

Darrell Fussell, PE Civil and Structural Engineering 2015 North Jackson Street, Clarksburg, LA 70423		PAGE: 1 of 4
JOB: Proposed Storage Facility Dunbar Ave. Bay St. Louis, MS.		DATE: 3/11/26 Rev. 3/13/26 Rev. 5/5/26 Rev. 6/29/26
		BY: DRF

HYDROLOGICAL CALCULATIONS

Scope:

Provide drainage calculations for the proposed storage facility on Ruella Ave. at Dunbar Ave. in Bay St. Louis Mississippi.

The drainage calculations are based on the Rational Method for computing quantities of storm water runoff. The Rational method is based on the following:

$Q = CIA$

Q = peak runoff rate, cfs

C = runoff coefficient

I = average rainfall intensity

A = drainage area, acres

1. Existing Conditions:

The existing 3.26-acre site was previously developed with a large commercial building, paved parking areas, and paved drive areas for a total existing impervious area of 1.70 acres. The existing site drains from south to north across the property to an existing ditch along Ruella Ave.. The existing site drains as a single basin. (see sheet C1 for basin area details). (Note- The total area of the site is 4.09 acres. The proposed storage facility will be constructed on a 3.26 acre portion of the site. See sheet C1.1)

The existing drainage calculations are as follows:

Determination of "Tc"

Area = 3.26

Determination of "C"

Area Total = 3.26 acres

Darrell Fussell, PE Civil and Structural Engineering 225 N. Main St., Covington, LA 70423		PAGE: 2 of 4
JOB: Proposed Storage Facility Dunbar Ave. Bay St. Louis, MS.		DATE: 3/11/26 Rev. 3/13/26 Rev. 5/5/26 Rev. 6/29/26
		BY: DRF

Area of Grass = 1.42 acres

Area of Building Foundation and Paving = 1.84 acres

$$C = 0.25 (1.42/3.26) + 0.95(1.84/3.26) = 0.65$$

$T_c = 5$ min (Min. allowable value.)

2. Developed Conditions:

The proposed plans call for the construction of seven storage buildings along with paved parking and drive areas for a total developed impervious area of 1.26 acres and total limestone paving area of 1.53 acres. The developed site will drain as the existing. (see sheet C1 for developed site drainage details).

The developed drainage calculations are as follows:

Determination of "T_c"

Area = 3.26

Determination of "C"

Area Total = 3.26 acres

Area of Grass = 0.47 acres

Area of Building and Concrete Paving = 1.26 acres

Area of Limestone = 1.53 acres

$$C = 0.25(0.47/3.26) + 0.5(1.53/3.26) + .95(1.26/3.26) = 0.64$$

$T_c = 12$ min

(See TR55 Worksheet and sheet C1 for T_c calculation information.)

Darrell Fussell, PE Civil and Structural Engineering 222 N. Main Street, Suite 100, Bay St. Louis, MS 39320		PAGE: 3 of 4
JOB: Proposed Storage Facility Dunbar Ave. Bay St. Louis, MS.		DATE: 3/11/26 Rev. 3/13/26 Rev. 5/5/26 Rev. 6/29/26
		BY: DRF

HYDRAFLOW COMPUTER ANALYSIS

The pre-developed and developed areas, "C" values, and "Tc" values were input into the program along with the rainfall intensity data producing the following data for a 25-year storm (NOAA for Bay St. Louis attached).

Design Storm	10 Year Storm	25 Year Storm	100 Year Storm
Existing Flow	24.96 cfs	26.00 cfs	35.75 cfs
Developed Flow	16.99 cfs	18.38 cfs	24.10 cfs

Required Flow – Existing 15" RCP Driveway Culvert at outfall location, $L = 86'$, Slope = 0.0035 ft./ft

$Q = 4.91$ cfs. (Pipe Flowing Full)

Required Storage (100 Year Storm Developed Flow) = 13,614 Cubic Feet.
 (See "Hydraflow" Pond Report for details.)

Conclusion:

The developed flow is less than the existing flow because of the increased runoff length, paving type, and channel flow in the developed condition. In the existing condition, the runoff length is small because the the flow is across the site. The "C" value of the existing condition is high because of the existing concrete and asphalt.

Darrell Fussell, PE Civil and Structural Engineering 204 N. Main Street, Ocean Springs, AL 36567		PAGE: 4 of 4
JOB: Proposed Storage Facility Dunbar Ave. Bay St. Louis, MS.		DATE: 3/11/26 Rev. 3/13/26 Rev. 5/5/26 Rev. 6/29/26
		BY: DRF

A portion of the proposed limestone paving area with a storage volume of 13,766 cubic feet will be constructed as a detention area for the proposed site. The detention area will act as a dry pond with a bottom of 19.80' and maximum water surface elevation of 20.80'. The detention area will be drained by catch basins in the pond bottom. 1 – 15" HDPE metering pipe and 1- 12" HDPE metering pipe sloped at 0.0037 ft/ft will be constructed at the exit point of the detention area for a metered flow of 4.34 cfs. (See "Hydraflow" Pond Report for details.)

The metered flow will drain from the limestone paving area outlet pipes to subsurface drainage along the entrance drive for the development. The subsurface drainage along the entrance drive will be constructed using 18" HDPE Pipe sloped at 0.00156 ft./ft for a maximum flow volume of 4.91 cfs. (Pipe flowing full.)

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Monday, Jun 29 2026, 1:12 PM

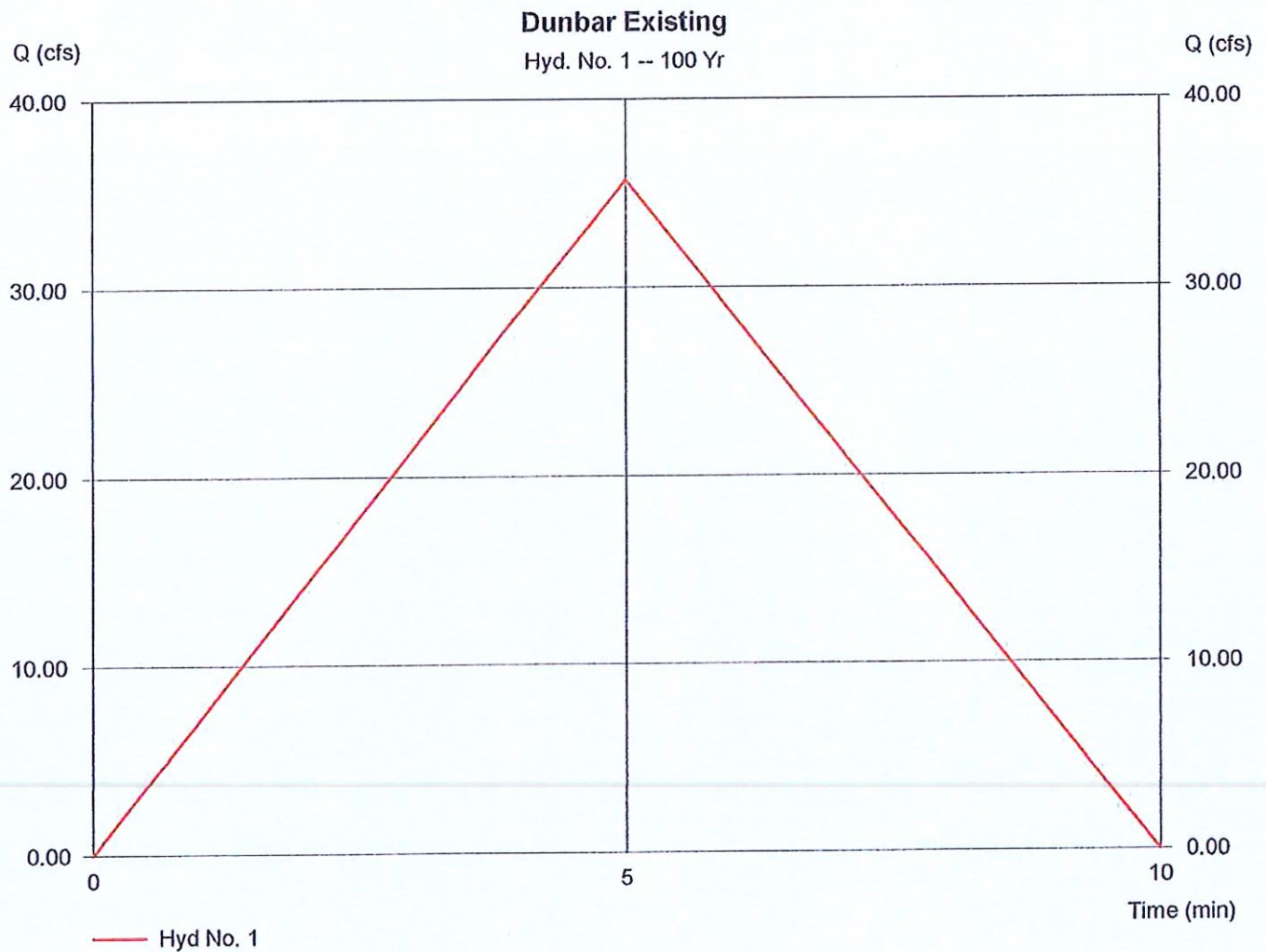
Hyd. No. 1

Dunbar Existing

Hydrograph type = Rational
Storm frequency = 100 yrs
Drainage area = 3.260 ac
Intensity = 16.873 in/hr
IDF Curve = bay st louis.IDF

Peak discharge = 35.75 cfs
Time interval = 1 min
Runoff coeff. = 0.65
Tc by User = 5.00 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 10,726 cuft



Hydrograph Plot

Hydratflow Hydrographs by Intelisolve

Monday, Jun 29 2026, 1:15 PM

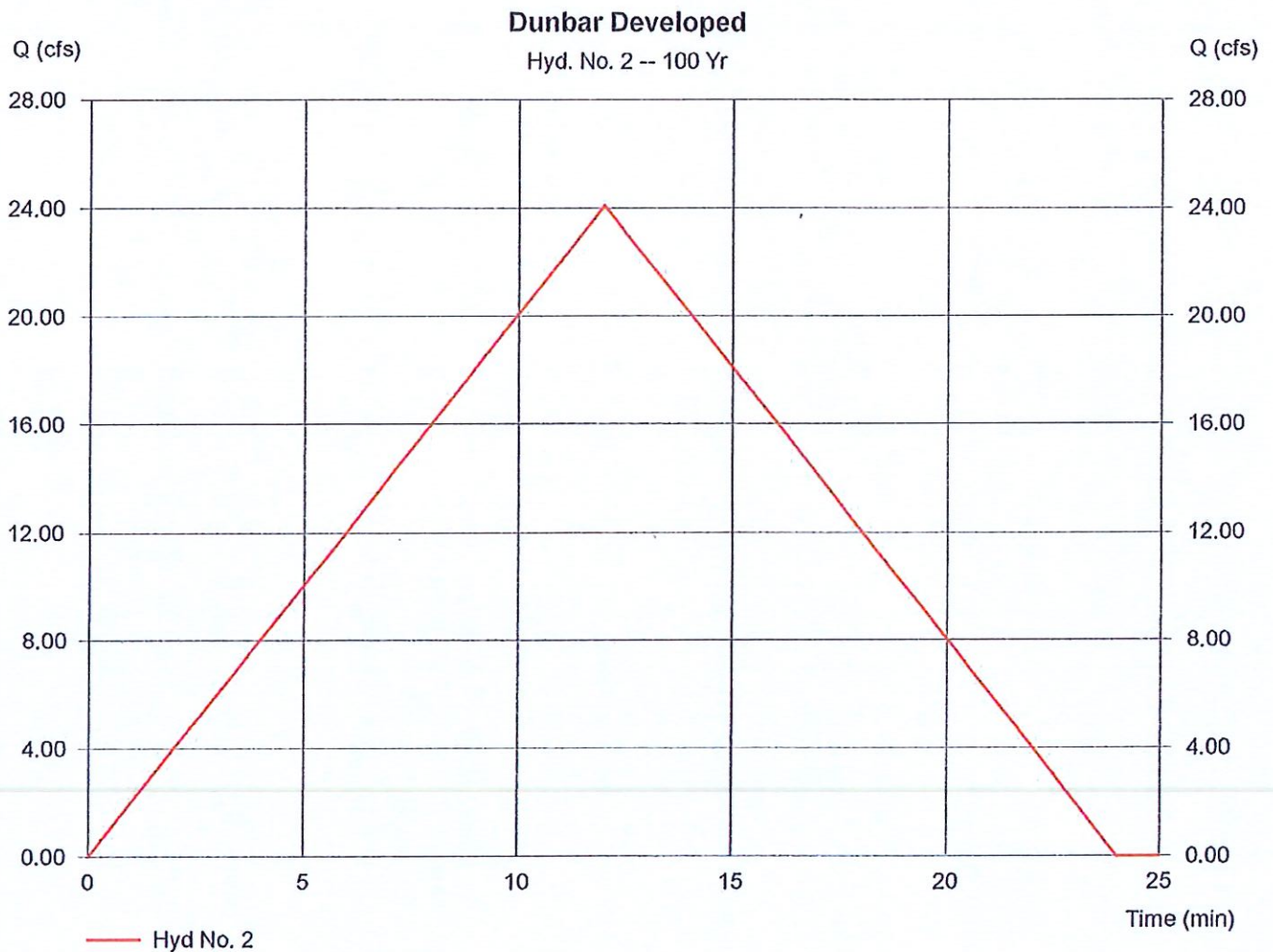
Hyd. No. 2

Dunbar Developed

Hydrograph type = Rational
Storm frequency = 100 yrs
Drainage area = 3,260 ac
Intensity = 11.553 in/hr
IDF Curve = bay st louis.IDF

Peak discharge = 24.10 cfs
Time interval = 1 min
Runoff coeff. = 0.64
Tc by TR55 = 12.00 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 17,355 cult



TR55 Tc Worksheet

Hydraflow Hydrographs by Intellisolve

Hyd. No. 2

Dunbar Developed

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>			
Sheet Flow							
Manning's n-value	= 0.025	0.011	0.011				
Flow length (ft)	= 100.0	0.0	0.0				
Two-year 24-hr precip. (in)	= 5.42	0.00	0.00				
Land slope (%)	= 1.00	0.00	0.00				
Travel Time (min)	= 2.37	+	0.00	+	0.00	=	2.37
Shallow Concentrated Flow							
Flow length (ft)	= 40.00	60.00	0.00				
Watercourse slope (%)	= 1.00	1.00	0.00				
Surface description	= Paved	Unpaved	Paved				
Average velocity (ft/s)	= 2.03	1.61	0.00				
Travel Time (min)	= 0.33	+	0.62	+	0.00	=	0.95
Channel Flow							
X sectional flow area (sqft)	= 3.00	1.23	0.00				
Wetted perimeter (ft)	= 6.32	3.93	0.00				
Channel slope (%)	= 0.12	0.12	0.00				
Manning's n-value	= 0.026	0.011	0.015				
Velocity (ft/s)	= 1.21	2.15	0.00				
Flow length (ft)	= 520.0	130.0	0.0				
Travel Time (min)	= 7.19	+	1.01	+	0.00	=	8.20
Total Travel Time, Tc					11.51 min		

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Wednesday, Jul 1 2026, 11:53 AM

Hyd. No. 3

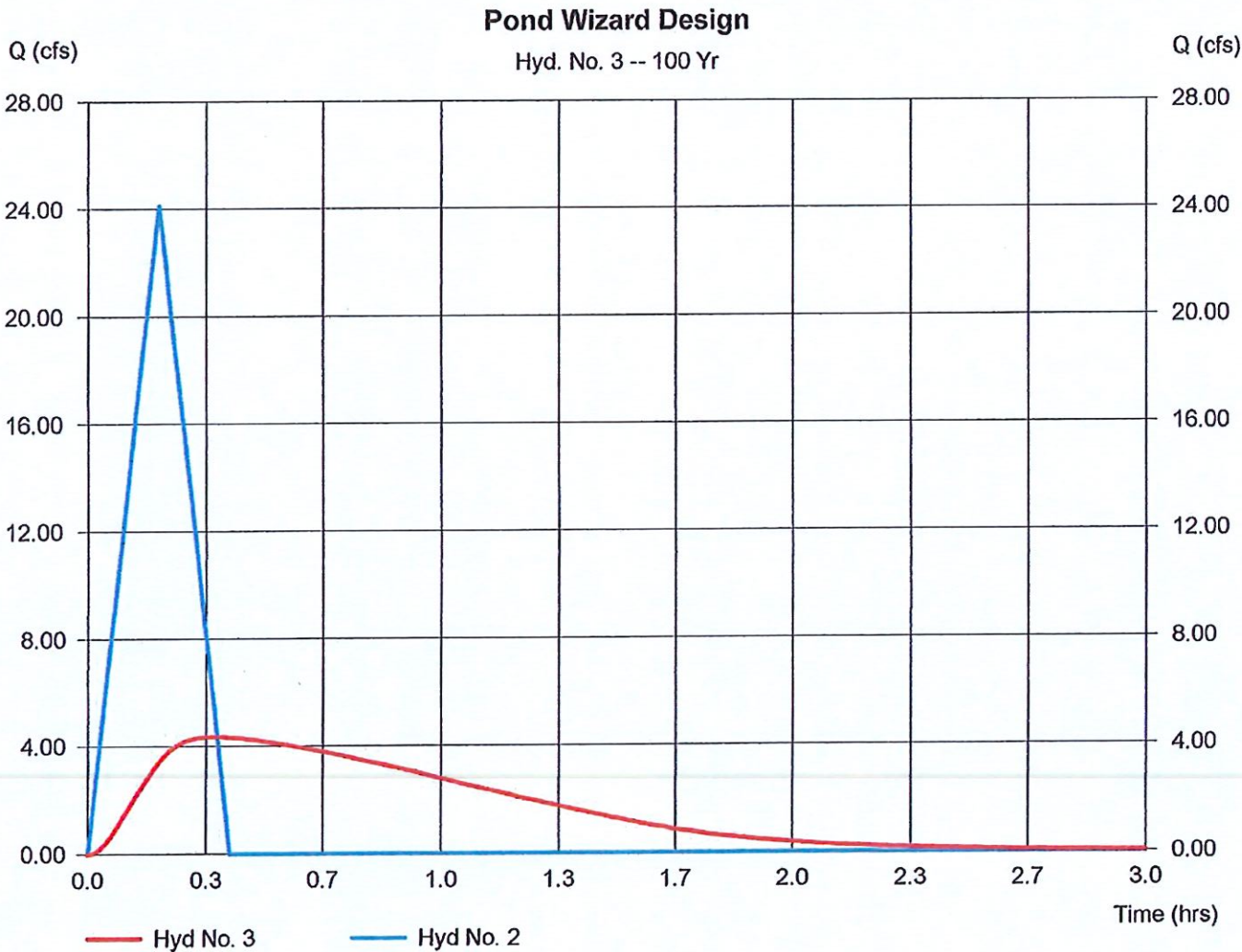
Pond Wizard Design

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Inflow hyd. No. = 2
Reservoir name = Pond Wizard Design

Peak discharge = 4.34 cfs
Time interval = 1 min
Max. Elevation = 20.79 ft
Max. Storage = 13,614 cuft

Storage Indication method used.

Hydrograph Volume = 17,346 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve

Wednesday, Jul 1 2026, 11:53 AM

Pond No. 1 - Pond Wizard Design

Pond Data

Bottom LxW = 198.7 x 2.0 ft Side slope = 50.0:1 Bottom elev. = 19.80 ft Depth = 1.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	19.80	397	0	0
0.05	19.85	1,426	45	45
0.10	19.90	2,505	98	143
0.15	19.95	3,633	153	297
0.20	20.00	4,812	211	508
0.25	20.05	6,040	271	779
0.30	20.10	7,319	334	1,112
0.35	20.15	8,647	399	1,511
0.40	20.20	10,026	467	1,978
0.45	20.25	11,454	537	2,515
0.50	20.30	12,933	609	3,124
0.55	20.35	14,461	685	3,809
0.60	20.40	16,040	762	4,571
0.65	20.45	17,669	843	5,414
0.70	20.50	19,347	925	6,339
0.75	20.55	21,076	1,010	7,349
0.80	20.60	22,854	1,098	8,447
0.85	20.65	24,683	1,188	9,635
0.90	20.70	26,561	1,281	10,916
0.95	20.75	28,490	1,376	12,292
1.00	20.80	30,468	1,474	13,766

Culvert / Orifice Structures

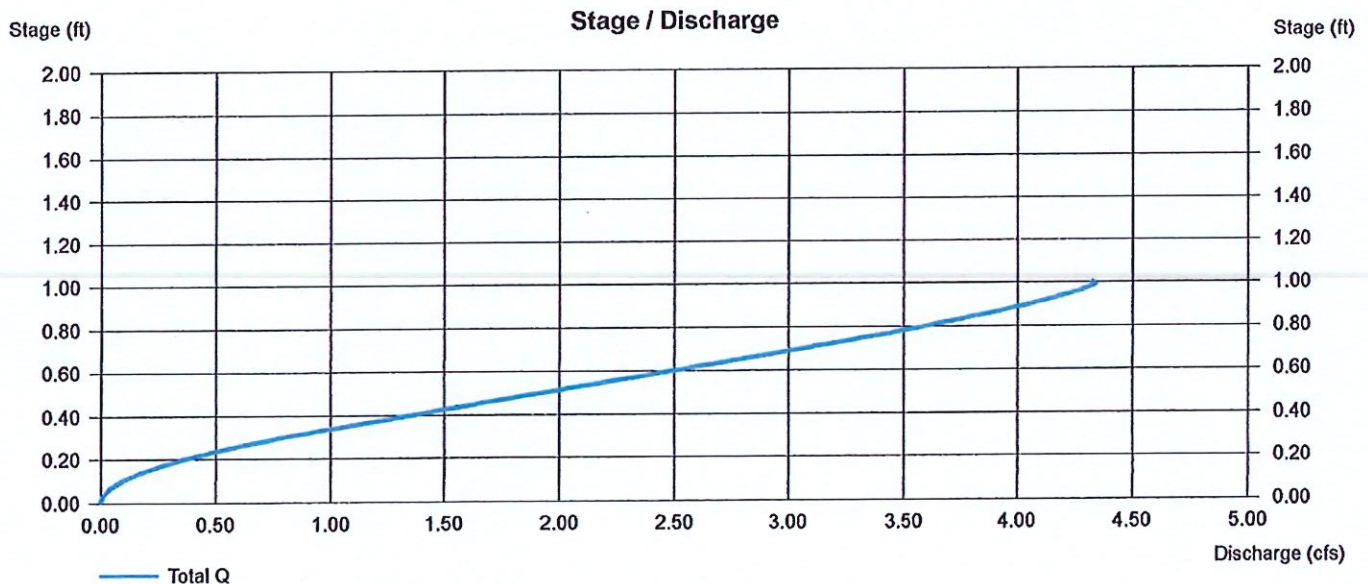
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	12.00	0.00	0.00
Span (in)	= 15.00	12.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 19.80	19.80	0.00	0.00
Length (ft)	= 50.00	50.00	0.00	0.00
Slope (%)	= 0.40	0.40	0.00	0.00
N-Value	= .011	.011	.013	.013
Orif. Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 0.00	0.00	0.00	0.00
Weir Type	= —	---	---	---
Multi-Stage	= No	No	No	No

Exfiltration = 0.000 in/hr (Wet area) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Monday, Jun 29 2026, 1:53 PM

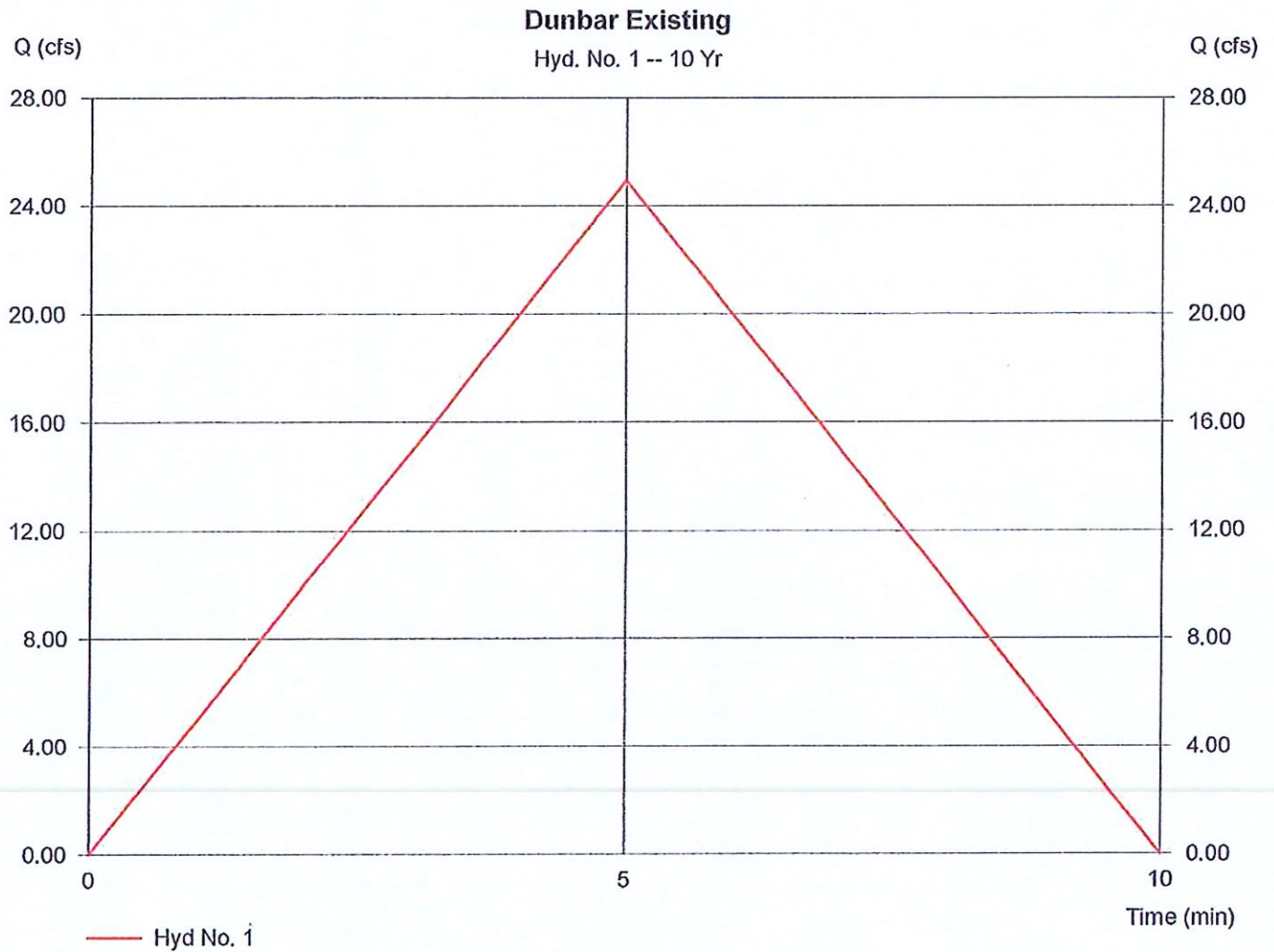
Hyd. No. 1

Dunbar Existing

Hydrograph type = Rational
Storm frequency = 10 yrs
Drainage area = 3.260 ac
Intensity = 11.778 in/hr
IDF Curve = bay st louis.IDF

Peak discharge = 24.96 cfs
Time interval = 1 min
Runoff coeff. = 0.65
Tc by User = 5.00 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 7,487 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Monday, Jun 29 2026, 1:54 PM

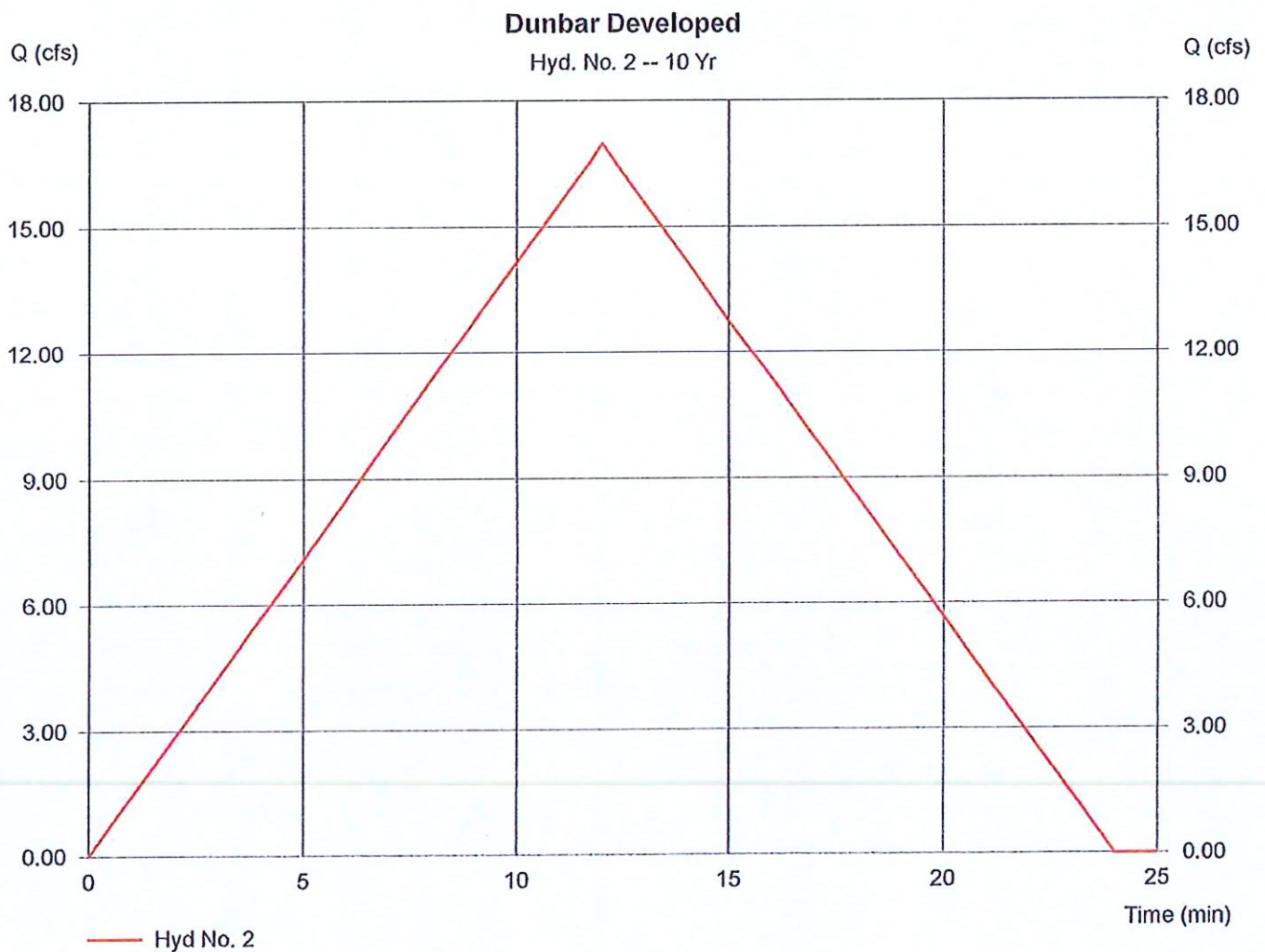
Hyd. No. 2

Dunbar Developed

Hydrograph type = Rational
Storm frequency = 10 yrs
Drainage area = 3.260 ac
Intensity = 8.142 in/hr
IDF Curve = bay st louis.IDF

Peak discharge = 16.99 cfs
Time interval = 1 min
Runoff coeff. = 0.64
Tc by TR55 = 12.00 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 12,230 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Wednesday, Jul 1 2026, 11:28 AM

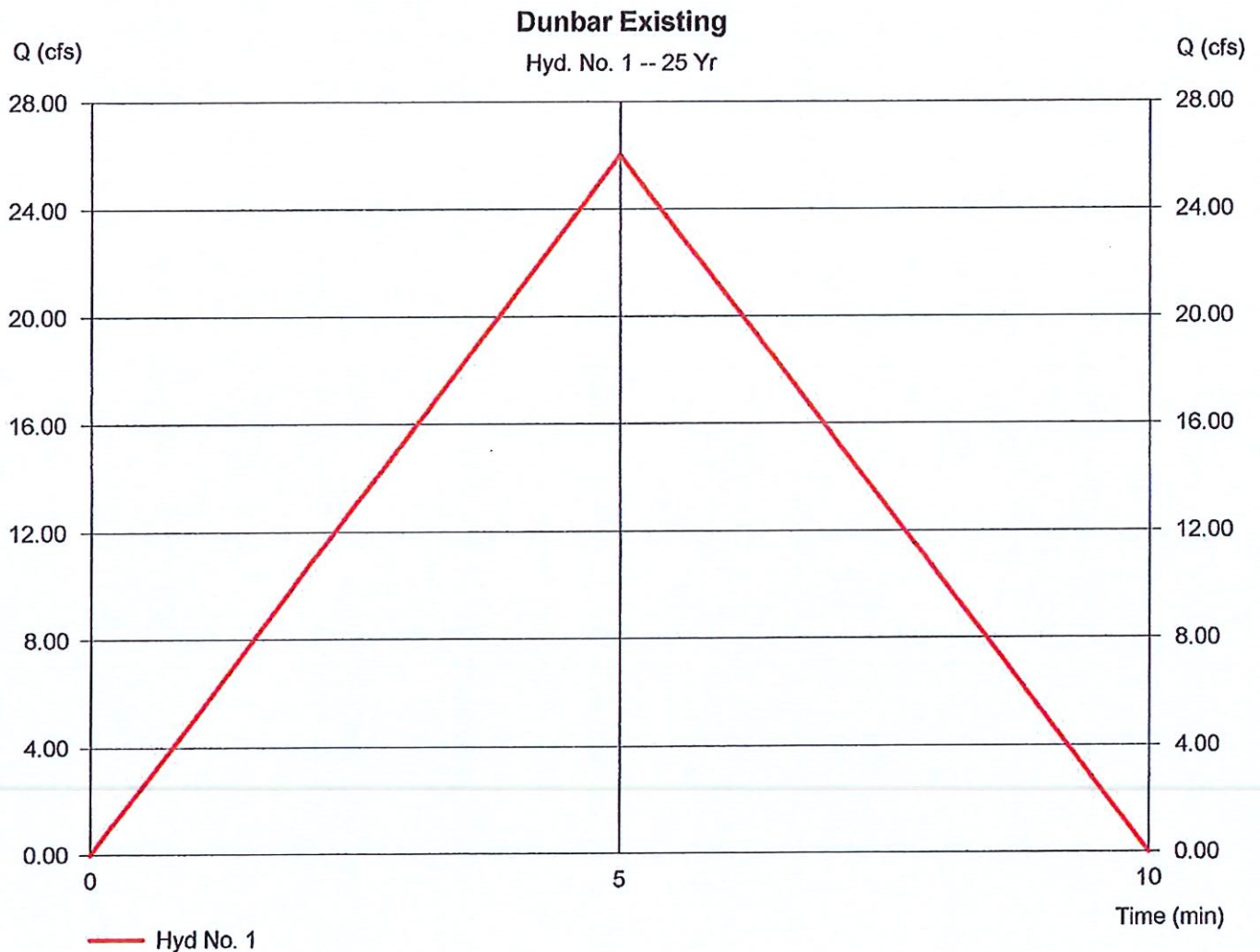
Hyd. No. 1

Dunbar Existing

Hydrograph type = Rational
Storm frequency = 25 yrs
Drainage area = 3.260 ac
Intensity = 12.270 in/hr
IDF Curve = bay st louis.IDF

Peak discharge = 26.00 cfs
Time interval = 1 min
Runoff coeff. = 0.65
Tc by User = 5.00 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 7,800 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

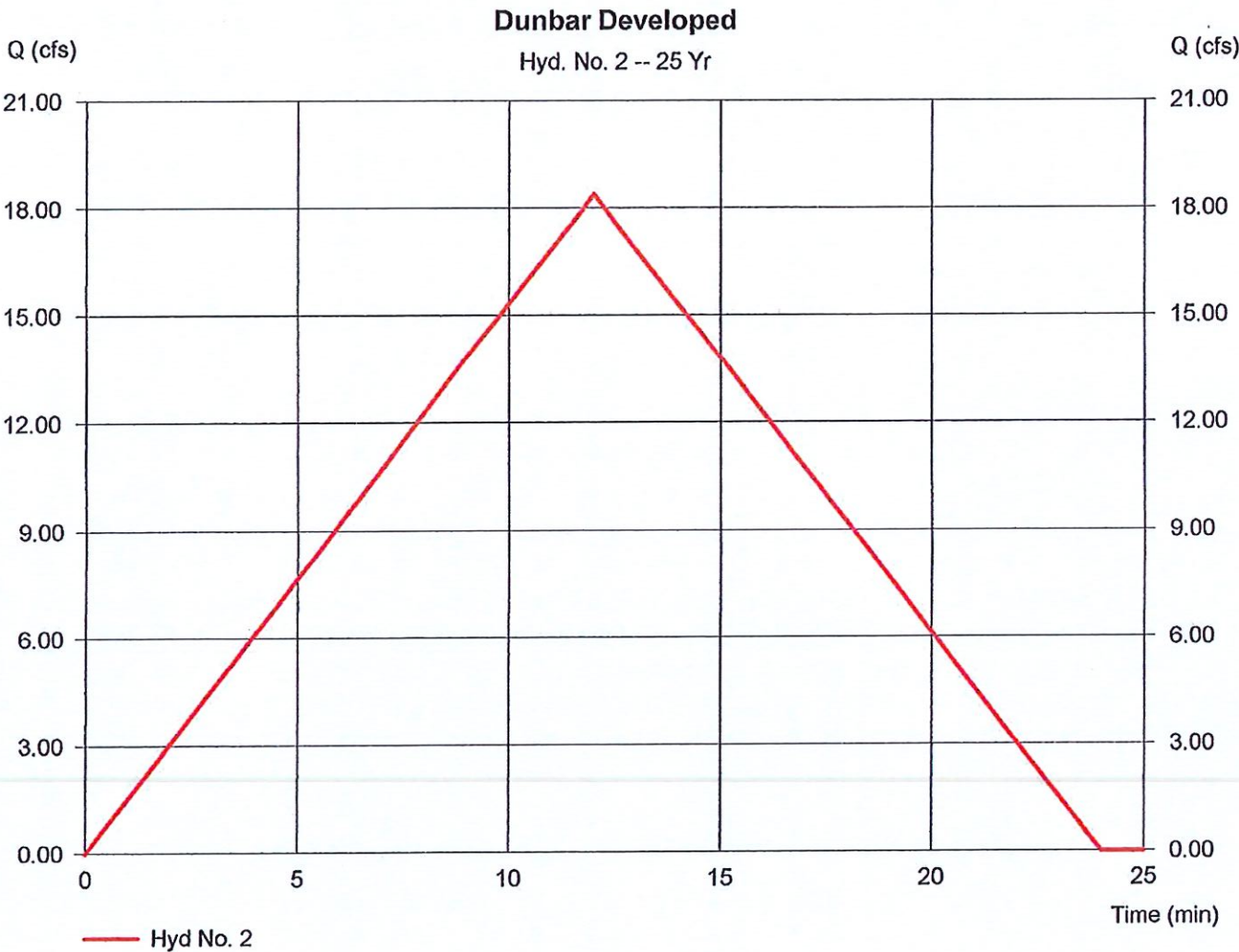
Wednesday, Jul 1 2026, 11:28 AM

Hyd. No. 2

Dunbar Developed

Hydrograph type	= Rational	Peak discharge	= 18.38 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 3.260 ac	Runoff coeff.	= 0.64
Intensity	= 8.811 in/hr	Tc by TR55	= 12.00 min
IDF Curve	= bay st louis.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 13,236 cuft



NOAA Atlas 14, Volume 9, Version 2
 Location name: Stennis Space Center, Mississippi,
 USA*

Latitude: 30.3942°, Longitude: -89.5825°

Elevation: 33 ft**

* source: ESRI Maps

** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Urruh, Michael Yekta, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aeriels](#)

PF tabular

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	6.67 (5.45-8.15)	7.63 (6.22-9.32)	9.20 (7.48-11.3)	10.5 (8.48-12.9)	12.3 (9.65-15.3)	13.6 (10.5-17.2)	15.0 (11.3-19.2)	16.4 (11.9-21.3)	18.2 (12.8-24.0)	19.6 (13.5-26.1)
10-min	4.89 (3.98-5.96)	5.59 (4.55-6.83)	6.74 (5.47-8.24)	7.69 (6.22-9.43)	8.99 (7.06-11.2)	9.99 (7.70-12.6)	11.0 (8.24-14.0)	12.0 (8.70-15.6)	13.3 (9.36-17.6)	14.3 (9.86-19.1)
15-min	3.97 (3.24-4.85)	4.54 (3.70-5.55)	5.48 (4.45-6.70)	6.25 (5.05-7.66)	7.31 (5.74-9.12)	8.12 (6.26-10.2)	8.93 (6.70-11.4)	9.75 (7.07-12.7)	10.8 (7.61-14.3)	11.6 (8.02-15.6)
30-min	3.03 (2.47-3.70)	3.49 (2.84-4.26)	4.23 (3.44-5.18)	4.85 (3.92-5.94)	5.68 (4.46-7.08)	6.32 (4.87-7.94)	6.95 (5.21-8.87)	7.58 (5.50-9.84)	8.42 (5.91-11.1)	9.04 (6.22-12.1)
60-min	2.02 (1.65-2.47)	2.33 (1.90-2.84)	2.84 (2.31-3.47)	3.28 (2.65-4.02)	3.92 (3.10-4.93)	4.43 (3.43-5.61)	4.96 (3.74-6.38)	5.52 (4.02-7.21)	6.29 (4.43-8.35)	6.89 (4.74-9.21)
2-hr	1.27 (1.04-1.53)	1.45 (1.19-1.76)	1.78 (1.46-2.16)	2.07 (1.69-2.52)	2.50 (2.00-3.13)	2.85 (2.23-3.59)	3.23 (2.45-4.13)	3.63 (2.66-4.71)	4.19 (2.97-5.53)	4.63 (3.21-6.15)
3-hr	0.941 (0.777-1.13)	1.08 (0.891-1.30)	1.33 (1.09-1.60)	1.56 (1.28-1.89)	1.91 (1.54-2.39)	2.20 (1.73-2.77)	2.52 (1.93-3.22)	2.86 (2.11-3.72)	3.35 (2.40-4.42)	3.75 (2.61-4.96)
6-hr	0.559 (0.466-0.668)	0.647 (0.538-0.772)	0.807 (0.669-0.965)	0.956 (0.789-1.15)	1.18 (0.964-1.48)	1.38 (1.10-1.73)	1.59 (1.23-2.02)	1.83 (1.36-2.36)	2.16 (1.55-2.83)	2.43 (1.70-3.19)
12-hr	0.326 (0.273-0.385)	0.382 (0.321-0.453)	0.484 (0.404-0.574)	0.576 (0.479-0.685)	0.715 (0.584-0.882)	0.832 (0.664-1.03)	0.957 (0.742-1.20)	1.09 (0.817-1.40)	1.28 (0.929-1.67)	1.44 (1.01-1.88)
24-hr	0.190 (0.161-0.223)	0.226 (0.191-0.265)	0.287 (0.242-0.337)	0.341 (0.286-0.402)	0.422 (0.346-0.514)	0.488 (0.392-0.598)	0.558 (0.435-0.694)	0.632 (0.476-0.801)	0.737 (0.536-0.951)	0.820 (0.582-1.06)
2-day	0.110	0.130	0.164	0.195	0.239	0.276	0.314	0.354	0.411	0.455

Precipitation Frequency Data Server

	(0.093-0.127)	(0.110-0.151)	(0.140-0.192)	(0.165-0.228)	(0.198-0.289)	(0.223-0.335)	(0.246-0.387)	(0.268-0.445)	(0.300-0.525)	(0.325-0.586)
3-day	0.078 (0.067-0.091)	0.093 (0.079-0.107)	0.116 (0.100-0.136)	0.139 (0.118-0.162)	0.171 (0.142-0.205)	0.197 (0.160-0.237)	0.223 (0.176-0.274)	0.252 (0.191-0.315)	0.291 (0.214-0.371)	0.322 (0.231-0.413)
4-day	0.062 (0.053-0.072)	0.073 (0.063-0.085)	0.093 (0.079-0.107)	0.110 (0.094-0.127)	0.134 (0.112-0.160)	0.154 (0.126-0.186)	0.175 (0.138-0.214)	0.197 (0.150-0.246)	0.228 (0.168-0.289)	0.252 (0.181-0.322)
7-day	0.041 (0.036-0.047)	0.043 (0.041-0.055)	0.059 (0.051-0.068)	0.069 (0.059-0.080)	0.084 (0.070-0.100)	0.096 (0.079-0.115)	0.109 (0.087-0.132)	0.122 (0.094-0.152)	0.141 (0.105-0.179)	0.156 (0.113-0.199)
10-day	0.033 (0.028-0.037)	0.037 (0.032-0.043)	0.046 (0.039-0.052)	0.053 (0.045-0.060)	0.063 (0.053-0.075)	0.072 (0.059-0.086)	0.081 (0.065-0.099)	0.091 (0.070-0.113)	0.105 (0.078-0.132)	0.116 (0.084-0.147)
20-day	0.022 (0.019-0.025)	0.025 (0.022-0.028)	0.029 (0.026-0.033)	0.034 (0.029-0.038)	0.039 (0.033-0.046)	0.044 (0.036-0.052)	0.049 (0.039-0.058)	0.054 (0.041-0.066)	0.060 (0.045-0.076)	0.066 (0.048-0.083)
30-day	0.018 (0.016-0.020)	0.020 (0.017-0.022)	0.024 (0.021-0.026)	0.027 (0.023-0.030)	0.031 (0.026-0.035)	0.034 (0.028-0.040)	0.037 (0.030-0.044)	0.041 (0.031-0.049)	0.045 (0.034-0.056)	0.048 (0.035-0.061)
45-day	0.014 (0.013-0.016)	0.016 (0.014-0.018)	0.019 (0.017-0.021)	0.021 (0.019-0.024)	0.024 (0.021-0.028)	0.027 (0.022-0.031)	0.029 (0.023-0.034)	0.031 (0.024-0.038)	0.034 (0.026-0.042)	0.036 (0.027-0.045)
60-day	0.012 (0.011-0.014)	0.014 (0.012-0.015)	0.016 (0.014-0.018)	0.018 (0.016-0.020)	0.021 (0.018-0.024)	0.023 (0.019-0.026)	0.024 (0.020-0.029)	0.026 (0.020-0.032)	0.028 (0.021-0.035)	0.030 (0.022-0.037)

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