TXHYETO.XLS: A Tool To Facilitate Use of Texas-Specific Hyetographs for Design Storm Modeling

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Outline

- Overview
- Methods Currently in Use
  - Empirical, Dimensionless Hyetographs (Williams-Sether, 2004)
    - Graphical Method
  - Linear Interpolation
- Proposed Alternative Method
  - Distribution Mixture Model

Overview

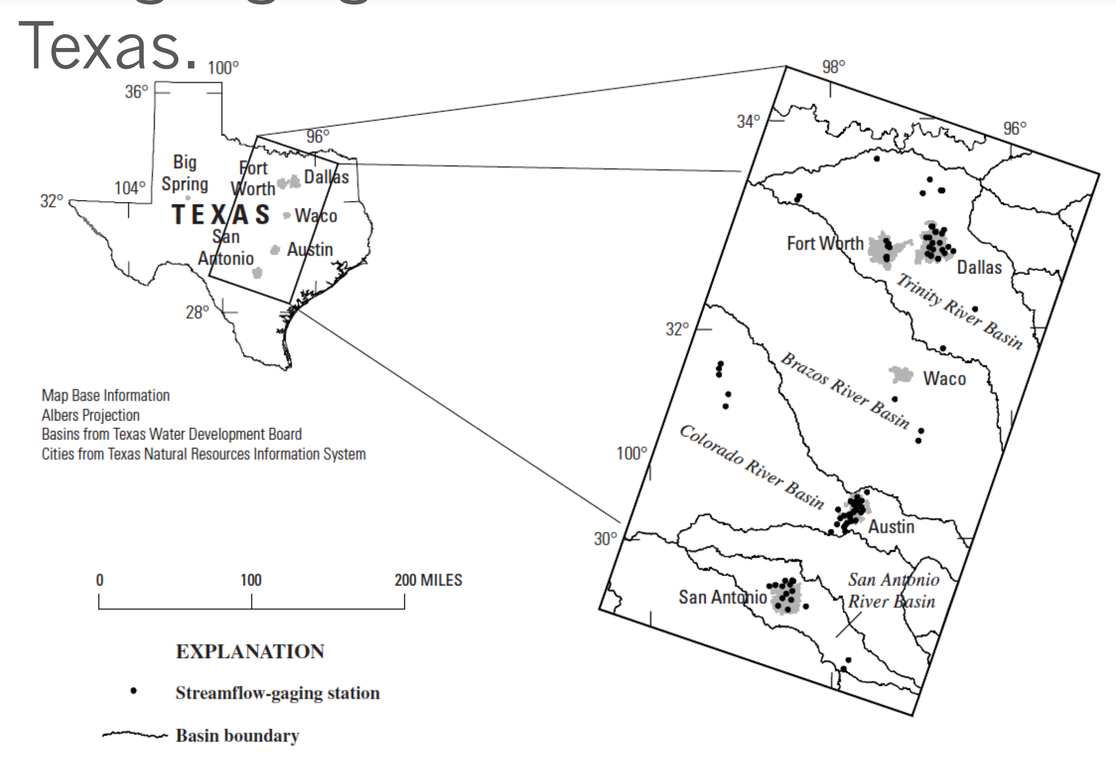
- Empirical, Dimensionless, Cumulative Rainfall Hyetographs Developed for Selected Watersheds in Texas
- The graphical method for dimensional modeling found using the Texas Dimensionless Hyetographs is widely used but is limited with small or non-incremental time steps
- Two methods of interpolation were explored
  - Linear interpolation
  - Distribution-mixture function
- TXHYETO.XLS, a provisional tool, was created

Texas Dimensionless Hyetographs

- Texas-specific storm hyetographs were reported in Williams-Sether et. al. (2004) as a design storm tool for use in drainage design
- These hyetographs are limited because of difficulty in "dimensionalizing" the tabulated hyetograph values for use in hydrologic software (SWMM/HECHMS)
- Difficulties in dimensionalizing is two-fold
  - Tabulated values must be rescaled into dimensional values
  - Dimensionalized tabulation time intervals may not correspond to the time intervals of interest

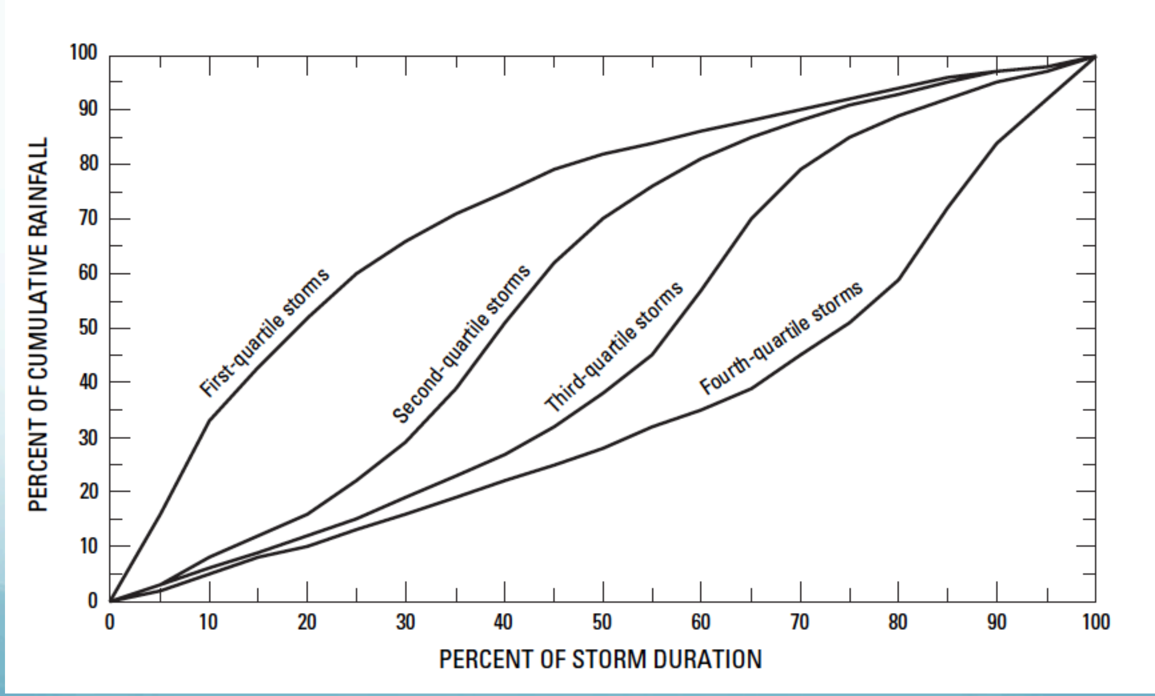
Texas Dimensionless Hyetographs

- Williams-Sether et. al. (2004) analyzed data from over 1,600 runoff-producing storms at 91 USGS streamflow-gauging stations in North and South Central Texas.

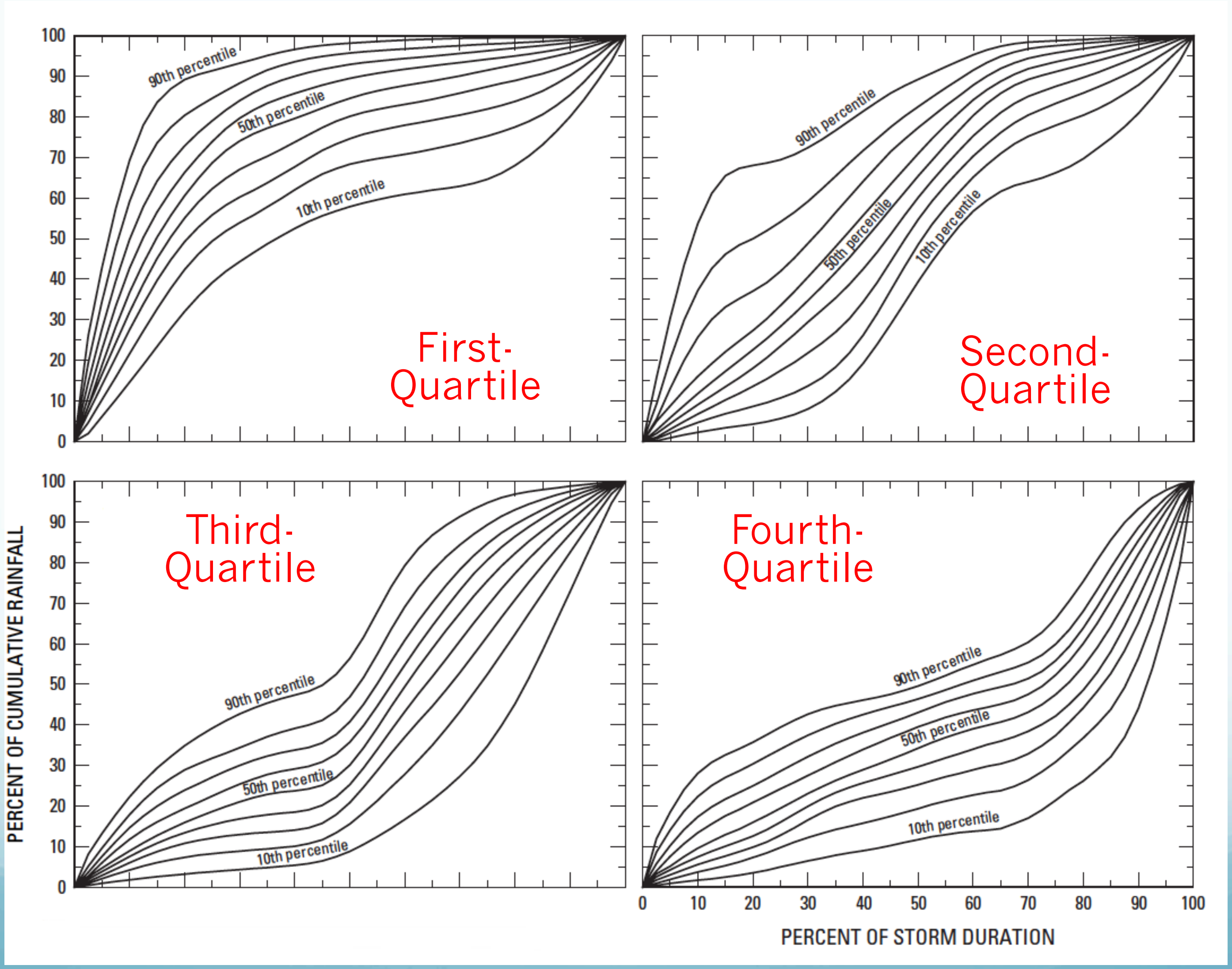


Texas Dimensionless Hyetographs

- They developed empirical, dimensionless, cumulative-rainfall hyetographs.
- Storm-quartile classifications were determined using Huff 1967, and 1990 type classification



Texas Dimensionless Hyetographs



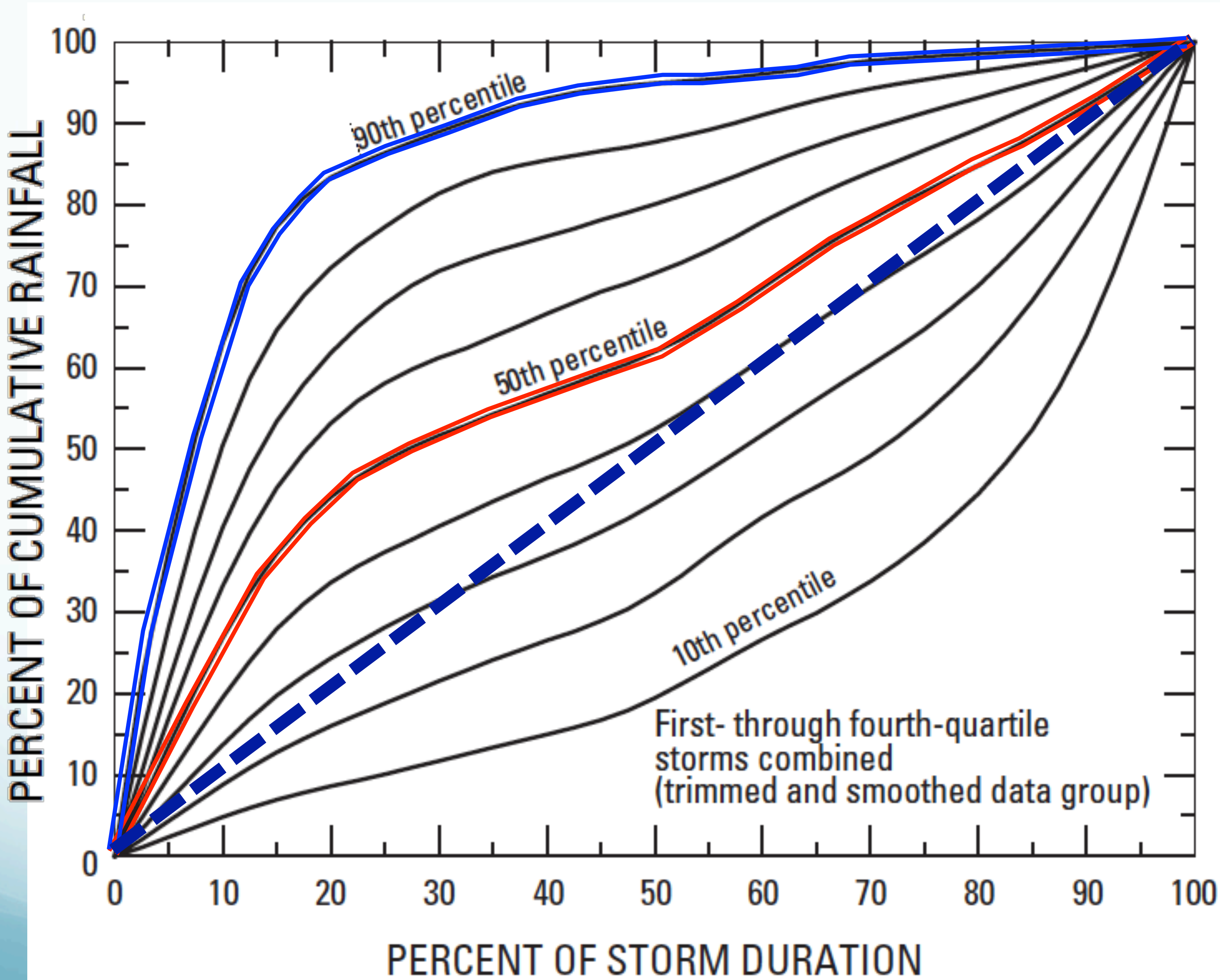
Texas Dimensionless Hyetographs

- A combined dimensionless family of envelopes was produced
- Presented in both graphical and tabular form.
- Used to estimate distributions of rainfall with time for Texas watersheds drainage areas of <160 mi^2.

Supplement 5. Trimmed and smoothed percentiles for empirical hyetograph analysis, 1959–86.—Continued

[The interval is the center of the percent-of-storm-duration interval; --, no data]

Interval	Percentile										
	10th	20th	25th	30th	40th	50th	60th	70th	75th	80th	90th
					First- through fourth-quartile storms combined; storm duration 0 to 72 hours						
2.5	1.08	2.04	2.58	3.34	4.69	6.37	7.81	10.30	12.16	14.66	21.60
5.0	2.35	4.32	5.47	6.84	9.74	13.58	16.97	21.38	24.48	28.12	37.57
7.5	3.59	6.56	8.32	10.27	14.68	20.49	25.56	31.57	35.63	40.20	51.55
10.0	4.82	8.78	11.16	13.68	19.47	26.83	33.19	40.38	45.16	50.47	63.04
12.5	5.92	10.85	13.80	16.85	23.94	32.42	39.68	47.57	52.72	58.62	71.66
15.0	6.92	12.77	16.23	19.72	27.91	37.21	45.23	53.41	58.54	64.61	77.38
17.5	7.80	14.43	18.29	22.14	31.01	41.00	49.56	57.96	62.97	68.83	80.89
20.0	8.60	15.99	20.23	24.32	33.59	44.11	53.16	61.80	66.74	72.25	83.32
22.5	9.31	17.38	21.89	26.21	35.63	46.55	55.92	65.02	69.84	74.94	85.01
25.0	10.06	18.75	23.51	28.07	37.35	48.54	58.09	67.80	72.62	77.28	86.35
27.5	10.87	20.11	25.00	29.79	38.88	50.23	59.80	70.07	75.06	79.47	87.66
30.0	11.70	21.51	26.51	31.41	40.52	51.68	61.22	71.87	76.92	81.38	88.96
32.5	12.51	22.77	27.81	32.85	42.01	52.90	62.34	73.12	78.10	82.81	90.18
35.0	13.35	24.09	29.22	34.30	43.56	54.27	63.76	74.21	79.02	84.02	91.29
37.5	14.16	25.27	30.47	35.54	44.99	55.49	65.16	75.15	79.64	84.83	92.25
40.0	14.96	26.51	31.85	36.89	46.42	56.80	66.62	76.11	80.22	85.47	93.05
42.5	15.78	27.58	33.21	38.24	47.68	58.03	67.98	77.06	80.86	86.03	93.72
45.0	16.71	28.90	34.80	39.80	49.13	59.31	69.33	78.12	81.72	86.61	94.24
47.5	17.89	30.35	36.44	41.44	50.66	60.49	70.35	79.07	82.56	87.09	94.64
50.0	19.41	32.28	38.33	43.33	52.45	61.97	71.60	80.06	83.51	87.72	94.92
52.5	21.16	34.45	40.32	45.28	54.39	63.51	72.89	81.15	84.53	88.42	95.18
55.0	22.94	36.99	42.49	47.39	56.57	65.39	74.37	82.30	85.61	89.20	95.40
57.5	24.82	39.38	44.67	49.56	58.80	67.56	76.05	83.52	86.75	90.06	95.70
60.0	26.62	41.64	46.83	51.75	61.09	69.85	77.89	84.82	88.01	91.04	96.06
62.5	28.29	43.62	49.00	53.94	63.38	72.11	79.55	86.10	89.22	91.97	96.47
65.0	29.86	45.38	50.95	56.07	65.59	74.32	81.14	87.25	90.31	92.83	96.90
67.5	31.76	47.16	52.88	58.23	67.77	76.38	82.65	88.36	91.31	93.60	97.32
70.0	33.75	49.16	54.81	60.32	69.87	78.21	84.02	89.37	92.17	94.27	97.68
72.5	36.00	51.52	56.94	62.47	71.97	80.00	85.35	90.35	92.90	94.84	97.97
75.0	38.51	54.15	59.24	64.72	73.98	81.61	86.69	91.30	93.55	95.38	98.19
77.5	41.45	57.17	62.09	67.30	76.10	83.25	88.02	92.25	94.20	95.89	98.38
80.0	44.54	60.42	65.22	70.08	78.24	84.84	89.34	93.15	94.86	96.39	98.56
82.5	48.24	64.13	68.85	73.31	80.60	86.54	90.72	94.08	95.54	96.87	98.72
85.0	52.41	68.26	72.78	76.77	83.07	88.30	92.09	94.98	96.22	97.34	98.90
87.5	57.68	72.90	77.10	80.53	85.81	90.21	93.49	95.87	96.93	97.81	99.09
90.0	64.02	77.90	81.55	84.43	88.65	92.18	94.92	96.75	97.61	98.28	99.29
92.5	71.71	83.28	86.22	88.48	91.66	94.22	96.37	97.65	98.29	98.75	99.49
95.0	80.43	88.80	90.85	92.47	94.62	96.21	97.81	98.54	98.96	99.22	99.70
97.5	90.01	94.42	95.53	96.53	97.64	98.21	99.26	99.44	99.65	99.70	99.92

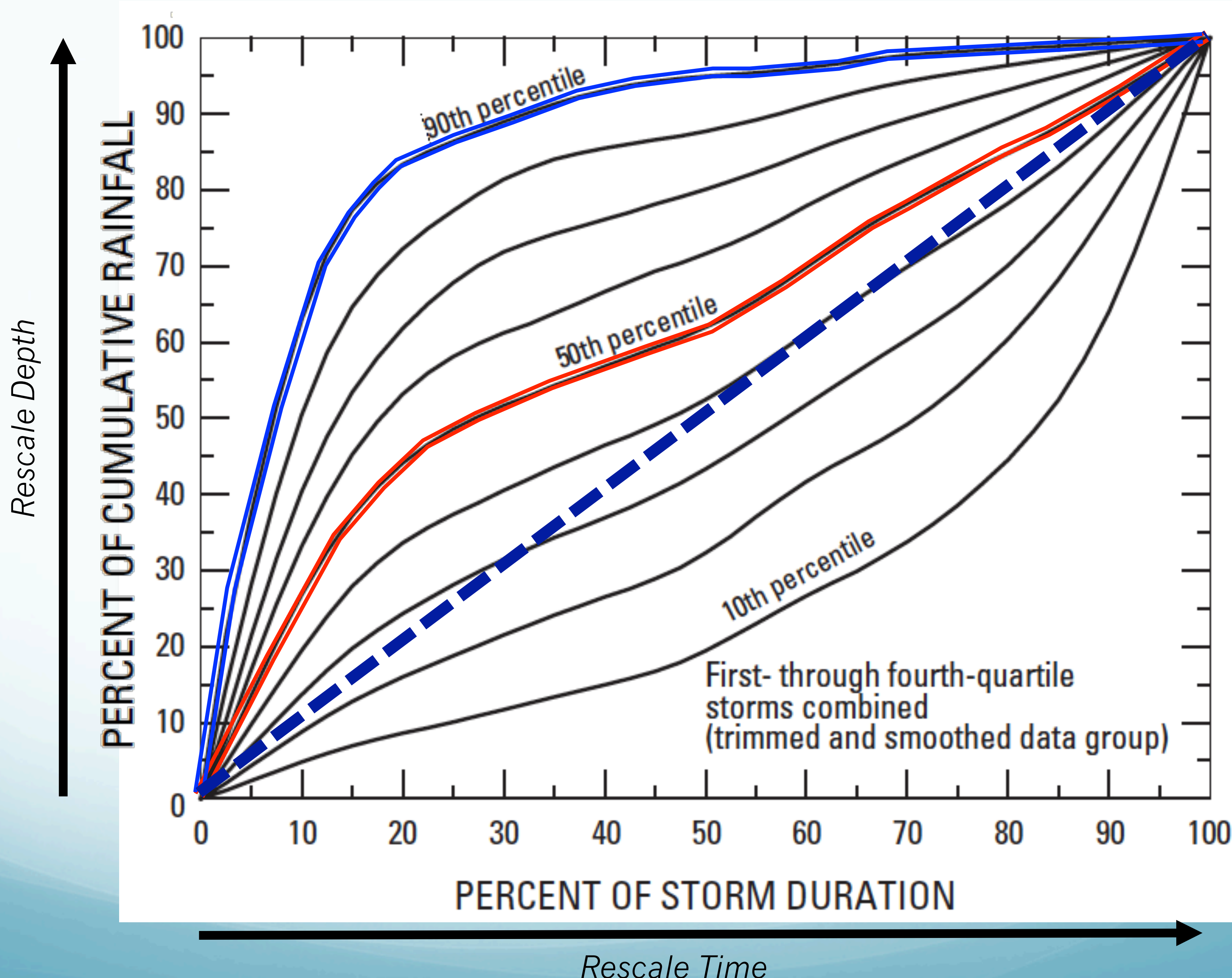

PERCENT OF CUMULATIVE RAINFALL
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
PERCENT OF STORM DURATION
90th percentile
50th percentile
10th percentile
First- through fourth-quartile
storms combined
(trimmed and smoothed data group)

Dimensionalization

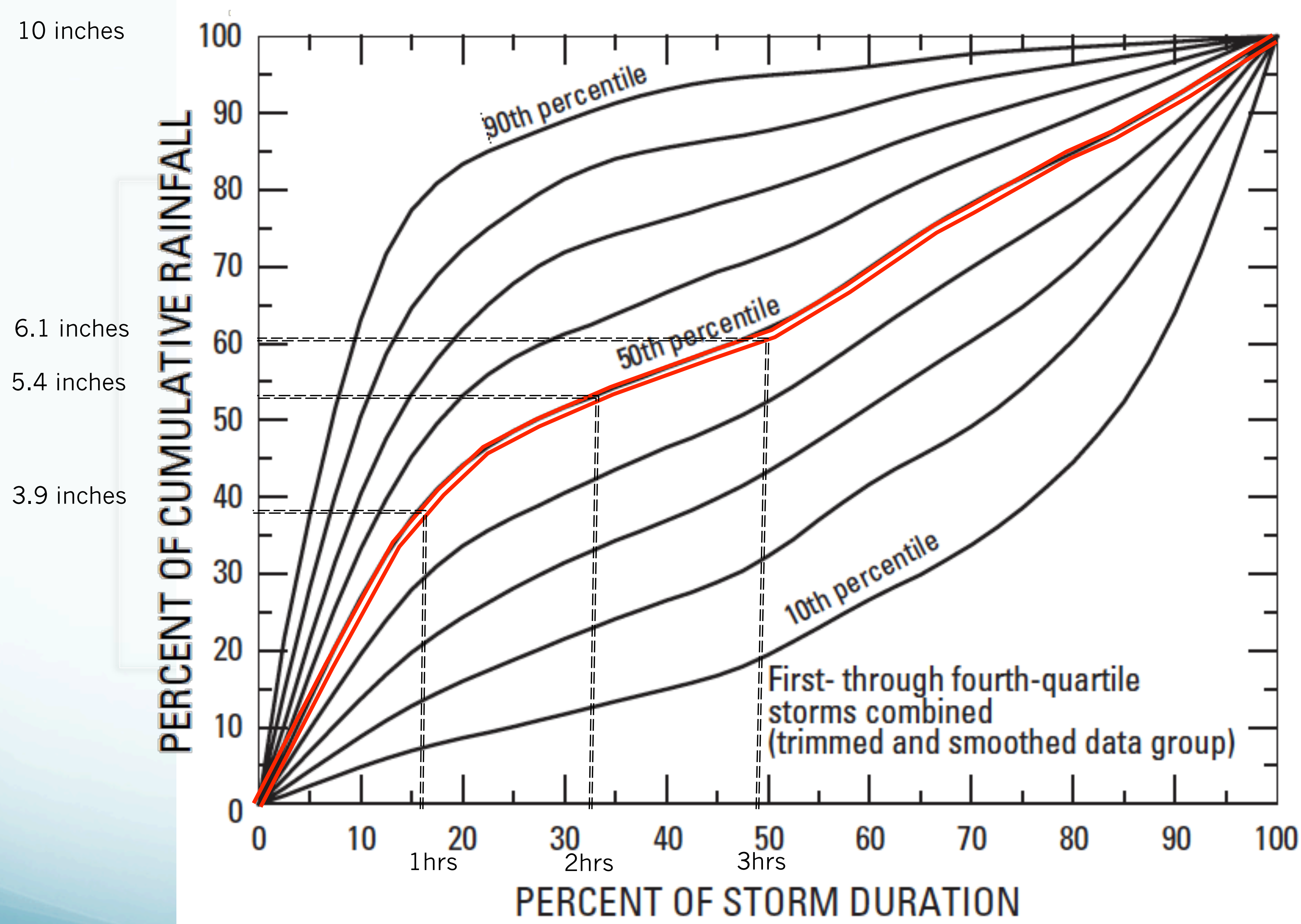
- Requires the user to rescale the time and percent cumulative rainfall into actual durations and total storm depth.
- Engineer must determine the depth for a particular duration
  - Various of tools to do this in Texas:
    - Asquith and Roussel (2004) and Asquith (1998) (DDF Atlas)
    - Frederick et. Al (1997)
    - Hershfield (1961) (TP-40)
    - EBDLKUP-NEW (a campanion product for this project)
  - Examples of tools elsewhere:
    - NOAA Atlas 14

Example of Rescaling Axes

- Example
  - Suppose a 4% chance (25 year) , 6 hour storm in Texas has an anticipated depth of 10 inches
    - After rescaling, the horizontal axis would range from 0 to 6 hours
    - After rescaling, the vertical axis would range from 0 to 10 inches



Rescale Depth
PERCENT OF CUMULATIVE RAINFALL
100
90
80
70
60
50
40
30
20
10
0
90th percentile
50th percentile
10th percentile
First- through fourth-quartile
storms combined
(trimmed and smoothed data group)
0
10
20
30
40
50
60
70
80
90
100
PERCENT OF STORM DURATION
Rescale Time



10 inches
6.1 inches
5.4 inches
3.9 inches
PERCENT OF CUMULATIVE RAINFALL
90th percentile
50th percentile
10th percentile
First- through fourth-quartile storms combined (trimmed and smoothed data group)
1hrs
2hrs
3hrs
PERCENT OF STORM DURATION
0
10
20
30
40
50
60
70
80
90
100

Alternative Method-Linear Interpolation

- An initial alternative method of Linear Interpolation was explored using Excel

- Linear Interpolation takes specified values of depth and duration, rescales them, and exports time and depth for time steps specified by user

Linear Interpolation Methodology

- Input desired duration and depth
- Exports rescaled duration and depth to linear interpolation tab

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1		Spreadsheet to dimensionalize Texas hyetographs															
2																	
3			INPUT:	6	Storm Duration, hours, from DDF Atlas, TP40, or equivalent.												
4			INPUT:	10	Storm Depth , inc	<= From DDF Atlas, TP40, HY35 or equivalent											
5							Percentile Storm										
6		Hours	Minutes	Time(Hrs	Depth (in	%-Durat	10	20	25	30	40	**50**	60	70	75	80	90
7		0	9	0.15	0.637	2.5	1.08	2.04	2.58	3.34	4.69	**6.37**	7.81	10.3	12.16	14.66	21.6
8		0	18	0.3	1.358	5	2.35	4.32	5.47	6.84	9.74	**13.58**	16.97	21.38	24.48	28.12	37.57
9		0	27	0.45	2.049	7.5	3.59	6.56	8.32	10.27	14.68	**20.49**	25.56	31.57	35.63	40.2	51.55
10		0	36	0.6	2.683	10	4.82	8.78	11.16	13.68	19.47	**26.83**	33.19	40.38	45.16	50.47	63.04
11		0	45	0.75	3.242	12.5	5.92	10.85	13.8	16.85	23.94	**32.42**	39.68	47.57	52.72	58.62	71.66
12		0	54	0.9	3.721	15	6.92	12.77	16.23	19.72	27.91	**37.21**	45.23	53.41	58.54	64.61	77.38
13		1	3	1.05	4.1	17.5	7.8	14.43	18.29	22.14	31.01	**41**	49.56	57.96	62.97	68.83	80.89
14		1	12	1.2	4.411	20	8.6	15.99	20.23	24.32	33.59	**44.11**	53.16	61.8	66.74	72.25	83.32
15		1	21	1.35	4.655	22.5	9.31	17.38	21.89	26.21	35.63	**46.55**	55.92	65.02	69.84	74.94	85.01
16		1	30	1.5	4.854	25	10.06	18.75	23.51	28.07	37.35	**48.54**	58.09	67.8	72.62	77.28	86.35
17		1	39	1.65	5.023	27.5	10.87	20.11	25	29.79	38.88	**50.23**	59.8	70.07	75.06	79.47	87.66
18		1	48	1.8	5.168	30	11.7	21.51	26.51	31.41	40.52	**51.68**	61.22	71.87	76.92	81.38	88.96
19		1	57	1.95	5.29	32.5	12.51	22.77	27.81	32.85	42.01	**52.9**	62.34	73.12	78.1	82.81	90.18
20		2	6	2.1	5.427	35	13.35	24.09	29.22	34.3	43.56	**54.27**	63.76	74.21	79.02	84.02	91.29
21		2	15	2.25	5.549	37.5	14.16	25.27	30.47	35.54	44.99	**55.49**	65.16	75.15	79.64	84.83	92.25
22		2	24	2.4	5.68	40	14.96	26.51	31.85	36.89	46.42	**56.8**	66.62	76.11	80.22	85.47	93.05
23		2	33	2.55	5.803	42.5	15.78	27.58	33.21	38.24	47.68	**58.03**	67.98	77.06	80.86	86.03	93.72
24		2	42	2.7	5.931	45	16.71	28.9	34.8	39.8	49.13	**59.31**	69.33	78.12	81.72	86.61	94.24
25		2	51	2.85	6.049	47.5	17.89	30.35	36.44	41.44	50.66	**60.49**	70.35	79.07	82.56	87.09	94.64
26		3	0	3	6.197	50	19.41	32.28	38.33	43.33	52.45	**61.97**	71.6	80.06	83.51	87.72	94.92
27		3	9	3.15	6.351	52.5	21.16	34.45	40.32	45.28	54.39	**63.51**	72.89	81.15	84.53	88.42	95.18
28		3	18	3.3	6.539	55	22.94	36.99	42.49	47.39	56.57	**65.39**	74.37	82.3	85.61	89.2	95.4
29		3	27	3.45	6.756	57.5	24.82	39.38	44.67	49.56	58.8	**67.56**	76.05	83.52	86.75	90.06	95.7
30		3	36	3.6	6.985	60	26.62	41.64	46.83	51.75	61.09	**69.85**	77.89	84.82	88.01	91.04	96.06
31		3	45	3.75	7.211	62.5	28.29	43.62	49	53.94	63.38	**72.11**	79.55	86.1	89.22	91.97	96.47
32		3	54	3.9	7.432	65	29.86	45.38	50.95	56.07	65.59	**74.32**	81.14	87.25	90.31	92.83	96.9
33		4	3	4.05	7.638	67.5	31.76	47.16	52.88	58.23	67.77	**76.38**	82.65	88.36	91.31	93.6	97.32
34		4	12	4.2	7.821	70	33.75	49.16	54.81	60.32	69.87	**78.21**	84.02	89.37	92.17	94.27	97.68
35		4	21	4.35	8	72.5	36	51.52	56.94	62.47	71.97	**80**	85.35	90.35	92.9	94.84	97.97
36		4	30	4.5	8.161	75	38.51	54.15	59.24	64.72	73.98	**81.61**	86.69	91.3	93.55	95.38	98.19
37		4	39	4.65	8.325	77.5	41.45	57.17	62.09	67.3	76.1	**83.25**	88.02	92.25	94.2	95.89	98.38
38		4	48	4.8	8.484	80	44.54	60.42	65.22	70.08	78.24	**84.84**	89.34	93.15	94.86	96.39	98.56
39		4	57	4.95	8.654	82.5	48.24	64.13	68.85	73.31	80.6	**86.54**	90.72	94.08	95.54	96.87	98.72
40		5	6	5.1	8.83	85	52.41	68.26	72.78	76.77	83.07	**88.3**	92.09	94.98	96.22	97.34	98.9
41		5	15	5.25	9.021	87.5	57.68	72.9	77.1	80.53	85.81	**90.21**	93.49	95.87	96.93	97.81	99.09
42		5	24	5.4	9.218	90	64.02	77.9	81.55	84.43	88.65	**92.18**	94.92	96.75	97.61	98.28	99.29
43		5	33	5.55	9.422	92.5	71.71	83.28	86.22	88.48	91.66	**94.22**	96.37	97.65	98.29	98.75	99.49
44		5	42	5.7	9.621	95	80.43	88.8	90.85	92.47	94.62	**96.21**	97.81	98.54	98.96	99.22	99.7
45		5	51	5.85	9.821	97.5	90.01	94.42	95.53	96.53	97.64	**98.21**	99.26	99.44	99.65	99.7	99.92
46																	

Methodology

- User chooses desired time step
- Reprogramming is necessary for different time steps

	A	B	C	D	E	F	G	H	I	J	K
1	Interpolated Hyetograph				Interpolation Points based on Time in A3 to A+Max				Dimensional Hyetograph (from Tables)		
2	Time(min)	Time(hrs)	Depth(in)		T-low	T-high	D-low	D-high	Time(Hrs)	Depth (in)	
3	0	0.00	0.00		0	0.15	0	0.637	0	0	
4	15	0.25	1.12		0.15	0.3	0.637	1.358	0.150	0.637	
5	30	0.50	2.26		0.45	0.6	2.049	2.683	0.300	1.358	
6	45	0.75	3.24		0.75	0.9	3.242	3.721	0.450	2.049	
7	60	1.00	3.97		0.9	1.05	3.721	4.1	0.600	2.683	
8	75	1.25	4.49		1.2	1.35	4.411	4.655	0.750	3.242	
9	90	1.50	4.85		1.5	1.65	4.854	5.023	0.900	3.721	
10	105	1.75	5.12		1.65	1.8	5.023	5.168	1.050	4.1	
11	120	2.00	5.34		1.95	2.1	5.29	5.427	1.200	4.411	
12	135	2.25	5.55		2.25	2.4	5.549	5.68	1.350	4.655	
13	150	2.50	5.76		2.4	2.55	5.68	5.803	1.500	4.854	
14	165	2.75	5.97		2.7	2.85	5.931	6.049	1.650	5.023	
15	180	3.00	6.20		3	3.15	6.197	6.351	1.800	5.168	
16	195	3.25	6.48		3.15	3.3	6.351	6.539	1.950	5.29	
17	210	3.50	6.83		3.45	3.6	6.756	6.985	2.100	5.427	
18	225	3.75	7.21		3.75	3.9	7.211	7.432	2.250	5.549	
19	240	4.00	7.57		3.9	4.05	7.432	7.638	2.400	5.68	
20	255	4.25	7.88		4.2	4.35	7.821	8	2.550	5.803	
21	270	4.50	8.16		4.5	4.65	8.161	8.325	2.700	5.931	
22	285	4.75	8.43		4.65	4.8	8.325	8.484	2.850	6.049	
23	300	5.00	8.71		4.95	5.1	8.654	8.83	3.000	6.197	
24	315	5.25	9.02		5.25	5.4	9.021	9.218	3.150	6.351	
25	330	5.50	9.35		5.4	5.55	9.218	9.422	3.300	6.539	
26	345	5.75	9.69		5.7	5.85	9.621	9.821	3.450	6.756	
27	360	6.00	10.00		6	1E+09	10	10	3.600	6.985	
28									3.750	7.211	
29									3.900	7.432	
30									4.050	7.638	
31									4.200	7.821	
32									4.350	8	
33									4.500	8.161	
34									4.650	8.325	
35									4.800	8.484	
36									4.950	8.654	
37									5.100	8.83	
38									5.250	9.021	
39									5.400	9.218	
40									5.550	9.422	
41									5.700	9.621	
42									5.850	9.821	
43									6	10	
44									1000000006	10	
45											

=G3+(H3-G3)*(B3-E3)/(F3-E3)

=INDEX($I$3:$I$43,MATCH(B3,$I$3:$I$43,1))

=INDEX($I$3:$I$43,MATCH(B3,$I$3:$I$43,1)+1)

=INDEX($J$3:$J$43,MATCH(B3,$I$3:$I$43,1))

=INDEX($J$3:$J$43,MATCH(B3,$I$3:$I$43,1)+1)

This row fixed set Time = DURATION + 1.0E-9
or the search will fail last row of interpolation

Alternative Method-Distribution Mixture Model

- Linear interpolation method is situation specific
- Distribution-mixture model
  - fits smooth functions to the tabulation values from Texas Dimensionless Hyetograph
  - can be used to directly estimate time-depth pairs
  - Time depth pairs can be directly input into computer based runoff modeling software (SWMM/HECHMS)

Distribution-Mixture Model

- Several candidate functions were explored based on the shape of the 50th and 90th percentile curves
- A function built from a mixture of two distributions was selected as the best fit functional form because it was able to reproduce the shape of the dimensionless hyetographs over the entire range of the dimensionless storm better than the other functions researched .
- The functional form was fit using a non-linear least-squares approach where the difference between the model value and the tabulated value were minimized by changing the values of the parameters

Methodology

- Distribution-mixture function model

$$D^*(t^*) = w_1(I_{t^*}(\alpha,\beta)) - w_2\left(\frac{1}{\sigma\sqrt{2\pi}}\exp\left(-\frac{(t^*-\mu)^2}{2\sigma^2}\right)\right)$$

where

$D^*(\ )$	is the dimensionless depth of precipitation as a function of dimensionless time.
t^*	is the dimensionless time.
w_1	is a weighting parameter.
α	is a shape parameter for the Beta distribution.
β	is a shape parameter for the Beta distribution.
w_2	is a weighting parameter.
μ	is the mean (used to locate the mode of the function in this work).
σ	is the standard deviation (used to control the width of the function in this work).

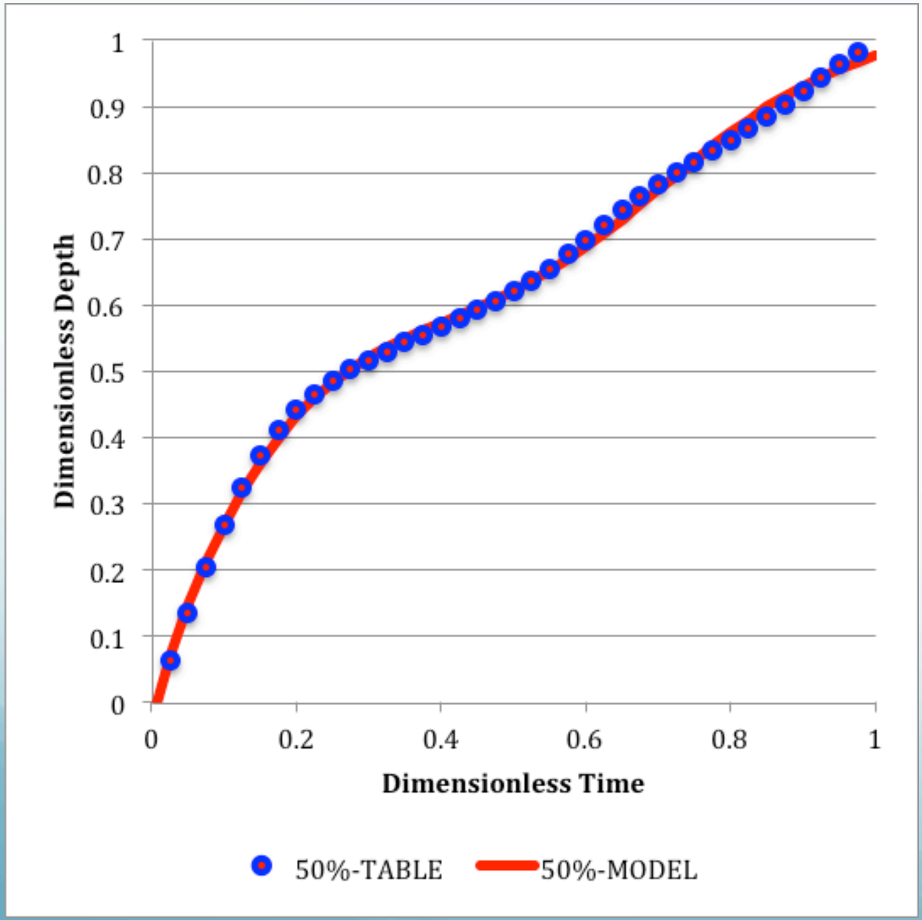
Parameter Estimation

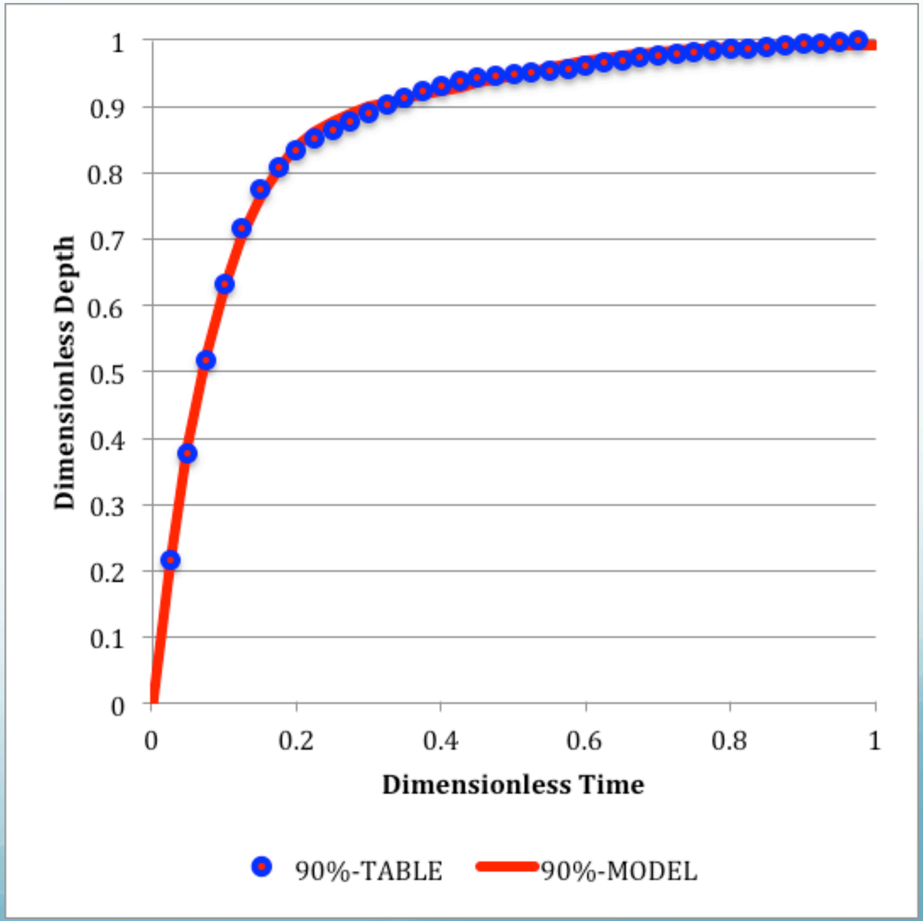
- The functional form was fit using a non-linear least-squares approach.
- The difference between the model value and the tabulated values were minimized by changing the parameters.
- Excel Solver (GRG Algorithm) was used.
  - Program defaults were used with initial estimates by trial-and-error

$$D^*(t^*) = w_1(I_{t^*}(\alpha, \beta)) - w_2\left(\frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{(t^* - \mu)^2}{2\sigma^2}\right)\right)$$

Distribution-Mixture Model

- Comparison of Williams-Sether tabulated values to distribution-mixture model function





TXHYETO.XLS

	A	B	C	D	J	K
1	Spreadsheet to dimensionalize Texas hyetographs				Mixture Model Parameters	
2	50th Percentile Hyetograph				w_1	1.038977414
3		INPUT:	6	Storm Duration, hours, from DDF Atlas, TP40, or equivalent.	α	0.795462882
4		INPUT:	10	Storm Depth , inches, from DDF Atlas, TP40, or equivalent.	β	3.485892325
5					w_2	0.248832841
6					μ	0.471873548
7	TIME (MIN)	TIME (HRS)	DEPTH (IN)		σ	0.283390998
8	0	0	0			
9	15	0.25	1.14086			
10	30	0.5	2.355945			
11	45	0.75	3.252356			
12	60	1	3.928036			
13	75	1.25	4.438726			
14	90	1.5	4.826142			
15	105	1.75	5.125504			
16	120	2	5.367787			
17	135	2.25	5.580054			
18	150	2.5	5.785012			
19	165	2.75	6.000375			
20	180	3	6.238334			
21	195	3.25	6.505373			
22	210	3.5	6.802513			
23	225	3.75	7.126003			
24	240	4	7.468401			
25	255	4.25	7.819879			
26	270	4.5	8.16963			
27	285	4.75	8.507161			
28	300	5	8.823376			
29	315	5.25	9.111306			
30	330	5.5	9.366478			
31	345	5.75	9.586911			
32	360	6	10			
33						
34						
35						

```
=IF(B8<=0,0,IF(B8>=$C$3,$C$4,($K$2*(BETA.DIST(B8/$C$3,$K$3,$K$4,TRUE,0,1))
-$K$5*NORM.DIST(B8/$C$3,$K$6,$K$7,FALSE))*$C$4))
```

Dimensionless2Dimensional-50 | Dimensionless2Dimensional-90

Comparison

- Compare the interpolation and distribution-mixture model – less than 5% difference

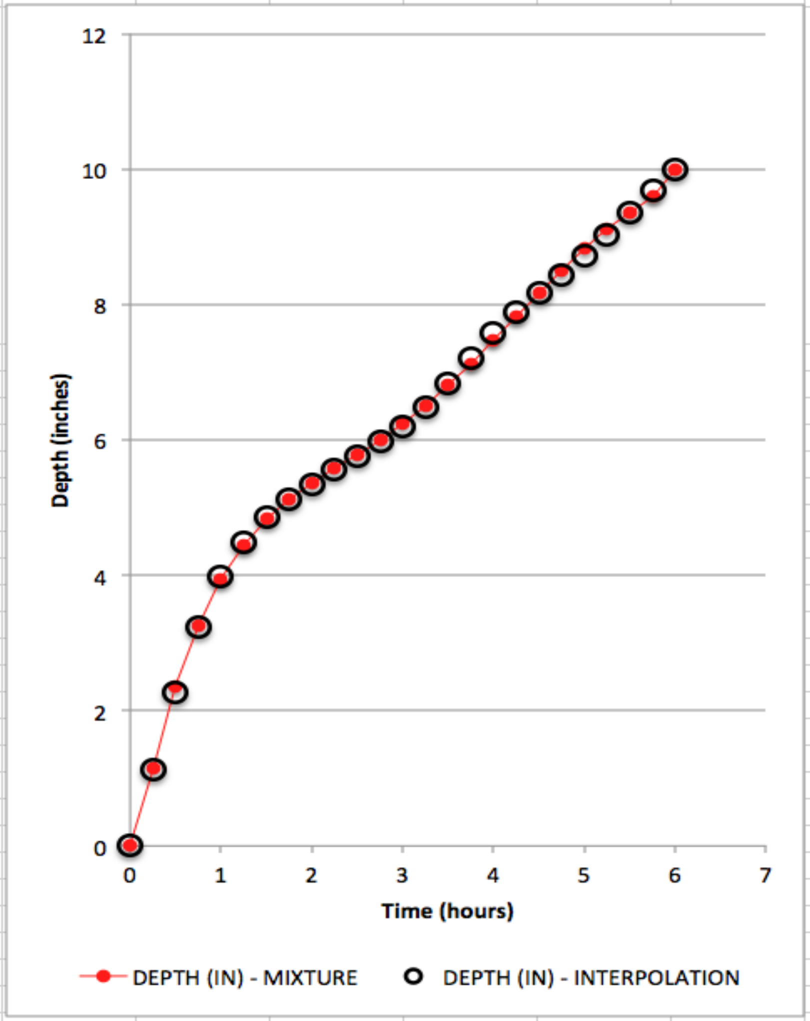
Spreadsheet to dimensionalize Texas hyetographs

50-th Percentile Hyetograph

INPUT: 6 Storm Duration, hours, from DDF Atlas, TP40, or equivalent.

INPUT: 10 Storm Depth , inches, from DDF Atlas, TP40, or equivalent.

TIME (MIN)	TIME (HRS)	DEPTH (IN) - MIXTURE	DEPTH (IN) - INTERPOLATION	PERCENT DIFFERENCE
0	0	0	0	0.00%
15	0.25	1.1409	1.118	2.08%
30	0.5	2.3559	2.26	4.23%
45	0.75	3.2524	3.242	0.32%
60	1	3.928	3.974	-1.15%
75	1.25	4.4387	4.492	-1.19%
90	1.5	4.8261	4.854	-0.57%
105	1.75	5.1255	5.12	0.11%
120	2	5.3678	5.336	0.60%
135	2.25	5.5801	5.549	0.56%
150	2.5	5.785	5.762	0.40%
165	2.75	6.0004	5.97	0.50%
180	3	6.2383	6.197	0.67%
195	3.25	6.5054	6.476	0.45%
210	3.5	6.8025	6.832	-0.44%
225	3.75	7.126	7.211	-1.18%
240	4	7.4684	7.569	-1.33%
255	4.25	7.8199	7.881	-0.77%
270	4.5	8.1696	8.161	0.11%
285	4.75	8.5072	8.431	0.90%
300	5	8.8234	8.713	1.27%
315	5.25	9.1113	9.021	1.00%
330	5.5	9.3665	9.354	0.13%
345	5.75	9.5869	9.688	-1.04%
360	6	10	10	0.00%

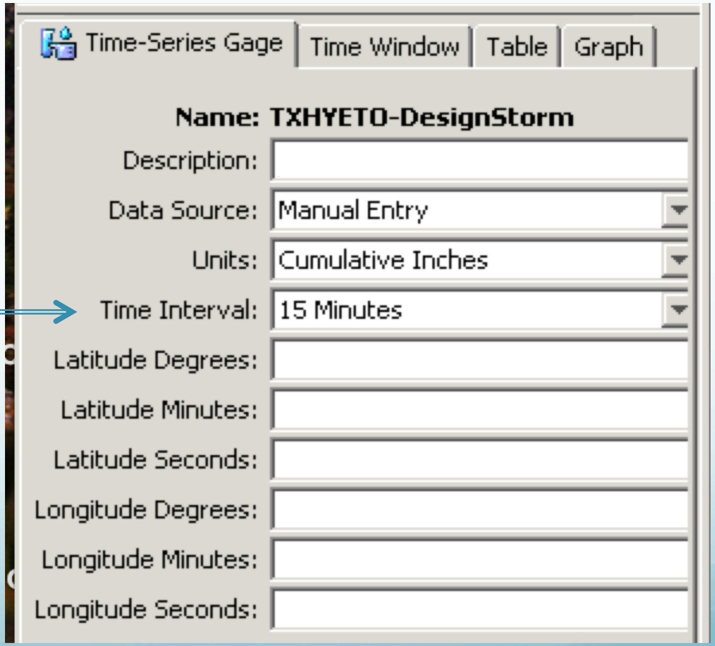


HEC-HMS Example

HEC-HMS

- TXHYETO.XLS efficiently supplies design storms for Texas into HEC-HMS or SWMM
- Example for 6-hour storm with 15 min. increments

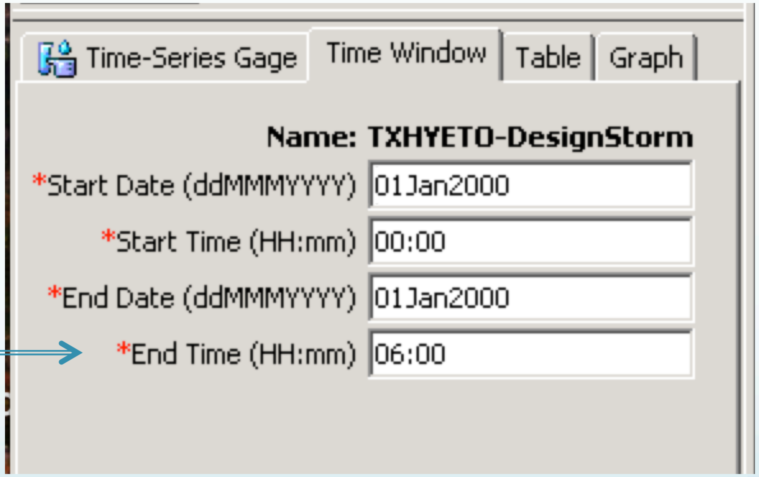
Input desired time increments (15 min. for this example)



HEC-HMS

- The purpose of the tool is to simplify supplying design storms for Texas into HEC-HMS or SWMM.

Input desired storm duration (6-hour storm)



HEC-HMS

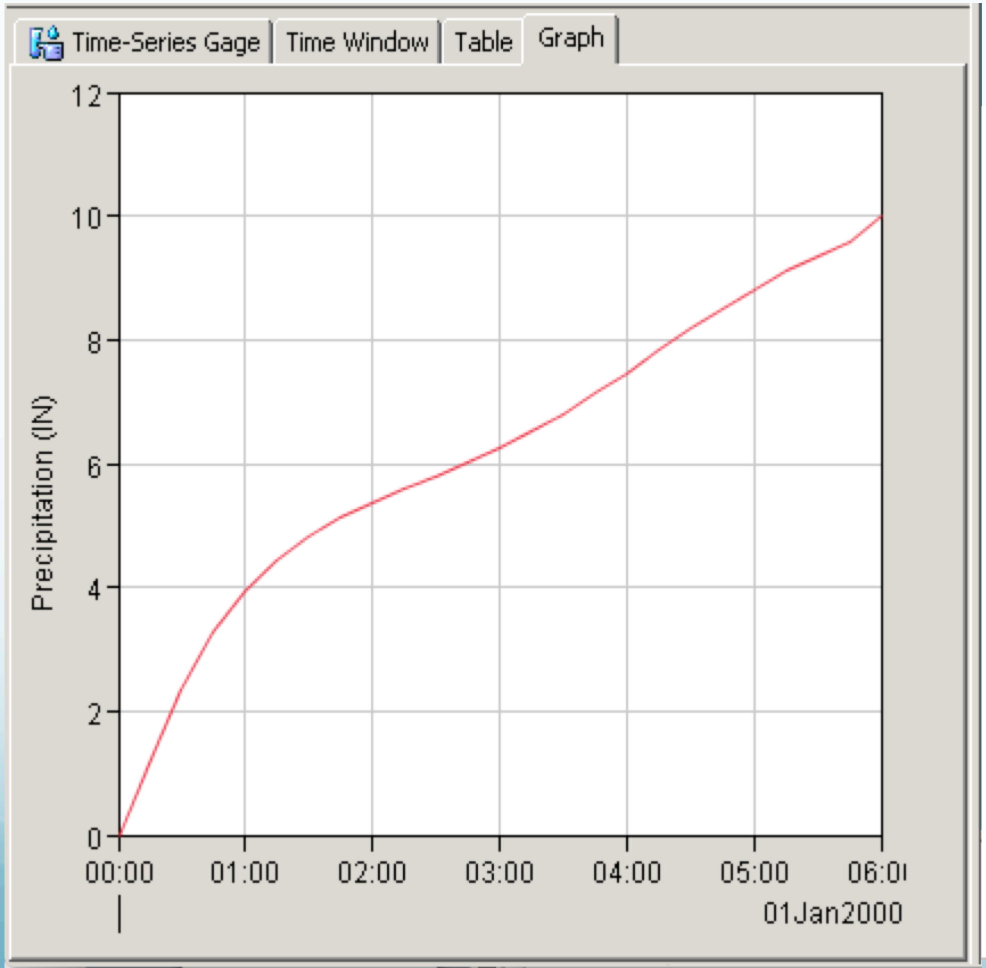
	A	B	C	D	E
1	Spreadsheet to dimensionalize Texas hyetographs				
2	50th Percentile Hyetograph				
3		INPUT:	6	Storm Duration, hou	
4		INPUT:	10	Storm Depth , inche	
5					
6					
7	TIME (MIN)	TIME (HRS)	DEPTH (IN)		
8	0	0	0		
9	15	0.25	1.14086		
10	30	0.5	2.355945	=IF(B8<=0,0,IF(B8	
11	45	0.75	3.252356		
12	60	1	3.928036		
13	75	1.25	4.438726		
14	90	1.5	4.826142		
15	105	1.75	5.125504		
16	120	2	5.367787		
17	135	2.25	5.580054		
18	150	2.5	5.785012		
19	165	2.75	6.000375		
20	180	3	6.238334		
21	195	3.25	6.505373		
22	210	3.5	6.802513		
23	225	3.75	7.126003		
24	240	4	7.468401		
25	255	4.25	7.819879		
26	270	4.5	8.16963		
27	285	4.75	8.507161		
28	300	5	8.823376		
29	315	5.25	9.111306		
30	330	5.5	9.366478		
31	345	5.75	9.586911		
32	360	6	10		

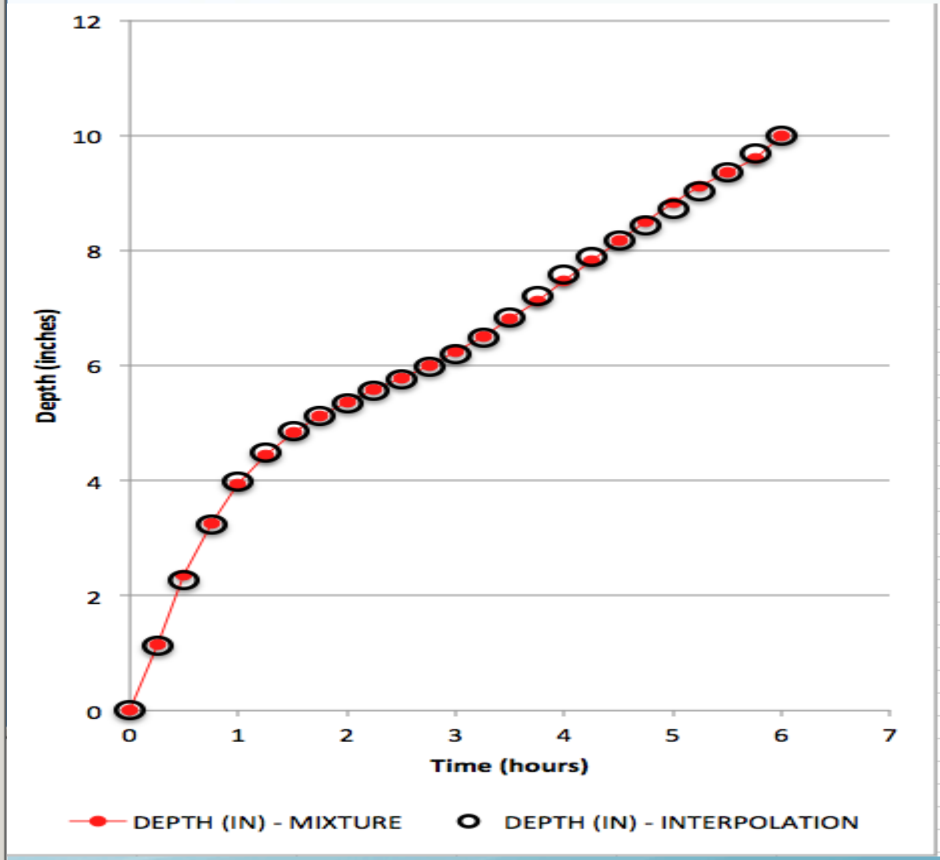
Input tabulated depths from TXHYETO.XLS

Time-Series Gage | Time Window | Table | Graph

Time (ddMMMYYYY, HH...	Precipitation (IN)
01Jan2000, 00:00	0
01Jan2000, 00:15	1.140860275
01Jan2000, 00:30	2.355945266
01Jan2000, 00:45	3.2523557
01Jan2000, 01:00	3.92803553
01Jan2000, 01:15	4.438726076
01Jan2000, 01:30	4.826142335
01Jan2000, 01:45	5.125504072
01Jan2000, 02:00	5.367787363
01Jan2000, 02:15	5.580053565
01Jan2000, 02:30	5.785012167
01Jan2000, 02:45	6.000374911
01Jan2000, 03:00	6.238334305
01Jan2000, 03:15	6.5053735
01Jan2000, 03:30	6.802512679
01Jan2000, 03:45	7.126003481

HEC-HMS


Time-Series Gage
Time Window
Table
Graph
Precipitation (IN)
12
10
8
6
4
2
0
00:00
01:00
02:00
03:00
04:00
05:00
06:0
01Jan2000


Depth (inches)
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
Time (hours)
DEPTH (IN) - MIXTURE
DEPTH (IN) - INTERPOLATION

Conclusions

- The provisional tool, TXHYETO.XLS, dimensionalizes the Texas dimensionless hyetographs for use in rainfall-runoff models
- Tool uses a distribution-mixture function to approximate the shape of the Texas Dimensionless Hyetograph
- Distribution-mixture model utilized in TXHYETO.XLS replicates estimates made using linear interpolation with a relative error of <5%

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