

GRANT TRUCKING TRUCK MAINTENANCE SHOP
910 WEST 24TH STREET
OGDEN, UTAH 84401
STORM WATER STUDY
Project No. 15N231
8-18-2016

General Site Information:

The proposed maintenance shop site is located at 910 West 24th Street along the east side of Interstate 15 in Ogden, Utah. Construction will consist of a new commercial building, gravel parking lots, and concrete paving with underground utilities when completed.

Storm water from the site will be collected in inlet boxes and catch basins and will continue via storm drain to the northwest end of the site. Storm water will be retained in an existing retention pond located at that end of the site. The attached figure shows the project site and location of the pond. Retention 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 0.68 was calculated for A-1 and 0.72 for A-2. This yields a coefficient of 0.71 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 10 and 13 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.

Required Detention:

The required retention for the 100-year storm is 19,165 cubic feet for the entire study area. This retention volume is calculated without percolation or evaporation. The existing retention pond will be expanded as needed to provide the design volume of 19,710 cubic feet. In the event the retention facility experiences a storm larger than the design storm water will then spill out into a stream along the west perimeter of the site and continue westerly in a historical fashion.



Great Basin Engineering, Inc.

Prepared by Devin Marie Lujan, E.I.T.

A handwritten signature in blue ink, appearing to read 'D. Lujan'.

Reviewed by Ryan Bingham, P.E.

A handwritten signature in blue ink, appearing to read 'R. Bingham'.



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CONSULTANTS

STAMP



**GRANT TRUCKING
TRUCK
MAINTENANCE SHOP**

910 W 24th STREET
OGDEN, UTAH 84401

MARK DATE DESCRIPTION

ISSUE DATE: AUG 28, 2015
PROJECT NO: 15460
CAD DWG FILE:
DRAWN BY:
CHK'D BY:

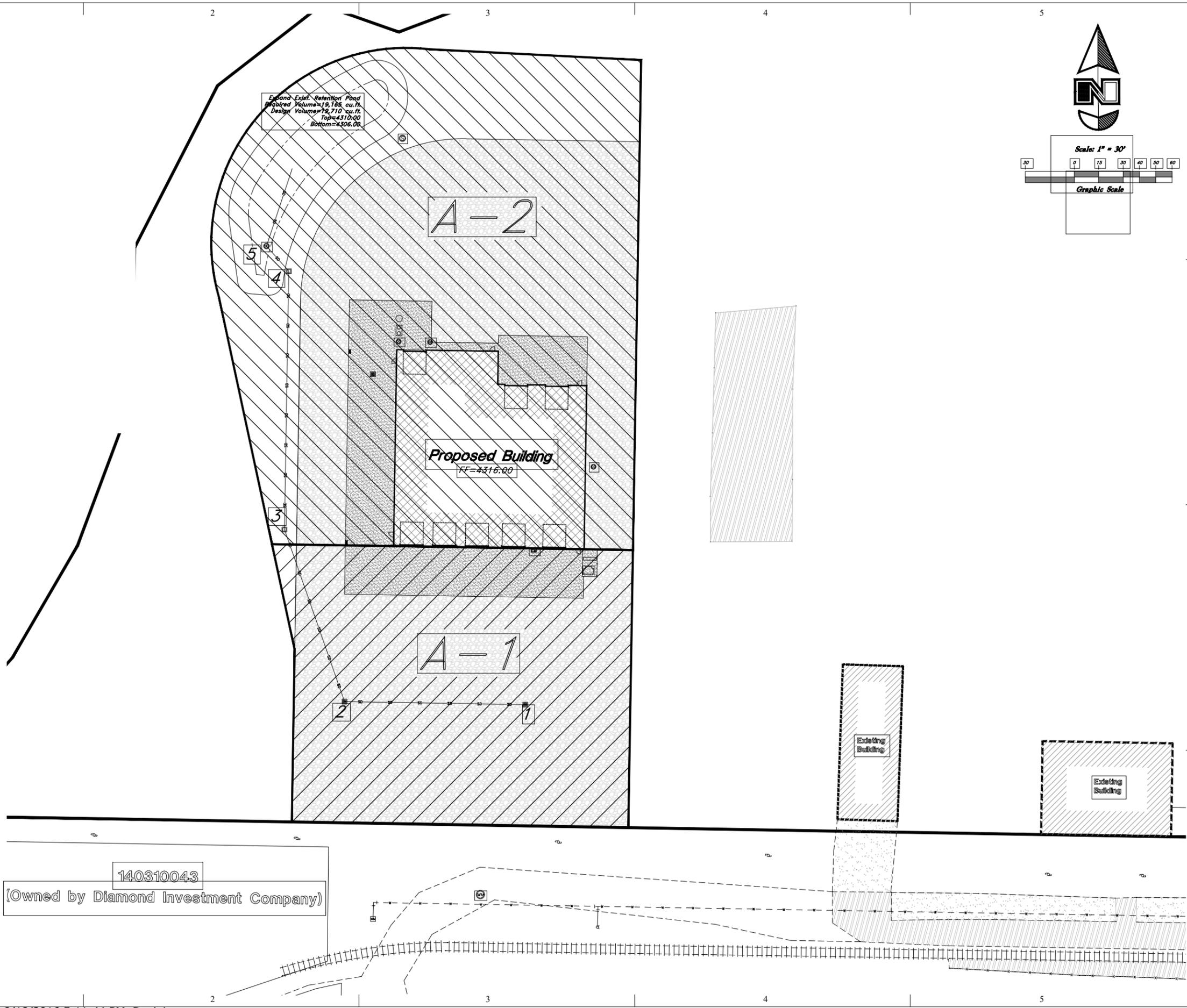
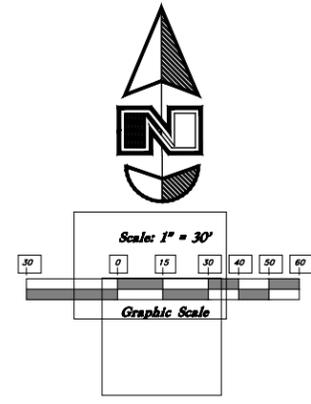
REVIEW SET
NOV 05, 2015

SHEET TITLE

Storm Water Study

SHEET NO:

SWS



Expand-Exist. Retention Pond
Required Volume=19,185 cu.ft.
Design Volume=19,710 cu.ft.
Top=4310.00
Bottom=4306.00

A-2

Proposed Building
KF=4316.00

A-1

140310043

(Owned by Diamond Investment Company)

Legend

(Note: All items may not appear on drawing)

- San. Sewer Manhole
- Water Manhole
- Storm Drain Manhole
- Cleanout
- Electrical Manhole
- Catch Basins
- Exist. Fire Hydrant
- Fire Hydrant
- Exist. Water Valve
- Water Valve
- Sanitary Sewer
- Culinary Water
- Gas Line
- Irrigation Line
- Storm Drain
- Telephone Line
- Secondary Waterline
- Power Line
- Fire Line
- Land Drain
- Power pole
- Power pole w/guy
- Light Pole
- Fence
- Flowline of ditch
- Overhead Power line
- Corrugated Metal Pipe
- Concrete Pipe
- Reinforced Concrete Pipe
- Ductile Iron
- Polyvinyl Chloride
- Top of Asphalt
- Edge of Asphalt
- Centerline
- Flowline
- Finish Floor
- Top of Curb
- Top of Wall
- Top of Walk
- Top of Concrete
- Natural Ground
- Finish Grade
- Match Existing
- Fire Department Connection
- Finish Contour
- Exist. Contour
- Finish Grade
- Exist. Grade
- Ridge Line
- Direction of Flow

- Existing Asphalt
- New Asphalt
- Heavy Duty Asphalt
- Existing Concrete
- New Concrete
- Spill Curb & Gutter
- Demo Tree

IF SHEET IS LESS THAN 22" x 34"
IT IS A REDUCED PRINT.
REDUCE SCALE ACCORDINGLY

Storm Water Calculations
 Grant Trucking Truck Maintenance Shop
 910 West 24th Street, Ogden UT
 15N231-S1-SWS.dwg

8/18/2016

2 Detained Areas

Hardscape C = 0.90
 Landscape C = 0.15

Drainage Areas	Total Area (ft ²)	Total Area (acres)	Hardscape Area (ft ²)	Hardscape Area (acres)	Landscape Area (ft ²)	Landscape Area (acres)	C
Σ Det. Areas	108584	2.493	80530	1.849	28054	0.644	0.706
Σ All Areas	108584	2.493	80530	1.849	28054	0.644	0.706
A-1	35584	0.817	25232	0.579	10352	0.238	0.682
A-2	73000	1.676	55298	1.269	17702	0.406	0.718

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	30.00	1.70	6.20	60.00	1.70	2.22	216.00	1.80	10.22
A-2	65.00	2.00	8.64	233.00	2.00	4.14	0.00	0.00	12.78

Rainfall Intensities
Data From NOAA

10-Year and 100-Year Intensities

The equations used for the 10-Year and 100-Year 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.)	I (100-yr.) (in./hr.)
A-1	10.2	2.52	5.04
A-2	12.8	2.30	4.59

Peak Flow Information
 Use Rational Method
 10-Year and 100-Year Intensities

Q=CIA

					Peak Flows	
Σ detained =					4.17	8.33
AREA	C	I10 (in./hr.)	I100 (in./hr.)	A (acres)	Q (10-yr.) (cfs)	Q (100-yr.) (cfs)
A-1	0.682	2.521	5.042	0.82	1.40	2.81
A-2	0.718	2.295	4.590	1.68	2.76	5.52

Node Inlet Requirements

Size pipes for **10** year storm

Area	Node #	% of Total	Q (cfs)
A-1	1	60.0%	0.84
A-1	2	40.0%	0.56
A-2	3	0.0%	0.00
A-2	4	0.0%	0.00
A-2	5	100.0%	2.76

PIPE FLOWS

Upstream Node	Downstream node	Pipe Flow (cfs)
1	2	0.84
2	3	1.40
3	4	1.40
4	5	1.40
5	Outfall	4.17

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	0.84	6	1.614%	0.196	0.125	0.011	1.000%	8
			8	0.348%	0.349	0.167	0.011	0.400%	
			10	0.106%	0.545	0.208	0.011	0.280%	
2	3	1.40	6	4.483%	0.196	0.125	0.011	1.000%	10
			8	0.967%	0.349	0.167	0.011	0.400%	
			10	0.294%	0.545	0.208	0.011	0.280%	
3	4	1.40	6	4.483%	0.196	0.125	0.011	1.000%	10
			8	0.967%	0.349	0.167	0.011	0.400%	
			10	0.294%	0.545	0.208	0.011	0.280%	
4	5	1.40	6	4.483%	0.196	0.125	0.011	1.000%	10
			8	0.967%	0.349	0.167	0.011	0.400%	
			10	0.294%	0.545	0.208	0.011	0.280%	
5	Outfall	4.17	12	1.367%	0.785	0.250	0.013	0.200%	15
			15	0.416%	1.227	0.313	0.013	0.150%	
			18	0.157%	1.767	0.375	0.013	0.120%	

GRANT TRUCKING

Retention Volume without Percolation

100-yr 24-hr Storm

C	=	0.71
i	=	0.126 in/hr
A	=	2.49 acres
t	=	86400 seconds

V	=	19165 cubic feet
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POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaik, 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	1.55 (1.36-1.79)	1.94 (1.73-2.26)	2.66 (2.34-3.07)	3.34 (2.89-3.86)	4.43 (3.76-5.17)	5.46 (4.48-6.44)	6.68 (5.29-7.98)	8.14 (6.20-9.95)	10.5 (7.55-13.3)	12.7 (8.68-16.4)
10-min	1.18 (1.03-1.36)	1.48 (1.31-1.72)	2.02 (1.78-2.35)	2.54 (2.20-2.94)	3.37 (2.86-3.93)	4.15 (3.40-4.90)	5.08 (4.02-6.08)	6.20 (4.72-7.57)	8.00 (5.74-10.1)	9.68 (6.61-12.5)
15-min	0.976 (0.848-1.13)	1.22 (1.08-1.42)	1.68 (1.47-1.94)	2.10 (1.82-2.43)	2.79 (2.36-3.25)	3.43 (2.81-4.05)	4.20 (3.32-5.02)	5.12 (3.90-6.25)	6.61 (4.75-8.34)	8.00 (5.46-10.3)
30-min	0.656 (0.572-0.758)	0.826 (0.730-0.956)	1.13 (0.988-1.30)	1.41 (1.23-1.64)	1.88 (1.59-2.19)	2.31 (1.89-2.73)	2.83 (2.24-3.38)	3.45 (2.63-4.21)	4.45 (3.20-5.62)	5.39 (3.67-6.96)
60-min	0.407 (0.354-0.469)	0.511 (0.451-0.592)	0.697 (0.612-0.806)	0.875 (0.759-1.01)	1.16 (0.984-1.35)	1.43 (1.17-1.69)	1.75 (1.39-2.09)	2.13 (1.63-2.61)	2.75 (1.98-3.48)	3.34 (2.27-4.31)
2-hr	0.258 (0.228-0.296)	0.324 (0.287-0.370)	0.416 (0.368-0.478)	0.506 (0.440-0.582)	0.658 (0.560-0.766)	0.795 (0.662-0.938)	0.960 (0.771-1.15)	1.16 (0.894-1.42)	1.48 (1.07-1.87)	1.77 (1.22-2.29)
3-hr	0.201 (0.181-0.226)	0.248 (0.222-0.279)	0.309 (0.277-0.348)	0.366 (0.325-0.413)	0.458 (0.400-0.523)	0.544 (0.465-0.629)	0.654 (0.544-0.771)	0.784 (0.630-0.956)	0.996 (0.759-1.26)	1.19 (0.870-1.54)
6-hr	0.137 (0.125-0.151)	0.167 (0.152-0.184)	0.201 (0.182-0.222)	0.232 (0.208-0.257)	0.279 (0.248-0.312)	0.319 (0.280-0.360)	0.364 (0.314-0.416)	0.414 (0.348-0.482)	0.520 (0.422-0.637)	0.616 (0.485-0.781)
12-hr	0.087 (0.080-0.094)	0.106 (0.098-0.115)	0.127 (0.117-0.139)	0.146 (0.133-0.160)	0.175 (0.158-0.193)	0.198 (0.177-0.221)	0.224 (0.196-0.252)	0.251 (0.215-0.288)	0.292 (0.243-0.344)	0.326 (0.264-0.391)
24-hr	0.054 (0.050-0.058)	0.066 (0.061-0.071)	0.078 (0.073-0.084)	0.089 (0.083-0.095)	0.103 (0.096-0.111)	0.114 (0.106-0.123)	0.126 (0.116-0.135)	0.137 (0.126-0.148)	0.153 (0.139-0.174)	0.165 (0.148-0.198)
2-day	0.031 (0.029-0.033)	0.038 (0.036-0.041)	0.045 (0.042-0.048)	0.051 (0.048-0.055)	0.059 (0.055-0.063)	0.065 (0.061-0.070)	0.071 (0.066-0.076)	0.077 (0.071-0.083)	0.085 (0.078-0.092)	0.092 (0.083-0.100)
3-day	0.023 (0.021-0.024)	0.028 (0.026-0.030)	0.033 (0.031-0.035)	0.037 (0.035-0.040)	0.043 (0.040-0.046)	0.048 (0.044-0.051)	0.052 (0.049-0.056)	0.057 (0.053-0.061)	0.063 (0.058-0.068)	0.068 (0.062-0.074)
4-day	0.018 (0.017-0.020)	0.022 (0.021-0.024)	0.027 (0.025-0.029)	0.030 (0.028-0.032)	0.035 (0.033-0.038)	0.039 (0.036-0.042)	0.043 (0.040-0.046)	0.047 (0.043-0.051)	0.052 (0.048-0.057)	0.056 (0.051-0.061)
7-day	0.012 (0.012-0.013)	0.015 (0.014-0.016)	0.018 (0.017-0.019)	0.020 (0.019-0.022)	0.024 (0.022-0.025)	0.026 (0.024-0.028)	0.029 (0.027-0.031)	0.031 (0.029-0.034)	0.034 (0.032-0.037)	0.037 (0.034-0.040)
10-day	0.010 (0.009-0.011)	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.016 (0.015-0.017)	0.018 (0.017-0.020)	0.020 (0.019-0.021)	0.022 (0.020-0.023)	0.024 (0.022-0.025)	0.026 (0.024-0.028)	0.027 (0.025-0.029)
20-day	0.006 (0.006-0.007)	0.008 (0.007-0.008)	0.009 (0.009-0.010)	0.010 (0.010-0.011)	0.012 (0.011-0.012)	0.013 (0.012-0.013)	0.014 (0.013-0.014)	0.014 (0.013-0.015)	0.015 (0.014-0.017)	0.016 (0.015-0.017)
30-day	0.005 (0.005-0.005)	0.006 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.009 (0.009-0.010)	0.010 (0.009-0.011)	0.011 (0.010-0.011)	0.011 (0.011-0.012)	0.012 (0.011-0.013)	0.013 (0.012-0.014)
45-day	0.004 (0.004-0.004)	0.005 (0.005-0.005)	0.006 (0.006-0.006)	0.007 (0.006-0.007)	0.008 (0.007-0.008)	0.008 (0.008-0.009)	0.009 (0.008-0.009)	0.009 (0.009-0.010)	0.010 (0.009-0.011)	0.010 (0.010-0.011)
60-day	0.004 (0.003-0.004)	0.005 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.006-0.006)	0.007 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.007-0.008)	0.008 (0.008-0.009)	0.009 (0.008-0.009)	0.009 (0.008-0.010)

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.

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PF graphical