

DRAINAGE REPORT

Car Wash- Preliminary

Truckee, CA



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Table of Contents

1. Project Description.....	1
2. Existing Conditions.....	1
2.1 Existing Land Uses.....	1
2.2 Existing Site Drainage.....	1
2.3 Existing Soils Data.....	1
2.4 Groundwater.....	1
3. Proposed Conditions.....	2
3.1 Proposed Land Uses.....	2
3.2 Proposed Site Drainage.....	2
4. Hydrologic and Hydraulic Modeling.....	2
4.1 Methodology.....	2
4.2 Existing and Proposed Conditions Modeling and Results.....	3
5. Water Quality Management.....	3
6. Limitations.....	4
7. References.....	5

List of Tables

Table 1 - Analysis Rainfall Depth.....	2
Table 2 - Existing and Proposed Conditions Model Results.....	3

Appendices

Appendix A	Project Location Map
Appendix B	Pre-Development Drainage Map
Appendix C	Post Development Drainage Map
Appendix D	Hydrology Basin Model
Appendix E	Pre-Development Hydrology Report
Appendix F	Post-Development Hydrology Report
Appendix G	Summary of Peak Flows
Appendix H	Rainfall Intensity Report
Appendix I	Stage-Storage Report
Appendix J	Town of Truckee Calculator

1. Project Description

The project site consists of approximately one acre in Truckee, California. The property is undeveloped except for infrastructure associated with Edwin Way. Proposed development includes construction of a commercial car wash

The purpose of this document is to:

- 1) Describe the existing watershed characteristics of the Project area;
- 2) Evaluate pre- and post-development hydrology for the 10-year and 100-year storm events to meet Town of Truckee flood control requirements; and
- 3) Provide documentation for design and sizing of water-quality treatment and hydromodification management features to meet requirements of the Phase II Municipal Separate Storm System (MS4) Permit.

2. Existing Conditions

2.1 Existing Land Uses

The project site is currently undeveloped except for Edwin Way that connects to Henness Road to the south and Prosser Dam Road to the north with associated utilities.

2.2 Existing Site Drainage

Surface water drainage across the undeveloped portion of the site consists of overland sheet flow east towards Edwin Way and an existing drainage course to the south. Runoff is collected in the road gutter is conveyed to existing subsurface drainage and ultimately discharges to Prosser Creek below Prosser Creek Reservoir. Existing Drainage Management Areas (DMAs) are shown on Plate 1.

2.3 Existing Soils Data

A geotechnical investigation prepared by NV5 and dated January 16th, 2020 concluded the top 6 to 12 inches of soil consisted of loose silty sand containing organic material. Medium dense to very dense silty sand and sandy gravel with varying amounts of cobbles were observed between 2 and 14 feet. Essential refusal was encountered on very dense soil approximately 3 to 7 feet depths.

2.4 Groundwater

No groundwater was encountered during subsurface investigations by NV5.

3. Proposed Conditions

3.1 Proposed Land Uses

This project site is proposed to have drive-thru car wash with parking for cleaning and employees.

3.2 Proposed Site Drainage

The proposed drainage utilizes and expands on the exiting drainage facilities located within Edwin Road and discharges at two locations as shown in Plate 2. Runoff from the roof is treated by a bioretention pond which outfalls to a drainage ditch returning to flow at the southern side of the property. The western portion of the property is conveyed by concrete gutters to inlets, where it is treated by underground infiltration chambers before being routed to an existing inlet structure at Edwin Road.

4. Hydrologic and Hydraulic Modeling

4.1 Methodology

The hydrology and hydraulics of the storm drainage for the project site was modeled using Hydrology Studio Software. Rainfall to runoff calculations were completed according to USDA Soil Conservation Service (SCS) Methods outlined in Technical Release 55. The SCS curve numbers were assigned per Town of Truckee Standards (SD#65). A composite curve number was applied to each basin representative of the land use. A snow coverage adjustment was applied to the curve number representing the reduced infiltration from the potential of frozen ground.

The average annual precipitation in the watershed is 32 inches per Truckee Standards Precipitation Map (SD#63). NOAA Atlas 14 were used for the 2-, 10-, and 100-year rainfall depths and are presented in Table 1. The time of concentration was calculated per the TR-55 guidelines and the time used was 0.1 hours (6 minutes). Hydrology Studio allows for a large variety of design storms to calculate pre and post flows. The model was run using a Type IA 24-hr unit hydrograph.

Table 1 - Analysis Rainfall Depth

	Active	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Active			✓			✓			✓
SCS Storms	> SCS Dimensionless Storms								
SCS 6hr		1.07	1.24	0	1.50	1.73	2.08	2.39	2.73
Type I, 24-hr		2.28	2.92	0	3.75	4.42	5.31	5.99	6.67
Type IA, 24-hr	✓	2.28	2.92	0	3.75	4.42	5.31	5.99	6.67

4.2 Existing and Proposed Conditions Modeling and Results

The existing condition model was configured to determine the runoff to outlets locations 1 and 2 to provide equitable comparison to post-development runoff and are presented in Table 2.

The modeling for the proposed condition accounts for the increase in impervious areas of the proposed road improvements and associated developments. The proposed development redistributes shed area discharge towards outlet 2. As a result, no peak flow attenuation is required for runoff to outlet 1.

Table 2 - Existing and Proposed Conditions Model Results

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Outflow (cfs)							
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1	NRCS Runoff	Pre dma 1		0.123			0.233			0.405
2	NRCS Runoff	Pre dma 2		0.261			0.495			0.861
3	NRCS Runoff	Post dma 1.1		0.061			0.107			0.175
4	NRCS Runoff	Post dma 1.2		0.142			0.219			0.332
5	NRCS Runoff	Post dma 1.3		0.038			0.073			0.127
6	NRCS Runoff	Post dma 2.1		0.132			0.226			0.365
7	NRCS Runoff	Post dma 2.2		0.107			0.204			0.354
8	Junction	junction 1		0.203			0.325			0.507
9	Pond Route	Post chamber 1		0.041			0.164			0.260
10	Junction	Post dma 1 outfall		0.054			0.225			0.368
11	Pond Route	Post pond 1		0.129			0.226			0.365
12	Junction	Post dma 2 outfall		0.235			0.430			0.720

5. Water Quality Management

Water Quality requirements are met using a bioretention basin and infiltration chambers and are to be finalized during final design. Preliminary Town of Truckee Storm Water BMP calculator results shown in appendix. Infiltration chambers are a dual system for both water quality and flood attenuation. The Town of Truckee calculator shows the entire volume of the system. However, in practice an orifice plate is located within chambers to allow for outflow after the required water quality volume. See stage storage report appendix I.

6. Limitations

This report was prepared on a preliminary level and in general accordance with the accepted standards of practice existing in Northern California for projects of similar size. No warranties, express or implied, are made.

Findings in this report are intended for the exclusive use of the project specified, and the design shown. Use beyond the specified could lead to environmental/structural damage, and noncompliance with regulatory requirements.

Readers should recognize that evaluation and study of hydrologic systems is an inexact art. Conclusions and recommendations are generally made with incomplete knowledge and assumptions. More extensive studies can reduce, but not eliminate the uncertainties associated with hydrologic design. Standard information, such as rainfall data, topographic mapping, and soils data, without verification or modification has been used. New information or regulations could fundamentally influence design. As the project is finalized or as additional information becomes available this report may require change.

Readers and, or reviewers who have additional information that is pertinent to this design or have noted material errors should contact us at the earliest opportunity, to facilitate timely changes.

7. References

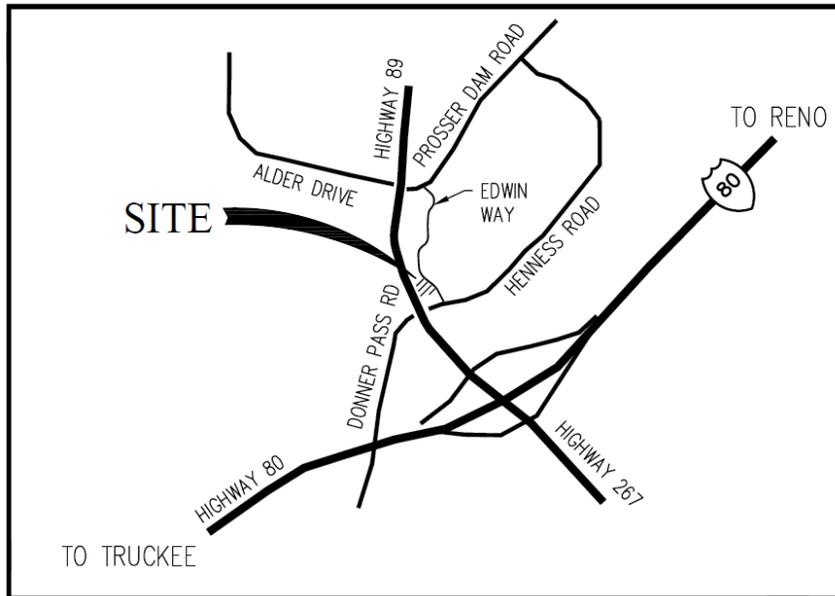
California Stormwater Quality Association (CASQA), 2003, Stormwater best management practices handbook, new development and redevelopment

State Water Resources Control Board, 2013, Water quality order no. 2013-0001-DWQ, National pollutant discharge elimination system (NPDES) general permit no. CAS000004, Waste discharge requirements (WDRs) for storm water discharges from small municipal separate storm sewer systems (MS4s) (General Permit)

Town of Truckee, 2003, Town of Truckee Public Improvement and Engineering Standards

US Department of Agriculture (USDA), 1986, Urban hydrology for small watershed TR-55, for the Natural Resources Conservation Service and Conservation Engineering Division,

APPENDIX A



VICINITY MAP

NO SCALE

APPENDIX B

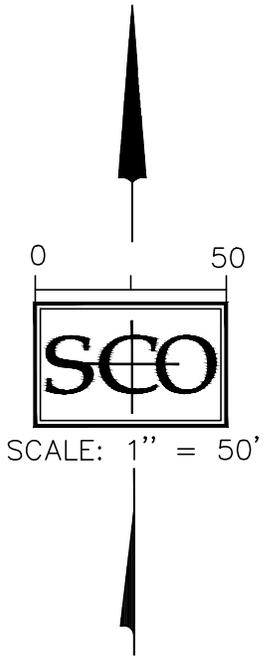


PLATE 1

APPENDIX C

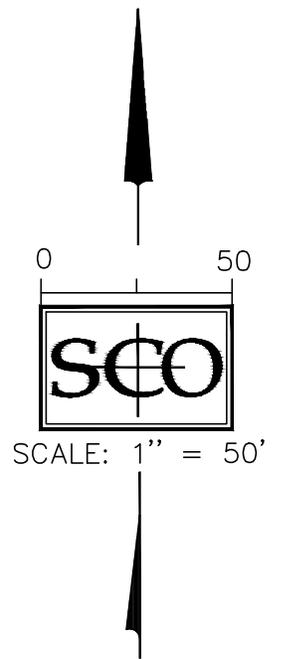
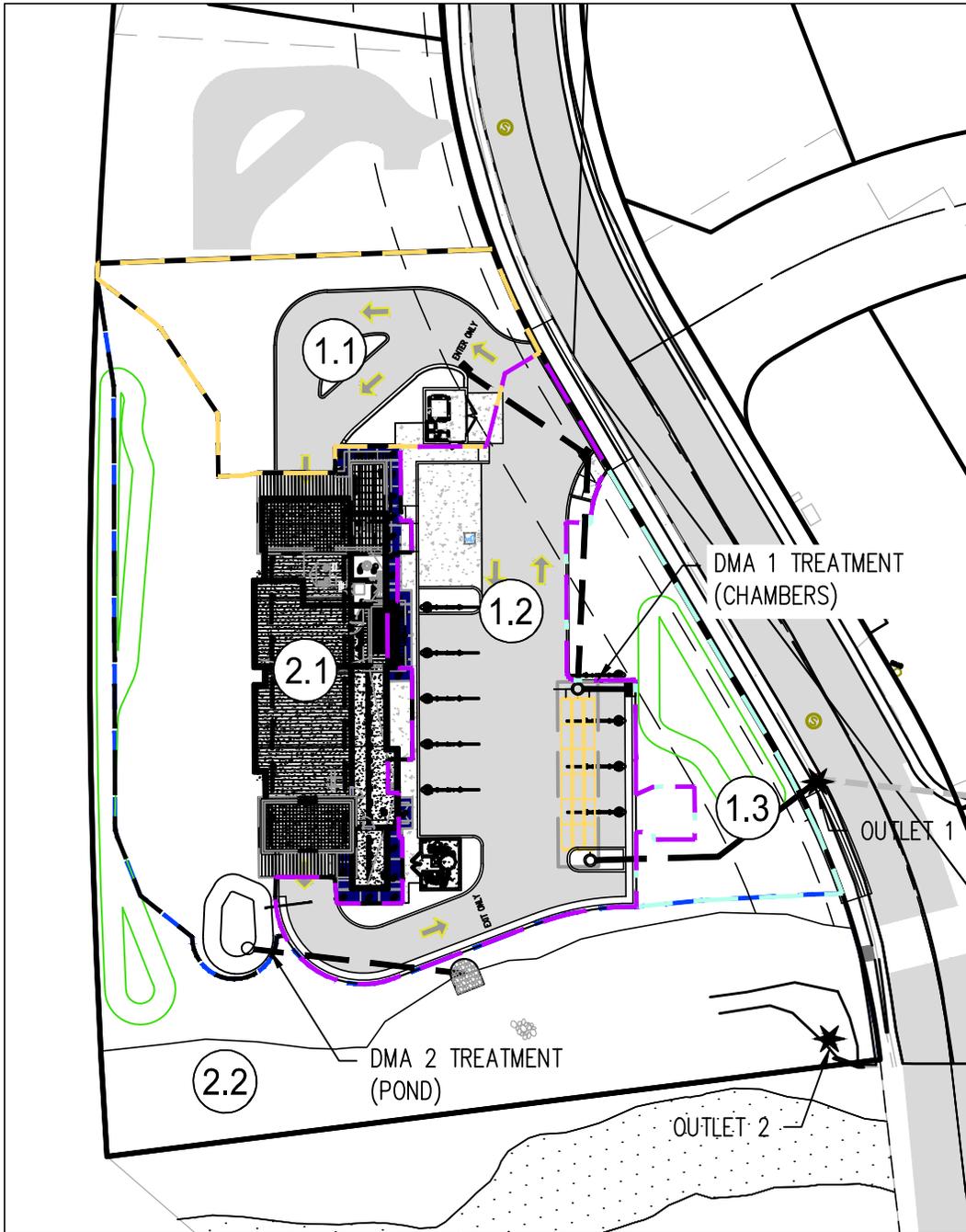


PLATE 2

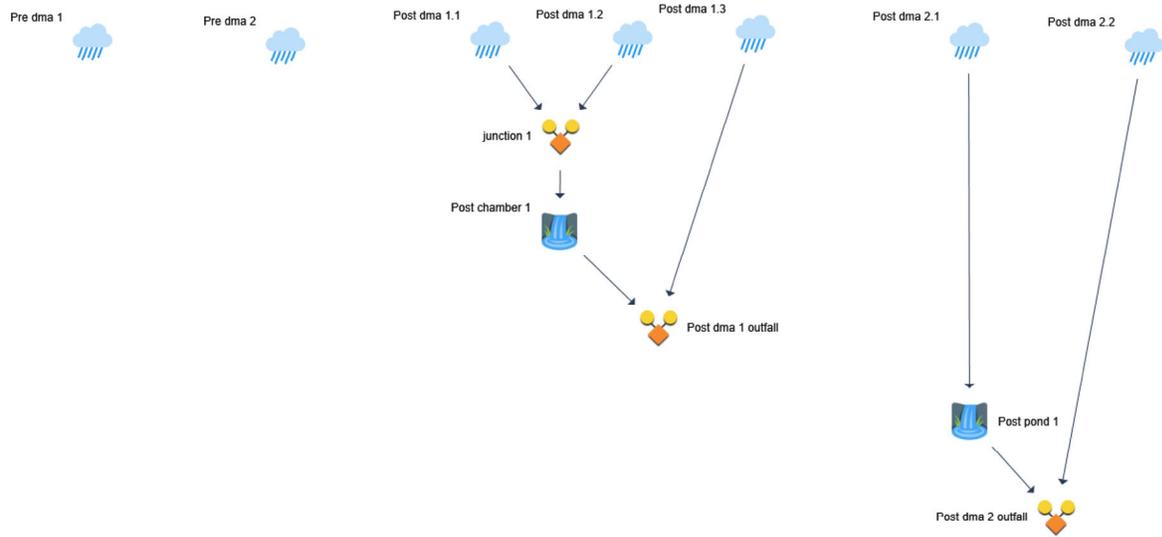
APPENDIX D

Basin Model

Hydrology Studio v 3.0.0.27

Project Name:

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APPENDIX E

Hydrograph Report

Project Name:

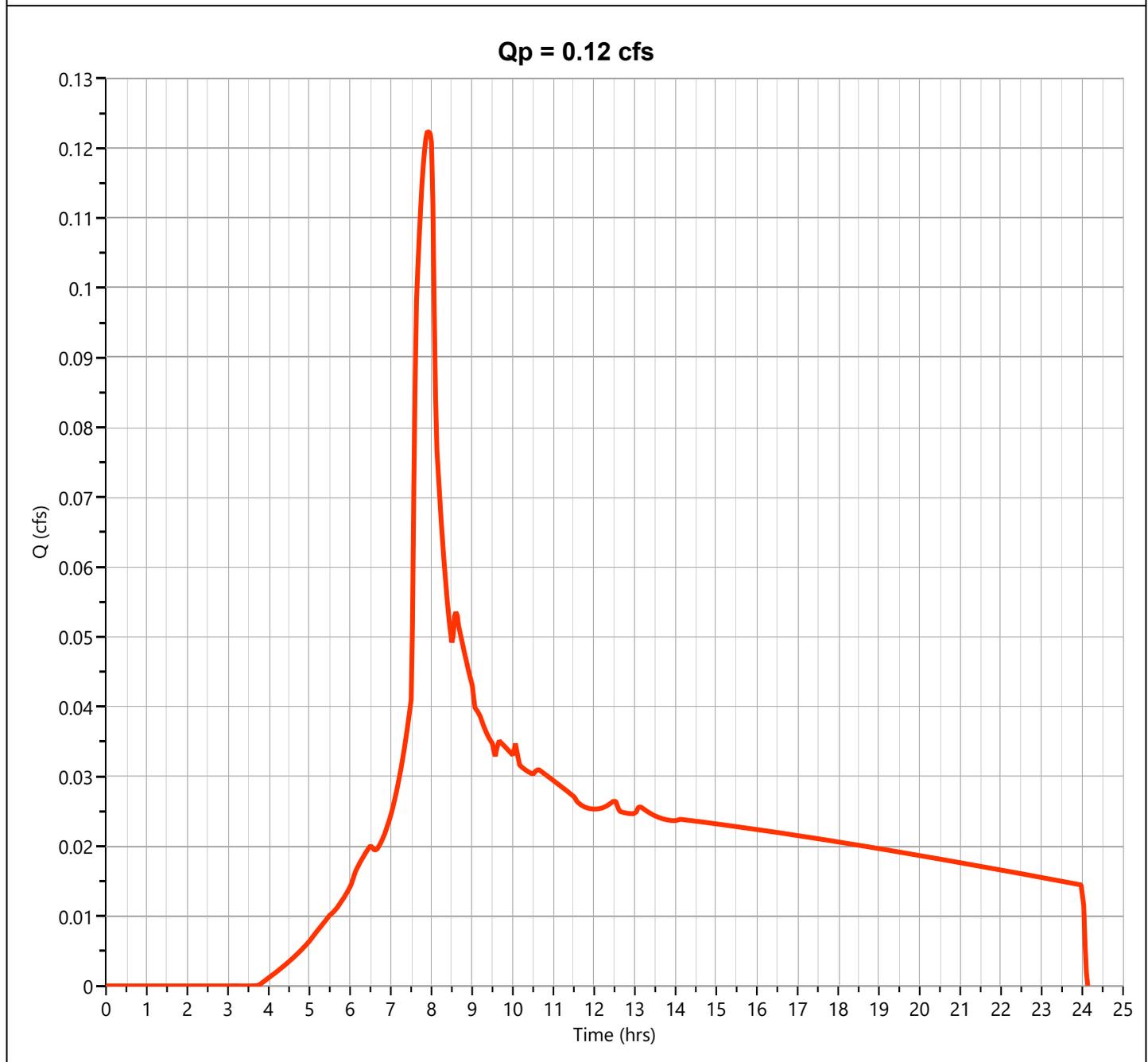
Hydrology Studio v 3.0.0.27

09-25-2023

Pre dma 1

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.123 cfs
Storm Frequency	= 2-yr	Time to Peak	= 7.93 hrs
Time Interval	= 2 min	Runoff Volume	= 1,801 cuft
Drainage Area	= 0.32 ac	Curve Number	= 86.8
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 2.92 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

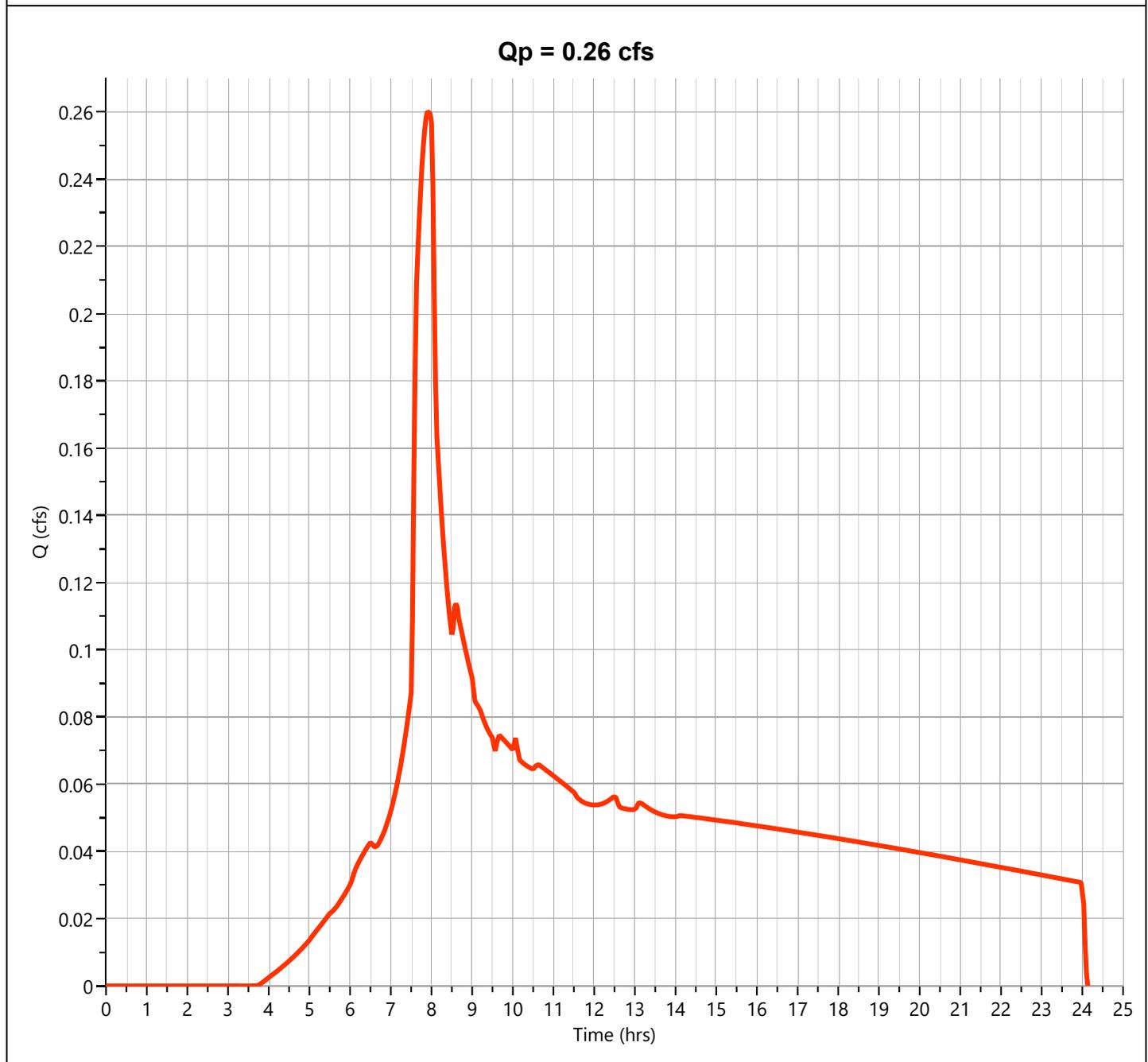
Hydrology Studio v 3.0.0.27

09-25-2023

Pre dma 2

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.261 cfs
Storm Frequency	= 2-yr	Time to Peak	= 7.93 hrs
Time Interval	= 2 min	Runoff Volume	= 3,828 cuft
Drainage Area	= 0.68 ac	Curve Number	= 86.8
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 2.92 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

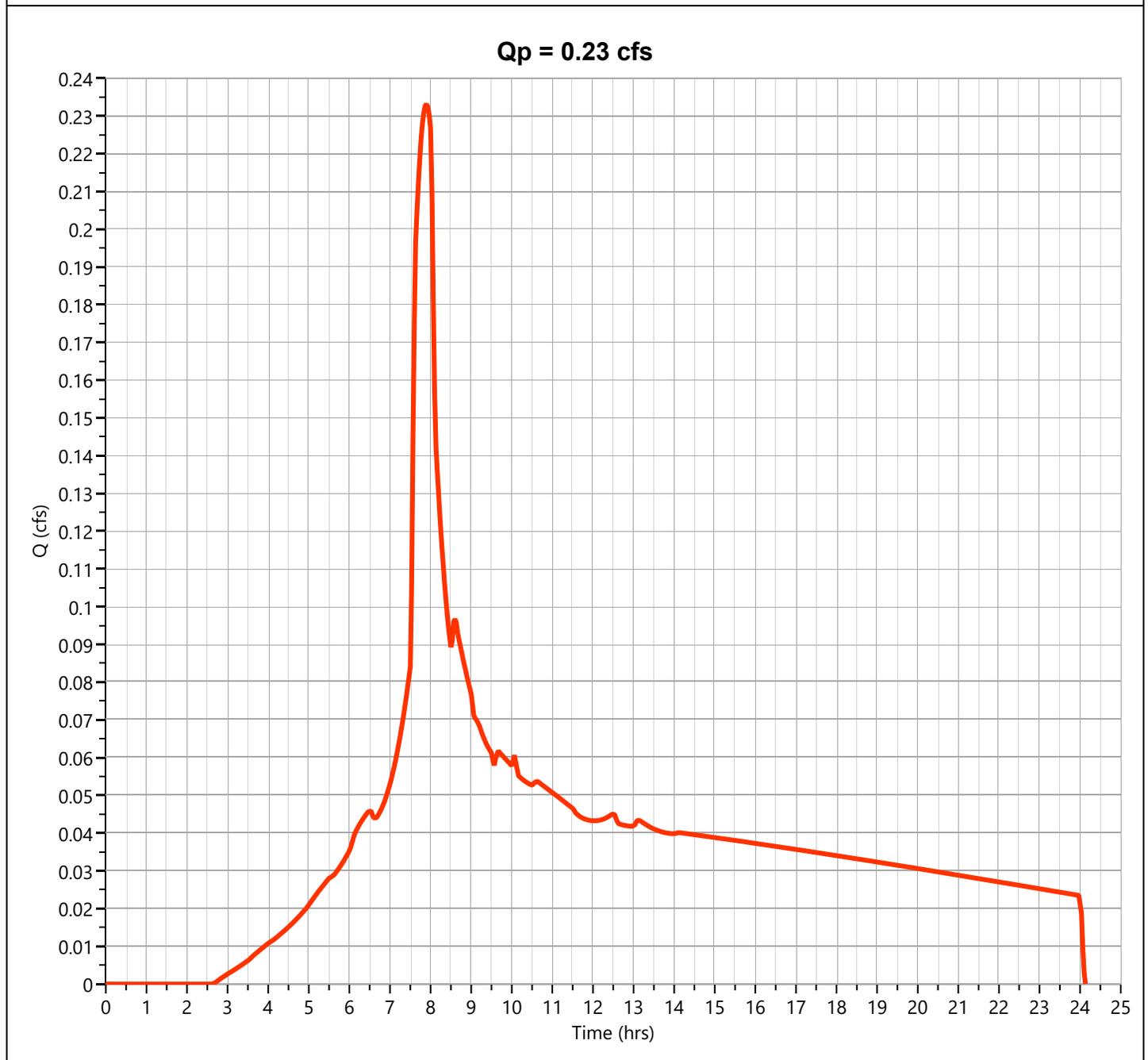
Hydrology Studio v 3.0.0.27

09-25-2023

Pre dma 1

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.233 cfs
Storm Frequency	= 10-yr	Time to Peak	= 7.90 hrs
Time Interval	= 2 min	Runoff Volume	= 3,273 cuft
Drainage Area	= 0.32 ac	Curve Number	= 86.8
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 4.42 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

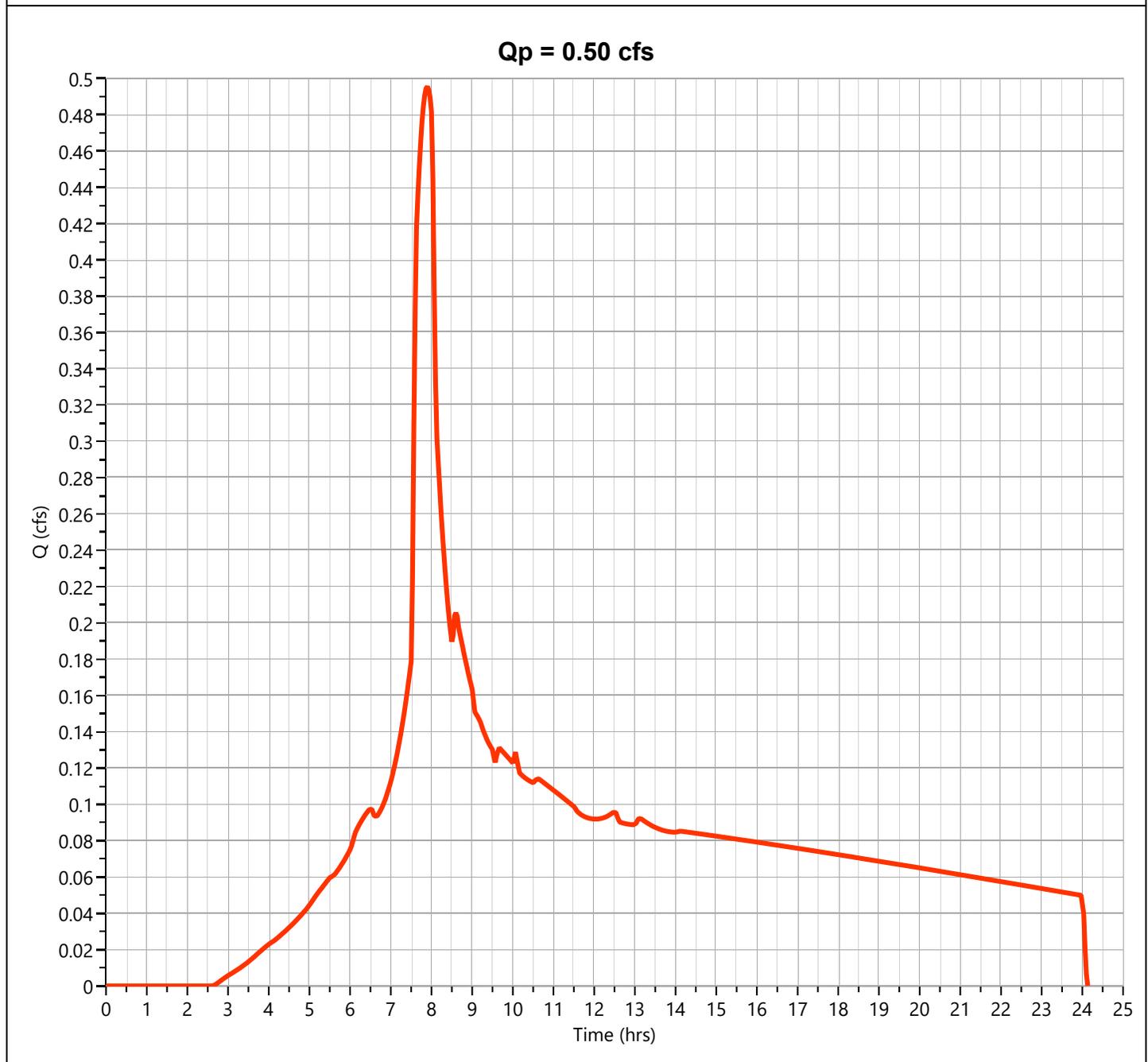
Hydrology Studio v 3.0.0.27

09-25-2023

Pre dma 2

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.495 cfs
Storm Frequency	= 10-yr	Time to Peak	= 7.90 hrs
Time Interval	= 2 min	Runoff Volume	= 6,955 cuft
Drainage Area	= 0.68 ac	Curve Number	= 86.8
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 4.42 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

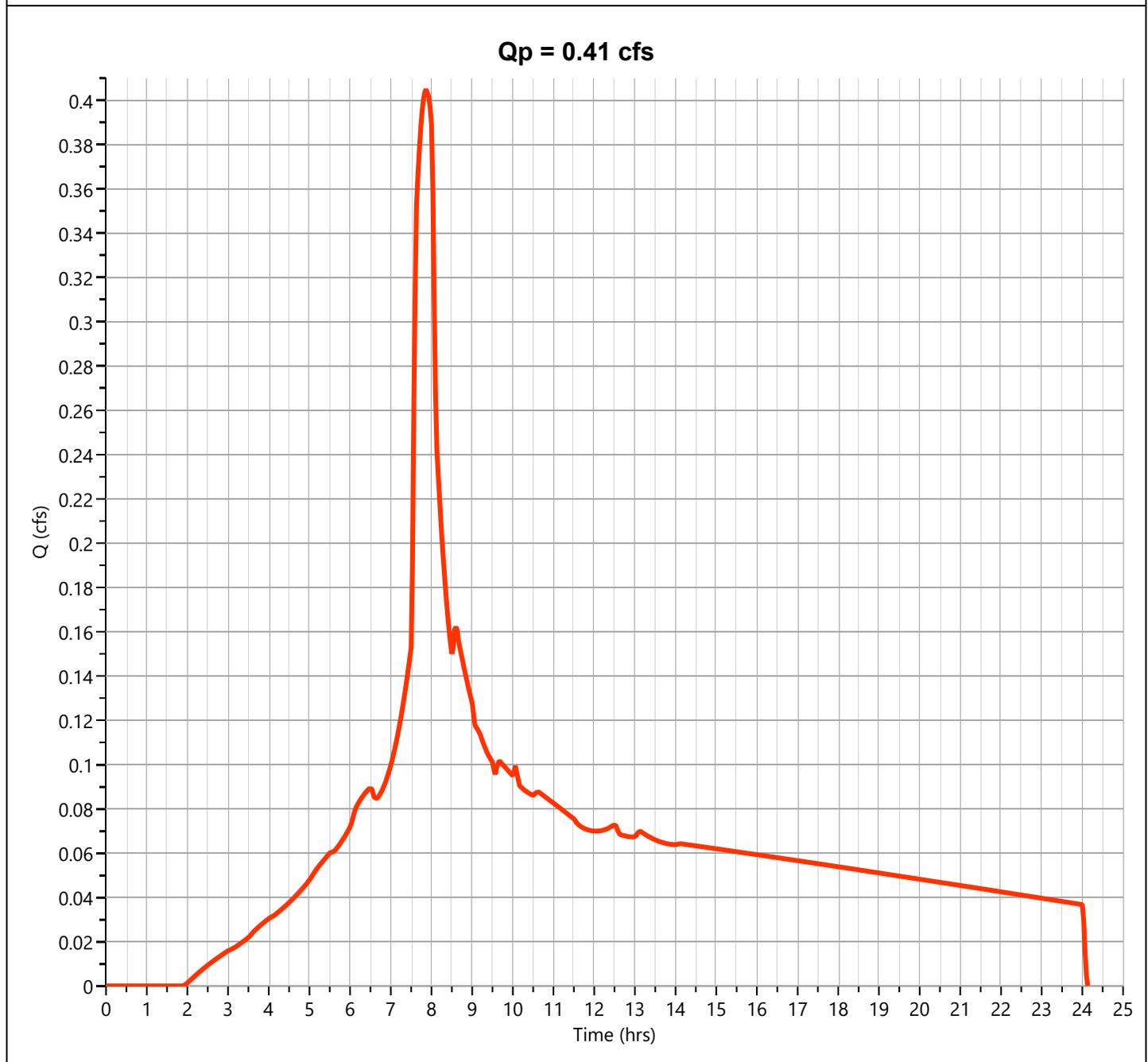
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Pre dma 1

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.405 cfs
Storm Frequency	= 100-yr	Time to Peak	= 7.87 hrs
Time Interval	= 2 min	Runoff Volume	= 5,596 cuft
Drainage Area	= 0.32 ac	Curve Number	= 86.8
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 6.67 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

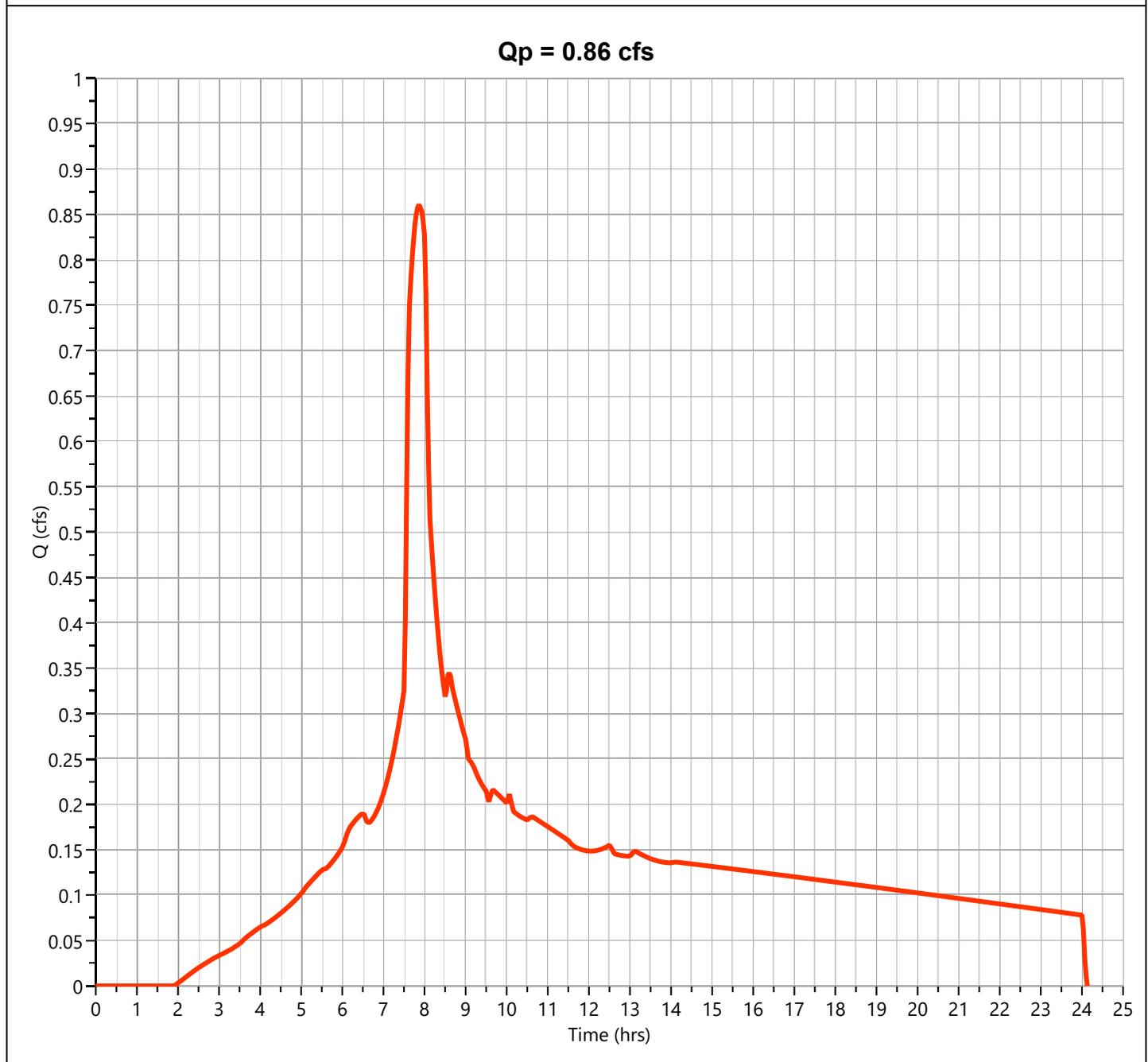
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09-25-2023

Pre dma 2

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.861 cfs
Storm Frequency	= 100-yr	Time to Peak	= 7.87 hrs
Time Interval	= 2 min	Runoff Volume	= 11,891 cuft
Drainage Area	= 0.68 ac	Curve Number	= 86.8
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 6.67 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484



APPENDIX F

Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.27

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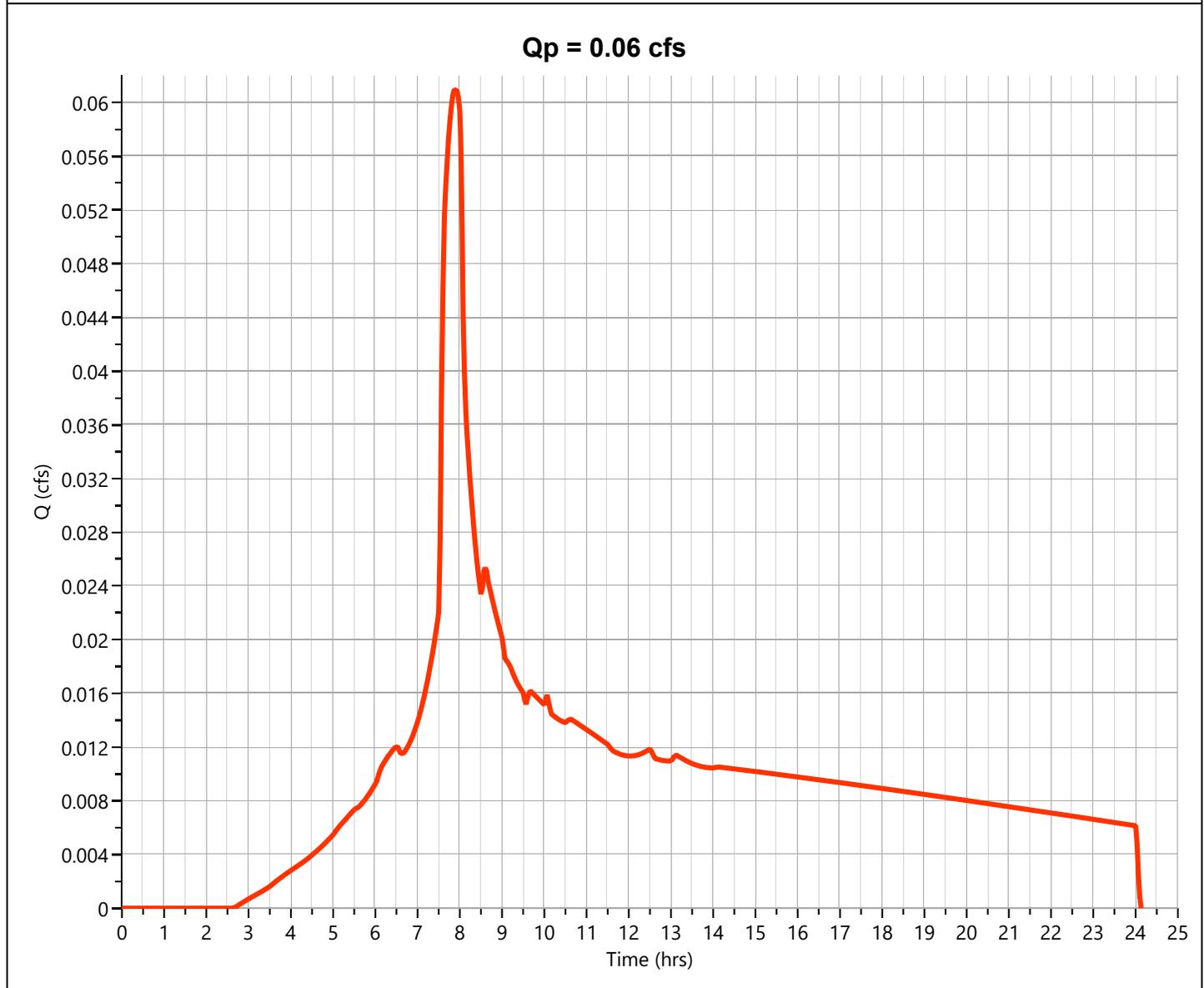
Post dma 1.1

Hyd. No. 3

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.061 cfs
Storm Frequency	= 2-yr	Time to Peak	= 7.90 hrs
Time Interval	= 2 min	Runoff Volume	= 858 cuft
Drainage Area	= 0.127 ac	Curve Number	= 90.86*
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 2.92 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484

* Composite CN Worksheet

AREA (ac)	CN	DESCRIPTION
0.081	87	landscaping
0.046	98	pavement
0.127	91	Weighted CN Method Employed



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

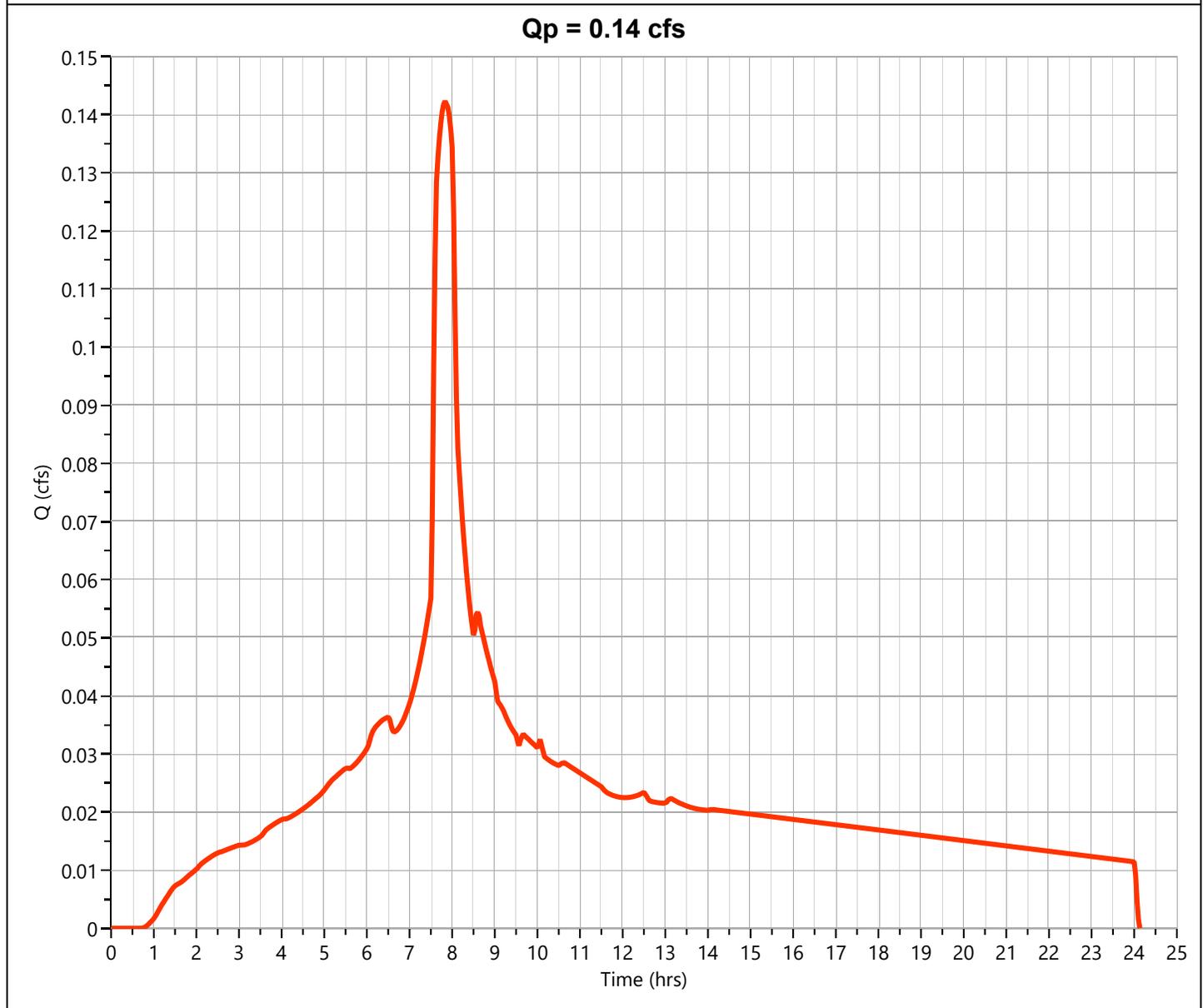
Post dma 1.2

Hyd. No. 4

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.142 cfs
Storm Frequency	= 2-yr	Time to Peak	= 7.83 hrs
Time Interval	= 2 min	Runoff Volume	= 2,013 cuft
Drainage Area	= 0.22 ac	Curve Number	= 98*
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 2.92 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484

* Composite CN Worksheet

AREA (ac)	CN	DESCRIPTION
0.22	98	ac
0.22	98	Weighted CN Method Employed



Hydrograph Report

Project Name:

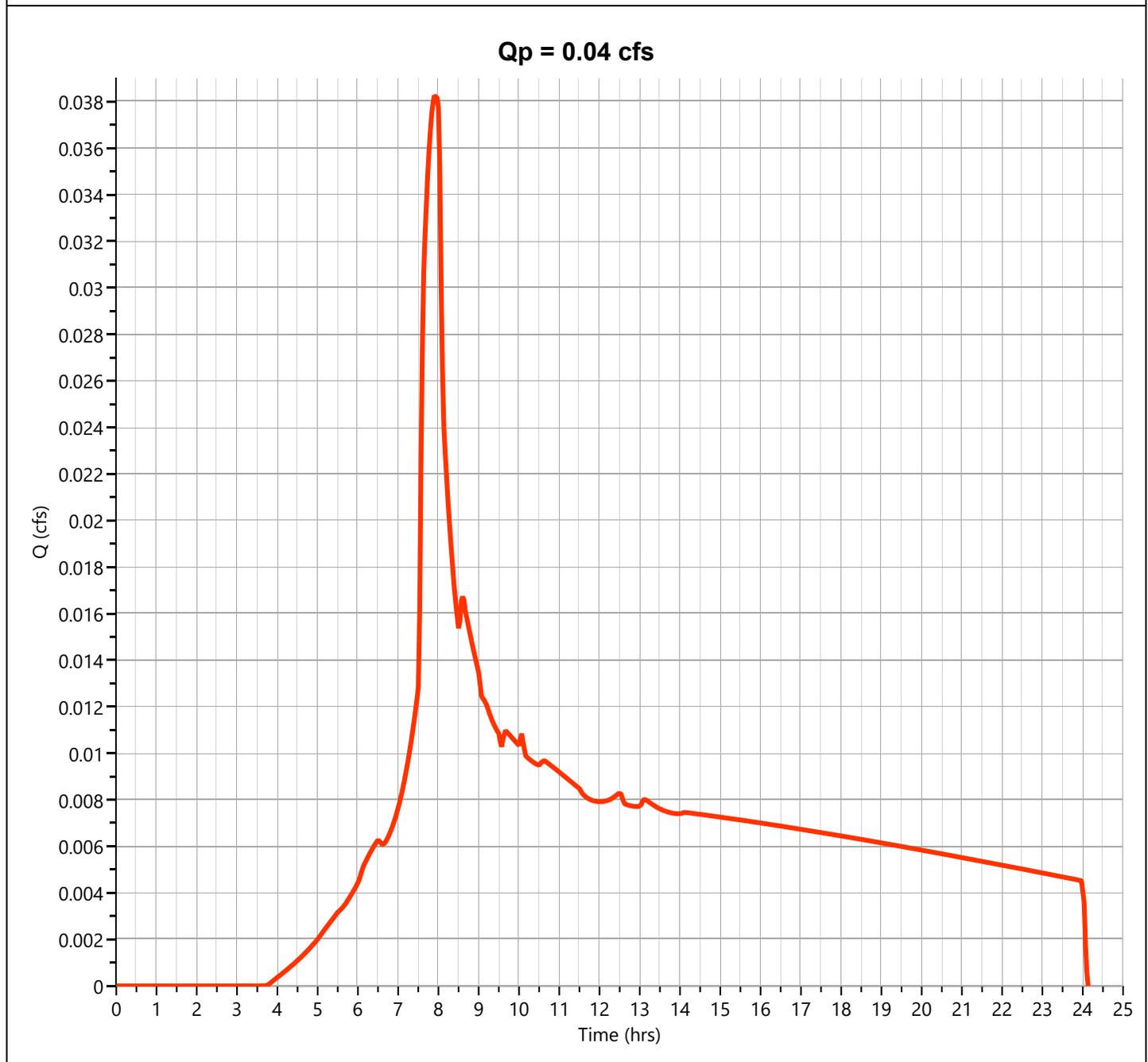
Hydrology Studio v 3.0.0.27

09-25-2023

Post dma 1.3

Hyd. No. 5

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.038 cfs
Storm Frequency	= 2-yr	Time to Peak	= 7.93 hrs
Time Interval	= 2 min	Runoff Volume	= 563 cuft
Drainage Area	= 0.1 ac	Curve Number	= 86.8
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 2.92 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

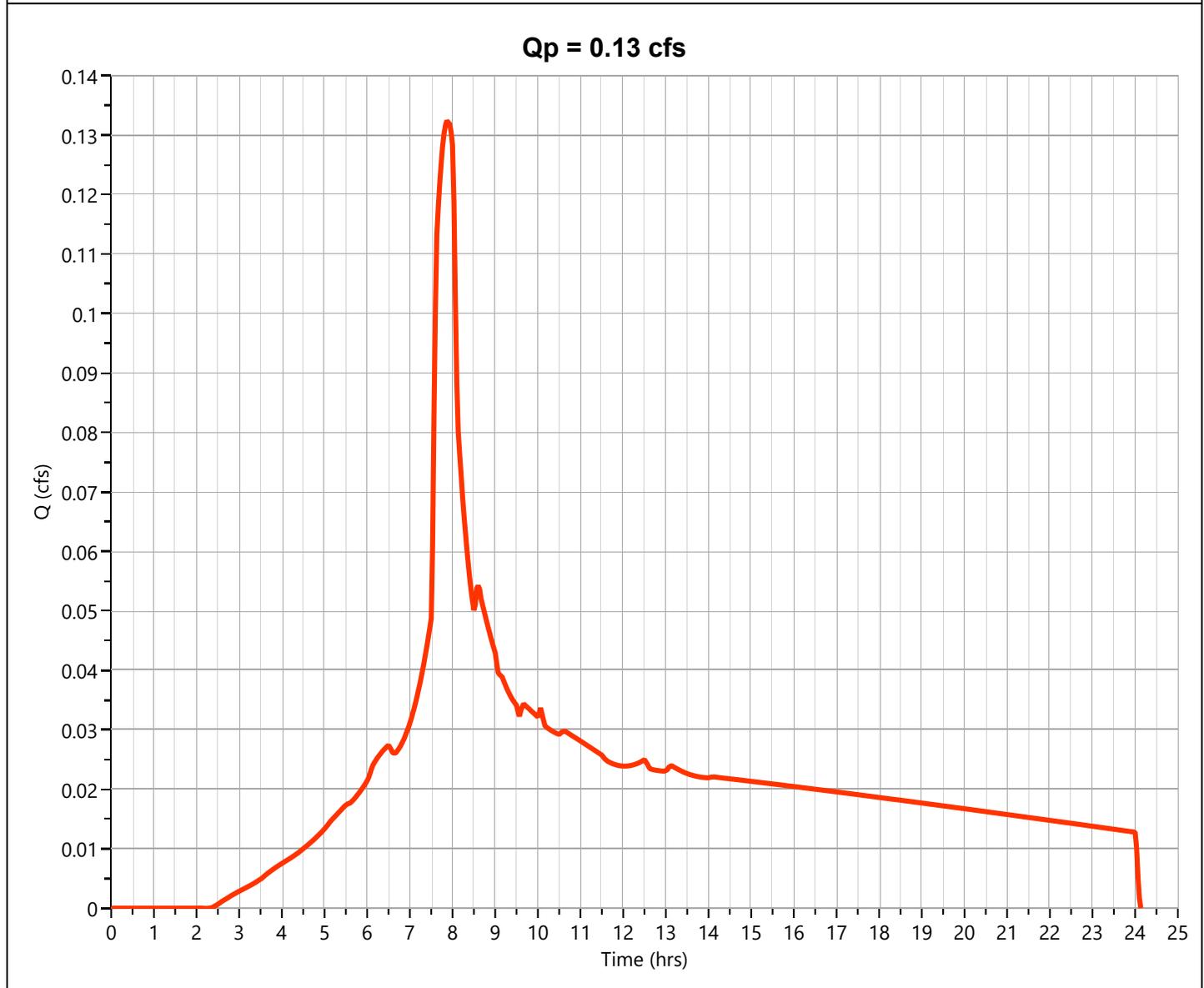
Post dma 2.1

Hyd. No. 6

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.132 cfs
Storm Frequency	= 2-yr	Time to Peak	= 7.90 hrs
Time Interval	= 2 min	Runoff Volume	= 1,845 cuft
Drainage Area	= 0.26 ac	Curve Number	= 92*
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 2.92 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484

* Composite CN Worksheet

AREA (ac)	CN	DESCRIPTION
0.11	98	roof
0.15	87	landscape
0.26	92	Weighted CN Method Employed



Hydrograph Report

Project Name:

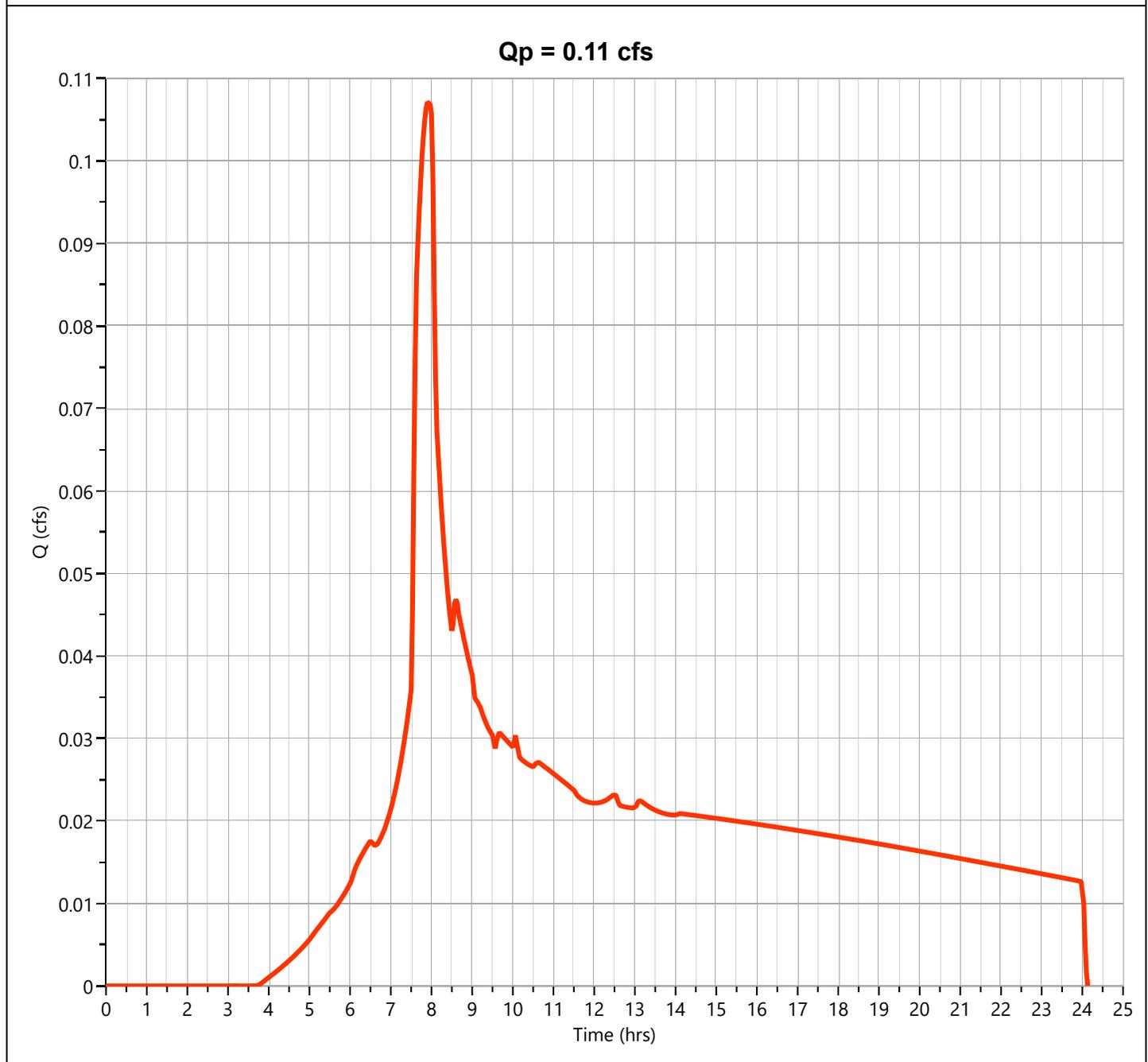
Hydrology Studio v 3.0.0.27

09-25-2023

Post dma 2.2

Hyd. No. 7

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.107 cfs
Storm Frequency	= 2-yr	Time to Peak	= 7.93 hrs
Time Interval	= 2 min	Runoff Volume	= 1,576 cuft
Drainage Area	= 0.28 ac	Curve Number	= 86.8
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 2.92 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

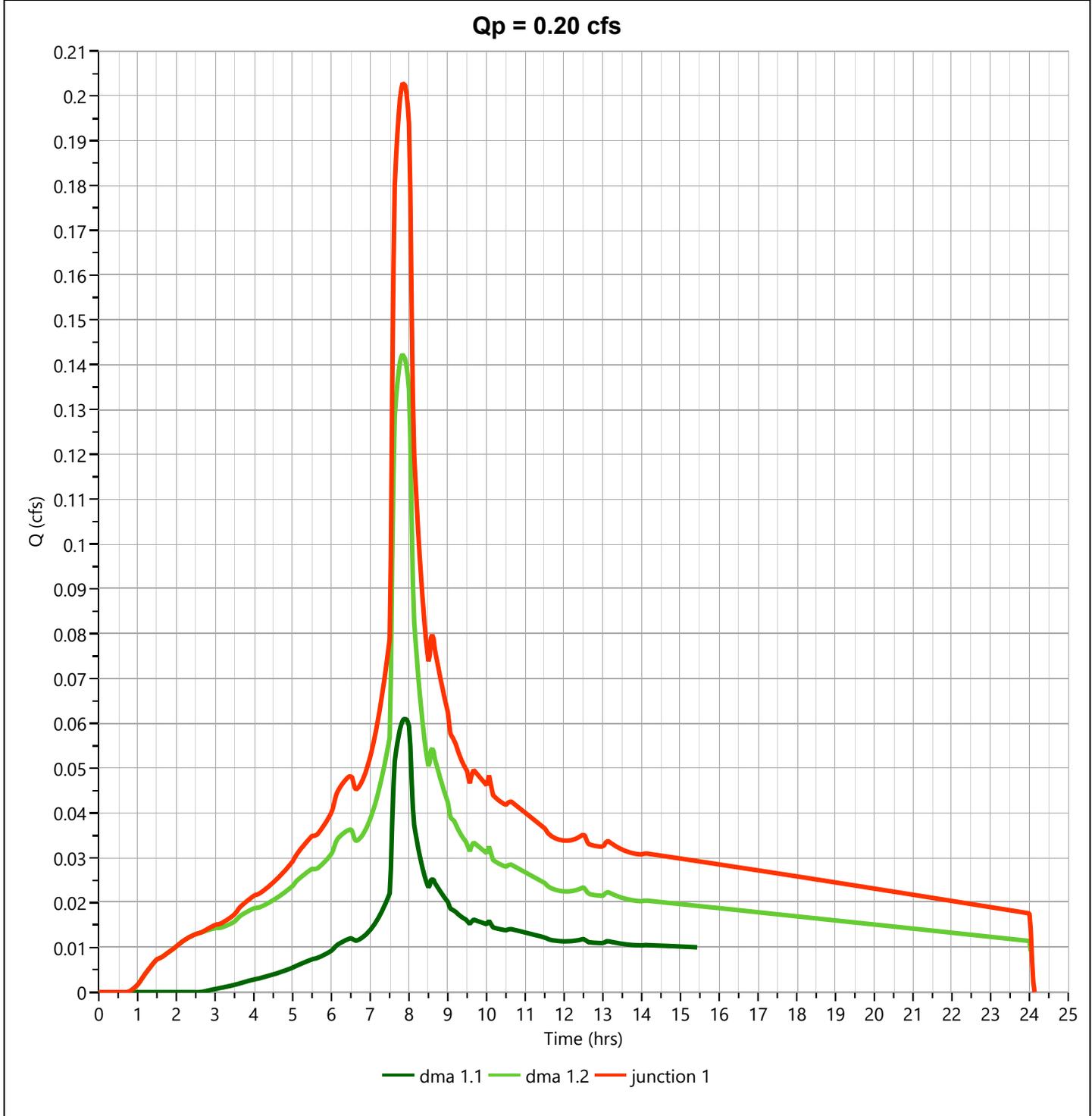
Hydrology Studio v 3.0.0.27

09-25-2023

junction 1

Hyd. No. 8

Hydrograph Type	= Junction	Peak Flow	= 0.203 cfs
Storm Frequency	= 2-yr	Time to Peak	= 7.87 hrs
Time Interval	= 2 min	Hydrograph Volume	= 2,871 cuft
Inflow Hydrographs	= 3, 4	Total Contrib. Area	= 0.347 ac



Hydrograph Report

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Post chamber 1

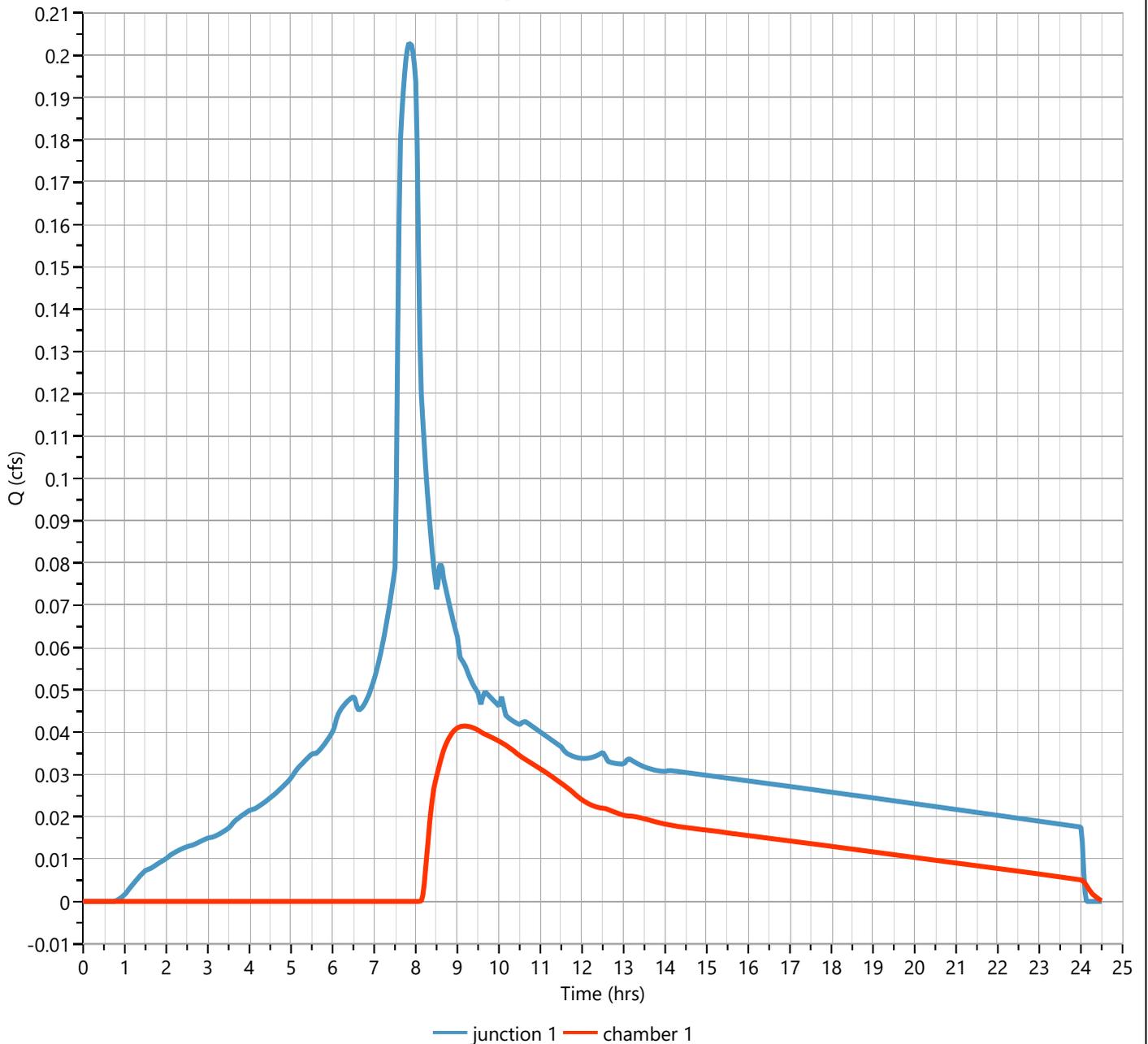
Hyd. No. 9

Hydrograph Type	= Pond Route	Peak Flow	= 0.041 cfs
Storm Frequency	= 2-yr	Time to Peak	= 9.20 hrs
Time Interval	= 2 min	Hydrograph Volume	= 1,030 cuft
Inflow Hydrograph	= 8 - junction 1	Max. Elevation	= 102.57 ft
Pond Name	= chambers 1	Max. Storage	= 1,006 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 2.31 hrs

Qp = 0.04 cfs



Hydrograph Report

Project Name:

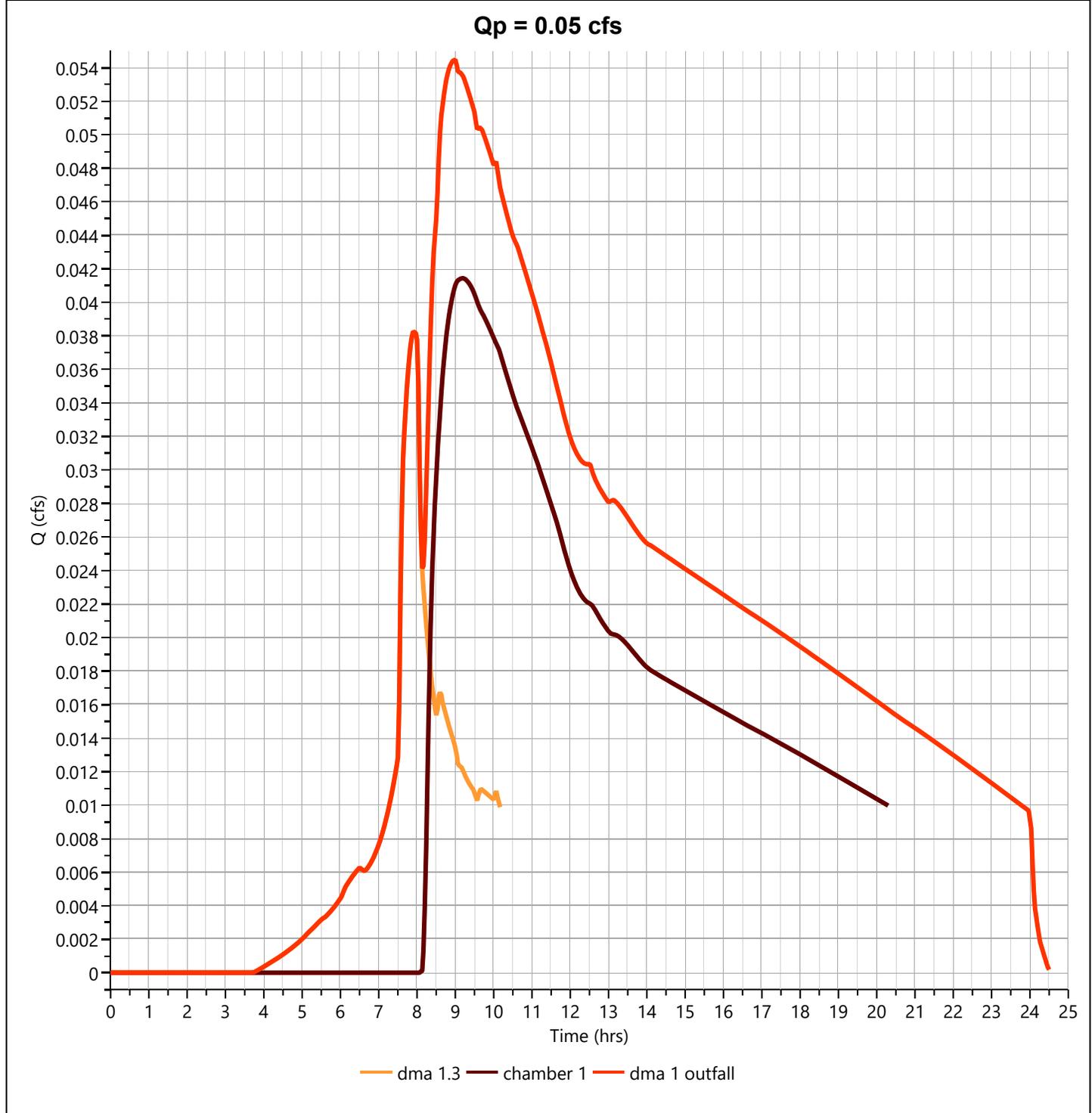
Hydrology Studio v 3.0.0.27

09-25-2023

Post dma 1 outfall

Hyd. No. 10

Hydrograph Type	= Junction	Peak Flow	= 0.054 cfs
Storm Frequency	= 2-yr	Time to Peak	= 9.00 hrs
Time Interval	= 2 min	Hydrograph Volume	= 1,593 cuft
Inflow Hydrographs	= 5, 9	Total Contrib. Area	= 0.1 ac



Hydrograph Report

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Post pond 1

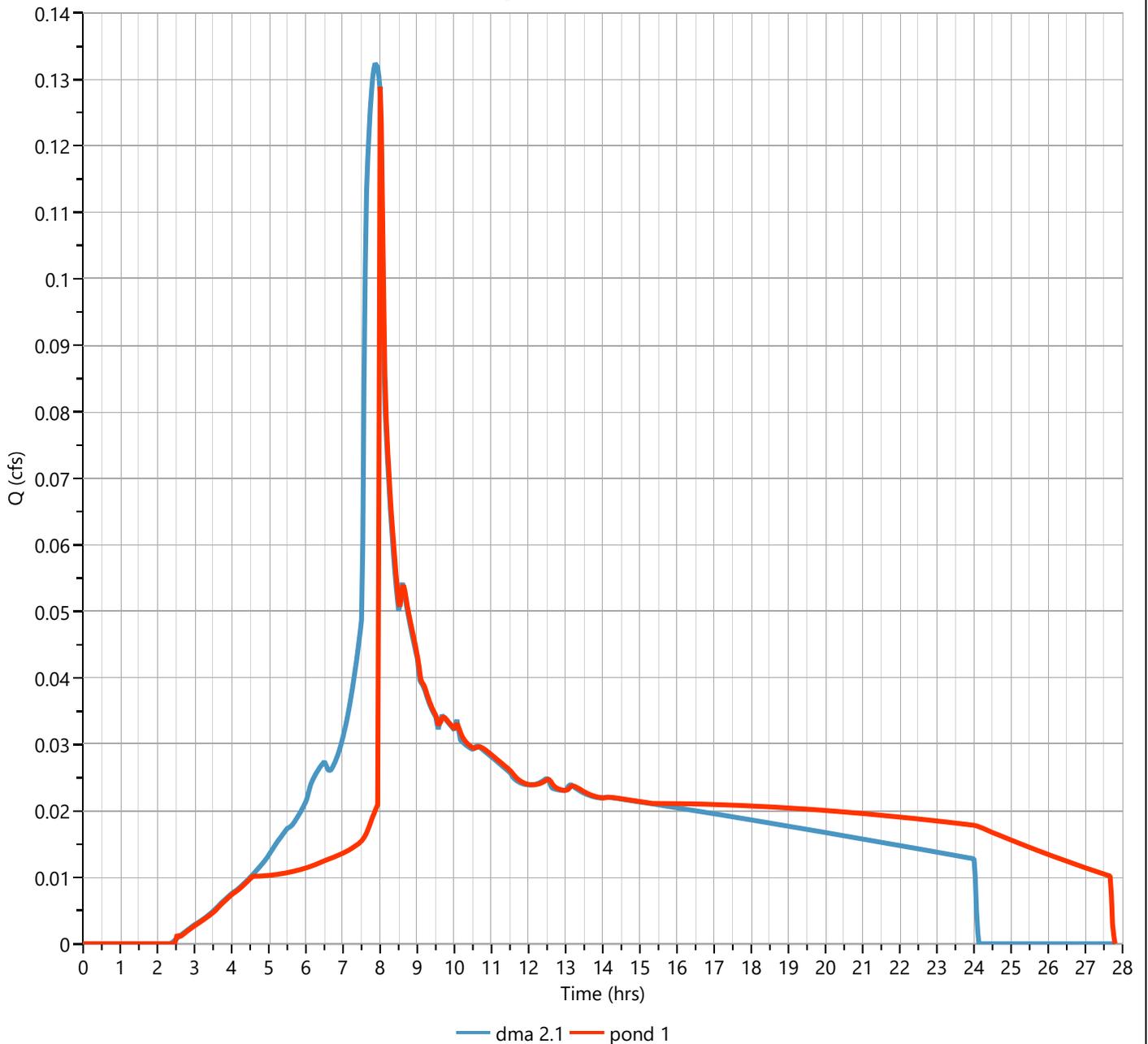
Hyd. No. 11

Hydrograph Type	= Pond Route	Peak Flow	= 0.129 cfs
Storm Frequency	= 2-yr	Time to Peak	= 8.00 hrs
Time Interval	= 2 min	Hydrograph Volume	= 1,845 cuft
Inflow Hydrograph	= 6 - dma 2.1	Max. Elevation	= 101.02 ft
Pond Name	= pond 1	Max. Storage	= 284 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 2.51 hrs

Qp = 0.13 cfs



Hydrograph Report

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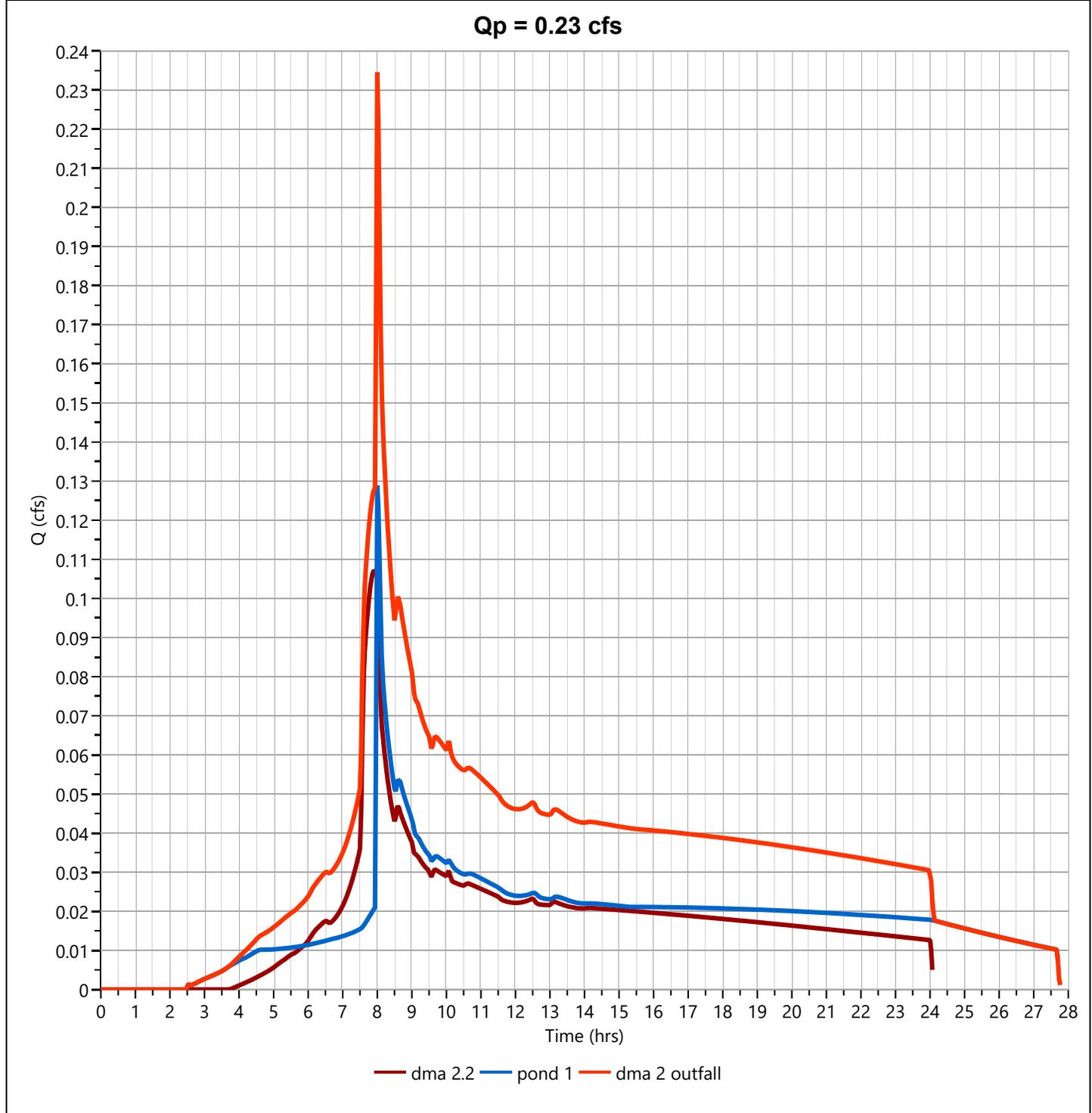
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09-25-2023

Post dma 2 outfall

Hyd. No. 12

Hydrograph Type	= Junction	Peak Flow	= 0.235 cfs
Storm Frequency	= 2-yr	Time to Peak	= 8.00 hrs
Time Interval	= 2 min	Hydrograph Volume	= 3,422 cuft
Inflow Hydrographs	= 7, 11	Total Contrib. Area	= 0.28 ac



Hydrograph Report

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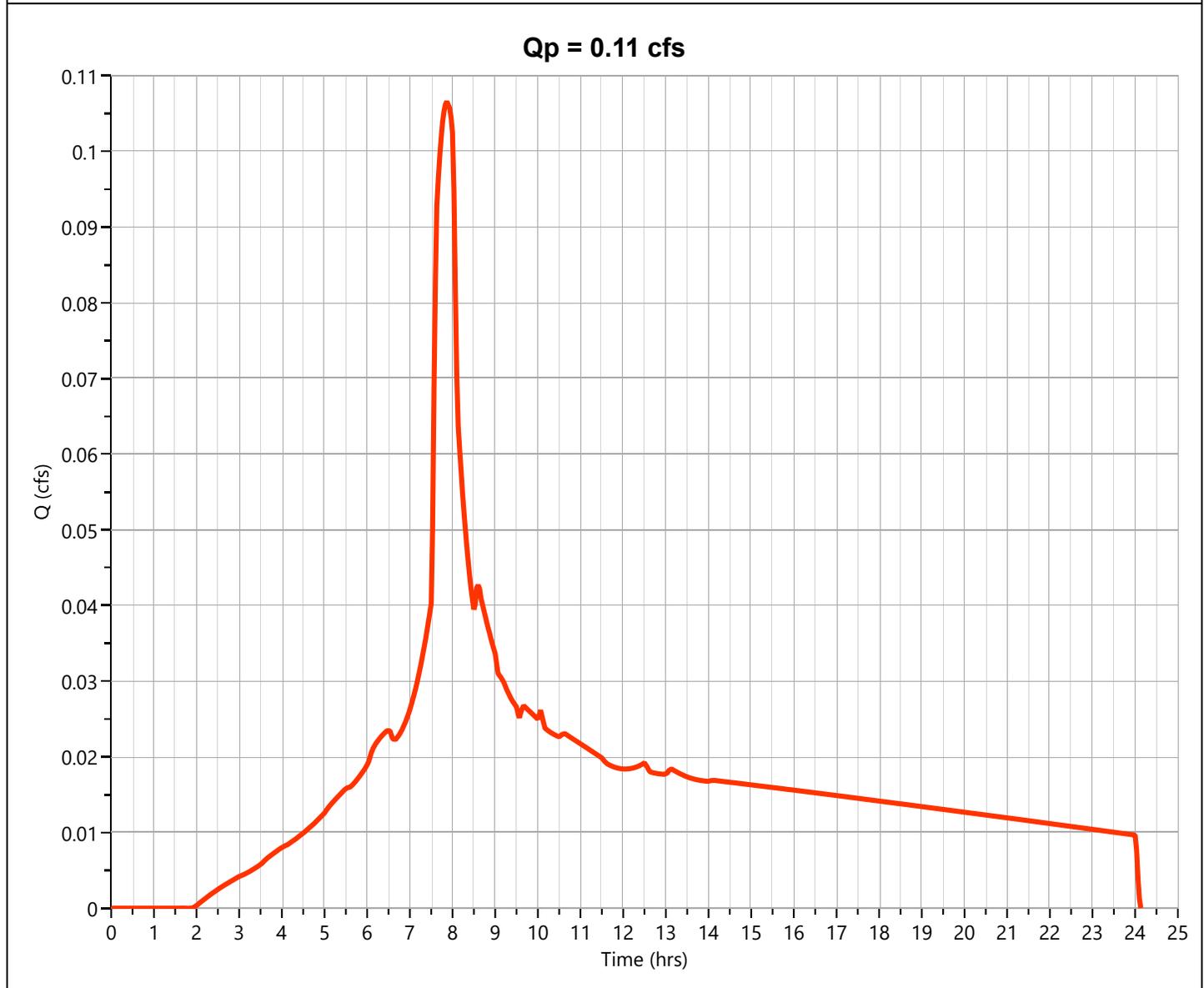
Post dma 1.1

Hyd. No. 3

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.107 cfs
Storm Frequency	= 10-yr	Time to Peak	= 7.87 hrs
Time Interval	= 2 min	Runoff Volume	= 1,472 cuft
Drainage Area	= 0.127 ac	Curve Number	= 90.86*
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 4.42 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484

* Composite CN Worksheet

AREA (ac)	CN	DESCRIPTION
0.081	87	landscaping
0.046	98	pavement
0.127	91	Weighted CN Method Employed



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.27

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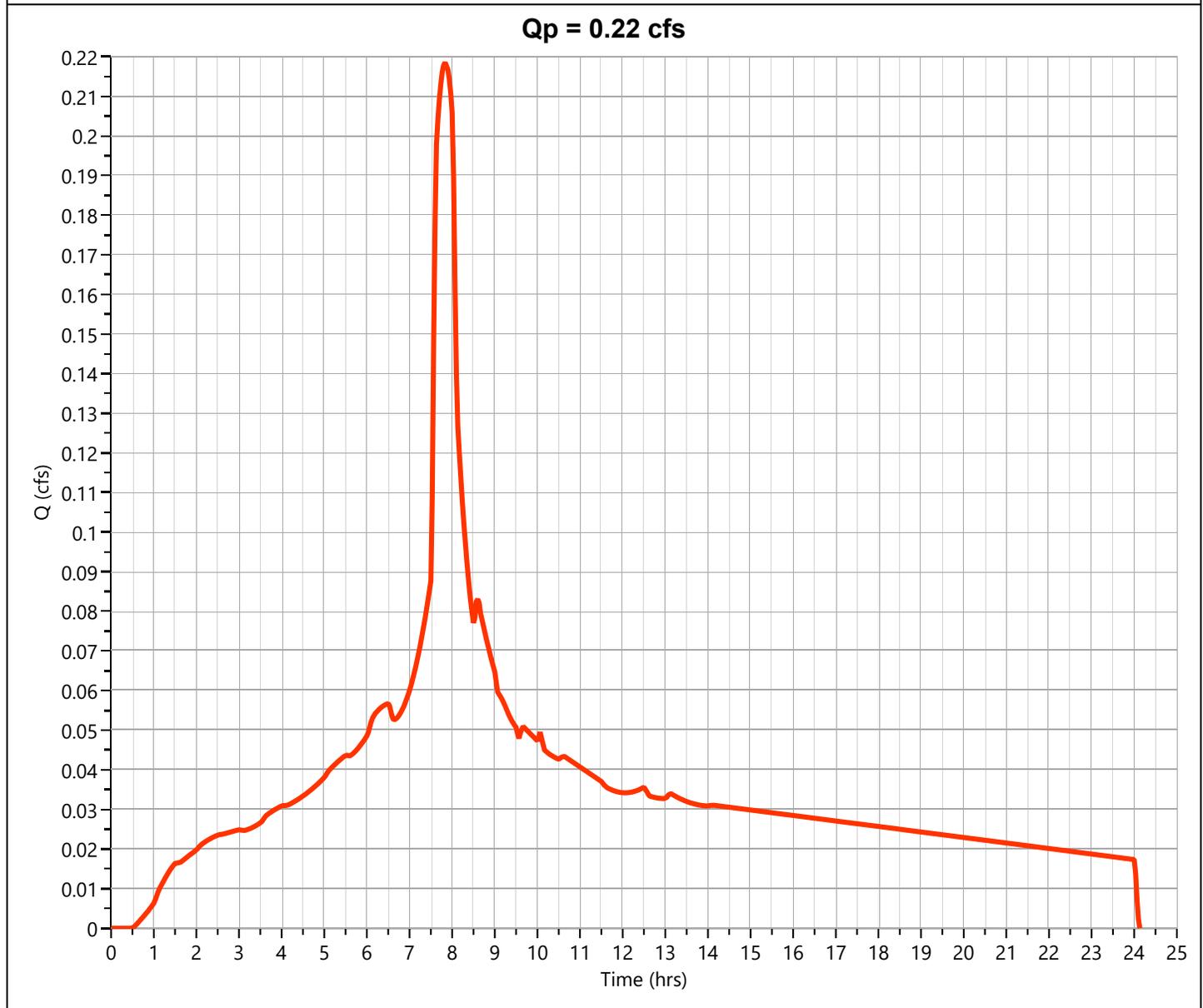
Post dma 1.2

Hyd. No. 4

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.219 cfs
Storm Frequency	= 10-yr	Time to Peak	= 7.83 hrs
Time Interval	= 2 min	Runoff Volume	= 3,133 cuft
Drainage Area	= 0.22 ac	Curve Number	= 98*
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 4.42 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484

* Composite CN Worksheet

AREA (ac)	CN	DESCRIPTION
0.22	98	ac
0.22	98	Weighted CN Method Employed



Hydrograph Report

Project Name:

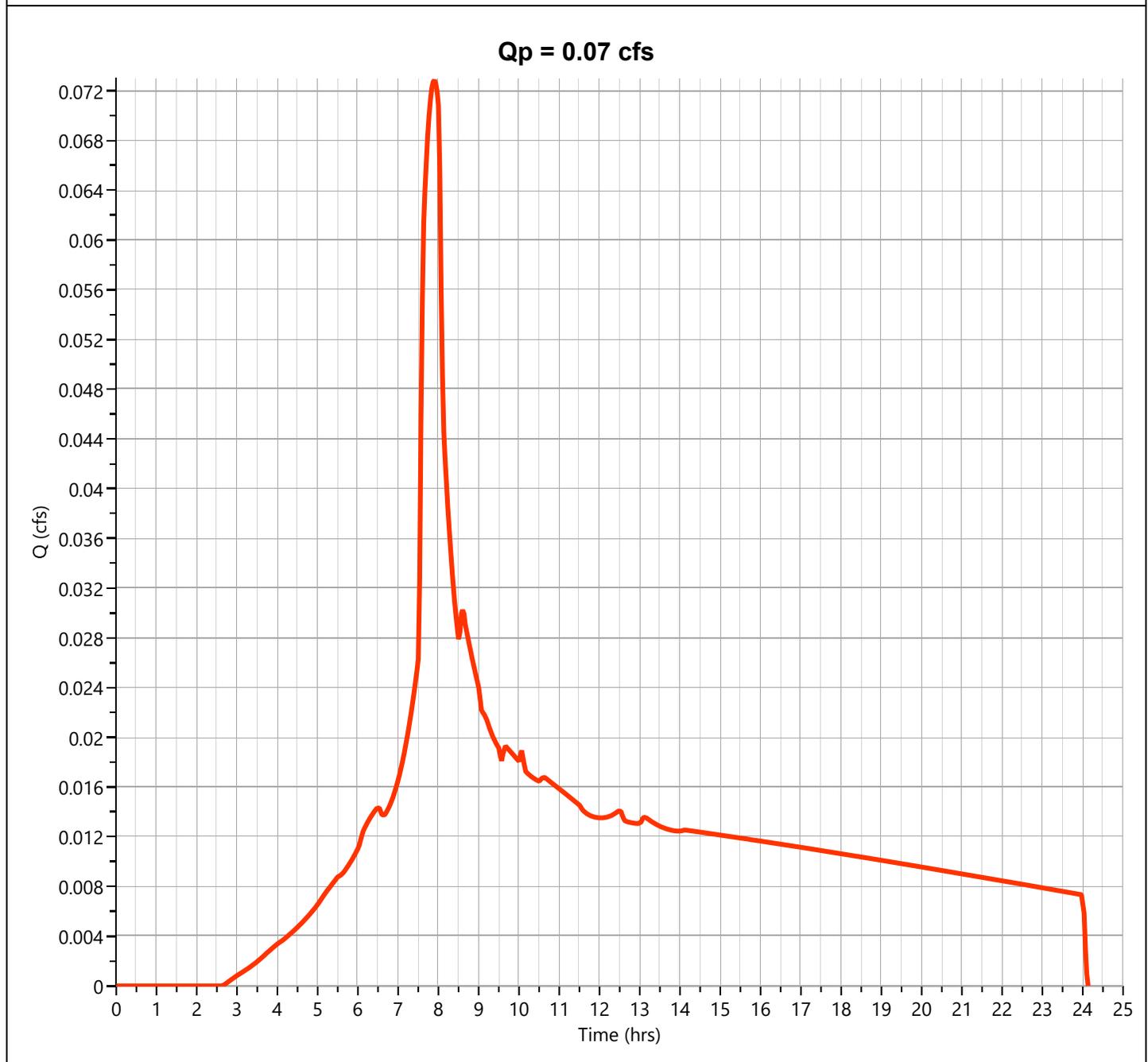
Hydrology Studio v 3.0.0.27

09-25-2023

Post dma 1.3

Hyd. No. 5

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.073 cfs
Storm Frequency	= 10-yr	Time to Peak	= 7.90 hrs
Time Interval	= 2 min	Runoff Volume	= 1,023 cuft
Drainage Area	= 0.1 ac	Curve Number	= 86.8
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 4.42 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

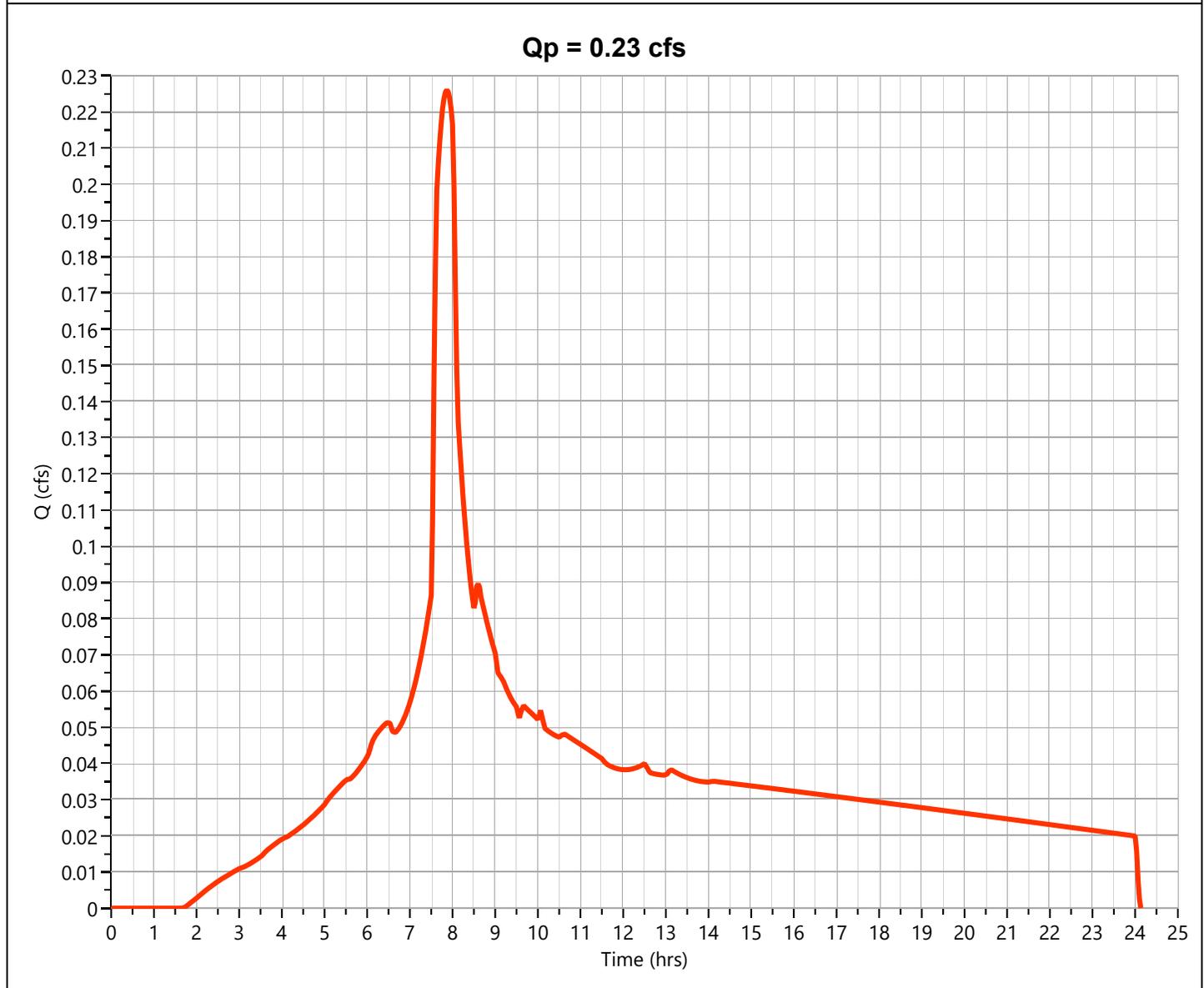
Post dma 2.1

Hyd. No. 6

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.226 cfs
Storm Frequency	= 10-yr	Time to Peak	= 7.87 hrs
Time Interval	= 2 min	Runoff Volume	= 3,118 cuft
Drainage Area	= 0.26 ac	Curve Number	= 92*
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 4.42 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484

* Composite CN Worksheet

AREA (ac)	CN	DESCRIPTION
0.11	98	roof
0.15	87	landscape
0.26	92	Weighted CN Method Employed



Hydrograph Report

Project Name:

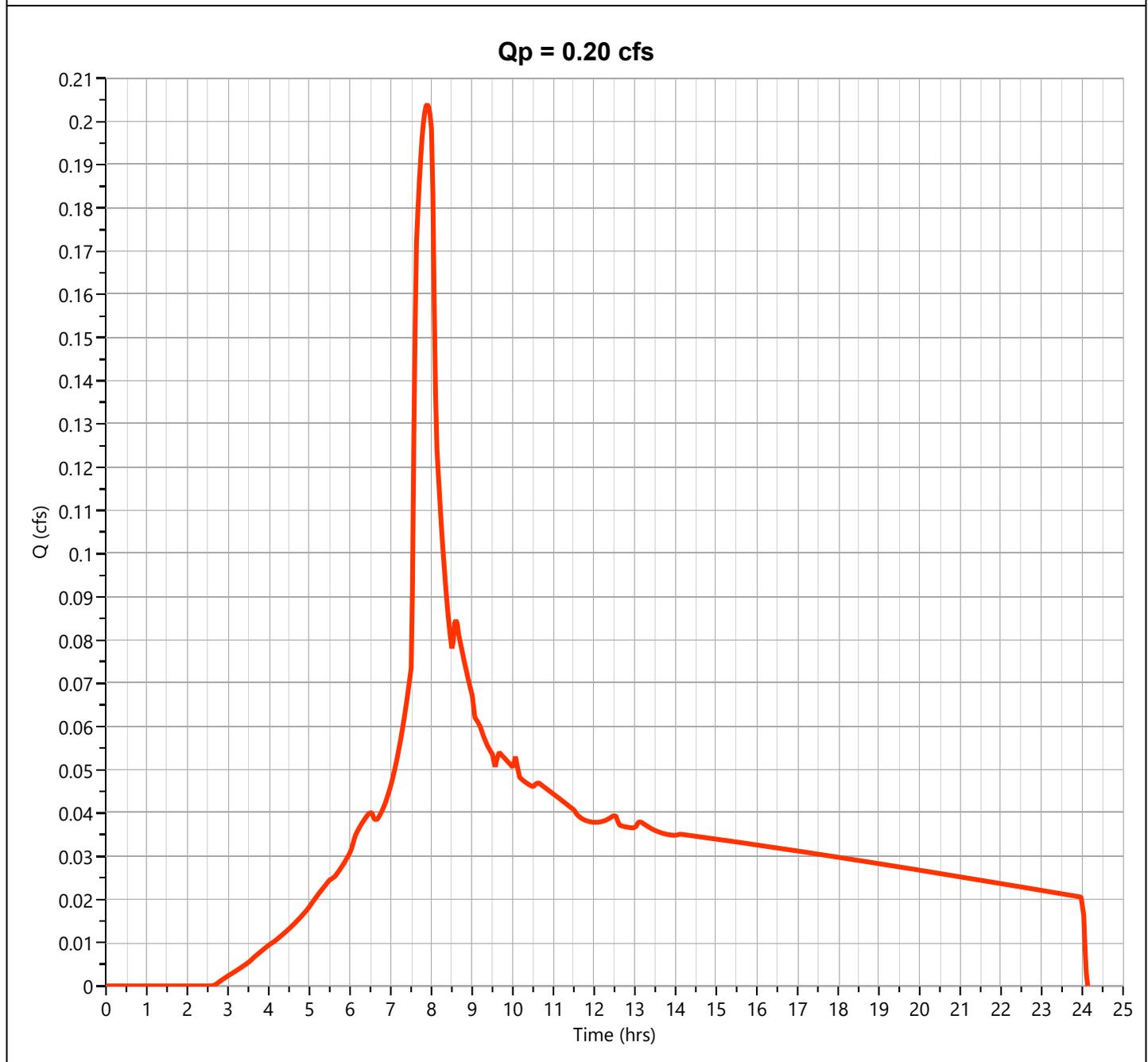
Hydrology Studio v 3.0.0.27

09-25-2023

Post dma 2.2

Hyd. No. 7

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.204 cfs
Storm Frequency	= 10-yr	Time to Peak	= 7.90 hrs
Time Interval	= 2 min	Runoff Volume	= 2,864 cuft
Drainage Area	= 0.28 ac	Curve Number	= 86.8
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 4.42 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

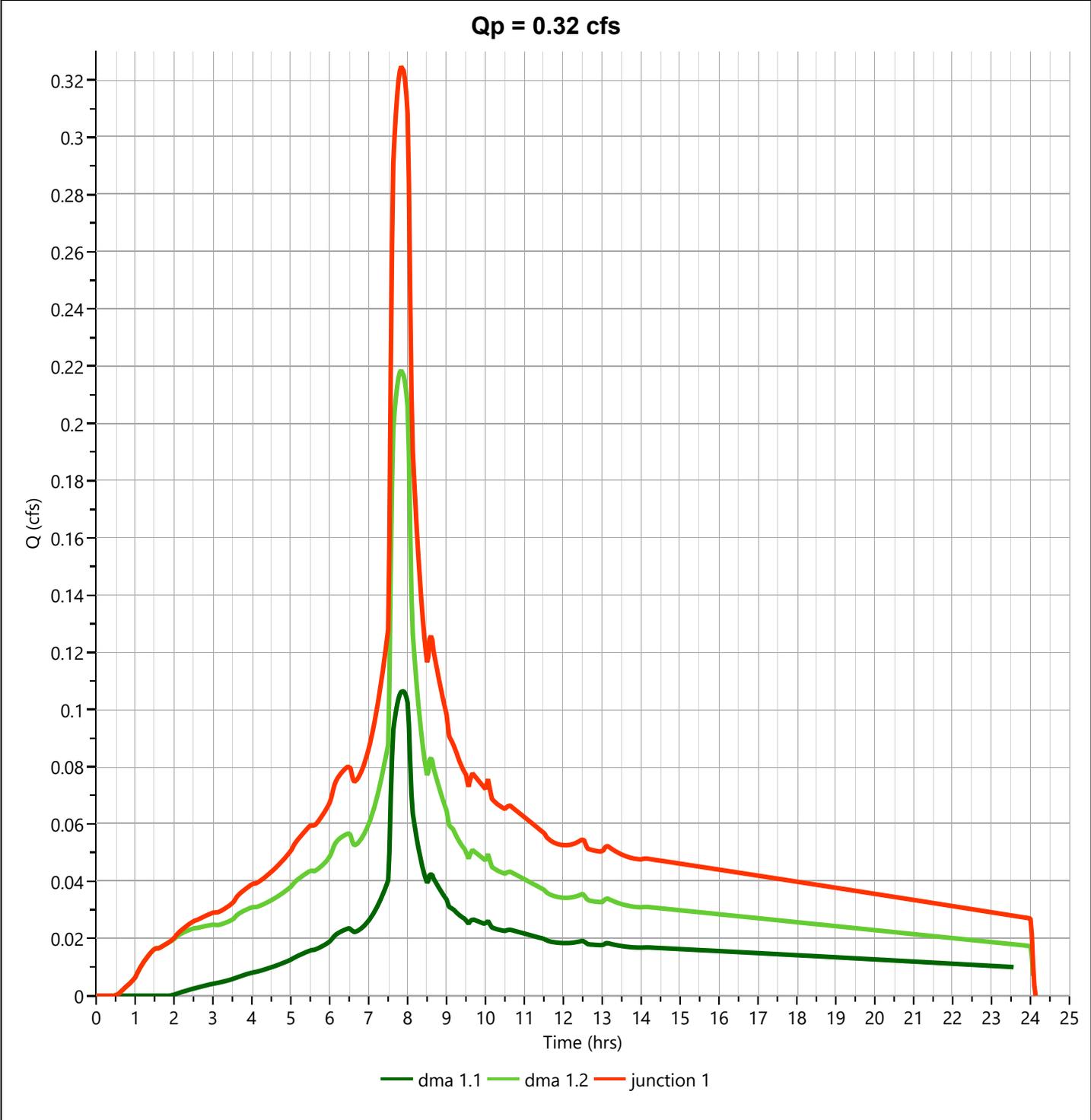
Hydrology Studio v 3.0.0.27

09-25-2023

junction 1

Hyd. No. 8

Hydrograph Type	= Junction	Peak Flow	= 0.325 cfs
Storm Frequency	= 10-yr	Time to Peak	= 7.87 hrs
Time Interval	= 2 min	Hydrograph Volume	= 4,605 cuft
Inflow Hydrographs	= 3, 4	Total Contrib. Area	= 0.347 ac



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

Post chamber 1

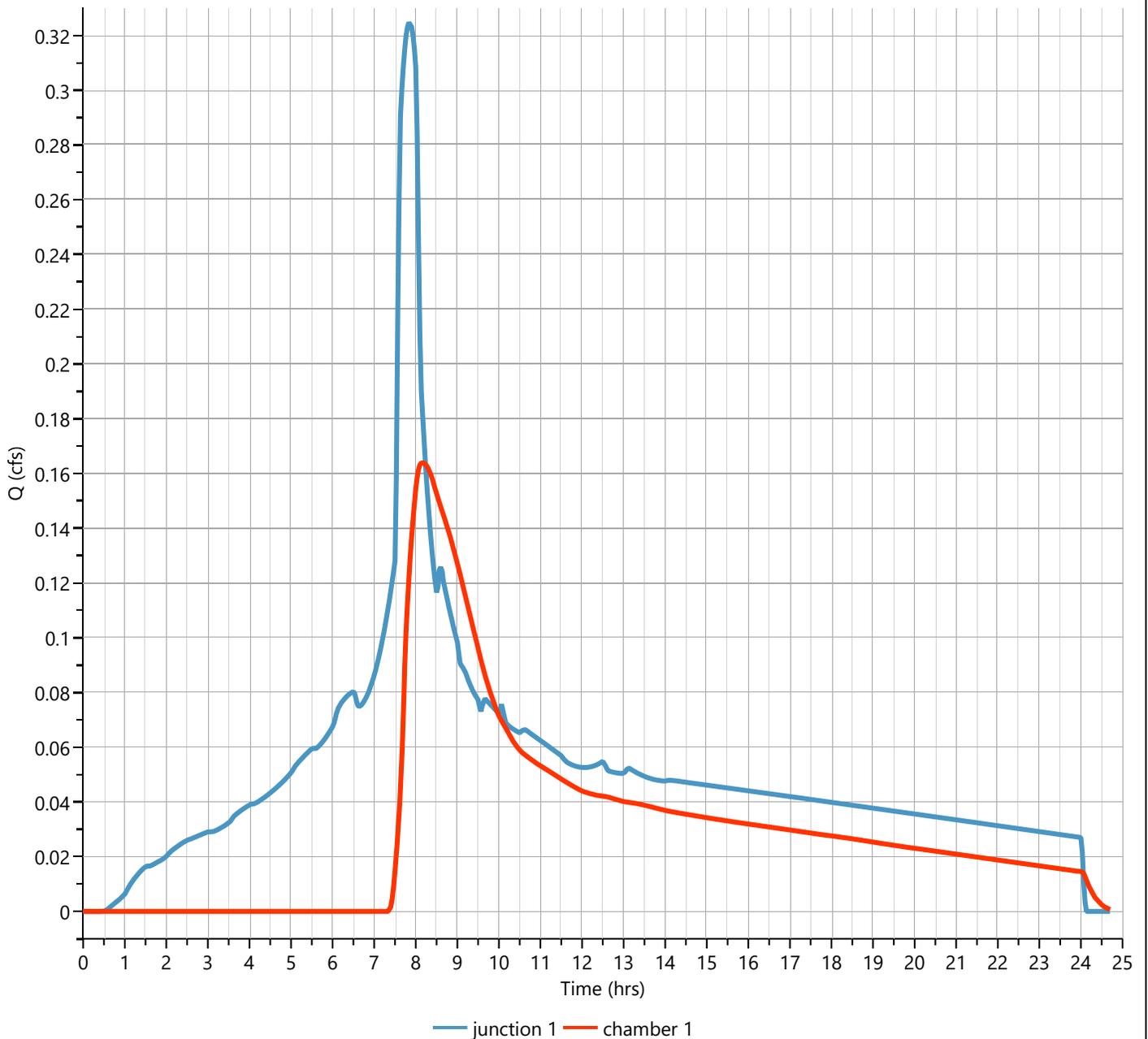
Hyd. No. 9

Hydrograph Type	= Pond Route	Peak Flow	= 0.164 cfs
Storm Frequency	= 10-yr	Time to Peak	= 8.17 hrs
Time Interval	= 2 min	Hydrograph Volume	= 2,664 cuft
Inflow Hydrograph	= 8 - junction 1	Max. Elevation	= 103.15 ft
Pond Name	= chambers 1	Max. Storage	= 1,299 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 1.61 hrs

Qp = 0.16 cfs



Hydrograph Report

Project Name:

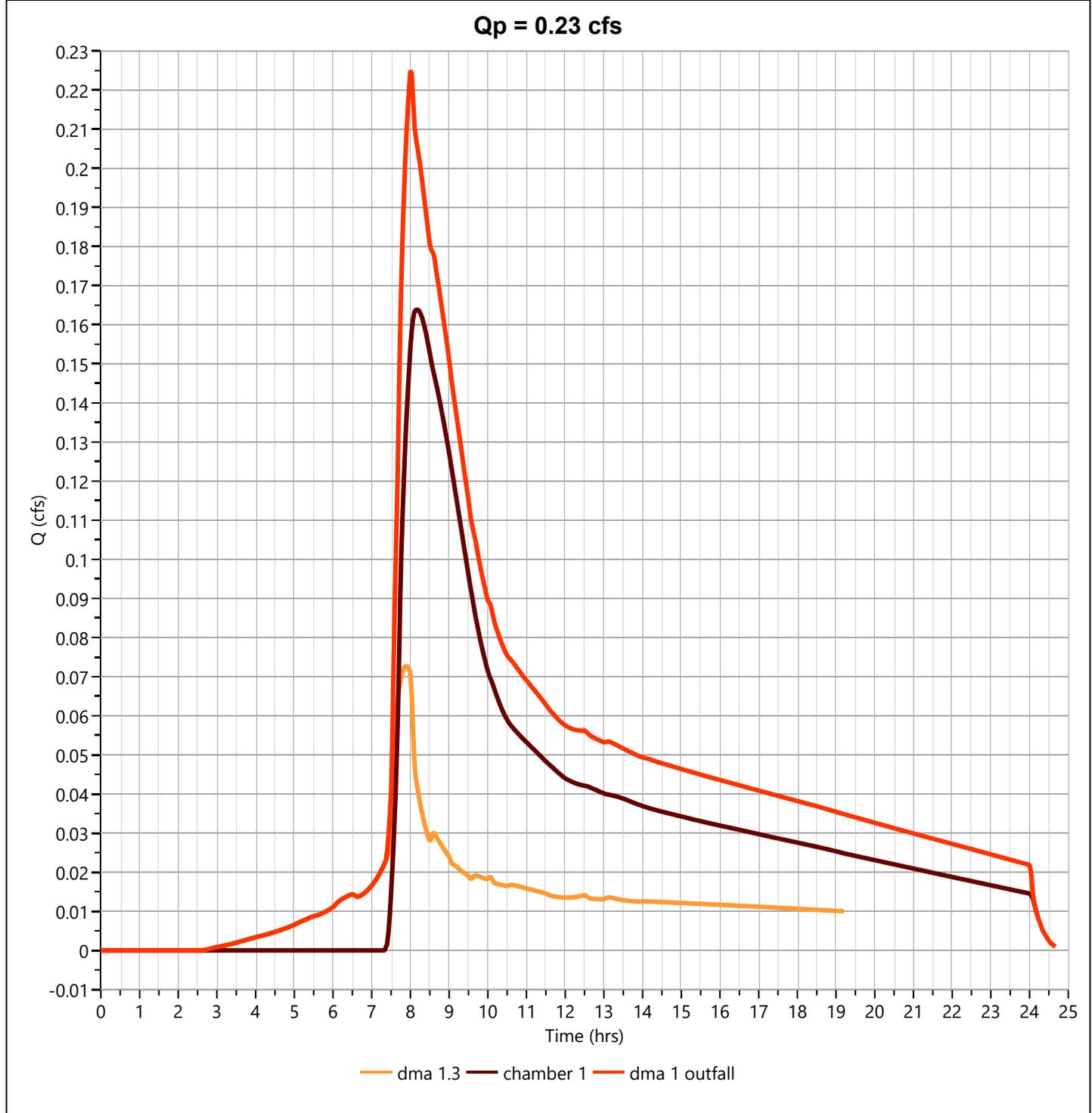
Hydrology Studio v 3.0.0.27

09-25-2023

Post dma 1 outfall

Hyd. No. 10

Hydrograph Type	= Junction	Peak Flow	= 0.225 cfs
Storm Frequency	= 10-yr	Time to Peak	= 8.00 hrs
Time Interval	= 2 min	Hydrograph Volume	= 3,687 cuft
Inflow Hydrographs	= 5, 9	Total Contrib. Area	= 0.1 ac



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

Post pond 1

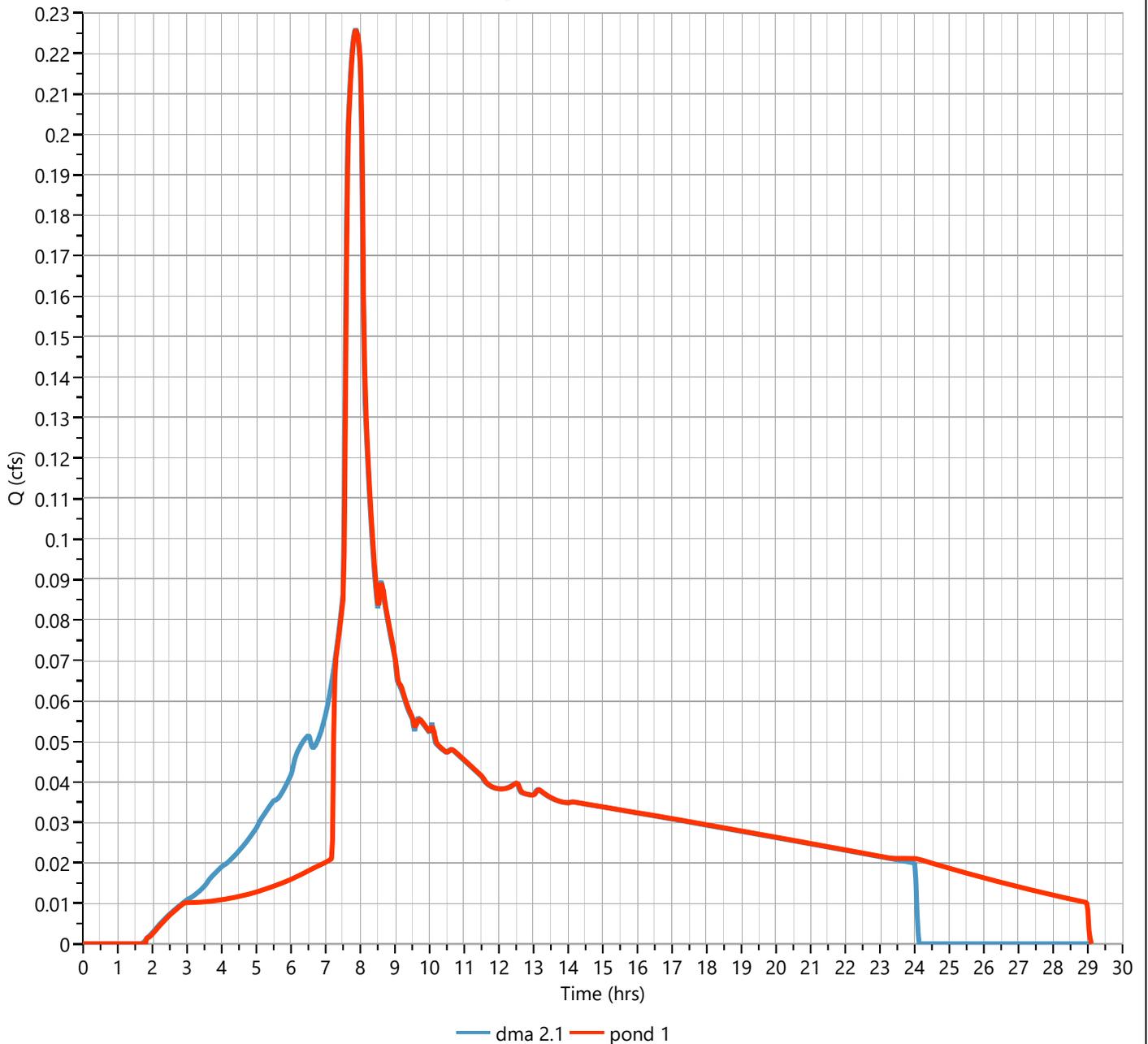
Hyd. No. 11

Hydrograph Type	= Pond Route	Peak Flow	= 0.226 cfs
Storm Frequency	= 10-yr	Time to Peak	= 7.87 hrs
Time Interval	= 2 min	Hydrograph Volume	= 3,118 cuft
Inflow Hydrograph	= 6 - dma 2.1	Max. Elevation	= 101.04 ft
Pond Name	= pond 1	Max. Storage	= 288 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 1.81 hrs

Qp = 0.23 cfs



Hydrograph Report

Project Name:

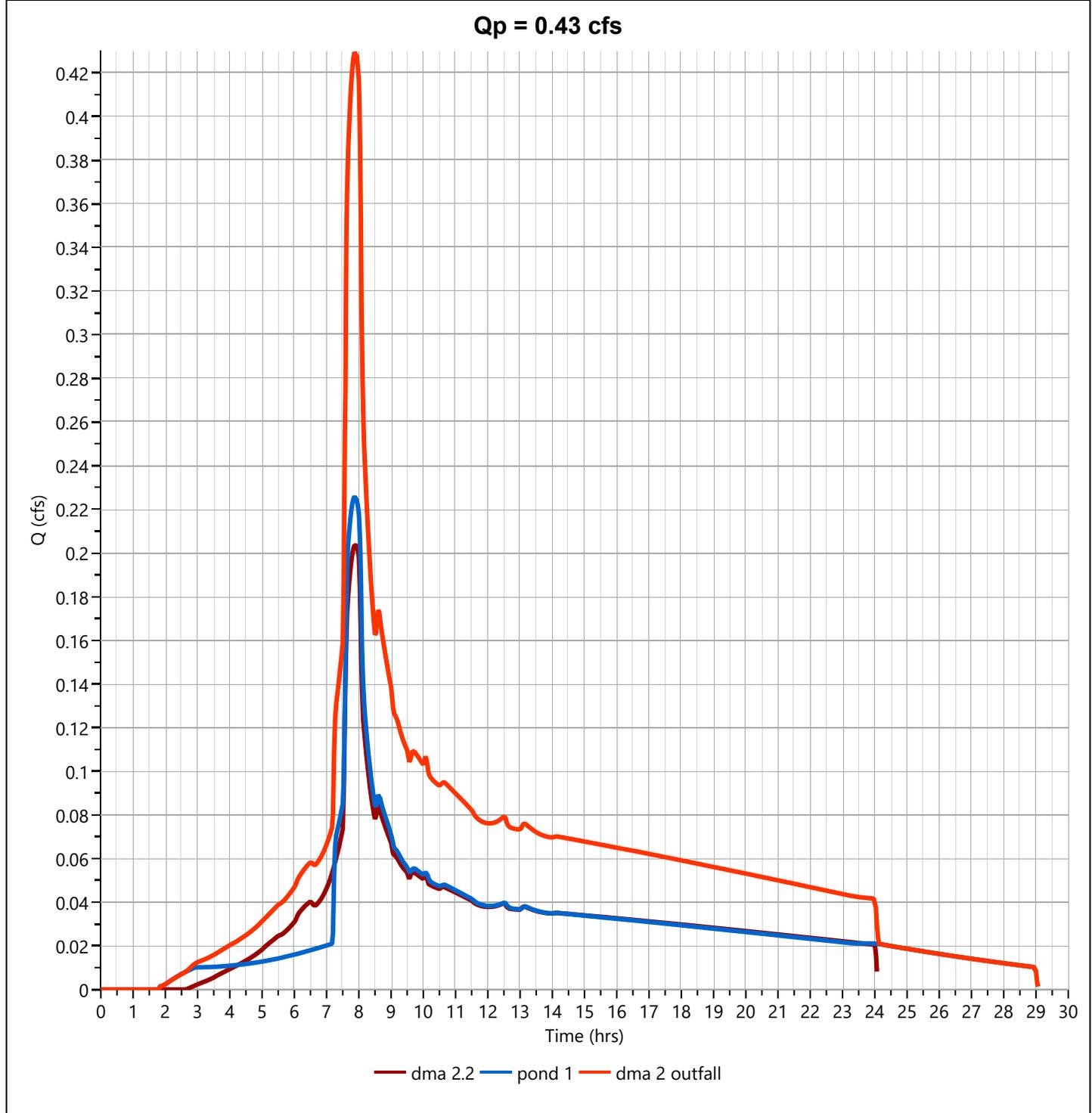
Hydrology Studio v 3.0.0.27

09-25-2023

Post dma 2 outfall

Hyd. No. 12

Hydrograph Type	= Junction	Peak Flow	= 0.430 cfs
Storm Frequency	= 10-yr	Time to Peak	= 7.90 hrs
Time Interval	= 2 min	Hydrograph Volume	= 5,982 cuft
Inflow Hydrographs	= 7, 11	Total Contrib. Area	= 0.28 ac



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

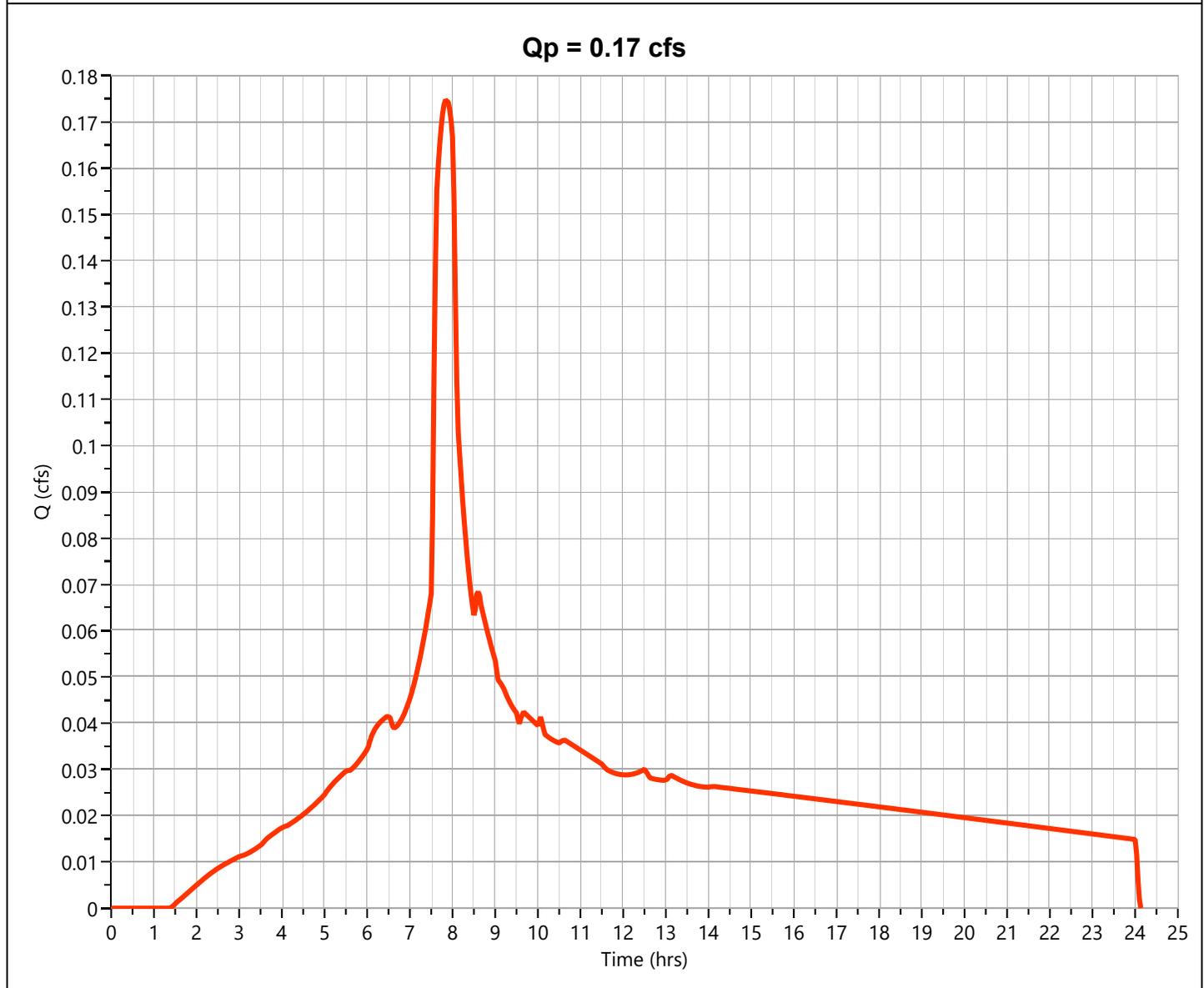
Post dma 1.1

Hyd. No. 3

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.175 cfs
Storm Frequency	= 100-yr	Time to Peak	= 7.87 hrs
Time Interval	= 2 min	Runoff Volume	= 2,420 cuft
Drainage Area	= 0.127 ac	Curve Number	= 90.86*
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 6.67 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484

* Composite CN Worksheet

AREA (ac)	CN	DESCRIPTION
0.081	87	landscaping
0.046	98	pavement
0.127	91	Weighted CN Method Employed



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

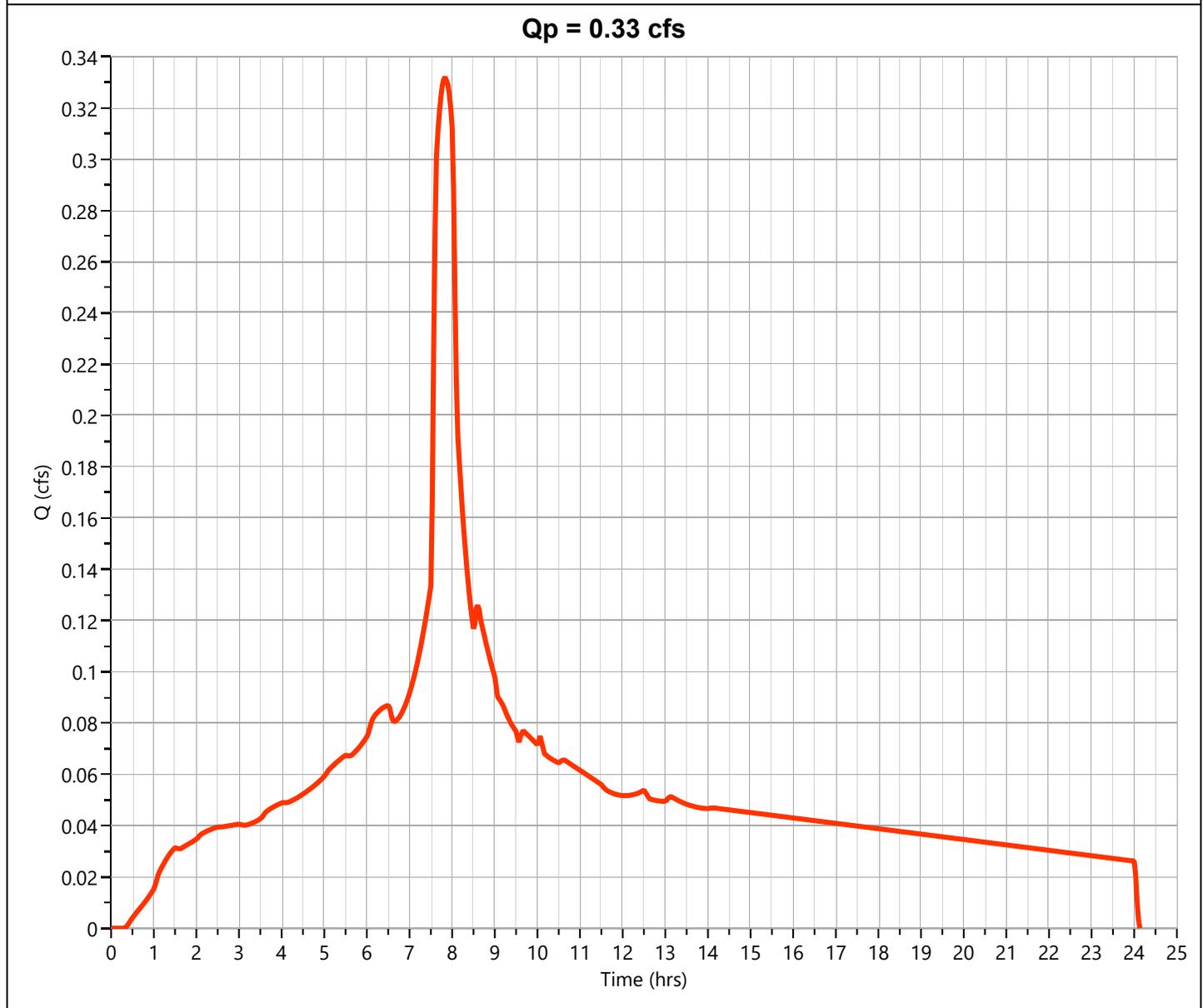
Post dma 1.2

Hyd. No. 4

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.332 cfs
Storm Frequency	= 100-yr	Time to Peak	= 7.83 hrs
Time Interval	= 2 min	Runoff Volume	= 4,815 cuft
Drainage Area	= 0.22 ac	Curve Number	= 98*
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 6.67 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484

* Composite CN Worksheet

AREA (ac)	CN	DESCRIPTION
0.22	98	ac
0.22	98	Weighted CN Method Employed



Hydrograph Report

Project Name:

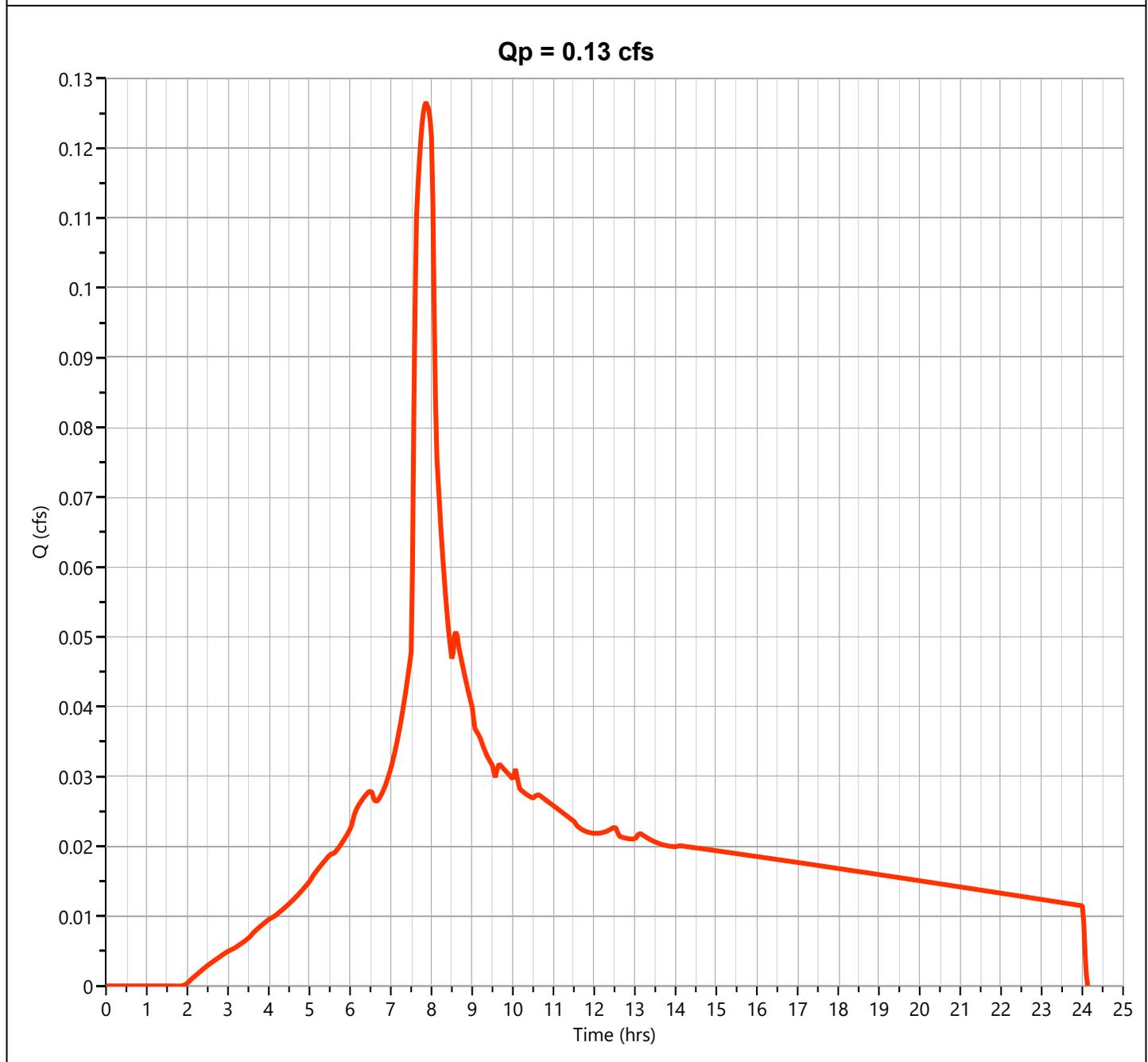
Hydrology Studio v 3.0.0.27

09-25-2023

Post dma 1.3

Hyd. No. 5

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.127 cfs
Storm Frequency	= 100-yr	Time to Peak	= 7.87 hrs
Time Interval	= 2 min	Runoff Volume	= 1,749 cuft
Drainage Area	= 0.1 ac	Curve Number	= 86.8
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 6.67 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

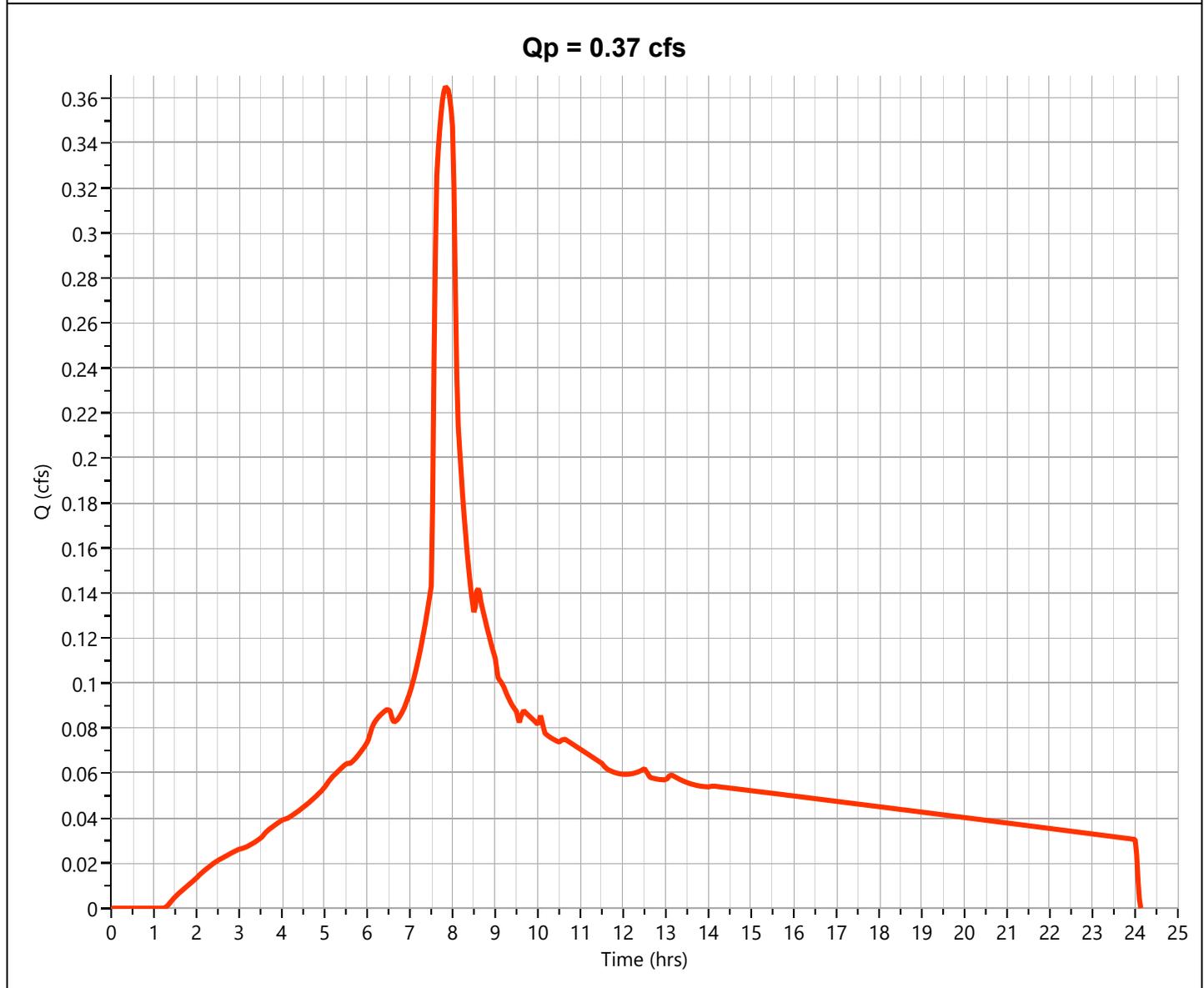
Post dma 2.1

Hyd. No. 6

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.365 cfs
Storm Frequency	= 100-yr	Time to Peak	= 7.87 hrs
Time Interval	= 2 min	Runoff Volume	= 5,069 cuft
Drainage Area	= 0.26 ac	Curve Number	= 92*
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 6.67 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484

* Composite CN Worksheet

AREA (ac)	CN	DESCRIPTION
0.11	98	roof
0.15	87	landscape
0.26	92	Weighted CN Method Employed



Hydrograph Report

Project Name:

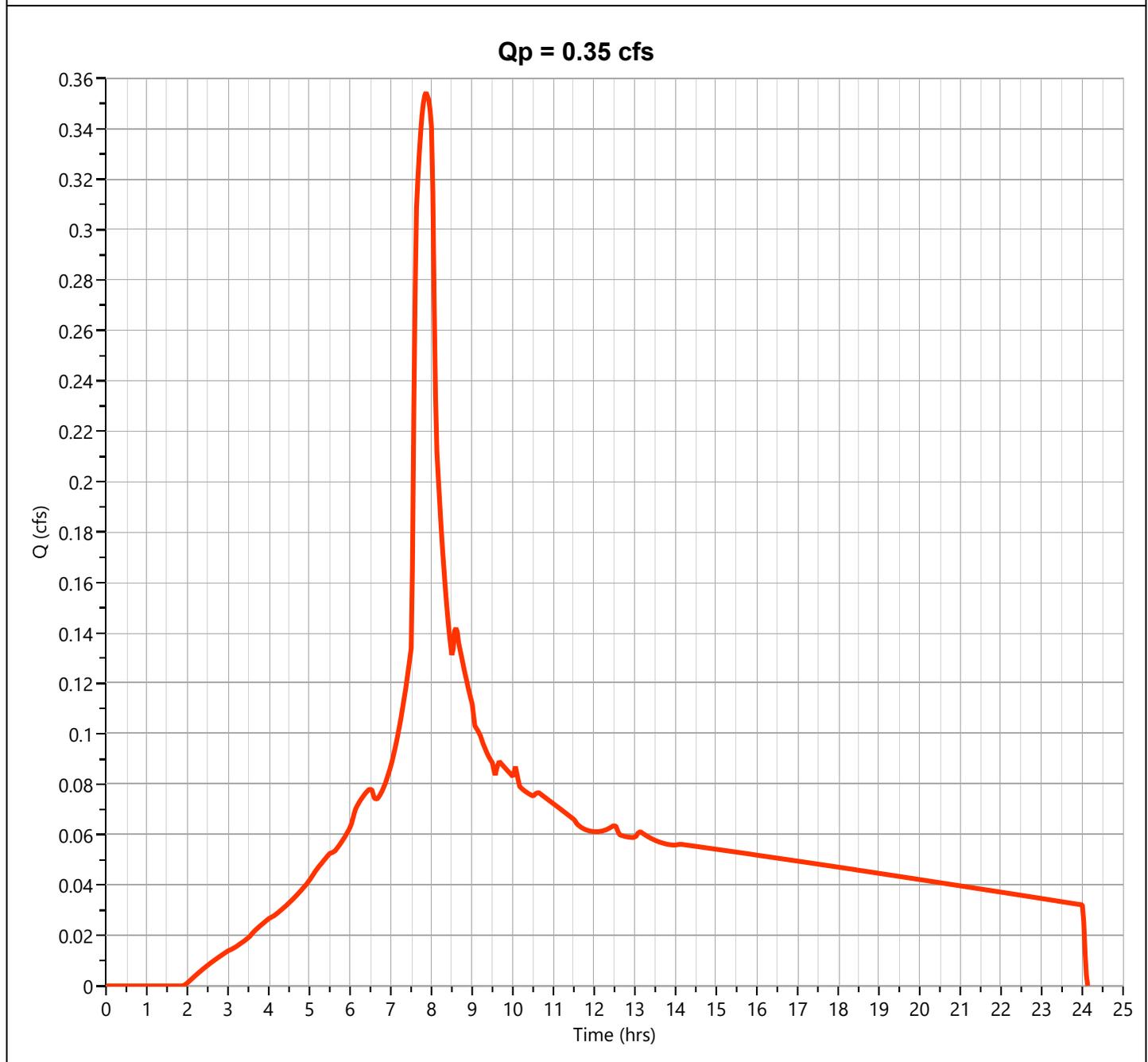
Hydrology Studio v 3.0.0.27

09-25-2023

Post dma 2.2

Hyd. No. 7

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.354 cfs
Storm Frequency	= 100-yr	Time to Peak	= 7.87 hrs
Time Interval	= 2 min	Runoff Volume	= 4,896 cuft
Drainage Area	= 0.28 ac	Curve Number	= 86.8
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 6.67 in	Design Storm	= Type IA
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

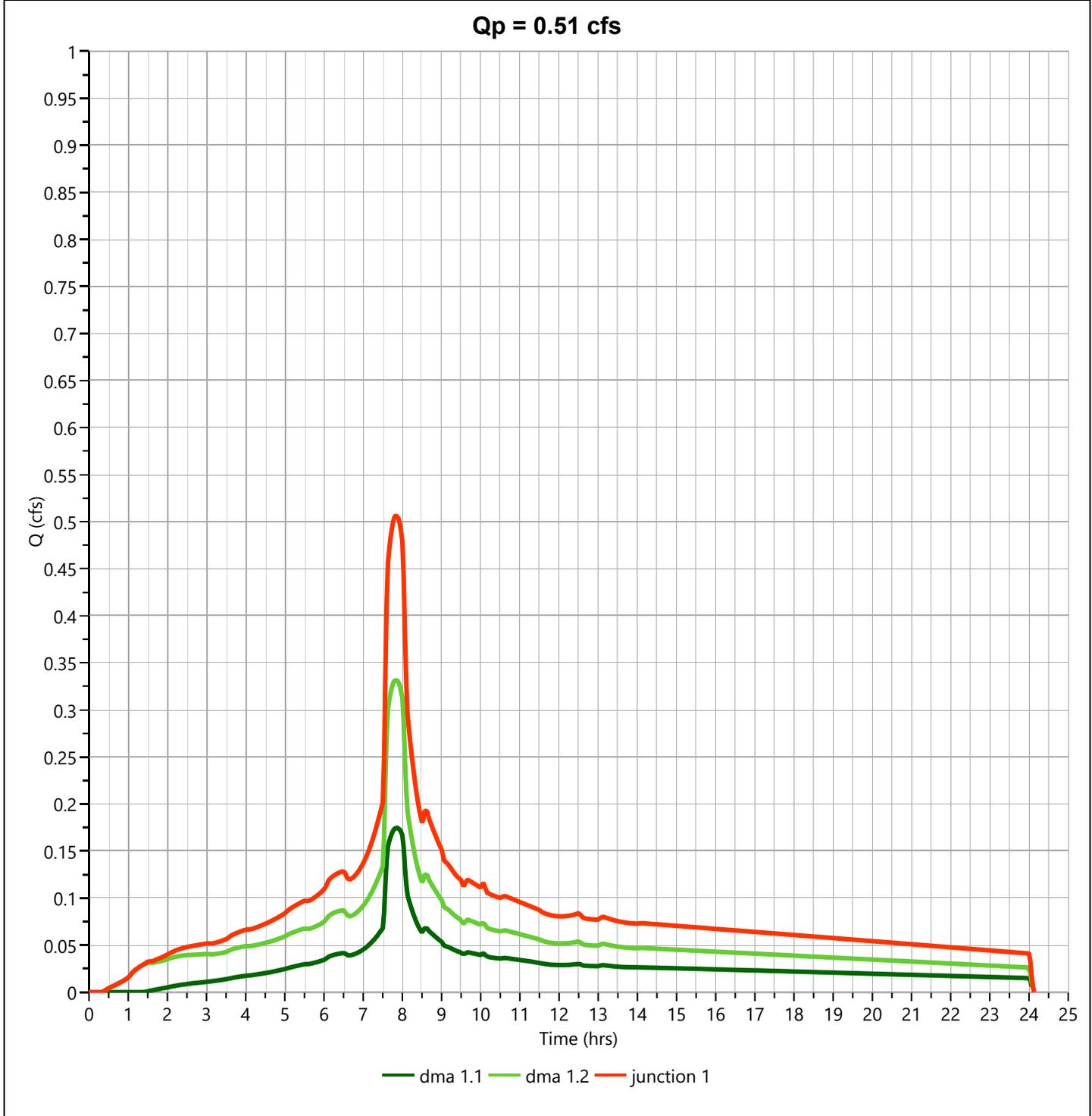
Hydrology Studio v 3.0.0.27

09-25-2023

junction 1

Hyd. No. 8

Hydrograph Type	= Junction	Peak Flow	= 0.507 cfs
Storm Frequency	= 100-yr	Time to Peak	= 7.83 hrs
Time Interval	= 2 min	Hydrograph Volume	= 7,234 cuft
Inflow Hydrographs	= 3, 4	Total Contrib. Area	= 0.347 ac



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

Post chamber 1

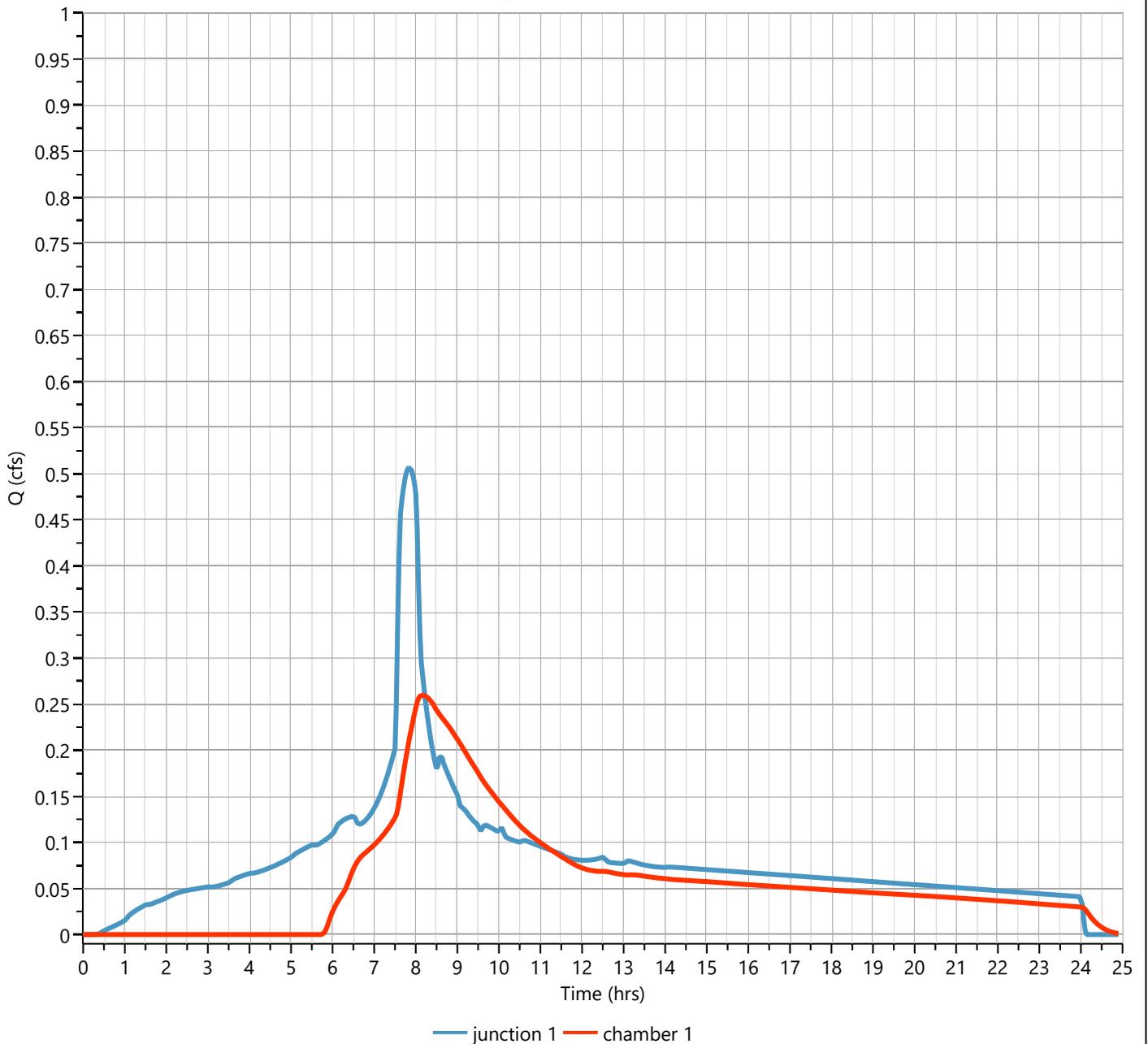
Hyd. No. 9

Hydrograph Type	= Pond Route	Peak Flow	= 0.260 cfs
Storm Frequency	= 100-yr	Time to Peak	= 8.17 hrs
Time Interval	= 2 min	Hydrograph Volume	= 5,169 cuft
Inflow Hydrograph	= 8 - junction 1	Max. Elevation	= 104.07 ft
Pond Name	= chambers 1	Max. Storage	= 1,677 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 1.38 hrs

Qp = 0.26 cfs



Hydrograph Report

Project Name:

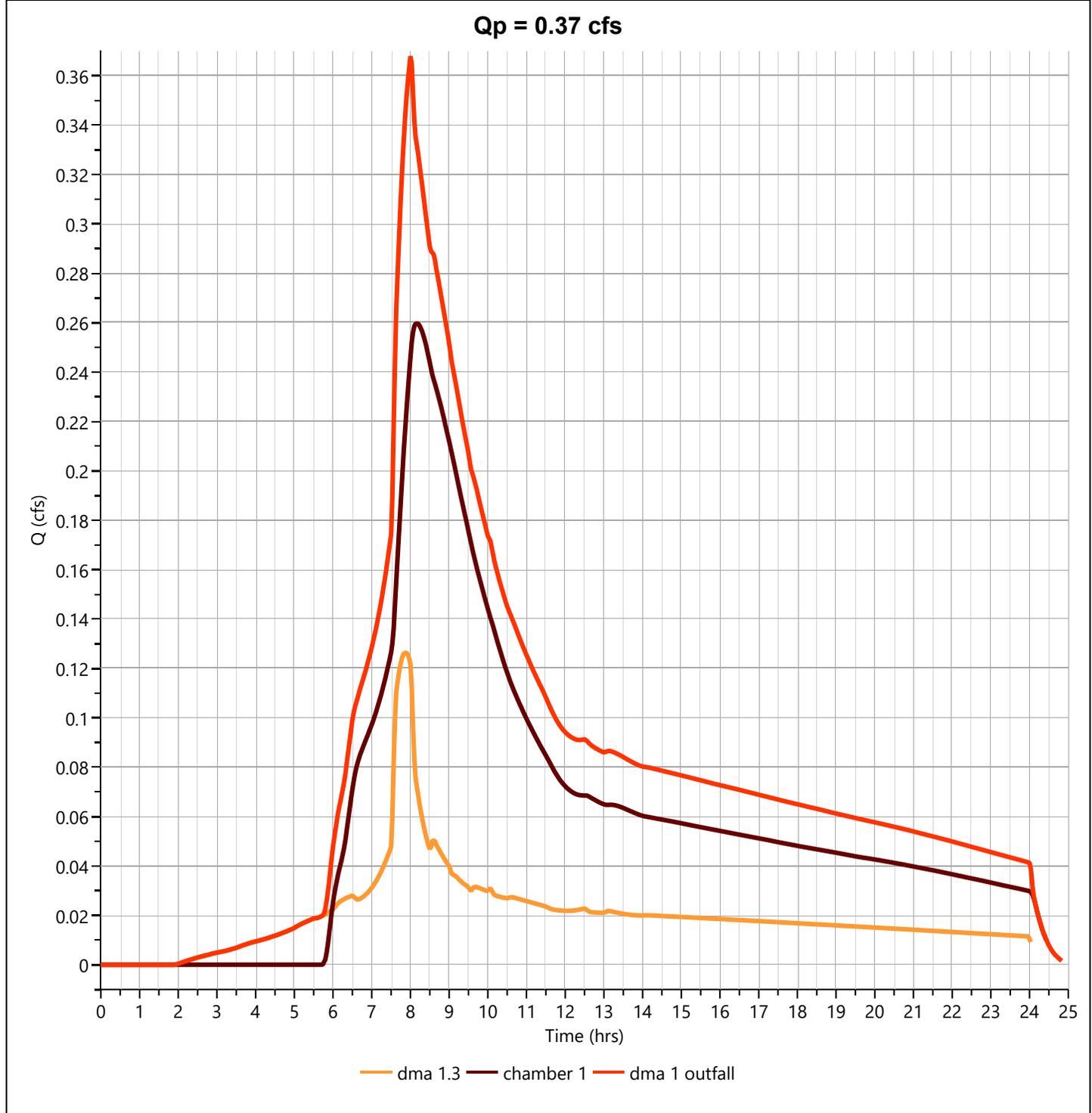
Hydrology Studio v 3.0.0.27

09-25-2023

Post dma 1 outfall

Hyd. No. 10

Hydrograph Type	= Junction	Peak Flow	= 0.368 cfs
Storm Frequency	= 100-yr	Time to Peak	= 8.00 hrs
Time Interval	= 2 min	Hydrograph Volume	= 6,917 cuft
Inflow Hydrographs	= 5, 9	Total Contrib. Area	= 0.1 ac



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

Post pond 1

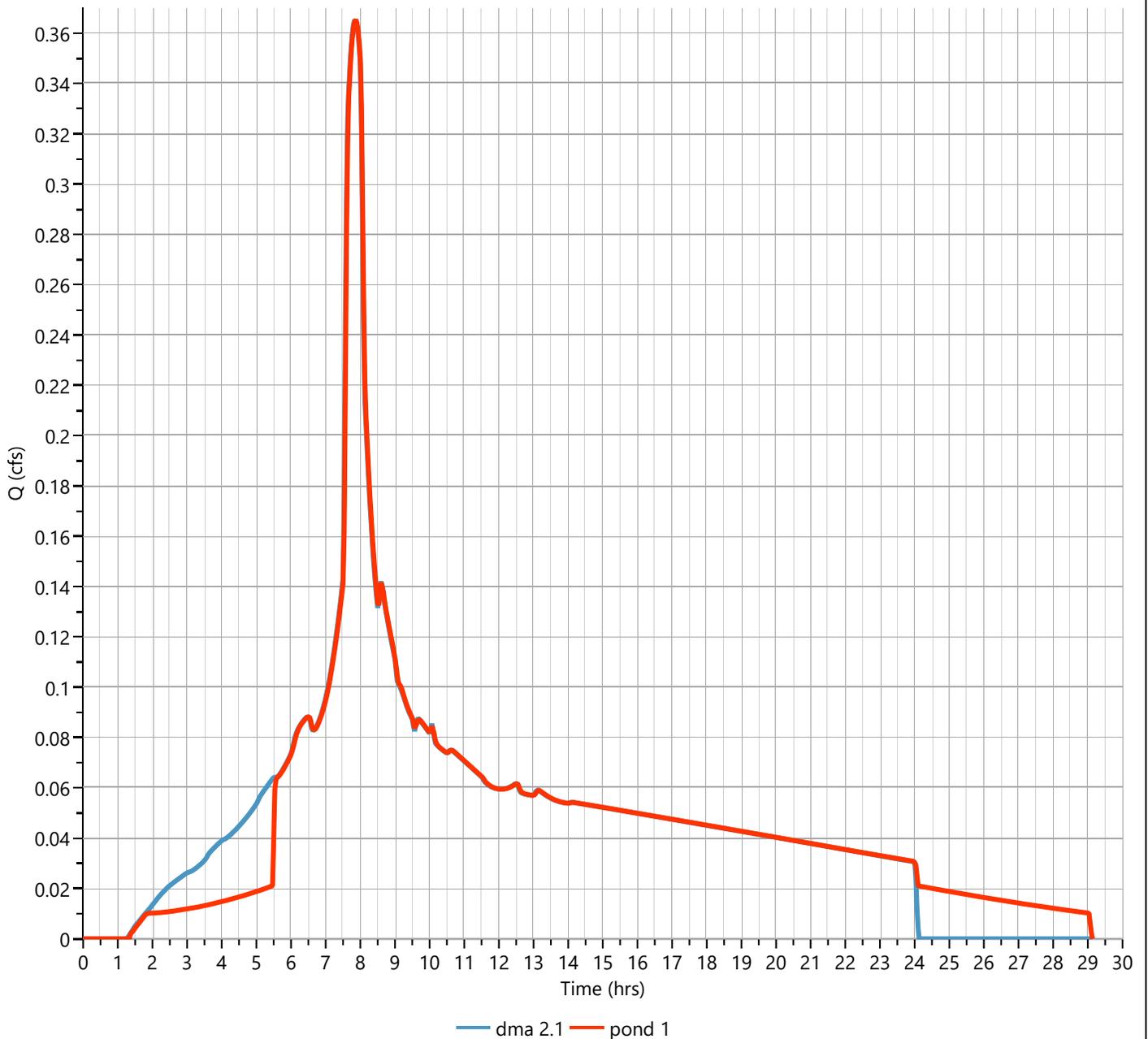
Hyd. No. 11

Hydrograph Type	= Pond Route	Peak Flow	= 0.365 cfs
Storm Frequency	= 100-yr	Time to Peak	= 7.87 hrs
Time Interval	= 2 min	Hydrograph Volume	= 5,069 cuft
Inflow Hydrograph	= 6 - dma 2.1	Max. Elevation	= 101.05 ft
Pond Name	= pond 1	Max. Storage	= 294 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 1.21 hrs

Qp = 0.37 cfs



Hydrograph Report

Project Name:

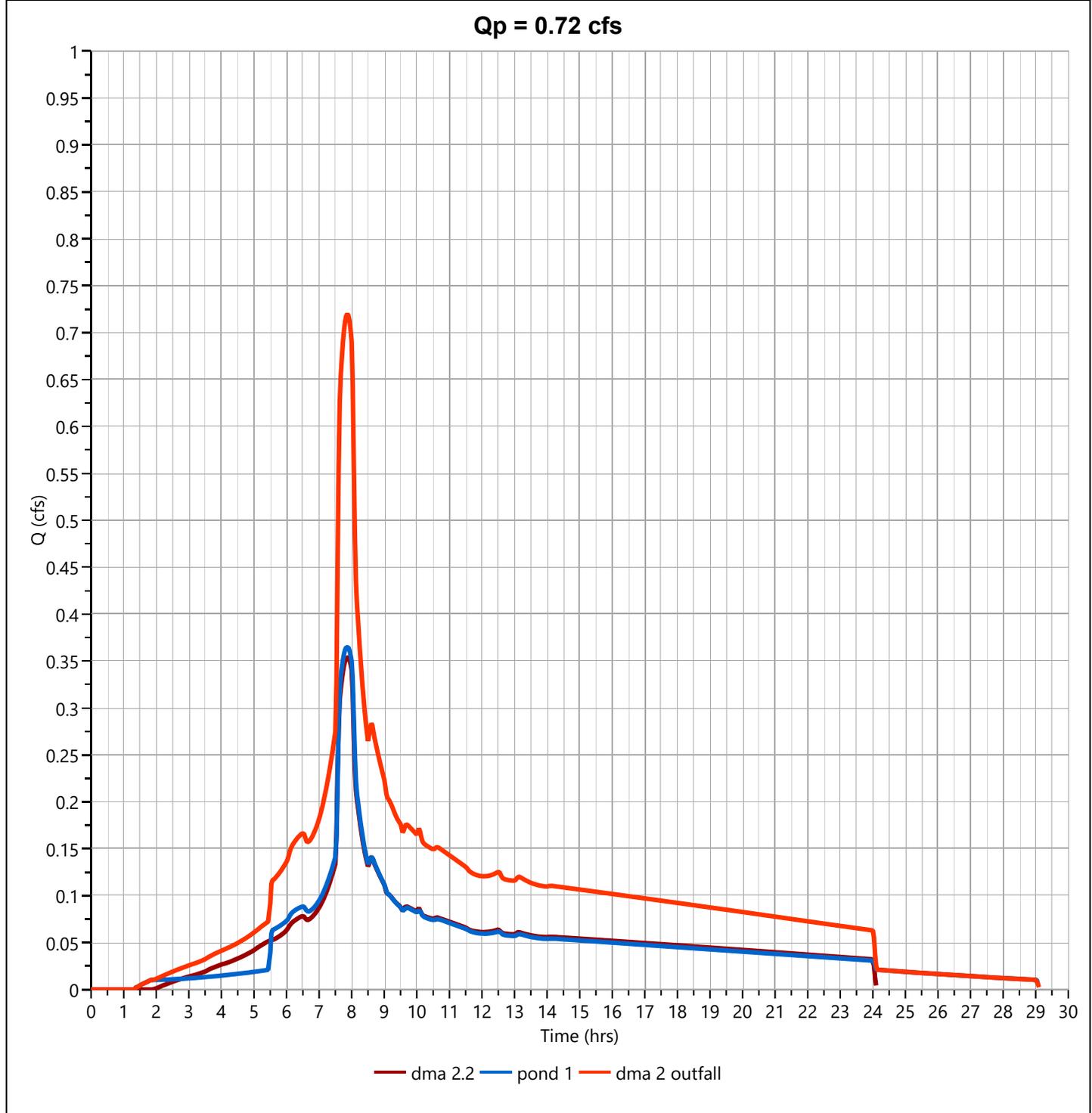
Hydrology Studio v 3.0.0.27

09-25-2023

Post dma 2 outfall

Hyd. No. 12

Hydrograph Type	= Junction	Peak Flow	= 0.720 cfs
Storm Frequency	= 100-yr	Time to Peak	= 7.87 hrs
Time Interval	= 2 min	Hydrograph Volume	= 9,965 cuft
Inflow Hydrographs	= 7, 11	Total Contrib. Area	= 0.28 ac



APPENDIX G

Hydrograph by Return Period

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Outflow (cfs)							
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1	NRCS Runoff	Pre dma 1		0.123			0.233			0.405
2	NRCS Runoff	Pre dma 2		0.261			0.495			0.861
3	NRCS Runoff	Post dma 1.1		0.061			0.107			0.175
4	NRCS Runoff	Post dma 1.2		0.142			0.219			0.332
5	NRCS Runoff	Post dma 1.3		0.038			0.073			0.127
6	NRCS Runoff	Post dma 2.1		0.132			0.226			0.365
7	NRCS Runoff	Post dma 2.2		0.107			0.204			0.354
8	Junction	junction 1		0.203			0.325			0.507
9	Pond Route	Post chamber 1		0.041			0.164			0.260
10	Junction	Post dma 1 outfall		0.054			0.225			0.368
11	Pond Route	Post pond 1		0.129			0.226			0.365
12	Junction	Post dma 2 outfall		0.235			0.430			0.720

Hydrograph 2-yr Summary

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre dma 1	0.123	7.93	1,801	---		
2	NRCS Runoff	Pre dma 2	0.261	7.93	3,828	---		
3	NRCS Runoff	Post dma 1.1	0.061	7.90	858	---		
4	NRCS Runoff	Post dma 1.2	0.142	7.83	2,013	---		
5	NRCS Runoff	Post dma 1.3	0.038	7.93	563	---		
6	NRCS Runoff	Post dma 2.1	0.132	7.90	1,845	---		
7	NRCS Runoff	Post dma 2.2	0.107	7.93	1,576	---		
8	Junction	junction 1	0.203	7.87	2,871	3, 4		
9	Pond Route	Post chamber 1	0.041	9.20	1,030	8	102.57	1,006
10	Junction	Post dma 1 outfall	0.054	9.00	1,593	5, 9		
11	Pond Route	Post pond 1	0.129	8.00	1,845	6	101.02	284
12	Junction	Post dma 2 outfall	0.235	8.00	3,422	7, 11		

Hydrograph 10-yr Summary

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre dma 1	0.233	7.90	3,273	---		
2	NRCS Runoff	Pre dma 2	0.495	7.90	6,955	---		
3	NRCS Runoff	Post dma 1.1	0.107	7.87	1,472	---		
4	NRCS Runoff	Post dma 1.2	0.219	7.83	3,133	---		
5	NRCS Runoff	Post dma 1.3	0.073	7.90	1,023	---		
6	NRCS Runoff	Post dma 2.1	0.226	7.87	3,118	---		
7	NRCS Runoff	Post dma 2.2	0.204	7.90	2,864	---		
8	Junction	junction 1	0.325	7.87	4,605	3, 4		
9	Pond Route	Post chamber 1	0.164	8.17	2,664	8	103.15	1,299
10	Junction	Post dma 1 outfall	0.225	8.00	3,687	5, 9		
11	Pond Route	Post pond 1	0.226	7.87	3,118	6	101.04	288
12	Junction	Post dma 2 outfall	0.430	7.90	5,982	7, 11		

Hydrograph 100-yr Summary

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre dma 1	0.405	7.87	5,596	---		
2	NRCS Runoff	Pre dma 2	0.861	7.87	11,891	---		
3	NRCS Runoff	Post dma 1.1	0.175	7.87	2,420	---		
4	NRCS Runoff	Post dma 1.2	0.332	7.83	4,815	---		
5	NRCS Runoff	Post dma 1.3	0.127	7.87	1,749	---		
6	NRCS Runoff	Post dma 2.1	0.365	7.87	5,069	---		
7	NRCS Runoff	Post dma 2.2	0.354	7.87	4,896	---		
8	Junction	junction 1	0.507	7.83	7,234	3, 4		
9	Pond Route	Post chamber 1	0.260	8.17	5,169	8	104.07	1,677
10	Junction	Post dma 1 outfall	0.368	8.00	6,917	5, 9		
11	Pond Route	Post pond 1	0.365	7.87	5,069	6	101.05	294
12	Junction	Post dma 2 outfall	0.720	7.87	9,965	7, 11		

APPENDIX H

Design Storm Report

Custom Storm filename:

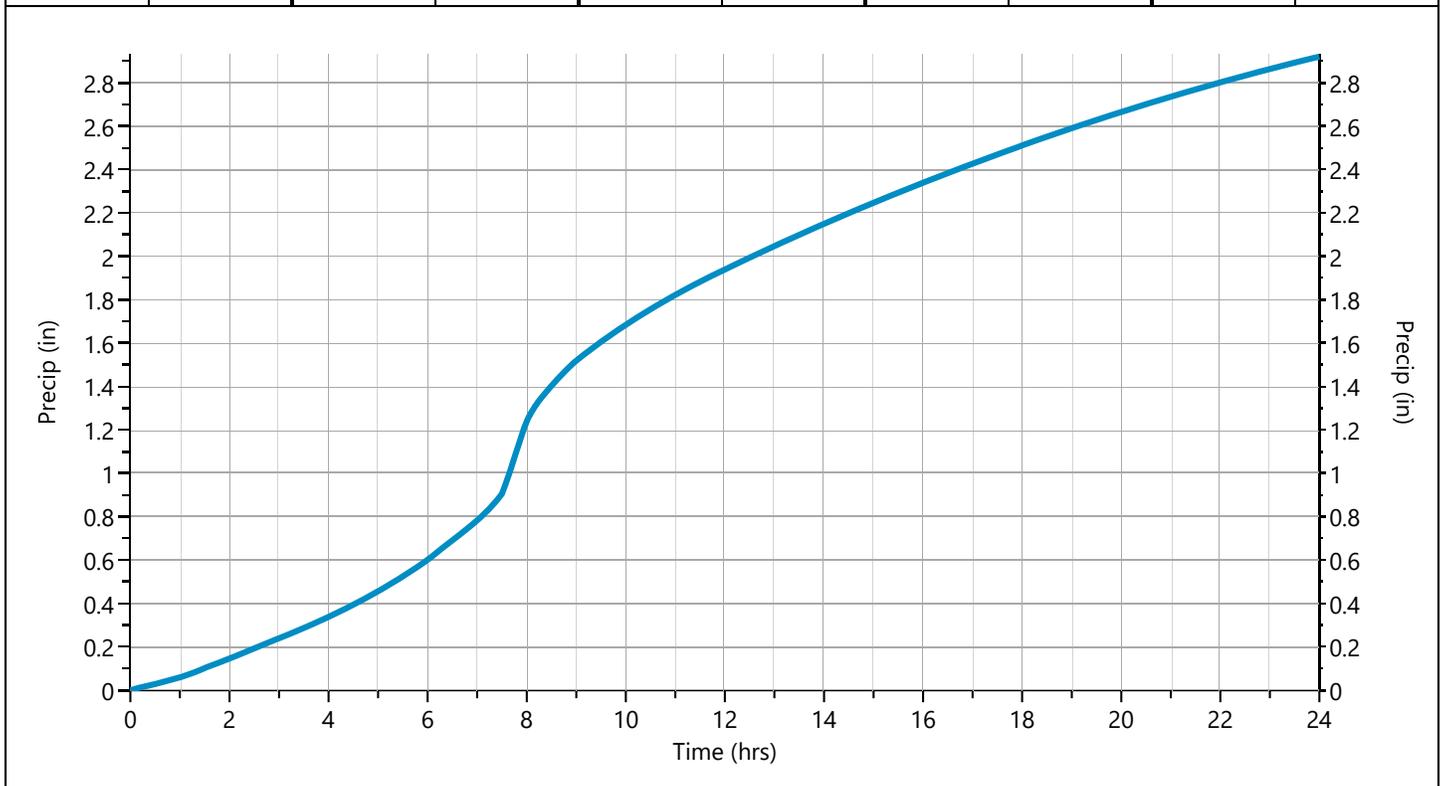
Hydrology Studio v 3.0.0.27

09-25-2023

Storm Distribution: NRCS/SCS - Type IA, 24-hr

Storm Duration	Total Rainfall Volume (in)								
	1-yr	✓ 2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
24 hrs	2.28	2.92	0.00	3.75	4.42	5.31	5.99	6.67	

Incremental Rainfall Distribution, 2-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
6.80	0.006022	7.17	0.007488	7.53	0.019920	7.90	0.022876	8.27	0.010342
6.83	0.006108	7.20	0.007678	7.57	0.020882	7.93	0.022443	8.30	0.009875
6.87	0.006203	7.23	0.007878	7.60	0.021599	7.97	0.021894	8.33	0.009447
6.90	0.006307	7.27	0.008087	7.63	0.022201	8.00	0.021231	8.37	0.009058
6.93	0.006422	7.30	0.008306	7.67	0.022689	8.03	0.014798	8.40	0.008707
6.97	0.006545	7.33	0.008535	7.70	0.023061	8.07	0.013963	8.43	0.008396
7.00	0.006679	7.37	0.008772	7.73	0.023318	8.10	0.013262	8.47	0.008123
7.03	0.006821	7.40	0.009020	7.77	0.023459	8.13	0.012600	8.50	0.007889
7.07	0.006974	7.43	0.009277	7.80	0.023486	8.17	0.011977	8.53	0.009634
7.10	0.007136	7.47	0.009543	7.83	0.023398	8.20	0.011394	8.57	0.008798
7.13	0.007307	7.50	0.009819	7.87	0.023195	8.23	0.010848	8.60	0.008611



Design Storm Report

Custom Storm filename:

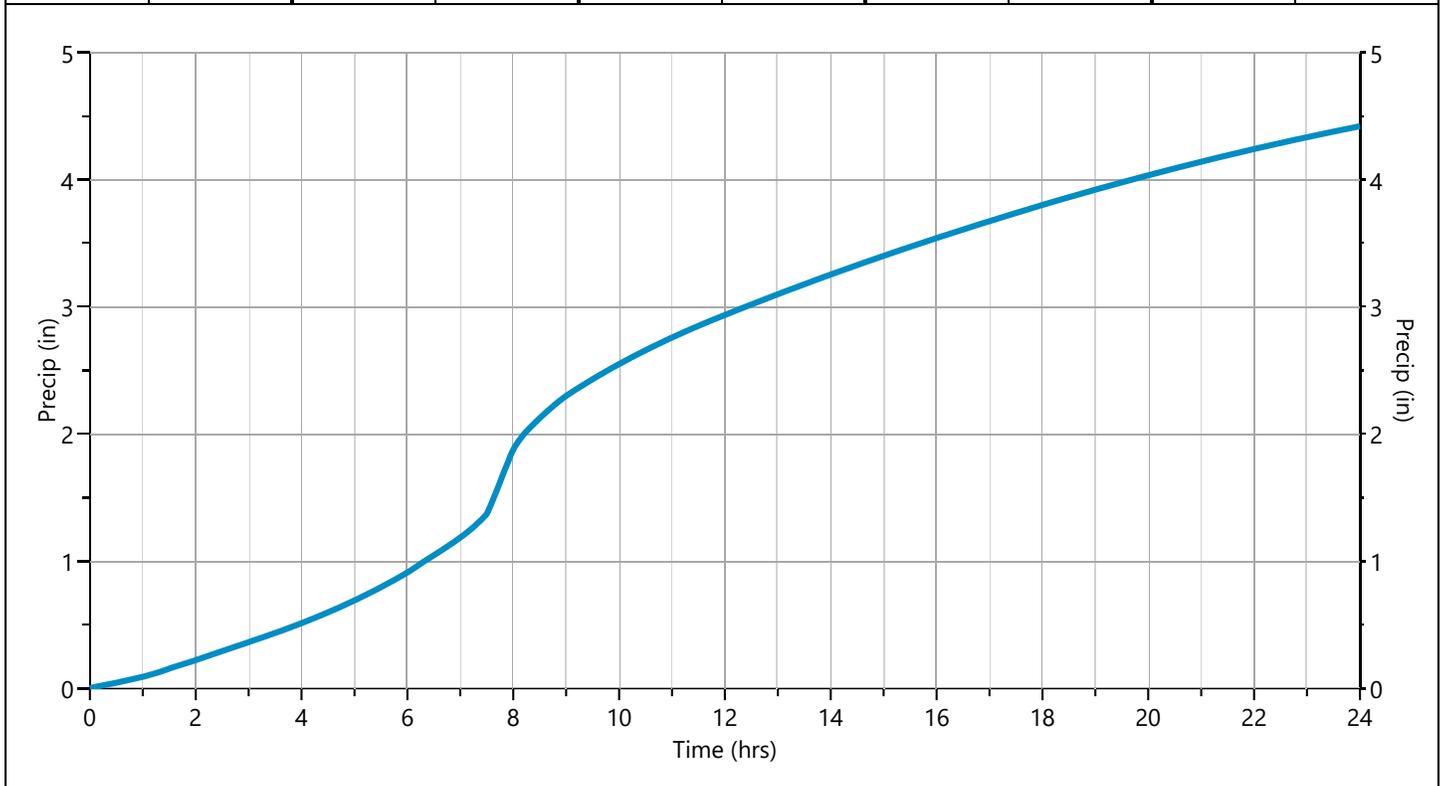
Hydrology Studio v 3.0.0.27

09-25-2023

Storm Distribution: NRCS/SCS - Type IA, 24-hr

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	5-yr	✓ 10-yr	25-yr	50-yr	100-yr	
24 hrs	2.28	2.92	0.00	3.75	4.42	5.31	5.99	6.67	

Incremental Rainfall Distribution, 10-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
6.80	0.009115	7.17	0.011334	7.53	0.030153	7.90	0.034628	8.27	0.015655
6.83	0.009245	7.20	0.011622	7.57	0.031609	7.93	0.033972	8.30	0.014948
6.87	0.009389	7.23	0.011925	7.60	0.032695	7.97	0.033141	8.33	0.014300
6.90	0.009548	7.27	0.012242	7.63	0.033606	8.00	0.032137	8.37	0.013710
6.93	0.009720	7.30	0.012573	7.67	0.034344	8.03	0.022399	8.40	0.013180
6.97	0.009908	7.33	0.012919	7.70	0.034907	8.07	0.021136	8.43	0.012708
7.00	0.010110	7.37	0.013279	7.73	0.035296	8.10	0.020075	8.47	0.012296
7.03	0.010326	7.40	0.013653	7.77	0.035510	8.13	0.019073	8.50	0.011942
7.07	0.010556	7.43	0.014042	7.80	0.035551	8.17	0.018130	8.53	0.014583
7.10	0.010801	7.47	0.014446	7.83	0.035417	8.20	0.017246	8.57	0.013317
7.13	0.011060	7.50	0.014863	7.87	0.035110	8.23	0.016421	8.60	0.013035



Design Storm Report

Custom Storm filename:

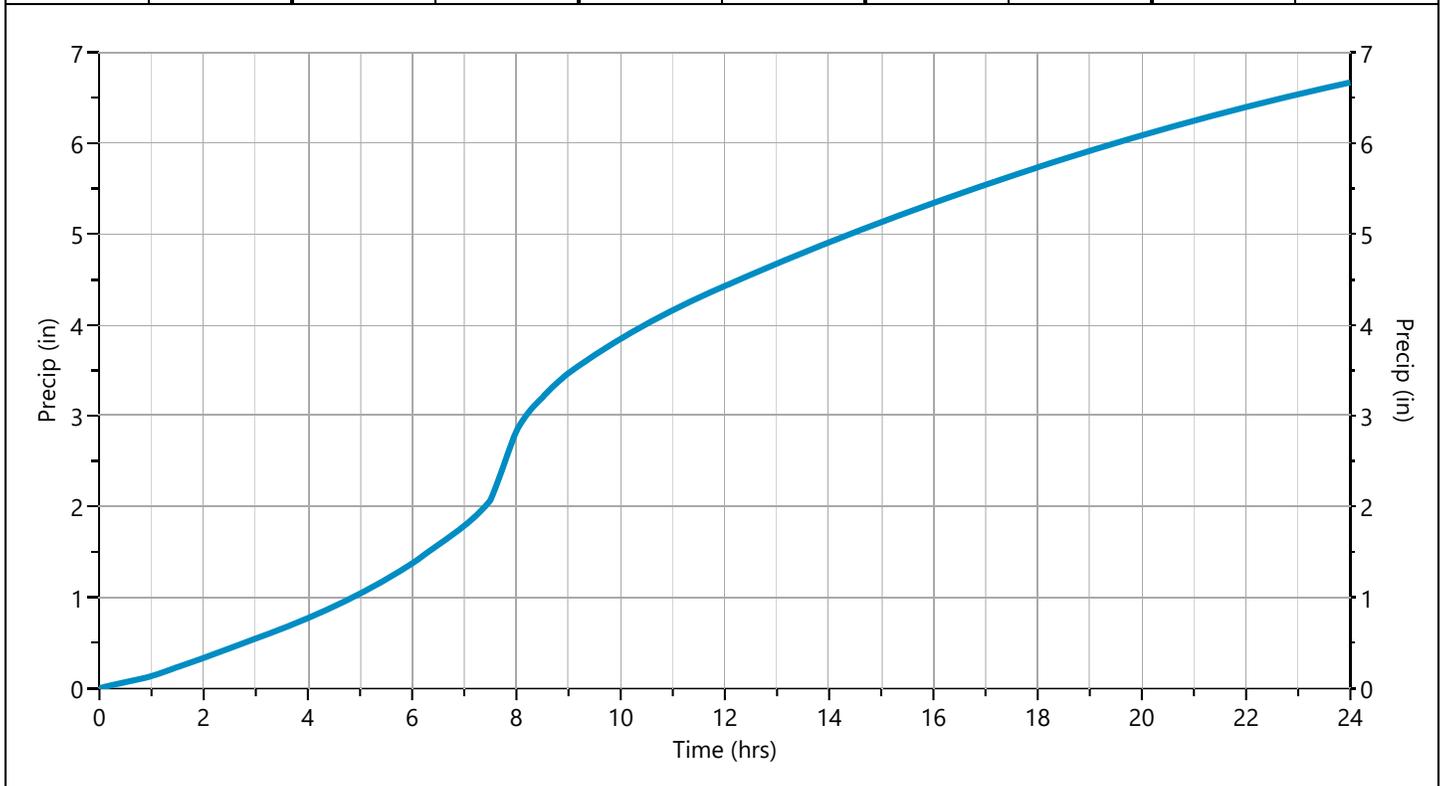
Hydrology Studio v 3.0.0.27

09-25-2023

Storm Distribution: NRCS/SCS - Type IA, 24-hr

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	✓ 100-yr	
24 hrs	2.28	2.92	0.00	3.75	4.42	5.31	5.99	6.67	

Incremental Rainfall Distribution, 100-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
6.80	0.013756	7.17	0.017104	7.53	0.045502	7.90	0.052255	8.27	0.023624
6.83	0.013951	7.20	0.017538	7.57	0.047700	7.93	0.051265	8.30	0.022557
6.87	0.014169	7.23	0.017995	7.60	0.049338	7.97	0.050012	8.33	0.021579
6.90	0.014408	7.27	0.018473	7.63	0.050714	8.00	0.048496	8.37	0.020689
6.93	0.014669	7.30	0.018973	7.67	0.051826	8.03	0.033801	8.40	0.019889
6.97	0.014951	7.33	0.019495	7.70	0.052676	8.07	0.031895	8.43	0.019178
7.00	0.015256	7.37	0.020038	7.73	0.053263	8.10	0.030294	8.47	0.018555
7.03	0.015582	7.40	0.020604	7.77	0.053587	8.13	0.028782	8.50	0.018021
7.07	0.015930	7.43	0.021191	7.80	0.053648	8.17	0.027359	8.53	0.022007
7.10	0.016299	7.47	0.021799	7.83	0.053447	8.20	0.026026	8.57	0.020096
7.13	0.016691	7.50	0.022430	7.87	0.052982	8.23	0.024780	8.60	0.019671



IDF Report

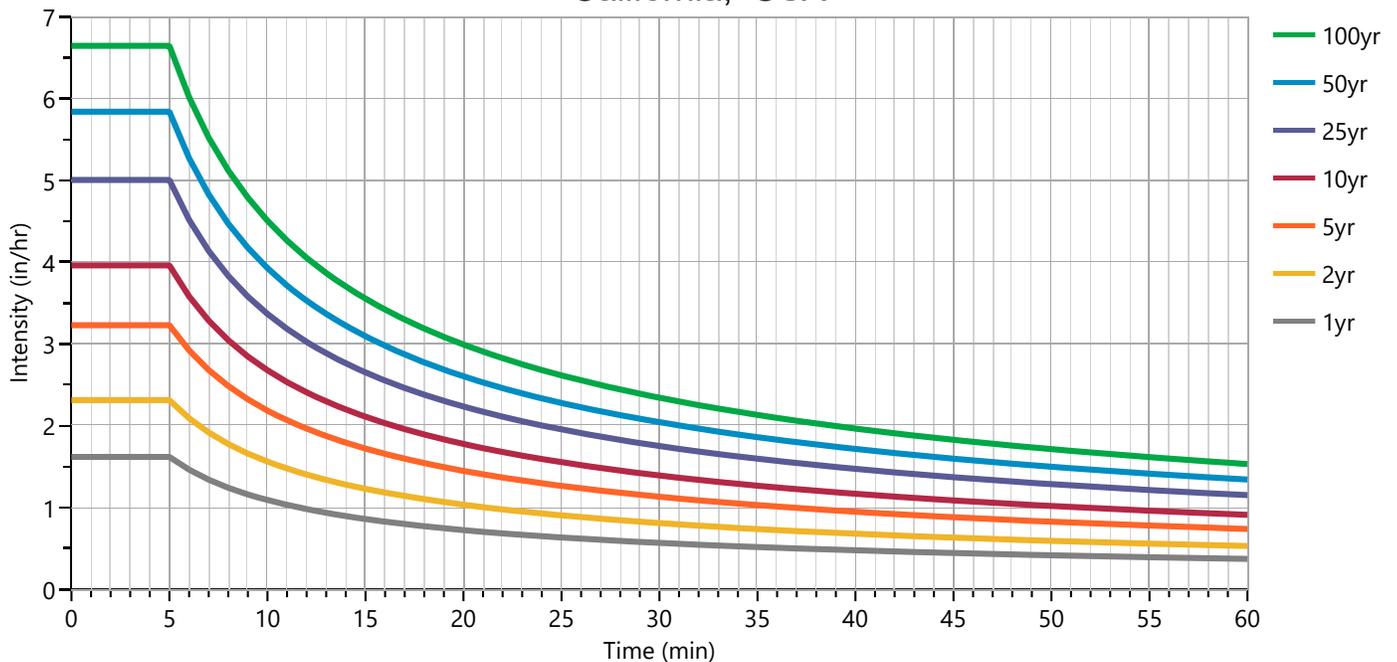
Equation Coefficients	Intensity = B / (Tc + D)^E (in/hr)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
B	4.6908	6.8485	0.0000	9.7396	11.6724	14.2205	16.6123	19.9160	
D	0.6000	0.7000	0.0000	0.8000	0.7000	0.5000	0.5000	0.8000	
E	0.6182	0.6241	0.0000	0.6284	0.6214	0.6130	0.6136	0.6248	

Minimum Tc = 5 minutes

Tc (min)	Intensity Values (in/hr)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
Cf	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
5	1.62	2.31	0	3.23	3.96	5.00	5.84	6.64	
10	1.09	1.56	0	2.18	2.68	3.36	3.92	4.50	
15	0.86	1.23	0	1.72	2.11	2.65	3.09	3.55	
20	0.72	1.03	0	1.45	1.78	2.23	2.60	2.99	
25	0.63	0.90	0	1.26	1.55	1.95	2.28	2.61	
30	0.57	0.81	0	1.13	1.39	1.75	2.04	2.34	
35	0.52	0.74	0	1.03	1.27	1.59	1.86	2.13	
40	0.48	0.68	0	0.95	1.17	1.47	1.71	1.96	
45	0.44	0.63	0	0.88	1.09	1.37	1.60	1.83	
50	0.41	0.59	0	0.83	1.02	1.28	1.50	1.71	
55	0.39	0.56	0	0.78	0.96	1.21	1.41	1.61	
60	0.37	0.53	0	0.74	0.91	1.15	1.34	1.53	

Cf = Correction Factor applied to Rational Method runoff coefficient.

California, USA



APPENDIX I

Pond Report

Project Name:

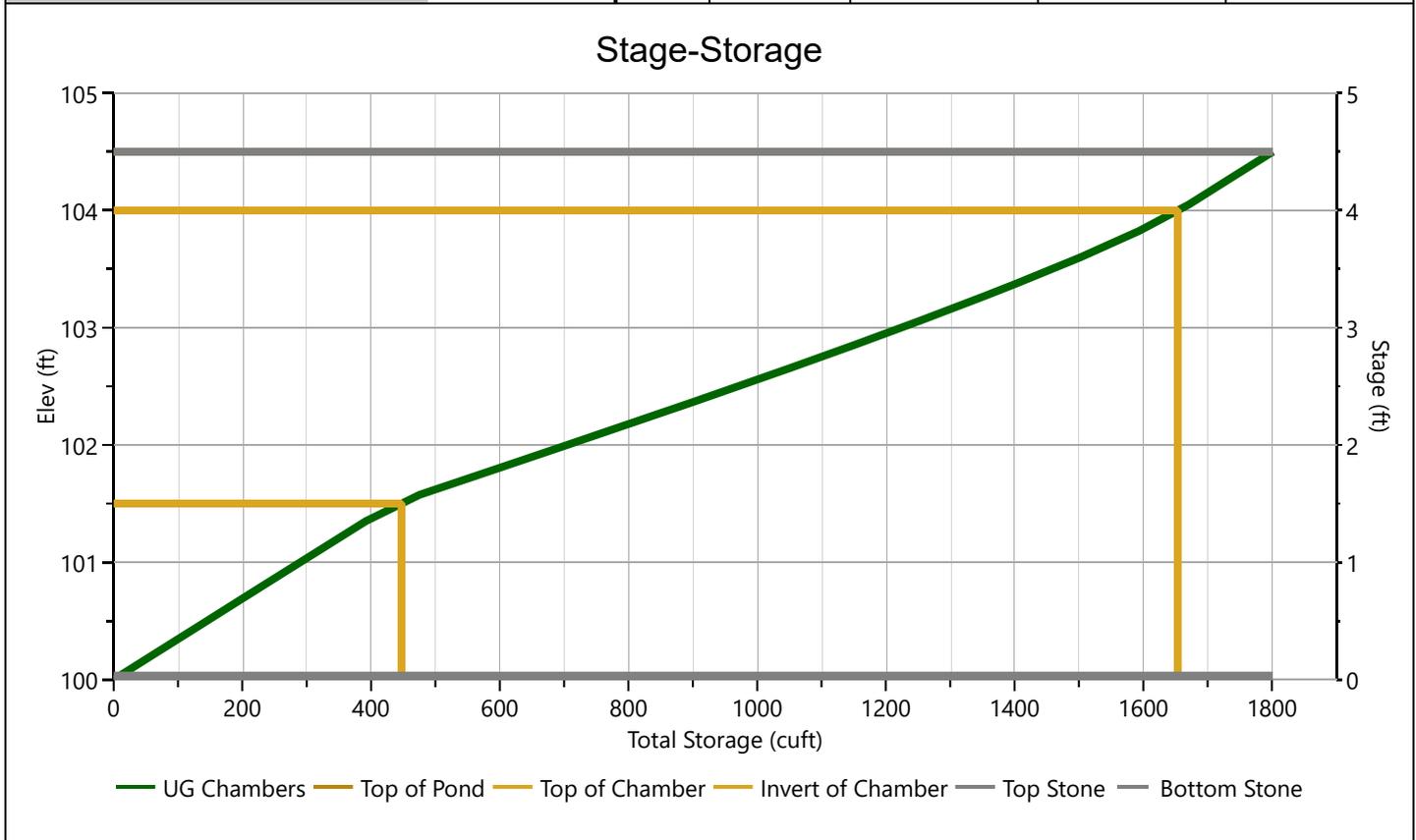
Hydrology Studio v 3.0.0.27

09-25-2023

chambers 1

Stage-Storage

StormTech® SC-740™ Chamber		Stage / Storage Table				
Description	Input	Stage (in)	Elevation (ft)	Contour Area (sqft)	Incr. Storage (cuft)	Total Storage (cuft)
Chamber Height, in	30	0.0	100.00	725	0.000	0.000
Chamber Shape	Arch	2.7	100.23	725	65.3	65.3
Chamber Width, in	51	5.4	100.45	725	65.3	131
Installed Length, ft	7.12	8.1	100.68	725	65.3	196
No. Chambers	18	10.8	100.90	725	65.3	261
Bare Chamber Stor, cuft	826	13.5	101.13	725	65.3	326
No. Rows	3	16.2	101.35	725	65.3	392
Space Between Rows, in	6	18.9	101.58	725	83.7	475
Stone Above, in	6	21.6	101.80	725	122	597
Stone Below, in	18	24.3	102.03	725	121	718
Stone Sides, in	12	27.0	102.25	725	120	839
Stone Ends, in	12	29.7	102.48	725	119	957
Encasement Voids, %	40.00	32.4	102.70	725	116	1,073
Encasement Bottom Elevation, ft	100.00	35.1	102.93	725	114	1,187
		37.8	103.15	725	110	1,297
		40.5	103.38	725	105	1,402
		43.2	103.60	725	99.6	1,502
		45.9	103.83	725	91.5	1,594
		48.6	104.05	725	77.2	1,671
		51.3	104.28	725	65.3	1,736
		54.0	104.50	725	65.3	1,801



Pond Report

Project Name:

Hydrology Studio v 3.0.0.27

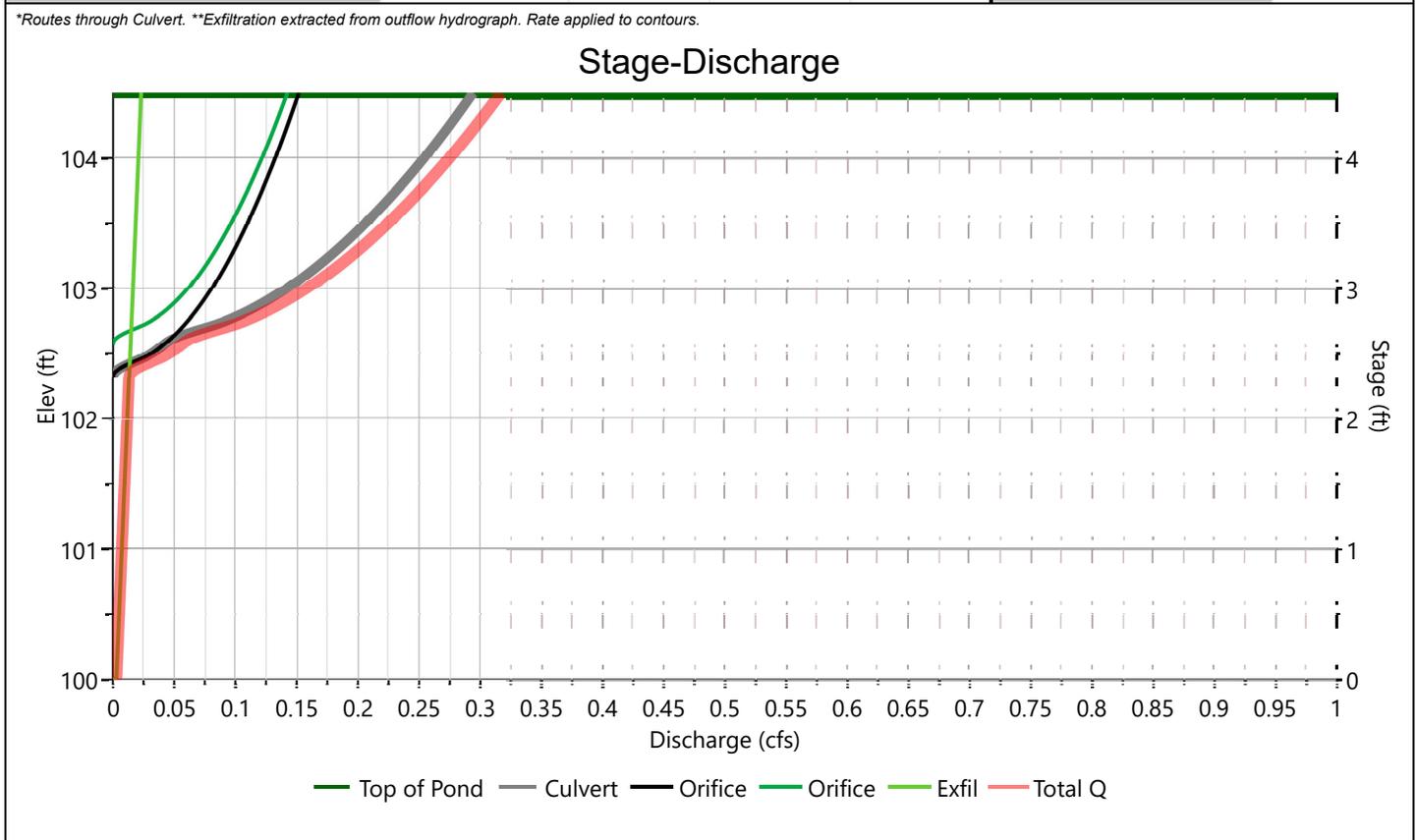
09-25-2023

chambers 1

Stage-Discharge

Culvert / Orifices	Culvert	Orifices			Perforated Riser
		1*	2*	3	
Rise, in	15	2	2		Hole Diameter, in
Span, in	15	2	2		No. holes
No. Barrels	1	1	1	1	Invert Elevation, ft
Invert Elevation, ft	100.00	102.33	102.58	103.00	Height, ft
Orifice Coefficient, Co	0.60	0.60	0.60	0.60	Orifice Coefficient, Co
Length, ft	50				
Barrel Slope, %	1				
N-Value, n	0.013				
Weirs	Riser*	Weirs			Ancillary
		1	2	3	
Shape / Type					Exfiltration, in/hr
Crest Elevation, ft					0.17**
Crest Length, ft					
Angle, deg					
Weir Coefficient, Cw					

*Routes through Culvert. **Exfiltration extracted from outflow hydrograph. Rate applied to contours.



Pond Report

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

chambers 1

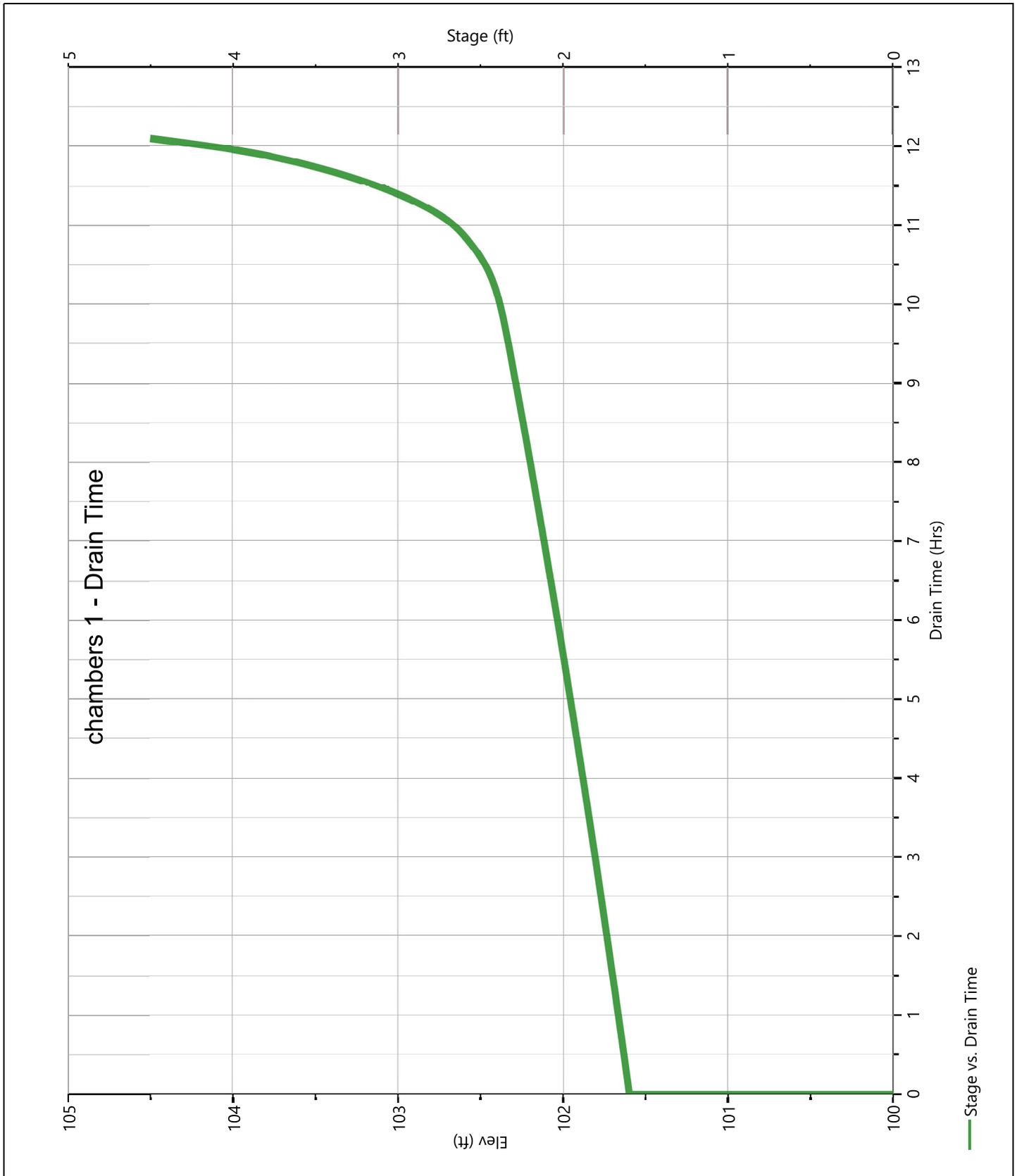
Stage-Storage-Discharge Summary

Stage (ft)	Elev. (ft)	Storage (cuft)	Culvert (cfs)	Orifices, cfs			Riser (cfs)	Weirs, cfs			Pf Riser (cfs)	Exfil (cfs)	User (cfs)	Total (cfs)
				1	2	3		1	2	3				
0.00	100.00	0.000	0.000	0.000	0.000						0.000		0.000	
0.23	100.23	65.3	0.000	0.000	0.000						0.004		0.004	
0.45	100.45	131	0.000	0.000	0.000						0.005		0.005	
0.68	100.68	196	0.000	0.000	0.000						0.006		0.006	
0.90	100.90	261	0.000	0.000	0.000						0.007		0.007	
1.13	101.13	326	0.000	0.000	0.000						0.008		0.008	
1.35	101.35	392	0.000	0.000	0.000						0.009		0.009	
1.58	101.58	475	0.000	0.000	0.000						0.010		0.010	
1.80	101.80	597	0.000	0.000	0.000						0.011		0.011	
2.03	102.03	718	0.000	0.000	0.000						0.012		0.012	
2.25	102.25	839	0.000	0.000	0.000						0.013		0.013	
2.48	102.48	957	0.026 ic	0.026	0.000						0.014		0.040	
2.70	102.70	1,073	0.076 ic	0.056	0.020						0.015		0.091	
2.93	102.93	1,187	0.129 ic	0.075	0.054						0.016		0.145	
3.15	103.15	1,297	0.163 ic	0.090	0.073						0.017		0.180	
3.38	103.38	1,402	0.192 ic	0.103	0.089						0.018		0.209	
3.60	103.60	1,502	0.216 ic	0.114	0.102						0.019		0.235	
3.82	103.83	1,594	0.238 ic	0.125	0.113						0.020		0.258	
4.05	104.05	1,671	0.258 ic	0.134	0.124						0.021		0.279	
4.27	104.28	1,736	0.277 ic	0.143	0.133						0.022		0.299	
4.50	104.50	1,801	0.294 ic	0.152	0.142						0.023		0.317	

Suffix key: ic = inlet control, oc = outlet control, s = submerged weir

chambers 1

Pond Drawdown



Pond Report

Project Name:

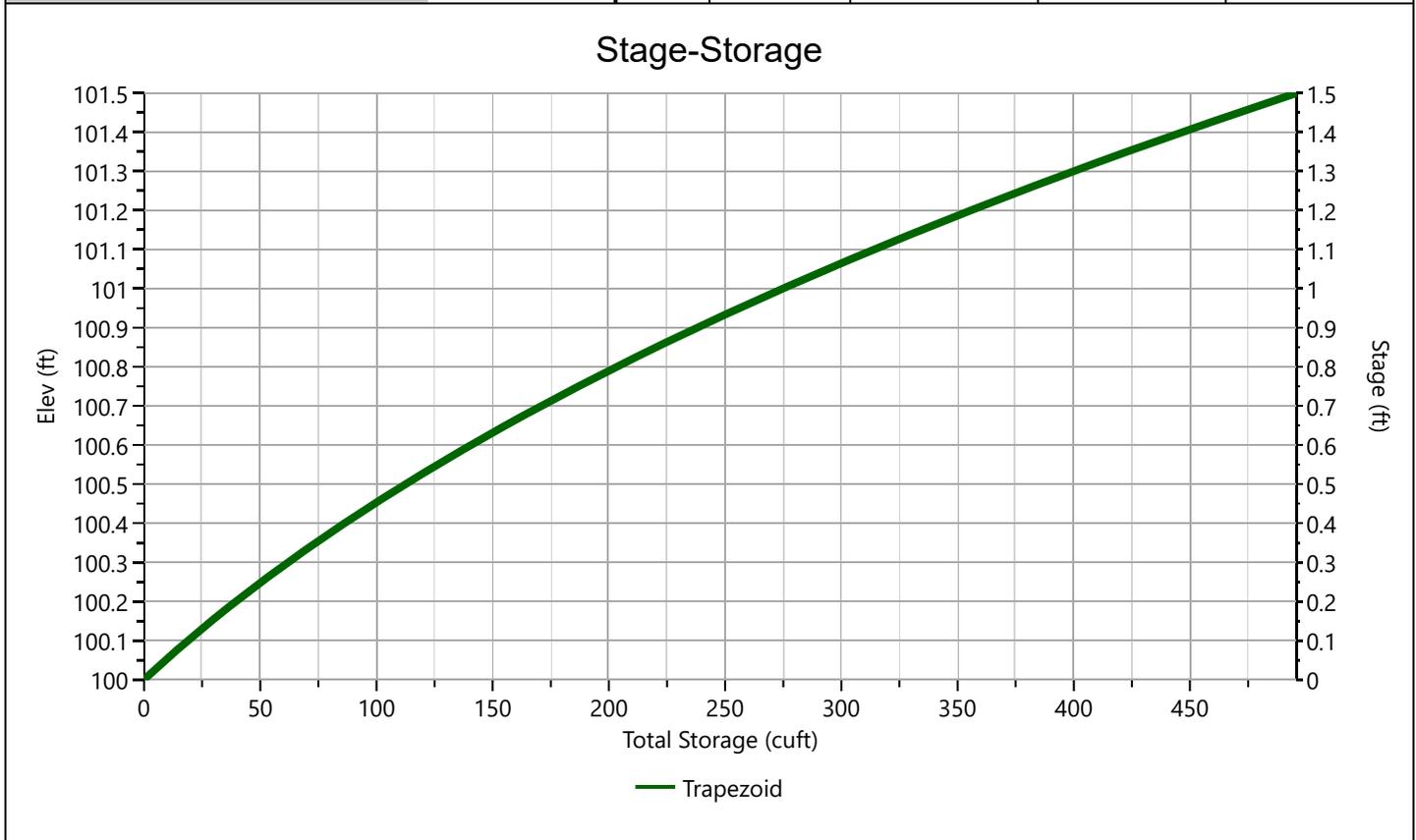
Hydrology Studio v 3.0.0.27

09-25-2023

pond 1

Stage-Storage

Trapezoid		Stage / Storage Table				
Description	Input	Stage (ft)	Elevation (ft)	Contour Area (sqft)	Incr. Storage (cuft)	Total Storage (cuft)
Bottom Elevation, ft	100.00	0.00	100.00	181	0.000	0.000
Bottom Length, ft	15.28	0.08	100.08	194	14.1	14.1
Bottom Width, ft	11.87	0.15	100.15	207	15.0	29.1
Side Slope, H:1	3.00	0.23	100.23	220	16.0	45.1
Total Depth, ft	1.50	0.30	100.30	233	17.0	62.1
Voids (%)	100.00	0.38	100.38	248	18.0	80.1
		0.45	100.45	262	19.1	99.2
		0.53	100.53	277	20.2	119
		0.60	100.60	292	21.3	141
		0.68	100.68	308	22.5	163
		0.75	100.75	324	23.7	187
		0.82	100.83	340	24.9	212
		0.90	100.90	357	26.2	238
		0.97	100.98	374	27.4	265
		1.05	101.05	392	28.7	294
		1.13	101.13	410	30.1	324
		1.20	101.20	429	31.5	356
		1.28	101.28	448	32.9	389
		1.35	101.35	467	34.3	423
		1.43	101.43	487	35.8	459
		1.50	101.50	507	37.2	496



Pond Report

Project Name:

Hydrology Studio v 3.0.0.27

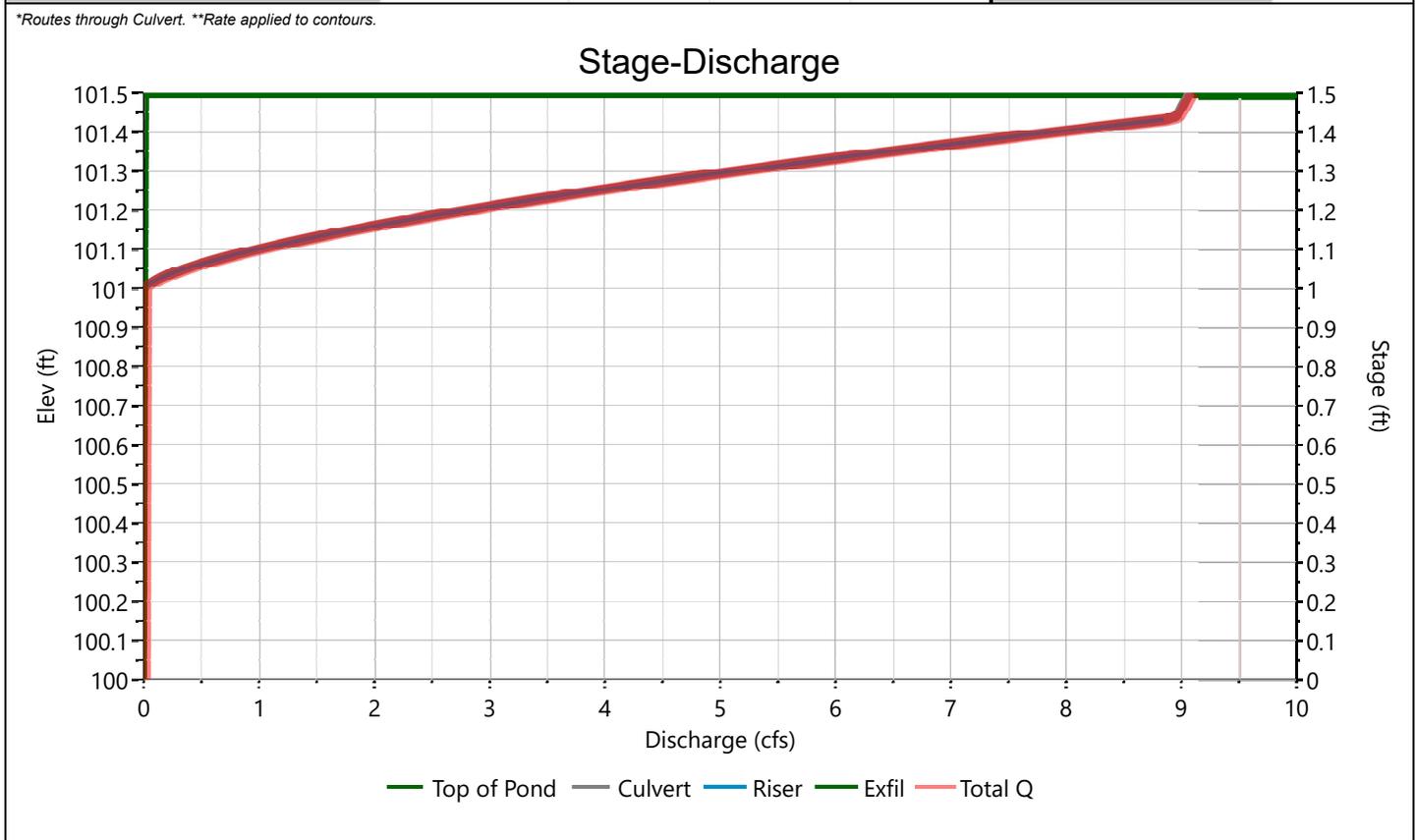
09-25-2023

pond 1

Stage-Discharge

Culvert / Orifices	Culvert	Orifices			Orifice Plate
		1	2	3	
Rise, in	15				Orifice Dia, in
Span, in	15				No. Orifices
No. Barrels	1				Invert Elevation, ft
Invert Elevation, ft	98.50				Height, ft
Orifice Coefficient, Co	0.60				Orifice Coefficient, Co
Length, ft	50				
Barrel Slope, %	1				
N-Value, n	0.013				
Weirs	Riser*	Weirs			Ancillary
		1	2	3	
Shape / Type	Circular				Exfiltration, in/hr
Crest Elevation, ft	101				2.40**
Crest Length, ft	9.42				
Angle, deg					
Weir Coefficient, Cw	3.3				

*Routes through Culvert. **Rate applied to contours.



Pond Report

Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

pond 1

Stage-Storage-Discharge Summary

Stage (ft)	Elev. (ft)	Storage (cuft)	Culvert (cfs)	Orifices, cfs			Riser (cfs)	Weirs, cfs			Pf Riser (cfs)	Exfil (cfs)	User (cfs)	Total (cfs)
				1	2	3		1	2	3				
0.00	100.00	0.000	0.000				0.000					0.000		0.000
0.08	100.08	14.1	0.000 oc				0.000					0.011		0.011
0.15	100.15	29.1	0.000 oc				0.000					0.011		0.011
0.23	100.23	45.1	0.000 oc				0.000					0.012		0.012
0.30	100.30	62.1	0.000 oc				0.000					0.013		0.013
0.38	100.38	80.1	0.000 oc				0.000					0.014		0.014
0.45	100.45	99.2	0.000 oc				0.000					0.015		0.015
0.53	100.53	119	0.000 oc				0.000					0.015		0.015
0.60	100.60	141	0.000 oc				0.000					0.016		0.016
0.68	100.68	163	0.000 oc				0.000					0.017		0.017
0.75	100.75	187	0.000 oc				0.000					0.018		0.018
0.82	100.83	212	0.000 oc				0.000					0.019		0.019
0.90	100.90	238	0.000 oc				0.000					0.020		0.020
0.97	100.98	265	0.000 oc				0.000					0.021		0.021
1.05	101.05	294	0.348 oc				0.348					0.022		0.369
1.13	101.13	324	1.374 oc				1.374					0.023		1.397
1.20	101.20	356	2.780 oc				2.780					0.024		2.804
1.28	101.28	389	4.483 oc				4.483					0.025		4.508
1.35	101.35	423	6.437 oc				6.437					0.026		6.463
1.43	101.43	459	8.613 oc				8.613					0.027		8.640
1.50	101.50	496	9.071 oc				0.000					0.028		9.099

Suffix key: ic = inlet control, oc = outlet control, s = submerged weir

Pond Report

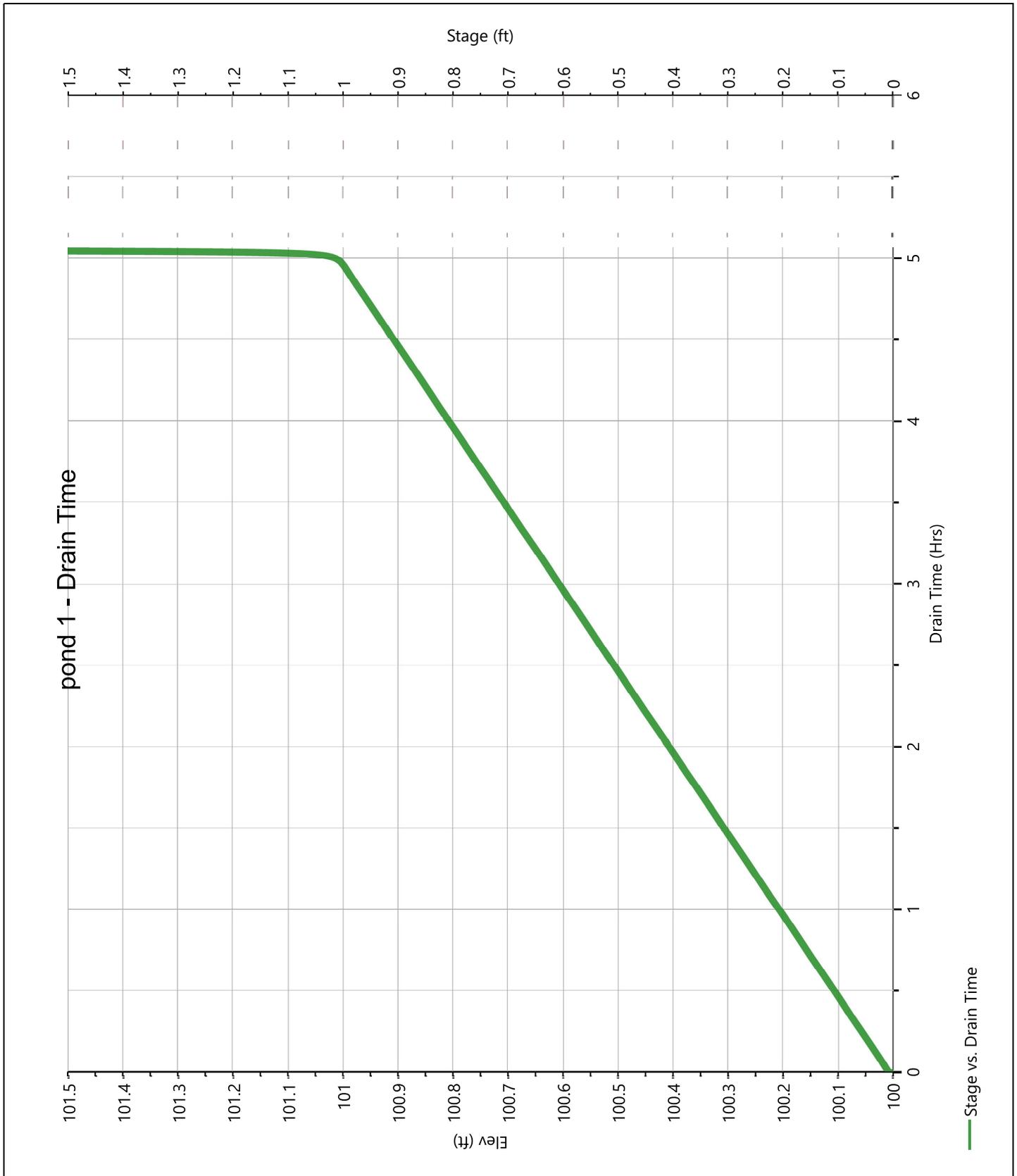
Project Name:

Hydrology Studio v 3.0.0.27

09-25-2023

pond 1

Pond Drawdown



APPENDIX J



Project Info

village	carwash
043-070-005	UNKNOWN ADDRESS
2.22837	0.9

Drainage Management Areas (DMAs)

DMA #	(A _{imp}) Impervious Area (sf)	(V _{ret}) Storm Volume (cf)	Volume Check
1	11718.23	878	<input checked="" type="checkbox"/>
2	4791.6	359	<input checked="" type="checkbox"/>

Infiltration Trenches (IT), Dry Wells & Subsurface Retention

Associated DMA #	(V _v) Void Volume (0.4 = 40%)	(L) Length (ft)	(W) Width (ft)	(D) Depth (ft)	(V _{ret}) Retention Volume (cf)
1 <input type="button" value="v"/>	.66	52.5	11.5	4.5	1934

Infiltration Basins

Associated DMA #	(V _{ret}) Retention Volume (cf)
2 <input type="button" value="v"/>	360

Environmental Noise Assessment

Village Car Wash

Truckee, California

BAC Job # 2022-145

Prepared For:

SCO Planning & Engineering, Inc.

Attn: Martin D. Wood
140 Litton Drive, Suite 240
Grass Valley, CA 95945

Prepared By:

Bollard Acoustical Consultants, Inc.



Dario Gotchet, Principal Consultant

September 20, 2023



Introduction

The proposed Village Car Wash (project) is located at the northeast intersection of State Route 89 (SR 89) and Henness Road in the Town of Truckee, California. The project proposes a car wash tunnel and vacuum system within the Village Development. The project site location with aerial imagery is shown in Figure 1. The Village Development site plan is presented in Figure 2. The site plan for the car wash component is provided in Figure 3.

Due to the proximity of the proposed project to existing and future noise-sensitive uses (residential), Bollard Acoustical Consultants, Inc. (BAC) was retained to prepare an assessment of potential noise impacts associated with the project. Specifically, the purposes of this assessment are to quantify noise levels associated with proposed car wash and vacuum system operations, to assess the state of compliance of those noise levels with applicable Town of Truckee noise criteria, and if necessary, to recommend measures to reduce those noise levels to acceptable limits at the nearest noise-sensitive uses.

It should be noted that a convenience store (c-store) / gas station component was previously proposed at the same location as the proposed car wash. At the request of the Town of Truckee planning staff, this report includes a comparison of noise level exposure associated with the car wash and c-store / gas station components at nearby existing and future residential uses.

Noise Fundamentals and Terminology

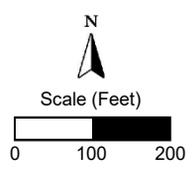
Noise is often described as unwanted sound. Sound is defined as any pressure variation in air that the human ear can detect. If the pressure variations occur frequently enough (at least 20 times per second), they can be heard, and thus are called sound. Measuring sound directly in terms of pressure would require a very large and awkward range of numbers. To avoid this, the decibel scale was devised. The decibel scale allows a million-fold increase in pressure to be expressed as 120 dB. Another useful aspect of the decibel scale is that changes in levels (dB) correspond closely to human perception of relative loudness. Appendix A contains definitions of Acoustical Terminology. Figure 4 shows common noise levels associated with various sources.

The perceived loudness of sounds is dependent upon many factors, including sound pressure level and frequency content. However, within the usual range of environmental noise levels, perception of loudness is relatively predictable, and can be approximated by weighing the frequency response of a sound level meter by means of the standardized A-weighting network. All noise levels reported in this section are in terms of A-weighted levels in decibels. Community noise is commonly described in terms of the “ambient” noise level, which is defined as the all-encompassing noise level associated with a given noise environment. A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level (L_{eq}) over a given time period (usually one hour). The L_{eq} is the foundation of the Day-Night Average Level noise descriptor, DNL or L_{dn} , and shows very good correlation with community response to noise.



Legend

- - - Car Wash Component Boundary (Approximate)
- 2017 Long-Term Ambient Noise Survey Sites

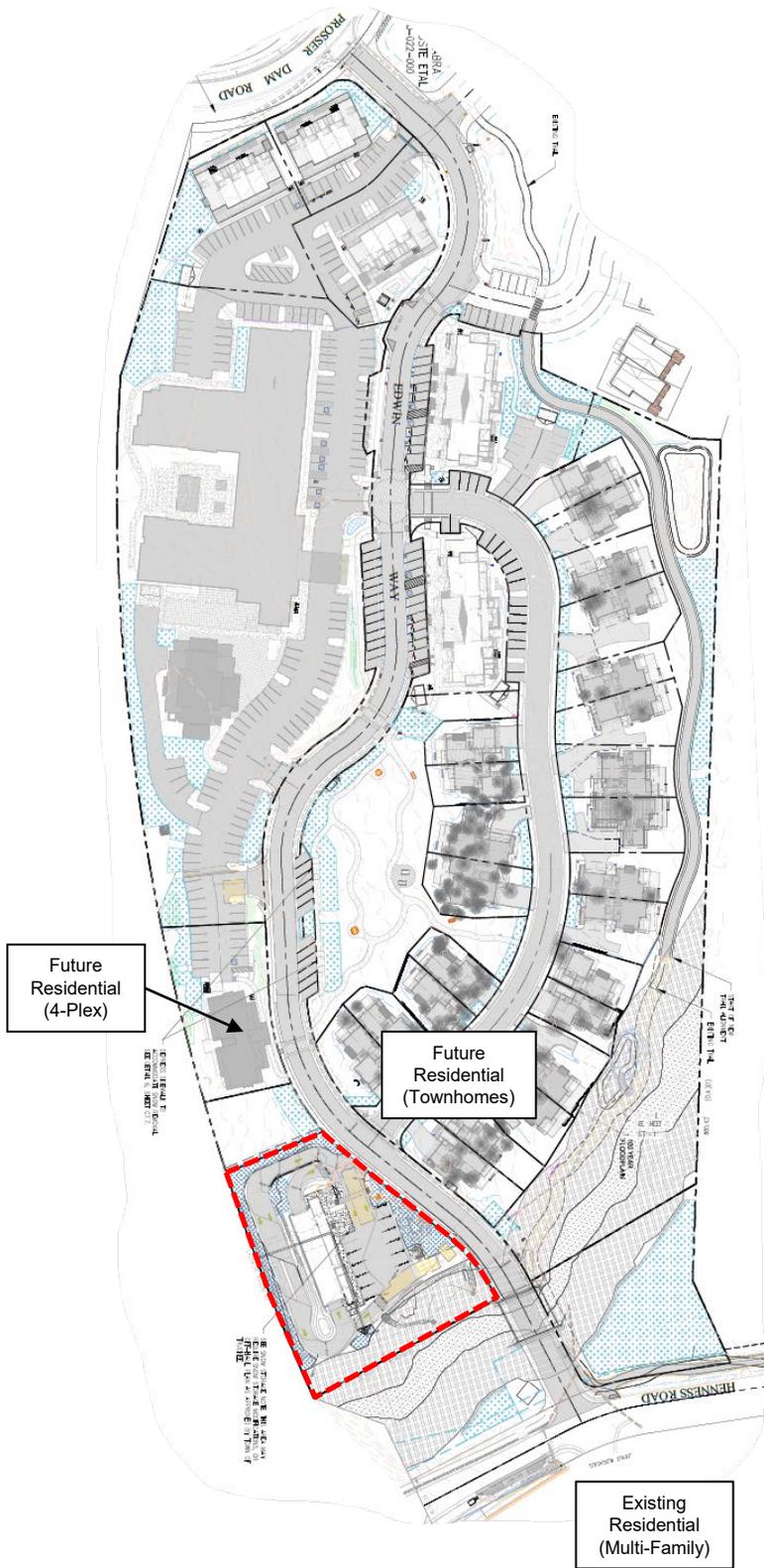


Village Car Wash
Truckee, California

Project Area

Figure 1





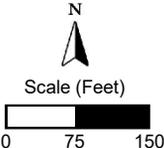
Future Residential (4-Plex)

Future Residential (Townhomes)

Existing Residential (Multi-Family)

Legend

--- Car Wash Component Boundary (Approximate)

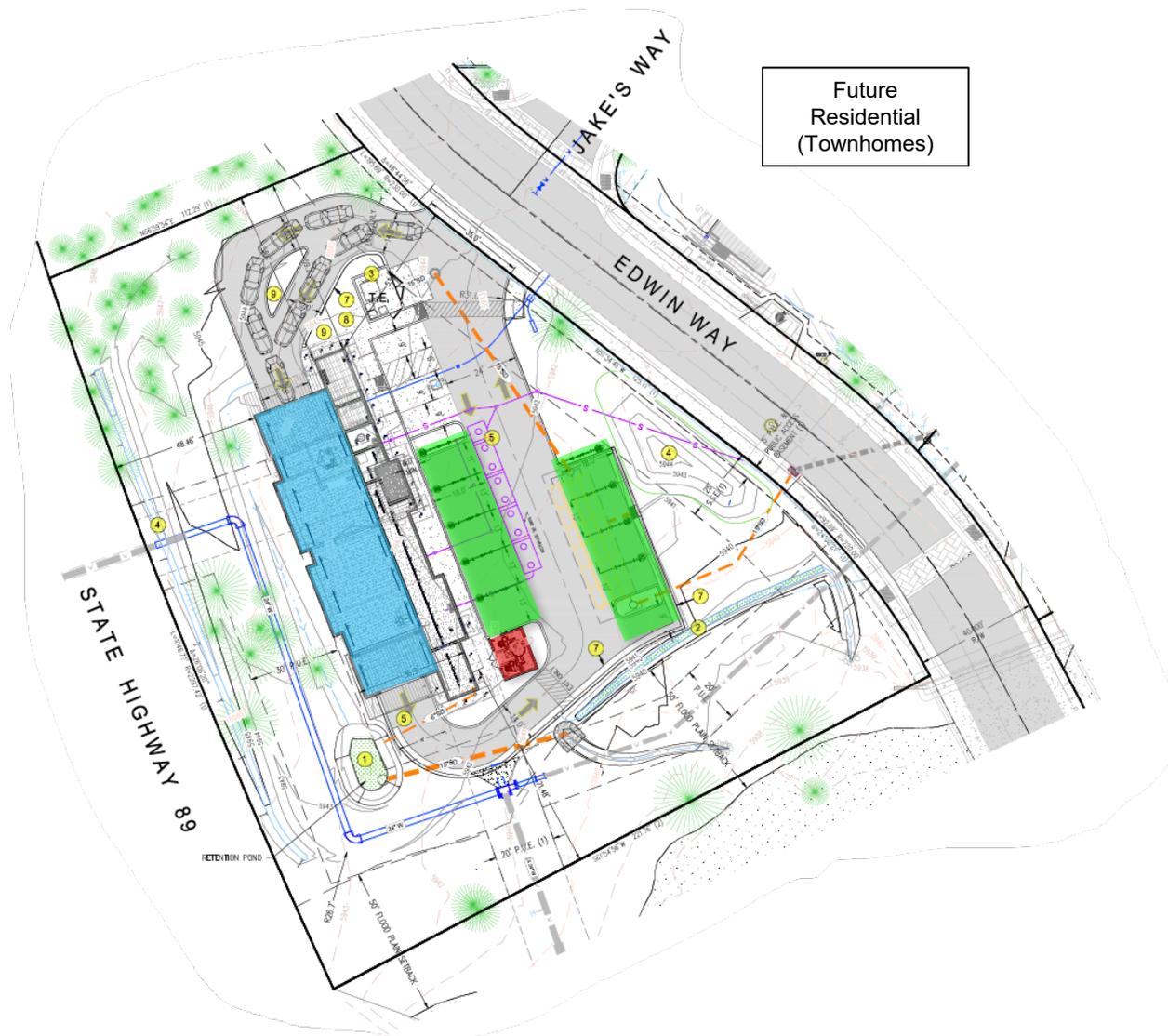


Village Car Wash
Truckee, California

Village Development Site Plan

Figure 2





Future Residential (Townhomes)

Site Plan Dated 8/7/2023

Legend

- Car Wash Tunnel
- Vacuum Areas (9 Parking Stalls – 16 Hoses)
- Fully-Enclosed Vacuum Producer Enclosure

Village Car Wash
Truckee, California

Car Wash Parcel Site Plan

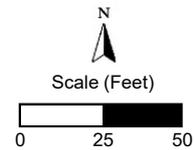
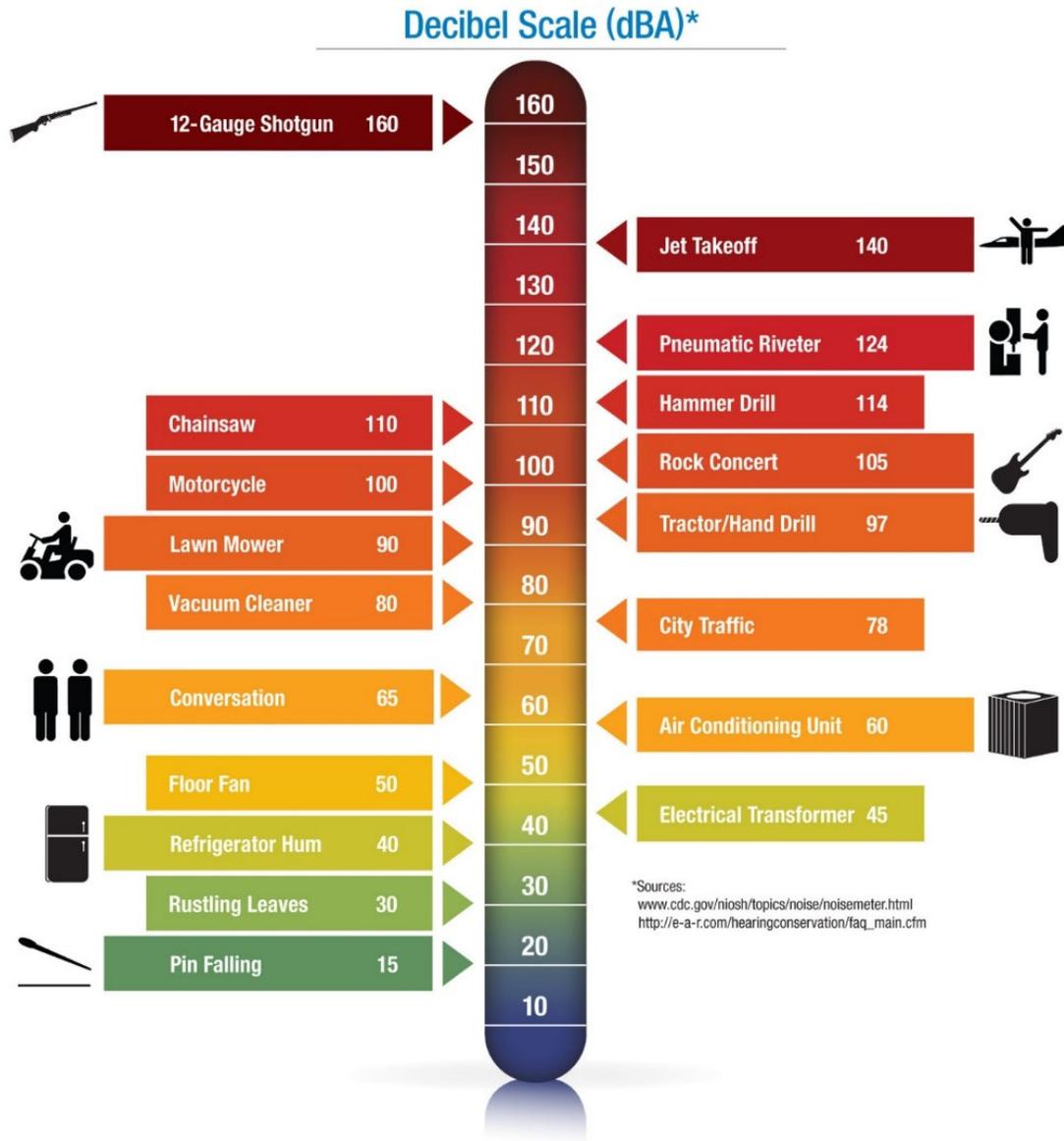


Figure 3



Figure 4
Typical A-Weighted Sound Levels of Common Noise Sources



The Day-Night Average Level (DNL or L_{dn}) is based upon the average noise level over a 24-hour day, with a +10-decibel weighting applied to noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours. The nighttime penalty is based upon the assumption that people react to nighttime noise exposures as though they were twice as loud as daytime exposures. Because DNL represents a 24-hour average, it tends to disguise short-term variations in the noise environment. DNL-based noise standards are commonly used to assess noise impacts associated with traffic, railroad, and aircraft noise sources.

Existing Ambient Noise Environment within the Project Vicinity

The existing ambient noise environment at the project site is primarily defined by traffic on State Route 89, and to a lesser extent by traffic on Prosser Dam Road, Henness Road, and Interstate 80. To generally quantify the existing ambient noise environment in the immediate project vicinity, BAC utilized the results from a long-term (72-hour) noise level survey conducted May 2-4, 2017, at three locations located within the Village Development. The 2017 noise survey locations are identified in Figure 1.

Larson-Davis Laboratories (LDL) Model 820 precision integrating sound level meters were used to complete the noise level surveys. The meters were calibrated before and after use with an LDL Model CAL200 acoustical calibrator to ensure the accuracy off the measurements. The equipment used meets all pertinent specifications of the American National Standards Institute for Type 1 sound level meters (ANSI S1.4). The results of the long-term ambient noise survey are shown numerically and graphically in Appendices B and C (respectively) and are summarized below in Table 1.

Table 1
Summary of 2017 BAC Long-Term Ambient Noise Monitoring Results^{1,2}

Date	Daytime ³ (7 a.m. to 10 p.m.)			Nighttime ³ (10 p.m. to 7 a.m.)			DNL (dB)
	Leq	L ₅₀	L _{max}	Leq	L ₅₀	L _{max}	
Site 1 – Approximately 115' from centerline of Highway 89							
May 2, 2017	61 (59-64)	59 (52-63)	78 (73-87)	54 (47-61)	48 (44-58)	78 (73-87)	63
May 3, 2017	61 (56-64)	59 (52-63)	77 (72-84)	55 (48-61)	49 (45-59)	70 (64-77)	63
May 4, 2017	62 (57-64)	59 (52-63)	77 (72-83)	55 (48-61)	49 (46-59)	70 (67-75)	63
Site 2 – Approximately 305' from centerline of Highway 89							
May 2, 2017	52 (50-55)	48 (47-52)	72 (67-78)	50 (47-54)	48 (46-53)	61 (56-71)	57
May 3, 2017	53 (50-54)	50 (47-54)	70 (64-74)	51 (47-55)	49 (46-54)	64 (57-72)	57
May 4, 2017	54 (50-56)	52 (48-55)	70 (63-77)	51 (47-55)	49 (46-54)	60 (55-71)	58
Site 3 – Approximately 85' from centerline of Henness Road							
May 2, 2017	51 (49-53)	47 (44-50)	72 (62-81)	50 (47-53)	48 (46-52)	61 (54-70)	57
May 3, 2017	52 (48-56)	49 (45-52)	72 (64-87)	52 (47-55)	49 (46-54)	66 (58-84)	58
May 4, 2017	54 (51-56)	51 (46-55)	71 (63-77)	51 (48-56)	49 (47-53)	61 (56-68)	58
¹ Long-term ambient noise monitoring locations are identified in Figure 1.							
² Detailed long-term noise measurement results are provided in Appendices B and C.							
³ Data format: Average (Low-High)							

Source: BAC 2017.

Criteria for Acceptable Noise Exposure

The Town of Truckee Municipal Code

Chapter 18.44 of the Town of Truckee Municipal Code (Noise) contains codes and ordinances which are pertinent to the evaluation of project on-site commercial operations noise sources. The applicable criteria are reproduced and summarized as follows:

18.44.040 – Exterior Noise Standards

It shall be unlawful for any person, at any location within the Town, to create any noise or to allow the creation of any noise on property leased, occupied, owned, or otherwise controlled by the person which does not comply with the provisions of this Section, unless the provisions of either Sections 18.44.050 (Residential Interior Noise Standards) or 18.44.070 (Exceptions), below, have been met.

- A. Exterior levels.** Exterior noise levels, when measured at any receiving church, commercial property, public library, residential or school property, do not conform to the provisions of this Section when they exceed the noise level standards established by (Municipal Code) Table 2 (Municipal Code Table 3-7).
- B. Ambient noise level adjustment.** In the event the measured ambient noise level exceeds the applicable noise level standard in any category above, the applicable standards shall be adjusted to equal the ambient noise level. For example, if the applicable noise level standard is 60 dB(A) and the ambient noise level is 63 dB(A), the applicable noise level standard would be adjusted to 63 dB(A). In these cases, a use would not exceed the applicable noise level standard if it did not increase the ambient noise level by more than 3.0 dB(A) when the ambient noise level is between 60 and 65 dB(A) or by more than 1.5 dB(A) when the ambient noise level is greater than 65 dB(A).

Table 2
Summary of Town of Truckee Municipal Code Exterior Noise Level Standards
Receiving Land Use – Residential Uses

Duration Exceeded, Min.	Statistical Descriptor	Noise Level (dB)	
		Daytime (7 a.m.-10 p.m.)	Nighttime (10 p.m.-7 a.m.)
30 ¹	L ₅₀	55	50
15	L ₂₅	60	55
5	L ₈	65	60
1	L ₂	70	65
0	L _{max}	75	70

¹ For example, this means the measured noise level may not exceed 55 dB for more than 30 minutes out of any one-hour time period.

Source: Town of Truckee Municipal Code, Chapter 18.44, Table 3-7.

Noise Standards Applied to the Project

The Town of Truckee Municipal Code noise level standards shown in Table 2 depend on what time of day the noise occurs and the duration of operation each given noise source during a given hour. The project applicant has indicated that the car wash and vacuum hours of operation will be limited to daytime hours, 7:00 a.m. to 9:00 p.m. In addition, car wash operations could potentially exceed 30 minutes during a given busy hour. Based on the provided project operations information, the Town's daytime median (L_{50}) noise level standard of 55 dB was applied to project car wash and vacuum system operational noise levels and assessed at the nearest existing and future residential uses. Satisfaction of the Town's noise level criterion at the nearest existing and future residential uses would ensure for satisfaction of the Town's noise level limit at existing and future residential uses located farther away.

Evaluation of Project Car Wash Operations Noise Levels

Noise generated by project car wash operations were quantified through a combination of manufacturer reference noise level data, application of accepted noise modeling techniques, and utilization of the provided site plans. The most significant noise sources associated with proposed car wash operations have been identified as the car wash drying assembly (used for drying vehicles at the end of the wash cycle) and the vacuum system equipment. The proposed locations of the car wash tunnel and vacuum areas are shown in Figure 3. Predicted noise levels resulting from those sources at the nearest existing and future residential uses are evaluated in the following sections.

Car Wash Drying Assembly

Based on the experience of Bollard Acoustical Consultants, noise levels generated by car washes are primarily due to the drying portion of the operation. It is the understanding of BAC that the project proposes the installation of four (4) Sonny's Enterprises blower arch assemblies, Part # BL1-45HP-1. According to manufacturer's noise specification data sheet in Appendix D, each blower arch assembly generates a maximum noise level of 79 dB L_{max} at 50 feet. The combined noise level from the simultaneous operation of all four blower arch assemblies is calculated to be 85 dB L_{max} at 50 feet.

Based on BAC's experience with noise level data collection at various existing car washes, the noise level generation of car wash drying assemblies vary depending on the orientation of the measurement position relative to the tunnel opening. Worst-case drying assembly noise levels occur at a position directly facing the car wash exit, considered to be 0 degrees off-axis. For car wash tunnels that are 100 feet or more in length, drying assembly noise levels at the car wash entrance are approximately 10 dB lower than those at the exit. At off-axis positions, the building facade provides varying degrees of noise level reduction. At positions 45 degrees off-axis relative to the facade of the car wash exit and entrance, drying assembly noise levels are approximately 6 dB lower. At 90 degrees off-axis, drying assembly noise levels are approximately 15 dB lower.

According to a car wash system representative, the car wash cycle is approximately 1.5 minutes in duration, and that the drying assembly would be in operation during the last 30 seconds (or 0.5 minutes) of the cycle. Based on this information, the car wash is calculated to go through 40 full cycles (60 minutes ÷ 1.5 minutes per cycle) and the dryer would operate for approximately 20 minutes (40 car wash cycles x 0.5 minutes of drying) during a busy hour of operations. However, the project’s emissions assessment states that approximately 45 cars are expected to be generated during a maximum peak hour for the car wash. Assuming 45 car wash cycles per hour, approximately 22 minutes of drying assembly operation is calculated. Based on 22 minutes of dryer operations per hour, the resulting median (L₅₀) drying assembly noise level is calculated to be approximately 5 dB lower than the equipment’s reference maximum (L_{max}) noise levels presented in Appendix D.

Finally, it is the understanding of BAC that the car wash tunnel entrance and exit will be equipped with polycarbonate doors manufactured by BayWatch. It is our further understanding that the doors will remain closed during each car wash cycle. According to the equipment manufacturer measurement data (provided as Appendix E), this specific door provides approximately 14 dB of dryer noise reduction. Based on this information, an adjustment of -14 dB was applied to drying assembly noise level exposure at the nearest existing and future residential uses.

Car wash drying assembly noise level exposure was calculated based on the orientation to tunnel entrance/exit, as discussed above. Noise attenuation due to distance was calculated based on standard spherical spreading loss from a point source (-6 dB per doubling of distance). Car wash drying assembly noise exposure was calculated at the property lines of the nearest existing and future residential uses and the results of those calculations relative to the applicable Town of Truckee Municipal Code noise level criterion are presented in Table 3.

**Table 3
Predicted Car Wash Drying Assembly Noise Levels at Nearest Residential Uses**

Receiver¹	Direction	Distance (ft)²	Predicted Noise Level, L₅₀ (dB)^{3,4}
Future Residential (Townhomes)	Northeast	220	38
Future Residential (4-Plex)	North	255	52
Existing Residential (Multi-Family)	South	290	51
Municipal Code Daytime Noise Level Standard, L₅₀ (dB)			55
¹ Receiver locations shown in Figure 1. ² Distances scaled from car wash dryers to property lines using the provided site plans. ³ Predicted noise levels include offsets for orientation to tunnel entrance/exit, as discussed in this report. ⁴ Predicted noise levels include consideration of proposed entrance and exit doors in closed position during dryer operations, as discussed in this report.			

Source: BAC 2023.

As indicated in Table 3, car wash drying assembly equipment noise levels are predicted satisfy the Town of Truckee Municipal Code 55 dB L₅₀ daytime noise level standard at the nearest

existing and future residential uses. As a result, no further consideration of car wash drying assembly noise mitigation measures would be warranted for the project.

Vacuum Station Equipment

It is our understanding that the project proposes the installation of a 16-hose central dry vacuum system with palm arches offered by Vacutech. The project site plan indicates that there will be two vacuum areas, which are shown in Figure 3.

It is our understanding that the central vacuum piping system will be powered by one (1) 40 HP direct drive vacuum producer. According to the provided plans, the noise-generating vacuum turbine producer will be contained within a fully-enclosed equipment enclosure. The location of the vacuum producer enclosure is shown in Figure 3. The site plans further indicate that the vacuum enclosure walls will be constructed of 8-inch-thick CMU block and have a combination plywood/corrugated metal roof. Further, it is our understanding that the vacuum producer will be equipped with a muffler kit containing a silencer. After a review of the provided vacuum enclosure construction plans and based on BAC's experience and field observations with similarly configured car washes and equipment enclosures, noise impacts due to the operation of the vacuum turbine producer are not expected due to the significant transmission loss that would be provided by the proposed vacuum motor enclosure. As a result, no further analysis would be warranted for the vacuum system turbine producer.

Based on noise level measurements conducted by BAC staff at recently completed car wash projects, the primary noise-generating aspects of central vacuum piping systems are use of the suction nozzles located at each of the stalls – specifically, noise associated with active suction nozzles hanging off nozzle hangers. Reference sound level data obtained from the proposed vacuum system manufacturer (Vacutech) is provided as Appendix F. The sound level data provided in Appendix F show measured and projected sound levels from 19 vacuum hoses off their respective nozzle hangers at distances ranging from 45 to 85 feet.

For the purposes of this analysis, it was conservatively assumed that all 16 proposed vacuum suction nozzles would be in concurrent operation (worst-case noise exposure). Based on the manufacturer sound level data in Appendix F, the operations assumptions above, and assuming standard spherical spreading loss (-6 dB per doubling of distance from a stationary source), worst-case project vacuum equipment noise exposure was calculated at the property lines of the nearest existing and future residential uses. The results of those calculations relative to the applicable Town of Truckee Municipal Code noise level criterion are presented in Table 4.

Table 4
Predicted Worst-Case Vacuum Nozzle Noise Levels at Nearest Residential Uses

Receiver¹	Direction	Distance (ft)²	Predicted Noise Level, L₅₀ (dB)³
Future Residential (Townhome)	Northeast	160	44
Future Residential (4-Plex)	North	235	40
Existing Residential (Multi-Family)	South	290	38
Municipal Code Daytime Noise Level Standard, L₅₀ (dB)			55
¹ Receiver locations shown in Figure 1.			
² Distances scaled from effective noise center of vacuum areas to property lines using the provided site plans.			
³ Predicted combined noise level from operation of all proposed vacuum nozzles concurrently (worst-case).			

Source: BAC 2023.

The Table 4 data indicate that worst-case vacuum nozzle noise levels are predicted to satisfy the Town of Truckee Municipal Code 55 dB L₅₀ daytime noise level standard at the nearest existing and future residential uses. As a result, no further consideration of vacuum system equipment noise mitigation measures would be warranted for the project.

Car Wash Building HVAC Equipment

Heating, ventilating, and air conditioning (HVAC) requirements for the car wash building would most likely be met using packaged roof-mounted system. According to BAC reference file data, HVAC systems for similar uses (12.5-ton packaged unit system) are expected to have a reference noise level of 45 dB L₅₀ at a distance of 100 feet.

Based on the sound power data above, and assuming standard spherical spreading loss (-6 dB per doubling of distance), car wash building HVAC equipment noise exposure was calculated at the property lines of the nearest existing and future residential uses. The results of those calculations relative to the applicable Town of Truckee Municipal Code noise level criterion are presented in Table 5.

Table 5
Predicted HVAC Equipment Noise Levels at Nearest Residential Uses

Receiver¹	Direction	Distance (ft)²	Predicted Noise Level, L₅₀ (dB)
Future Residential (Townhome)	Northeast	160	41
Future Residential (4-Plex)	North	175	40
Existing Residential (Multi-Family)	South	280	36
Municipal Code Daytime Noise Level Standard, L₅₀ (dB)			55
¹ Receiver locations shown in Figure 1.			
² Distances scaled from car wash building rooftop to property lines using the provided site plans.			

Source: BAC 2023.

As shown in Table 5, car wash building HVAC equipment noise levels are predicted satisfy the Town of Truckee Municipal Code 55 dB L₅₀ daytime noise level standard at the nearest existing and future residential uses. As a result, no further consideration of car wash building HVAC equipment noise mitigation measures would be warranted for the project.

Combined Project Car Wash Component Noise Generation

The preceding analyses consisted of the noise-generation associated with car wash drying assembly, vacuum system, and building HVAC equipment independently. Because it is likely that the noise sources will operate simultaneously, an analysis of cumulative (combined) noise-generation was also conducted for the project. The calculated combined noise generation of project car wash dryers, vacuum system, and building HVAC equipment at the property lines of the nearest existing and future residential uses was calculated and the results of those calculations relative to the applicable Town of Truckee Municipal Code noise level criterion is presented in Table 6.

It should be noted that due to the logarithmic nature of the decibel scale, the sum of two noise values which differ by 10 dB equates to an overall increase in noise levels of 0.4 dB. When the noise sources are equivalent, the sum would result in an overall increase in noise levels of 3 dB.

Table 6
Predicted Combined Equipment Noise Levels at Nearest Residential Uses

Receiver	Predicted Noise Levels, L ₅₀ (dB) ¹			Calculated Combined, L ₅₀ ²
	Car Wash Dryers	Vacuums	HVAC	
Future Residential (Townhome)	38	44	41	46
Future Residential (4-Plex)	52	40	40	52
Existing Residential (Multi-Family)	51	38	36	51
Municipal Code Daytime Noise Level Standard, L₅₀ (dB)				55
¹ Predicted equipment noise levels from Tables 3-5.				
² Calculated combined equipment noise level exposure.				

Source: BAC 2023.

As shown in Table 6, calculated combined equipment noise level exposure would comply with Town of Truckee 55 dB L₅₀ daytime noise level standard at the nearest existing and future residential uses. As a result, additional consideration of car wash component equipment noise mitigation measures would not be warranted for the project.

Comparison of Car Wash & C-Store / Gas Station Operations Noise

As mentioned previously, a c-store / gas station was previously proposed at the same location as the car wash. At the request of the Town of Truckee planning staff, the following section includes a comparison of predicted noise level exposure associated with car wash and c-store / gas station operations at nearby existing and future residential uses. The most significant noise sources associated with c-store / gas station operations have been identified as mechanical

equipment (HVAC), parking lot movements, and truck deliveries (i.e., deliveries of product to c-store and fueling tankers), and on-site truck circulation.

C-Store / Gas Station Component Mechanical Equipment (HVAC)

Heating, ventilating, and air conditioning (HVAC) requirements for the proposed convenience store will most likely be met using packaged roof-mounted systems. As a means of determining potential noise exposure due to rooftop mechanical equipment, BAC utilized reference file data collected for previous studies. BAC reference file data for HVAC systems indicate that a 12.5-ton packaged unit can be expected to generate an A-weighted sound power level of 85 dB, or equivalent to approximately 45 dB L₅₀ at a distance of 100 feet. When projected from the c-store building to the nearest future residential use to the northeast located approximately 225 away, median HVAC noise level exposure is calculated to be 38 dB L₅₀. When projected from the c-store building to the nearest future residential use to the north located approximately 230 away, median HVAC noise level exposure is calculated to be 38 dB L₅₀. Finally, when projected to the nearest existing residential use to the south located approximately 300 feet away, median HVAC noise level exposure is calculated to be 35 dB L₅₀.

C-Store / Gas Station Component Parking Lot Movements

As a means of determining potential noise exposure due to project parking lot activities, Bollard Acoustical Consultants, Inc. utilized specific parking lot noise level measurements conducted by BAC. Specifically, a series of individual noise measurements were conducted of multiple vehicle types arriving and departing a parking area, including engines starting and stopping, car doors opening and closing, and persons conversing as they entered and exited the vehicles. The results of those measurements revealed that individual parking lot movements generated mean noise levels of 65 dB SEL at a distance of 50 feet.

According to the project site plans, the c-store / gas station would have approximately 10 parking spaces and 8 gas pumps. Conservatively assuming each vehicle spends five minutes in the parking lot, this would result in a total of 216 vehicle trips to and from the site per hour at maximum capacity. Peak hour parking and gas pump area noise exposure was determined using the following equation:

$$\text{Peak Hour } L_{eq}/L_{50} = 65 + 10 \cdot \log(N) - 35.6$$

Where 65 is the SEL for a single automobile parking operation, N is the number of parking area operations in a peak hour (216 in this case), and 35.6 is 10 times the logarithm of the number of seconds in an hour. Given the equation above, the reference median noise level is calculated to be 53 dB L₅₀ at a distance of 50 feet. When projected from the c-store / gas station parking area to the nearest future residential use to the northeast located approximately 200 feet away, median parking lot noise level exposure is calculated to be 41 dB L₅₀. When projected from the parking area to the nearest future residential use to the north, also located approximately 200 feet away, median parking lot noise level exposure is calculated to be 41 dB L₅₀. Finally, when projected to the nearest existing residential use to the south located approximately 315 away, median parking area noise level exposure is calculated to be 37 dB L₅₀.

C-Store / Gas Station Component Truck Deliveries

It is the experience of BAC that deliveries of product to c-stores occur at the front of the store with medium-duty vendor trucks/vans. The primary noise sources associated with delivery activities are trucks stopping (air brakes), trucks backing into position (back-up alarms), and pulling away from the delivery area (revving engines).

For a conservative assessment of daily truck delivery noise levels at c-store / gas station component, it was assumed that 4 medium duty trucks/vans would have deliveries on a typical busy day. For the purposes of comparison against the Town's median (L₅₀) noise level standard, it was assumed that 2 medium duty trucks/vans could have deliveries to the site during the same worst-case hour.

BAC file data indicate that noise level exposure associated with medium-duty truck deliveries (including side-step vans) is approximately 76 dB SEL at a distance of 100 feet. Based on 2 medium duty truck deliveries during a worst-case busy hour and an SEL of 76 dB, the median noise level computes to 43 dB L₅₀ at a reference distance of 100 feet during the worst-case hour of deliveries. When projected from the c-store delivery area to the nearest future residential use to the northeast located approximately 200 feet away, median truck delivery activity noise level exposure is calculated to be 37 dB L₅₀. When projected from the delivery area to the nearest future residential use to the north located approximately 250 feet away, median truck delivery activity noise level exposure is calculated to be 35 dB L₅₀. Finally, when projected to the nearest existing residential use to the south located approximately 300 feet away, median truck delivery noise level exposure is calculated to be 34 dB L₅₀.

C-Store / Gas Station Component On-Site Truck Circulation

As mentioned above, it is the experience of BAC that deliveries of product to c-stores occur at the front of the store with medium-duty vendor trucks/vans. However, the gas station would also receive deliveries from heavy fueling trucks for the purposes of refiling the underground fuel storage tanks.

On-site truck passbys are expected to be relatively brief and will occur at low speeds. To predict noise levels generated by on-site truck circulation, BAC utilized file data obtained from measurements conducted by BAC of heavy and medium duty truck passbys. According to BAC file data, single-event heavy truck passby noise levels are approximately 83 dB SEL at a reference distance of 50 feet. BAC file data also indicate that single-event medium truck passby noise levels are approximately 76 SEL at a reference distance of 50 feet.

For the purposes of comparison against the Town's median (L₅₀) noise level standard, it was assumed that 1 heavy fueling truck and 2 medium duty trucks/vans could have deliveries to the site during the same worst-case hour. Given the aforementioned worst-case hour of deliveries, the median noise level computes to 49 dB L₅₀ at a reference distance of 50 feet from the passby route. When projected from the on-site truck passby route to the nearest future residential use to the northeast located approximately 100 feet away, median on-site truck circulation noise level exposure is calculated to be 43 dB L₅₀. When projected from the on-site truck passby

route to the nearest future residential use to the north located approximately 175 feet away, median on-site truck circulation noise level exposure is calculated to be 38 dB L₅₀. Finally, when projected to the nearest existing residential use to the south located approximately 300 away, on-site truck circulation noise level exposure is calculated to be 33 dB L₅₀.

Comparison of Car Wash vs. C-Store / Gas Station Operations Noise

Predicted noise levels associated with car wash and c-store / gas station operations are summarized below in Tables 7 and 8, respectively.

**Table 7
Combined Car Wash Component Noise Exposure at Nearest Residential Uses**

Receiver	Predicted Noise Levels, L ₅₀ (dB)		Calculated Combined
	Drying Assembly	Vacuums	
Future Residential (Townhome)	47	44	49
Future Residential (4-Plex)	53	41	53
Existing Residential (Multi-Family)	51	38	51

Source: BAC 2023.

**Table 8
Combined C-Store / Gas Station Component Noise Exposure at Nearest Residential Uses**

Receiver	Predicted Noise Levels, L ₅₀ (dB)				Calculated Combined
	HVAC	Parking	Truck Deliveries	Truck Circ.	
Future Residential (Townhome)	38	41	37	43	46
Future Residential (4-Plex)	38	41	35	38	44
Existing Residential (Multi-Family)	35	37	34	33	41

Source: BAC 2023.

Based on the data provided in Tables 7 and 8, combined noise levels associated with the car wash component are calculated to be higher than those associated with a c-store / gas station component. Nonetheless, noise exposure from the development of either component is predicted to comply with the Town’s 55 dB L₅₀ daytime noise level standard at the closest existing and future residential uses.

Conclusions

Based on the analysis and results presented in this report, noise level exposure from the Village Car Wash is predicted to satisfy the Town of Truckee 55 dB L₅₀ daytime noise level standard at the nearest existing and future residential uses.

At the request of the Town of Truckee planning staff, this report includes a comparison of noise level exposure associated with car wash and c-store / gas station operations at nearby existing and future residential uses. Based on the analysis and results presented in this report,

combined noise levels associated with the car wash component are calculated to be higher than those associated with a c-store / gas station component. Nonetheless, the results presented in this report indicate that noise exposure from the development of either component is predicted to comply with the Town's 55 dB L₅₀ daytime noise level standard at the closest existing and future residential uses.

These conclusions are based on the provided site plans, equipment manufacturer noise level data, BAC file data and field observations, and equipment operations assumptions cited herein. Deviations from the resources or assumptions cited above could cause actual noise levels to differ from those predicted in this assessment.

This concludes BAC's noise assessment for the Village Car Wash in Truckee, California. Please contact BAC at (530) 537-2328 or dariog@bacnoise.com with any questions regarding this assessment.

Appendix A Acoustical Terminology

Acoustics	The science of sound.
Ambient Noise	The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.
Attenuation	The reduction of an acoustic signal.
A-Weighting	A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response.
Decibel or dB	Fundamental unit of sound. A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell.
CNEL	Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 - 10 p.m.) weighted by a factor of three and nighttime hours weighted by a factor of 10 prior to averaging.
Frequency	The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz.
IIC	Impact Insulation Class (IIC): A single-number representation of a floor/ceiling partition's impact generated noise insulation performance. The field-measured version of this number is the FIIC.
L_{dn}	Day/Night Average Sound Level. Similar to CNEL but with no evening weighting.
Leq	Equivalent or energy-averaged sound level.
L_{max}	The highest root-mean-square (RMS) sound level measured over a given period of time.
Loudness	A subjective term for the sensation of the magnitude of sound.
Masking	The amount (or the process) by which the threshold of audibility is for one sound is raised by the presence of another (masking) sound.
Noise	Unwanted sound.
Peak Noise	The level corresponding to the highest (not RMS) sound pressure measured over a given period of time. This term is often confused with the "Maximum" level, which is the highest RMS level.
RT₆₀	The time it takes reverberant sound to decay by 60 dB once the source has been removed.
STC	Sound Transmission Class (STC): A single-number representation of a partition's noise insulation performance. This number is based on laboratory-measured, 16-band (1/3-octave) transmission loss (TL) data of the subject partition. The field-measured version of this number is the FSTC.



Appendix B-1
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 1
Tuesday, May 02, 2017

Hour	Leq	Lmax	L50	L90
0:00	50	68	45	41
1:00	47	66	44	41
2:00	48	66	46	42
3:00	49	67	45	42
4:00	52	74	48	44
5:00	56	77	49	45
6:00	61	73	58	51
7:00	64	82	63	54
8:00	62	73	61	53
9:00	62	78	60	49
10:00	60	73	57	47
11:00	61	75	58	47
12:00	61	77	58	48
13:00	61	75	58	48
14:00	62	77	60	50
15:00	62	76	60	51
16:00	62	77	61	53
17:00	62	76	61	53
18:00	61	84	58	50
19:00	60	77	57	49
20:00	61	87	54	48
21:00	59	86	52	48
22:00	54	68	50	47
23:00	52	69	49	45

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	64	59	61	61	47	54
Lmax (Maximum)	87	73	78	77	66	70
L50 (Median)	63	52	59	58	44	48
L90 (Background)	54	47	50	51	41	44

Computed Ldn, dB	63
% Daytime Energy	89%
% Nighttime Energy	11%

Appendix B-2
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 1
Wednesday, May 03, 2017

Hour	Leq	Lmax	L50	L90
0:00	51	68	48	44
1:00	49	71	45	41
2:00	50	69	46	42
3:00	48	64	46	41
4:00	51	69	48	45
5:00	56	77	51	47
6:00	61	72	59	52
7:00	64	74	63	56
8:00	63	75	61	52
9:00	61	77	59	47
10:00	61	75	57	46
11:00	60	73	57	45
12:00	61	82	59	51
13:00	61	78	59	52
14:00	62	76	60	52
15:00	61	73	59	50
16:00	62	77	61	52
17:00	62	83	61	51
18:00	61	76	59	50
19:00	59	74	57	51
20:00	61	84	54	50
21:00	56	72	52	48
22:00	54	69	50	47
23:00	54	72	49	45

Statistical Summary						
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	64	56	61	61	48	55
Lmax (Maximum)	84	72	77	77	64	70
L50 (Median)	63	52	59	59	45	49
L90 (Background)	56	45	50	52	41	45

Computed Ldn, dB	63
% Daytime Energy	88%
% Nighttime Energy	12%

Appendix B-3
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 1
Thursday, May 04, 2017

Hour	Leq	Lmax	L50	L90
0:00	50	69	46	41
1:00	49	71	46	41
2:00	50	69	47	43
3:00	48	67	46	42
4:00	51	67	48	44
5:00	57	75	50	47
6:00	61	73	59	53
7:00	64	75	63	56
8:00	63	78	62	54
9:00	62	75	60	50
10:00	61	79	58	48
11:00	61	74	59	51
12:00	62	77	60	52
13:00	62	79	60	53
14:00	63	76	61	54
15:00	63	80	61	54
16:00	63	79	62	55
17:00	62	74	61	54
18:00	61	83	59	51
19:00	60	74	57	50
20:00	60	81	54	48
21:00	57	72	52	47
22:00	55	70	50	47
23:00	53	68	50	46

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	64	57	62	61	48	55
Lmax (Maximum)	83	72	77	75	67	70
L50 (Median)	63	52	59	59	46	49
L90 (Background)	56	47	52	53	41	45

Computed Ldn, dB	63
% Daytime Energy	89%
% Nighttime Energy	11%

Appendix B-4
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 2
Tuesday, May 02, 2017

Hour	Leq	Lmax	L50	L90
0:00	47	57	46	42
1:00	48	64	46	42
2:00	48	56	46	43
3:00	47	56	46	42
4:00	49	62	49	45
5:00	49	61	48	46
6:00	54	71	53	51
7:00	55	74	52	49
8:00	53	72	49	47
9:00	51	74	48	45
10:00	50	68	47	44
11:00	51	72	47	44
12:00	55	78	48	45
13:00	51	72	48	45
14:00	52	72	48	46
15:00	52	73	48	44
16:00	50	70	48	46
17:00	51	67	49	46
18:00	52	77	47	45
19:00	50	71	48	45
20:00	50	69	49	47
21:00	51	67	50	48
22:00	51	65	50	47
23:00	50	59	49	46

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	55	50	52	54	47	50
Lmax (Maximum)	78	67	72	71	56	61
L50 (Median)	52	47	48	53	46	48
L90 (Background)	49	44	46	51	42	45

Computed Ldn, dB	57
% Daytime Energy	72%
% Nighttime Energy	28%

Appendix B-5
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 2
Wednesday, May 03, 2017

Hour	Leq	Lmax	L50	L90
0:00	49	58	48	45
1:00	47	57	46	42
2:00	49	64	48	43
3:00	48	62	47	42
4:00	50	69	49	46
5:00	52	61	51	48
6:00	55	72	54	52
7:00	54	70	53	50
8:00	52	71	50	47
9:00	50	64	48	45
10:00	51	72	47	44
11:00	50	65	47	44
12:00	54	73	53	50
13:00	54	69	54	51
14:00	54	73	53	50
15:00	54	74	50	47
16:00	52	74	49	47
17:00	50	67	49	46
18:00	51	67	48	45
19:00	54	67	53	50
20:00	52	72	51	49
21:00	52	71	50	48
22:00	50	61	50	47
23:00	50	68	49	45

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	54	50	53	55	47	51
Lmax (Maximum)	74	64	70	72	57	64
L50 (Median)	54	47	50	54	46	49
L90 (Background)	51	44	47	52	42	46

Computed Ldn, dB	57
% Daytime Energy	72%
% Nighttime Energy	28%

Appendix B-6
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 2
Thursday, May 04, 2017

Hour	Leq	Lmax	L50	L90
0:00	48	57	46	40
1:00	47	58	46	42
2:00	49	65	47	44
3:00	48	55	47	42
4:00	50	58	49	45
5:00	50	61	49	47
6:00	55	71	54	52
7:00	55	72	54	51
8:00	53	71	51	48
9:00	50	63	49	46
10:00	51	69	48	45
11:00	54	73	53	50
12:00	55	77	54	52
13:00	55	70	54	52
14:00	56	73	54	52
15:00	56	69	55	53
16:00	55	71	54	52
17:00	54	63	53	51
18:00	53	77	51	49
19:00	52	70	51	48
20:00	51	66	50	48
21:00	52	72	50	47
22:00	50	59	50	47
23:00	51	59	50	47

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	56	50	54	55	47	51
Lmax (Maximum)	77	63	70	71	55	60
L50 (Median)	55	48	52	54	46	49
L90 (Background)	53	45	50	52	40	45

Computed Ldn, dB	58
% Daytime Energy	78%
% Nighttime Energy	22%

Appendix B-7
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 3
Tuesday, May 02, 2017

Hour	Leq	Lmax	L50	L90
0:00	48	61	46	41
1:00	49	58	47	43
2:00	48	57	46	42
3:00	50	60	48	45
4:00	47	54	47	44
5:00	53	62	52	50
6:00	53	70	50	46
7:00	52	72	47	44
8:00	52	80	45	43
9:00	51	71	44	42
10:00	49	68	45	43
11:00	53	77	46	43
12:00	50	67	46	43
13:00	50	73	46	43
14:00	50	71	46	42
15:00	49	63	47	44
16:00	49	67	47	44
17:00	53	81	46	43
18:00	51	75	47	44
19:00	50	62	49	46
20:00	52	76	50	47
21:00	51	72	50	47
22:00	51	62	50	46
23:00	50	63	49	44

Statistical Summary						
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	53	49	51	53	47	50
Lmax (Maximum)	81	62	72	70	54	61
L50 (Median)	50	44	47	52	46	48
L90 (Background)	47	42	44	50	41	45

Leq (Average)	53
Lmax (Maximum)	81
L50 (Median)	50
L90 (Background)	47

Computed Ldn, dB	57
% Daytime Energy	67%
% Nighttime Energy	33%

Appendix B-8
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 3
Wednesday, May 03, 2017

Hour	Leq	Lmax	L50	L90
0:00	47	58	46	42
1:00	50	64	48	43
2:00	50	66	48	42
3:00	51	65	50	46
4:00	51	59	51	47
5:00	55	66	54	51
6:00	53	68	51	48
7:00	50	68	47	44
8:00	48	65	46	43
9:00	52	74	45	43
10:00	48	68	45	42
11:00	53	67	51	48
12:00	53	69	52	49
13:00	53	75	50	47
14:00	52	72	48	44
15:00	50	65	48	44
16:00	50	76	47	44
17:00	51	70	47	44
18:00	54	79	52	49
19:00	56	87	52	49
20:00	54	78	51	48
21:00	52	64	51	48
22:00	55	84	50	46
23:00	49	61	48	41

Statistical Summary						
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	56	48	52	55	47	52
Lmax (Maximum)	87	64	72	84	58	66
L50 (Median)	52	45	49	54	46	49
L90 (Background)	49	42	46	51	41	45

Computed Ldn, dB	58
% Daytime Energy	65%
% Nighttime Energy	35%

Appendix B-9
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 3
Thursday, May 04, 2017

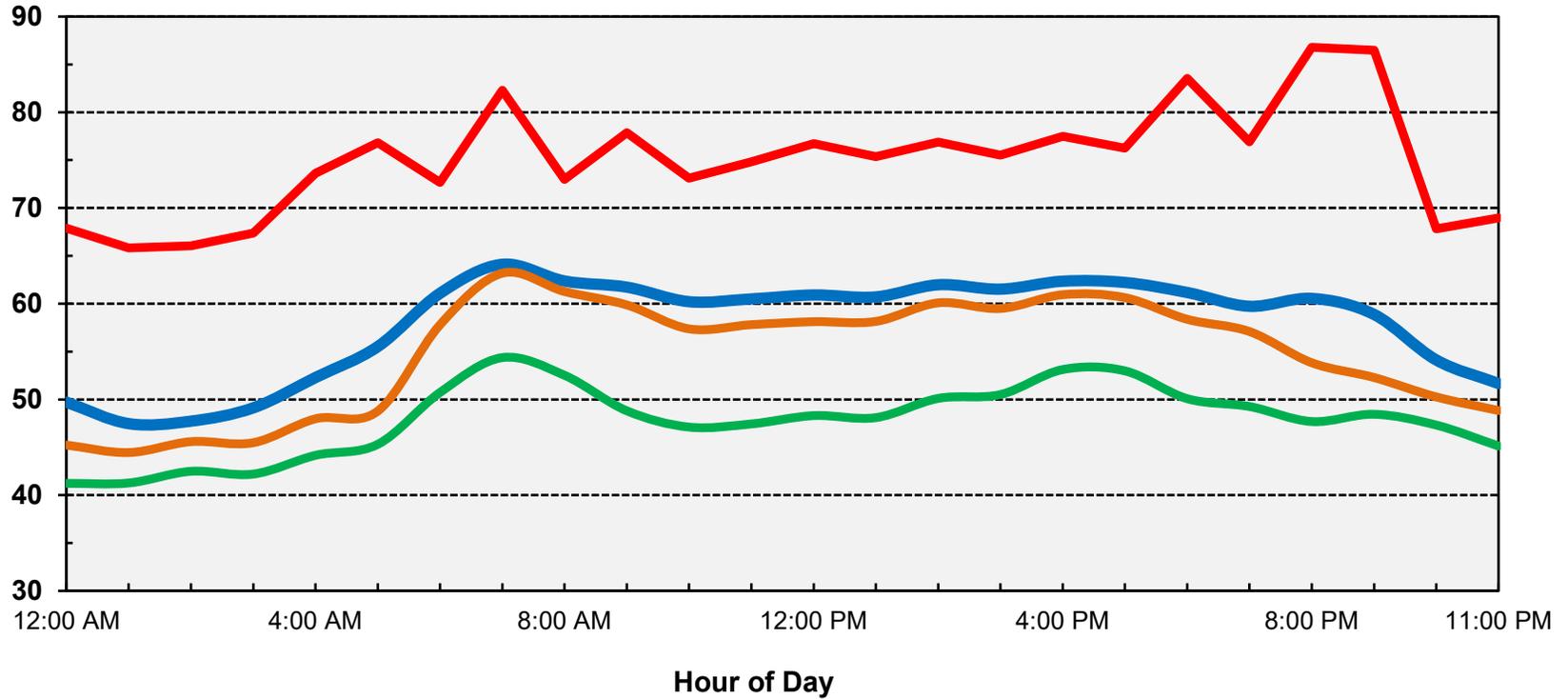
Hour	Leq	Lmax	L50	L90
0:00	49	58	48	43
1:00	50	64	48	44
2:00	48	56	47	41
3:00	50	59	49	44
4:00	50	58	50	47
5:00	54	67	53	50
6:00	56	68	53	51
7:00	52	73	49	47
8:00	51	73	47	44
9:00	51	67	46	42
10:00	54	74	52	49
11:00	55	76	54	51
12:00	55	67	54	51
13:00	55	73	54	51
14:00	56	67	55	52
15:00	56	72	54	52
16:00	54	66	53	50
17:00	54	77	51	48
18:00	54	74	52	49
19:00	52	63	51	48
20:00	53	77	51	47
21:00	51	63	50	47
22:00	52	60	51	47
23:00	48	62	47	43

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	56	51	54	56	48	51
Lmax (Maximum)	77	63	71	68	56	61
L50 (Median)	55	46	51	53	47	49
L90 (Background)	52	42	49	51	41	46

Computed Ldn, dB	58
% Daytime Energy	74%
% Nighttime Energy	26%

Appendix C-1
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 1
Tuesday, May 02, 2017

Sound Level, dBA

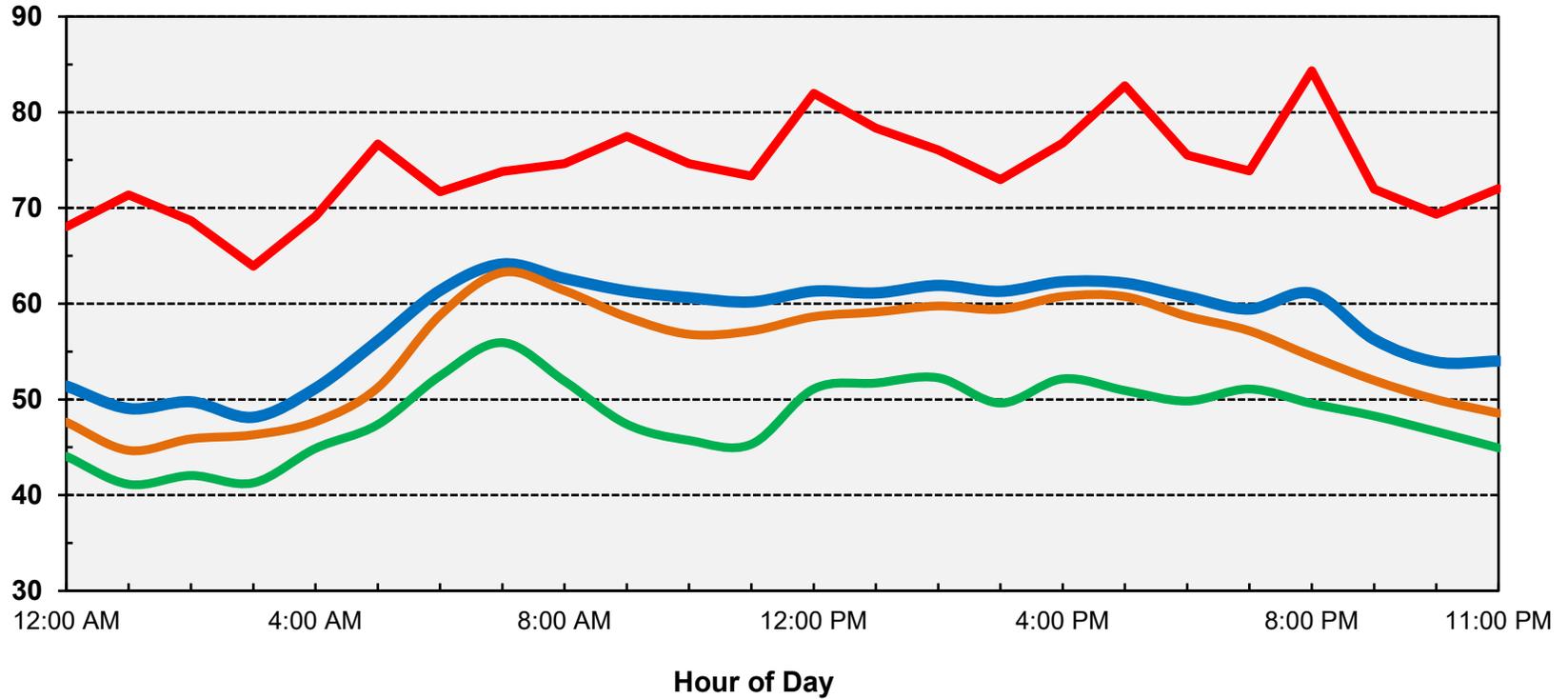


— Average (Leq) — Maximum (Lmax) — L50 — L90

Ldn: 63 dB

Appendix C-2
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 1
Wednesday, May 03, 2017

Sound Level, dBA

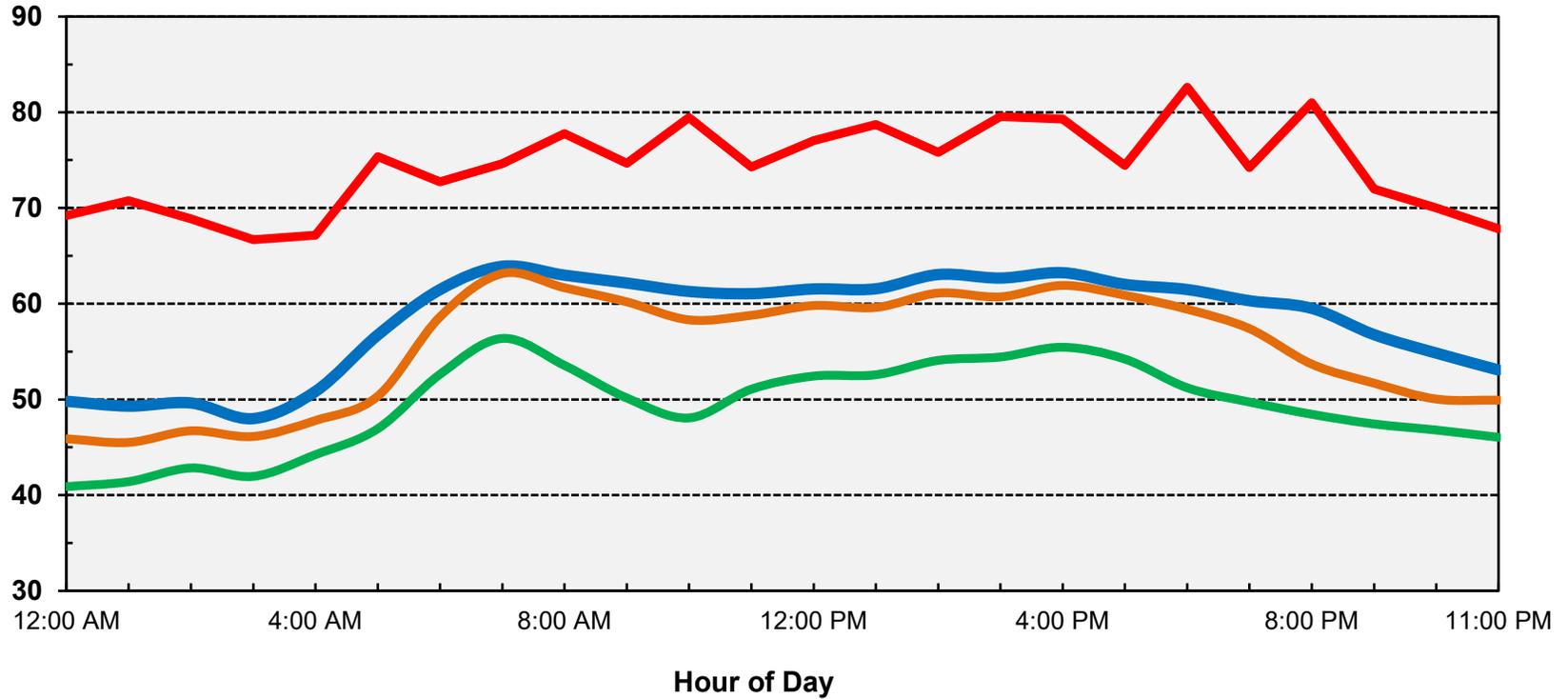


— Average (Leq) — Maximum (Lmax) — L50 — L90

Ldn: 63 dB

Appendix C-3
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 1
Thursday, May 04, 2017

Sound Level, dBA

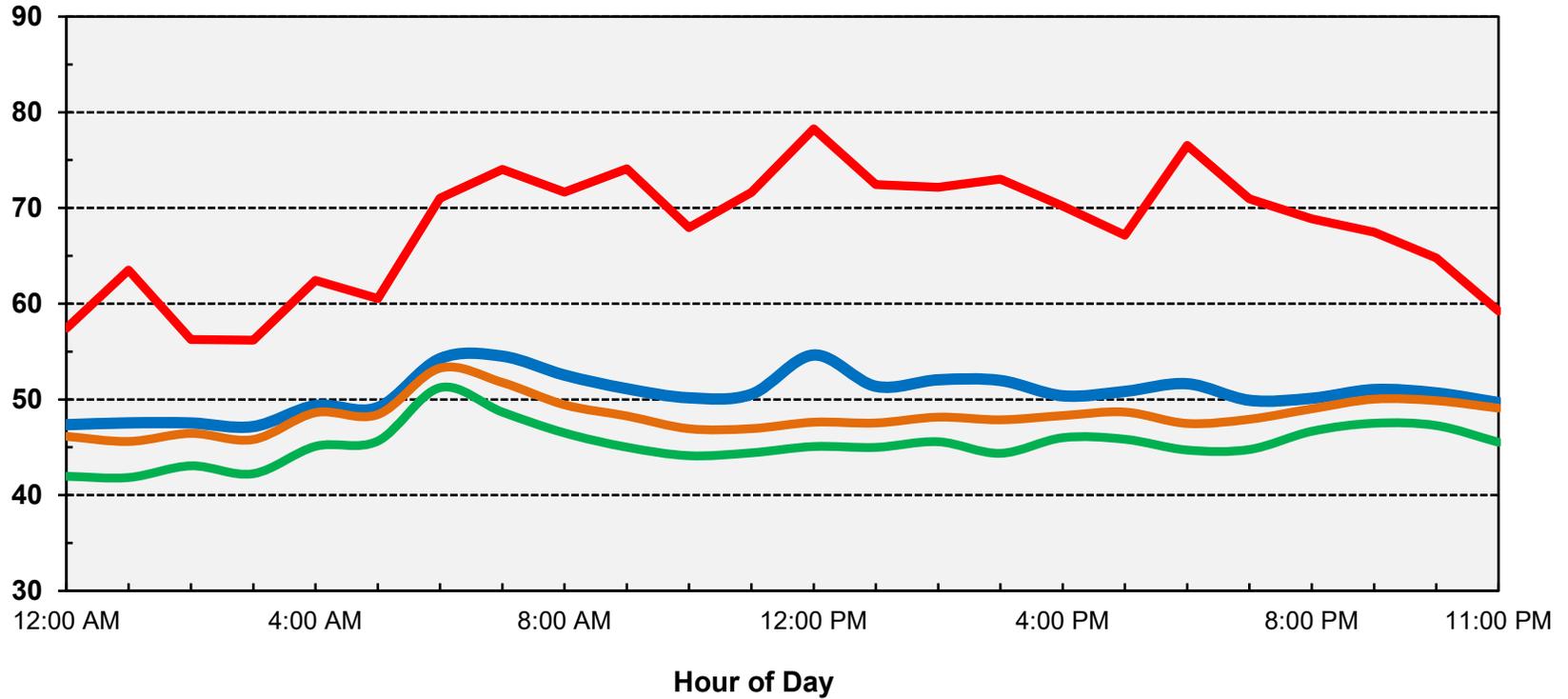


— Average (Leq) — Maximum (Lmax) — L50 — L90

Ldn: 63 dB

Appendix C-4
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 2
Tuesday, May 02, 2017

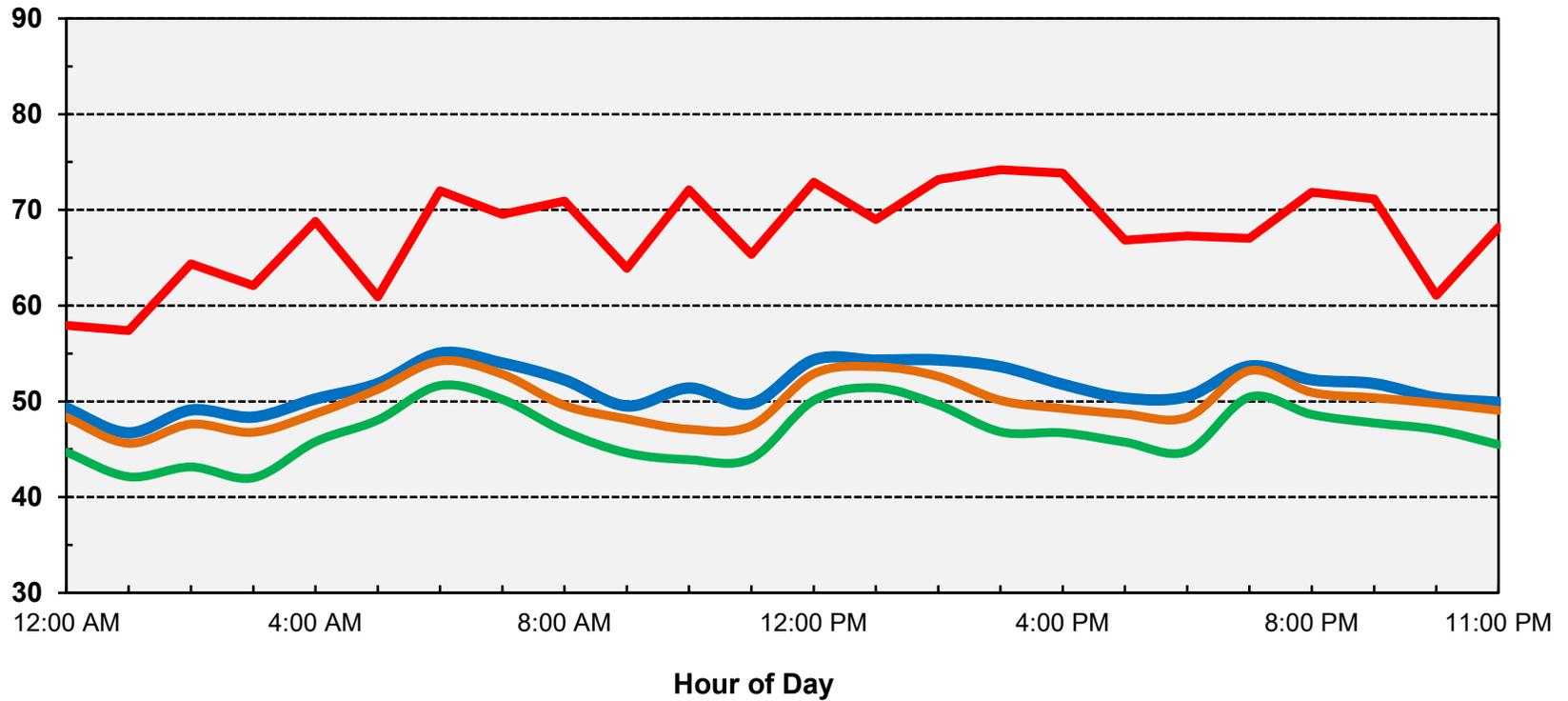
Sound Level, dBA



Ldn: 57 dB

**Appendix C-5
 Village at Grays Crossing
 Ambient Noise Monitoring Results - Site 2
 Wednesday, May 03, 2017**

Sound Level, dBA

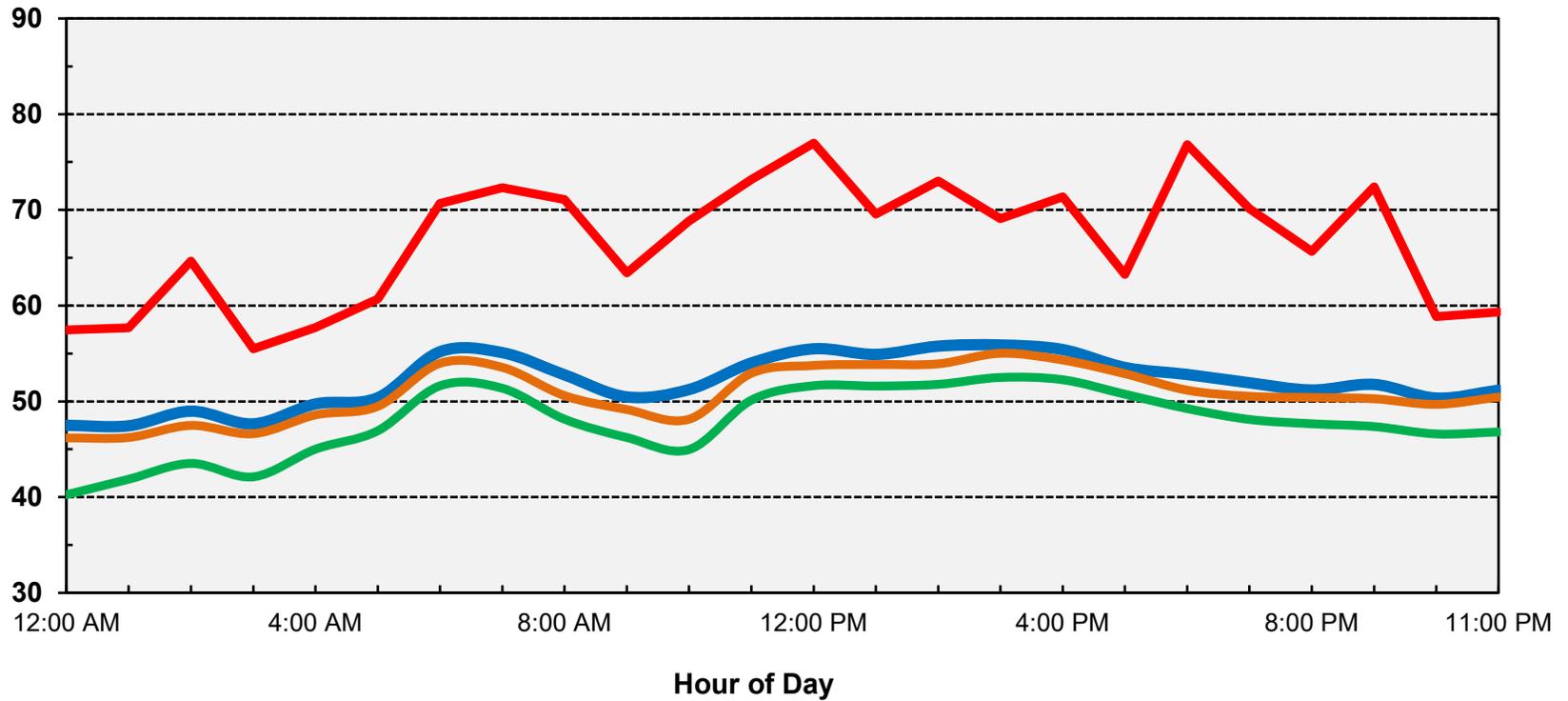


— Average (Leq)
 — Maximum (Lmax)
 — L50
 — L90

Ldn: 57 dB

**Appendix C-6
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 2
Thursday, May 04, 2017**

Sound Level, dBA

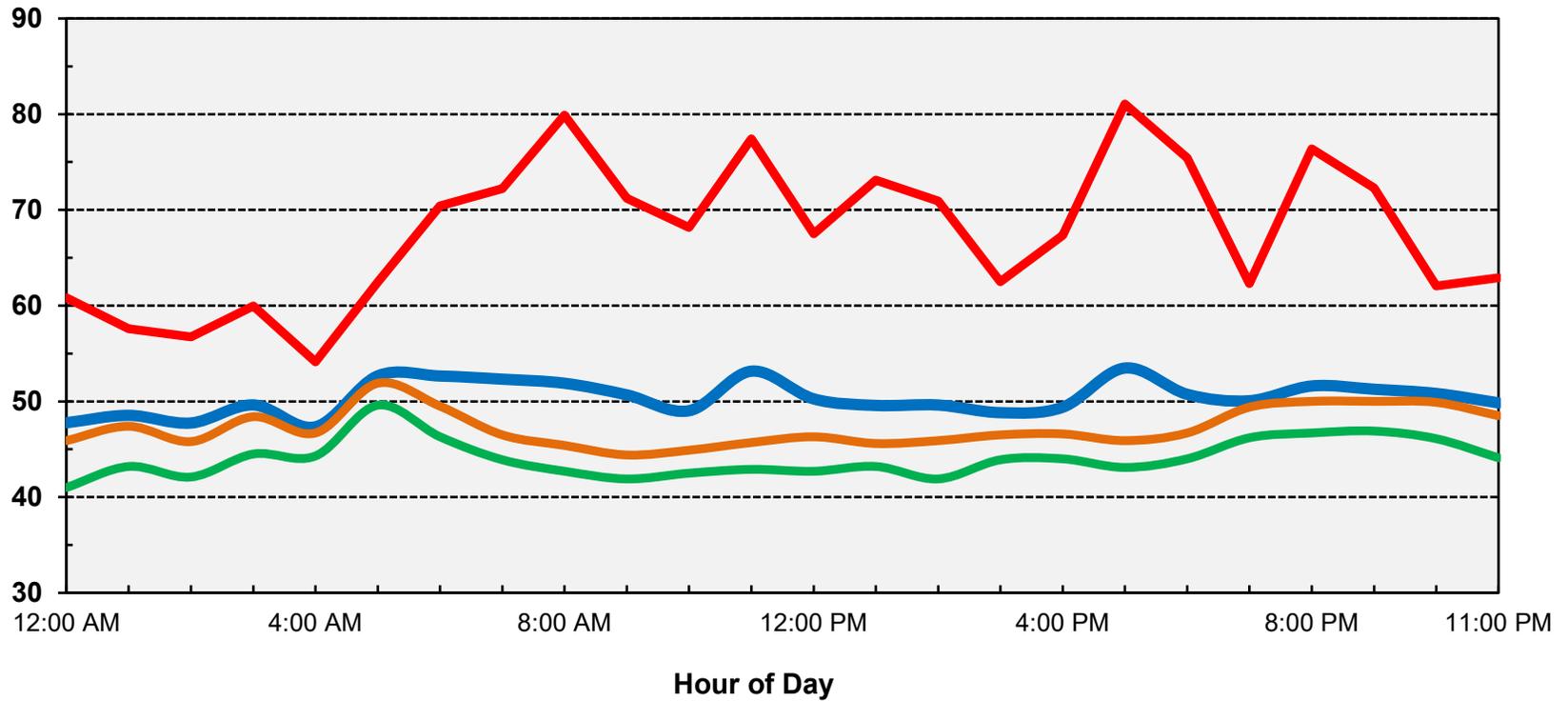


— Average (Leq) — Maximum (Lmax) — L50 — L90

Ldn: 58 dB

**Appendix C-7
 Village at Grays Crossing
 Ambient Noise Monitoring Results - Site 3
 Tuesday, May 02, 2017**

Sound Level, dBA

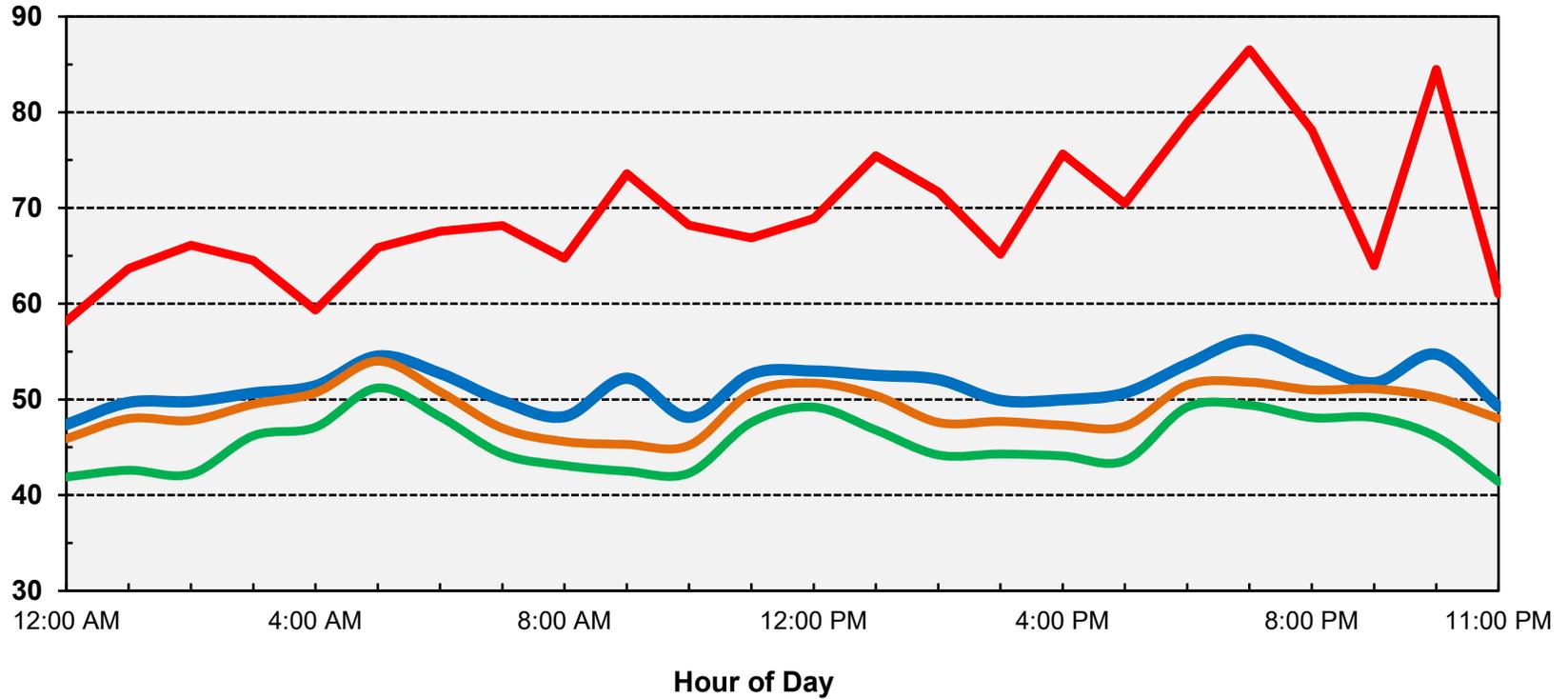


— Average (Leq)
 — Maximum (Lmax)
 — L50
 — L90

Ldn: 57 dB

Appendix C-8
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 3
Wednesday, May 03, 2017

Sound Level, dBA

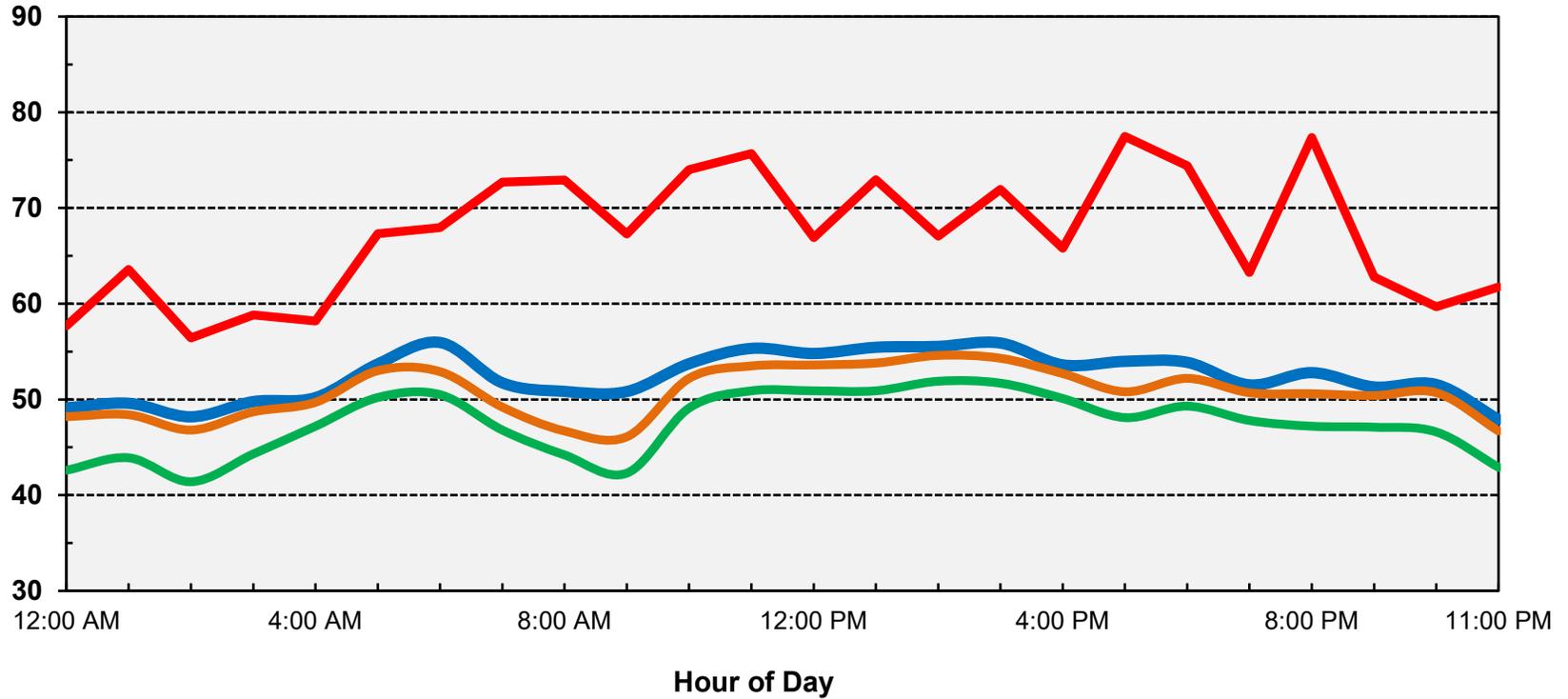


— Average (Leq) — Maximum (Lmax) — L50 — L90

Ldn: 58 dB

Appendix C-9
Village at Grays Crossing
Ambient Noise Monitoring Results - Site 3
Thursday, May 04, 2017

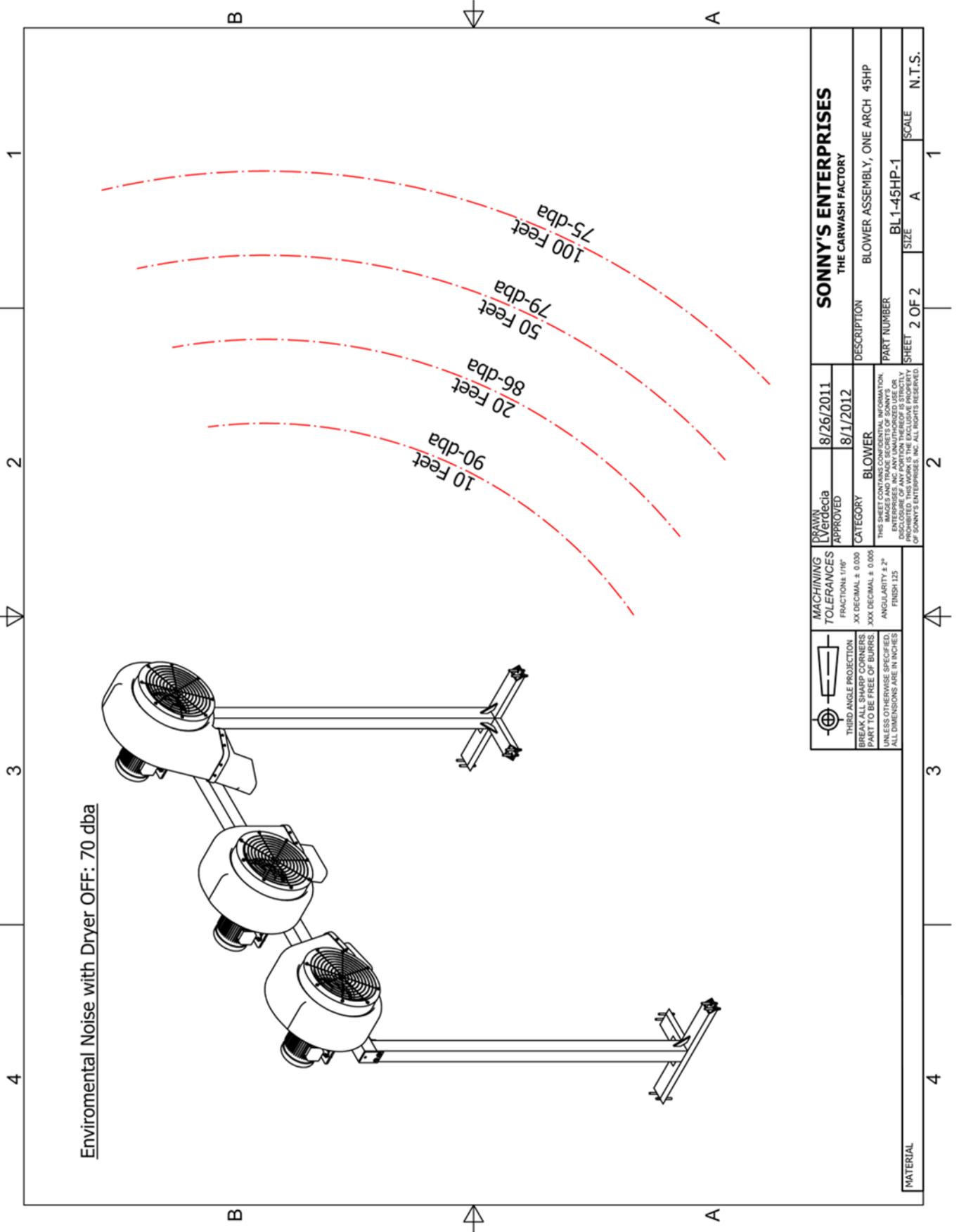
Sound Level, dBA



— Average (Leq) — Maximum (Lmax) — L50 — L90

Ldn: 58 dB

Appendix D



Appendix E

Polycarbonate Door Effectiveness



Sound Level Measurements for BayWatch Polycarbonate Doors With Mark VII AquaJet XT

Car Wash w/ On-Board Dryer (30hp)

Feet From Door	Entry Door Open	Entry Door Closed
10'	93 db	80 db
20'	90 db	76 db
25'	88 db	74 db
30'	85 db	71 db
50'	80 db	66 db

Appendix F
Vacuum Hose Noise Data



February 10th, 2016

Re: Vacutech Sound Study Projections for Bella Terra Car Wash in Huntington Beach, CA

To: Chase Russell – Owner of Bella Terra Car Wash 16061 Beach Blvd. Huntington Beach, CA

The chart below shows a cumulative average of that data taken from express car washes of this type and size. It is presented in an incremental form based on the worst case scenario of the vacuum hoses being off the hook, so to speak. Based on the collective average of the 45' reading to the 85' reading and is presented in the chart below:

Vacutech Noise Study Projections	
Average of all 19 hoses off and in use	
Average @ 45'	52.3 db
Average @ 55'	54.6 db
Average @ 65'	52.1 db
Average @ 75'	49.2 db
Average @ 85'	49.0 db

SOUND LEVEL METER USED: SIMPSON MODEL #40003 – MSHA APPROVED. MEETS OSHA AND WALSH-HEALY REQUIREMENTS FOR NOISE CONTROL. CONFORMS TO ANSI S1.4 1983, IEC 651 SPECS FOR METER TYPE.

NOTE: Typical outside vacuum system with 1.5" x 15' vacuum nozzles (4" wide by 3/4" opening) in use with customer vacuuming.



LSC Transportation Consultants, Inc.

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Tahoe City, CA 96145

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November 1, 2022

Scott Mathot
Town of Truckee
10183 Truckee Airport Road
Truckee, CA 96161

RE: Truckee Village at Gray's Crossing Car Wash Limited Transportation Analysis

Dear Mr. Mathot:

Per your request, LSC Transportation Consultants, Inc. is pleased to present our limited transportation analysis for the proposed car wash project located at 10012 Edwin Way in Truckee, California. This project consists of an automated car wash and 10 vacuum stations. This report is a qualitative analysis to determine if the proposed car wash would impact intersection level of service at Henness Road/Edwin Way or Prosser Dam Road/Edwin Way.

This analysis focuses on a 'Future Buildout of the Town's General Plan' traffic scenario during the Town's design period of peak summer conditions. Traffic volumes along Henness Road and Prosser Dam Road near Edwin Way were estimated based on Town's TransCAD Traffic Model and existing counts. The growth in traffic volumes was then distributed along Edwin Way or past Edwin along Henness Road and Prosser Dam Road. Based on the Gray's Crossing Specific Plan (January 2004), most of the commercial growth will occur along Edwin Way and the proposed car wash would be included within the planned growth. Additional growth in residential lots is expected to generate traffic along Prosser Dam Road and Henness Road past Edwin Way.

Standard trip generation rates from the Institute of Transportation Engineers (ITE) *Trip Generation Manual, 11th Edition* (2021) were used estimate the number of new trips associated with the car wash. The estimated PM peak hour trip generation would range from 45 to roughly 120 trips depending on how the car wash uses are classified. Using the 'worst case' scenario of 120 trips, 50 percent were assumed to be entering in the peak hour and 90 percent were assumed to access the site from the south via Henness Road.

Using the estimated traffic volumes and the worst-case scenario trip generation, level of service (LOS) calculations were conducted based on standard *Highway Capacity Manual 7th Edition (HCM)* methodology. All resulting intersection LOS were acceptable with LOS B or better for the worst movement on both Henness Road/Edwin Way and Prosser Dam Road/Edwin Way

Therefore, in conclusion, LSC expects that there would be no LOS issues at either Henness Road/Edwin Way and Prosser Dam Road/Edwin Way with the addition of the proposed car wash.

Respectfully Submitted,

LSC TRANSPORTATION CONSULTANTS, INC.

By Leslie Suen

Leslie Suen, PE, Associate Engineer
LSC Transportation Consultants, Inc.



PLANNING • ENGINEERING • SURVEYING

May 5, 2023

Via: email to ydahn@townoftruckee.com

Re: **Emissions Comparison – Village at Grays Crossing
Gas Station/Convenience Store Vs. Car Wash**

The following memorandum is provided for a vehicular emissions comparison of a eight (8) fueling position gas station with convenience store which was included in the adopted village at Gray’s Crossing Specific Plan and analyzed in the Environmental Impact Report (EIR) versus the currently proposed full-service car wash.

The EIR determined 2,604 Average Daily trips for the proposed gas station and convenience store utilizing ITE Manual Land Use Code 843. (See attached Table 6.2-A).

Utilizing the Adopted Town of Truckee Air Quality Mitigation Calculations, the proposed gas station and convenience store would potentially generate 9,114 weekly trips and 39,190.2 weekly miles traveled which would total 3,575 g = (.00394 tons) emissions. See calculation table below:

Comparatively, a proposed car wash per LSC’s memorandum dated November 1, 2022 identifies standard trip generation rates from the Institute of Transportation (ITE) Trip Generation Manual, 11th edition (2021) with a PM peak hour of roughly 45 to 120 trips and assumes 50%, or 60 trips entering the site during the peak hour. Additionally, the applicant assumes an average operating day to include approximately 300 car washes and average daily trips. Utilizing the Adopted Town of Truckee Air Quality Mitigation Calculations, the proposed car wash would potentially generate 2,100 weekly trips and 9,030 weekly miles traveled which would total 824 g = (.0009083 tons) emissions, or only about 23.0% of the emissions from a gas station / convenience store. See calculation table below:

	TRIP EMISSIONS	
	Car Wash	Gas Station
Daily Cars	300	1302
Total per Week	2100	9114
Miles per trip	4.3	4.3
Daily Miles	1290	5599
Weekly Miles	9030	39190
Miles per year	469560	2037890
Kilograms / Ton	907	907
Kilogram/Gram	0.001	0.001
Grams Emissions/Mile	0.091206	0.091206
Grams of Weekly Emissions	824	3574
Tons of Weekly Emissions	0.0009	0.0039
Yearly Grams of Emissions	42827	185868
Yearly Emissions - Tons	0.047218	0.204926

Percentage Comparison	23.0%
-----------------------	-------

Idling time does generate additional emissions and is expected to be greater with a car wash, but during peak hours at a gas station/convenience store, idling cars are also commonplace while waiting for a pump to open up and on occasion where a passenger goes into the convenience store, while the driver waits in a parking stall at idle. Comparatively, it is assumed that the average consumer takes 45 seconds to select a wash and use a credit card to purchase a car wash and the average car wash takes about 90 seconds (1 minute – 30 seconds) to go through the “wash tunnel”. If we first look at the max. peak hour of the car wash, we expect 45 cars, or 1 car every 90 seconds entering the site. As the first cars enter and select/purchase a wash, and begin the wash, the normal idling time would equate to approximately 2 minutes 15 seconds. Once the “wash tunnel” is at max. capacity, selection/purchase time is irrelevant as customers are waiting for their time to approach/enter the tunnel and can use that time for selection/purchase. During this peak hour of 45 customers, the access isle would continue to slowly back up beginning with a 2 minutes 15 second idling time and once the access isle is full (up to 13 cars), idle times could be up to 30 minutes assuming last car in line and 1 min.- 30 seconds through the “wash tunnel”. Assuming an average during this peak hour of 16 minutes the peak hour would result in the equivalent of 172 miles driven. The remaining 255 cars of the average day would likely see idling times of 2 minutes - 15 seconds which would equate to the equivalent of 137 miles for a total average day idling equivalent of 308 miles. The cumulative result is an average day of 300 cars with their trip to the car wash and associated idling time would equate to 1,598 miles traveled and a weekly total of 11,186 miles.

As per the Adopted Town of Truckee Air Quality Mitigation Calculations, the proposed car wash would potentially generate 2,100 weekly trips totaling 9,030 weekly miles traveled together with 2,156 equivalent miles of idling which would equate to 1,020 g = (.0011 ton) emissions, or about 28.6% of a gas station / convenience store. See calculation table below:

	EQUIVALENT IDLING EMISSIONS			COMBINED Total (Idle + Trip)
	Normal	Average Peak	Total	
# of cars	255	45	300	
Average Idle Time (Min)	2.25	16		
Average Idle Time (Hours)	0.038	0.267	0.304	
Miles per trip	4.3	4.3		
Idle gas use (gph)	0.65	0.65		
Average Fuel Efficiency (mpg)	22	22		
Miles per hour	14.3	14.3		
Equivalent Miles Driven	137	172	308	1598
Weekly Equivalent Miles	957	1201	2158	11188
Miles per year	49775	62462	112237	581797
Kilograms / Ton	907	907	1814	907
Kilogram/Gram	0.001	0.001	0.002	0.001
Grams Emissions/Mile	0.091206	0.091206	0.182412	0.091206
Grams of Weekly Emissions	87	110	197	1020
Tons of Weekly Emissions	0.0001	0.0001	0.0002	0.0011251
Yearly Grams of Emissions	4540	5697	10237	53063
Yearly Emissions - Tons	0.00501	0.00628	0.01129	0.05850

Village Car Wash – Emissions Comparison – Village at Gray’s Crossing

To Summarize, a full-service car wash has some additional attributed idling time as compared to a gas station/convenience store; however, the volume of overall emissions/air quality impact is approximately 14.3% of a gas station which is significantly below what was evaluated with the previous EIR. Items not taken into account include customers that turn off their car during the wash cycle or waiting to move forward while approaching the wash tunnel, newer cars that automatically shut off while the brake is depressed at stop and electric/ev vehicles that wash their car just as regularly as non-ev vehicles.

Table 6.2-A

Gray's Crossing Weekday Trip Generation - Increased Development Alternative

Land Use	ITE Land Use Code	Number of Units	Units	Unadjusted Trip Generation Rates				Total Project Generated Vehicle Trips				Percent Pass-By Trips	Percent Trips Remaining Internal to the Site	Project Generated External New Vehicle Trips				Reduction In Internal Trips Due To Pedestrian Access	Project Generated Internal Vehicle Trips				
				Average Daily	PM Peak-Hour			Average Daily	PM Peak-Hour					Average Daily	PM Peak-Hour				Average Daily	PM Peak-Hour			
					In	Out	Total		In	Out	Total				In	Out	Total			In	Out	Total	
Summer Weekday																							
Planning Area 1																							
Single-Family Detached	210	120	DU	6.49	0.39	0.26	0.65	779	47	31	78	0%	15%	662	40	26	66	0%	117	7	5	12	
Cottage	210	80	DU	6.49	0.39	0.26	0.65	519	31	21	52	0%	15%	441	26	18	44	0%	78	5	3	8	
Church	560	17.5	KSF	9.11	0.36	0.30	0.66	159	6	5	11	0%	14%	137	5	4	9	0%	22	1	1	2	
							Subtotal	1,457	84	57	141			1,240	71	48	119		Subtotal	217	13	9	22
Planning Area 2																							
Single-Family Detached	210	137	DU	6.49	0.39	0.26	0.65	889	53	36	89	0%	15%	756	45	31	76	10%	120	7	5	12	
Planning Area 3																							
Single-Family Detached	210	58	DU	6.49	0.39	0.26	0.65	376	23	15	38	0%	15%	320	20	13	32	10%	51	3	2	5	
Planning Area 4																							
Single-Family Detached	210	32	DU	6.49	0.39	0.26	0.65	208	12	8	20	0%	15%	177	10	7	17	10%	28	2	1	3	
Planning Area 5																							
Golf Course	430	18	Hole	35.74	1.21	1.53	2.74	643	22	28	50	0%	75%	161	6	7	13	0%	482	17	21	38	
Fitness Center	493	5.0	KSF	42.59	2.62	1.68	4.30	213	13	8	21	0%	75%	53	3	2	5	0%	160	10	6	16	
							Subtotal	856	35	36	71			214	9	9	18		Subtotal	670	29	28	54
Planning Area 6																							
Single-Family Detached	210	42	DU	6.49	0.39	0.26	0.65	273	16	11	27	0%	15%	232	14	9	23	10%	37	2	1	4	
Planning Area 7																							
Single-Family Detached	210	29	DU	6.49	0.39	0.26	0.65	188	11	8	19	0%	15%	160	9	7	16	10%	25	1	1	3	
Planning Area 8																							
Apartment	220	112	DU	6.63	0.42	0.20	0.62	743	47	22	69	0%	15%	632	40	19	59	10%	100	6	3	9	
Lofts	220	23	DU	6.63	0.42	0.20	0.62	152	10	5	15	0%	15%	129	9	4	13	10%	21	1	1	2	
Specialty Retail	814	34.8	KSF	40.67	1.11	1.48	2.59	1,415	39	52	91	0%	14%	1,217	34	45	78	0%	198	5	7	13	
Office	710	4.1	KSF	11.01	0.25	1.24	1.49	45	1	5	6	0%	14%	39	1	4	5	0%	6	0	1	1	
Gas Station with Convenience Store	843	16	FP	162.78	6.69	6.69	13.38	2,604	107	107	214	35%	14%	1,456	60	60	120	0%	365	15	15	30	
Lodge	330	120	Room	3.45	0.18	0.24	0.42	414	22	29	51	0%	15%	352	19	25	43	0%	62	3	4	8	
Church	560	15.0	KSF	9.11	0.36	0.30	0.66	137	5	5	10	0%	14%	118	4	4	9	0%	19	1	1	1	
Community Center	495	7.2	KSF	22.88	0.60	1.15	1.75	165	4	8	12	0%	75%	41	1	2	3	0%	124	3	6	9	
							Subtotal	5,675	235	233	468			3,984	168	163	330		Subtotal	895	34	38	73
Planning Area 9																							
Multi-Family	230	120	DU	5.24	0.29	0.18	0.47	629	35	22	57	0%	15%	535	30	19	48	10%	85	5	3	8	
							Total	10,551	504	426	930			7,618	376	306	679		Total	2,128	96	88	184

Note: DU = dwelling unit, KSF = 1,000 square feet of floor area, Hole = golf hole, FP = fueling positions
 Shading indicates areas where changes were made.