

FAVERO'S LEGACY
2200 SOUTH 3900 WEST
UNINCORPORATED WEBER COUNTY, UTAH 84401
STORM WATER STUDY
Project No. 02N302
9-23-2016

General Site Information:

The proposed Favero's Legacy site is located on the southeast corner of 2200 South 3900 West to the west of Ogden in Unincorporated Weber County, Utah. Construction will include a new residential development, serving a total of 9 lots, sidewalks, curb and gutter, underground utilities, and landscaped areas when completed. Landscaped common areas will be constructed along the west side of the development.

Storm water from the site will be collected in inlet boxes and catch basins throughout the site and along the adjacent roadways and will continue via storm drain to outfall locations along 2200 South Street. Storm water will be detained in detention ponding areas located in each drainage area of the site. The site is allowed a unit-release of 0.1 cfs per acre for the 10-yr storm into the existing storm drainage system in 2200 South Street and will continue westerly along 2200 South Street in a historical fashion. The attached figure shows the project site and location of storm water outfalls. Detention calculations have been provided for the site. (See attached figure and calculations).

The study area is broken up into 2 drainage areas (labeled A-1 and A-2). A runoff coefficient of 0.15 is used for natural ground and landscaped areas. A runoff coefficient of 0.90 is used for asphalt, concrete, buildings, and other hard surfaced areas. An average runoff coefficient of 0.49 was calculated for A-1 and 0.38 for A-2. This yields a coefficient of 0.40 for the study area as a whole.

Times of concentration are calculated using the FAA method assuming flow resistance coefficients of $K=0.35$ for landscape and $K=0.91$ for hardscape for each of the areas. The times of concentration are about 19 and 24 minutes respectively for areas A-1 and A-2. These times are based on the hydraulically longest drainage path inside each respective drainage area over grass or other vegetation, asphalt, concrete, and/or through a pipeline as applicable. Times calculated to be less than 5 minutes should be rounded to 5 minutes when using this method. Rainfall Intensities were taken from the NOAA website for pipe sizing and detention requirements. The values obtained were interpolated as necessary. A copy of these data is attached.

Data showing area information, runoff coefficient, time of concentration, peak flow, and required detention for the site are also provided and can be found in the attached calculations.

Pipe Sizes:

Storm water pipes in the project are proposed to be polyvinylchloride pipes (PVC), concrete pipe (CP), and/or reinforced concrete pipe (RCP). All pipes in the project are sloped to provide the design capacity while maintaining a minimum scour speed of at least 2 feet per second when the pipes are flowing at least half full. The pipes and inlet boxes have sufficient capacity to convey the 10-year storm without surcharging.

Orifice Plate:

An orifice plate will be used at each detention facility to control the rate that storm water flows from the project. They will be located at the junction boxes at nodes 3 and 5 (See attached figure). They have been assigned node numbers 101 and 102 in order to model the flows up- and down-stream of the orifice plate. The orifice plate opening will be sized in order to utilize the pond capacities during a 10-yr storm with a release rate of 0.1 cfs/ac. The orifice plate will allow small flows to pass through without detention. As the rate of storm water into the pipes and detention facility increases, the orifice plate will restrict the flow. The maximum flow through the plate will occur when the detention basin reaches the maximum design depth. A detail of the orifice plate can be found in the construction documents for this project.

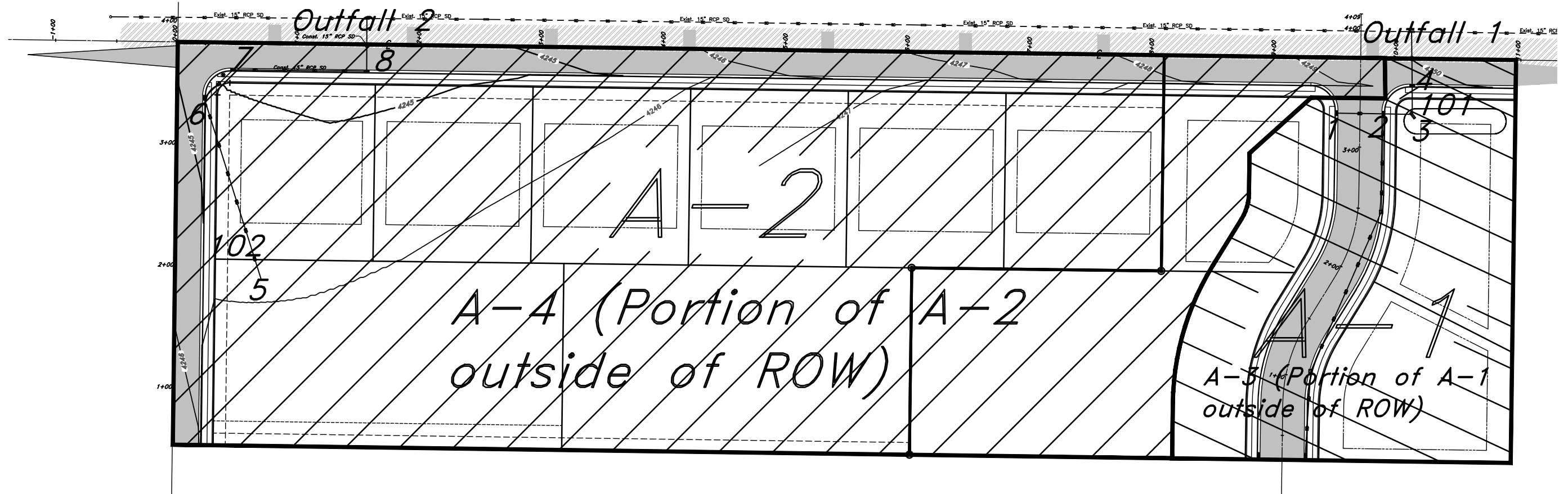
Required Detention:

The required detention for the 10-year storm with a release rate of 0.1 cfs/acre is 1,822 cubic feet for A-1 and 3,369 cubic feet for A-2. Note that these volumes do not account for areas within the public right of ways on 2200 South Street or 3900 West Street. Volume will be provided to meet these requirements. In the event the detention facility experiences a storm larger than the design storm water will then spill out onto 2200 South Street and continue westerly in a historical fashion.

Great Basin Engineering, Inc.

Prepared by Ryan Bingham, P.E.





Storm Water Study

Storm Water Calculations
 Favero's Legacy
 2200 S 3900 W Weber County, UT
 02N302-SWS.dwg

9/23/2016

2 Detained Areas

Hardscape C =	0.90
Landscape C =	0.15

	Zone 1 (ft ²)
Avg. lot size	18481
Avg. home size	4000
Avg. patio/driveway size	2500
C =	0.414

Drainage Areas	Total Area (acres)	Category Runoff Coefficients		Area (acres)	Category Runoff Coefficients		C
		0.775	0.763		0.200	0.414	
		66' Road Area (acres)	60' Road Area (acres)		Common Area (acres)	Zone 1 Area (acres)	
Σ Det. Areas	8.302	1.054	0.428		3.000	3.820	0.400
Σ All Areas	8.302	1.054	0.428		3.000	3.820	0.400
A-1	1.744	0.082	0.428		0.220	1.015	0.489
A-2	6.558	0.973	0.000		2.780	2.806	0.377

Time of Concentration--use FAA Method

For FAA Method, use K's of..

K = 0.35 for landscape
 K = 0.91 for hardscape

$$t_c = \frac{1.8(1.1 - K)\sqrt{L}}{\sqrt[3]{S}}$$

Assume Pipe Flow is at 2 ft/s Scour Speed

**Note: S is in percent, 5 min is smallest allowed Tc

Area	Length on Landscape (ft)	Slope of Landscape (%)	Time on Landscape (min.)	Length on Hardscape (ft)	Slope of Hardscape (%)	Time on Hardscape (min.)	Length in Pipe (ft)	Time in Pipe (min.)	TC for entire Area (min.)
A-1	125.00	2.00	11.98	131.00	1.00	3.91	316.00	2.63	18.53
A-2	214.00	2.00	15.67	527.00	1.00	7.85	22.00	0.18	23.71

Rainfall Intensities
Data From NOAA

10-Year Storm Intensities

The equations used for the 10-Year Storm Intensities were found using the attached Rainfall data as well as Interpolated data where applicable.

Storm Intensities		
AREA	Tc (minutes)	I (10-yr.) (in./hr.)
A-1	18.5	1.82
A-2	23.7	1.58

Peak Flow Information
Use Rational Method
10-Year Storm Intensities

$$Q=CIA$$

AREA	C	I10 (in./hr.)
A-1	0.489	1.825
A-2	0.377	1.580

Peak Flows	
Σ detained =	5.46
A (acres)	Q (10-yr.) (cfs)
1.74	1.56
6.56	3.90

Node Inlet Requirements

Size pipes for 10 year storm

Area	Node #	% of Total	Q (cfs)
A-1	1	40.0%	0.62
A-1	2	40.0%	0.62
A-1	3	12.0%	0.19
A-1	4	8.0%	0.12
A-1	101	-81.3%	(1.27)
A-2	5	77.0%	3.01
A-2	6	5.0%	0.20
A-2	7	3.0%	0.12
A-2	8	15.0%	0.59
A-2	102	-62.7%	(2.45)

PIPE FLOWS

Upstream Node	Downstream node	Pipe Flow (cfs)
1	2	0.62
2	3	1.25
3	101	1.43
4	Outfall 1	0.29
5	102	3.01
6	7	0.75
7	8	0.87
8	Outfall 2	1.46
101	4	0.17
102	6	0.56

Options for Pipe Sizes Between the Specified Nodes

Up Stream Node	Dn Stream Node	Q (cfs)	Pipe Size (in)	Design Min Slope (%)	Area (ft ²)	Rh (ft)	Manning's n	Scour Min. Slope (%)	First Trial Pipe Size
1	2	0.62	15	0.009%	1.227	0.313	0.013	0.150%	15
		0.62	18	0.004%	1.767	0.375	0.013	0.120%	
		0.62	24	0.001%	3.142	0.500	0.013	0.080%	
2	3	1.25	15	0.037%	1.227	0.313	0.013	0.150%	15
		1.25	18	0.014%	1.767	0.375	0.013	0.120%	
		1.25	24	0.003%	3.142	0.500	0.013	0.080%	
3	101	1.43	15	0.049%	1.227	0.313	0.013	0.150%	15
		1.43	18	0.019%	1.767	0.375	0.013	0.120%	
		1.43	24	0.004%	3.142	0.500	0.013	0.080%	
4	Outfall 1	0.29	15	0.002%	1.227	0.313	0.013	0.150%	15
		0.29	18	0.001%	1.767	0.375	0.013	0.120%	
		0.29	24	0.000%	3.142	0.500	0.013	0.080%	
5	102	3.01	15	0.217%	1.227	0.313	0.013	0.150%	15
		3.01	18	0.082%	1.767	0.375	0.013	0.120%	
		3.01	24	0.018%	3.142	0.500	0.013	0.080%	
6	7	0.75	15	0.014%	1.227	0.313	0.013	0.150%	15
		0.75	18	0.005%	1.767	0.375	0.013	0.120%	
		0.75	24	0.001%	3.142	0.500	0.013	0.080%	
7	8	0.87	15	0.018%	1.227	0.313	0.013	0.150%	15
		0.87	18	0.007%	1.767	0.375	0.013	0.120%	
		0.87	24	0.001%	3.142	0.500	0.013	0.080%	
8	Outfall 2	1.46	15	0.051%	1.227	0.313	0.013	0.150%	15
		1.46	18	0.019%	1.767	0.375	0.013	0.120%	
		1.46	24	0.004%	3.142	0.500	0.013	0.080%	
101	4	0.17	15	0.001%	1.227	0.313	0.013	0.150%	15
		0.17	18	0.000%	1.767	0.375	0.013	0.120%	
		0.17	24	0.000%	3.142	0.500	0.013	0.080%	
102	6	0.56	15	0.007%	1.227	0.313	0.013	0.150%	15
		0.56	18	0.003%	1.767	0.375	0.013	0.120%	
		0.56	24	0.001%	3.142	0.500	0.013	0.080%	

Favero's Legacy

Detention Facility serving A-1 areas outside ROW.

C = 0.48 Remaining Unit Discharge = 0.100 cfs/acre
 Area = 1.66 acres Release through Restriction = 0.166 cfs

Detention Pond Sized For The 10 Year Storm

Time min	Rainfall Intensity in./hr.	Accumulated Volume (CF)	Allowable Release (CF)	Needed Detention (CF)
5	3.25	770	50	720
10	2.47	1171	100	1071
15	2.04	1451	150	1301
20	1.74	1645	200	1446
25	1.53	1809	249	1560
30	1.37	1948	299	1649
35	1.26	2083	349	1734
40	1.14	2167	399	1768
45	1.05	2239	449	1790
50	0.97	2299	499	1800
55	0.90	2356	549	1808
60	0.85	2420	599	1822
90	0.62	2632	898	1734
120	0.49	2787	1197	1590
180	0.36	3029	1796	1233
360	0.23	3840	3592	248
720	0.14	4847	7183	-2336
1440	0.09	5802	14366	-8564

<- Req. De

Required Storage Volume = 1822 ft³

Favero's Legacy

Detention Facility serving A-2 areas outside ROW.

C = **0.31** Remaining Unit Discharge = **0.100** cfs/acre
 Area = **5.59** acres Release through Restriction = **0.559** cfs

Detention Pond Sized For The **10** Year Storm

Time min	Rainfall Intensity in./hr.	Accumulated Volume (CF)	Allowable Release (CF)	Needed Detention (CF)
5	3.25	1674	168	1506
10	2.47	2544	335	2209
15	2.04	3152	503	2649
20	1.74	3575	670	2905
25	1.53	3931	838	3093
30	1.37	4234	1005	3228
35	1.26	4527	1173	3355
40	1.14	4709	1340	3369
45	1.05	4866	1508	3358
50	0.97	4996	1676	3320
55	0.90	5120	1843	3277
60	0.85	5260	2011	3249
90	0.62	5719	3016	2703
120	0.49	6057	4021	2036
180	0.36	6582	6032	550
360	0.23	8344	12064	-3720
720	0.14	10532	24128	-13596
1440	0.09	12608	48256	-35647

<- Req. De

Required Storage Volume = **3369** ft³



NOAA Atlas 14, Volume 1, Version 5
Location name: Ogden, Utah, USA*
Latitude: 41.227°, Longitude: -112.079°
Elevation: 4239.39 ft**
 * source: ESRI Maps
 ** source: USGS



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/hour)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.51 (0.996-1.75)	1.90 (1.68-2.21)	2.59 (2.27-3.01)	3.25 (2.82-3.78)	4.32 (3.66-5.06)	5.32 (4.36-6.31)	6.52 (5.16-7.81)	7.94 (6.05-9.71)	10.2 (7.37-12.9)	12.4 (8.47-16.0)
10-min	1.15 (0.926-1.33)	1.45 (1.27-1.68)	1.97 (1.73-2.29)	2.47 (2.15-2.88)	3.29 (2.79-3.85)	4.05 (3.32-4.80)	4.96 (3.92-5.95)	6.04 (4.60-7.39)	7.79 (5.60-9.84)	9.43 (6.44-12.2)
15-min	0.952 (0.824-1.10)	1.19 (1.05-1.39)	1.63 (1.43-1.89)	2.04 (1.78-2.38)	2.72 (2.30-3.18)	3.34 (2.74-3.96)	4.10 (3.24-4.91)	4.99 (3.80-6.11)	6.44 (4.63-8.13)	7.79 (5.32-10.1)
30-min	0.640 (0.554-0.740)	0.804 (0.710-0.934)	1.10 (0.962-1.28)	1.37 (1.19-1.60)	1.83 (1.55-2.14)	2.25 (1.85-2.67)	2.76 (2.18-3.31)	3.36 (2.56-4.11)	4.34 (3.12-5.47)	5.25 (3.59-6.77)
60-min	0.396 (0.343-0.458)	0.497 (0.439-0.578)	0.679 (0.595-0.789)	0.851 (0.739-0.991)	1.13 (0.959-1.33)	1.39 (1.14-1.65)	1.71 (1.35-2.05)	2.08 (1.59-2.55)	2.68 (1.93-3.39)	3.25 (2.22-4.19)
2-hr	0.248 (0.220-0.284)	0.312 (0.276-0.356)	0.402 (0.354-0.460)	0.490 (0.426-0.562)	0.636 (0.542-0.738)	0.770 (0.640-0.906)	0.930 (0.746-1.11)	1.12 (0.866-1.37)	1.43 (1.04-1.80)	1.71 (1.19-2.21)
3-hr	0.194 (0.174-0.218)	0.239 (0.214-0.270)	0.299 (0.267-0.337)	0.355 (0.315-0.401)	0.445 (0.388-0.508)	0.529 (0.452-0.612)	0.635 (0.527-0.746)	0.761 (0.610-0.914)	0.966 (0.736-1.21)	1.15 (0.843-1.49)
6-hr	0.132 (0.121-0.145)	0.161 (0.146-0.178)	0.194 (0.176-0.215)	0.225 (0.202-0.249)	0.271 (0.241-0.303)	0.310 (0.272-0.350)	0.354 (0.306-0.405)	0.404 (0.341-0.469)	0.507 (0.413-0.614)	0.600 (0.473-0.752)
12-hr	0.084 (0.077-0.091)	0.102 (0.094-0.111)	0.123 (0.113-0.135)	0.142 (0.129-0.155)	0.169 (0.153-0.187)	0.192 (0.171-0.214)	0.216 (0.189-0.244)	0.243 (0.208-0.278)	0.284 (0.235-0.333)	0.317 (0.256-0.380)
24-hr	0.051 (0.047-0.055)	0.063 (0.058-0.068)	0.075 (0.069-0.081)	0.085 (0.079-0.092)	0.099 (0.091-0.107)	0.109 (0.101-0.118)	0.120 (0.110-0.130)	0.131 (0.120-0.142)	0.146 (0.132-0.169)	0.161 (0.141-0.193)
2-day	0.030 (0.028-0.032)	0.036 (0.034-0.039)	0.043 (0.040-0.046)	0.049 (0.045-0.052)	0.056 (0.052-0.060)	0.062 (0.057-0.066)	0.068 (0.062-0.073)	0.073 (0.067-0.079)	0.081 (0.074-0.087)	0.086 (0.078-0.097)
3-day	0.022 (0.020-0.023)	0.026 (0.024-0.028)	0.031 (0.029-0.034)	0.035 (0.033-0.038)	0.041 (0.038-0.044)	0.045 (0.042-0.049)	0.050 (0.046-0.053)	0.054 (0.049-0.058)	0.060 (0.054-0.065)	0.064 (0.058-0.071)
4-day	0.017 (0.016-0.019)	0.021 (0.020-0.023)	0.025 (0.024-0.027)	0.029 (0.027-0.031)	0.033 (0.031-0.036)	0.037 (0.034-0.040)	0.041 (0.037-0.044)	0.044 (0.041-0.048)	0.049 (0.045-0.053)	0.053 (0.048-0.058)
7-day	0.012 (0.011-0.013)	0.014 (0.013-0.016)	0.017 (0.016-0.018)	0.019 (0.018-0.021)	0.022 (0.021-0.024)	0.025 (0.023-0.026)	0.027 (0.025-0.029)	0.029 (0.027-0.031)	0.032 (0.029-0.035)	0.034 (0.031-0.037)
10-day	0.009 (0.009-0.010)	0.011 (0.011-0.012)	0.013 (0.013-0.014)	0.015 (0.014-0.016)	0.017 (0.016-0.019)	0.019 (0.018-0.020)	0.020 (0.019-0.022)	0.022 (0.020-0.024)	0.024 (0.022-0.026)	0.025 (0.023-0.027)
20-day	0.006 (0.006-0.006)	0.007 (0.007-0.008)	0.009 (0.008-0.009)	0.010 (0.009-0.010)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.013 (0.012-0.013)	0.013 (0.012-0.014)	0.014 (0.013-0.015)	0.015 (0.014-0.016)
30-day	0.005 (0.004-0.005)	0.006 (0.005-0.006)	0.007 (0.006-0.007)	0.008 (0.007-0.008)	0.009 (0.008-0.009)	0.009 (0.009-0.010)	0.010 (0.009-0.011)	0.010 (0.010-0.011)	0.011 (0.010-0.012)	0.012 (0.011-0.013)
45-day	0.004 (0.004-0.004)	0.005 (0.004-0.005)	0.006 (0.005-0.006)	0.006 (0.006-0.007)	0.007 (0.007-0.007)	0.007 (0.007-0.008)	0.008 (0.007-0.008)	0.008 (0.008-0.009)	0.009 (0.008-0.010)	0.009 (0.009-0.010)
60-day	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.005 (0.005-0.005)	0.005 (0.005-0.006)	0.006 (0.006-0.007)	0.007 (0.006-0.007)	0.007 (0.007-0.008)	0.007 (0.007-0.008)	0.008 (0.007-0.008)	0.008 (0.008-0.009)

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