CE 3354 Engineering Hydrology
Exercise Set 2

Exercises

1. A raingage is located in a 2.5 acre impervious watershed with non initial abstraction. The gage records a catch of 1.0 inches of precipitation in one hour. The maximum intensity was 2.4 inches per hour for 10 minutes. Assume that 10 minutes is the characteristic time for which all parts of the watershed can contribute runoff to a discharge point.

   Determine:

   a) Volume of rainfall in cubic feet for the watershed.

   b) Maximum (peak) discharge rate for the watershed.

2. Consider the rainfall data in Table 1

Table 1: Somewhere USA Precipitation Data

Time (minutes)	Cumulative Depth (inches
0.00	0.00
30.0	0.04
60.0	0.38
90.0	1.07
120.	1.44
150.	1.62
180.	1.70

Determine:

a) A depth (cumulative inches) hyetograph in 30 minute intervals (plot).

b) An intensity (inches/hour) hyetograph in 30 minute intervals (plot).

3. The intersection of US 408 and US 417 in Orange County, Florida at 28°32'51.2"N 81°15'28.5"W is the approximate centroid of that county. Using NOAA Atlas 14 (use the online PFDS tool)

   Determine:

   a) The 1-hr rainfall depth for a 100-yr Annual Recurrance Interval (ARI).

   b) The 1-hr average rainfall intensity for a 100-yr Annual Recurrance Interval (ARI).

   c) The 6-hr rainfall depth for a 100-yr Annual Recurrance Interval (ARI).

   d) The 6-hr average rainfall intensity for a 100-yr Annual Recurrance Interval (ARI).

4. 55 mm of rain is recorded for a 6-hour storm by a raingage for a 10 km^2 watershed. The runoff from the storm indicates that only 45 mm of rain fell on the entire area.

   a) The areal reduction factor (ARF).

   b) Compare the result to Central Texas areal reduction factors

5. Table 2 is precipitation data for a 6-hour storm in Somewhere Else USA.

Table 2: Somewhere Else USA Precipitation Data – End of Interval Catch

Time (hours)	Cumulative Depth (inches
0.00	0.00
0.25	0.10
0.50	0.21
0.75	0.33
1.00	0.48
1.25	0.64
1.50	0.81
1.75	1.08
2.00	1.38
2.25	2.46
2.50	3.60
2.75	3.90
3.00	4.20
3.25	4.44
3.50	4.68
3.75	4.86
4.00	5.01
4.25	5.16
4.50	5.28
4.75	5.40
5.00	5.52
5.25	5.64
5.50	5.76
5.75	5.88
6.00	6.00

Determine:

a) The average rainfall intensity (inches/hour) from hour 3:00 to hour 4:00.

b) The average rainfall intensity (inches/hour) for the first half of the storm.

c) The maximum rainfall intensity (inches/hour) in any one hour.

d) The maximum rainfall intensity (inches/hour) in any 15-minute interval.

e) The average rainfall intensity (inches/hour) for the last half hour of the storm.

6. Using the NRCS Type III rainfall distribution

   Determine:

   a) The cumulative rainfall depth (inches) for half-hour increments for a 10 inch total depth, 24-hour storm.

   b) The rainfall intensity (inches/hour) for each half-hour increment of the storm.

   c) The maximum rainfall intensity (inches/hour) in any 30-minute interval.

7. Table 3 is intensity duration data for Somewhere USA.

Table 3: Somewhere USA Intensity-Duration

Duration (minutes)	Intensity (inches/hour)
10.0	4.00
15.0	3.20
20.0	2.70
30.0	1.90
60.0	1.20
120.	0.80
180.	0.60

Determine:

a) Plot the intensity duration on the plot type that produces a straight line.

b) An equation (model) of the "best" straight line for these values.

8. Table 4 is a measured 1-hour hyetograph for Baltimore, Maryland.

Table 4: Baltimore, Maryland Rainfall Data

Time (minutes)	Intensity (cm/hour)
0.00 - 10.0	2.00
10.0 - 20.0	6.00
20.0 - 30.0	12.00
30.0 - 40.0	8.00
40.0 - 50.0	6.00
50.0 - 60.0	3.00

Determine:

a) The average intensity in cm/hr.

b) The net volume of rainfall in m^3 and liters if the watershed is 4,000 m^2

c) An approximate Annual Recurrance Interval (ARI) for the measured event, using NOAA Atlas 14.

9. The map in Figure 1 shows the location of 6 rain gages and a watershed boundary. The rainfall depths for a certain storm are shown by each gage. An isohyetal map is displayed on the figure as is a linear distance scale.

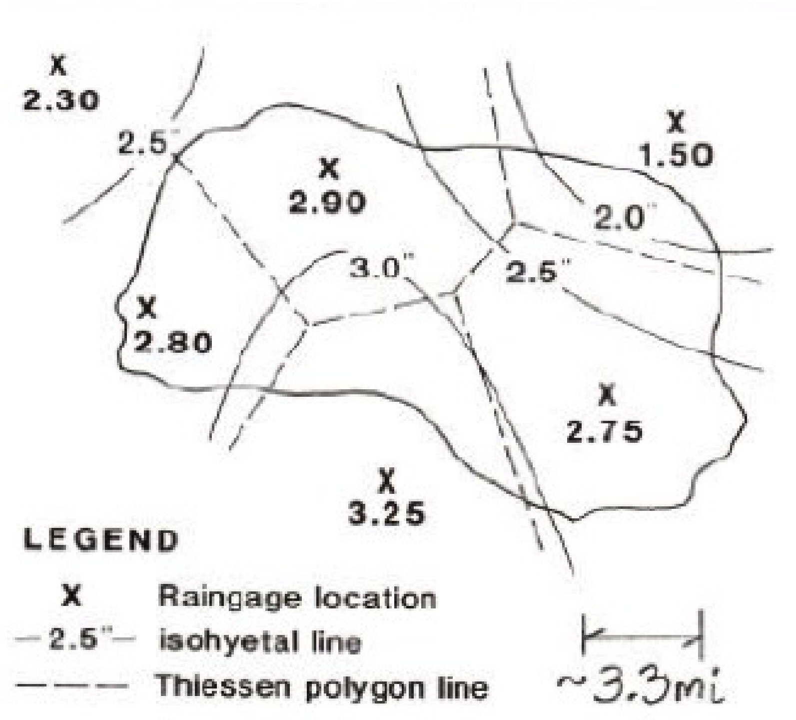

Figure 1: Raingages

Determine:

a) The Theissen polygon boundaries – verify if the gage in the upper left corner is included in the polygon boundaries in the picture (i.e determine your own boundaries for the gages, do they agree with the drawing?).

b) The polygon areas and compute the Theissen weights.

c) The average weighted precipitation over the watershed (using the Theissen weights).

d) The average weighted precipitation (using the Isoheyets).

10. The map in Figure 2 shows the location of 8 rain gages and the watershed boundary. The rainfall depths for a certain storm are in Table 5. Use the Thiessen polygon method to determine the mean rainfall depth over the watershed for this storm event.

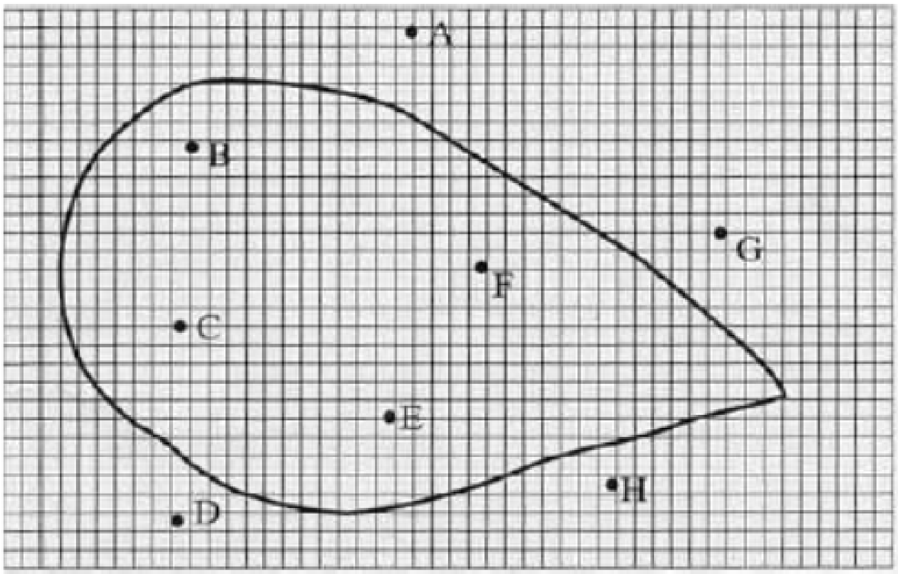

Figure 2: Nowhere Watershed Active Raingages

Table 5: Nowhere Watershed Precipitation

Gage	Cumulative Depth (millimeters)
A	25.00
B	18.00
C	92.00
D	95.00
E	192.0
F	175.0
G	152.0
H	168.0

Determine:

a) The mean rainfall depth over the watershed for this storm event using the arithmetic mean.

b) The mean rainfall depth over the watershed for this storm event using the Thiessen polygon method.

11. The map excerpt in Figure 3, shows a stream gage labeled as U.S.G.S. no. 1. Various rain gages are shown as rectangles surrounding the catch for the gage for some time interval.

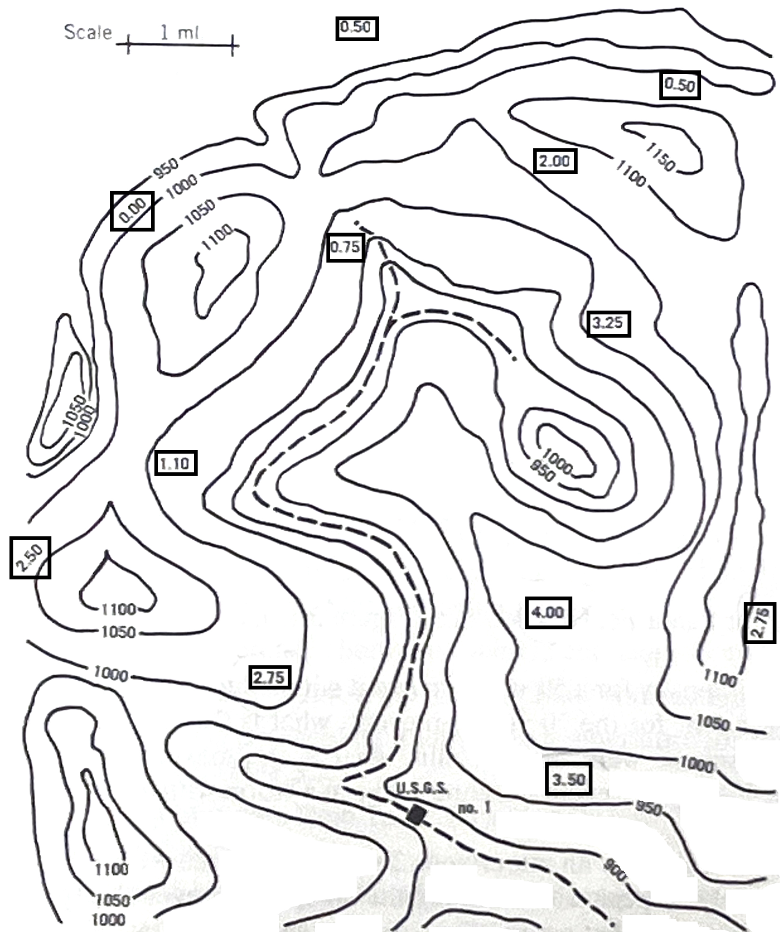

Figure 3: U.S.G.S. No. 1 Area Map

Determine:

a) The drainage area boundary using watershed delineation principles.

b) The drainage area in square miles.

c) The average precipitation over the area by arithmetic mean.

d) The average precipitation over the area by Thiessen polygon method.