

CE 3354 Engineering Hydrology Exercise Set 4

Exercises

1. Use the Oklahoma data you prepared in ES-3 and analyze using the Bulletin 17C procedure (using the PeakFQ software tool - use station skew option).

If starting from just the data in ES3 you will have to carefully build an input file – the **Beargrass-B17C.txt**¹ file is the correct format.

Solution

The **Beargrass-B17C.txt** file is shown below

```
* WCF2.DATA  1/9/89 -- BULLETIN 17 EXAMPLES
*-----1-----2-----3-----4-----5-----6-----7-----8

Z                               USGS

*          LAT   LON          AREA          ELEV
* STATIONID DDMSSDDMMSS      1234567123456712345678

H 12345678      3527470973329      645.55      1202.01
N 12345678      OKLAHOMA FROM ES3
Y 12345678      20.0
2 12345678
3 12345678      19230101 200000
3 12345678      19240101 42000
3 12345678      19250101 11300
3 12345678      19260101 32400
3 12345678      19270101 108000
3 12345678      19280101 73000
3 12345678      19290101 76500
3 12345678      19300101 47800
3 12345678      19310101 28200
3 12345678      19320101 33700
3 12345678      19330101 25700
3 12345678      19340101 11700
3 12345678      19350101 77800
3 12345678      19360101 26600
```

¹This file is located in same directory as this document

3	12345678	19370101	47500
3	12345678	19380101	75600
3	12345678	19390101	19200
3	12345678	19400101	27800
3	12345678	19410101	51000
3	12345678	19420101	94000
3	12345678	19430101	97200
3	12345678	19440101	179000
3	12345678	19450101	124000
3	12345678	19460101	110000
3	12345678	19470101	114000
3	12345678	19480101	70200
3	12345678	19490101	70700
3	12345678	19500101	92800
3	12345678	19510101	135000
3	12345678	19520101	25800
3	12345678	19530101	17500
3	12345678	19540101	18700
3	12345678	19550101	36300
3	12345678	19560101	49200
3	12345678	19570101	120000
3	12345678	19580101	56800
3	12345678	19590101	54800
3	12345678	19600101	158000
3	12345678	19610101	165000
3	12345678	19620101	103000
3	12345678	19630101	19700
3	12345678	19640101	21100
3	12345678	19650101	171000
3	12345678	19660101	10400
3	12345678	19670101	42000
3	12345678	19680101	52800
3	12345678	19690101	77000
3	12345678	19700101	101000
3	12345678	19710101	17100

*

Now load this file into PeakFQ, adjust the settings (EMA, and set skew to *station skew*), like below

PeakFQ Version 7.3

File Help

Use File menu to Open PeakFQ data or PKFQWin spec file. PeakFQ Data File: C:\Users\texas-skew\Desktop\PeakFQ-Files\012345678_d\BEARGRASS-B17B.TXT
 Update Station, Threshold and Output specifications as desired. PeakFQ Spec File:
 Click Run PeakFQ button to generate results.

Station Specifications | Input/View | Output Options | Results |

Global Analysis Option: EMA Global PILF (LO) Test Option: Multiple Grubbs-Beck

Station ID	Option	Beginning Year	Ending Year	Record Length	Inc Hist	Skew	Use B17B	Regional	Reg Skew	Mean	Low Hist	PILF (LO)	PILF (LO)	High Sys	Hi-Outlier	Gage Base	Urban/Reg	Latitude
12345678	EMA	1945	1975	31	Yes	Station	No			0	0	0	Multiple	5200	0	0	No	36.038

Run PEAKFQ

Figure 1: PeakFQ 7.3 Set up screen for Beargrass Creek Data Analysis

Then run the program and extract results (either graphically, or using the output file Table 4)

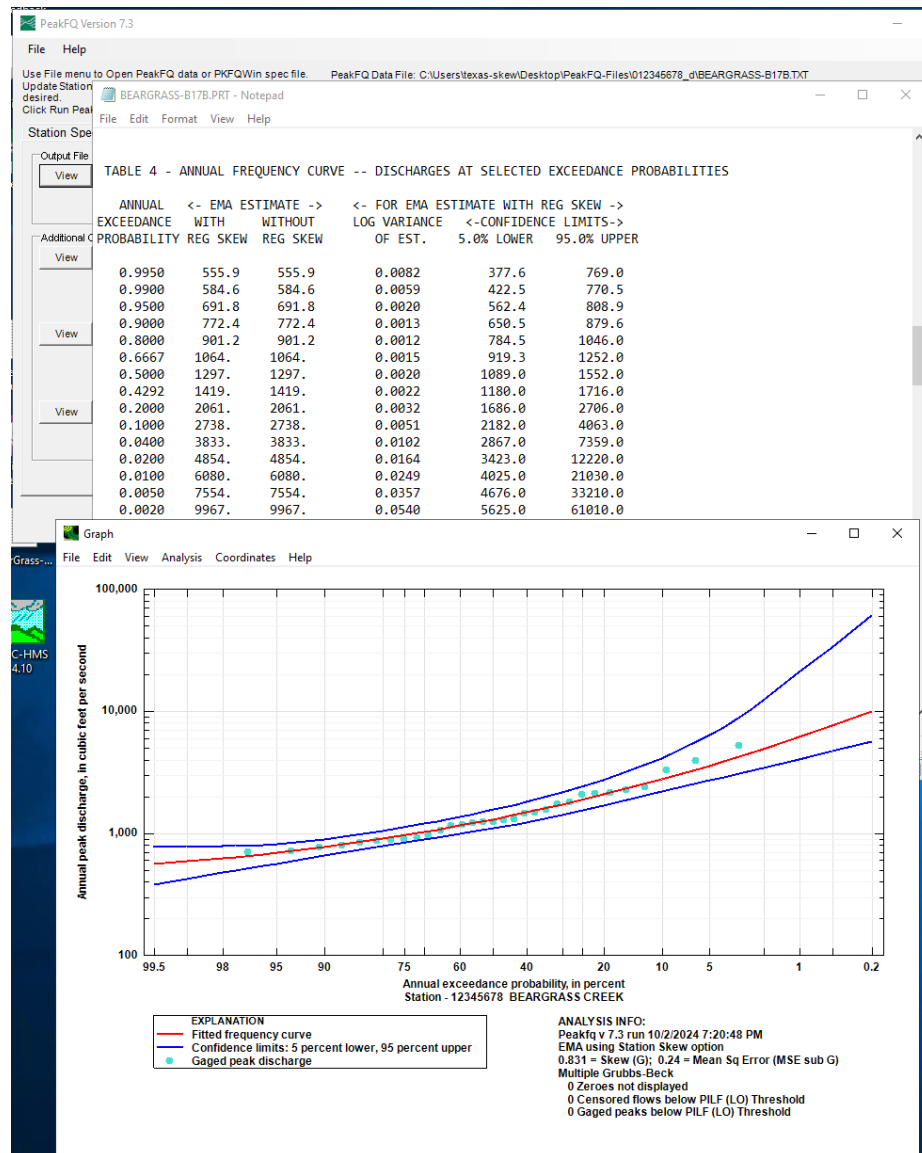


Figure 2: PeakFQ 7.3 results for Beargrass Creek Data Analysis

2. Locate USGS Station 08144800 Brady Creek near Eden, TX. and analyze the historical peaks using the Bulletin 17C procedures (using the PeakFQ software tool use station skew option). Determine the median discharge predicted for this station by PeakFQ. Also determine the discharge per square mile of contributing drainage area.

Solution

The screenshot shows the USGS NWIS web interface. At the top, there's a navigation bar with the USGS logo and the text "science for a changing world". Below this is a search bar with the text "USGS 08144800 Brady Ck nr Eden, TX". The main content area is titled "National Water Information System: Web Interface" and includes a "USGS Water Resources" section. A "Data Category" dropdown is set to "Site Information" and a "Geographic Area" dropdown is set to "United States". A "GO" button is next to the dropdowns. Below this is a "Click to hide News Bulletins" section with a link to "Explore the NEW USGS National Water Dashboard". The main heading is "USGS 08144800 Brady Ck nr Eden, TX". Below this is a "Stream Site" section with a "DESCRIPTION:" box containing the following information: Latitude 31°11'03", Longitude 99°50'27" NAD27, Concho County, Texas, Hydrologic Unit 12090110, Drainage area: 101 square miles, Contributing drainage area: 101 square miles, Datum of gage: 2,000.99 feet above NGVD29. Below the description is an "AVAILABLE DATA:" section with a table showing data types, begin dates, end dates, and counts.

USGS 08144800 Brady Ck nr Eden, TX

Available data for this site: **SUMMARY OF ALL AVAILABLE DATA** GO

Stream Site

DESCRIPTION:

Latitude 31°11'03", Longitude 99°50'27" NAD27
 Concho County, Texas, Hydrologic Unit 12090110
 Drainage area: 101 square miles
 Contributing drainage area: 101 square miles,
 Datum of gage: 2,000.99 feet above NGVD29.

AVAILABLE DATA:

Data Type	Begin Date	End Date	Count

Figure 3: Find NWIS data for Brady Creek Data Analysis

The **Brady Creek STA_08144800.txt** file is shown below

Z08144800	USGS		
H08144800	3111030995027004848095SW12090110101	101	2000.99
N08144800	Brady Ck nr Eden, TX		
Y08144800			
308144800	19611009	2786	3.18
308144800	19630505	3.006	1.45
308144800	19631001	0.006	
308144800	19650518	57.06	2.24
308144800	19660428	51106	7.08
308144800	19670817	45606	6.72
308144800	19680310	11.06	1.78
308144800	19690911	9466	4.37
308144800	19700515	12.06	1.83
308144800	19710530	10206	4.04
308144800	19720615	3756	3.00
308144800	19730603	4106	3.07
308144800	19731012	33206	6.16
308144800	19750511	2446	3.07
308144800	19760711	4736	3.51
308144800	19770624	37206	6.45
308144800	19780528	38.06	1.84
308144800	19790809	10.06	1.51
308144800	19800909	13506	4.58
308144800	19810516	48.06	2.03
308144800	19820505	1776	2.71
308144800	19830606	1356	2.55
308144800	19840812	3336	3.14
308144800	19841231	60.06	2.08

Then run the program and extract results (either graphically, or using the output file Table 4)

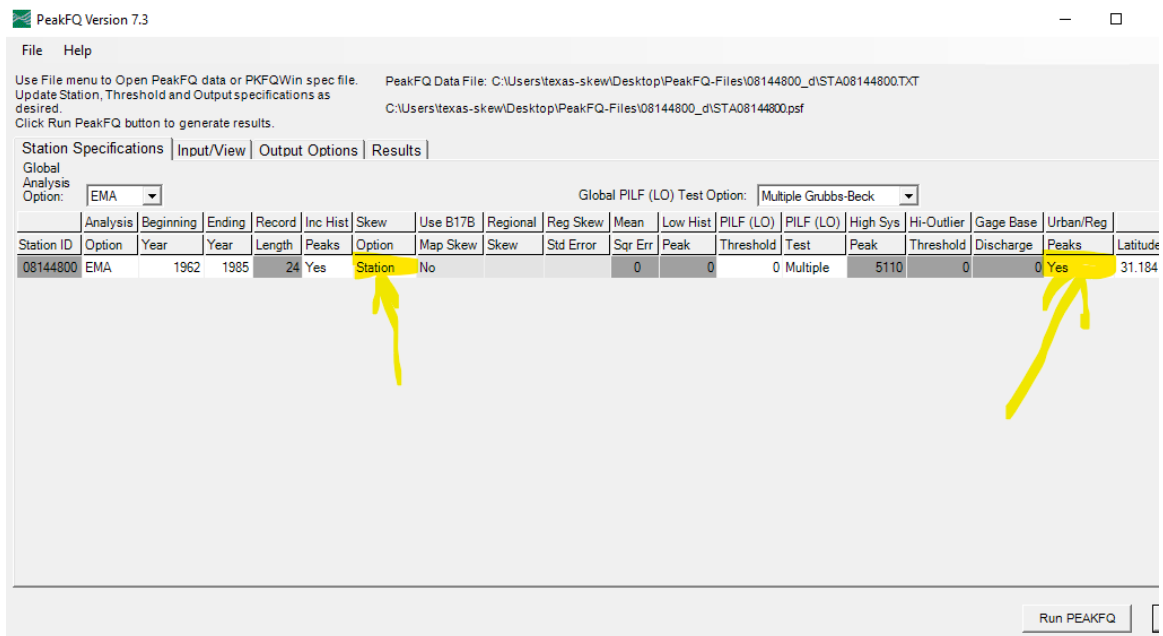


Figure 4: PeakFQ 7.3 setup for Brady Creek Data Analysis

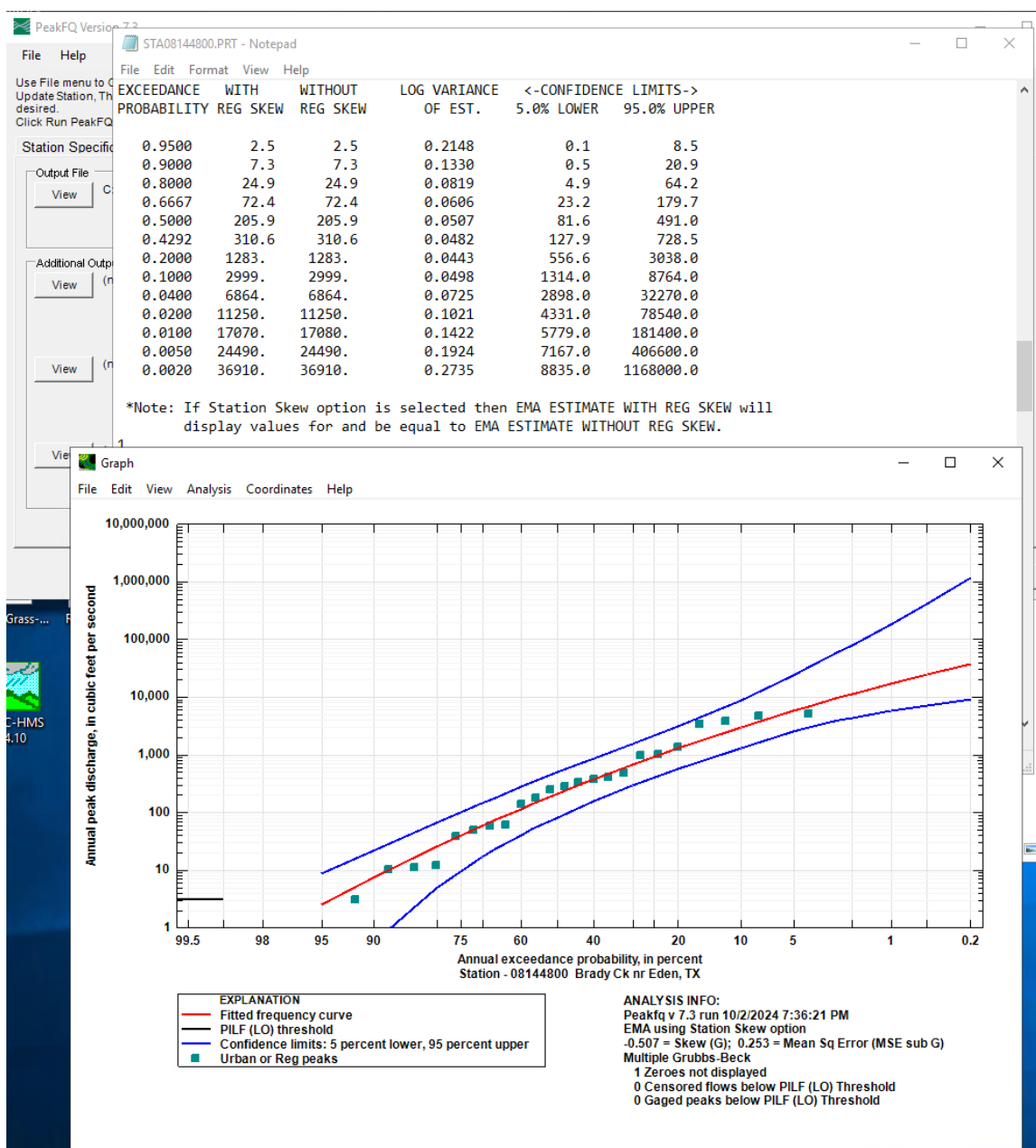


Figure 5: PeakFQ 7.3 results for Brady Creek Data Analysis

Median discharge is 205.9 CFS (Table 4 50% exceedance probability) Median Discharge per square mile is $\frac{205.9 \text{ cfs}}{101 \text{ mi}^2} = 2.04 \frac{\text{cfs}}{\text{mi}^2}$, can also apply to other probabilities. This value is useful to check that the smallish drainage area for the study is producing resonable estimates.

3. Use the NOAA Precipitation Frequency Data Server to prepare Intensity-Duration-Frequency curves for Eden, Texas (Concho County). The desired ARI are 2-yr, 10-yr, 50-yr, and 100-yr (4 curves).

Solution

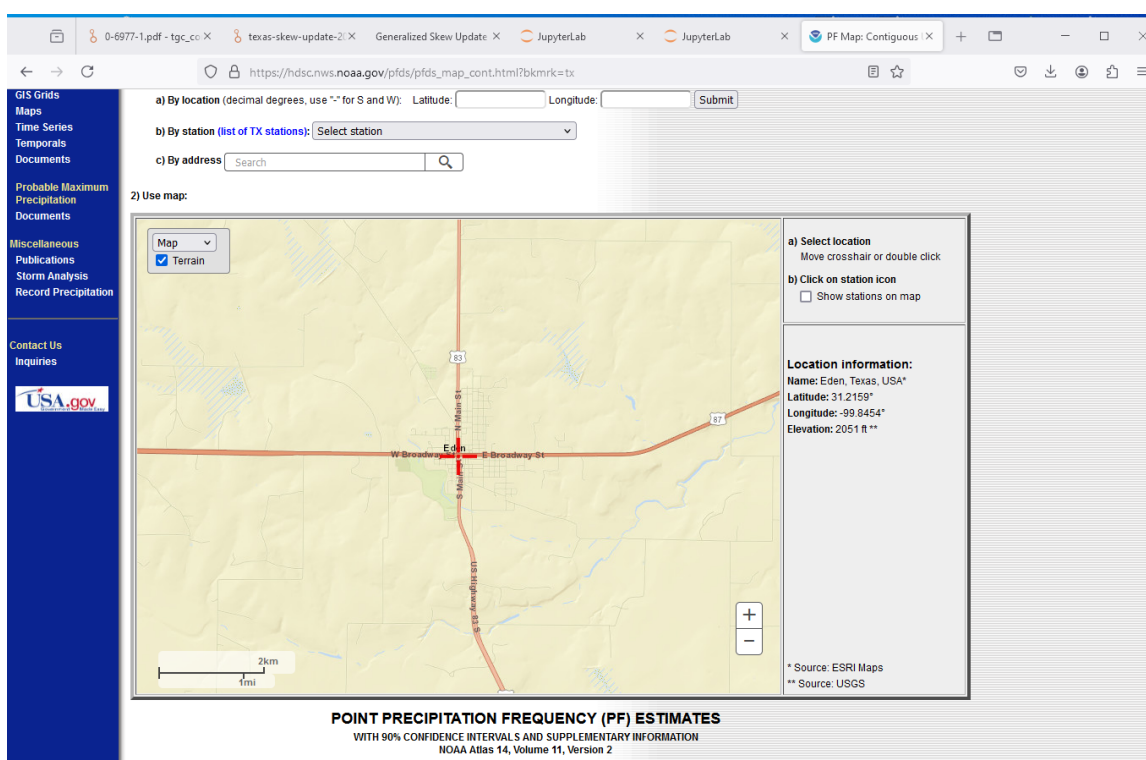


Figure 6: NOAA PFDS landing page for Eden, Tx.

In practice, use the tabular part to build own charts, as the online charts are not useable (except to check your homebrew work)

0-5977-1.pdf - tgc_co x texas-skew-update-2 x Generalized Skew Update x JupyterLab x JupyterLab x PF Map: Contiguous x + -

https://hdscnws.noaa.gov/pfds/pfds_map_cont.html?bkmrk=tx

AMS-based precipitation frequency estimates with 90% confidence intervals (in inches/hour)¹

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 11, Version 2

PF tabular PF graphical Supplementary information Print page

Duration	Annual exceedance probability (1/years)								
	1/2	1/5	1/10	1/25	1/50	1/100	1/200	1/500	1/1000
5-min	4.96 (3.79-6.54)	6.55 (5.00-8.62)	7.73 (5.81-10.3)	9.24 (6.71-12.6)	10.3 (7.32-14.4)	11.4 (7.87-16.2)	12.5 (8.39-18.1)	13.9 (9.01-20.7)	14.9 (9.42-22.6)
10-min	3.98 (3.04-5.25)	5.26 (4.03-6.92)	6.22 (4.67-8.26)	7.44 (5.42-10.1)	8.35 (5.92-11.6)	9.20 (6.35-13.1)	10.0 (6.73-14.5)	11.0 (7.18-16.4)	11.7 (7.43-17.9)
15-min	3.29 (2.51-4.34)	4.34 (3.32-5.70)	5.11 (3.84-6.79)	6.10 (4.43-8.29)	6.82 (4.83-9.47)	7.52 (5.18-10.7)	8.21 (5.52-11.9)	9.10 (5.92-13.6)	9.76 (6.18-14.8)
30-min	2.27 (1.73-2.99)	2.98 (2.28-3.92)	3.50 (2.63-4.65)	4.17 (3.03-5.66)	4.65 (3.29-6.46)	5.12 (3.53-7.27)	5.60 (3.76-8.12)	6.22 (4.05-9.28)	6.70 (4.24-10.2)
60-min	1.46 (1.11-1.92)	1.92 (1.47-2.53)	2.27 (1.71-3.02)	2.72 (1.97-3.68)	3.04 (2.15-4.21)	3.36 (2.31-4.77)	3.69 (2.48-5.35)	4.13 (2.68-6.15)	4.47 (2.83-6.79)
2-hr	0.881 (0.677-1.15)	1.18 (0.910-1.54)	1.41 (1.07-1.85)	1.71 (1.25-2.30)	1.94 (1.38-2.66)	2.17 (1.51-3.04)	2.42 (1.64-3.46)	2.75 (1.80-4.05)	3.02 (1.92-4.53)
3-hr	0.646 (0.498-0.833)	0.875 (0.676-1.13)	1.05 (0.801-1.37)	1.29 (0.950-1.72)	1.47 (1.05-2.01)	1.66 (1.16-2.32)	1.87 (1.27-2.65)	2.15 (1.41-3.14)	2.38 (1.52-3.54)
6-hr	0.378 (0.293-0.481)	0.518 (0.404-0.662)	0.628 (0.483-0.813)	0.780 (0.580-1.03)	0.899 (0.650-1.21)	1.03 (0.722-1.41)	1.17 (0.790-1.64)	1.36 (0.900-1.96)	1.52 (0.980-2.23)
12-hr	0.218 (0.170-0.274)	0.300 (0.236-0.379)	0.365 (0.284-0.469)	0.457 (0.343-0.599)	0.530 (0.397-0.709)	0.610 (0.432-0.830)	0.698 (0.481-0.966)	0.824 (0.548-1.17)	0.928 (0.601-1.34)
24-hr	0.126 (0.099-0.157)	0.174 (0.138-0.218)	0.212 (0.166-0.269)	0.266 (0.201-0.345)	0.309 (0.227-0.409)	0.357 (0.255-0.480)	0.410 (0.284-0.560)	0.487 (0.328-0.681)	0.550 (0.358-0.783)
2-day	0.073 (0.058-0.090)	0.099 (0.079-0.123)	0.121 (0.095-0.152)	0.151 (0.115-0.193)	0.175 (0.130-0.229)	0.202 (0.145-0.268)	0.232 (0.162-0.313)	0.276 (0.196-0.380)	0.312 (0.204-0.437)
3-day	0.053 (0.042-0.065)	0.072 (0.058-0.088)	0.087 (0.069-0.108)	0.108 (0.083-0.138)	0.125 (0.093-0.163)	0.144 (0.104-0.190)	0.165 (0.116-0.221)	0.196 (0.132-0.268)	0.221 (0.145-0.307)
4-day	0.042 (0.034-0.051)	0.057 (0.046-0.070)	0.069 (0.055-0.086)	0.085 (0.066-0.108)	0.099 (0.074-0.128)	0.114 (0.082-0.149)	0.130 (0.091-0.172)	0.153 (0.104-0.208)	0.172 (0.113-0.238)
7-day	0.027 (0.022-0.032)	0.036 (0.029-0.044)	0.044 (0.035-0.054)	0.054 (0.042-0.068)	0.062 (0.047-0.080)	0.071 (0.052-0.092)	0.080 (0.057-0.106)	0.094 (0.064-0.126)	0.105 (0.069-0.143)
10-day	0.020 (0.016-0.025)	0.027 (0.022-0.033)	0.033 (0.027-0.041)	0.041 (0.032-0.051)	0.047 (0.035-0.059)	0.053 (0.039-0.068)	0.060 (0.042-0.078)	0.069 (0.047-0.092)	0.076 (0.051-0.103)
20-day	0.012 (0.010-0.015)	0.017 (0.014-0.020)	0.020 (0.016-0.024)	0.024 (0.019-0.030)	0.027 (0.020-0.034)	0.030 (0.022-0.038)	0.034 (0.024-0.043)	0.038 (0.028-0.050)	0.042 (0.028-0.056)
30-day	0.009 (0.008-0.011)	0.012 (0.010-0.015)	0.015 (0.012-0.018)	0.018 (0.014-0.022)	0.020 (0.015-0.025)	0.022 (0.016-0.028)	0.024 (0.017-0.031)	0.027 (0.019-0.036)	0.030 (0.020-0.039)
45-day	0.007 (0.006-0.008)	0.010 (0.008-0.013)	0.011 (0.009-0.014)	0.014 (0.010-0.019)	0.015 (0.010-0.020)	0.017 (0.012-0.024)	0.018 (0.012-0.025)	0.020 (0.014-0.028)	0.022 (0.016-0.030)

Figure 7: NOAA PFDS Tabular Results for Eden, Tx.

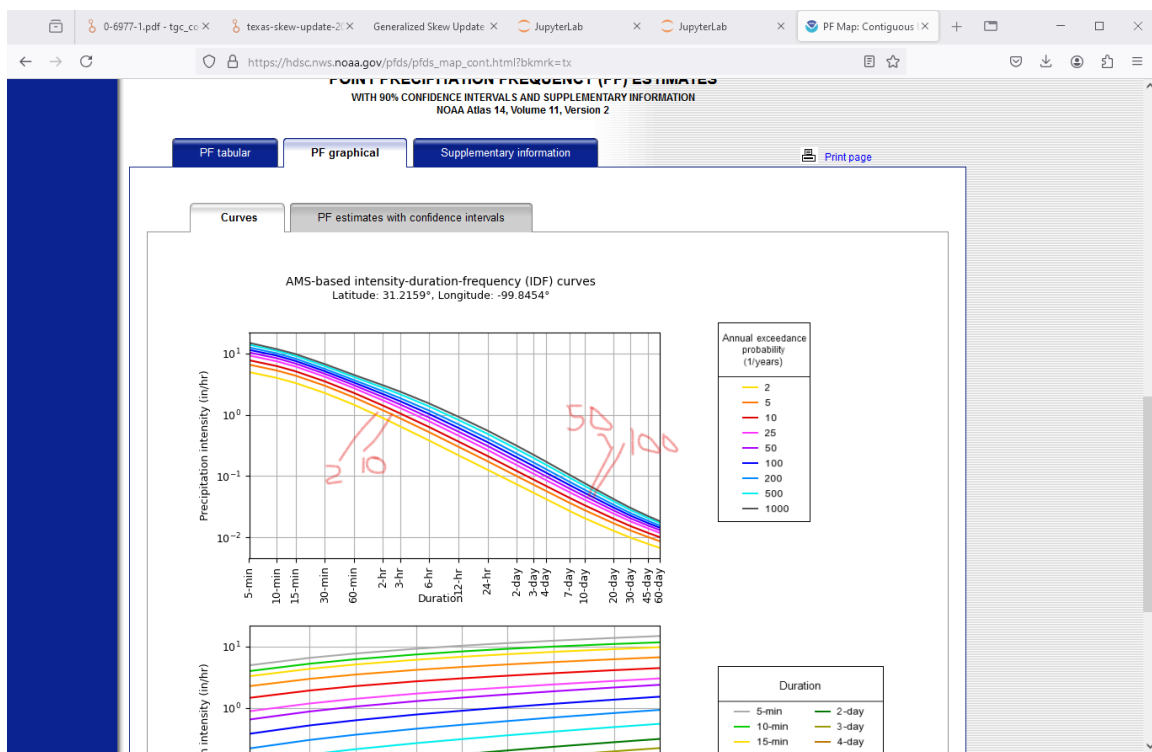


Figure 8: NOAA PFDS Charts for Eden, Tx.

4. Use the NOAA Precipitation Frequency Data Server and the SCS Rainfall Distributions to prepare a 50-yr, 24-hour hyetograph for Eden, Texas.

Solution

Find the 50-yr, 24-hr depth from PFDS, which is 7.44 inches. Then construct SDS distribution using ENGR-1330 methods

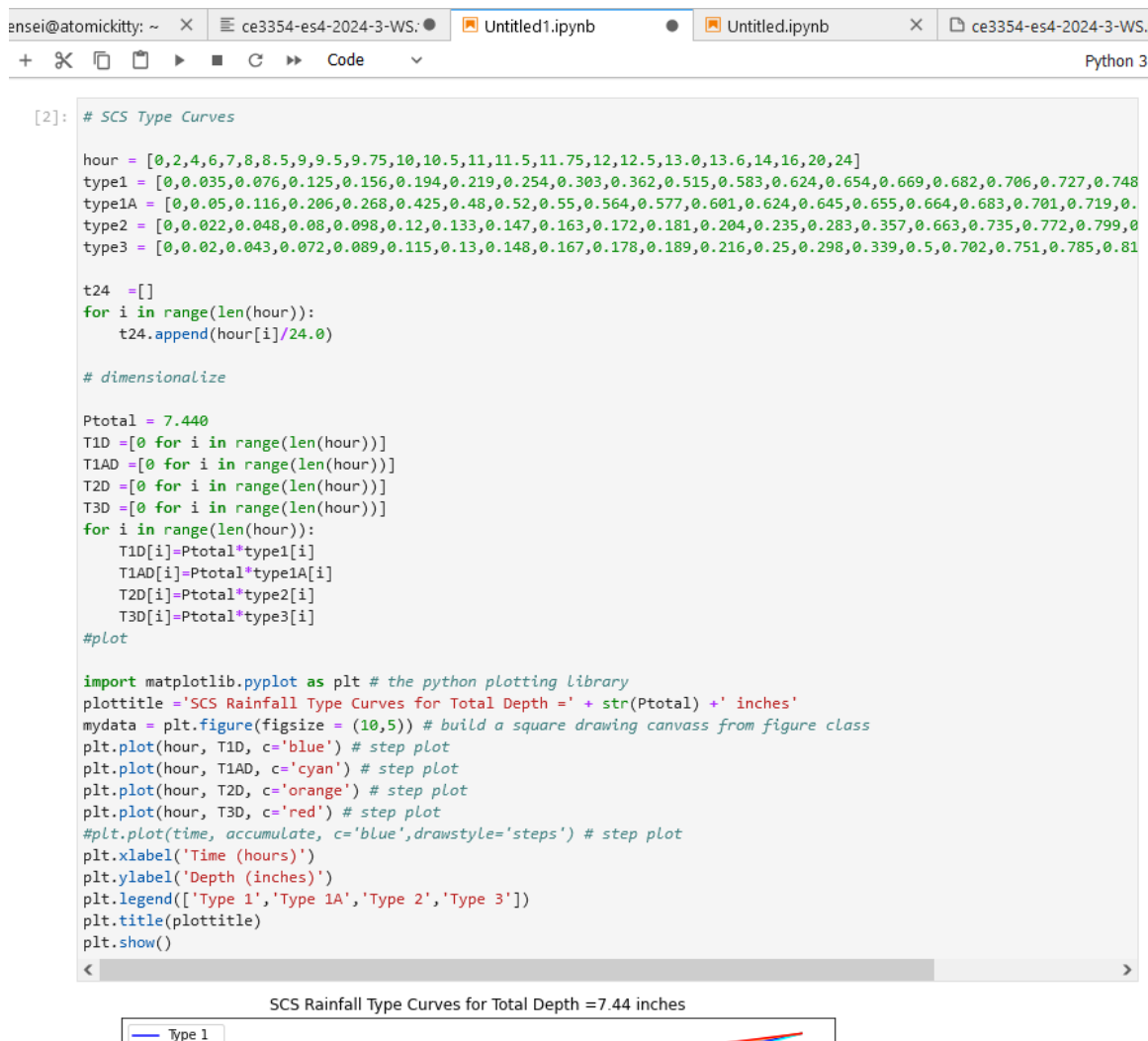


Figure 9: SCS generation script from class notes

```

plt.plot(time, accum, c='blue', drawstyle='steps') # step plot
plt.plot(time, accum, c='blue', drawstyle='steps') # step plot
plt.xlabel('Time (hours)')
plt.ylabel('Depth (inches)')
plt.legend(['Type 1', 'Type 1A', 'Type 2', 'Type 3'])
plt.title(plottitle)
plt.show()

```

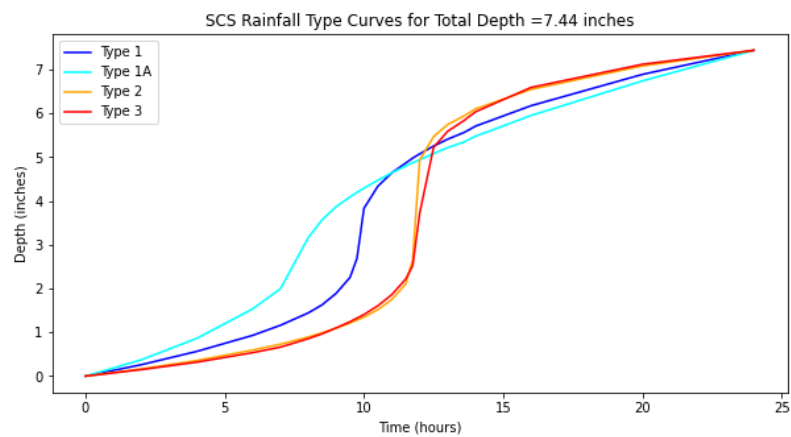


Figure 10: SCS Hyetographs

5. Use the NOAA Precipitation Frequency Data Server and the Texas Hyetograph Tool (TxHYETO-2015.xlsx) to prepare a 50-yr, 24-hour hyetograph for Eden, Texas.

Solution

Using the same total depth employ the TXHYETO-2015.xls tool:

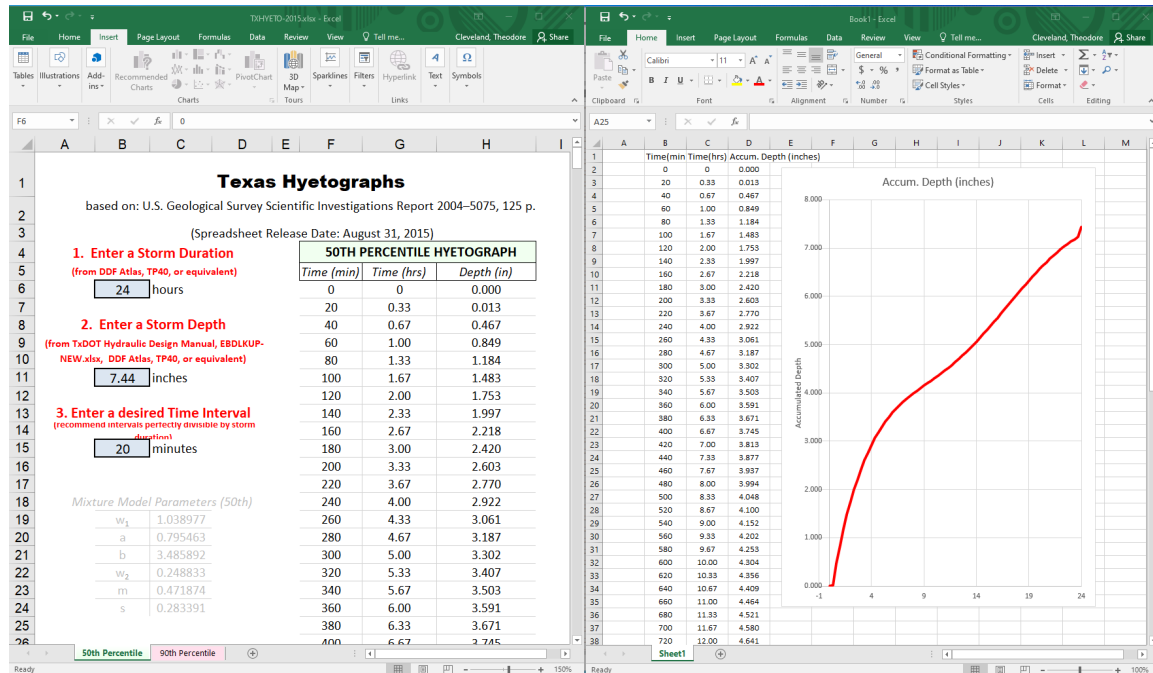


Figure 11: Texas 50% Hyetograph

Save these 50-yr, 24-hour hyetograph for Eden, Texas.; you will reuse them as inputs for the Hardin Branch project.

Beargrass-B17C in PeakFQ format (minor editing may still be needed)

* WCF2.DATA 1/9/89 -- BULLETIN 17 EXAMPLES

*---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---8

Z USGS

* STATIONID	LAT DDMMSS	LON DDDMMSS	AREA 1234567	ELEV 12345678
H 12345678	3527470973329		645.55	1202.01
N 12345678	OKLAHOMA	FROM ES3		
Y 12345678	20.0			
2 12345678				
3 12345678	19230101	200000		
3 12345678	19240101	42000		
3 12345678	19250101	11300		
3 12345678	19260101	32400		
3 12345678	19270101	108000		
3 12345678	19280101	73000		
3 12345678	19290101	76500		
3 12345678	19300101	47800		
3 12345678	19310101	28200		
3 12345678	19320101	33700		
3 12345678	19330101	25700		
3 12345678	19340101	11700		
3 12345678	19350101	77800		
3 12345678	19360101	26600		
3 12345678	19370101	47500		
3 12345678	19380101	75600		
3 12345678	19390101	19200		
3 12345678	19400101	27800		
3 12345678	19410101	51000		
3 12345678	19420101	94000		
3 12345678	19430101	97200		
3 12345678	19440101	179000		
3 12345678	19450101	124000		
3 12345678	19460101	110000		
3 12345678	19470101	114000		
3 12345678	19480101	70200		
3 12345678	19490101	70700		

3	12345678	19500101	92800
3	12345678	19510101	135000
3	12345678	19520101	25800
3	12345678	19530101	17500
3	12345678	19540101	18700
3	12345678	19550101	36300
3	12345678	19560101	49200
3	12345678	19570101	120000
3	12345678	19580101	56800
3	12345678	19590101	54800
3	12345678	19600101	158000
3	12345678	19610101	165000
3	12345678	19620101	103000
3	12345678	19630101	19700
3	12345678	19640101	21100
3	12345678	19650101	171000
3	12345678	19660101	10400
3	12345678	19670101	42000
3	12345678	19680101	52800
3	12345678	19690101	77000
3	12345678	19700101	101000
3	12345678	19710101	17100

*

Station 08144800 in PeakFQ format (minor editing may still be needed)

Z08144800	USGS		
H08144800	3111030995027004848095SW12090110101	101	2000.99
N08144800	Brady Ck nr Eden, TX		
Y08144800			
308144800	19611009	2786	3.18
308144800	19630505	3.006	1.45
308144800	19631001	0.006	
308144800	19650518	57.06	2.24
308144800	19660428	51106	7.08
308144800	19670817	45606	6.72
308144800	19680310	11.06	1.78
308144800	19690911	9466	4.37
308144800	19700515	12.06	1.83
308144800	19710530	10206	4.04
308144800	19720615	3756	3.00
308144800	19730603	4106	3.07
308144800	19731012	33206	6.16
308144800	19750511	2446	3.07
308144800	19760711	4736	3.51
308144800	19770624	37206	6.45
308144800	19780528	38.06	1.84
308144800	19790809	10.06	1.51
308144800	19800909	13506	4.58
308144800	19810516	48.06	2.03
308144800	19820505	1776	2.71
308144800	19830606	1356	2.55
308144800	19840812	3336	3.14
308144800	19841231	60.06	2.08