STORM WATER MANAGEMENT ANALYSIS

for

5 Tiffany Lane Weston, Connecticut

June 14, 2018 Revised: January 5, 2024

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Job #851

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1.0 PROJECT DESCRIPTION

A new single-family dwelling, detached studio, detached storage structure, pool, and associated residential appurtenances were constructed in 2020 and will remain. Prior to that, the lot was vacant. The project site, including a storm water management system, was designed by this office in 2018 and subsequently approved by the various town departments. The design was approved. However, the storm water management system was altered by the contractor during construction for unknown reasons, and the designed detention system was not installed.

This report and the associated design have been prepared to adapt the as-built conditions to a compliant storm water management system. The storm water runoff from the detached studio, detached storage structure, pool, a portion of the dwelling, and a portion of the lawn area will be collected, detained, and treated on-site with the use of an underground detention system. The rest of the developed area has been directed along the west side of the driveway where they outlet to stone aprons and landscaped areas.

2.0 SOIL ANALYSIS

The subject parcel was researched and tested for storm water infiltration suitability. According to the Soil Survey of Fairfield County the proposed development area is underlain with Hollis-Chatfield-Rock outcrop complex (75C), having hydrologic soil group "D". The soils were confirmed with excavated test pits. The results of the on-site testing are located on the Site Development Plan from 2018.

3.0 METHODOLOGY & ANALYSIS

Watershed

This study was prepared using the Soil Conservation Service (SCS) methodology. This method outlines procedures for calculating peak rates of runoff resulting from precipitation events and procedures for developing runoff hydrographs. The calculations use the unit hydrograph method as described by Technical Release 55 (TR-55). The rates of runoff for the pre-development and post-development conditions were compared to determine any change as a result of the improvements.

Composite values for area, curve number (CN) and time of concentration (Tc) were calculated for each the pre-development and post-development condition. The curve numbers were calculated using the following values:

Cover Description	Hyd. Condition	CN
Undeveloped: woods-grass combination	Fair "D"	82
Proposed Lawn: grassland	Fair "D"	82
Impervious: house, driveway, improvements	-	98

The pre-development condition was modeled, based on the pre-development condition model designed and approved in 2018, as undeveloped land with cover type woods-grass combination in fair hydrologic condition. The value calculated for the pre development condition was as follows:

<u>Description</u>	<u>Area</u>	$\underline{\mathrm{CN}}$	<u>Tc</u>
Pre-Development	2.13 acres	82	30.5 min.

The post-development condition was modeled as two sub-watersheds, one of which will be detained, and the other that will flow off-site. "Pond 1 Inflow" consists of runoff from the studio, storage structure, a portion of the dwelling, and a portion of landscaped area and will be detained in pond 1. "Pool Inflow" considers the proposed pool as a storage system up to 4 inches of depth. Overflow from the pool will also be detained in Pond 1. "Undetained Area" consists of runoff from the uncovered deck, walkway, driveway, a portion of the dwelling, and vegetated land that will be allowed to flow offsite as it does today.

Values used for the post-development condition were as follows:

Descrip	<u>otion</u>	<u>Area</u>	<u>CN</u>	<u>Tc</u>
Undet	ained Area	2.0 acres	83	30.5 min.
	[Proposed Lawn: woods-grass "D"	1.84 acres	82]	
	[Impervious: driveway, walkway, etc.	0.16 acres	98]	
Pond 1	Inflow	0.12 acres	91	6 min.
	[Impervious: driveway, dwelling, etc.	0.07 acres	98]	
	[Proposed Lawn: grassland "D"	0.05 acres	82]	

In accordance with the policies of the Town of Weston, systems shall be designed to accommodate Type III cumulative rainfall distribution. 24-hour rainfall depths for the 2-year, 5-year, 10-year, 25-year, and 50-year storms shall be considered. Rainfall depths were kept consistent with those used in the 2018 report. The rainfall values are as follows:

- A 2-year, 24-hour storm consisting of 3.50 inches of rainfall;
- A 5-year, 24-hour storm consisting of 4.30 inches of rainfall;
- A 10-year, 24-hour storm consisting of 5.10 inches of rainfall;
- A 25-year, 24-hour storm consisting of 6.40 inches of rainfall;
- A 50-year, 24-hour storm consisting of 7.30 inches of rainfall;

The design storm used for this study is the 24 hour SCS Type III cumulative rainfall distribution. All of the watersheds were analyzed by the computer program *Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2019*; the results of which are located in Appendix B. For convenience and to conserve resources, the drainage calculations included in the appendices of this report were limited to the 50 year storm event.

Detention System

Runoff from a portion of the lawn area will be collected into a yard drain and will then be directed into the underground detention system. Here, the runoff will be detained and infiltrate into the surrounding soils. Likewise, runoff from the roofs will be directed to the detention system as well. The system has been designed to collect and detain up to the 50 year storm and keep the proposed development's runoff flow rates below that of the calculated pre-development rates.

The proposed detention systems were routed with the use of the computer program *Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2019*; the results of which are located in Appendix B. Infiltration rates were used as part of the design; however, the values used were two thirds the measured rates for a factor of safety.

Results
The calculated storm water peak flows are as follows:

	2-YEAR	5-YEAR	10-YEAR	25-YEAR	50-YEAR
CONDITION	FLOW	FLOW	FLOW	FLOW	FLOW
Pre-Development	2.52 CFS	3.50 CFS	4.50 CFS	6.15 CFS	7.30 CFS
Undetained Area	2.47 CFS	3.39 CFS	4.33 CFS	5.88 CFS	6.96 CFS
Pond 1 Inflow	0.35 CFS	0.45 CFS	0.54 CFS	0.70 CFS	0.81 CFS
Pool Inflow	0.04 CFS	0.05 CFS	0.06 CFS	0.08 CFS	0.09 CFS
Pool Route	0.00 CFS	0.00 CFS	0.00 CFS	0.03 CFS	0.06 CFS
Pond 1 Inflow Com	nb.				
With Pool Route	0.35 CFS	0.45 CFS	0.54 CFS	0.70 CFS	0.81 CFS
Pond 1 Route	0.05 CFS	0.22 CFS	0.50 CFS	0.66 CFS	0.76 CFS
Final Combined	2.50 CFS	3.50 CFS	4.47 CFS	6.07 CFS	7.20 CFS

In order to accurately analyze the post-development condition, the Pre-Development hydrograph is compared to a combined hydrograph consisting of the undetained area hydrograph and the final combined hydrographs that result from detention pond outflows.

	2-YEAR	5-YEAR	10-YEAR	25-YEAR	50-YEAR
CONDITION	FLOW	FLOW	FLOW	FLOW	FLOW
Pre-Development	2.52 CFS	3.50 CFS	4.50 CFS	6.15 CFS	7.30 CFS
Final Combined	2.50 CFS	3.50 CFS	4.47 CFS	6.07 CFS	7.20 CFS
PRO. CHANGE	-0.02 CFS	0.00 CFS	-0.03 CFS	-0.08 CFS	-0.10 CFS

The proposed change shows that the storm water flow rates are expected to be reduced as a result of the development and proposed system.

4.0 STORM WATER QUALITY ANALYSIS

The majority of storm water introduced to the system will be roof runoff where the observance of any oils, grease or particulates is remote.

The system was planned in accordance with design considerations found in the 2004 Connecticut Stormwater Quality Manual. As stated in the manual they should be enabled to infiltrate the full Water Quality Volume (WQV). The underground detention system (Pond 1) was designed to handle 158.3% of the WQV of the entire site. Calculations for the system are located in Appendix B.

The homeowner will be responsible for the implementation of an annual maintenance program which should include gutter and yard drain cleaning and pipe maintenance. Proper fertilizer and pesticide management and household pet waste management should be observed.

5.0 CONCLUSION

The proposed storm water collection system has been designed to adequately convey the required storm event without any adverse impacts or increase in overall storm water flow and while maintaining adequate water quality.

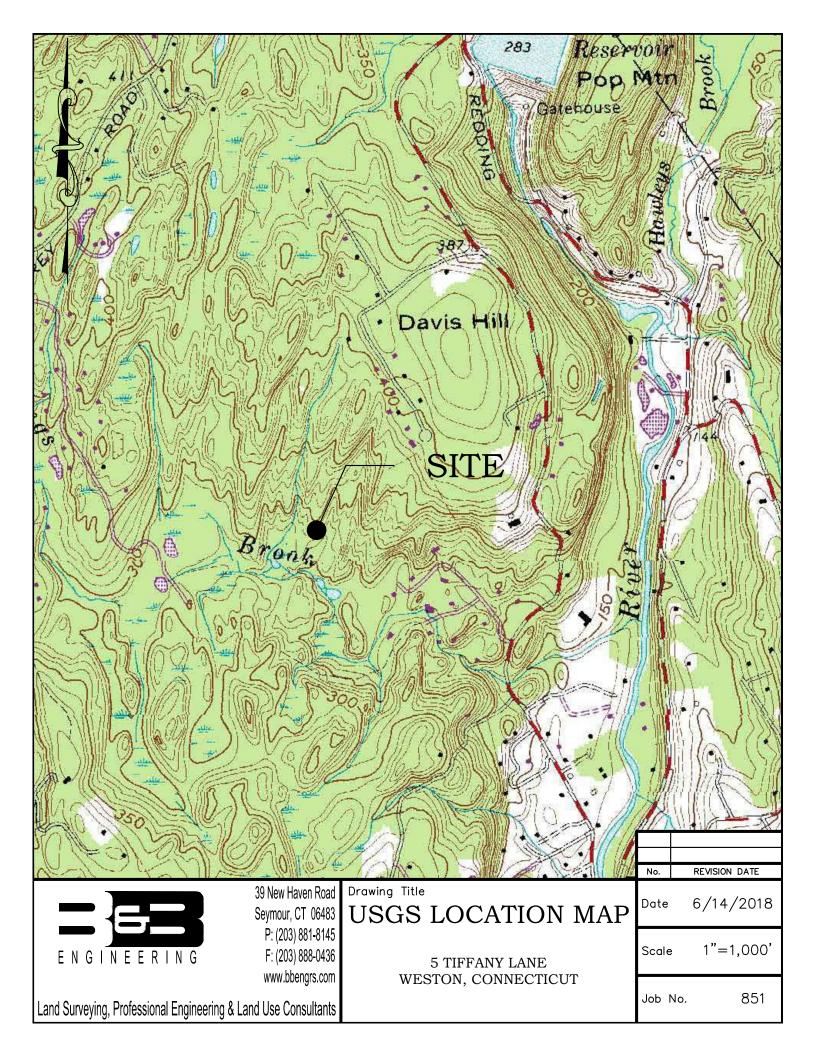
6.0 REFERENCES

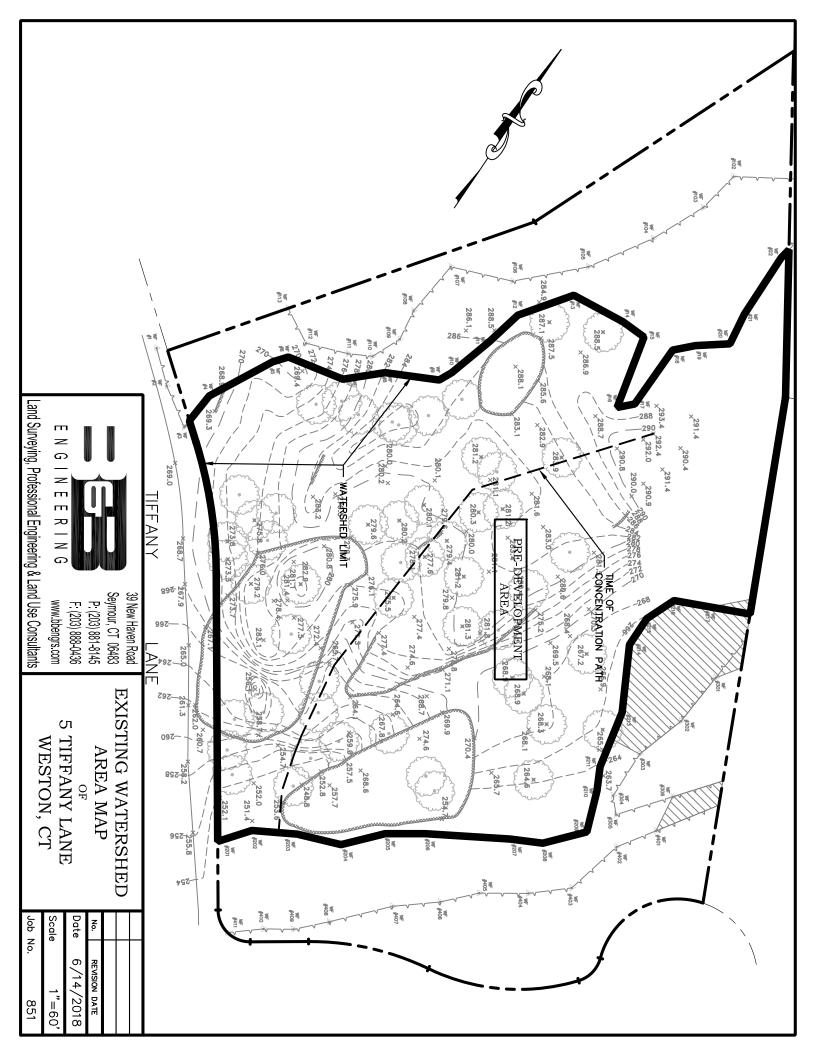
- 1. Urban Hydrology for Small Watersheds, Technical Release No. 55, USDA Soil Conservation Service Publication, June 1986.
- 2. Rainfall Frequency Values for Connecticut with 24-Hour Storm Duration, United States Department of Commerce and Weather Bureau, T.P. 40, May 1961.
- 3. 2002 Connecticut Guidelines for Soil Erosion and Sediment Control, The Connecticut Council on Soil and Water Conservation.
- 4. Debo, Thomas N. and Reese, Andrew J., *Municipal Stormwater Management*, Second Edition, Boca Raton, Lewis Publishers, 2003
- 5. Web Soil Survey. 8/1/2006. National Resources Conservation Service http://websoilsurvey.nrcs.usda.gov/app/>

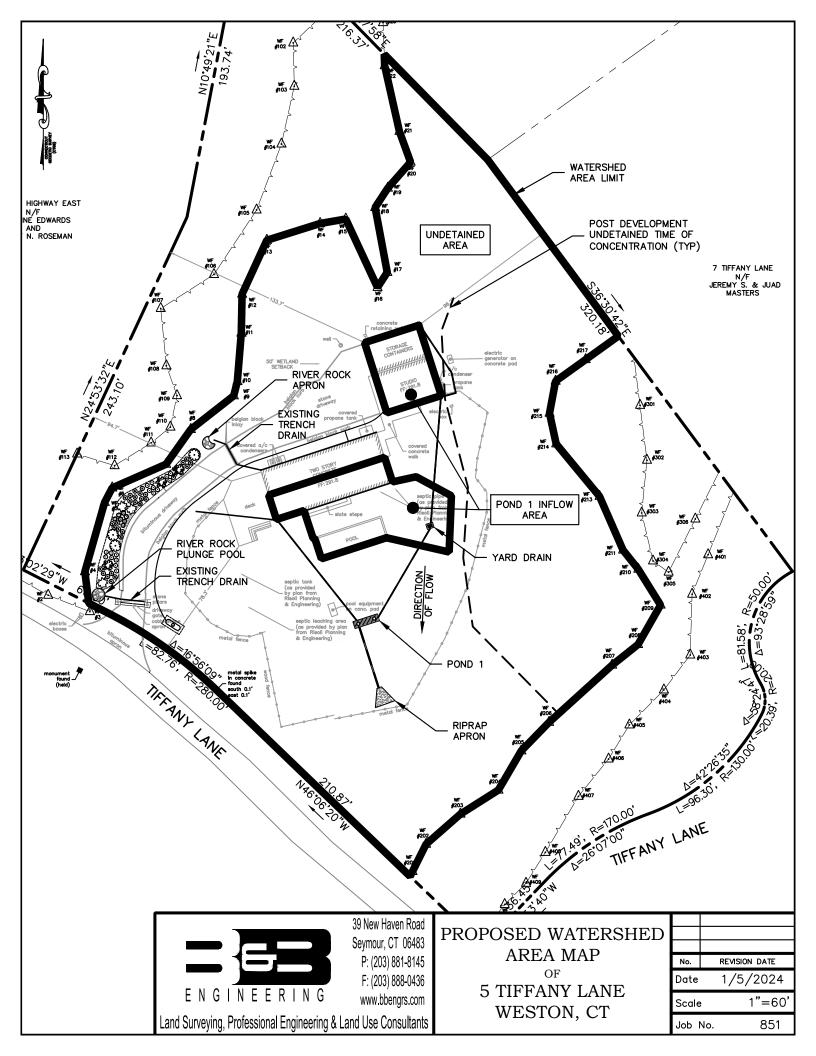
APPENDIX A Figures

CONTENTS:

- USGS Location Map
- Predevelopment Watershed Area Map
- Postdevelopment Watershed Area Map







<u>APPENDIX B</u>

Data & Calculations

CONTENTS:

- Hydrograph Return Period Recap
- Graphical Hydrograph Reports
- Pond Report
- Storm Water Quality Calculations

Hydrograph Return Period Recap Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

	Hydrograph	Inflow		Peak Outflow (cfs)							Hydrograph	
lo.	type (origin)	hyd(s)	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	Description	
1	SCS Runoff			2.522		3.497	4.497	6.146	7.295		Predevelopment	
3	SCS Runoff			2.468		3.390	4.333	5.881	6.957		Undetained Area	
5	SCS Runoff			0.347		0.445	0.543	0.701	0.810		Pond Inflow 1	
7	SCS Runoff			0.043		0.053	0.063	0.079	0.090		Pool Inflow	
3	Reservoir	7		0.000		0.002	0.003	0.025	0.055		Route Pool	
9	Combine	5, 8		0.347		0.445	0.543	0.701	0.810		Pond 1 Inflow Combined With Route	
10	Reservoir	9		0.048		0.215	0.497	0.656	0.763		Pond 1 Route	
11	Combine	3, 10		2.503		3.500	4.472	6.066	7.202		Final Combined	

Proj. file: 851 Hydraflow-new pro.gpw

Wednesday, 12 / 20 / 2023

Hydrograph Summary Report Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

yd. o.	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	7.295	2	742	40,769				Predevelopment
3	SCS Runoff	6.957	2	742	39,004				Undetained Area
5	SCS Runoff	0.810	2	724	2,609				Pond Inflow 1
7	SCS Runoff	0.090	2	724	312				Pool Inflow
3	Reservoir	0.055	2	732	135	7	280.42	179	Route Pool
9	Combine	0.810	2	724	2,745	5, 8			Pond 1 Inflow Combined With Route
10	Reservoir	0.763	2	724	1,106	9	276.95	443	Pond 1 Route
11	Combine	7.202	2	742	40,110	3, 10			Final Combined
351	Hydraflow-n	ew pro.ar	ow		Return F	Period: 50 Y	⊥ ′ear	Wednesda	y, 12 / 20 / 2023

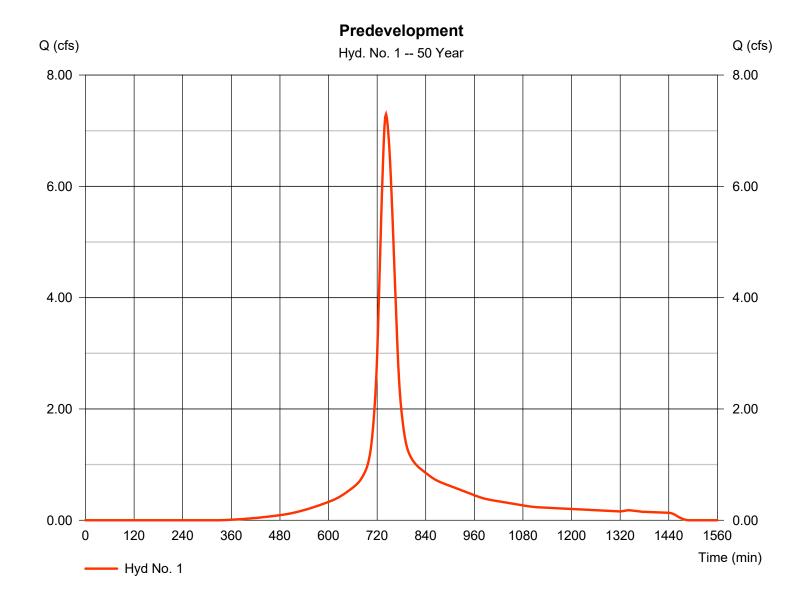
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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Hyd. No. 1

Predevelopment

Hydrograph type = SCS Runoff Peak discharge = 7.295 cfsStorm frequency = 50 yrsTime to peak = 742 min Time interval = 2 min Hyd. volume = 40,769 cuftDrainage area Curve number = 2.134 ac= 82 = 0 ftBasin Slope = 0.0 %Hydraulic length Tc method Time of conc. (Tc) $= 30.50 \, \text{min}$ = TR55 Total precip. = 7.30 inDistribution = Type III Storm duration = 24 hrs Shape factor = 484



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

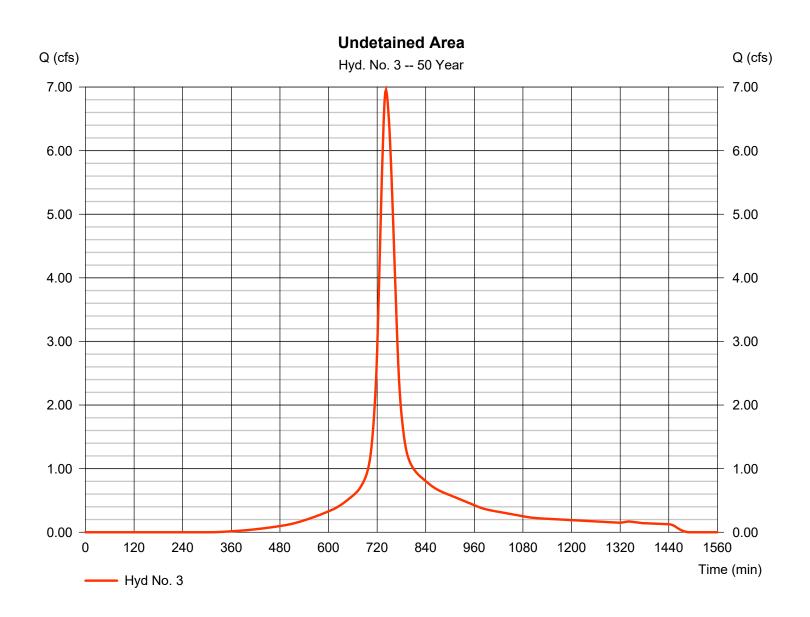
Wednesday, 12 / 20 / 2023

Hyd. No. 3

Undetained Area

Hydrograph type = SCS Runoff Peak discharge = 6.957 cfsStorm frequency = 50 yrsTime to peak = 742 min Time interval = 2 min Hyd. volume = 39.004 cuft Drainage area Curve number = 1.998 ac= 83* Basin Slope = 0.0 %Hydraulic length = 0 ftTc method Time of conc. (Tc) $= 30.50 \, \text{min}$ = TR55 Total precip. = 7.30 inDistribution = Type III Shape factor Storm duration = 24 hrs = 484

^{*} Composite (Area/CN) = [(1.840 x 82) + (0.159 x 98)] / 1.998



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

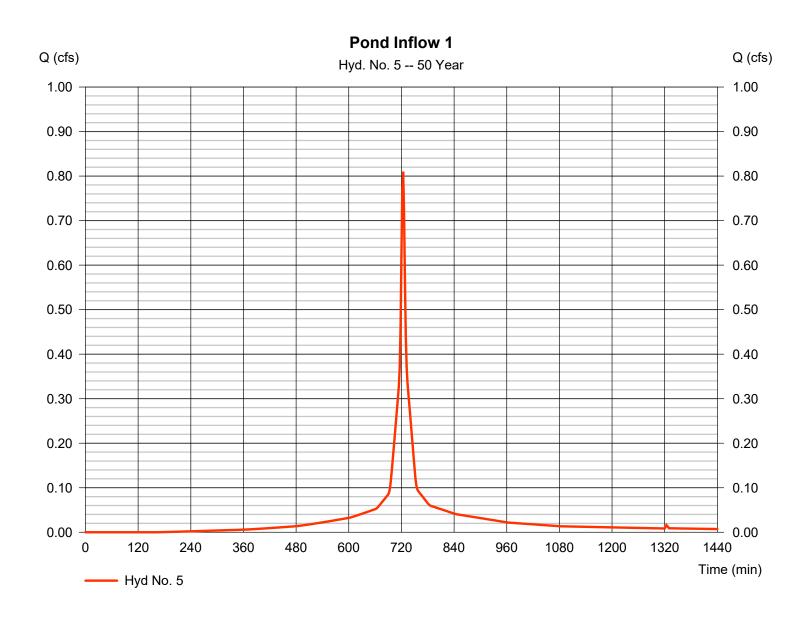
Wednesday, 12 / 20 / 2023

Hyd. No. 5

Pond Inflow 1

Hydrograph type = SCS Runoff Peak discharge = 0.810 cfsStorm frequency = 50 yrsTime to peak = 724 min Time interval = 2 min Hyd. volume = 2.609 cuftCurve number Drainage area = 0.123 ac= 91* Basin Slope = 0.0 %Hydraulic length = 0 ftTc method Time of conc. (Tc) = User $= 6.00 \, \text{min}$ Total precip. = 7.30 inDistribution = Type III Shape factor Storm duration = 24 hrs = 484

^{*} Composite (Area/CN) = [(0.055 x 82) + (0.068 x 98)] / 0.123



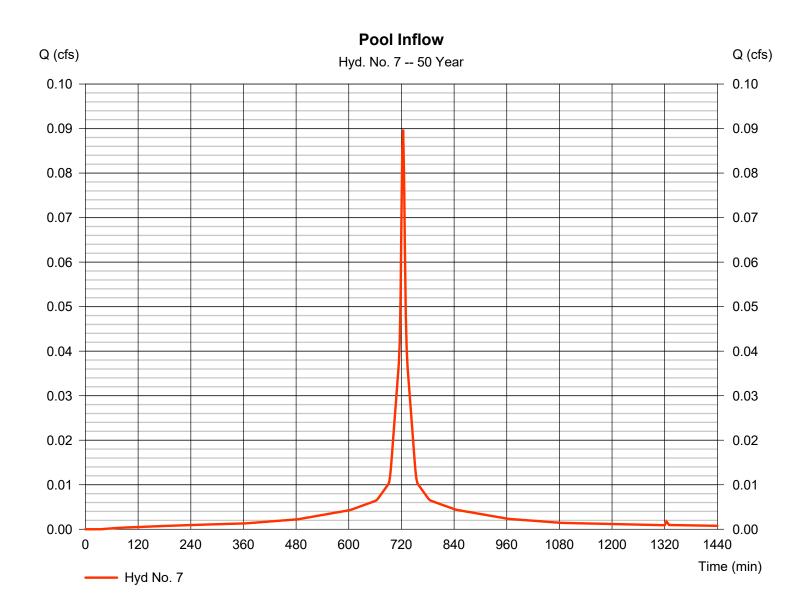
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 20 / 2023

Hyd. No. 7

Pool Inflow

Hydrograph type = SCS Runoff Peak discharge = 0.090 cfsStorm frequency = 50 yrsTime to peak = 724 min Time interval = 2 min Hyd. volume = 312 cuft Drainage area Curve number = 0.013 ac= 98 Basin Slope = 0.0 %Hydraulic length = 0 ftTc method Time of conc. (Tc) = 6.00 min = User Total precip. = 7.30 inDistribution = Type III Storm duration = 24 hrs Shape factor = 484



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

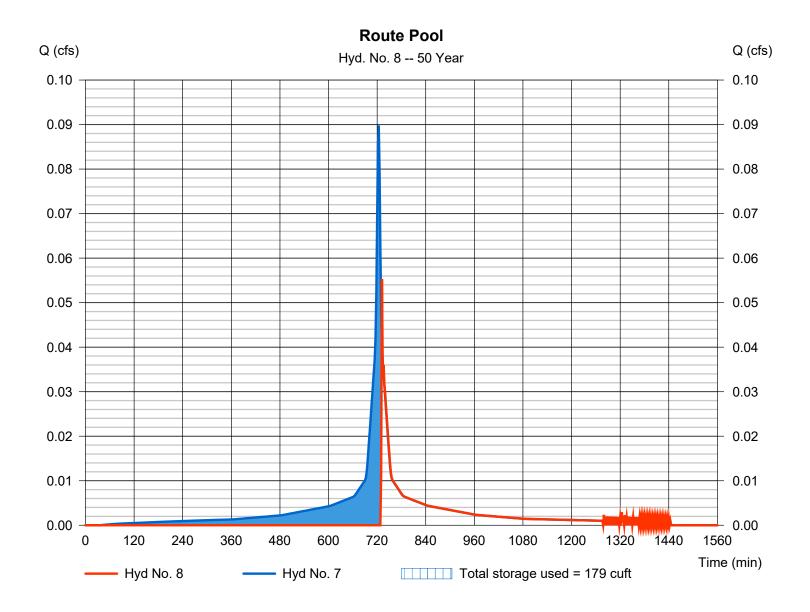
Wednesday, 12 / 20 / 2023

Hyd. No. 8

Route Pool

Hydrograph type = Reservoir Peak discharge = 0.055 cfsStorm frequency = 50 yrsTime to peak = 732 min Time interval = 2 min Hyd. volume = 135 cuft Inflow hyd. No. = 7 - Pool Inflow Max. Elevation = 280.42 ftReservoir name = Pool Max. Storage = 179 cuft

Storage Indication method used.



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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Pond No. 2 - Pool

Pond Data

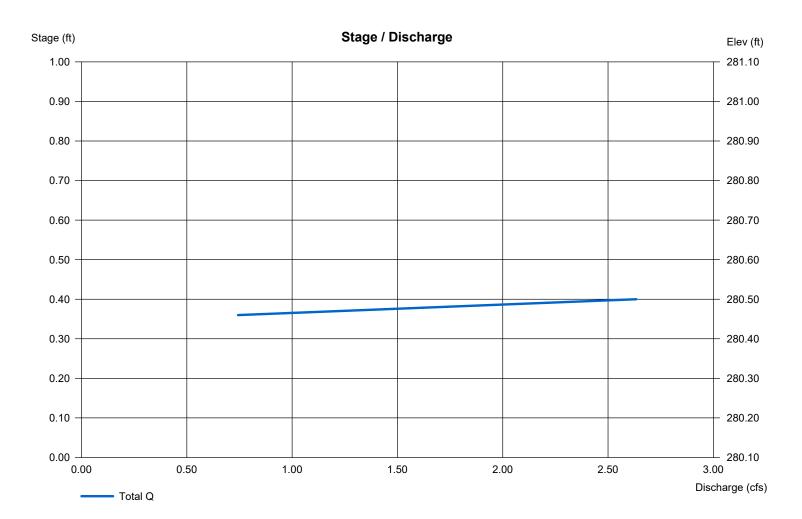
Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 280.10 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	280.10	554	0	0
0.40	280.50	554	222	222

Culvert / Ori	fice Structu	res			Weir Structu	ires			
	[A]	[B]	[C]	[PrfRsr]		[A]	[B]	[C]	[D]
Rise (in)	= 0.00	0.00	0.00	0.00	Crest Len (ft)	= 42.70	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00	Crest El. (ft)	= 280.43	0.00	0.00	0.00
No. Barrels	= 0	0	0	0	Weir Coeff.	= 3.33	3.33	3.33	3.33
Invert El. (ft)	= 0.00	0.00	0.00	0.00	Weir Type	= Rect			
Length (ft)	= 0.00	0.00	0.00	0.00	Multi-Stage	= No	No	No	No
Slope (%)	= 0.00	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).



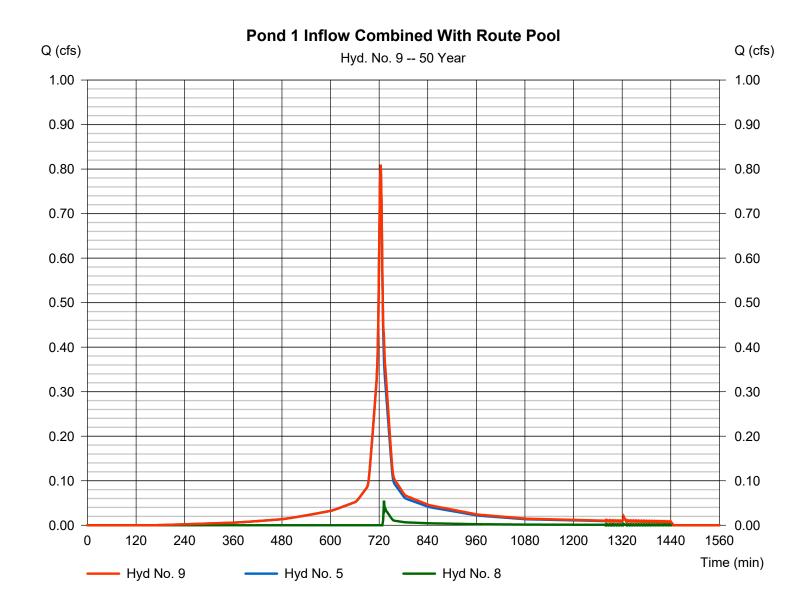
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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Hyd. No. 9

Pond 1 Inflow Combined With Route Pool

= Combine Peak discharge Hydrograph type = 0.810 cfsStorm frequency Time to peak = 50 yrs= 724 min Time interval = 2 min Hyd. volume = 2,745 cuftInflow hyds. = 5, 8 Contrib. drain. area = 0.123 ac



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

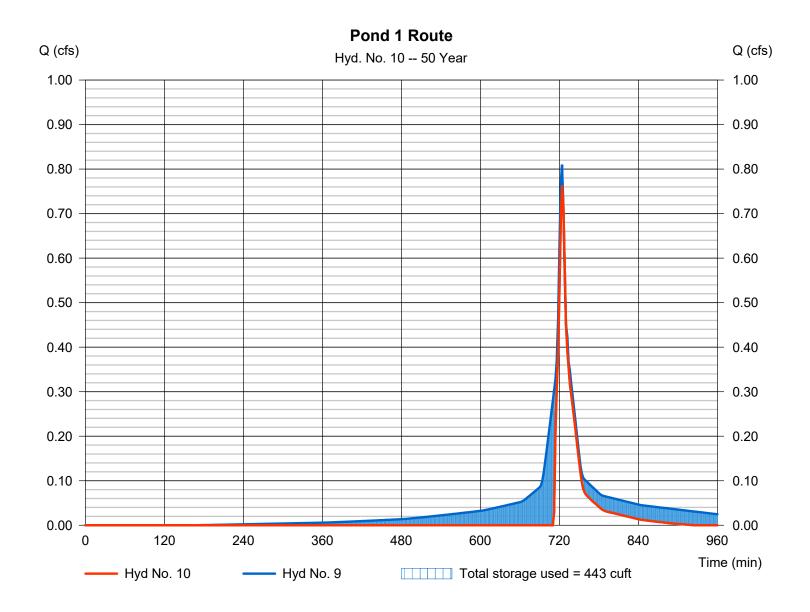
Wednesday, 12 / 20 / 2023

Hyd. No. 10

Pond 1 Route

Hydrograph type = Reservoir Peak discharge = 0.763 cfsStorm frequency = 50 yrsTime to peak = 724 min Time interval = 2 min Hyd. volume = 1,106 cuft = 9 - Pond 1 Inflow Combined WMhaRaEllevation Inflow hyd. No. $= 276.95 \, \text{ft}$ = 443 cuft Reservoir name = 24x48Max. Storage

Storage Indication method used. Exfiltration extracted from Outflow.



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 20 / 2023

Pond No. 1 - 24x48

Pond Data

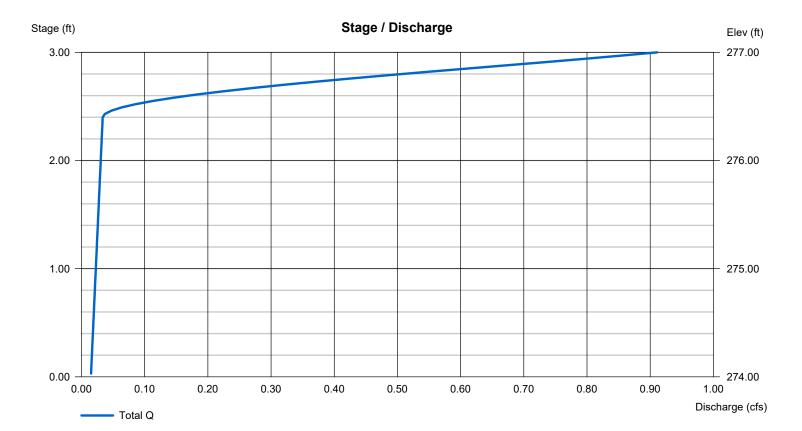
UG Chambers -Invert elev. = 274.50 ft, Rise x Span = 2.00 x 2.83 ft, Barrel Len = 56.00 ft, No. Barrels = 1, Slope = 0.00%, Headers = No **Encasement** -Invert elev. = 274.00 ft, Width = 3.83 ft, Height = 3.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	274.00	n/a	0	0
0.30	274.30	n/a	26	26
0.60	274.60	n/a	35	61
0.90	274.90	n/a	54	115
1.20	275.20	n/a	54	170
1.50	275.50	n/a	54	224
1.80	275.80	n/a	54	278
2.10	276.10	n/a	54	332
2.40	276.40	n/a	54	387
2.70	276.70	n/a	35	422
3.00	277.00	n/a	26	448

Culvert / Ori	fice Structur	Weir Structures							
	[A]	[B]	[C]	[PrfRsr]		[A]	[B]	[C]	[D]
Rise (in)	= 8.00	0.00	0.00	0.00	Crest Len (ft)	Inactive	0.00	0.00	0.00
Span (in)	= 8.00	0.00	0.00	0.00	Crest El. (ft)	= 0.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0	Weir Coeff.	= 3.33	3.33	3.33	3.33
Invert El. (ft)	= 276.40	0.00	0.00	0.00	Weir Type	= 1			
Length (ft)	= 71.00	0.00	0.00	0.00	Multi-Stage	= Yes	No	No	No
Slope (%)	= 15.90	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)	= 3.000 (b)	y 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).



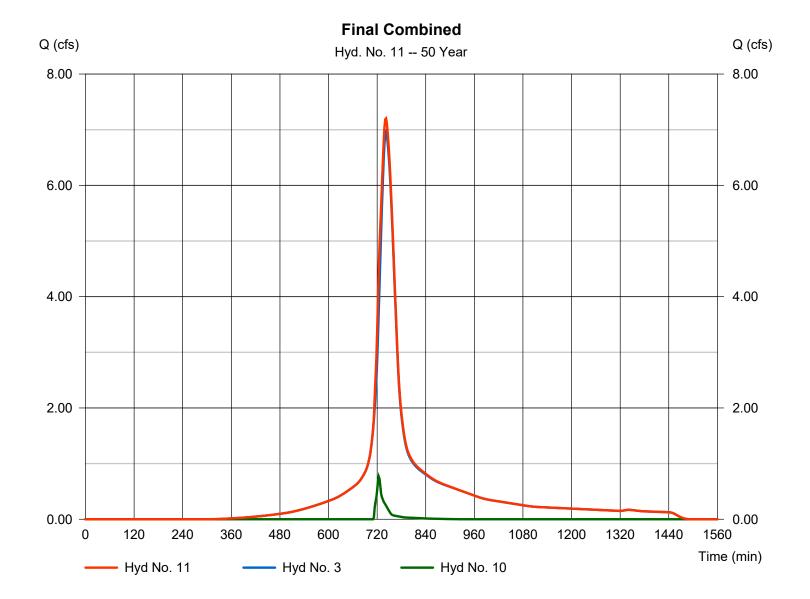
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 20 / 2023

Hyd. No. 11

Final Combined

Hydrograph type = Combine = 7.202 cfsPeak discharge Storm frequency = 50 yrsTime to peak = 742 min Time interval = 2 min Hyd. volume = 40,110 cuft= 3, 10 Inflow hyds. Contrib. drain. area = 1.998 ac



STORM WATER QUALITY CALCULATIONS

POND Underground Detention System

as defined by "2004 Connecticut Stormwater Quality Manual"

Watershed:

Determine "Water Quality Volume" (WQV)

$$WQV = \frac{1" (R)(A)}{12} \qquad R = \text{volumetric runoff coefficient} = 0.05 + 0.009(I)$$

$$= 0.05 + 0.009 (55.3) = 0.548$$

$$= \frac{1" (0.54752) (0.123)}{12} \qquad A = \text{site area in acres} = 0.12$$

$$= 0.006 \qquad \text{Acre-Feet}$$

$$= 244 \qquad \text{CF} \qquad \text{Volume of designed basin} \qquad = 387 \quad \text{CF}$$

PER THE MANUAL, THE INFILTRATION SUTRUCTURES SHOULD BE DESIGNED TO MAINTAIN AT LEAST THE WATER QUALITY VOLUME (WQV)

AS DESIGNED, THE DETENTION SYSTEM HAS A TOTAL CAPACITY OF EQUATES TO 158.3% OF THE WQV.

THEREFORE, THE SYSTEMS COMPLY WITH THE REQUIREMENTS OF THE 2004 CONNECTICUT STORMWATER QUALITY MANUAL FOR UNDERGROUND INFILTRATION SYSTEMS.

