discharge

Hydrograph type =	= Reservoir	Peak discharge	= 23.84 cfs
Storm frequency =	= 2 yrs	Time to peak	= 12.13 hrs
Time interval =	= 2 min	Hyd. volume	= 162,062 cuft
Inflow hyd. No.	= 7 - Diverted to Basin	Max. Elevation	= 1018.26 ft
Reservoir name	= Detention Pond	Max. Storage	= 61,593 cuft

Storage Indication method used.



13
Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	34.68	2	720	90,035				Onsite - Pre
2	SCS Runoff	56.75	2	718	136,022				Onsite - Post
3	SCS Runoff	58.54	2	718	156,210				Offsite Southwest
4	Diversion1	14.20	2	710	120,579	3			To Basin
5	Diversion2	44.34	2	718	35,631	3			To ROW
6	Combine	48.88	2	720	210,615	1, 4,			Target Release
7	Combine	70.95	2	718	256,601	2, 4,			Diverted to Basin
8	Reservoir	44.32	2	726	256,456	7	1018.88	78,515	Basin Discharge

C:\Users\rferguson\OneDrive - HDR, Inc\WQRKettrojeEtsib6M0\SeaRM ANALYSLEesteay,\WAX1Dev2025ment.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 1

Onsite - Pre

Hydrograph type	= SCS Runoff	Peak discharge	= 34.68 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 90,035 cuft
Drainage area	= 9.230 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.60 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(9.230 x 74)] / 9.230



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 2

Onsite - Post

Hydrograph type	= SCS Runoff	Peak discharge	= 56.75 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 136,022 cuft
Drainage area	= 9.230 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.00 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.660 x 98) + (3.570 x 74)] / 9.230



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 3

Offsite Southwest

Hydrograph type	= SCS Runoff	Peak discharge	= 58.54 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 156,210 cuft
Drainage area	= 8.500 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.10 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 4

To Basin

Hydrograph type	= Diversion1	Peak discharge	= 14.20 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.83 hrs
Time interval	= 2 min	Hyd. volume	= 120,579 cuft
Inflow hydrograph	= 3 - Offsite Southwest	2nd diverted hyd.	= 5
Diversion method	= Constant Q	Constant Q	= 14.20 cfs



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 5

To ROW

= Diversion2	Peak discharge	= 44.34 cfs
= 10 yrs	Time to peak	= 11.97 hrs
= 2 min	Hyd. volume	= 35,631 cuft
= 3 - Offsite Southwest	2nd diverted hyd.	= 4
= Constant Q	Constant Q	= 14.20 cfs
	 Diversion2 10 yrs 2 min 3 - Offsite Southwest Constant Q 	= Diversion2Peak discharge= 10 yrsTime to peak= 2 minHyd. volume= 3 - Offsite Southwest2nd diverted hyd.= Constant QConstant Q



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 6

Target Release

Time interval= 2 minHyd. volume= 210,615 cuftInflow hyds.= 1, 4Contrib. drain. area= 9.230 ac	Hydrograph type	= Combine	Peak discharge	= 48.88 cfs
	Storm frequency	= 10 yrs	Time to peak	= 12.00 hrs
	Time interval	= 2 min	Hyd. volume	= 210,615 cuft
	Inflow hyds.	= 1, 4	Contrib. drain. area	= 9.230 ac



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 7

Diverted to Basin

uft
u



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 8

Basin Discharge

Hydrograph type =	= Reservoir	Peak discharge	= 44.32 cfs
Storm frequency :	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 256,456 cuft
Inflow hyd. No.	= 7 - Diverted to Basin	Max. Elevation	= 1018.88 ft
Reservoir name	= Detention Pond	Max. Storage	= 78,515 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	61.86	2	720	160,952				Onsite - Pre
2	SCS Runoff	86.96	2	718	214,186				Onsite - Post
3	SCS Runoff	85.26	2	718	230,190				Offsite Southwest
4	Diversion1	11.20	2	704	160,348	3			To Basin
5	Diversion2	74.06	2	718	69,843	3			To ROW
6	Combine	73.06	2	720	321,300	1, 4,			Target Release
7	Combine	98.16	2	718	374,533	2, 4,			Diverted to Basin
8	Reservoir	68.80	2	724	374,383	7	1019.38	92,176	Basin Discharge

C:\Users\rferguson\OneDrive - HDR, Inc\WQRKettrojetesib6MO0SY@aRM ANALYSLEestean,\00AX1Dev2025ment.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 1

Onsite - Pre

Hydrograph type	= SCS Runoff	Peak discharge	= 61.86 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 160,952 cuft
Drainage area	= 9.230 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.60 min
Total precip.	= 7.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(9.230 x 74)] / 9.230



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 2

Onsite - Post

Hydrograph type	= SCS Runoff	Peak discharge	= 86.96 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 214,186 cuft
Drainage area	= 9.230 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.00 min
Total precip.	= 7.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.660 x 98) + (3.570 x 74)] / 9.230



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 3

Offsite Southwest

Hydrograph type	= SCS Runoff	Peak discharge	= 85.26 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 230,190 cuft
Drainage area	= 8.500 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.10 min
Total precip.	= 7.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 4

To Basin

Hydrograph type	= Diversion1	Peak discharge	= 11.20 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.73 hrs
Time interval	= 2 min	Hyd. volume	= 160,348 cuft
Inflow hydrograph	= 3 - Offsite Southwest	2nd diverted hyd.	= 5
Diversion method	= Constant Q	Constant Q	= 11.20 cfs



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 5

To ROW

Hydrograph type	= Diversion2	Peak discharge	= 74.06 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 69,843 cuft
Inflow hydrograph	= 3 - Offsite Southwest	2nd diverted hyd.	= 4
Diversion method	= Constant Q	Constant Q	= 11.20 cfs



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 6

Target Release

Hydrograph type	= Combine	Peak discharge	= 73.06 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 321,300 cuft
Inflow hyds.	= 1, 4	Contrib. drain. area	= 9.230 ac



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 7

Diverted to Basin

Hydrograph type	= Combine	Peak discharge	= 98.16 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 374,533 cuft
Inflow hyds.	= 2, 4	Contrib. drain. area	= 9.230 ac
innow nyus.	- 2,4	Contrib. drain. area	- 9.230 ac



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 8

Basin Discharge

Hydrograph type	= Reservoir	Peak discharge	= 68.80 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 374,383 cuft
Inflow hyd. No.	= 7 - Diverted to Basin	Max. Elevation	= 1019.38 ft
Reservoir name	= Detention Pond	Max. Storage	= 92,176 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Pond No. 1 - Detention Pond

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1016.00	n/a	0	0
0.50	1016.50	n/a	13,631	13,631
1.00	1017.00	n/a	13,630	27,261
1.50	1017.50	n/a	13,631	40,892
2.00	1018.00	n/a	13,631	54,523
2.50	1018.50	n/a	13,630	68,153
3.00	1019.00	n/a	13,631	81,784
3.50	1019.50	n/a	13,630	95,414
4.00	1020.00	n/a	13,631	109,045
4.50	1020.50	n/a	14,167	123,212
5.00	1021.00	n/a	15,246	138,458
5.50	1021.50	n/a	16,136	154,594
6.00	1022.00	n/a	16,834	171,428

Culvert / Orifice Structures

Weir Structures

	[A]	[B]	[C]	[PrfRsr]		[A]	[B]	[C]	[D]
Rise (in)	= 48.00	0.00	0.00	0.00	Crest Len (ft)	= 3.84	0.00	6.00	0.50
Span (in)	= 48.00	0.00	0.00	0.00	Crest El. (ft)	= 1017.25	1016.00	1019.00	1016.00
No. Barrels	= 1	0	0	0	Weir Coeff.	= 3.33	0.68	3.33	3.33
Invert El. (ft)	= 1012.25	0.00	0.00	0.00	Weir Type	= Rect	30 degV	Rect	Rect
Length (ft)	= 181.00	0.00	0.00	0.00	Multi-Stage	= Yes	Yes	Yes	Yes
Slope (%)	= 0.55	0.00	0.00	n/a					
N-Value	= .013	.013	.013	n/a					
Orifice Coeff.	= 0.60	0.60	0.60	0.60	Exfil.(in/hr)	= 0.000 (by	Wet area)		
Multi-Stage	= n/a	No	No	No	TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table													0 ()
Stage ft	Storage cuft	Elevation ft	Clv A cfs	CIv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	1016.00	0.00				0.00		0.00	0.00			0.000
0.50	13,631	1016.50	65.68 oc				0.00	0.12	0.00	0.59			0.709
1.00	27,261	1017.00	65.68 oc				0.00	0.68	0.00	1.66			2.345
1.50	40,892	1017.50	65.68 oc				1.60	1.87	0.00	3.06			6.531
2.00	54,523	1018.00	65.68 oc				8.31	3.85	0.00	4.71			16.86
2.50	68,153	1018.50	65.68 oc				17.87	6.72	0.00	6.58			31.17
3.00	81,784	1019.00	65.68 oc				29.60	10.60	0.00	8.65			48.85
3.50	95,414	1019.50	75.95 oc				43.16	15.14 s	7.06	10.59 s	s		75.95
4.00	109,045	1020.00	105.88 oc				55.72 s	18.72 s	19.98	11.46 s	s		105.88
4.50	123,212	1020.50	128.51 oc				59.90 s	20.90 s	36.33 s	11.37 s	s		128.51
5.00	138,458	1021.00	143.06 oc				62.08 s	22.91 s	46.85 s	11.22 s	s		143.06
5.50	154,594	1021.50	153.96 oc				63.63 s	24.90 s	54.34 s	11.09 s	s		153.96
6.00	171,428	1022.00	162.81 ic				64.75 s	26.87 s	60.22 s	10.96 s	s		162.80

FC



Attachment 6

Hydraflow Hydrographs – Future Condition Report

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	16.18	2	722	42,841				Onsite - Pre
2	SCS Runoff	33.86	2	718	78,977				Onsite - Post
3	SCS Runoff	38.43	2	718	100,787				Offsite Southwest
4	Diversion1	13.20	2	714	83,223	3			To Basin
5	Diversion2	25.23	2	718	17,564	3			To ROW
6	Combine	29.38	2	722	126,064	1, 4,			Target Release
7	Combine	47.06	2	718	162,200	2, 4,			Diverted to Basin
8	Reservoir	23.84	2	728	162,062	7	1018.26	61,593	Basin Discharge

C:\Users\rferguson\OneDrive - HDR, Inc\WQRKetturojectstib61/20/6aiORM ANALYSLeetstay,\DatureLDevelopment.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 1

Onsite - Pre

Hydrograph type =	SCS Runoff	Peak discharge	= 16.18 cfs
Storm frequency =	= 2 yrs	Time to peak	= 12.03 hrs
Time interval =	= 2 min	Hyd. volume	= 42,841 cuft
Drainage area =	= 9.230 ac	Curve number	= 74*
Basin Slope =	= 0.0 %	Hydraulic length	= 0 ft
Tc method =	= TR55	Time of conc. (Tc)	= 11.60 min
Total precip. =	= 3.50 in	Distribution	= Type II
Storm duration =	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(9.230 x 74)] / 9.230



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 1

Onsite - Pre

<u>Description</u>	A		<u>B</u>		<u>C</u>		<u>Totals</u>
Sheet Flow Manning's n-value Flow length (ft) Two-year 24-hr precip. (in) Land slope (%)	= 0.150 = 100.0 = 3.50 = 2.00		0.011 0.0 0.00 0.00		0.011 0.0 0.00 0.00		
Travel Time (min)	= 9.37	+	0.00	+	0.00	=	9.37
Shallow Concentrated Flow Flow length (ft) Watercourse slope (%) Surface description Average velocity (ft/s)	= 320.00 = 3.00 = Unpaved =2.79	d	0.00 0.00 Paved 0.00		0.00 0.00 Paved 0.00		
Travel Time (min)	= 1.91	+	0.00	+	0.00	=	1.91
Channel Flow X sectional flow area (sqft) Wetted perimeter (ft) Channel slope (%) Manning's n-value Velocity (ft/s)	= 20.00 = 15.00 = 1.75 = 0.015 =15.93		0.00 0.00 0.00 0.015 0.00		0.00 0.00 0.00 0.015 0.00		
Flow length (ft)	({0})345.0		0.0		0.0		
Travel Time (min)	= 0.36	+	0.00	+	0.00	=	0.36
Total Travel Time, Tc							11.60 min

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 2

Onsite - Post

Hydrograph type =	SCS Runoff	Peak discharge	= 33.86 cfs
Storm frequency =	2 yrs	Time to peak	= 11.97 hrs
Time interval =	2 min	Hyd. volume	= 78,977 cuft
Drainage area =	≔ 9.230 ac	Curve number	= 89*
Basin Slope =	0.0 %	Hydraulic length	= 0 ft
Tc method =	: TR55	Time of conc. (Tc)	= 8.00 min
Total precip. =	÷ 3.50 in	Distribution	= Type II
Storm duration =	· 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.930 x 98) + (3.300 x 74)] / 9.230



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 2

Onsite - Post

<u>Description</u>	<u>A</u>		<u>B</u>		<u>C</u>		<u>Totals</u>
Sheet Flow Manning's n-value Flow length (ft) Two-year 24-hr precip. (in) Land slope (%) Travel Time (min)	= 0.240 = 60.0 = 3.50 = 6.50 = 5.66	+	0.011 0.0 0.00 0.00 0.00	+	0.011 0.0 0.00 0.00 0.00	=	5.66
Shallow Concentrated Flow Flow length (ft) Watercourse slope (%) Surface description Average velocity (ft/s)	= 175.00 = 2.00 = Paved =2.87		0.00 0.00 Paved 0.00		0.00 0.00 Paved 0.00		
Travel Time (min)	= 1.01	+	0.00	+	0.00	=	1.01
Channel Flow X sectional flow area (sqft) Wetted perimeter (ft) Channel slope (%) Manning's n-value Velocity (ft/s)	= 3.14 = 6.28 = 1.50 = 0.015 =7.65		0.00 0.00 0.00 0.015 0.00		0.00 0.00 0.00 0.015 0.00		
Flow length (ft)	({0})590.0		0.0		0.0		
Travel Time (min)	= 1.29	+	0.00	+	0.00	=	1.29
Total Travel Time, Tc							8.00 min

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 3

Offsite Southwest

Hydrograph type	= SCS Runoff	Peak discharge	= 38.43 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 100,787 cuft
Drainage area	= 8.500 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.10 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



7

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 3

Offsite Southwest

Description	<u>A</u>		<u>B</u>		<u>C</u>		<u>Totals</u>
Sheet Flow Manning's n-value Flow length (ft) Two-year 24-hr precip. (in) Land slope (%)	= 0.011 = 300.0 = 3.50 = 2.00		0.011 0.0 0.00 0.00		0.011 0.0 0.00 0.00		0.70
Travel Time (min)	= 2.79	+	0.00	+	0.00	=	2.79
Shallow Concentrated Flow Flow length (ft) Watercourse slope (%) Surface description Average velocity (ft/s)	= 670.00 = 1.65 = Paved =2.61		0.00 0.00 Paved 0.00		0.00 0.00 Paved 0.00		
Travel Time (min)	= 4.28	+	0.00	+	0.00	=	4.28
Channel Flow							
X sectional flow area (sqft) Wetted perimeter (ft) Channel slope (%) Manning's n-value Velocity (ft/s)	= 0.00 = 0.00 = 0.00 = 0.015 =0.00		0.00 0.00 0.00 0.015 0.00		0.00 0.00 0.00 0.015		
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00
Total Travel Time, Tc							7.10 min

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 4

To Basin

Hydrograph type	= Diversion1	Peak discharge	= 13.20 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.90 hrs
Time interval	= 2 min	Hyd. volume	= 83,223 cuft
Inflow hydrograph	= 3 - Offsite Southwest	2nd diverted hyd.	= 5
Diversion method	= Constant Q	Constant Q	= 13.20 cfs



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 5

To ROW

Hydrograph type	= Diversion2	Peak discharge	= 25.23 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 17,564 cuft
Inflow hydrograph	= 3 - Offsite Southwest	2nd diverted hyd.	= 4
Diversion method	= Constant Q	Constant Q	= 13.20 cfs



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 6

Target Release

Hydrograph type	= Combine	Peak discharge	= 29.38 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 126,064 cuft
Inflow hyds.	= 1, 4	Contrib. drain. area	= 9.230 ac
5	,		



11

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 7

Diverted to Basin

Hydrograph type Storm frequency	= Combine = 2 vrs	Peak discharge Time to peak	= 47.06 cfs = 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 162,200 cuft
Inflow hyds.	= 2, 4	Contrib. drain. area	= 9.230 ac



12

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 8

Basin Discharge

Hydrograph type =	= Reservoir	Peak discharge	= 23.84 cfs
Storm frequency =	= 2 yrs	Time to peak	= 12.13 hrs
Time interval =	= 2 min	Hyd. volume	= 162,062 cuft
Inflow hyd. No.	= 7 - Diverted to Basin	Max. Elevation	= 1018.26 ft
Reservoir name	= Detention Pond	Max. Storage	= 61,593 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	34.68	2	720	90,035				Onsite - Pre
2	SCS Runoff	56.75	2	718	136,022				Onsite - Post
3	SCS Runoff	58.54	2	718	156,210				Offsite Southwest
4	Diversion1	14.20	2	710	120,579	3			To Basin
5	Diversion2	44.34	2	718	35,631	3			To ROW
6	Combine	48.88	2	720	210,615	1, 4,			Target Release
7	Combine	70.95	2	718	256,601	2, 4,			Diverted to Basin
8	Reservoir	44.32	2	726	256,456	7	1018.88	78,515	Basin Discharge
								VT10144941/15/	

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 1

Onsite - Pre

Hydrograph type	= SCS Runoff	Peak discharge	= 34.68 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 90,035 cuft
Drainage area	= 9.230 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.60 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(9.230 x 74)] / 9.230



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 2

Onsite - Post

Hydrograph type	= SCS Runoff	Peak discharge	= 56.75 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 136,022 cuft
Drainage area	= 9.230 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.00 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.930 x 98) + (3.300 x 74)] / 9.230


Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 3

Offsite Southwest

Hydrograph type	= SCS Runoff	Peak discharge	= 58.54 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 156,210 cuft
Drainage area	= 8.500 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.10 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 4

To Basin

Hydrograph type	= Diversion1	Peak discharge	= 14.20 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.83 hrs
Time interval	= 2 min	Hyd. volume	= 120,579 cuft
Inflow hydrograph	= 3 - Offsite Southwest	2nd diverted hyd.	= 5
Diversion method	= Constant Q	Constant Q	= 14.20 cfs



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 5

To ROW

= Diversion2	Peak discharge	= 44.34 cfs
= 10 yrs	Time to peak	= 11.97 hrs
= 2 min	Hyd. volume	= 35,631 cuft
= 3 - Offsite Southwest	2nd diverted hyd.	= 4
= Constant Q	Constant Q	= 14.20 cfs
	 Diversion2 10 yrs 2 min 3 - Offsite Southwest Constant Q 	= Diversion2Peak discharge= 10 yrsTime to peak= 2 minHyd. volume= 3 - Offsite Southwest2nd diverted hyd.= Constant QConstant Q



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 6

Target Release

Time interval= 2 minHyd. volume= 210,615 cuftInflow hyds.= 1, 4Contrib. drain. area= 9.230 ac	Hydrograph type	= Combine	Peak discharge	= 48.88 cfs
	Storm frequency	= 10 yrs	Time to peak	= 12.00 hrs
	Time interval	= 2 min	Hyd. volume	= 210,615 cuft
	Inflow hyds.	= 1, 4	Contrib. drain. area	= 9.230 ac



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 7

Diverted to Basin

uft
u



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 8

Basin Discharge

Hydrograph type =	= Reservoir	Peak discharge	= 44.32 cfs
Storm frequency :	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 256,456 cuft
Inflow hyd. No.	= 7 - Diverted to Basin	Max. Elevation	= 1018.88 ft
Reservoir name	= Detention Pond	Max. Storage	= 78,515 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	61.86	2	720	160,952				Onsite - Pre
2	SCS Runoff	86.96	2	718	214,186				Onsite - Post
3	SCS Runoff	85.26	2	718	230,190				Offsite Southwest
4	Diversion1	11.20	2	704	160,348	3			To Basin
5	Diversion2	74.06	2	718	69,843	3			To ROW
6	Combine	73.06	2	720	321,300	1, 4,			Target Release
7	Combine	98.16	2	718	374,533	2, 4,			Diverted to Basin
8	Reservoir	68.80	2	724	374,383	7	1019.38	92,176	Basin Discharge
C:\								Y.\$1534-#834/\F)	ታህ/ተፋቢን ድዋጅ ከment dow

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 1

Onsite - Pre

Hydrograph type	= SCS Runoff	Peak discharge	= 61.86 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 160,952 cuft
Drainage area	= 9.230 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.60 min
Total precip.	= 7.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(9.230 x 74)] / 9.230



Tuesday, 02 / 11 / 2025

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 2

Onsite - Post

Hydrograph type	= SCS Runoff	Peak discharge	= 86.96 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 214,186 cuft
Drainage area	= 9.230 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.00 min
Total precip.	= 7.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.930 x 98) + (3.300 x 74)] / 9.230



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 3

Offsite Southwest

Hydrograph type	= SCS Runoff	Peak discharge	= 85.26 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 230,190 cuft
Drainage area	= 8.500 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.10 min
Total precip.	= 7.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 4

To Basin

Hydrograph type	= Diversion1	Peak discharge	= 11.20 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.73 hrs
Time interval	= 2 min	Hyd. volume	= 160,348 cuft
Inflow hydrograph	= 3 - Offsite Southwest	2nd diverted hyd.	= 5
Diversion method	= Constant Q	Constant Q	= 11.20 cfs



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 5

To ROW

Hydrograph type	= Diversion2	Peak discharge	= 74.06 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 69,843 cuft
Inflow hydrograph	= 3 - Offsite Southwest	2nd diverted hyd.	= 4
Diversion method	= Constant Q	Constant Q	= 11.20 cfs



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 6

Target Release

Hydrograph type	= Combine	Peak discharge	= 73.06 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 321,300 cuft
Inflow hyds.	= 1, 4	Contrib. drain. area	= 9.230 ac



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 7

Diverted to Basin

Hydrograph type storm frequency fine interval Inflow hyds.	= Combine	Peak discharge	= 98.16 cfs
	= 100 yrs	Time to peak	= 11.97 hrs
	= 2 min	Hyd. volume	= 374,533 cuft
	= 2, 4	Contrib. drain. area	= 9.230 ac
innow nyus.	- 2,4	Contrib. drain. area	- 9.230 ac



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No. 8

Basin Discharge

Hydrograph type	= Reservoir	Peak discharge	= 68.80 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 374,383 cuft
Inflow hyd. No.	= 7 - Diverted to Basin	Max. Elevation	= 1019.38 ft
Reservoir name	= Detention Pond	Max. Storage	= 92,176 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Pond No. 1 - Detention Pond

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)		
0.00	1016.00	n/a	0	0		
0.50	1016.50	n/a	13,631	13,631		
1.00	1017.00	n/a	13,630	27,261		
1.50	1017.50	n/a	13,631	40,892		
2.00	1018.00	n/a	13,631	54,523		
2.50	1018.50	n/a	13,630	68,153		
3.00	1019.00	n/a	13,631	81,784		
3.50	1019.50	n/a	13,630	95,414		
4.00	1020.00	n/a	13,631	109,045		
4.50	1020.50	n/a	14,167	123,212		
5.00	1021.00	n/a	15,246	138,458		
5.50	1021.50	n/a	16,136	154,594		
6.00	1022.00	n/a	16,834	171,428		

Culvert / Orifice Structures

Weir Structures

	[A]	[B]	[C]	[PrfRsr]		[A]	[B]	[C]	[D]
Rise (in)	= 48.00	0.00	0.00	0.00	Crest Len (ft)	= 3.84	0.00	6.00	0.50
Span (in)	= 48.00	0.00	0.00	0.00	Crest El. (ft)	= 1017.25	1016.00	1019.00	1016.00
No. Barrels	= 1	0	0	0	Weir Coeff.	= 3.33	0.68	3.33	3.33
Invert El. (ft)	= 1012.25	0.00	0.00	0.00	Weir Type	= Rect	30 degV	Rect	Rect
Length (ft)	= 181.00	0.00	0.00	0.00	Multi-Stage	= Yes	Yes	Yes	Yes
Slope (%)	= 0.55	0.00	0.00	n/a					
N-Value	= .013	.013	.013	n/a					
Orifice Coeff.	= 0.60	0.60	0.60	0.60	Exfil.(in/hr)	= 0.000 (by Wet area)			
Multi-Stage	= n/a	No	No	No	TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage /	Stage / Storage / Discharge Table												
Stage ft	Storage cuft	Elevation ft	Clv A cfs	CIv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	1016.00	0.00				0.00		0.00	0.00			0.000
0.50	13,631	1016.50	65.68 oc				0.00	0.12	0.00	0.59			0.709
1.00	27,261	1017.00	65.68 oc				0.00	0.68	0.00	1.66			2.345
1.50	40,892	1017.50	65.68 oc				1.60	1.87	0.00	3.06			6.531
2.00	54,523	1018.00	65.68 oc				8.31	3.85	0.00	4.71			16.86
2.50	68,153	1018.50	65.68 oc				17.87	6.72	0.00	6.58			31.17
3.00	81,784	1019.00	65.68 oc				29.60	10.60	0.00	8.65			48.85
3.50	95,414	1019.50	75.95 oc				43.16	15.14 s	7.06	10.59 s	s		75.95
4.00	109,045	1020.00	105.88 oc				55.72 s	18.72 s	19.98	11.46 s	s		105.88
4.50	123,212	1020.50	128.51 oc				59.90 s	20.90 s	36.33 s	11.37 s	s		128.51
5.00	138,458	1021.00	143.06 oc				62.08 s	22.91 s	46.85 s	11.22 s	s		143.06
5.50	154,594	1021.50	153.96 oc				63.63 s	24.90 s	54.34 s	11.09 s	s		153.96
6.00	171,428	1022.00	162.81 ic				64.75 s	26.87 s	60.22 s	10.96 s	s		162.80