“Q”

Hydrology Report

Anthem Winery P14-00320-MOD and Exception to Road and Street Standards,
Variance P14-00321-VAR and Viewshed, and
Agricultural Erosion Control Plan P14-00322-ECPA
Planning Commission Hearing Date (Wednesday, October 3, 2018)

HYDROLOGY REPORT

Prepared for

ANTHEM WINERY
3123 DRY CREEK ROAD
NAPA, CA 94558

Prepared for:
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400 Spear Street, Suite #122
San Francisco, CA 94105

RSA+ Project No. 4111010.0

December 3, 2015

Revised: June 5, 2018

TABLE OF CONTENTS

ATTACHMENTS

1. VICINITY MAP, SOIL MAP
2. CIVIL IMPROVEMENT PLANS
3. HYDROLOGY CALCULATIONS

I. Purpose

This report addresses the runoff requirements of Napa County Policy CON-50c. This project is identified as a "Discretionary Project". The requirements are outlined in the Napa County General Plan, dated June 23, 2009.

II. Existing Conditions

The Anthem Winery project is located at 3123 Dry Creek Road, Napa, California. The project's APNs are 035-460-038 and 035-470-046, and have a combined area of 44.77 +/- acres. The project site varies in slope from 1-30%. Redwood Creek, a blue-line stream, runs roughly north to south on the western side of the property. There are two residences, a guest house, and a winery located on the parcels. Refer to Attachment 1 for a Vicinity Map and Soil Map.

III. Proposed Development

The Owner is applying to the County of Napa for a modification to a Winery Use Permit that allows operation of a 50,000 gallon per year winery. The proposed winery will be constructed in the area of the existing winery, and will be entirely on the south parcel (035-470-046). Public access to the proposed winery will be from the existing residential driveway connecting to Dry Creek Road. The driveway will be upgraded as required to provide commercial access. The proposed project will disturb an area of approximately 2.5 acres. Refer to Civil Improvement Plans in Attachment 2, for the overall scope of the project.

IV. PRE & POST-DEVELOPMENT DRAINAGE STUDY

This drainage study computes the pre- and post-development total flow rates from the project area for the 2-, 10-, 50- and 100-year, 24-hour design storms, as required by CON-50c. It shows that post-development runoff does not exceed pre-development runoff for these events.

The following precipitation data for the project site was collected from the NOAA Atlas 14, Volume 6 – California (refer to NOAA Precipitation Frequency table in Attachment 3):

Table 1 - NOAA Precipitation Data

Storm Frequency	Precipitation Depth (inches, in 24 hour period)
2-yr	3.40
10-yr	5.17
50-yr	6.99
100-yr	7.77

Existing Conditions

The method used for studying the site stormwater runoff is a hydrograph analysis. The unit hydrograph rainfall distribution for the County of Napa falls under Type IA-distribution. The SCS hydrograph analysis is based on the National Resources Conservation Service Technical Release 55 for Urban Hydrology for Small Watersheds (TR-55) method. The purpose of the hydrograph analysis is to identify and mitigate the increase in the pre- to post-construction runoff flows. The project site consists of 3 separate watersheds, Redwood Creek and Salvador Channel. Five drainage sub-sheds have been identified within the three watersheds in order to model the pre- to post-construction runoff for the project site. The sub-sheds are then added together and the total existing flow rates are analyzed for the purpose of this study. The existing runoff for the 2-, 10-, 50- and 100-year, 24-hour storm events are as follows (refer to Basin Maps and Hydrology Calculations in Attachment 3.

Table 2 – Existing Stormwater Runoff

Watershed 1 –Redwood Creek			
Shed 1	A_1	7.39	[acre]
Existing Impervious Area	A_{1_Paved}	0.06	[acre]
Existing Curve Number	CN_1	79	
Existing Time of Concentration	T_{C-1}	10.24	[min]
Watershed 2 – Salvador Channel			
Sub-shed 2A	A_{2A}	1.56	[acre]
Existing Impervious Area	A_{2A_Paved}	0.12	[acre]
Existing Curve Number	CN_{2A}	78	
Existing Time of Concentration	T_{C-2A}	7.44	[min]
Sub-shed 2B	A_{2B}	8.98	[acre]
Existing Impervious Area	A_{2B_Paved}	0.59	[acre]
Existing Curve Number	CN_{2B}	76	
Existing Time of Concentration	T_{C-2B}	11.53	[min]
Watershed 3 – Salvador Channel			
Sub-shed 3A	A_{3A}	1.62	[acre]
Existing Impervious Area	A_{3A_Paved}	0.24	[acre]
Existing Curve Number	CN_{3A}	82	
Existing Time of Concentration	T_{C-3A}	9.39	[min]
Sub-shed 3B	A_{3B}	0.22	[acre]
Existing Impervious Area	A_{3B_Paved}	0.10	[acre]
Existing Curve Number	CN_{3B}	88	
Existing Time of Concentration	T_{C-3B}	6.00*	[min]
Watershed 1 – Redwood Creek			
Total Existing Peak Flow (2-yr)	$\mathbf{Q_{2YEAR-EXIST}}$	**2.43**	**[cfs]**
Total Existing Peak Flow (10-yr)	$\mathbf{Q_{10YEAR-EXIST}}$	**5.32**	**[cfs]**
Total Existing Peak Flow (50-yr)	$\mathbf{Q_{50YEAR-EXIST}}$	**8.54**	**[cfs]**
Total Existing Peak Flow (100-yr)	$\mathbf{Q_{100YEAR-EXIST}}$	**9.95**	**[cfs]**

Watershed 2 - Salvador Channel			
Total Existing Peak Flow (2-yr)	**$Q_{2YEAR-EXIST}$**	**2.65**	**[cfs]**
Total Existing Peak Flow (10-yr)	**$Q_{10YEAR-EXIST}$**	**6.46**	**[cfs]**
Total Existing Peak Flow (50-yr)	**$Q_{50YEAR-EXIST}$**	**10.88**	**[cfs]**
Total Existing Peak Flow (100-yr)	**$Q_{100YEAR-EXIST}$**	**12.84**	**[cfs]**
Watershed 3 - Salvador Channel			
Total Existing Peak Flow (2-yr)	**$Q_{2YEAR-EXIST}$**	**0.76**	**[cfs]**
Total Existing Peak Flow (10-yr)	**$Q_{10YEAR-EXIST}$**	**1.52**	**[cfs]**
Total Existing Peak Flow (50-yr)	**$Q_{50YEAR-EXIST}$**	**2.34**	**[cfs]**
Total Existing Peak Flow (100-yr)	**$Q_{100YEAR-EXIST}$**	**2.71**	**[cfs]**

See worksheets included in Attachment 3
*** Adopted minimum Tc=6.00 min.**

Proposed Conditions

To comply with the CON-50c requirement for stormwater quantity control, the post-development flow may not exceed pre-development flow for the 2-, 10-, 50-, and 100-year, 24-hour storm event.

The same drainage watersheds and sub-sheds were used to analyze the post-construction runoff flows. Watershed 1 will sheet flow to vegetated areas at the same flow rate as the existing condition. No mitigation is required for Watershed 1. 12,700 cubic feet of detention chambers will be installed under the winery driveway entrance in sub-shed 2A to mitigate post-construction peak flows in the Salvador Channel Watershed 2. Two, 4-foot diameter by 80-foot long detention pipes, providing 2,010 cubic feet of detention, will be installed in the driveway near the Dry Creek Road entrance in sub-shed 3A to mitigate post construction peak flows in the Salvador Channel Watershed 3. The captured stormwater will be conveyed to level spreaders and rock outfalls and will then return to natural flow lines. These measures will limit the peak developed discharge rates to the pre-construction levels. The proposed runoff for the 2-, 10-, 50-, and 100-year, 24-hour storm events are shown in table 3 (refer to Basin Maps and Hydrology Calculations in Attachment 3).

Table 3 – Proposed Stormwater Runoff

Watershed 1 – Redwood Creek			
Shed 1	A_1	7.39	[acre]
Proposed Impervious Area	A_1	0.24	[acre]
Proposed Curve Number	CN_1	79	
Proposed Time of Concentration	T_{C-1}	10.24	[min]
Watershed 2 Area – Salvador Channel			
Sub-shed 2A	A_{2A}	1.56	[acre]
Proposed Impervious Area	A_{2A}	0.98	[acre]
Proposed Curve Number	CN_{2A}	92	
Proposed Time of Concentration	T_{C-2A}	6.00*	[min]

Sub-shed 2B	A_{2B}	8.98	[acre]
Proposed Impervious Area	A_{2B}	1.15	[acre]
Proposed Curve Number	CN_{2B}	77	
Proposed Time of Concentration	$T_{C\text{-}2B}$	9.64	[min]
Watershed 3 Area – Salvador Channel			
Sub-shed 3A	A_{2C}	1.62	[acre]
Proposed Impervious Area	A_{2C}	0.38	[acre]
Proposed Curve Number	CN_{2C}	83	
Proposed Time of Concentration	$T_{C\text{-}2C}$	6.00*	[min]
Sub-shed 3B	A_{2C}	0.22	[acre]
Proposed Impervious Area	A_{2C}	0.12	[acre]
Proposed Curve Number	CN_{2C}	89	
Proposed Time of Concentration	$T_{C\text{-}2C}$	6.00*	[min]
Watershed 1 – Redwood Creek			
Total Proposed Peak Flow (2-yr)	$\mathbf{Q_{2YEAR\text{-}POST}}$	**2.43**	**[cfs]**
Total Proposed Peak Flow (10-yr)	$\mathbf{Q_{10YEAR\text{-}POST}}$	**5.32**	**[cfs]**
Total Proposed Peak Flow (50-yr)	$\mathbf{Q_{50YEAR\text{-}POST}}$	**8.54**	**[cfs]**
Total Proposed Peak Flow (100-yr)	$\mathbf{Q_{100YEAR\text{-}POST}}$	**9.95**	**[cfs]**
Watershed 2 – Salvador Channel			
Total Proposed Peak Flow (2-yr)	$\mathbf{Q_{2YEAR\text{-}POST}}$	**2.65**	**[cfs]**
Total Proposed Peak Flow (10-yr)	$\mathbf{Q_{10YEAR\text{-}POST}}$	**6.29**	**[cfs]**
Total Proposed Peak Flow (50-yr)	$\mathbf{Q_{50YEAR\text{-}POST}}$	**10.32**	**[cfs]**
Total Proposed Peak Flow (100-yr)	$\mathbf{Q_{100YEAR\text{-}POST}}$	**12.07**	**[cfs]**
Watershed 3 – Salvador Channel			
Total Proposed Peak Flow (2-yr)	$\mathbf{Q_{2YEAR\text{-}POST}}$	**0.72**	**[cfs]**
Total Proposed Peak Flow (10-yr)	$\mathbf{Q_{10YEAR\text{-}POST}}$	**1.28**	**[cfs]**
Total Proposed Peak Flow (50-yr)	$\mathbf{Q_{50YEAR\text{-}POST}}$	**1.81**	**[cfs]**
Total Proposed Peak Flow (100-yr)	$\mathbf{Q_{100YEAR\text{-}POST}}$	**2.02**	**[cfs]**

See worksheets included in Attachment 3
*** Adopted minimum Tc=6.00 min.**

Upon successful completion of the project and construction of the detention chambers, the post-development peak flow rates will not exceed the pre-development peak flow rates for the 2-, 10-, 50-, and 100-year 24-hour storm events, for the Redwood Creek and Salvador Channel watersheds.

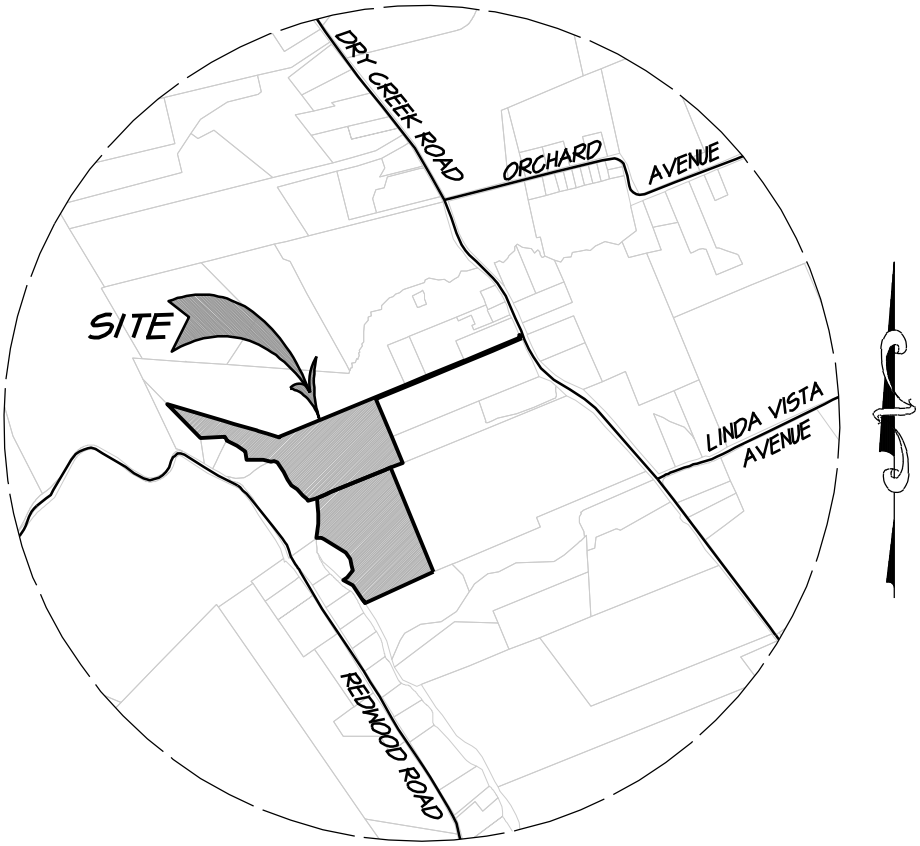
V. Conclusions

There will be no net increase in post-construction peak runoff during 2-, 10-, 50-, and 100-year storm events as required by the Napa County General Plan Policy CON-50c.

ATTACHMENT 1

Vicinity Map, Soil Map

ANTHEM WINERY
VICINITY MAP
NAPA COUNTY CALIFORNIA



VICINITY MAP

SCALE: 1" = 2000'

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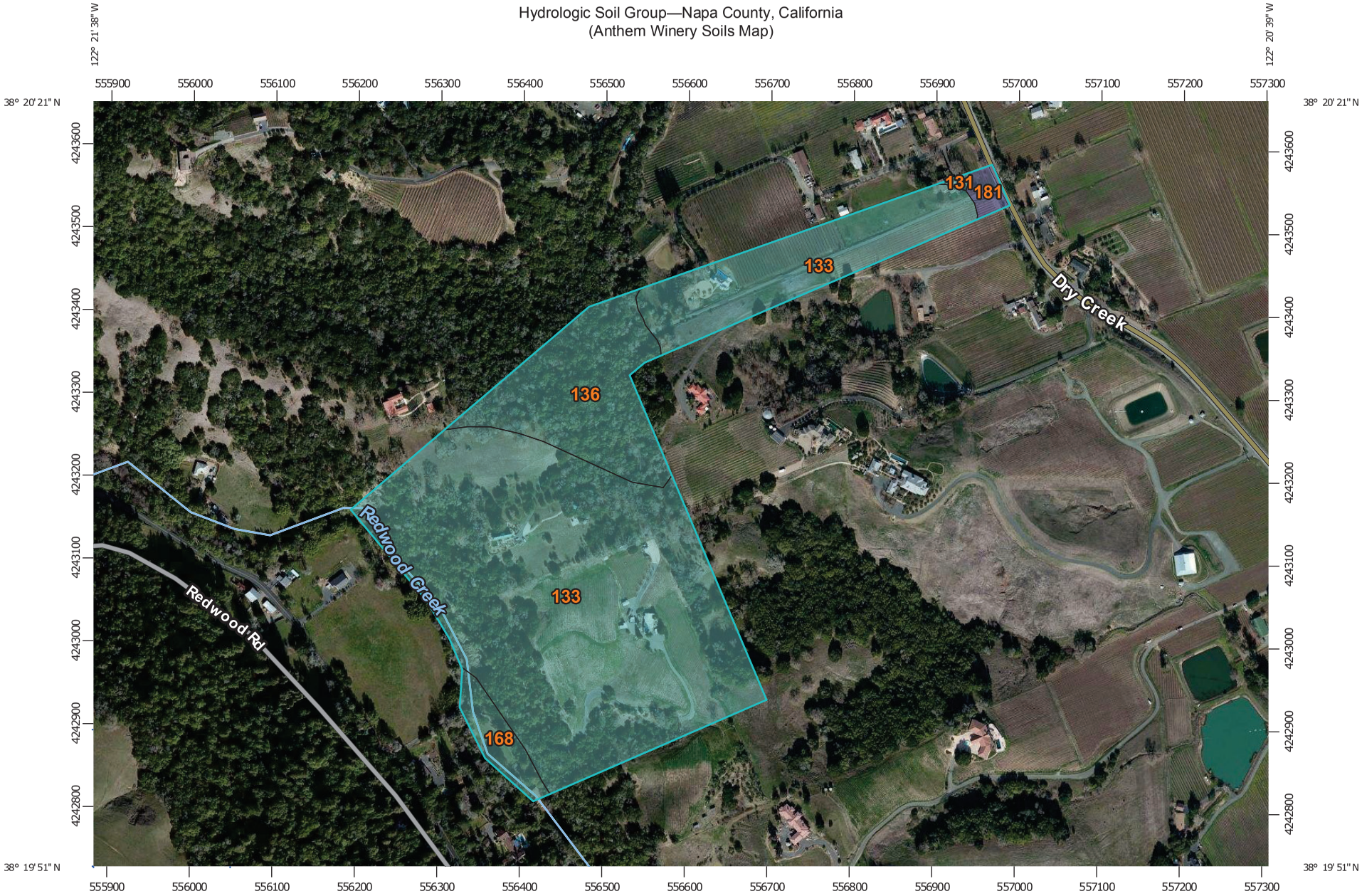
MARCH 12, 2015 4111010.0 Exh-Vicinity Map.dwg

Hydrologic Soil Group—Napa County, California
(Anthem Winery Soils Map)



Map Scale: 1:6,510 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 300 600 1200 1800

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Napa County, California
Survey Area Data: Version 7, Sep 25, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 2, 2010—Feb 17, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Napa County, California (CA055)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
131	Fagan clay loam, 5 to 15 percent slopes	C	0.1	0.2%
133	Fagan clay loam, 30 to 50 percent slopes	C	39.0	80.0%
136	Felton gravelly loam, 30 to 50 percent slopes	C	7.6	15.5%
168	Perkins gravelly loam, 2 to 5 percent slopes	C	1.5	3.2%
181	Yolo loam, 0 to 2 percent slopes	B	0.5	1.1%
Totals for Area of Interest			**48.7**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

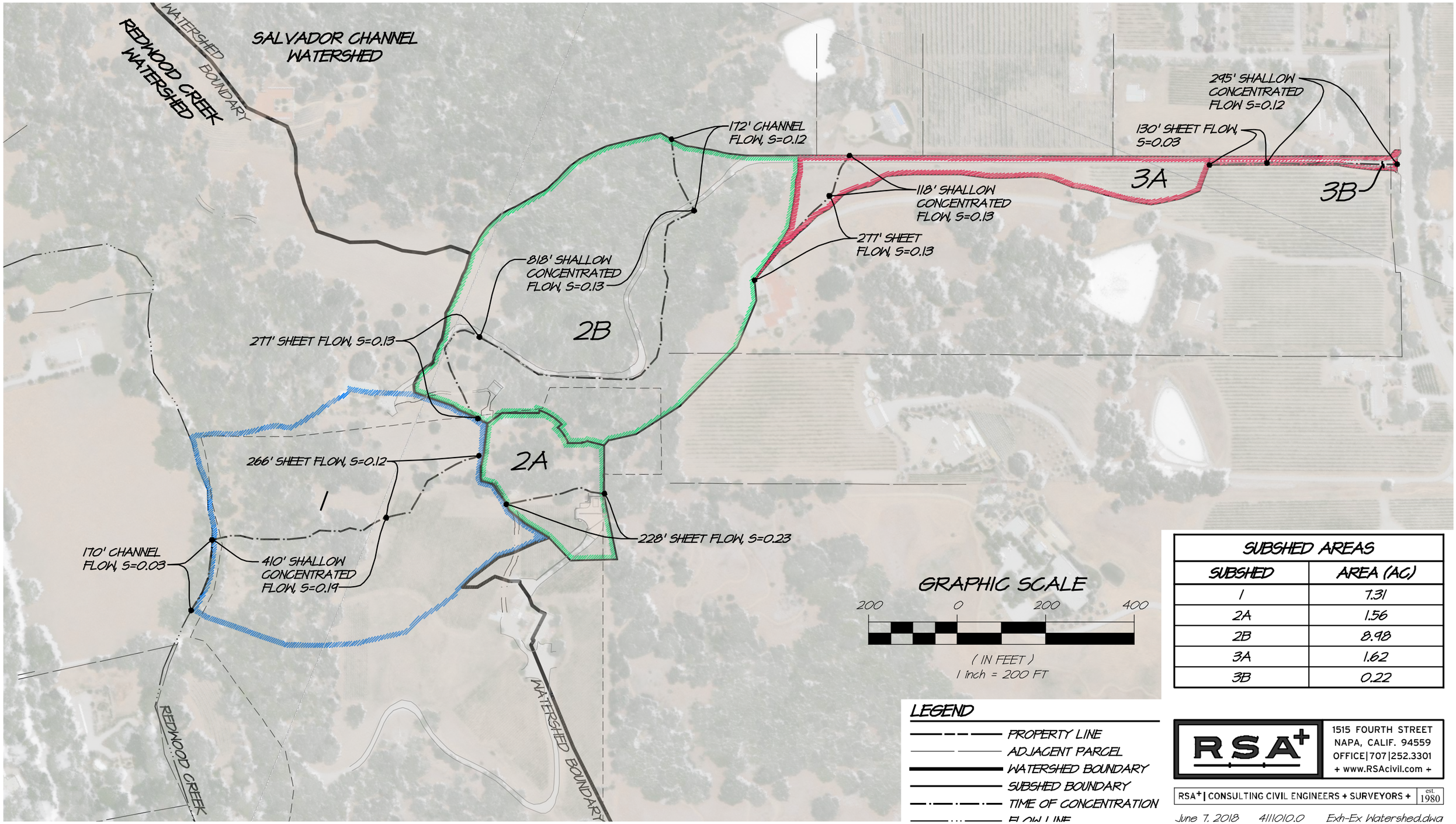
ATTACHMENT 2

Civil Improvement Plans

ATTACHMENT 3

Hydrology Calculations

ANTHEM WINERY
EXISTING DRAINAGE WATERSHED MAP



GRAPHIC SCALE

200 0 200 400

(IN FEET)

1 inch = 200 FT

SUBSHED AREAS	
SUBSHED	AREA (AC)
1	7.31
2A	1.56
2B	8.98
3A	1.62
3B	0.22

LEGEND

- PROPERTY LINE
- ADJACENT PARCEL
- WATERSHED BOUNDARY
- SUBSHED BOUNDARY
- TIME OF CONCENTRATION
- FLOW LINE

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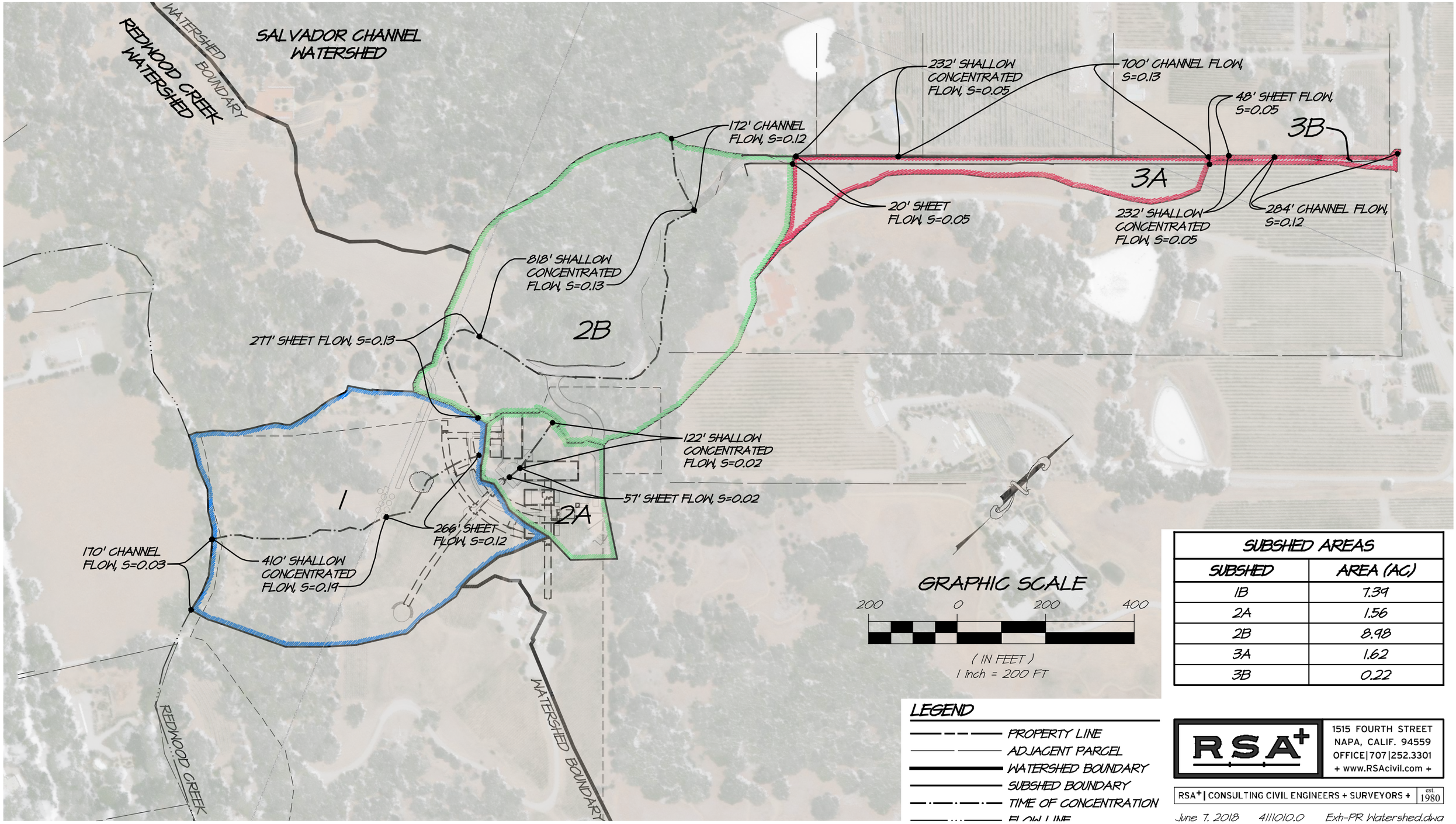
ANTHEM WINERY
PROPOSED DRAINAGE WATERSHED MAP



GRAPHIC SCALE

200 0 200 400

(IN FEET)

1 inch = 200 FT

SUBSHED AREAS	
SUBSHED	AREA (AC)
1B	7.39
2A	1.56
2B	8.98
3A	1.62
3B	0.22

LEGEND

- PROPERTY LINE
- ADJACENT PARCEL
- WATERSHED BOUNDARY
- SUBSHED BOUNDARY
- TIME OF CONCENTRATION
- FLOW LINE

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June 7, 2018 4111010.0 Exh-PR Watershed.dwg

NOAA Atlas 14, Volume 6, Version 2
Location name: Napa, California, US*
Latitude: 38.3352°, Longitude: -122.3532°
Elevation: 381 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.135 (0.120–0.153)	0.167 (0.149–0.190)	0.210 (0.186–0.239)	0.245 (0.215–0.282)	0.293 (0.248–0.351)	0.331 (0.273–0.406)	0.369 (0.296–0.466)	0.410 (0.318–0.533)	0.465 (0.344–0.634)	0.508 (0.362–0.721)
10-min	0.193 (0.172–0.219)	0.240 (0.213–0.272)	0.301 (0.267–0.343)	0.351 (0.309–0.404)	0.421 (0.355–0.503)	0.474 (0.391–0.581)	0.530 (0.424–0.667)	0.587 (0.456–0.764)	0.666 (0.493–0.909)	0.728 (0.519–1.03)
15-min	0.234 (0.208–0.265)	0.290 (0.258–0.329)	0.364 (0.323–0.415)	0.425 (0.373–0.489)	0.509 (0.430–0.608)	0.574 (0.473–0.703)	0.640 (0.513–0.807)	0.710 (0.551–0.924)	0.806 (0.596–1.10)	0.881 (0.627–1.25)
30-min	0.335 (0.298–0.380)	0.415 (0.369–0.472)	0.521 (0.462–0.594)	0.609 (0.534–0.700)	0.728 (0.615–0.871)	0.822 (0.677–1.01)	0.917 (0.735–1.16)	1.02 (0.789–1.32)	1.15 (0.854–1.57)	1.26 (0.898–1.79)
60-min	0.485 (0.432–0.551)	0.602 (0.535–0.684)	0.756 (0.670–0.862)	0.883 (0.775–1.02)	1.06 (0.892–1.26)	1.19 (0.982–1.46)	1.33 (1.07–1.68)	1.47 (1.14–1.92)	1.67 (1.24–2.28)	1.83 (1.30–2.60)
2-hr	0.738 (0.657–0.837)	0.907 (0.807–1.03)	1.13 (1.00–1.29)	1.31 (1.15–1.51)	1.56 (1.31–1.86)	1.75 (1.44–2.14)	1.94 (1.55–2.44)	2.14 (1.66–2.78)	2.41 (1.78–3.29)	2.62 (1.87–3.72)
3-hr	0.944 (0.841–1.07)	1.16 (1.03–1.32)	1.44 (1.28–1.64)	1.67 (1.47–1.92)	1.98 (1.67–2.37)	2.21 (1.83–2.71)	2.45 (1.97–3.09)	2.70 (2.10–3.52)	3.04 (2.25–4.15)	3.30 (2.35–4.68)
6-hr	1.40 (1.25–1.59)	1.73 (1.54–1.97)	2.15 (1.91–2.45)	2.49 (2.19–2.87)	2.95 (2.49–3.53)	3.30 (2.72–4.05)	3.66 (2.93–4.61)	4.02 (3.12–5.23)	4.51 (3.34–6.15)	4.88 (3.48–6.93)
12-hr	1.94 (1.72–2.20)	2.44 (2.17–2.77)	3.08 (2.73–3.52)	3.60 (3.16–4.15)	4.30 (3.63–5.14)	4.82 (3.97–5.91)	5.34 (4.28–6.74)	5.88 (4.56–7.65)	6.59 (4.88–8.99)	7.14 (5.08–10.1)
24-hr	2.63 (2.37–2.98)	3.40 (3.06–3.86)	4.38 (3.93–4.99)	5.17 (4.60–5.92)	6.21 (5.38–7.31)	6.99 (5.96–8.38)	7.77 (6.49–9.50)	8.56 (6.98–10.7)	9.61 (7.57–12.5)	10.4 (7.97–13.9)
2-day	3.42 (3.08–3.88)	4.43 (3.98–5.03)	5.72 (5.13–6.50)	6.74 (6.01–7.73)	8.12 (7.03–9.55)	9.15 (7.79–11.0)	10.2 (8.50–12.4)	11.2 (9.17–14.1)	12.6 (9.96–16.4)	13.7 (10.5–18.3)
3-day	3.99 (3.59–4.53)	5.16 (4.63–5.86)	6.65 (5.96–7.56)	7.84 (6.98–8.98)	9.42 (8.17–11.1)	10.6 (9.05–12.7)	11.8 (9.87–14.5)	13.0 (10.6–16.3)	14.7 (11.6–19.0)	15.9 (12.2–21.2)
4-day	4.45 (4.01–5.05)	5.76 (5.17–6.54)	7.42 (6.65–8.44)	8.74 (7.78–10.0)	10.5 (9.09–12.3)	11.8 (10.1–14.1)	13.1 (10.9–16.0)	14.4 (11.8–18.1)	16.2 (12.8–21.0)	17.5 (13.4–23.4)
7-day	5.47 (4.92–6.21)	7.12 (6.40–8.08)	9.17 (8.22–10.4)	10.8 (9.60–12.3)	12.9 (11.2–15.1)	14.4 (12.3–17.3)	15.9 (13.3–19.5)	17.4 (14.2–21.8)	19.4 (15.3–25.1)	20.8 (16.0–27.8)
10-day	6.23 (5.61–7.07)	8.13 (7.31–9.23)	10.5 (9.39–11.9)	12.3 (10.9–14.1)	14.6 (12.7–17.2)	16.3 (13.9–19.5)	18.0 (15.0–22.0)	19.6 (16.0–24.5)	21.7 (17.1–28.1)	23.2 (17.8–31.0)
20-day	8.17 (7.35–9.27)	10.7 (9.58–12.1)	13.7 (12.3–15.6)	16.0 (14.2–18.3)	18.9 (16.4–22.2)	20.9 (17.8–25.1)	22.9 (19.1–28.0)	24.8 (20.2–31.1)	27.2 (21.5–35.3)	29.0 (22.2–38.7)
30-day	9.86 (8.87–11.2)	12.8 (11.5–14.5)	16.3 (14.6–18.6)	19.0 (16.9–21.7)	22.3 (19.3–26.3)	24.7 (21.0–29.5)	26.9 (22.4–32.9)	29.0 (23.7–36.3)	31.7 (25.0–41.1)	33.7 (25.8–44.9)
45-day	12.1 (10.9–13.8)	15.6 (14.0–17.7)	19.7 (17.6–22.4)	22.8 (20.3–26.1)	26.6 (23.0–31.3)	29.2 (24.9–35.0)	31.8 (26.5–38.8)	34.2 (27.9–42.8)	37.2 (29.3–48.2)	39.3 (30.1–52.4)
60-day	14.6 (13.1–16.5)	18.4 (16.6–20.9)	23.1 (20.7–26.2)	26.5 (23.6–30.4)	30.8 (26.7–36.2)	33.8 (28.8–40.5)	36.6 (30.5–44.7)	39.2 (32.0–49.1)	42.5 (33.5–55.1)	44.9 (34.4–59.9)

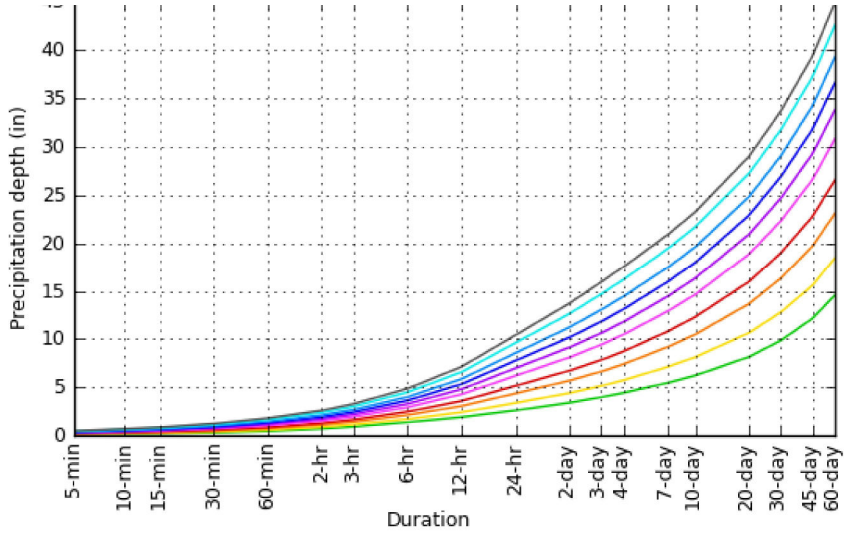
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

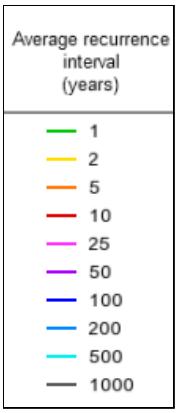
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

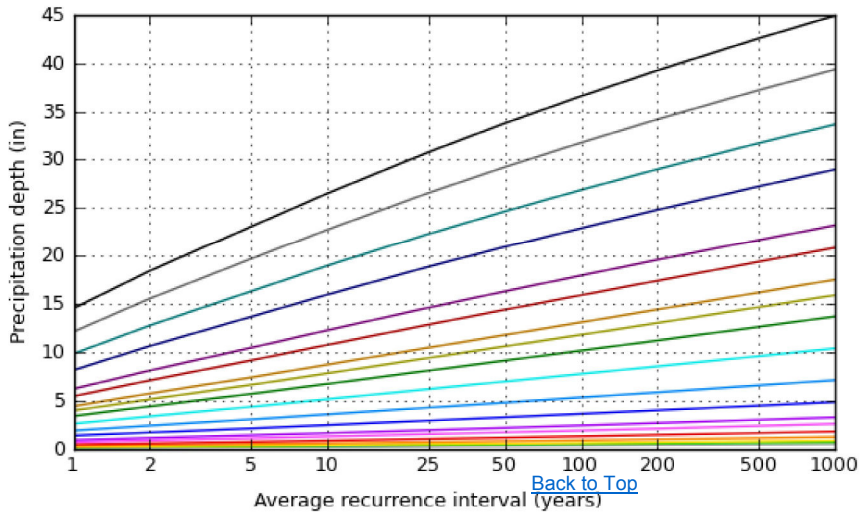
Please refer to NOAA Atlas 14 document for more information.

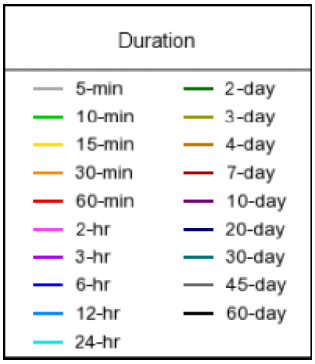
Back to Top

PF graphical









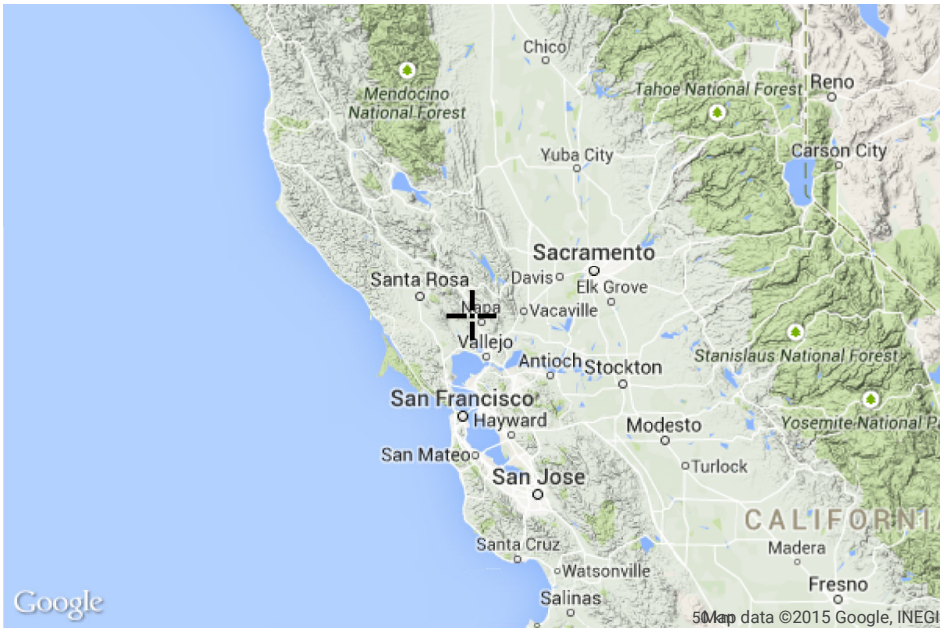
Back to Top

Maps & aerials

NOAA Atlas 14, Volume 6, Version 2

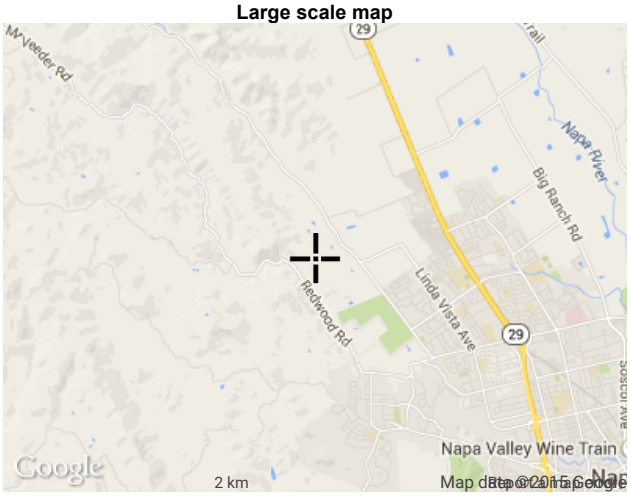
Created (GMT): Wed Mar 4 21:58:48 2015

Small scale terrain



Large scale terrain

Large scale map



Large scale aerial

Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
Office of Hydrologic Development
1325 East West Highway
Silver Spring, MD 20910

Worksheet: Runoff Curve Number

Project	Anthem Winery	By	DJS	Date	6/7/2018
Location	Watershed 1	Checked	PSW	Date	6/7/2018
Subshed name	Existing Conditions	Check one:	☑ Present	☐ Developed	

RUNOFF CURVE NUMBER

Soil name and hydrologic group (SCS book)	**Cover description** (cover type, treatment and hydrogic condition; percent impervious)	**CN** (1) (Table 2-2)	**Area** ☑ acres ☐ mi2 ☐ %	**Product of CN x Area**
133-C	Impervious Area (Roads, roofs, etc.)	98	0.06	5.88
133-C	Pasture Land (fair)	79	2.36	186.44
133-C	Woods (fair)	73	3.30	240.90
133-C	Row Crop - Straight (Poor)	88	1.67	146.96
		TOTAL:	7.39	580.18

(1) Use only one CN source per line

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{580.18}{7.39} = 78.51$; **USE CN** **79**

Worksheet: Time of Concentration (T_c) or travel time (T_t)

Project: Anthem Winery	By: DJS	Date: 6/7/2018	
Location: Project Site	Checked: PSW	Date: 6/7/2018	
Subshed name: Watershed 1	Check one: ☑ Present ☐ Developed		
Note: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic or description of flow segments.	Check one: ☑ Tc ☐ Tt through subarea		

SHEET FLOW (applicable to Tc only)

	Segment ID	1				
1.	Surface description (table 3-1)	Range				
2.	Manning's roughness coefficient, n (table3-1)	0.13				
3.	Flow length, L (total L, 300 ft) ft	266				
4.	Two-year 24-hour rainfall, P_2 in	3.4				
5.	Land slope, s ft/ft	0.12				
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t hr	0.1509	+		=	0.1509

SHALLOW CONCENTRATED FLOW

	Segment ID	2				
7.	Surface description (paved or unpaved)	Unpaved				
8.	Flow length, L ft	410				
9.	Watercourse slope, s ft/ft	0.19				
10.	Average velocity, V (figure 3-1) ft/sec	7.0329				
11.	$T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.0162	+		=	0.0162

CHANNEL FLOW

	Segment ID	3				
12.	Cross sectional flow area, a ft^2	64				
13.	Wetted perimeter, p_w ft	32.98				
14.	Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft	1.9406				
15.	Channel slope, s ft/ft	0.03				
16.	Manning's roughness coefficient, n	0.03				
17.	$V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ft/sec	13.3838				
18.	Flow length, L ft	170				
19.	$T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.0035	+		=	0.0035
20.	Watershed or subarea T_c or T_t (add T_t in steps 6, 11 and 19) hr					0.1706

T_c = 10.24 mins

Worksheet: Runoff Curve Number

Project	Anthem Winery	By	DJS	Date	6/7/2018
Location	Watershed 1	Checked	PSW	Date	6/7/2018
Subshed name	Proposed Conditions	Check one:	☐ Present	☑ Developed	

RUNOFF CURVE NUMBER

Soil name and hydrologic group (SCS book)	Cover description (cover type, treatment and hydrogic condition; percent impervious)	CN (1) (Table 2-2)	Area ☑ acres ☐ mi2 ☐ %	Product of CN x Area
133-C	Impervious Area (Roads, roofs,ect.)	98	0.24	23.52
133-C	Row Crop- Striaght (Poor)	88	1.75	154.00
133-C	Pasture Land (fair)	79	2.10	165.90
133-C	Woods (fair)	73	3.30	240.90

(1) Use only one CN source per line

TOTAL: 7.39 | 584.32

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{584.32}{7.39} = 79.07$$; **USE CN** **79**

Worksheet: Time of Concentration (T_c) or travel time (T_t)

Project: Anthem Winery	By: DJS	Date: 6/7/2018	
Location: Project Site	Checked: PSW	Date: 6/7/2018	
Subshed name: Watershed 1	Check one: ☐ Present	☑ Developed	
Note: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic or description of flow segments.	Check one: ☑ Tc	☐ Tt through subarea	

SHEET FLOW (applicable to Tc only)

	Segment ID	1				
1.	Surface description (table 3-1)	Range				
2.	Manning's roughness coefficient, n (table3-1)	0.13				
3.	Flow length, L (total L, 300 ft) ft	266				
4.	Two-year 24-hour rainfall, P_2 in	3.4				
5.	Land slope, s ft/ft	0.12				
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr	0.1509	+		=	0.1509

SHALLOW CONCENTRATED FLOW

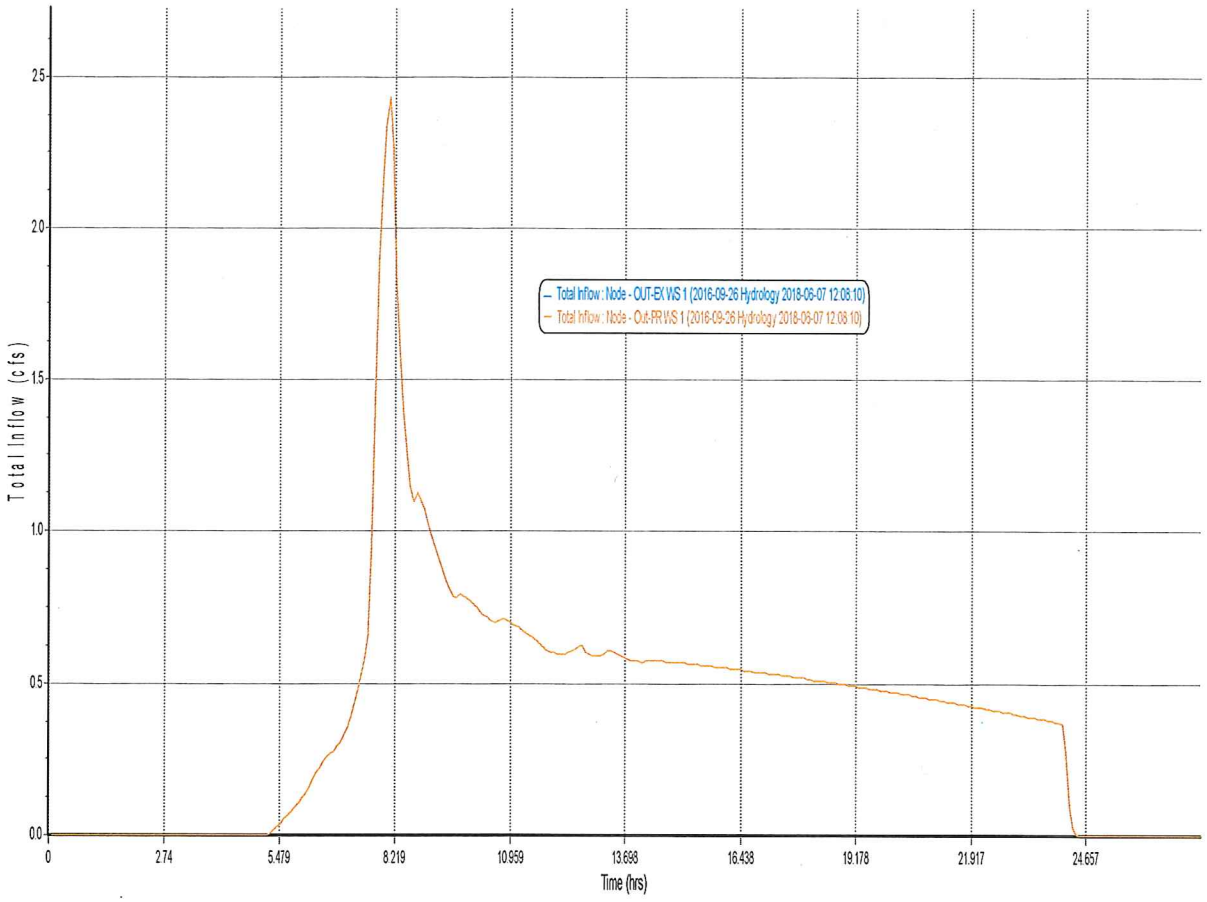
	Segment ID	2				
7.	Surface description (paved or unpaved)	Unpaved				
8.	Flow length, L ft	410				
9.	Watercourse slope, s ft/ft	0.19				
10.	Average velocity, V (figure 3-1) ft/sec	7.0329				
11.	$T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.0162	+		=	0.0162

CHANNEL FLOW

	Segment ID	3				
12.	Cross sectional flow area, a ft^2	64				
13.	Wetted perimeter, p_w ft	32.98				
14.	Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft	1.9406				
15.	Channel slope, s ft/ft	0.03				
16.	Manning's roughness coefficient, n	0.03				
17.	$V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ft/sec	13.3838				
18.	Flow length, L ft	170				
19.	$T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.0035	+		=	0.0035
20.	Watershed or subarea T_c or T_t (add T_t in steps 6, 11 and 19) hr					0.1706

$T_c = 10.24$ mins

Watershed 1: 2-yr Storm Event Runoff



Existing Watershed Runoff Results

Total Rainfall (in) 3.40

Peak Runoff (cfs) 2.43

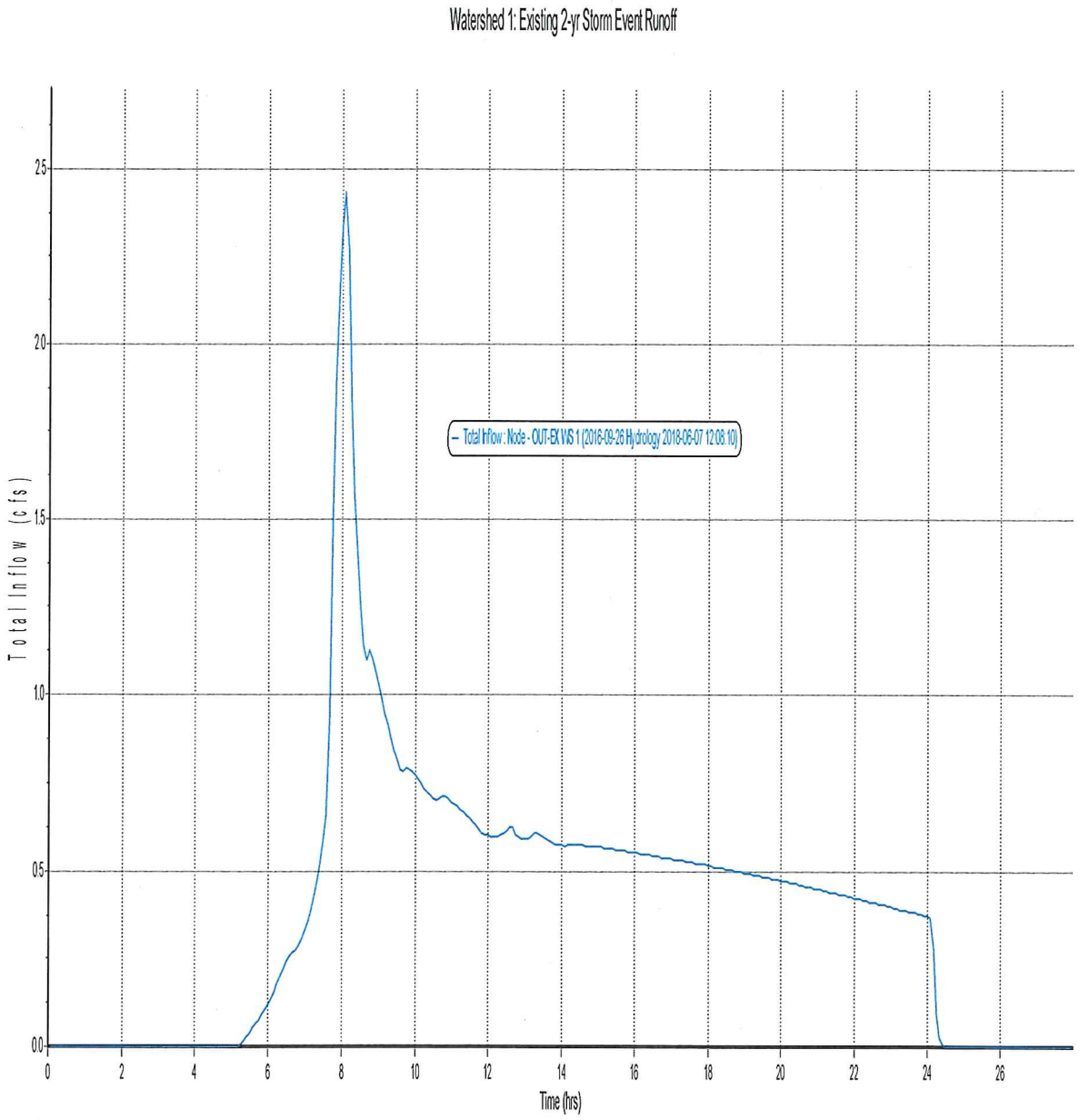
Time to Peak (hrs) 8.03

Proposed Watershed Runoff Results

Total Rainfall (in) 3.40

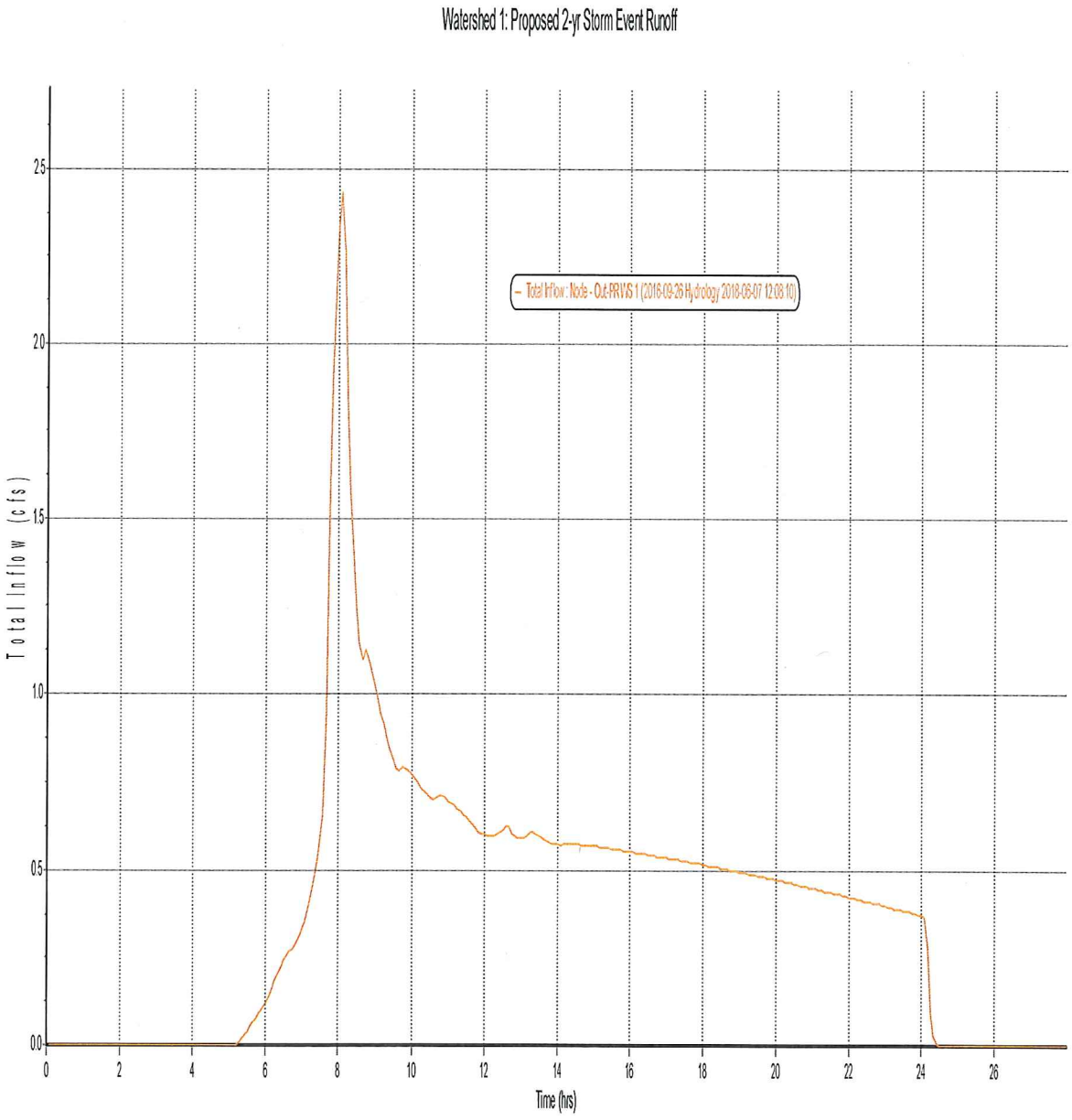
Peak Runoff (cfs) 2.43

Time to Peak (hrs) 8.03



Existing Watershed Runoff Results

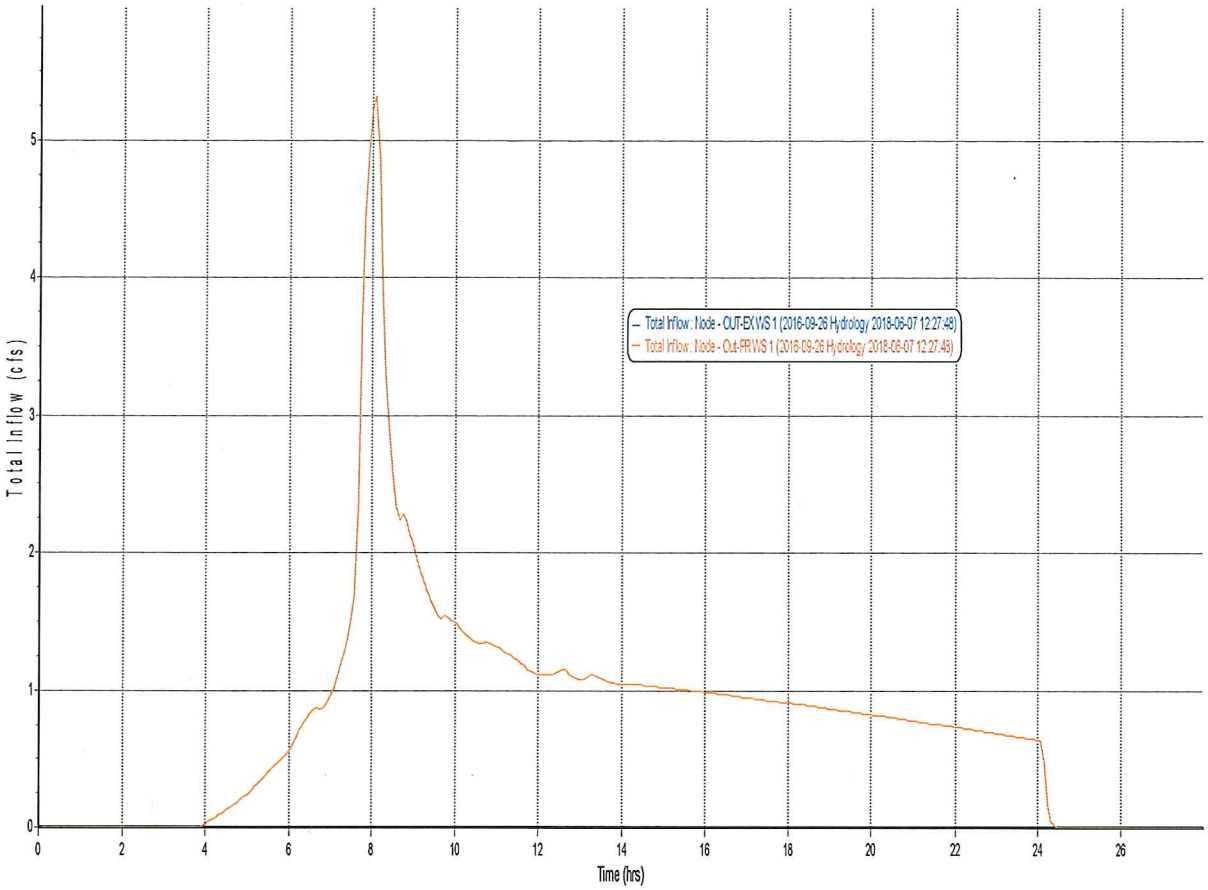
Watershed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
1	79	10.24	7.39	3.40	8.03	2.43



Proposed Watershed Runoff Results

Watershed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
1	79	10.24	7.39	3.40	8.03	2.43

Watershed 1: 10-yr Storm Event



Existing Watershed Runoff Results

Total Rainfall (in) 5.17

Peak Runoff (cfs) 5.32

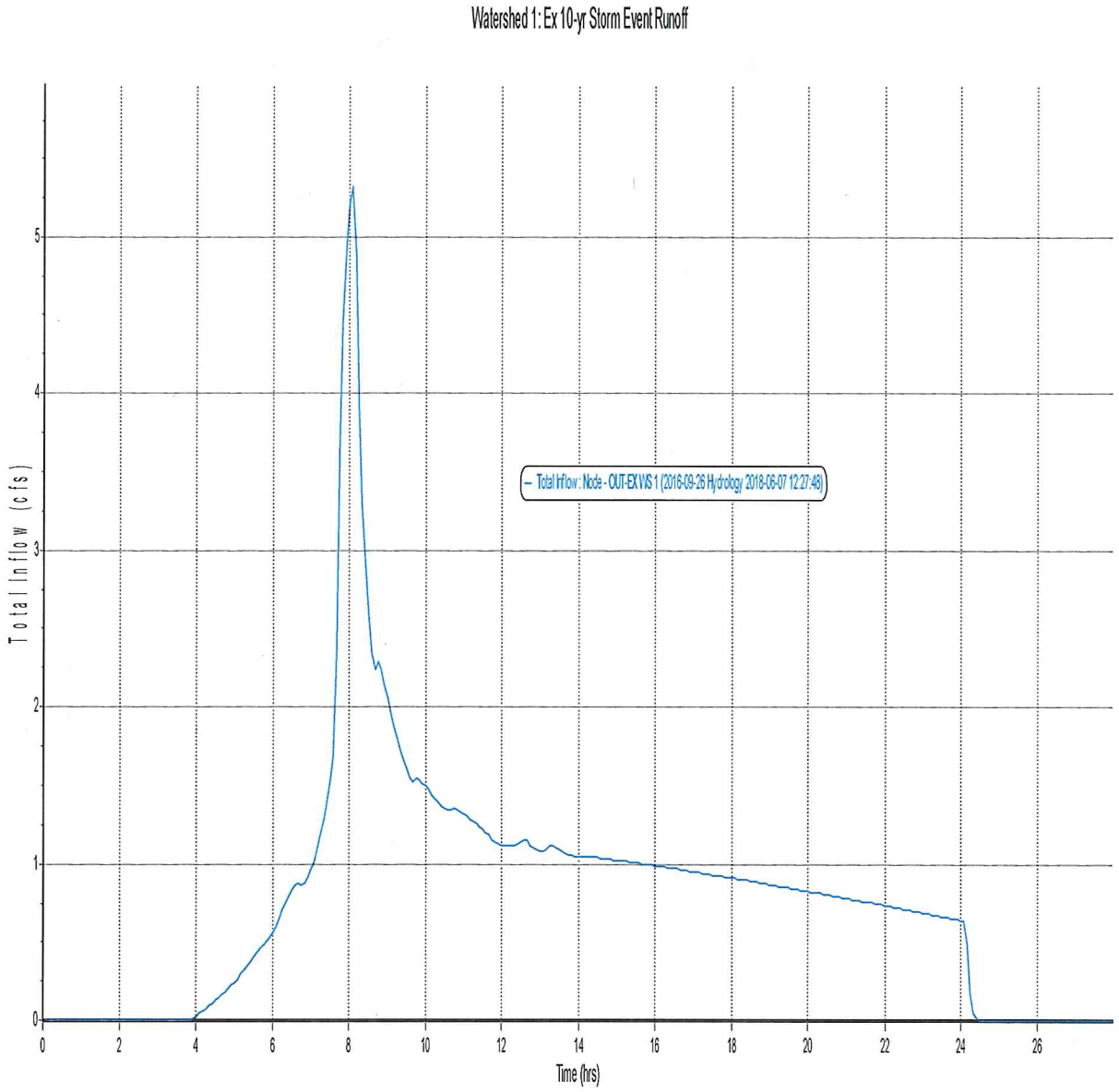
Time to Peak (hrs) 8.04

Proposed Watershed Runoff Results

Total Rainfall (in) 5.17

Peak Runoff (cfs) 5.32

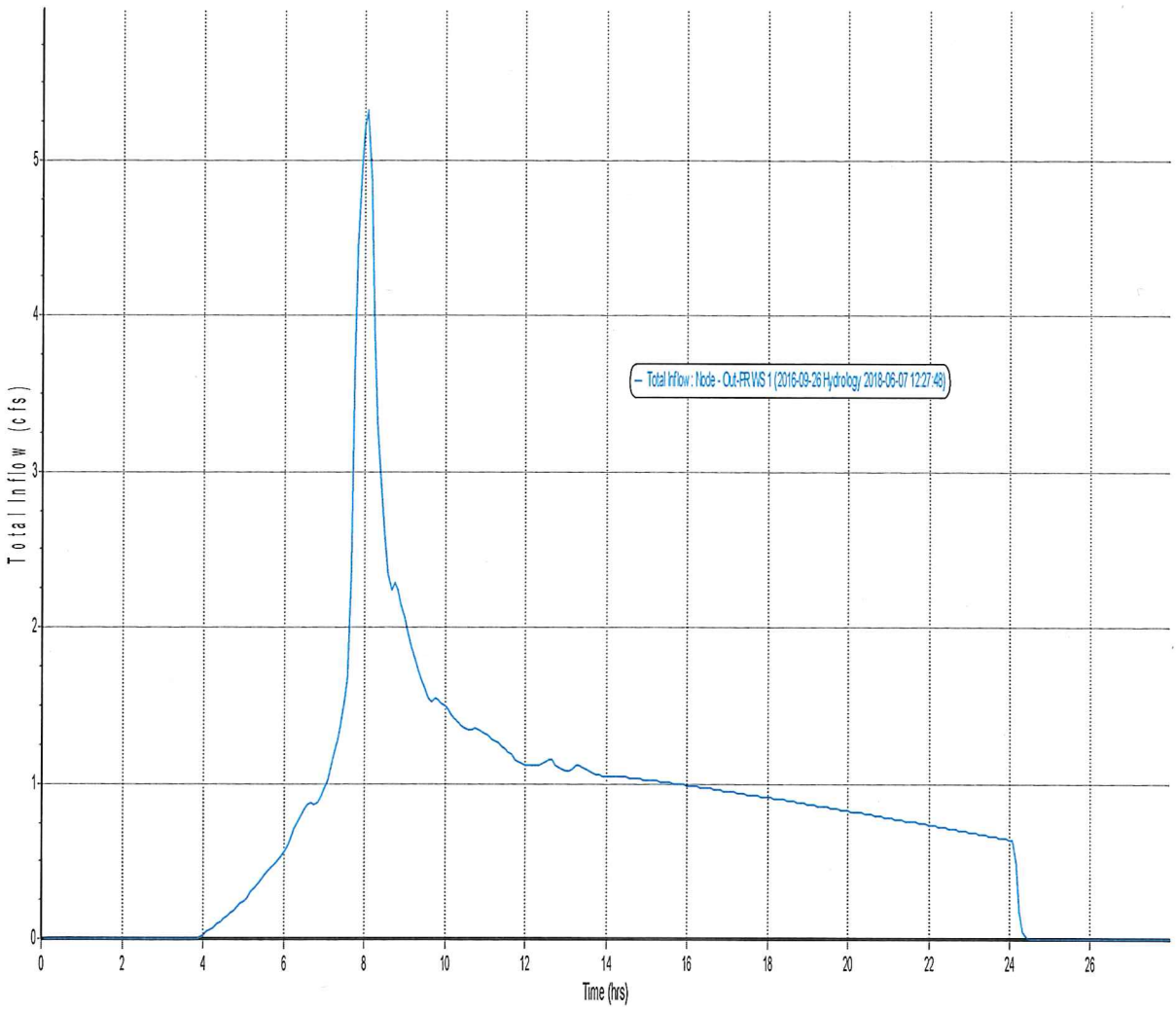
Time to Peak (hrs) 8.04



Existing Watershed Runoff Results

Watershed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
1	79	10.24	7.39	5.17	8.06	5.32

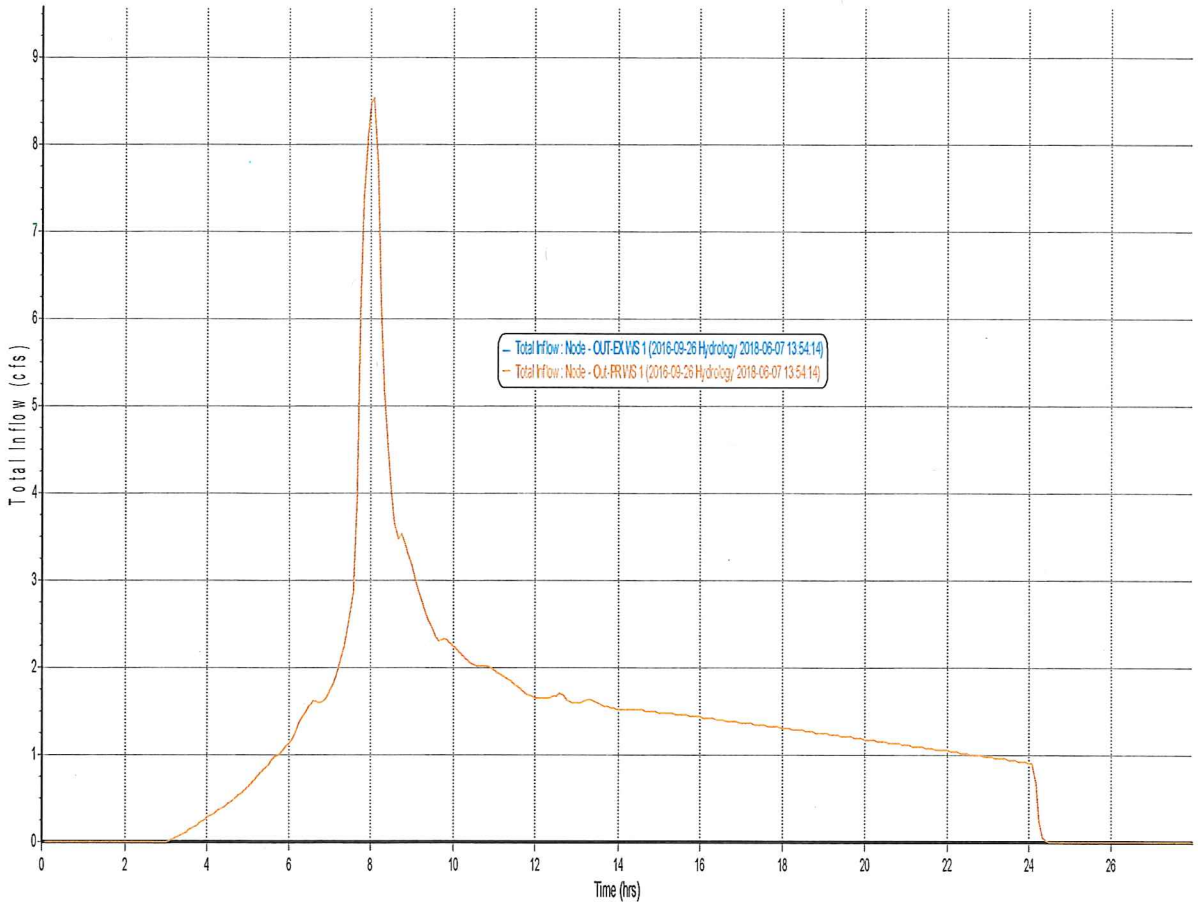
Watershed 1: Proposed 10-yr Storm Event Runoff



Proposed Watershed Runoff Results

Watershed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
1	79	10.24	7.39	5.17	8.10	5.32

Watershed : 50-yr Storm Event Runoff



Existing Watershed Runoff Results

Total Rainfall (in) 6.99

Peak Runoff (cfs) 8.54

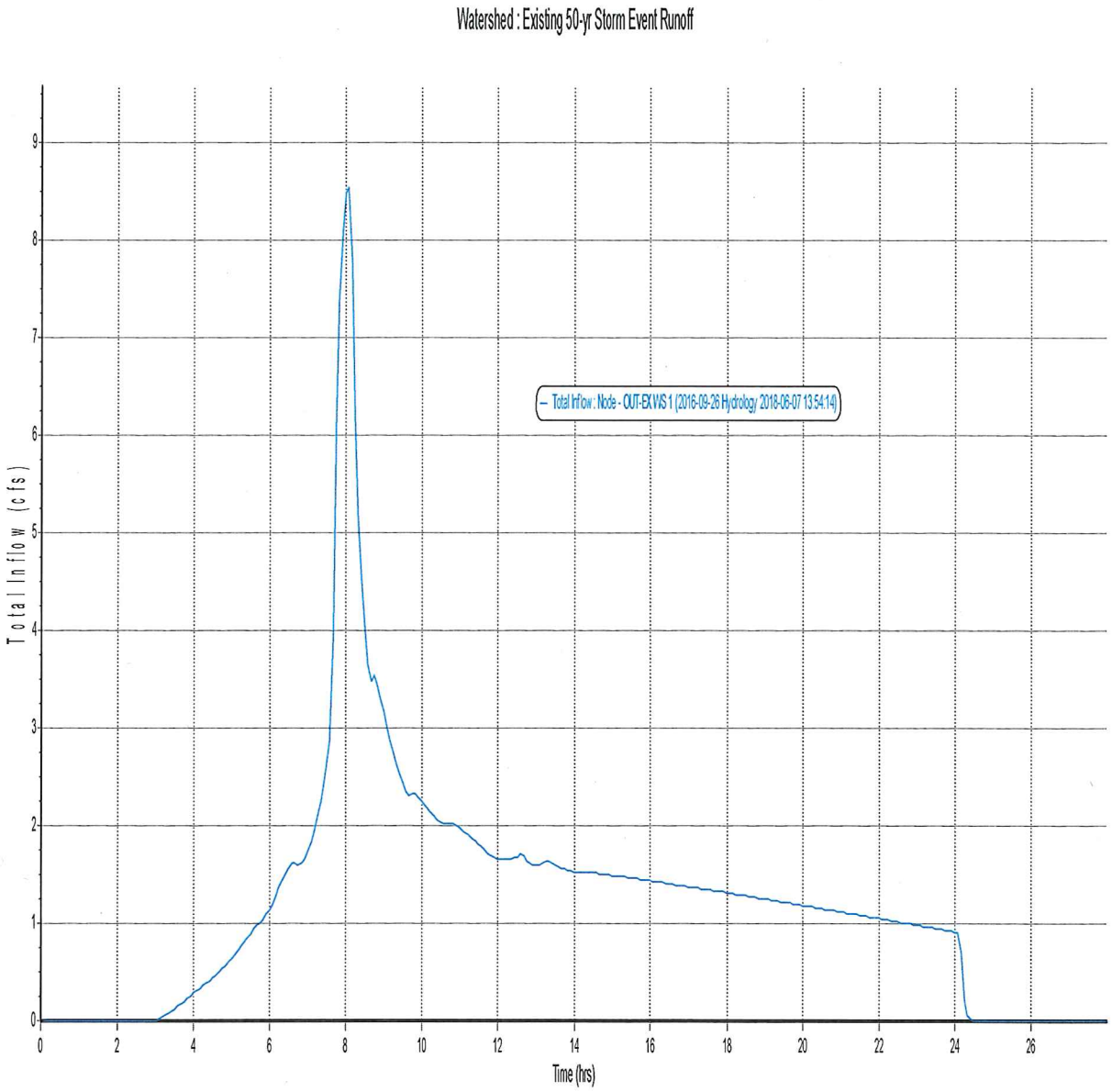
Time to Peak (hrs) 8.57

Proposed Watershed Runoff Results

Total Rainfall (in) 6.99

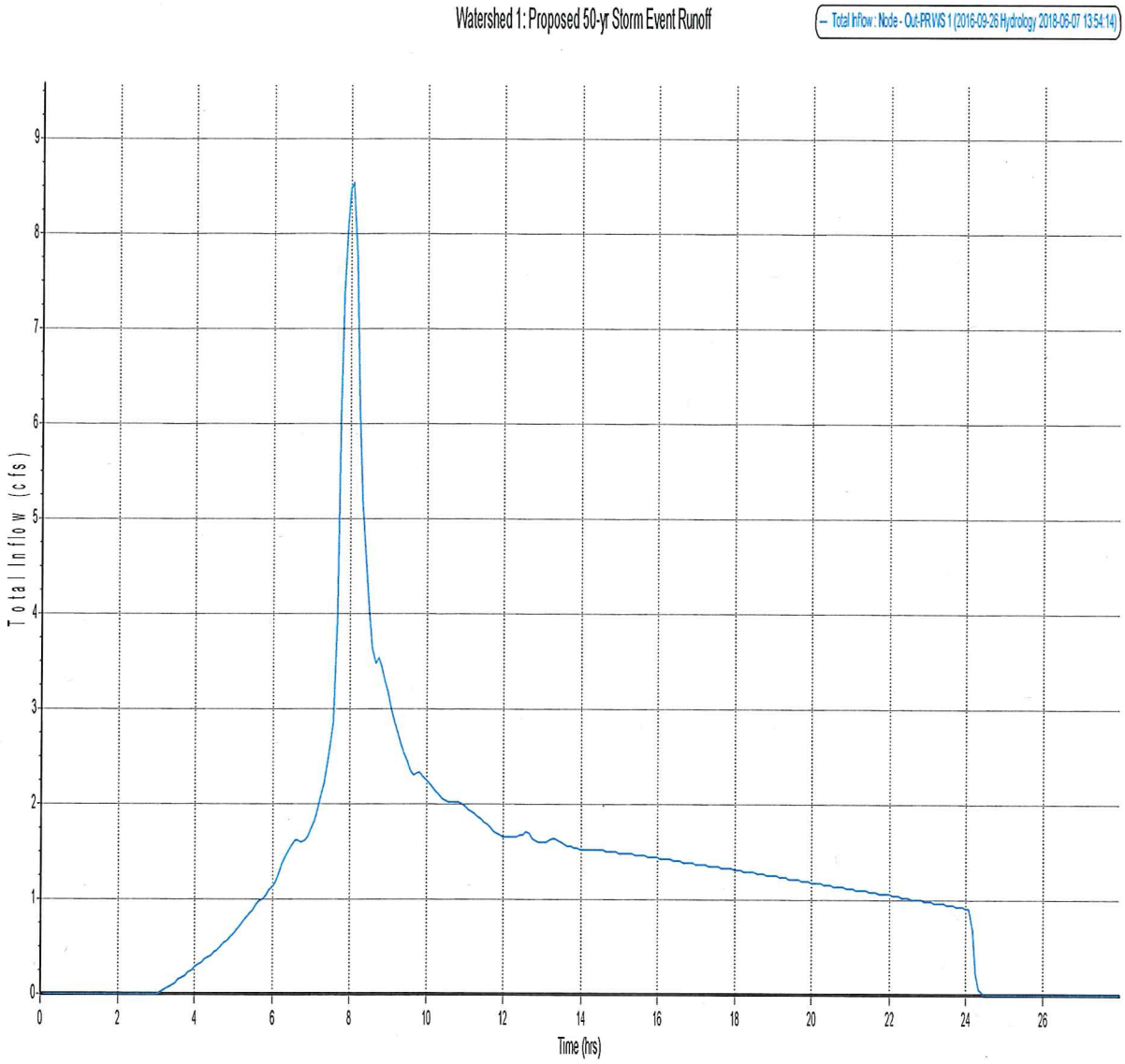
Peak Runoff (cfs) 8.54

Time to Peak (hrs) 8.08



Existing Watershed Runoff Results

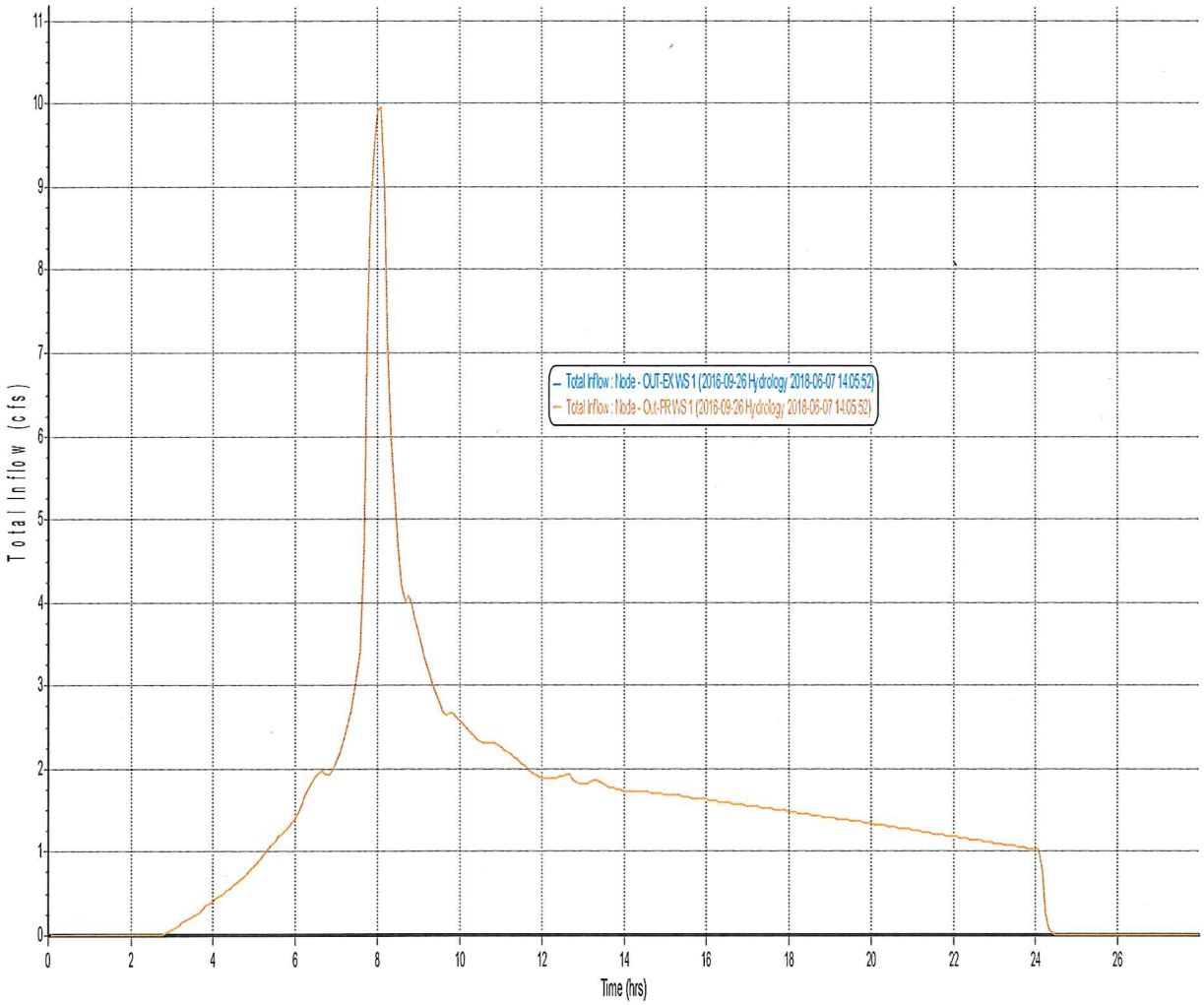
Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
1	79	10.24	7.39	6.99	8.08	8.54



Proposed Watershed Runoff Results

Watershed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
1	79	10.24	7.31	6.99	8.10	8.54

Watershed 1: 100-yr Storm Event Runoff



Existing Watershed Runoff Results

Total Rainfall (in) 7.77

Peak Runoff (cfs) 9.95

Time to Peak (hrs) 8.06

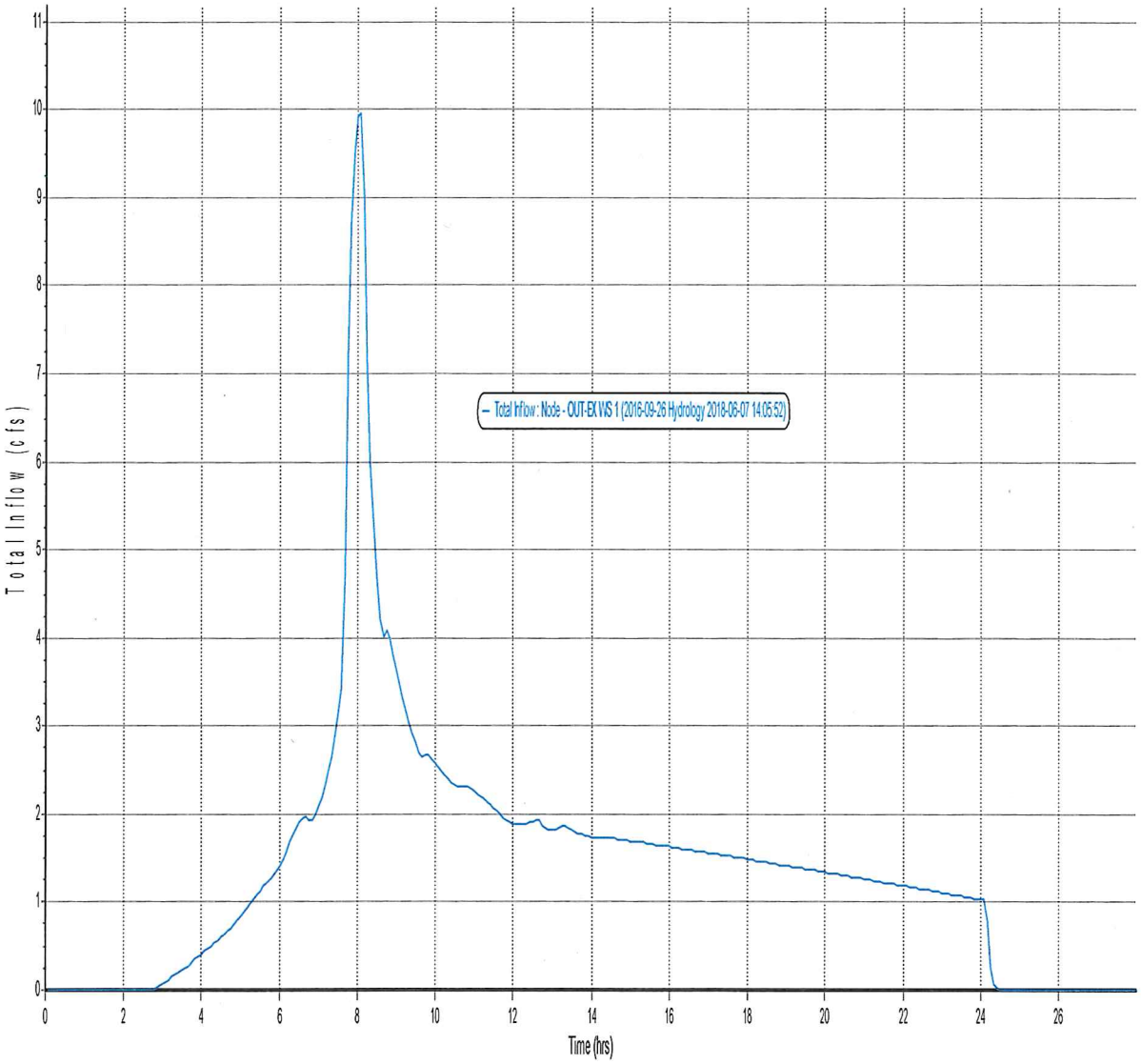
Proposed Watershed Runoff Results

Total Rainfall (in) 7.77

Peak Runoff (cfs) 9.95

Time to Peak (hrs) 8.06

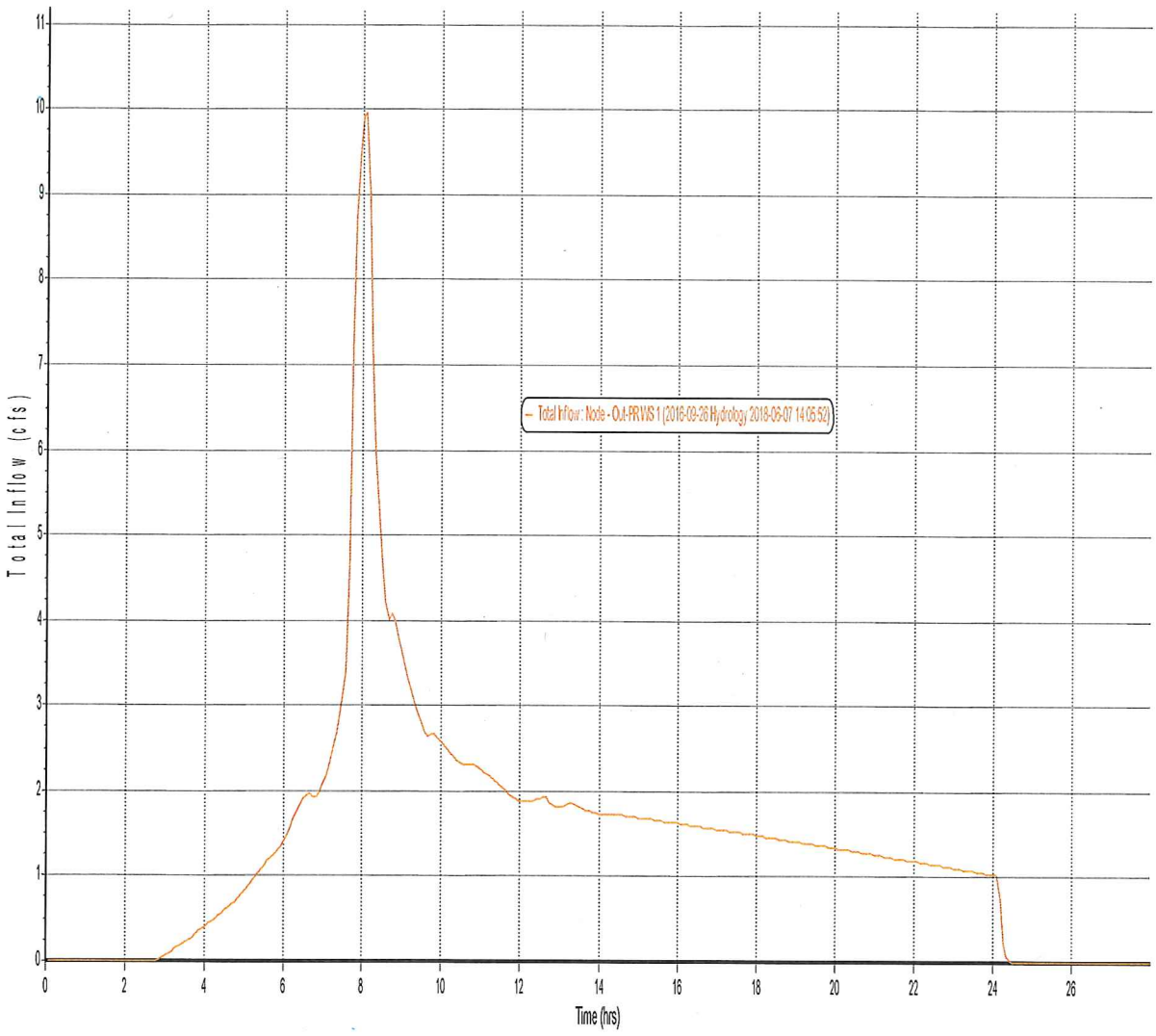
Watershed 1: Existing 100-yr Storm Event Runoff



Existing Watershed Runoff Results

Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
1B	79	10.24	7.39	7.77	8.06	9.95

Watershed 1: Proposed 100-yr Storm Event Runoff



Proposed Watershed Runoff Results

Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
1	79	10.24	7.39	7.77	8.08	9.95

Worksheet: Runoff Curve Number

Project	Anthem Winery	By	DJS	Date	9/28/2016
Location	Watershed 2A	Checked	PSW	Date	9/28/2016
Subshed name	Existing Conditions	Check one:	☑ Present	☐ Developed	

RUNOFF CURVE NUMBER

Soil name and hydrologic group (SCS book)	Cover description (cover type, treatment and hydrogic condition; percent impervious)	CN (1) (Table 2-2)	Area ☑ acres ☐ mi2 ☐ %	Product of CN x Area
133-C	Impervious Area (Roads, roofs, etc.)	98	0.12	11.76
133-C	Pasture Land (fair)	79	0.37	29.23
133-C	Row Crops- Straight (poor)	88	0.22	19.36
133-C	Woods (fair)	73	0.85	62.05

(1) Use only one CN source per line

TOTAL: 1.56 122.40

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{122.40}{1.56} = 78.46 \text{ ; USE CN } \boxed{78}$$

Worksheet: Time of Concentration (T_c) or travel time (T_t)

Project: Anthem Winery	By: DJS	Date: 9/28/2016	
Location: Project Site	Checked: PSW	Date: 9/28/2016	
Subshed name: Watershed 2A	Check one: ☑ Present ☐ Developed		
Note: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic or description of flow segments.	Check one: ☑ Tc ☐ Tt through subarea		

SHEET FLOW (applicable to Tc only)

	Segment ID				
1. Surface description (table 3-1)	1				
2. Manning's roughness coefficient, n (table3-1)	Range				
3. Flow length, L (total L, 300 ft) ft	0.13				
4. Two-year 24-hour rainfall, P_2 in	288				
5. Land slope, s ft/ft	3.4				
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr	0.23				
	0.1240	+		=	0.1240

SHALLOW CONCENTRATED FLOW

	Segment ID				
7. Surface description (paved or unpaved)					
8. Flow length, L ft					
9. Watercourse slope, s ft/ft					
10. Average velocity, V (figure 3-1) ft/sec					
11. $T_t = \frac{L}{3600\,V}$ Compute T_t hr		+		=	

CHANNEL FLOW

	Segment ID				
12. Cross sectional flow area, a ft^2					
13. Wetted perimeter, p_w ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft					
15. Channel slope, s ft/ft					
16. Manning's roughness coefficient, n					
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ft/sec					
18. Flow length, L ft					
19. $T_t = \frac{L}{3600\,V}$ Compute T_t hr		+		=	
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11 and 19) hr					0.1240

T_c = 7.44 mins

Worksheet: Runoff Curve Number

Project	Anthem Winery	By	DJS	Date	9/26/2016
Location	Watershed 2B	Checked	PSW	Date	9/26/2016
Subshed name	Existing Conditions	Check one:	☑ Present	☐ Developed	

RUNOFF CURVE NUMBER

Soil name and hydrologic group (SCS book)	Cover description (cover type, treatment and hydrogic condition; percent impervious)	CN (1) (Table 2-2)	Area ☑ acres ☐ mi2 ☐ %	Product of CN x Area
133-C	Impervious Area (Roads, roofs, etc.)	98	0.20	19.60
133-C	Pasture Land (fair)	79	0.79	62.41
133-C	Woods (fair)	73	1.94	141.62
136-C	Impervious Area (Roads, roofs, etc.)	98	0.39	38.22
136-C	Pasture Land (fair)	79	1.05	82.95
136-C	Woods (fair)	73	4.61	336.53
		TOTAL:	8.98	681.33

(1) Use only one CN source per line

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{681.33}{8.98} = 75.87 \text{ ; USE CN } \boxed{76}$$

Worksheet: Time of Concentration (T_c) or travel time (T_t)

Project: Anthem Winery	By: DJS	Date: 9/28/2016	
Location: Project Site	Checked: PSW	Date: 9/28/2016	
Subshed name: Watershed 2B	Check one: ☑ Present ☐ Developed		
Note: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic or description of flow segments.	Check one: ☑ Tc ☐ Tt through subarea		

SHEET FLOW (applicable to Tc only)

	Segment ID	1			
1.	Surface description (table 3-1)	Range			
2.	Manning's roughness coefficient, n (table3-1)	0.13			
3.	Flow length, L (total L, 300 ft) ft	277			
4.	Two-year 24-hour rainfall, P_2 in	3.4			
5.	Land slope, s ft/ft	0.13			
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr	0.1510	+	=	0.1510

SHALLOW CONCENTRATED FLOW

	Segment ID	2			
7.	Surface description (paved or unpaved)	unpaved			
8.	Flow length, L ft	818			
9.	Watercourse slope, s ft/ft	0.13			
10.	Average velocity, V (figure 3-1) ft/sec	5.8174			
11.	$T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.0391	+	=	0.0391

CHANNEL FLOW

	Segment ID	3			
12.	Cross sectional flow area, a ft^2	1.76			
13.	Wetted perimeter, p_w ft	4.71			
14.	Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft	0.3737			
15.	Channel slope, s ft/ft	0.12			
16.	Manning's roughness coefficient, n	0.012			
17.	$V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ft/sec	22.3147			
18.	Flow length, L ft	172			
19.	$T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.0021	+	=	0.0021
20.	Watershed or subarea T_c or T_t (add T_t in steps 6, 11 and 19) hr				0.1922

T_c = 11.53 mins

Worksheet: Runoff Curve Number

Project	Anthem Winery	By	DJS	Date	6/7/2018
Location	Watershed 2A	Checked	PSW	Date	6/7/2018
Subshed name	Proposed Conditions	Check one:	☐ Present		☑ Developed

RUNOFF CURVE NUMBER

Soil name and hydrologic group (SCS book)	**Cover description** (cover type, treatment and hydrogic condition; percent impervious)	**CN (1)** (Table 2-2)	**Area** ☑ acres ☐ mi2 ☐ %	**Product of CN x Area**
133-C	Impervious Area (Roads, roofs, etc.)	98	0.98	96.04
133-C	Pasture Land (fair)	79	0.46	36.34
133-C	Row Crops- Straight (poor)	88	0.12	10.56
		TOTAL:	1.56	142.94

(1) Use only one CN source per line

CN (weighted) = total product / total area = 142.94 / 1.56 = 91.63 ; **USE CN** **92**

Worksheet: Runoff Curve Number

Project	Anthem Winery	By	DJS	Date	9/26/2016
Location	Watershed 2B	Checked	PSW	Date	9/26/2016
Subshed name	Proposed Conditions	Check one:	☐ Present	☑ Developed	

RUNOFF CURVE NUMBER

Soil name and hydrologic group (SCS book)	Cover description (cover type, treatment and hydrogic condition; percent impervious)	CN (1) (Table 2-2)	Area ☑ acres ☐ mi2 ☐ %	Product of CN x Area
133-C	Impervious Area (Roads, roofs, etc.)	98	0.66	64.68
133-C	Pasture Land (fair)	79	0.69	54.51
133-C	Row Crops- Straight (poor)	88	0.09	7.92
133-C	Woods (fair)	73	2.02	147.46
136-C	Impervious Area (Roads, roofs, etc.)	98	0.49	48.02
136-C	Pasture Land (fair)	79	0.95	75.05
136-C	Woods (fair)	73	4.08	297.84
(1) Use only one CN source per line		TOTAL:	8.98	695.48

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{695.48}{8.98} = 77.45 \text{ ; USE CN } \boxed{77}$$

Worksheet: Time of Concentration (Tc) or travel time (Tt)

Project: Anthem Winery	By: DJS	Date: 9/28/2016	
Location: Project Site	Checked: PSW	Date: 9/28/2016	
Subshed name: Watershed 2B	Check one: ☐ Present	☑ Developed	
Note: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic or description of flow segments.	Check one: ☑ Tc	☐ Tt through subarea	

SHEET FLOW (applicable to Tc only)

	Segment ID	1	1		
1.	Surface description (table 3-1)	Range	Smooth Surface		
2.	Manning's roughness coefficient, n (table3-1)	0.13	0.011		
3.	Flow length, L (total L, 300 ft) ft	160	117		
4.	Two-year 24-hour rainfall, P_2 in	3.4	3.4		
5.	Land slope, s ft/ft	0.13	0.02		
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr	0.0973	+ 0.0222	=	0.1195

SHALLOW CONCENTRATED FLOW

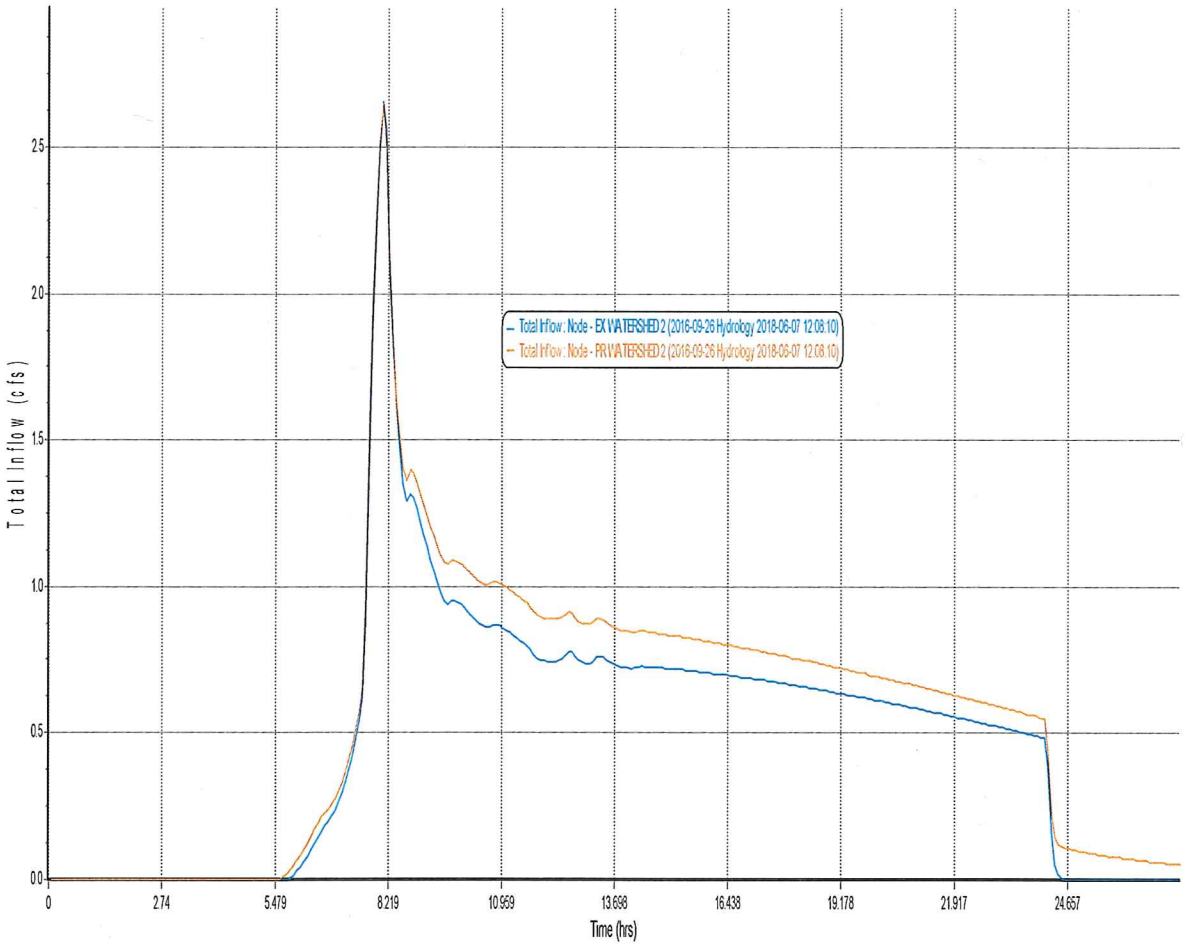
	Segment ID	2			
7.	Surface description (paved or unpaved)	unpaved			
8.	Flow length, L ft	818			
9.	Watercourse slope, s ft/ft	0.13			
10.	Average velocity, V (figure 3-1) ft/sec	5.8174			
11.	$T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.0391	+	=	0.0391

CHANNEL FLOW

	Segment ID	3			
12.	Cross sectional flow area, a ft^2	1.76			
13.	Wetted perimeter, p_w ft	4.71			
14.	Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft	0.3737			
15.	Channel slope, s ft/ft	0.12			
16.	Manning's roughness coefficient, n	0.012			
17.	$V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ft/sec	22.3147			
18.	Flow length, L ft	172			
19.	$T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.0021	+	=	0.0021
20.	Watershed or subarea T_c or T_t (add T_t in steps 6, 11 and 19) hr				0.1607

$T_c = 9.64$ mins

Watershed 2: 2-yr Storm Event Runoff



Existing Sub-shed Runoff Results

Total Rainfall (in) 3.40

Peak Runoff (cfs) 2.65

Time to Peak (hrs) 8.08

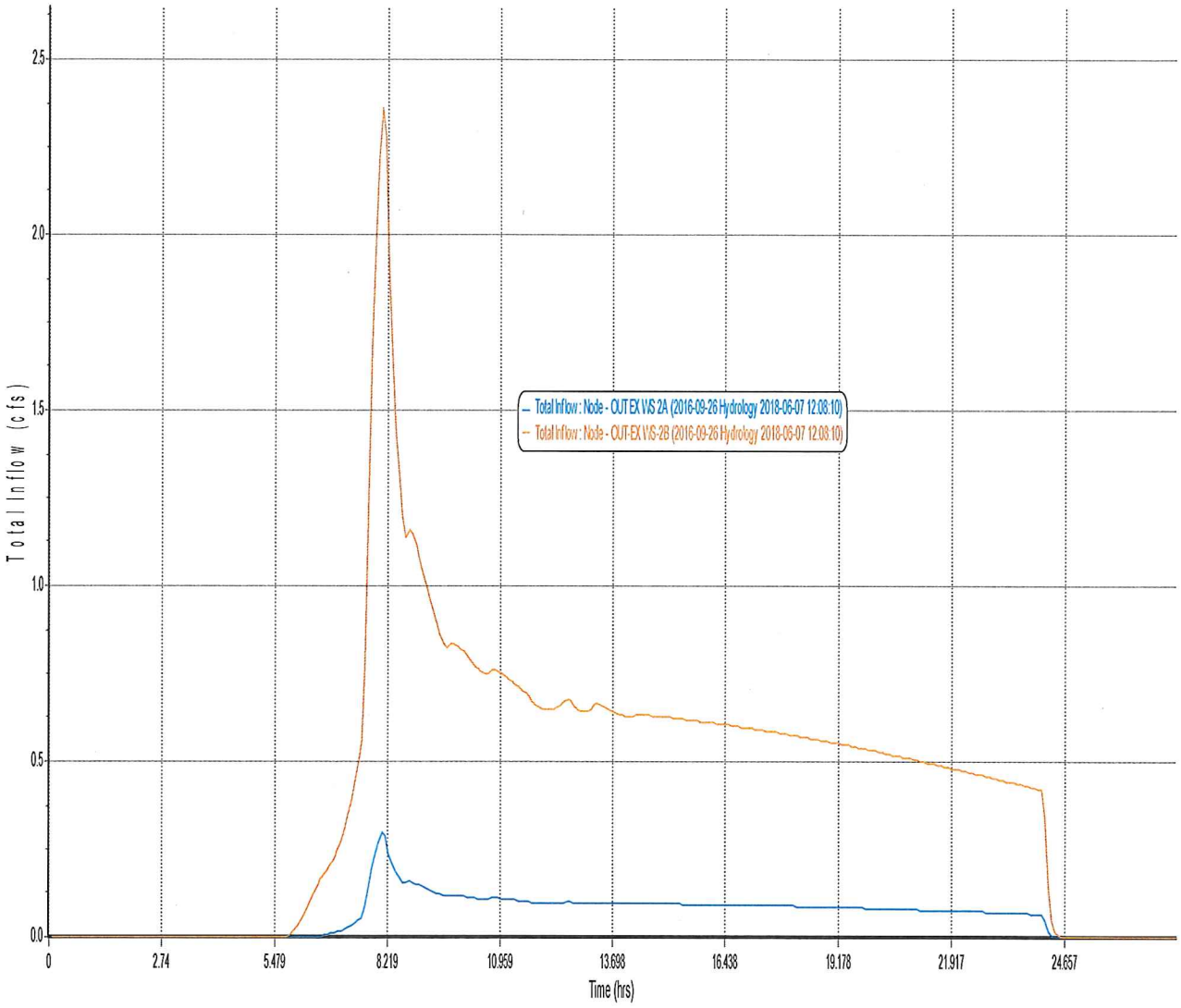
Proposed Sub-shed Runoff Results

Total Rainfall (in) 3.40

Peak Runoff (cfs) 2.65

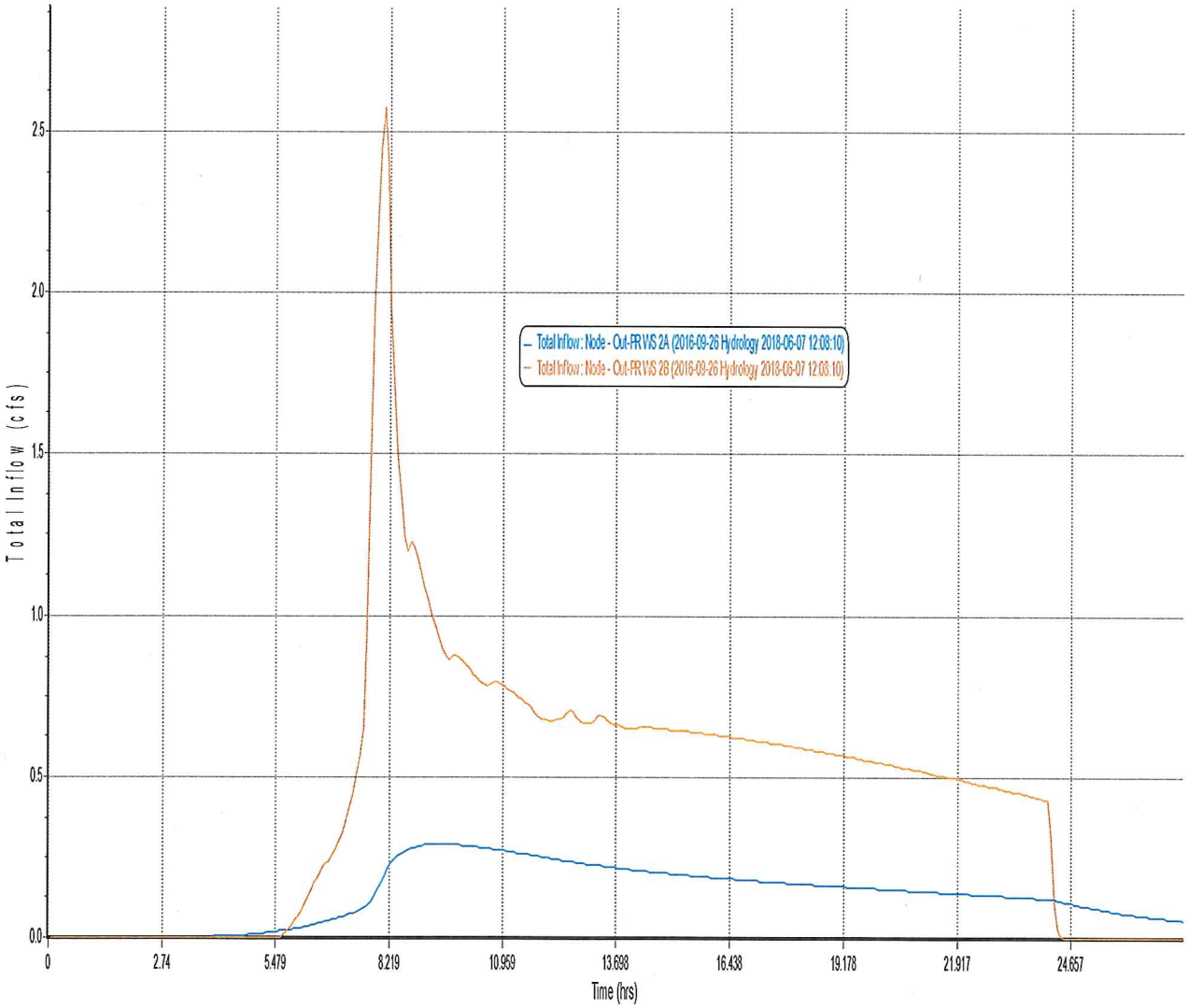
Time to Peak (hrs) 8.10

Watershed 2: Existing 2-yr Storm Event Runoff



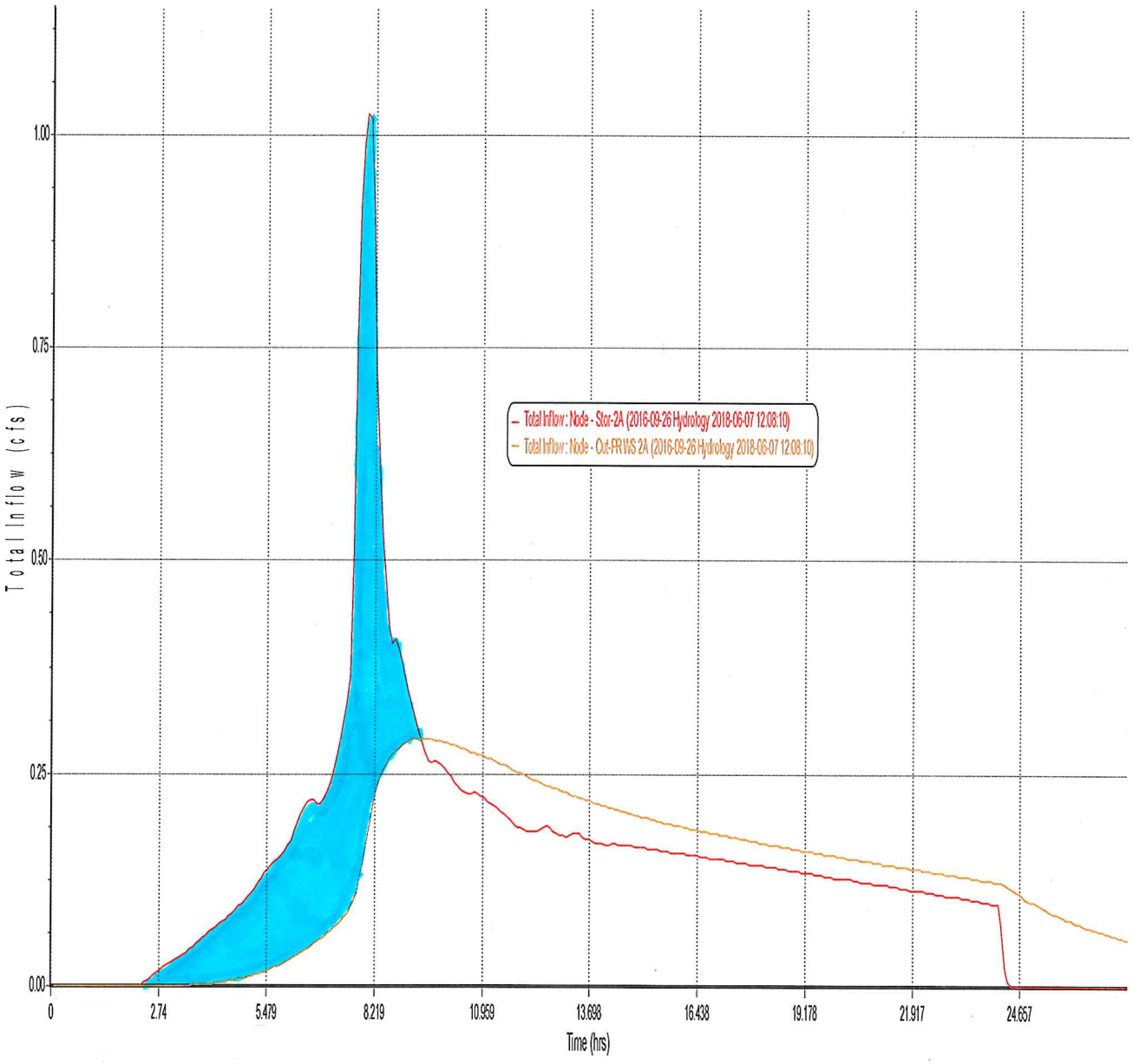
Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
2A	78	7.44	1.56	3.40	8.08	0.30
2B	76	11.53	8.98	3.40	8.06	2.36

Watershed 2: Proposed 2-yr Storm Event Runoff



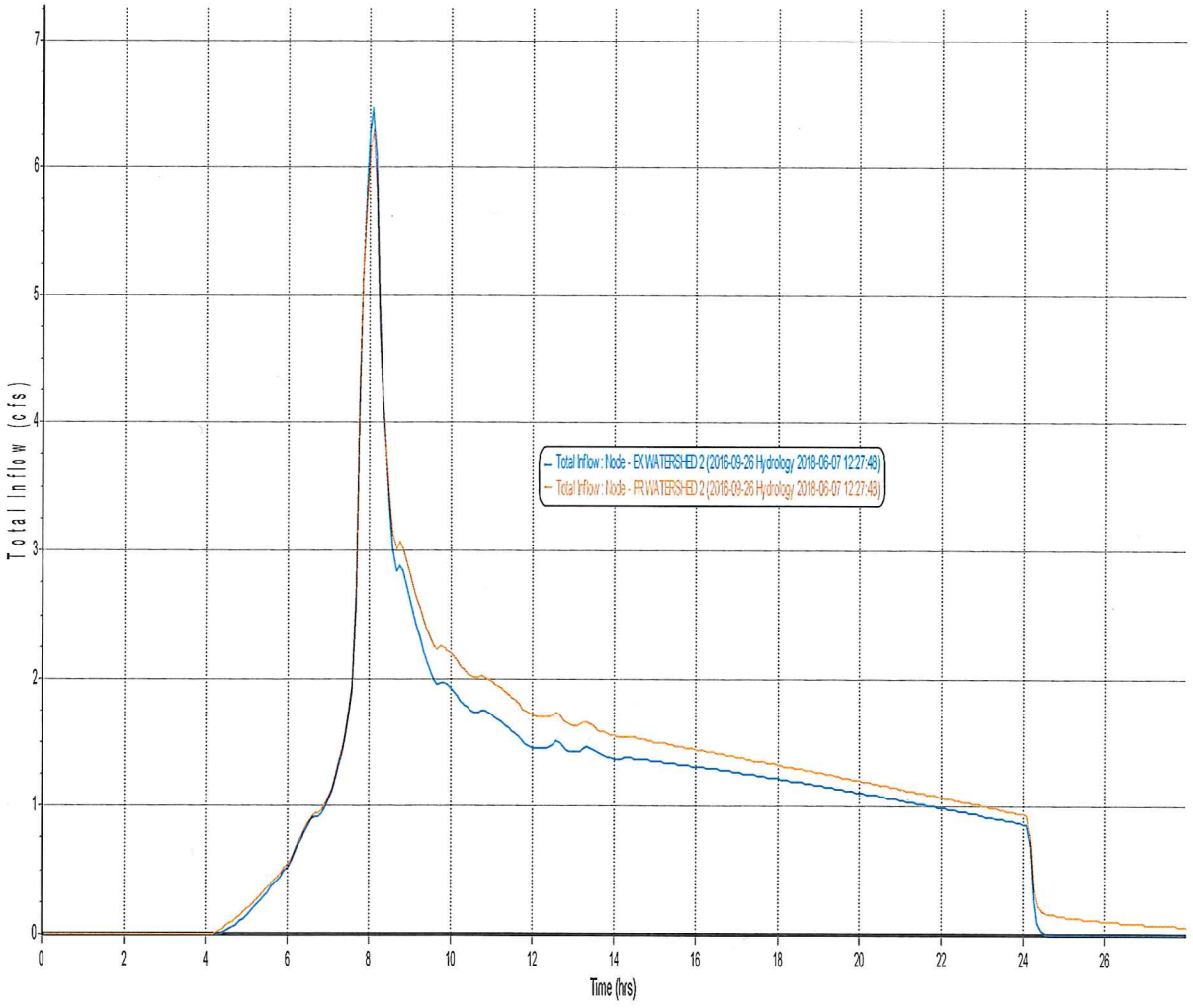
Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
2A	92	6.00	1.56	3.40	9.83	0.29
2B	77	9.64	8.98	3.40	8.08	2.57

Watershed 2: Proposed 2-yr Storm Event Storage



Storage……5,380 cu. ft.

Watershed 2: 10-yr Storm Event Runoff



Existing Sub-shed Runoff Results

Total Rainfall (in) 5.17

Peak Runoff (cfs) 6.46

Time to Peak (hrs) 8.08

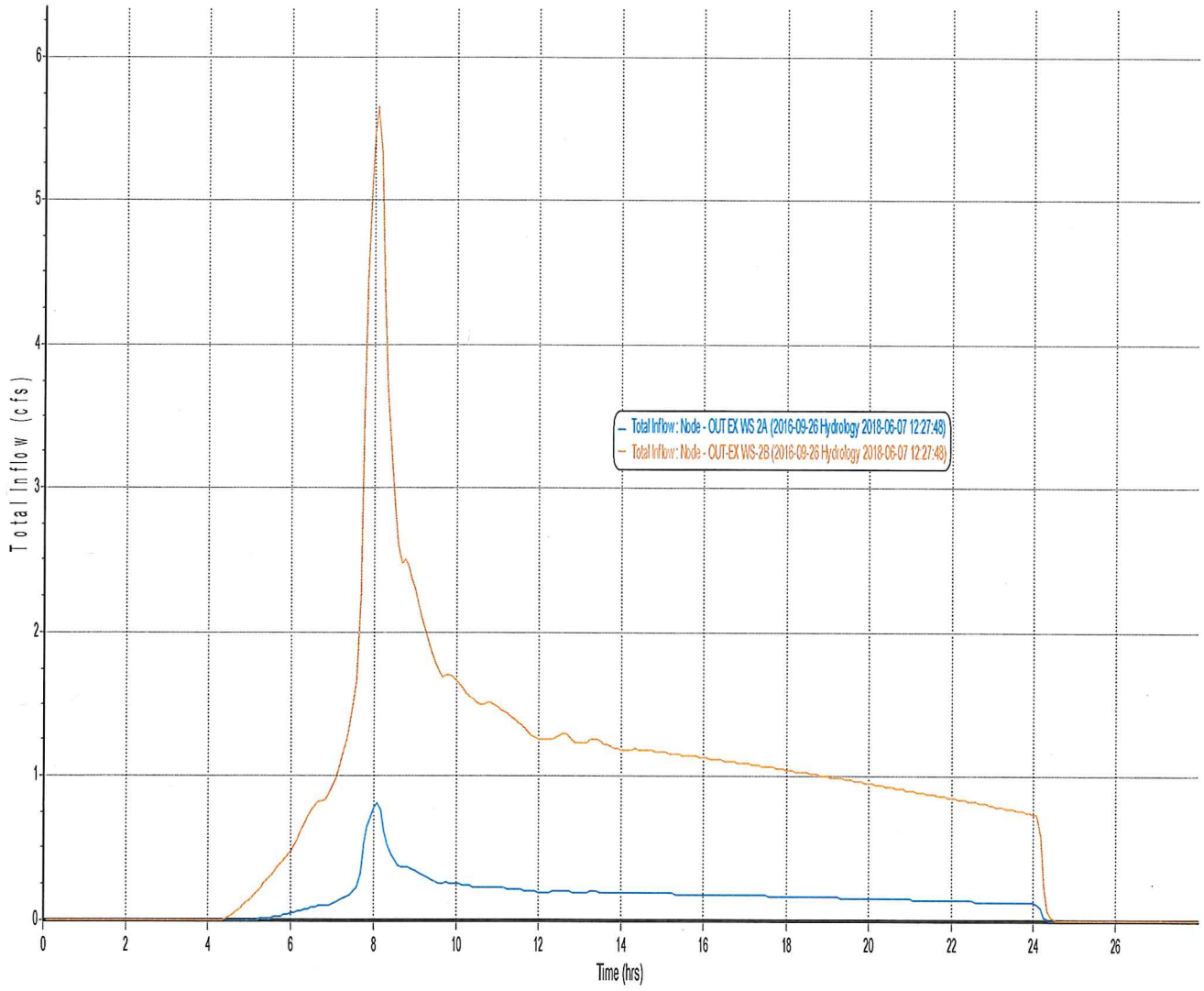
Proposed Sub-shed Runoff Results

Total Rainfall (in) 5.17

Peak Runoff (cfs) 6.29

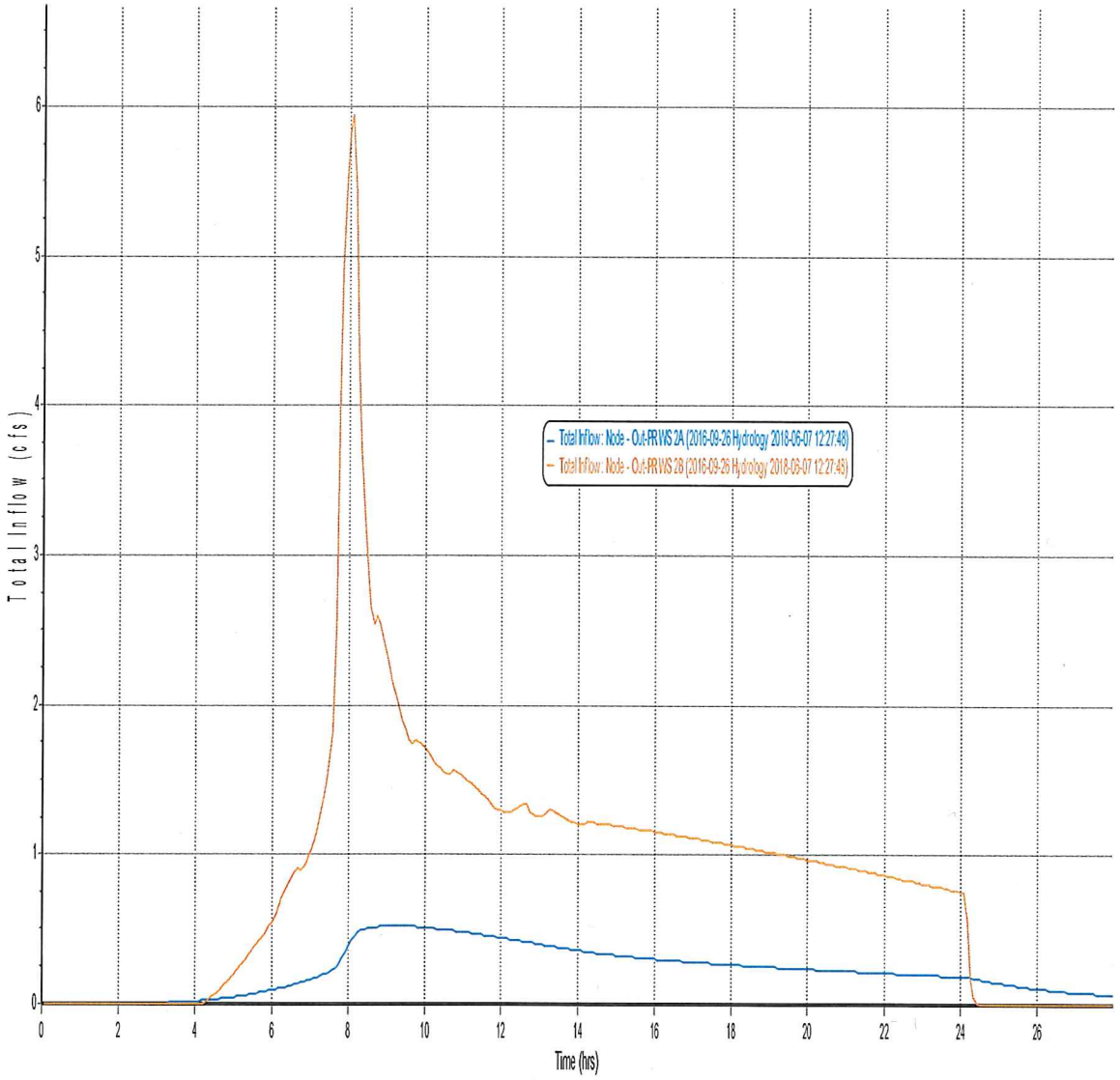
Time to Peak (hrs) 8.11

Watershed 2: Existing 10-yr Storm Event Runoff



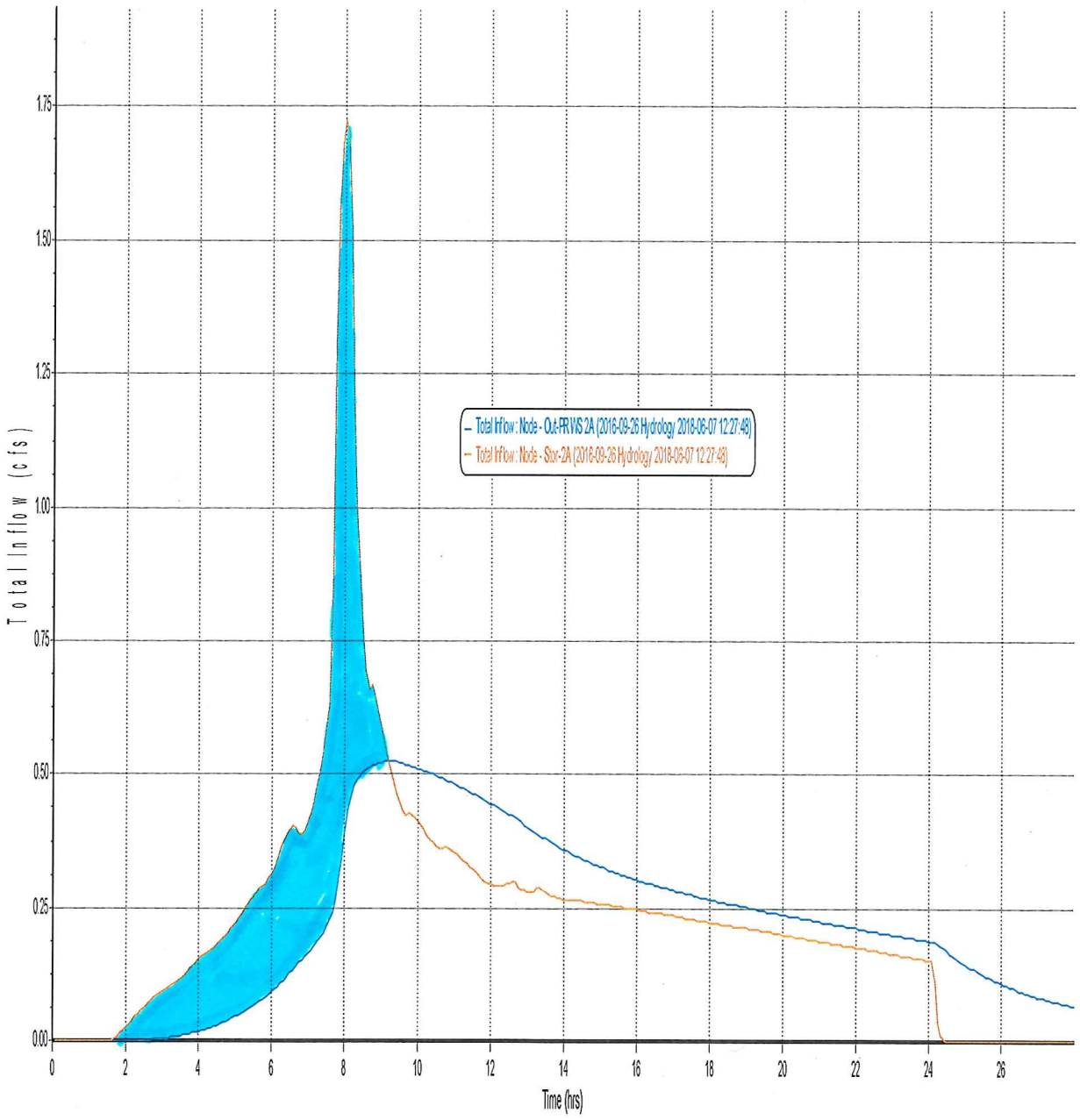
Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
2A	78	7.44	1.56	5.17	8.08	0.81
2B	76	11.53	8.98	5.17	8.06	5.65

Watershed 2: Proposed 10-yr Storm Event Runoff



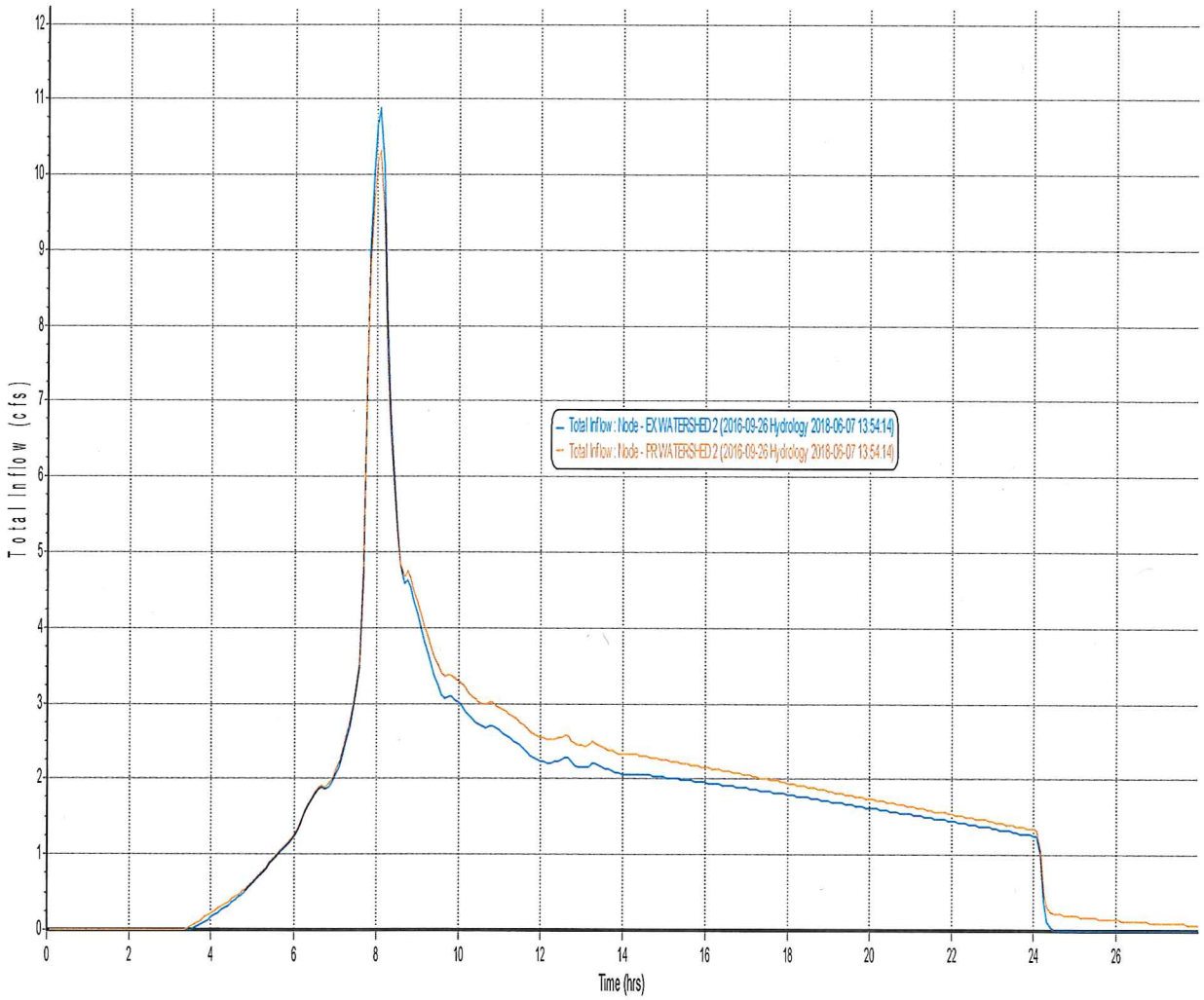
Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
2A	92	6.00	1.56	5.17	10.08	0.52
2B	77	9.64	8.98	5.17	8.08	5.94

Watershed 2: Proposed 10-yr Storm Event Storage



Storage……8,023 cu. ft

Watershed 2: 50-yr Storm Event Runoff



Existing Sub-shed Runoff Results

Total Rainfall (in) 6.99

Peak Runoff (cfs) 10.88

Time to Peak (hrs) 8.08

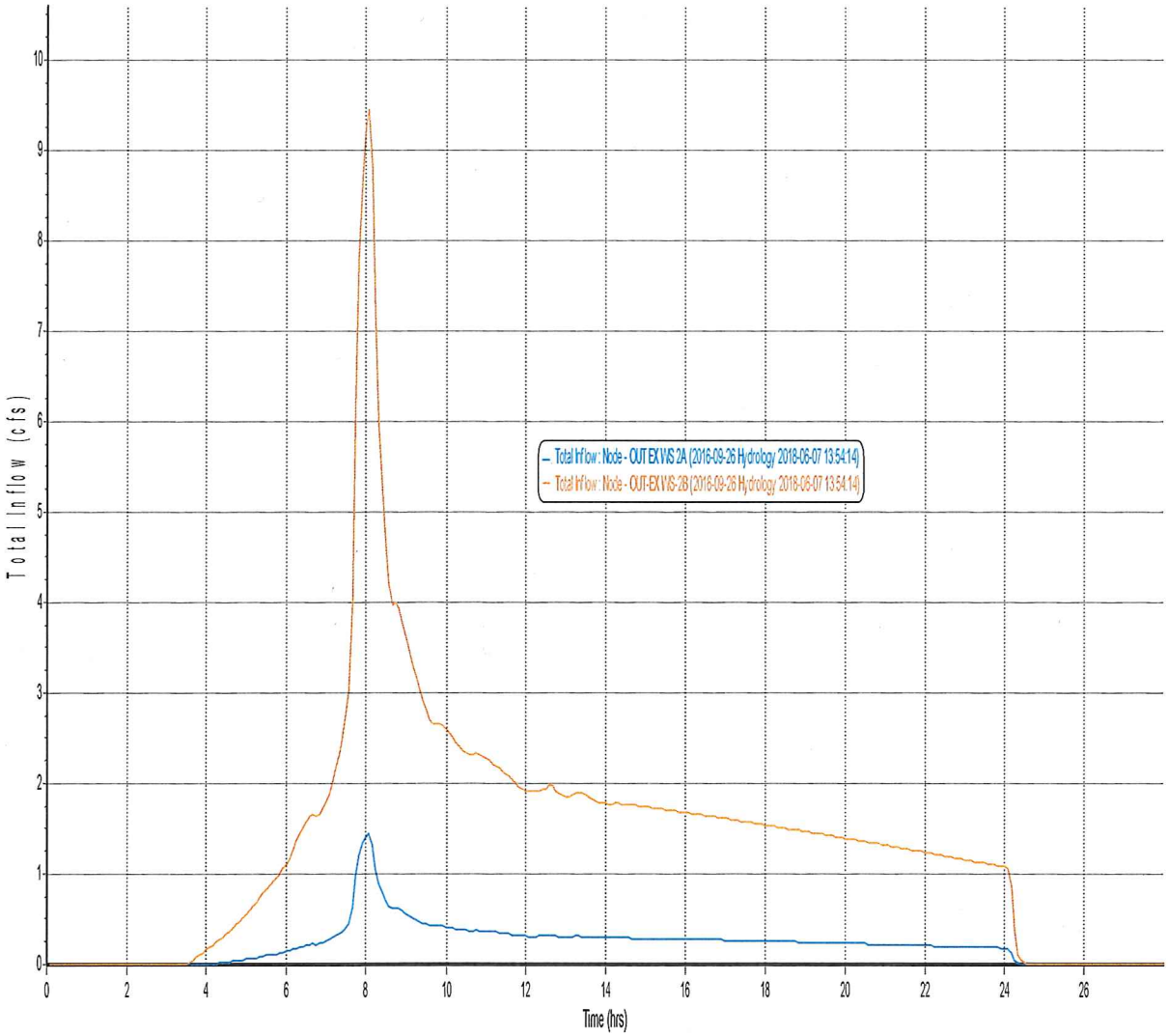
Proposed Sub-shed Runoff Results

Total Rainfall (in) 6.99

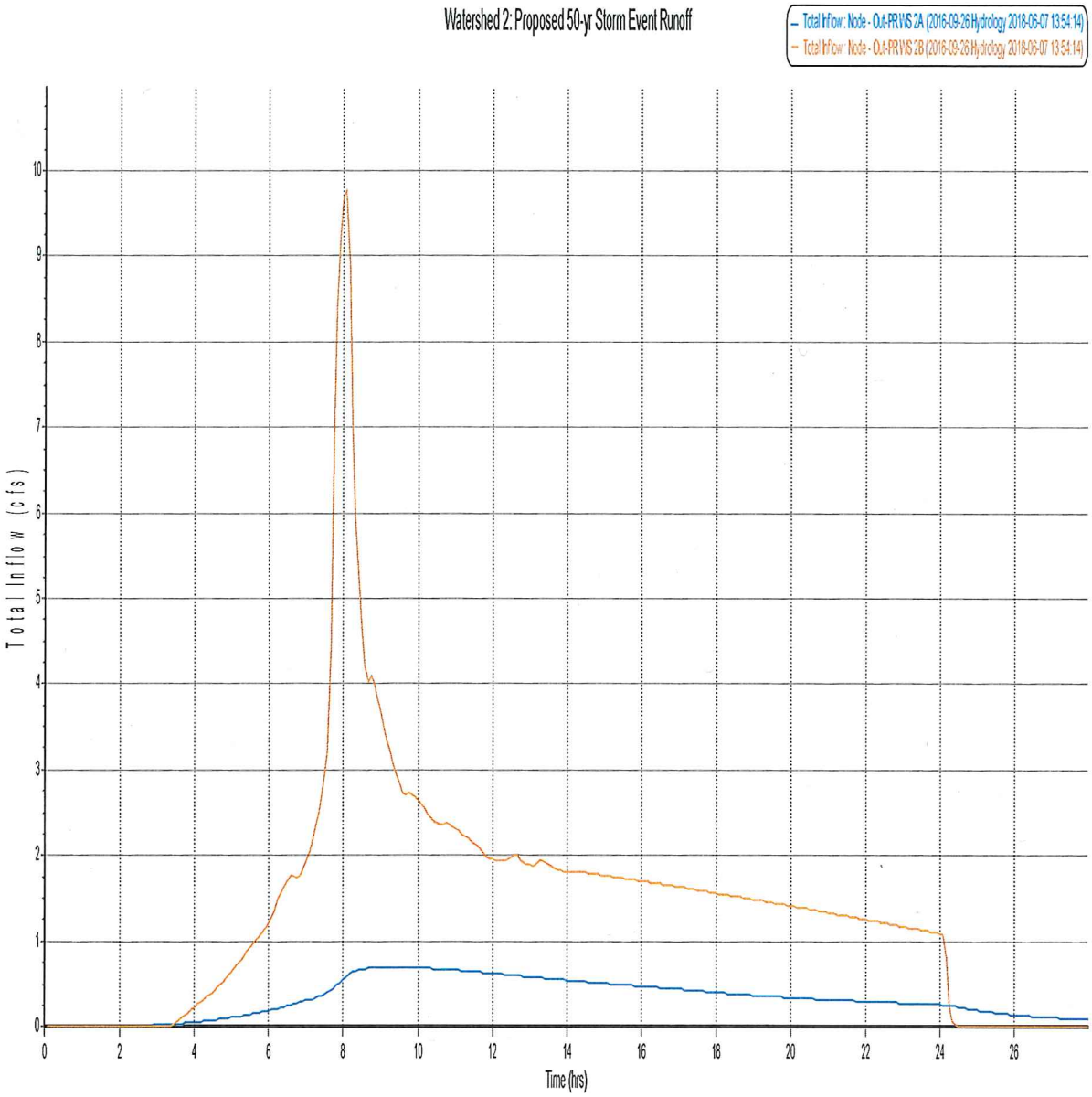
Peak Runoff (cfs) 10.32

Time to Peak (hrs) 8.11

Watershed 2: Existing 50-yr Storm Event Runoff

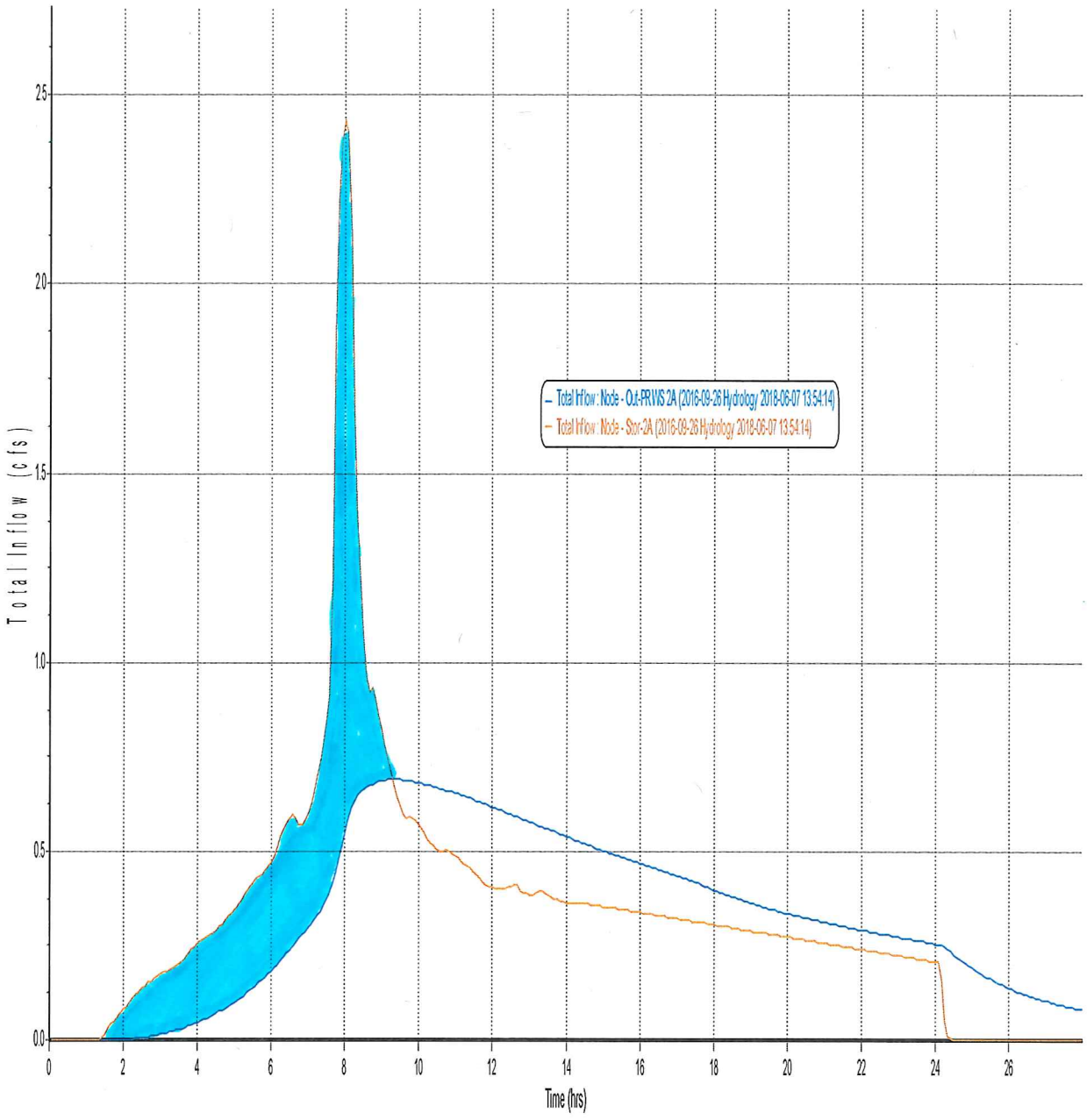


Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
2A	78	7.44	1.56	6.99	8.08	1.44
2B	76	11.53	8.98	6.99	8.06	9.44



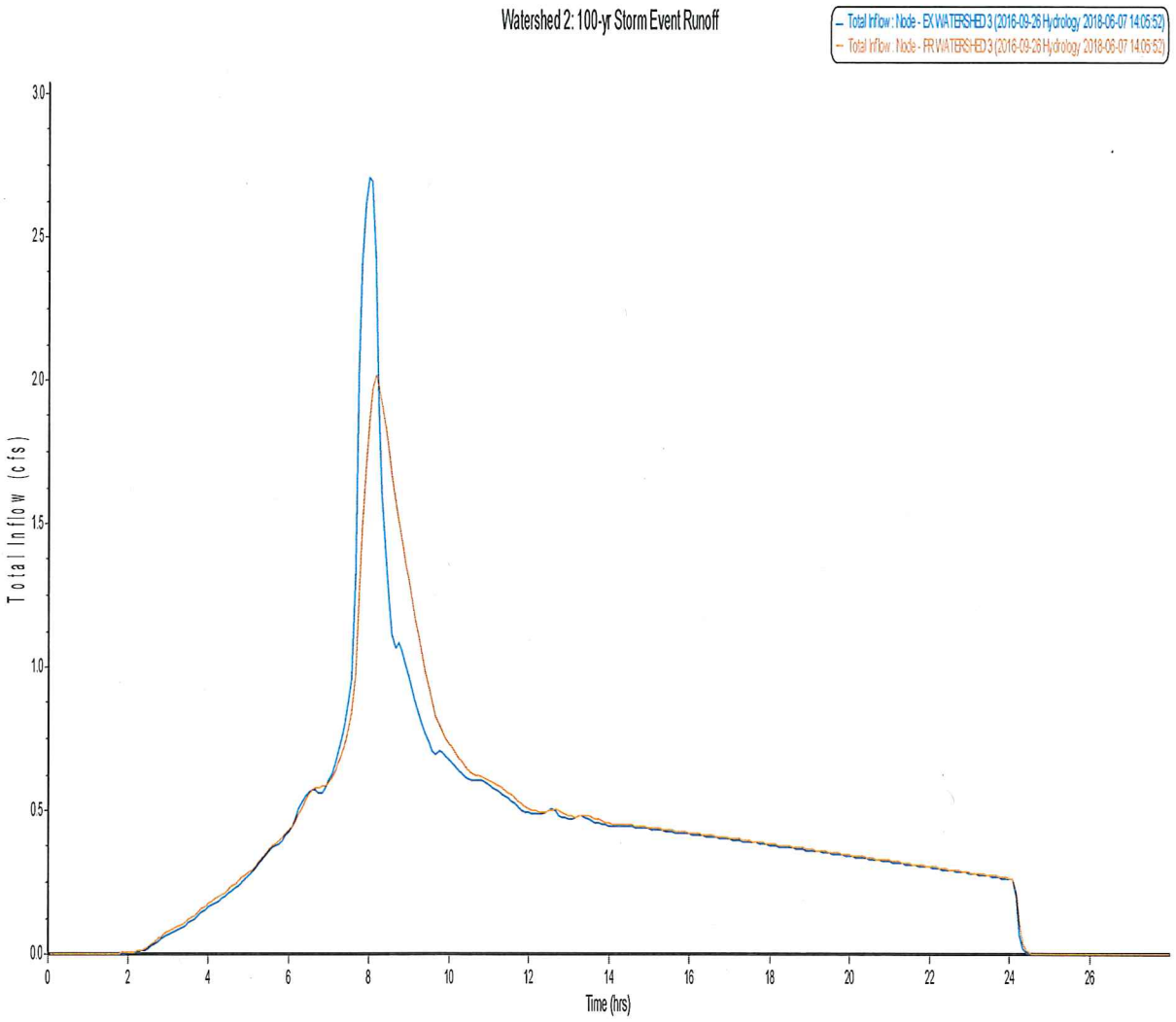
Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
2A	92	6.00	1.56	6.99	10.08	0.69
2B	77	9.64	8.98	6.99	8.08	9.77

Watershed 2: Proposed 50-yr Storm Event Storage



Storage……11,275 cu. ft.

Watershed 2: 100-yr Storm Event Runoff



Existing Sub-shed Runoff Results

Total Rainfall (in) 7.77

Peak Runoff (cfs) 12.84

Time to Peak (hrs) 8.05

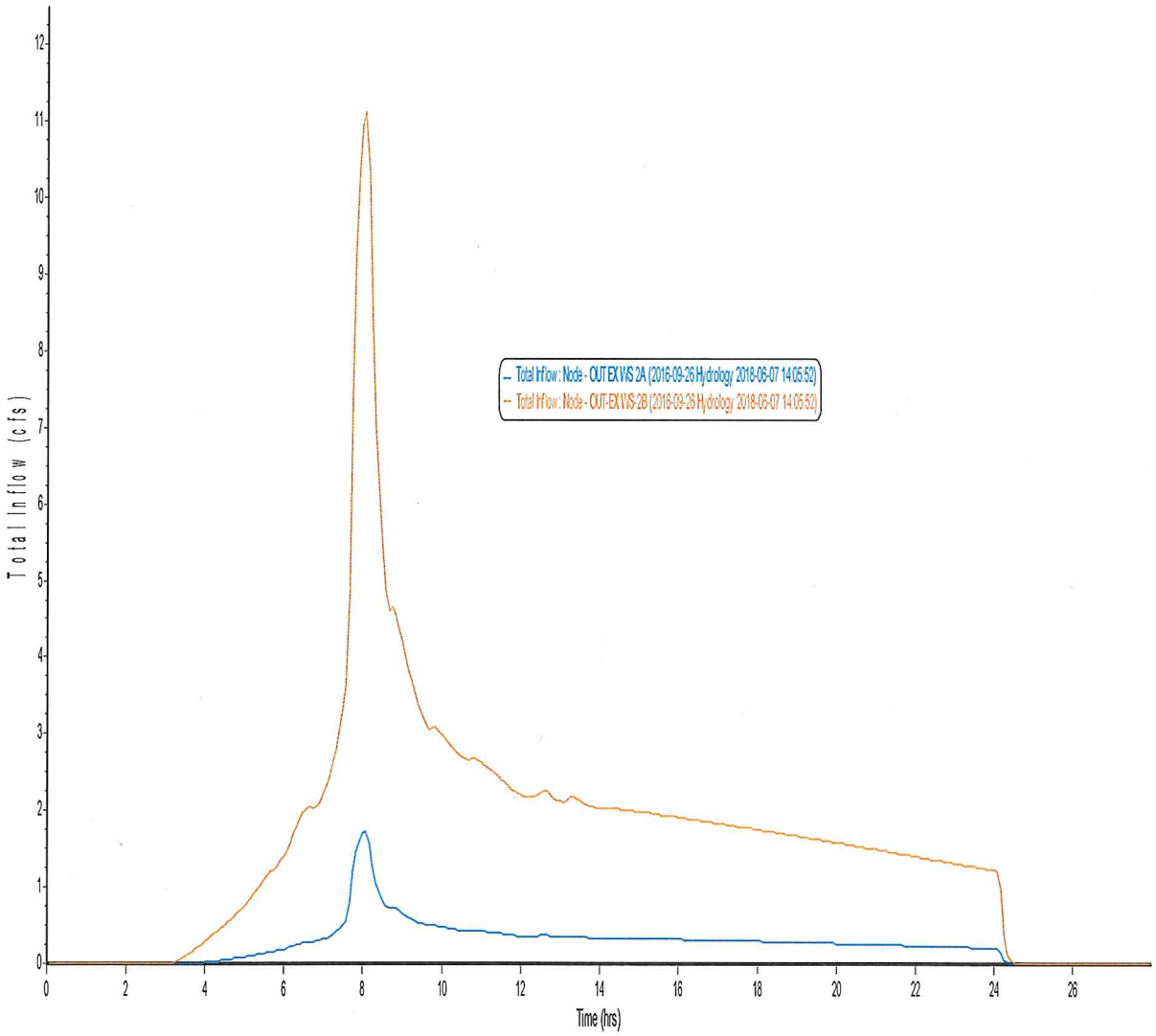
Proposed Sub-shed Runoff Results

Total Rainfall (in) 7.77

Peak Runoff (cfs) 12.07

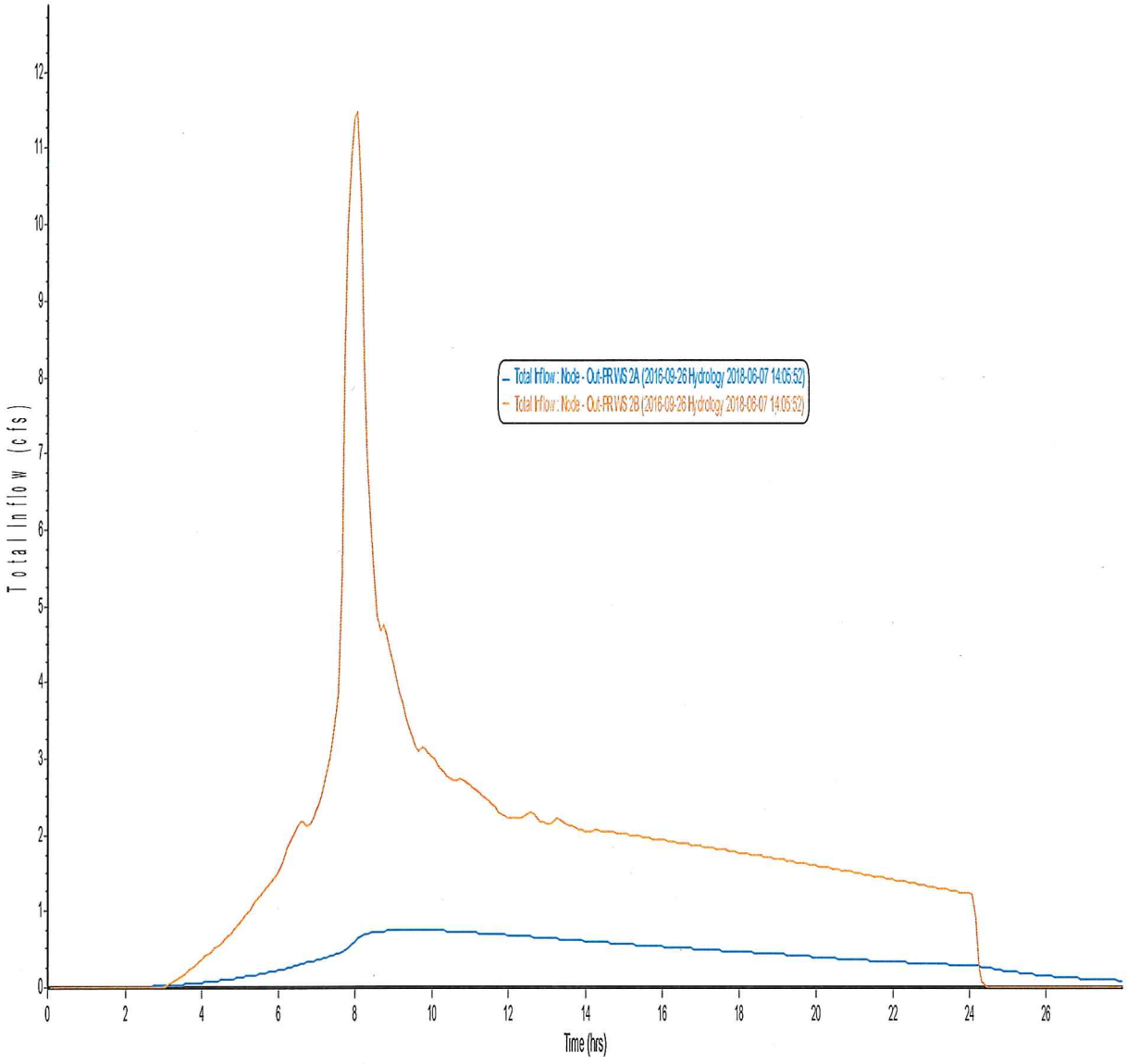
Time to Peak (hrs) 8.30

Watershed 2: Existing 100-yr Storm Event Runoff



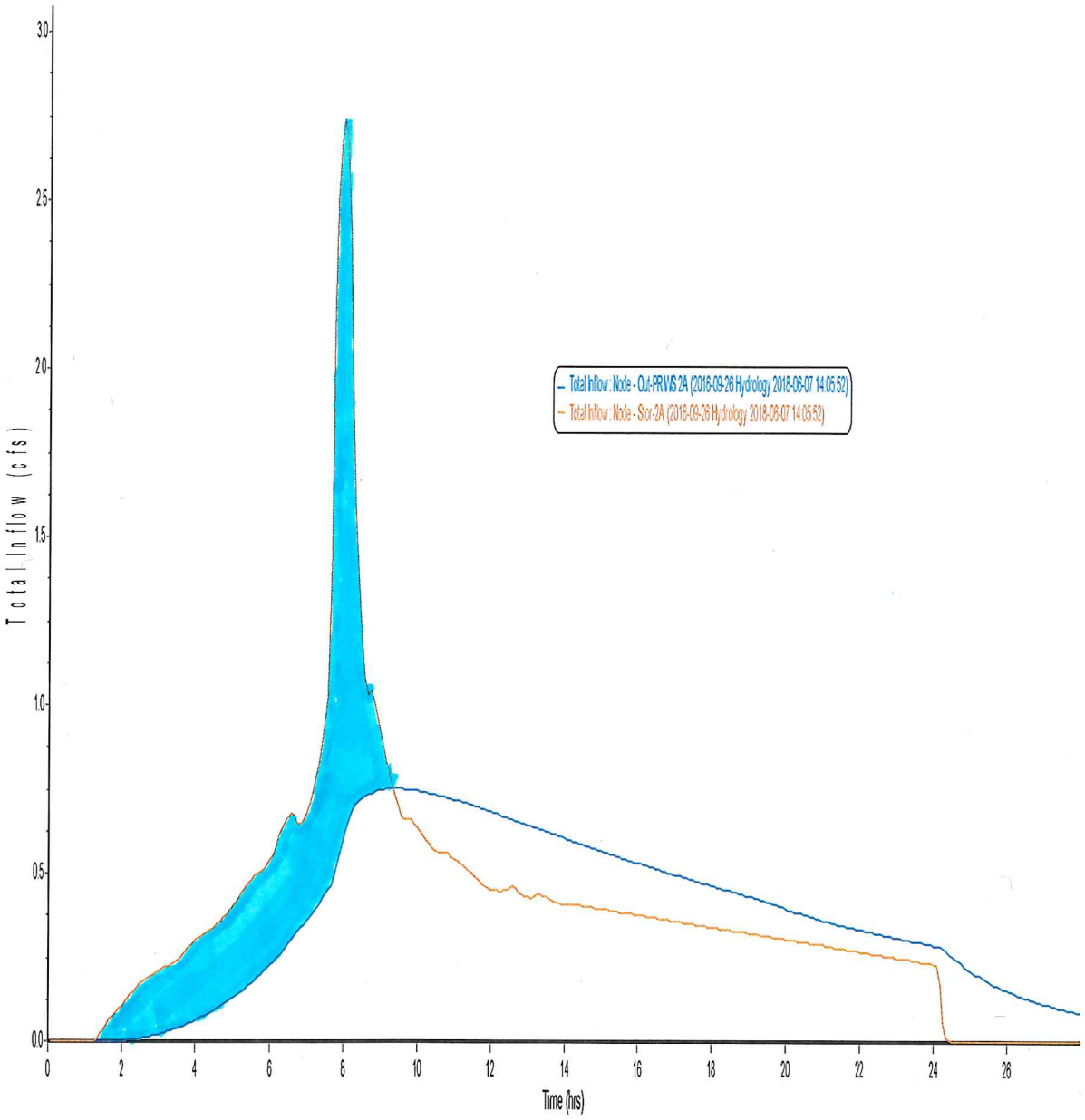
Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
2A	78	7.44	1.56	7.77	8.00	1.72
2B	76	11.53	8.98	7.77	8.02	11.12

Watershed 2: Proposed 100-yr Storm Event Runoff



Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
2A	92	6.00	1.56	7.77	10.33	0.75
2B	77	9.64	8.98	7.77	8.02	11.47

Watershed 2A: Proposed 100-yr Storm Event Storage



Storage.....12,645 cu. ft

Worksheet: Runoff Curve Number

Project	Anthem Winery	By	DJS	Date	9/28/2016
Location	Watershed 3A	Checked	PSW	Date	9/28/2016
Subshed name	Existing Conditions	Check one:	☑ Present	☐ Developed	

RUNOFF CURVE NUMBER

Soil name and hydrologic group (SCS book)	**Cover description** (cover type, treatment and hydrogic condition; percent impervious)	**CN (1)** (Table 2-2)	**Area** ☑ acres ☐ mi2 ☐ %	**Product of CN x Area**
133-C	Impervious Area (Roads, roofs, etc.)	98	0.24	23.52
133-C	Pasture Land (fair)	79	1.38	109.02
		TOTAL:	1.62	132.54

(1) Use only one CN source per line

CN (weighted) = total product / total area = 132.54 / 1.62 = 81.81 ; **USE CN** **82**

Worksheet: Time of Concentration (T_c) or travel time (T_t)

Project: Anthem Winery	By: DJS	Date: 9/28/2016	
Location: Project Site	Checked: PSW	Date: 9/28/2016	
Subshed name: Watershed 3A	Check one: ☑ Present	☐ Developed	
Note: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic or description of flow segments.	Check one: ☑ Tc	☐ Tt through subarea	

SHEET FLOW (applicable to Tc only)

	Segment ID	1			
1.	Surface description (table 3-1)	Range			
2.	Manning's roughness coefficient, n (table3-1)	0.13			
3.	Flow length, L (total L, 300 ft) ft	277			
4.	Two-year 24-hour rainfall, P_2 in	3.4			
5.	Land slope, s ft/ft	0.13			
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr	0.1510	+	=	0.1510

SHALLOW CONCENTRATED FLOW

	Segment ID	2	3		
7.	Surface description (paved or unpaved)	UNPAVED	PAVED		
8.	Flow length, L ft	108	10		
9.	Watercourse slope, s ft/ft	0.13	0.13		
10.	Average velocity, V (figure 3-1) ft/sec	5.8174	7.3294		
11.	$T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.0052	+ 0.0004	=	0.0055

CHANNEL FLOW

	Segment ID				
12.	Cross sectional flow area, a ft^2				
13.	Wetted perimeter, p_w ft				
14.	Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft				
15.	Channel slope, s ft/ft				
16.	Manning's roughness coefficient, n				
17.	$V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ft/sec				
18.	Flow length, L ft				
19.	$T_t = \frac{L}{3600\,V}$ Compute T_t hr		+	=	
20.	Watershed or subarea T_c or T_t (add T_t in steps 6, 11 and 19) hr				0.1565

T_c = 9.39 mins

Worksheet: Runoff Curve Number

Project: Anthem Winery	By: DJS	Date: 9/28/2016	
Location: Watershed 3B	Checked: PSW	Date: 9/28/2016	
Subshed name: Existing Conditions	Check one: ☑ Present ☐ Developed		

RUNOFF CURVE NUMBER

Soil name and hydrologic group (SCS book)	Cover description (cover type, treatment and hydrogic condition; percent impervious)	CN (1) (Table 2-2)	Area ☑ acres ☐ mi2 ☐ %	Product of CN x Area
133-C	Impervious Area (Roads, roofs, etc.)	98	0.10	9.80
133-C	Pasture Land (fair)	79	0.12	9.48
		TOTAL:	0.22	19.28

(1) Use only one CN source per line

CN (weighted) = total product / total area = 19.28 / 0.22 = 87.64 ; **USE CN** **88**

Worksheet: Runoff Curve Number

Project	Anthem Winery	By	DJS	Date	9/26/2016
Location	Watershed 3A	Checked	PSW	Date	9/26/2016
Subshed name	Proposed Conditions	Check one:	☐ Present	☑ Developed	

RUNOFF CURVE NUMBER

Soil name and hydrologic group (SCS book)	Cover description (cover type, treatment and hydrogic condition; percent impervious)	CN (1) (Table 2-2)	Area ☑ acres ☐ mi2 ☐ %	Product of CN x Area
133-C	Impervious Area (Roads, roofs, etc.)	98	0.38	37.24
133-C	Pasture Land (fair)	79	1.24	97.96

(1) Use only one CN source per line

TOTAL: 1.62 | 135.20

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{135.20}{1.62} = 83.46 \text{ ; USE CN } \boxed{83}$$

Worksheet: Runoff Curve Number

Project: Anthem Winery	By: DJS	Date: 9/28/2016	
Location: Watershed 3B	Checked: PSW	Date: 9/28/2016	
Subshed name: Proposed Conditions	Check one: ☐ Present	☑ Developed	

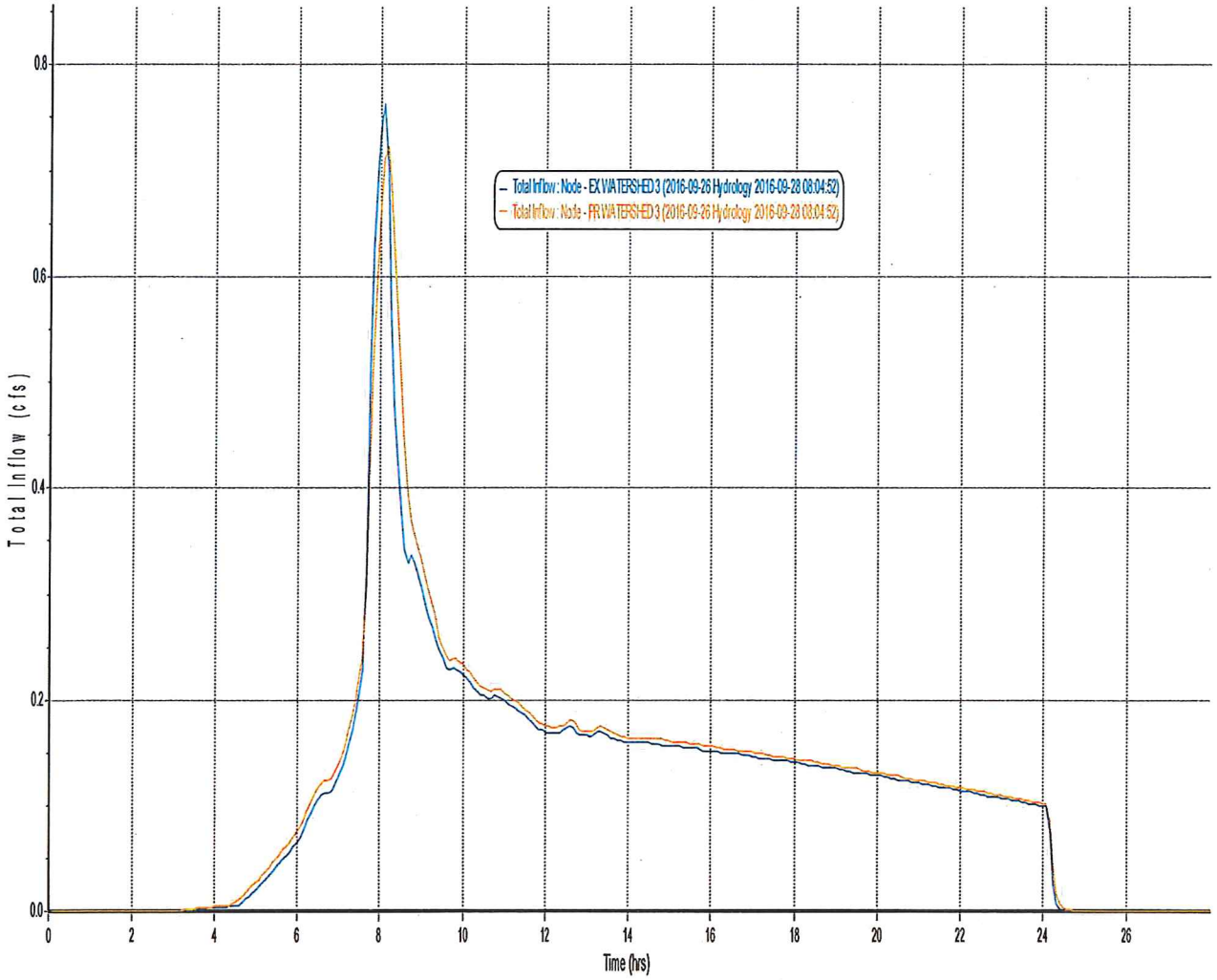
RUNOFF CURVE NUMBER

Soil name and hydrologic group (SCS book)	**Cover description** (cover type, treatment and hydrogic condition; percent impervious)	**CN (1)** (Table 2-2)	**Area** ☑ acres ☐ mi2 ☐ %	**Product of CN x Area**
133-C	Impervious Area (Roads, roofs, etc.)	98	0.12	11.76
133-C	Pasture Land (fair)	79	0.10	7.90
		TOTAL:	0.22	19.66

(1) Use only one CN source per line

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{19.66}{0.22} = 89.36$; USE CN **89**

Watershed 3: 2-yr Storm Event Runoff



Existing Sub-shed Runoff Results

Total Rainfall (in) 3.40

Peak Runoff (cfs) 0.76

Time to Peak (hrs) 8.08

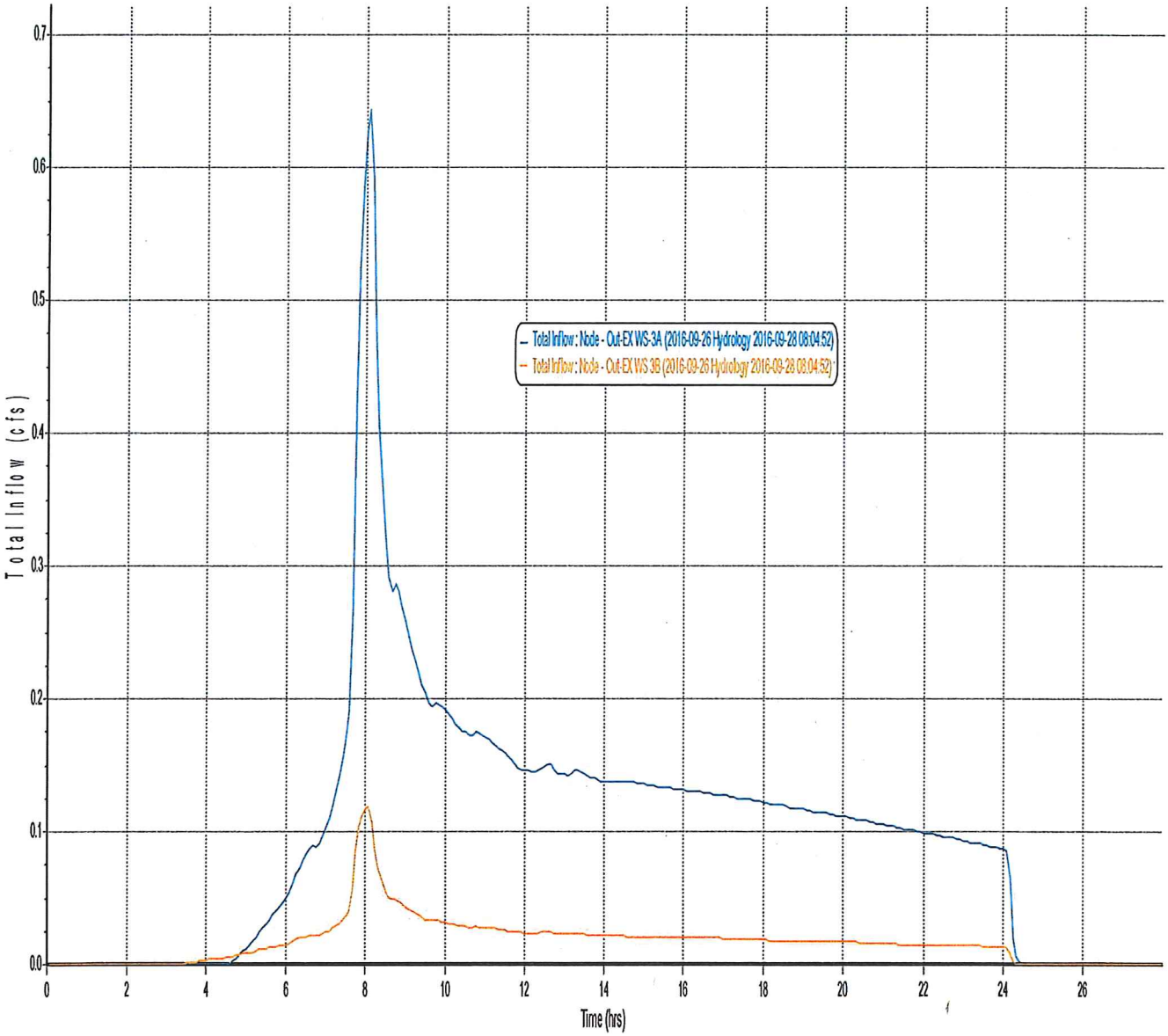
Proposed Sub-shed Runoff Results

Total Rainfall (in) 3.40

Peak Runoff (cfs) 0.72

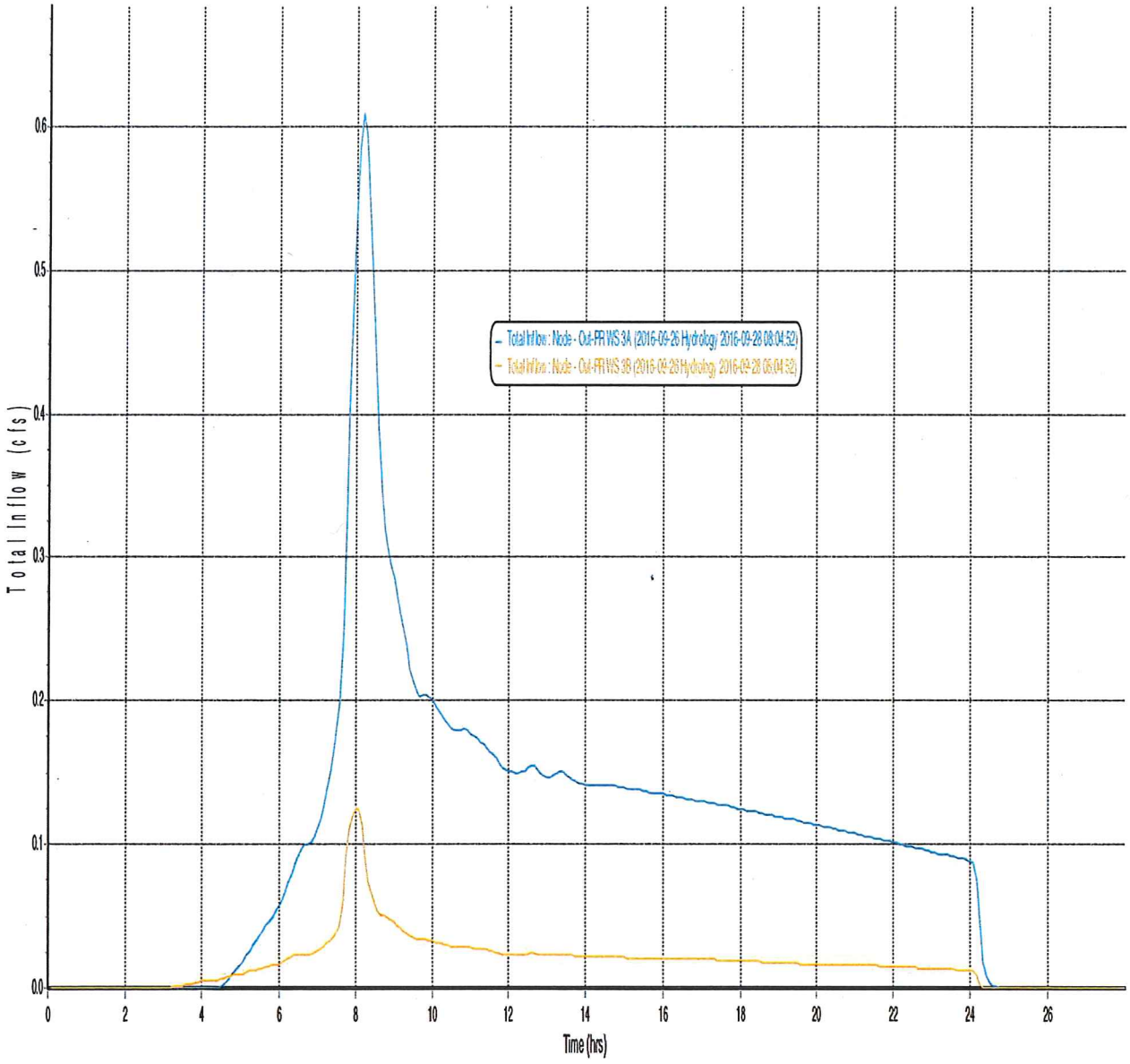
Time to Peak (hrs) 8.17

Watershed 3: Existing 2-yr Storm Event Runoff



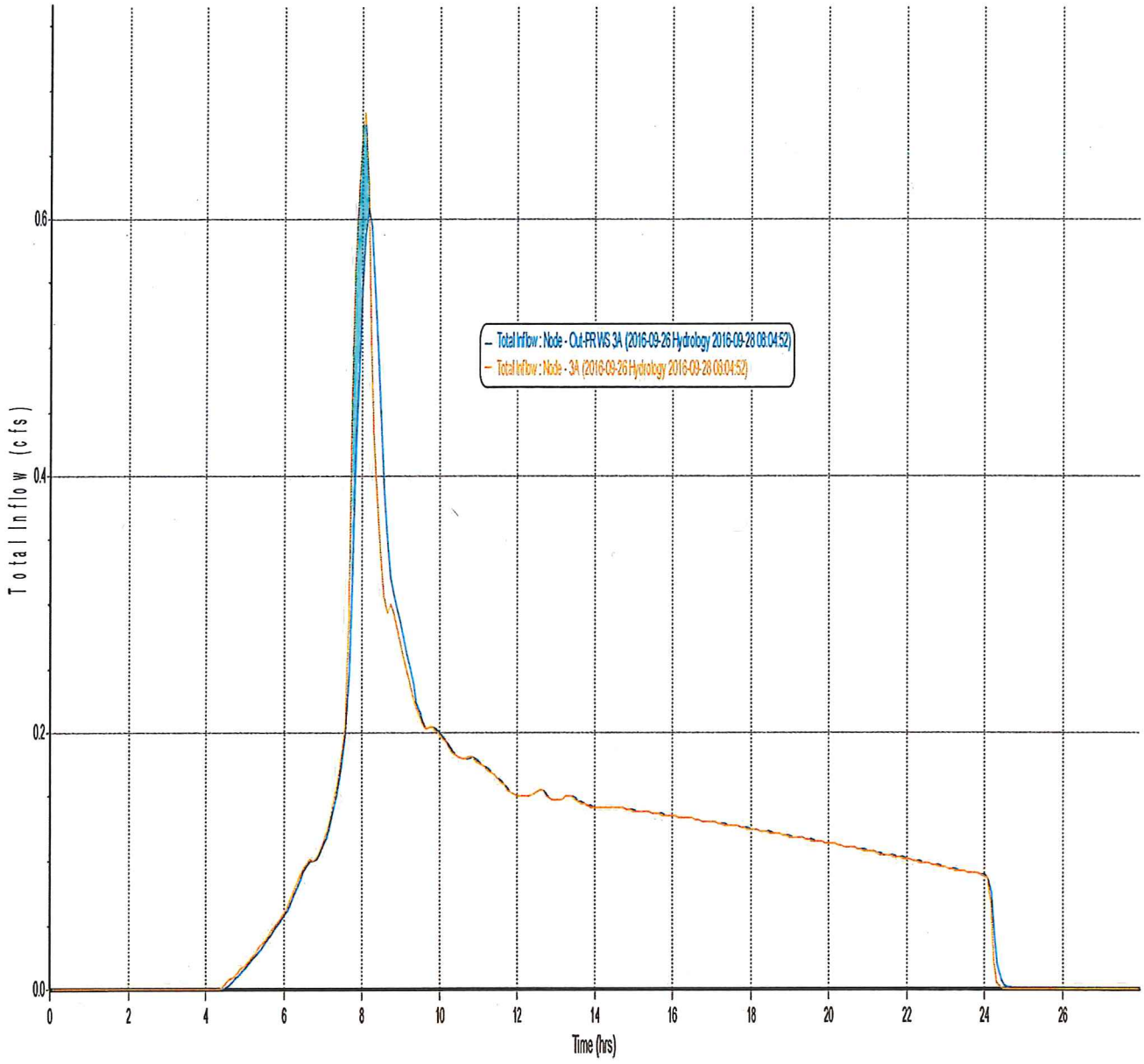
Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
3A	82	9.39	1.62	3.40	8.08	0.64
3B	88	6.00	0.22	3.40	8.07	0.12

Watershed 3: Proposed 2-yr Storm Event Runoff



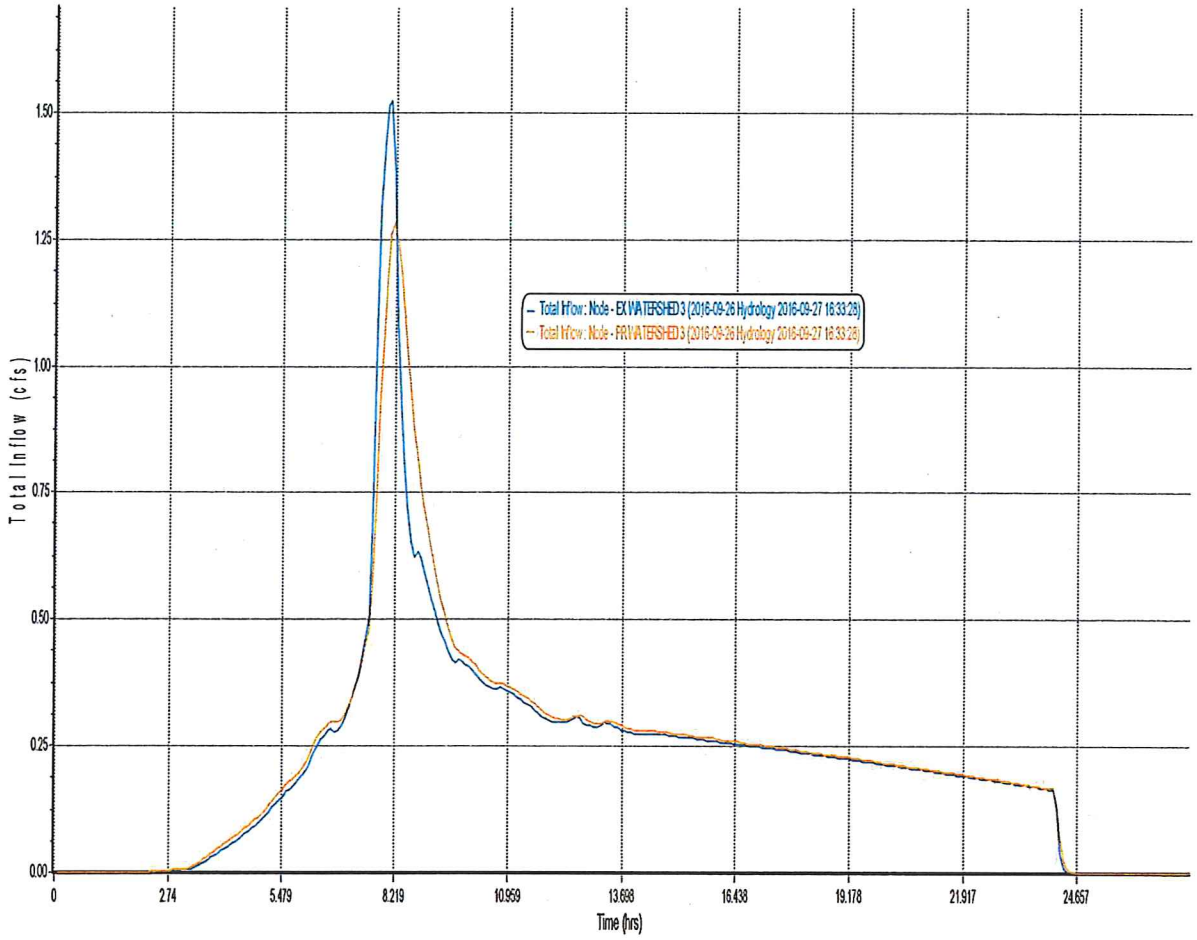
Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
3A	83	6.00	1.62	6.99	8.17	0.61
3B	89	6.00	0.22	6.99	8.00	0.13

Watershed 3A: Proposed 2-yr Storm Event Storage



Storage.....246 cu. ft.

Watershed 3: 10-yr Storm Event Runoff



Existing Sub-shed Runoff Results

Total Rainfall (in) 5.17

Peak Runoff (cfs) 1.52

Time to Peak (hrs) 8.08

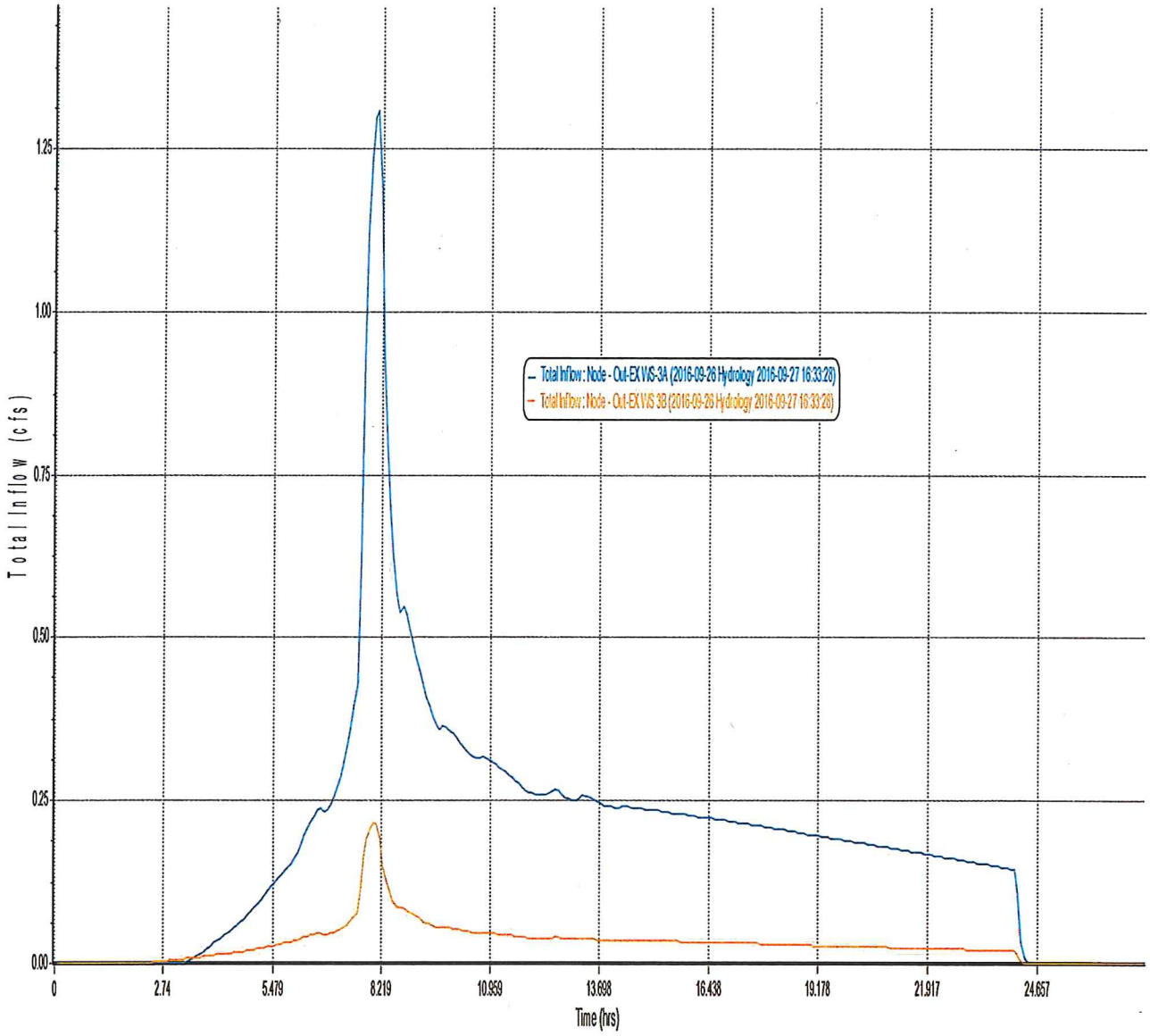
Proposed Sub-shed Runoff Results

Total Rainfall (in) 5.17

Peak Runoff (cfs) 1.28

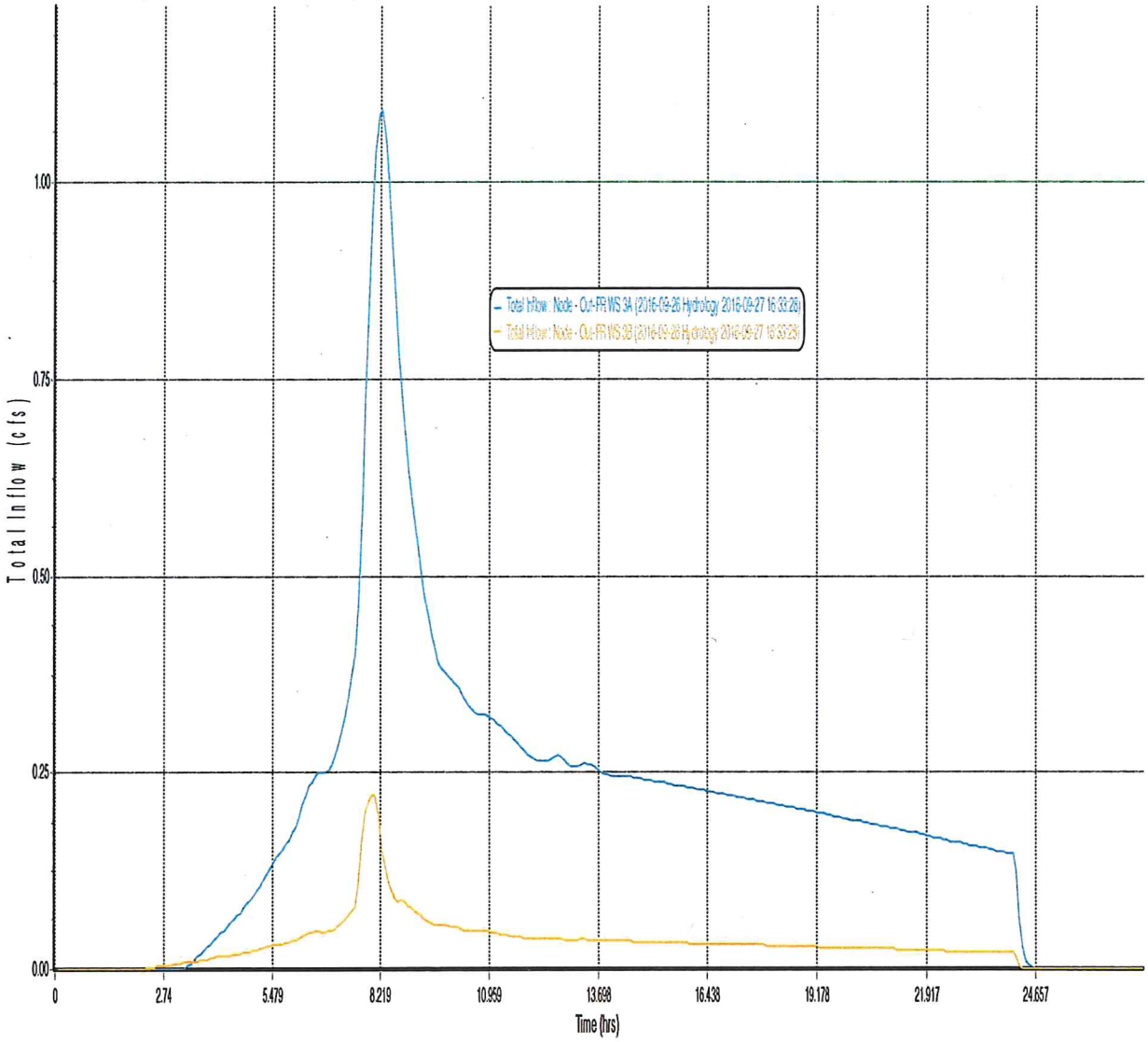
Time to Peak (hrs) 8.17

Watershed 3: Existing 10-yr Storm Event Runoff



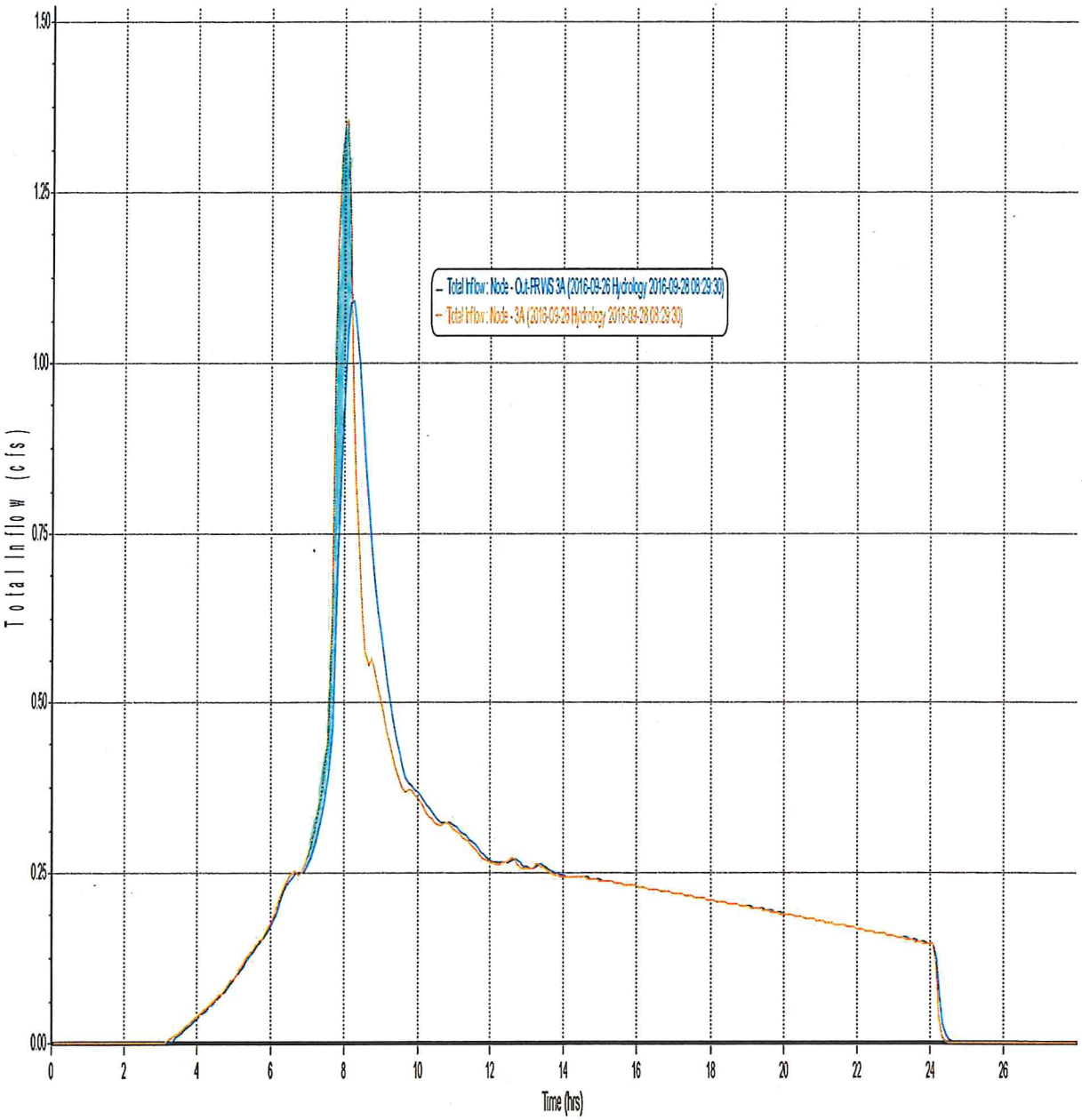
Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
3A	82	9.39	1.62	5.17	8.08	1.31
3B	88	6.00	0.22	5.17	8.00	0.22

Watershed 3: Proposed 10-yr Storm Event Runoff



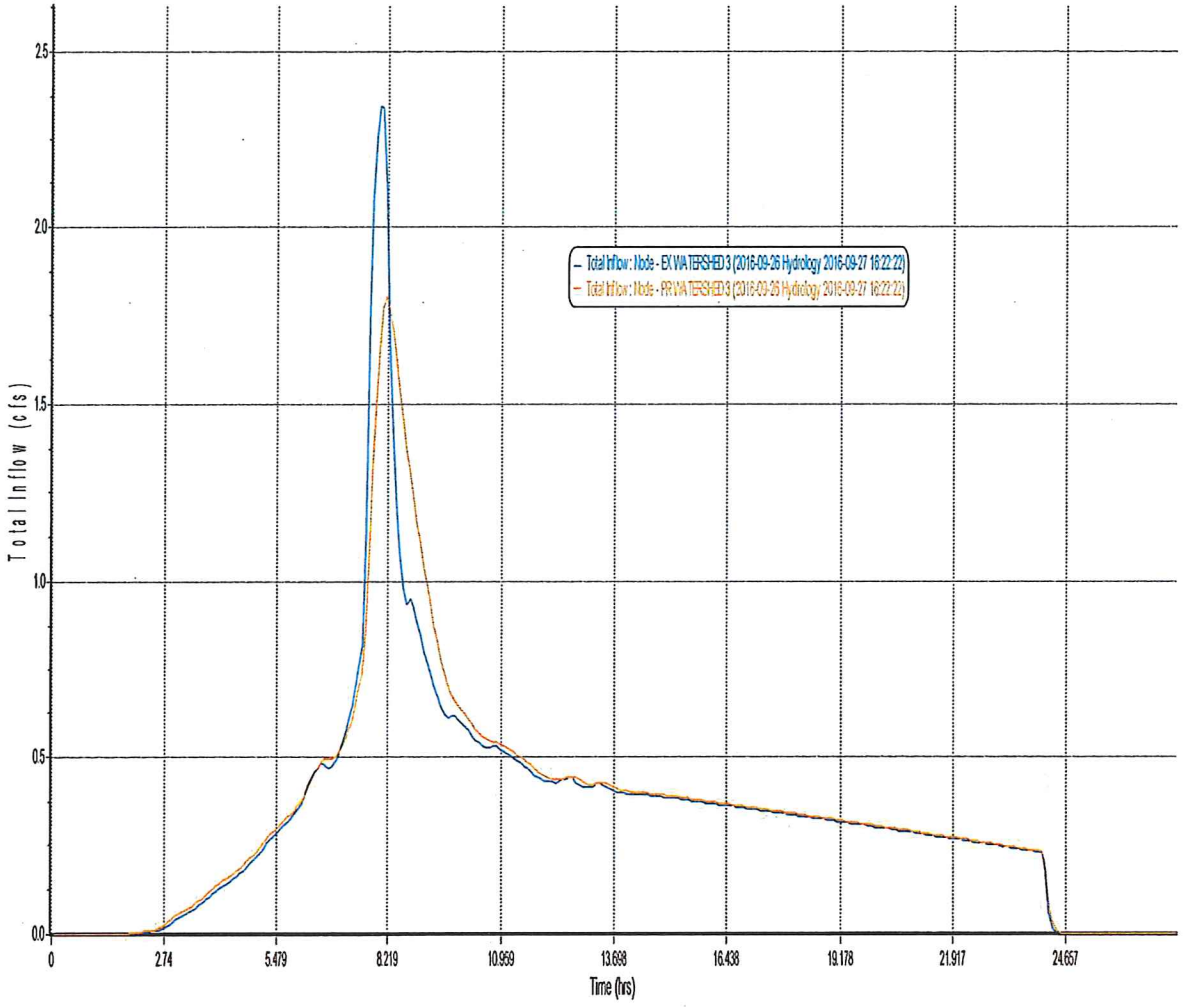
Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
3A	83	6.00	1.62	6.99	8.17	1.09
3B	89	6.00	0.22	6.99	8.00	0.22

Watershed 3A: Proposed 10-yr Storm Event Storage



Storage.....783 cu. ft.

Watershed 3: 50-yr Storm Event Runoff



Existing Sub-shed Runoff Results

Total Rainfall (in) 6.99

Peak Runoff (cfs) 2.34

Time to Peak (hrs) 8.00

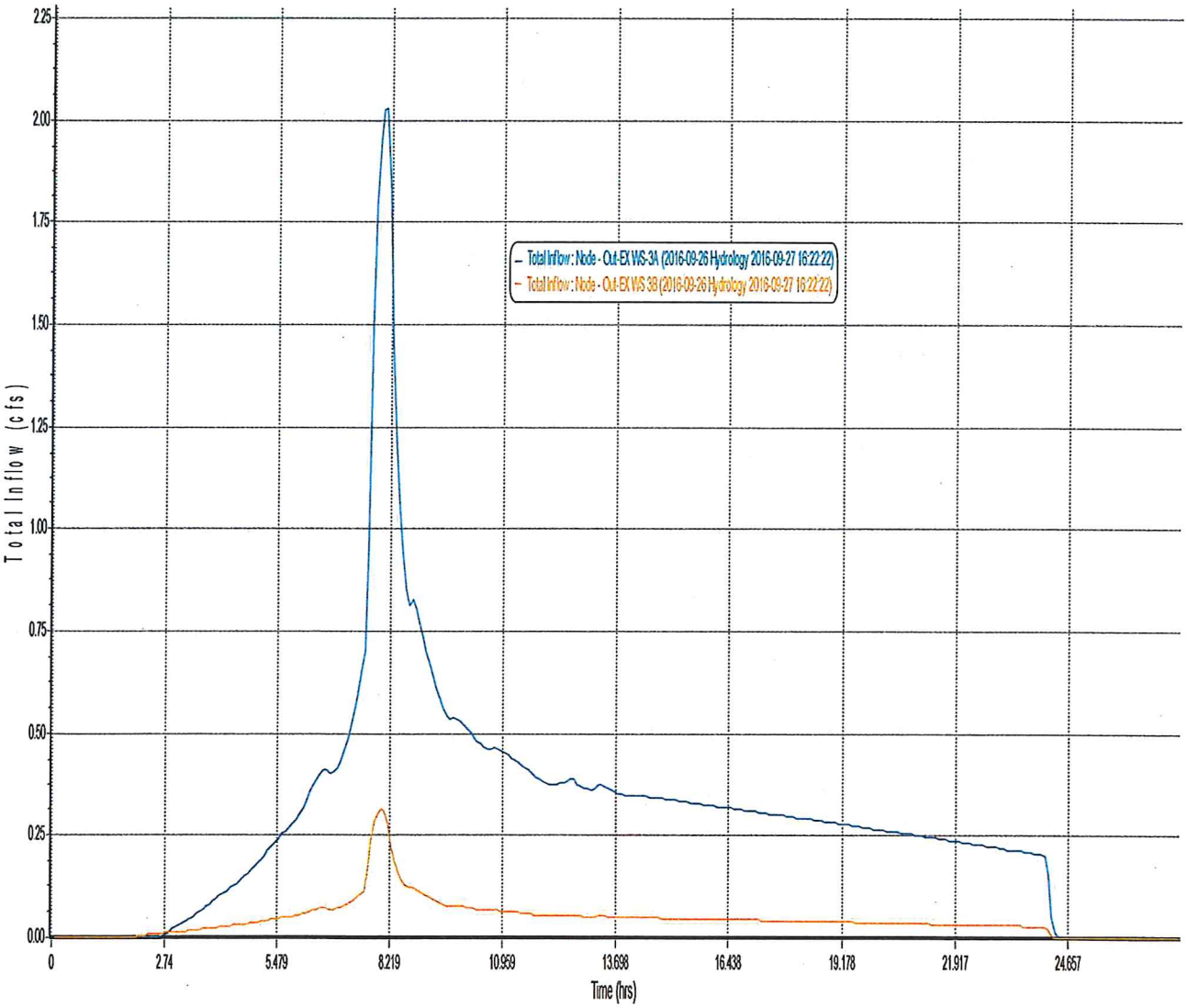
Proposed Sub-shed Runoff Results

Total Rainfall (in) 6.99

Peak Runoff (cfs) 1.81

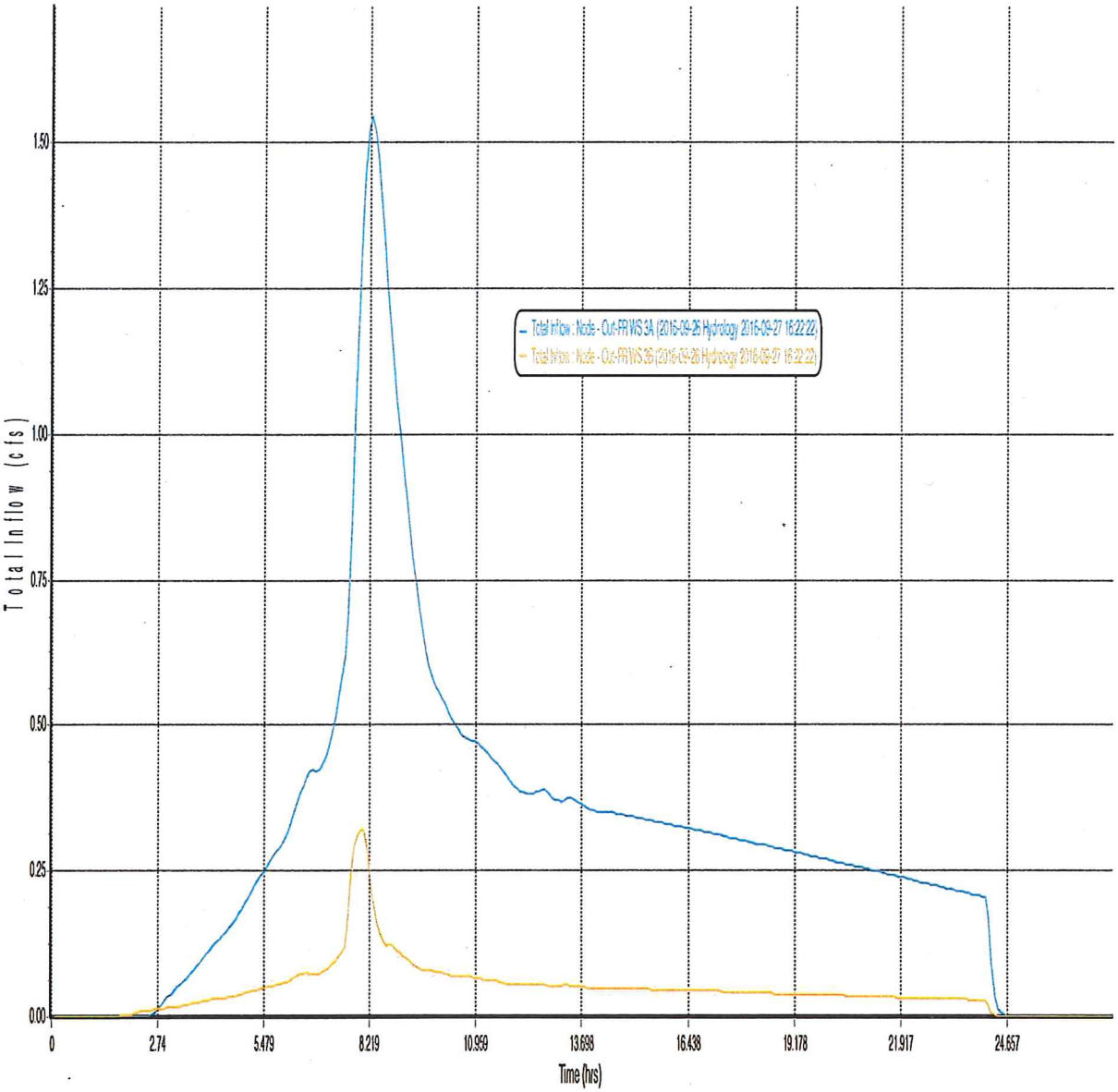
Time to Peak (hrs) 8.17

Watershed 3: Existing 50-yr Storm Event Runoff



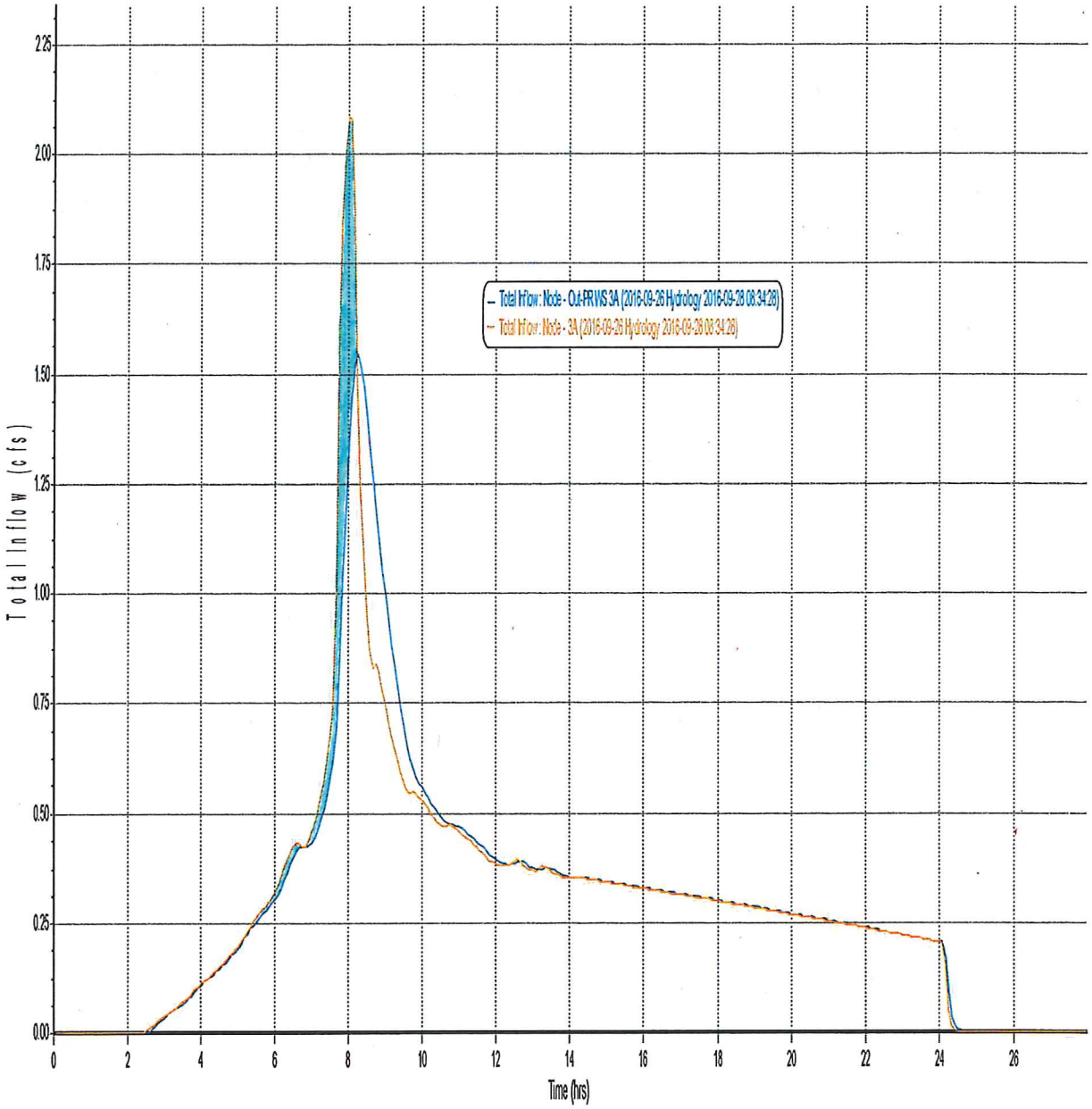
Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
3A	82	9.39	1.62	6.99	8.08	2.03
3B	88	6.00	0.22	6.99	8.00	0.32

Watershed 3: Proposed 50-yr Storm Event Runoff



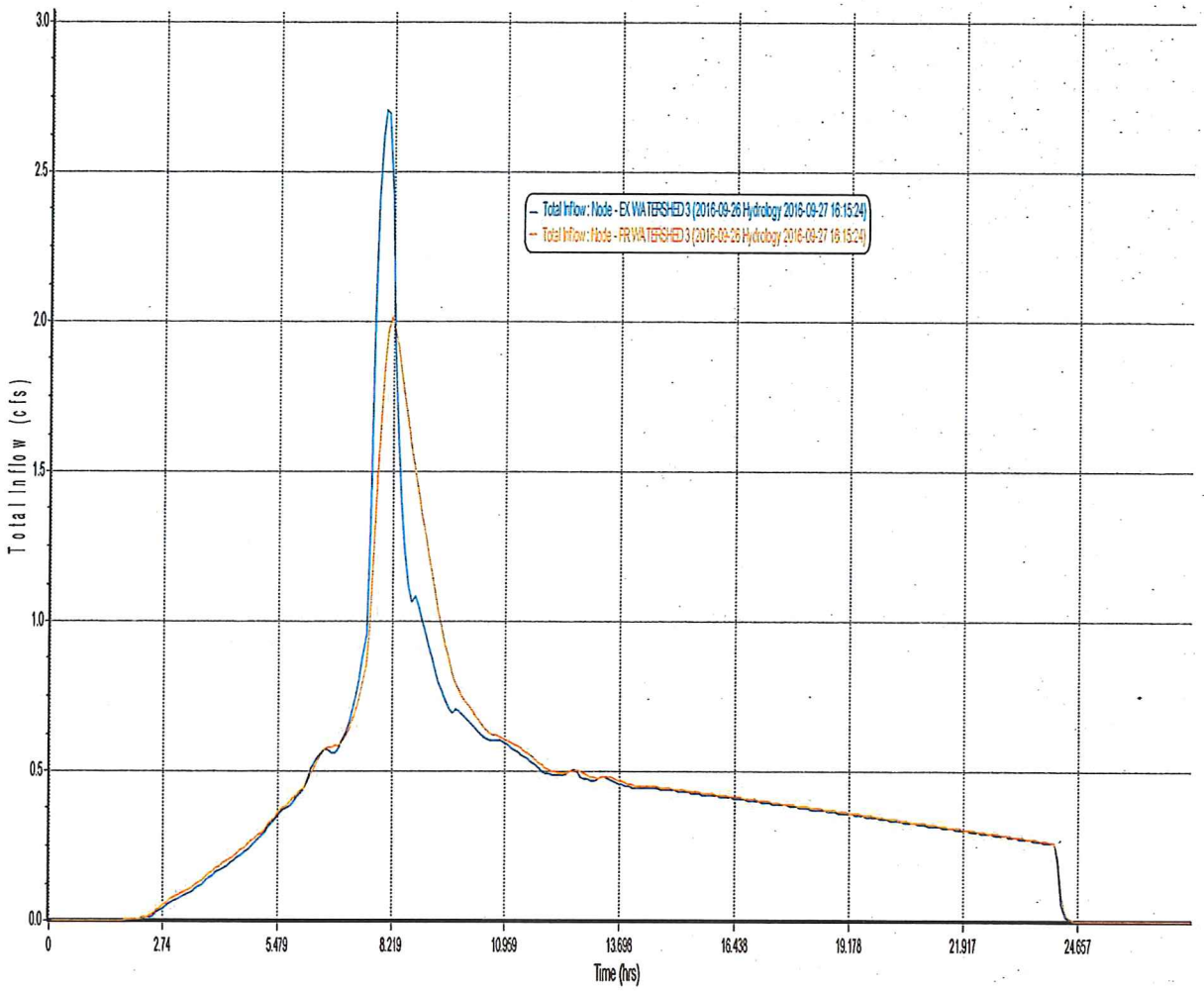
Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
3A	83	6.00	1.62	6.99	8.17	1.54
3B	89	6.00	0.22	6.99	8.00	0.32

Watershed 3A: Proposed 50-yr Storm Event Storage



Storage.....1,574 cu. ft.

Watershed 3: 100-yr Storm Event Runoff



Existing Sub-shed Runoff Results

Total Rainfall (in) 7.77

Peak Runoff (cfs) 2.71

Time to Peak (hrs) 8.00

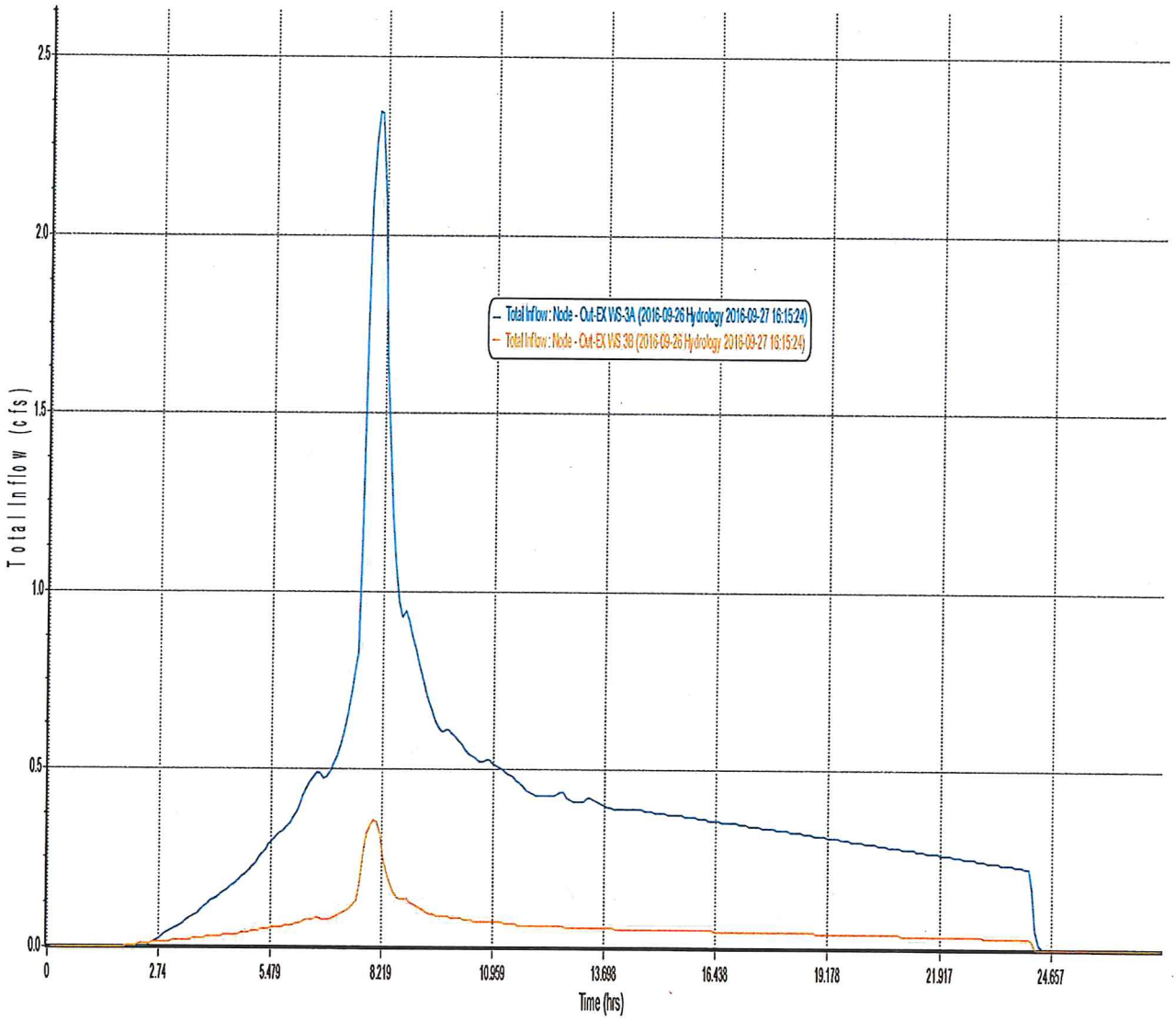
Proposed Sub-shed Runoff Results

Total Rainfall (in) 7.77

Peak Runoff (cfs) 2.02

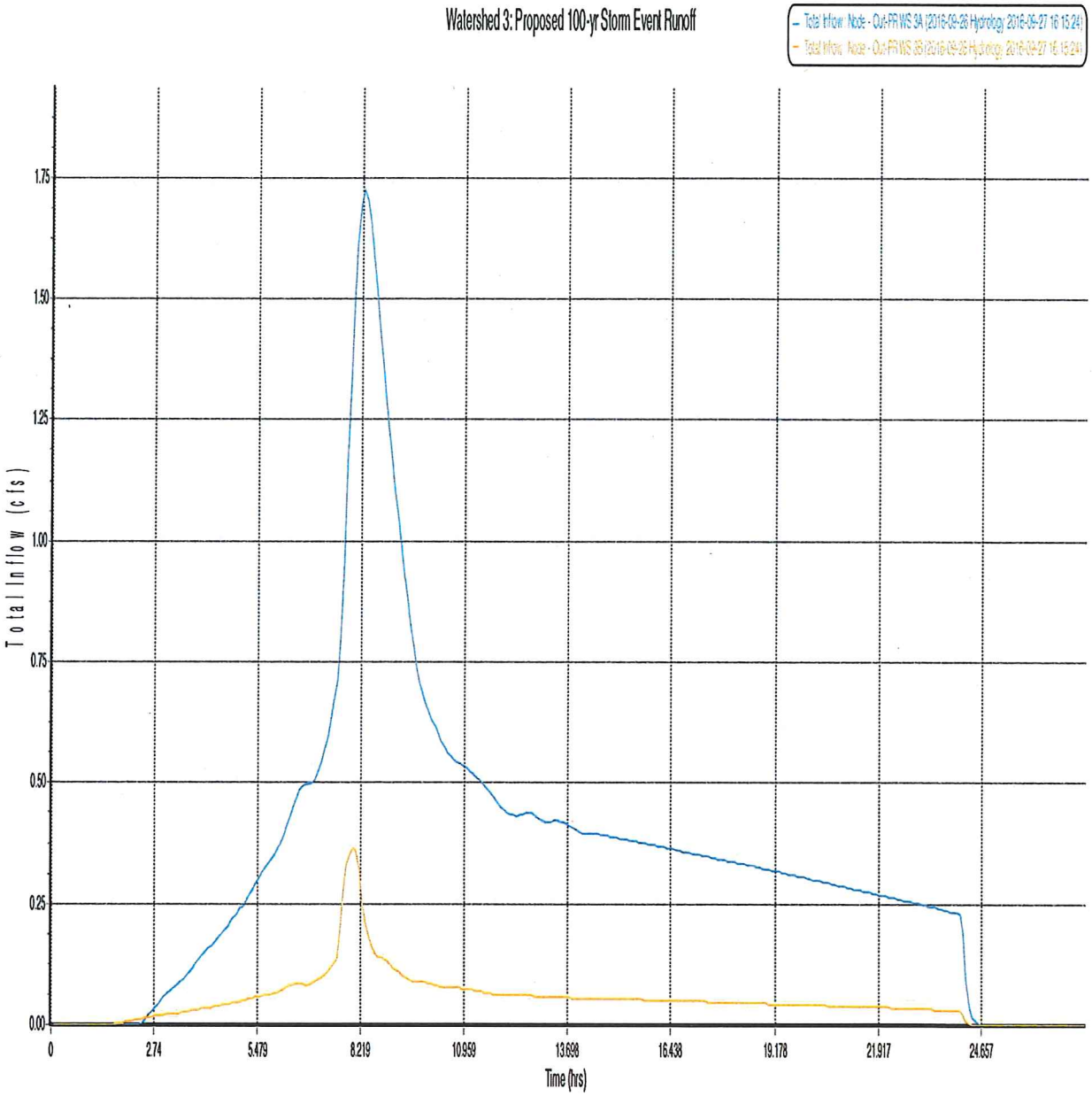
Time to Peak (hrs) 8.17

Watershed 3: Existing 100-yr Storm Event Runoff



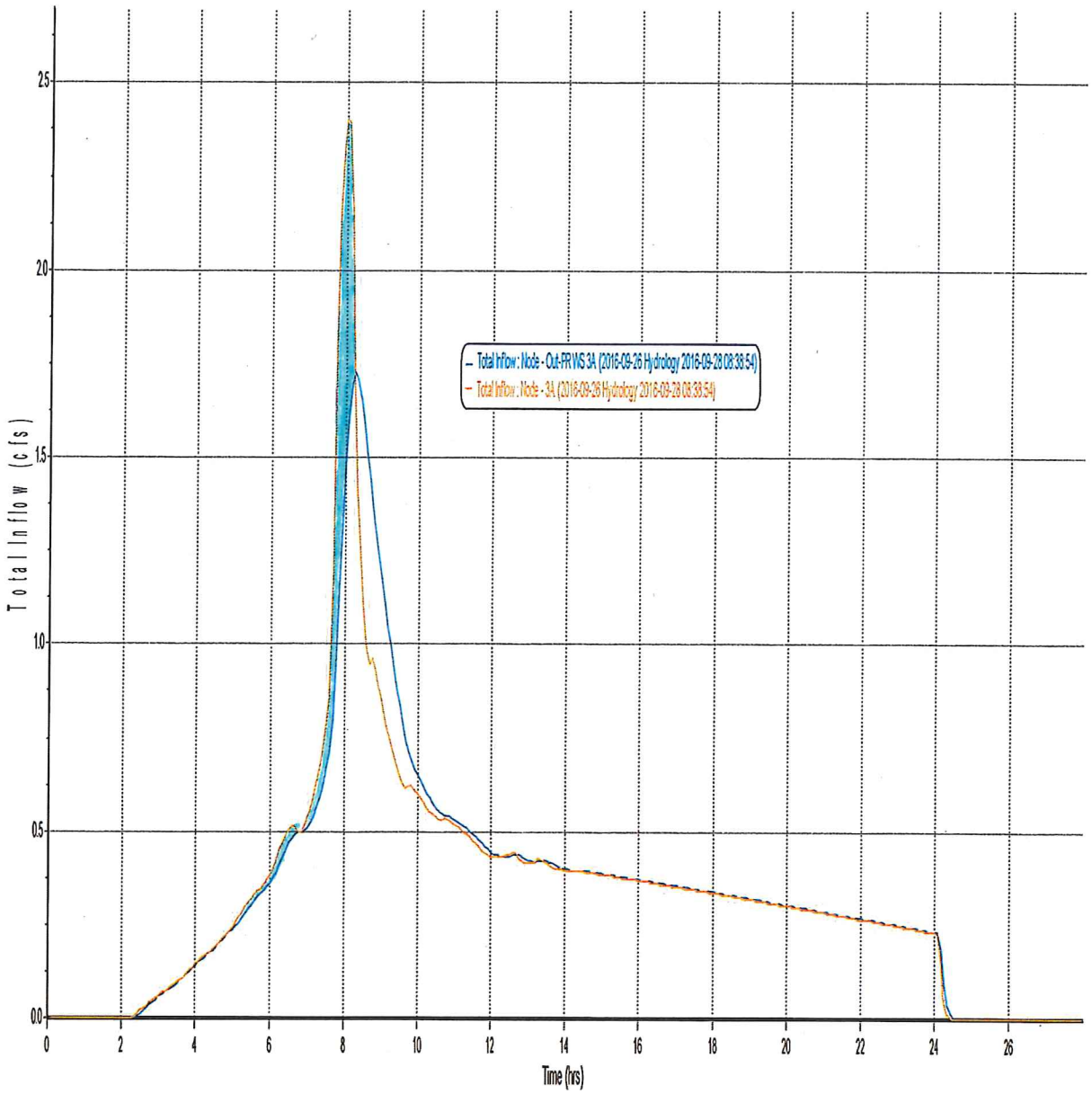
Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
3A	82	9.39	1.62	7.77	8.00	2.35
3B	88	6.00	0.22	7.77	8.08	0.36

Watershed 3: Proposed 100-yr Storm Event Runoff



Sub-shed	CN	Tc (mins)	Area (Ac.)	Total Rainfall (in.)	Time to Peak (hrs.)	Peak Runoff (cfs)
3A	83	6.00	1.62	7.77	8.17	1.72
3B	89	6.00	0.22	7.77	8.00	0.36

Watershed 3A: Proposed 100-yr Storm Event Storage



Storage.....1,963 cu. ft.