



Engineering Bulletin 11-02

Subject: Sump Volume Requirements
Application: Kern County Development Standards

Date: December 21, 2011

Background: In 1995, Kern County revised the standard by which retention basin sizing is based, and published it in the latest edition of the Kern County Development Standards dated August 5, 2010. Division 4 of the Development Standards defined the design volume for basins as runoff from the Intermediate Storm Design Discharge (ISDD) 5-day rainfall event from the impervious area. The equation is;

Runoff Volume = 0.12 (D_{10}) (a_i) (Area) where:

D_{10} = 10 yr 24-hr. depth of rainfall (in.)

a_i = average percentage of impervious area

Area = Drainage area of total development

0.12 = 1.44 x 1/12

1.44 = 5 day mass ratio (KC Hydrology Manual, Table B-1)

1/12 = Conversion of rainfall depth in inches to feet

The revision to the standard was chosen for consistency with the newly created multi-day detention basin sizing standard and to approximate the sump sizing criteria used by the City of Bakersfield in their application of 100yr 24hr rainfall event. The new Development Standards also linked ISDD calculations to the application of rainfall/runoff methodology found in the Kern County Hydrology Manual. Since the Hydrology Manual had adopted rainfall data found in NOAA Atlas 2, Volume XI, retention basin sizing was also tied to that data base.

Data Update: In May of 2011 the National Weather Service published NOAA Atlas 14, Volume 6, Version 2.0 for California. As stated in the introduction of the publication, this document supersedes precipitation-frequency estimates found in NOAA Atlas 2, Volume 11 and NOAA Atlas 14 Volume 1, which covered Kern County's desert region. Gage data used in the precipitation-frequency analysis for NOAA Atlas 14, Volume 6 incorporates the latest, quality-verified rainfall information available up through June, 2010. The precipitation-frequency data is now available to the public, via a graphic interface, at the Hydrometeorological Design Studies Center's web site. (<http://hdsc.nws.noaa.gov/hdsc/pfds/>). It contains both short and long duration, including multi-day rainfall data in tabular and graphic formats.

Policy: Retention basin sizing shall continue to be based upon runoff from the ISDD 5 day storm event from impervious area. The equation is now;

Runoff Volume (cu.ft.) = [$(D_{10\text{yr-5day}})/12$] (a_i) (Area) where;

$D_{10\text{-5day}}$ = 10yr 5 day depth of rainfall (in.) obtained from NOAA Atlas 14, Vol 6, Ver. 2.0

a_i = average percentage of impervious area

Area = Drainage area of total development (sq.ft.)

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES

DATA DESCRIPTION

Data type: Units: Time series type:

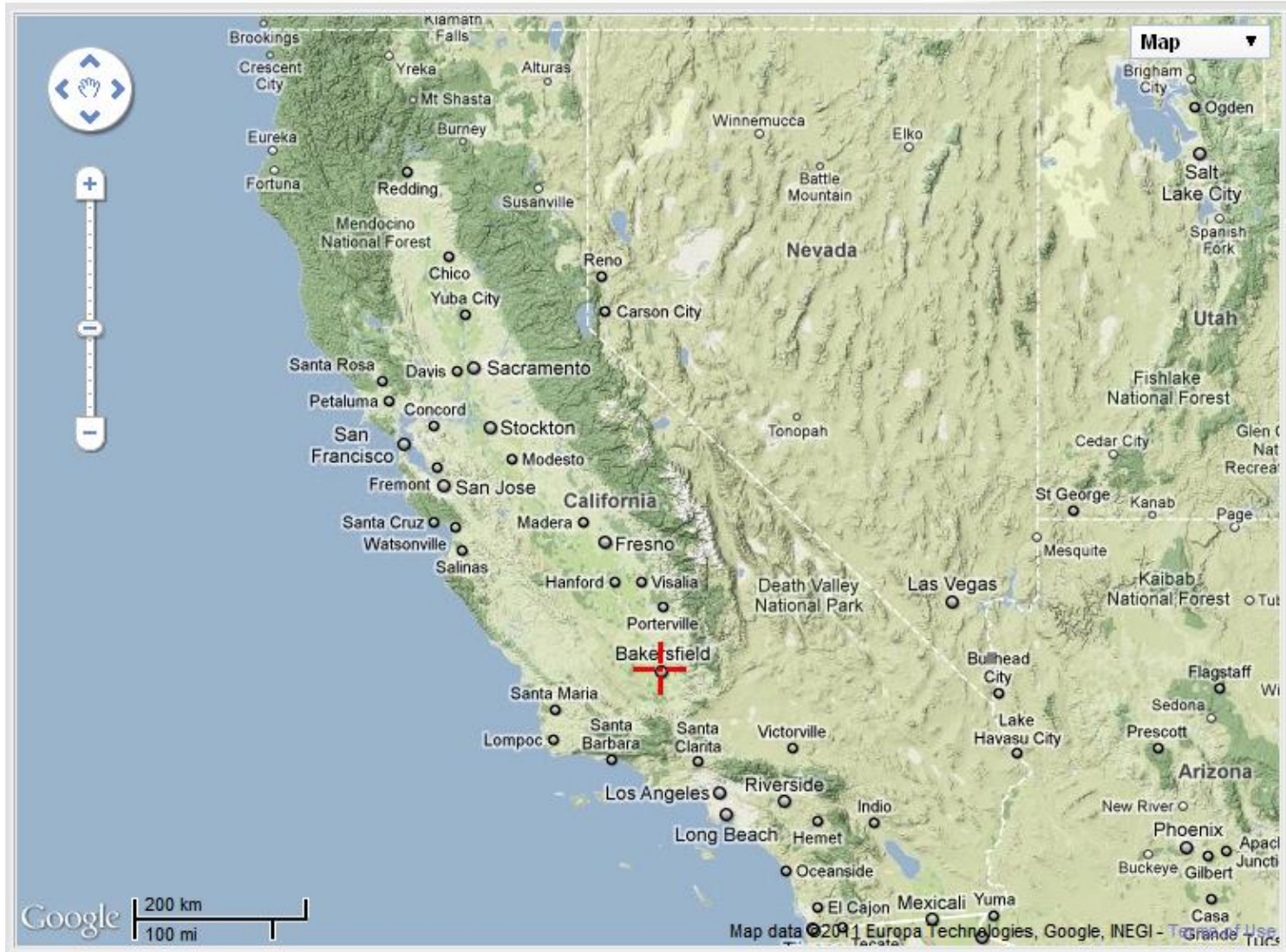
SELECT LOCATION

1. Manually:

a) Enter location (decimal degrees, use "-" for S and W): latitude: longitude:

b) Select station:

2. Use map:





NOAA Atlas 14, Volume 6, Version 2
Location name: Bakersfield, California, US*
Coordinates: 35.3940, -119.0505
Elevation: 404ft*
 * 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 & aeriels](#)

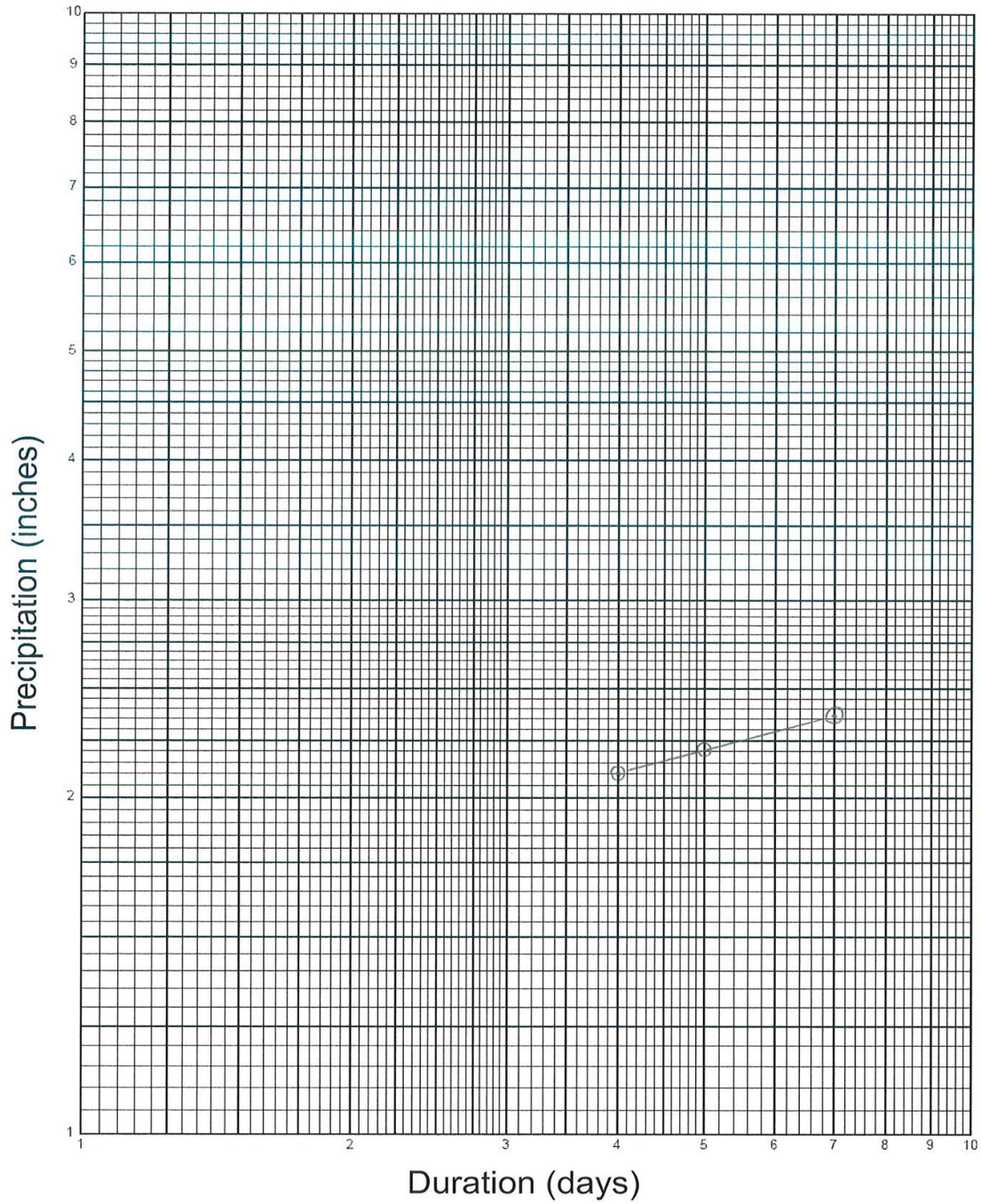
PF tabular

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	0.077 (0.063-0.095)	0.097 (0.080-0.120)	0.127 (0.104-0.158)	0.154 (0.125-0.193)	0.195 (0.153-0.252)	0.230 (0.177-0.303)	0.269 (0.202-0.362)	0.313 (0.229-0.433)	0.421 (0.296-0.607)	0.580 (0.393-0.863)
10-min	0.110 (0.090-0.136)	0.140 (0.114-0.172)	0.183 (0.149-0.226)	0.221 (0.179-0.276)	0.280 (0.220-0.361)	0.330 (0.254-0.434)	0.386 (0.290-0.519)	0.449 (0.328-0.621)	0.604 (0.424-0.870)	0.831 (0.564-1.24)
15-min	0.133 (0.109-0.164)	0.169 (0.138-0.208)	0.221 (0.180-0.273)	0.268 (0.217-0.334)	0.339 (0.266-0.436)	0.399 (0.307-0.525)	0.467 (0.350-0.628)	0.543 (0.397-0.751)	0.731 (0.513-1.05)	1.01 (0.682-1.50)
30-min	0.182 (0.149-0.224)	0.231 (0.189-0.285)	0.302 (0.247-0.374)	0.366 (0.296-0.456)	0.463 (0.363-0.596)	0.546 (0.420-0.717)	0.638 (0.479-0.859)	0.743 (0.542-1.03)	0.999 (0.701-1.44)	1.37 (0.932-2.05)
60-min	0.256 (0.210-0.315)	0.325 (0.266-0.401)	0.425 (0.347-0.526)	0.515 (0.417-0.642)	0.651 (0.511-0.839)	0.768 (0.590-1.01)	0.898 (0.674-1.21)	1.05 (0.763-1.45)	1.41 (0.986-2.02)	1.93 (1.31-2.88)
2-hr	0.354 (0.290-0.437)	0.446 (0.365-0.550)	0.574 (0.468-0.709)	0.684 (0.554-0.853)	0.846 (0.663-1.09)	0.978 (0.752-1.29)	1.12 (0.842-1.51)	1.28 (0.933-1.77)	1.50 (1.05-2.16)	1.95 (1.33-2.91)
3-hr	0.417 (0.342-0.513)	0.524 (0.429-0.647)	0.673 (0.550-0.833)	0.801 (0.649-0.999)	0.985 (0.773-1.27)	1.14 (0.872-1.49)	1.29 (0.971-1.74)	1.47 (1.07-2.03)	1.71 (1.20-2.46)	1.97 (1.34-2.94)
6-hr	0.520 (0.426-0.641)	0.659 (0.540-0.813)	0.850 (0.694-1.05)	1.01 (0.820-1.26)	1.24 (0.976-1.60)	1.43 (1.10-1.88)	1.63 (1.22-2.19)	1.84 (1.34-2.54)	2.14 (1.50-3.08)	2.38 (1.61-3.54)
12-hr	0.606 (0.497-0.747)	0.780 (0.638-0.962)	1.02 (0.836-1.27)	1.24 (1.00-1.54)	1.54 (1.21-1.99)	1.80 (1.38-2.36)	2.07 (1.55-2.78)	2.37 (1.73-3.27)	2.79 (1.96-4.02)	3.15 (2.14-4.69)
24-hr	0.742 (0.676-0.832)	0.966 (0.878-1.08)	1.29 (1.17-1.45)	1.58 (1.42-1.79)	2.01 (1.74-2.37)	2.38 (2.02-2.86)	2.78 (2.30-3.44)	3.24 (2.60-4.12)	3.92 (3.01-5.21)	4.50 (3.33-6.20)
2-day	0.865 (0.787-0.969)	1.12 (1.02-1.26)	1.50 (1.36-1.69)	1.84 (1.65-2.09)	2.36 (2.05-2.78)	2.81 (2.39-3.38)	3.32 (2.74-4.10)	3.90 (3.13-4.96)	4.78 (3.67-6.35)	5.54 (4.10-7.64)
3-day	0.931 (0.847-1.04)	1.20 (1.09-1.35)	1.61 (1.46-1.81)	1.97 (1.77-2.24)	2.53 (2.19-2.98)	3.01 (2.56-3.63)	3.56 (2.94-4.39)	4.18 (3.35-5.31)	5.13 (3.94-6.82)	5.96 (4.41-8.22)
4-day	0.992 (0.903-1.11)	1.28 (1.17-1.44)	1.71 (1.55-1.93)	2.10 (1.88-2.38)	2.68 (2.32-3.15)	3.18 (2.69-3.82)	3.73 (3.08-4.61)	4.36 (3.50-5.54)	5.31 (4.07-7.05)	6.13 (4.54-8.45)
7-day	1.12 (1.02-1.26)	1.46 (1.33-1.64)	1.94 (1.76-2.18)	2.36 (2.12-2.68)	2.97 (2.58-3.50)	3.48 (2.95-4.18)	4.02 (3.32-4.97)	4.62 (3.70-5.87)	5.49 (4.21-7.29)	6.21 (4.59-8.56)
10-day	1.22 (1.11-1.37)	1.59 (1.45-1.78)	2.11 (1.91-2.38)	2.56 (2.30-2.90)	3.19 (2.77-3.76)	3.71 (3.15-4.46)	4.25 (3.52-5.25)	4.84 (3.88-6.15)	5.67 (4.35-7.53)	6.34 (4.69-8.74)
20-day	1.53 (1.39-1.71)	2.01 (1.83-2.26)	2.67 (2.42-3.01)	3.23 (2.90-3.67)	4.01 (3.48-4.72)	4.63 (3.92-5.57)	5.27 (4.35-6.50)	5.93 (4.76-7.55)	6.85 (5.26-9.10)	7.57 (5.60-10.4)
30-day	1.79 (1.63-2.01)	2.37 (2.15-2.66)	3.15 (2.86-3.55)	3.81 (3.42-4.33)	4.73 (4.11-5.57)	5.46 (4.63-6.57)	6.21 (5.13-7.67)	6.99 (5.60-8.89)	8.05 (6.18-10.7)	8.87 (6.57-12.2)
45-day	2.20 (2.00-2.47)	2.90 (2.64-3.26)	3.86 (3.50-4.35)	4.67 (4.19-5.30)	5.80 (5.03-6.83)	6.70 (5.68-8.06)	7.62 (6.29-9.40)	8.57 (6.87-10.9)	9.87 (7.58-13.1)	10.9 (8.05-15.0)
60-day	2.52 (2.30-2.83)	3.32 (3.02-3.72)	4.41 (3.99-4.96)	5.33 (4.78-6.05)	6.62 (5.74-7.79)	7.64 (6.48-9.19)	8.70 (7.19-10.7)	9.78 (7.85-12.4)	11.3 (8.65-15.0)	12.4 (9.19-17.1)

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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- 6) Select 10yr 4day rainfall depth – **2.10** and 10yr 7 day rainfall depth – **2.36**
7) Plot points on log-log graph paper.



- 8) Read the solution for the 10 yr 5 day depth of rainfall– **2.20 inches**

9) Sump volume calculation:

$$\begin{aligned}\text{Runoff Volume (cu.ft.)} &= [(D_{10\text{yr-5day}})/12] (a_i) (\text{Area}) \\ &= [(2.20)/12](0.95)(1.00 \text{ ac.} \times 43560 \text{ sq.ft./ac}) \\ &= 7,586.7 \text{ cu.ft or } 7,590 \text{ cu.ft.}\end{aligned}$$