CE 3354 Engineering Hydrology
Exam 1 (Alternate) , Fall 2024

Students should write their name on **all sheets of paper**.
Students are permitted to use the internet to help answer questions.
Students are permitted to use their own notes and the textbook.
Students are **forbidden** to **communicate with other people** during the examination.

1. Provide short answers to the following questions:

   a) What is a "watershed?"

   b) What is "excess precipitation ?"

   c) What is "a hyetograph?"

   d) What is "a hydrograph?"

   e) What is "an intensity-duration-frequency curve?"

2. Figure 1 is a hand-drawn topographic map of somewhere in Texas. The drawn contour interval is 20 feet. Most of the contours are labeled — the South-East corner is at elevation $\approx 550ft$. The North-West corner is at elevation $\approx 650ft$.

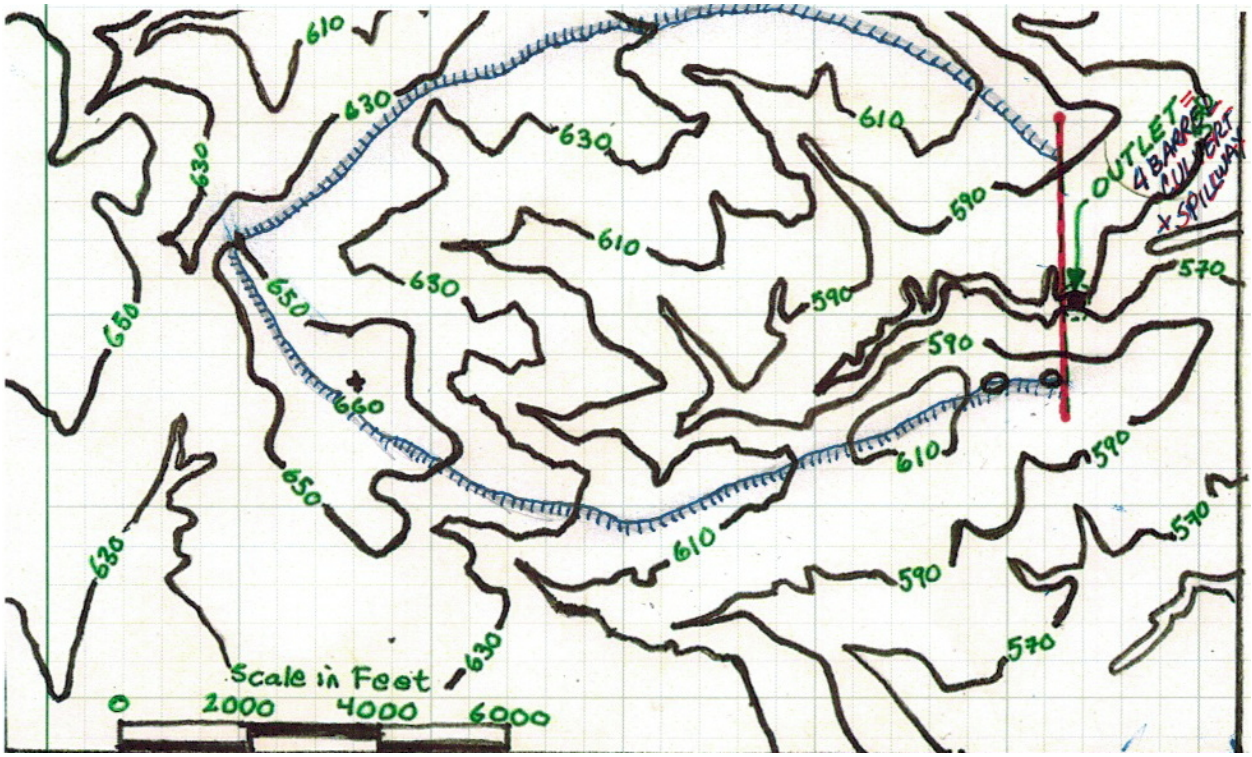

Figure 1: Topographic Map of a portion of the Earth. Elevations and linear distances are in $feet$. North (by convention) is up.

Useful unit conversions:

- 43560 $ft^2 = 1$ $acre$
- 640 $acres = 1$ $square\ mile$
- 5280 $feet = 1$ $mile$

a) What is the area in ft^2, $acres$, and mi^2 depicted by the map [1] on Figure 1 ? Explain by sketch or words how you computed the area.

b) Locate the highest point depicted on the map. Circle this point.

c) What is the numerical value of elevation in feet of this location (read from map)?

d) What is the numerical value of the contour line that encloses this location (read from map — the point is higher than this contour, but the point is entirely enclosed by a contour).

e) Lightly shade the area within the contour.

f) Determine the area in in ft^2, $acres$, and mi^2 of the shaded region. Again explain by sketch or words how you computed the area.

[1] The area of the whole rectangle

g) Delineate the watershed that drains to the location labeled "OUTLET" on the map.

h) Determine the drainage area in in ft^2, $acres$, and mi^2 of the watershed you delineated. Show any relevant calculations below. Describe how you estimated the drainage area.

i) Draw three different flow paths from the highest elevation portion of the watershed to the outlet. Determine the length in ft of these paths.

j) Determine the slope (dimensionless) of the longest path.

3. A dam is to be is built on the Eastern portion of the valley, near the outlet shown on Figure 1. The dam spillway crest (elevation at which discharge over the dam is uncontrolled) is 595 $feet$. The alignment of the dam is depicted by the vertical dashed line segment next to the outlet.

   (a) Estimate the volume of water stored when the dam impounds water to a water surface elevation of 565 $feet$.

   (b) Estimate the volume of water stored when the dam impounds water to a water surface elevation of 570 $feet$.

   (c) Estimate the volume of water stored when the dam impounds water to a water surface elevation of 580 $feet$.

   (d) Estimate the volume of water stored when the dam impounds water to a water surface elevation of 590 $feet$

   (e) Estimate the volume of water stored when the dam impounds water to a water surface elevation off 595 $feet$

Work Area

4. Figure 2 is a plot of the accumulated rainfall for the area depicted by the map in Figure 1. Table 1 is the actual values used to generate the plot. Figure 3 (The figure is blank; the student is to complete the figure.) is a plot of the incremental depths. Using the figure and data determine the following:

   (a) During what interval does the largest hourly rainfall occur?

   (b) Complete the table and Figure 3 by computing the incremental depths for the corresponding time intervals. Remember that the accumulated depth is the depth at the end of the interval.

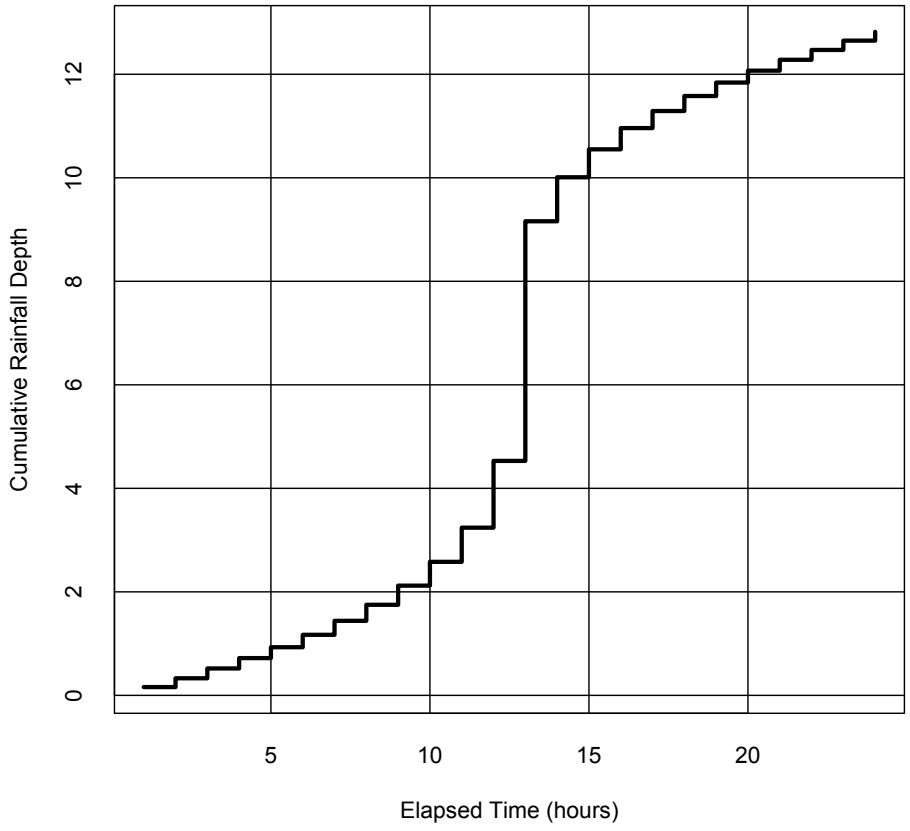

Figure 2: Cumulative rainfall for a 24-hour period on watershed determined for Figure 1

Table 1: Cumulative Rainfall for Figure 2

Elapsed Time (hours)	Cum. Rainfall	Inc. Rainfall
1	0.16	
2	0.33	
3	0.52	
4	0.72	
5	0.93	
6	1.17	
7	1.44	
8	1.75	
9	2.12	
10	2.58	
11	3.24	
12	4.53	
13	9.16	
14	10.01	
15	10.55	
16	10.96	
17	11.29	
18	11.58	
19	11.84	
20	12.07	
21	12.28	
22	12.47	
23	12.65	
24	12.82	

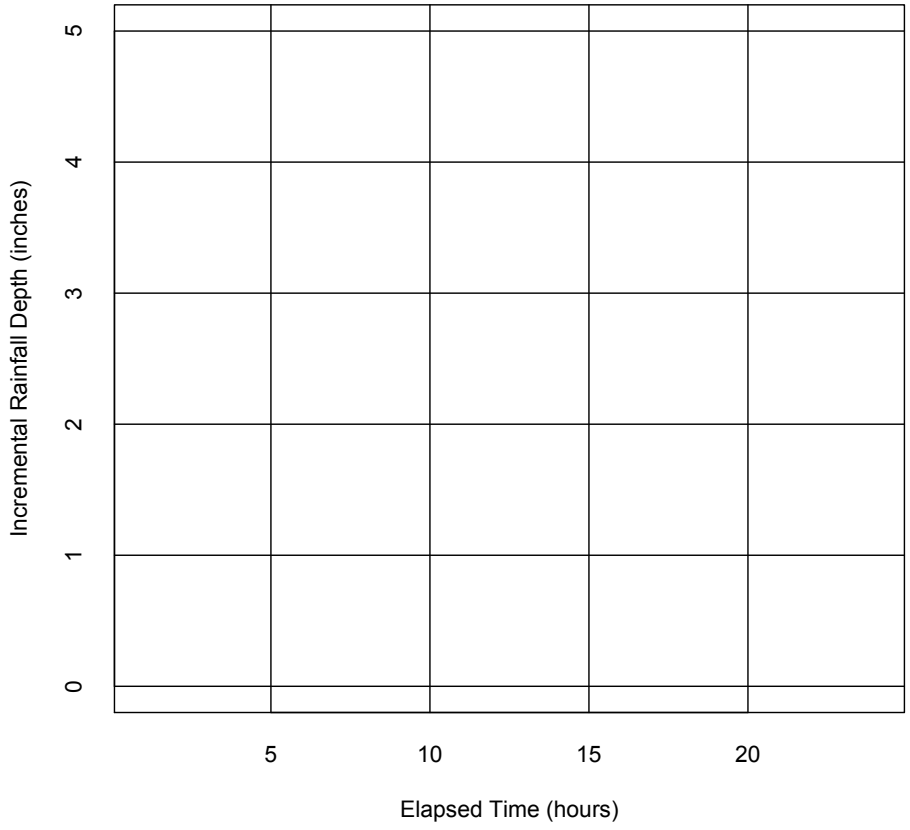

Figure 3: Incremental rainfall for a 24-hour period on watershed determined for Figure 1

5. Figure 4 is an observed runoff hydrograph at the watershed outlet (for the watershed in Figure).

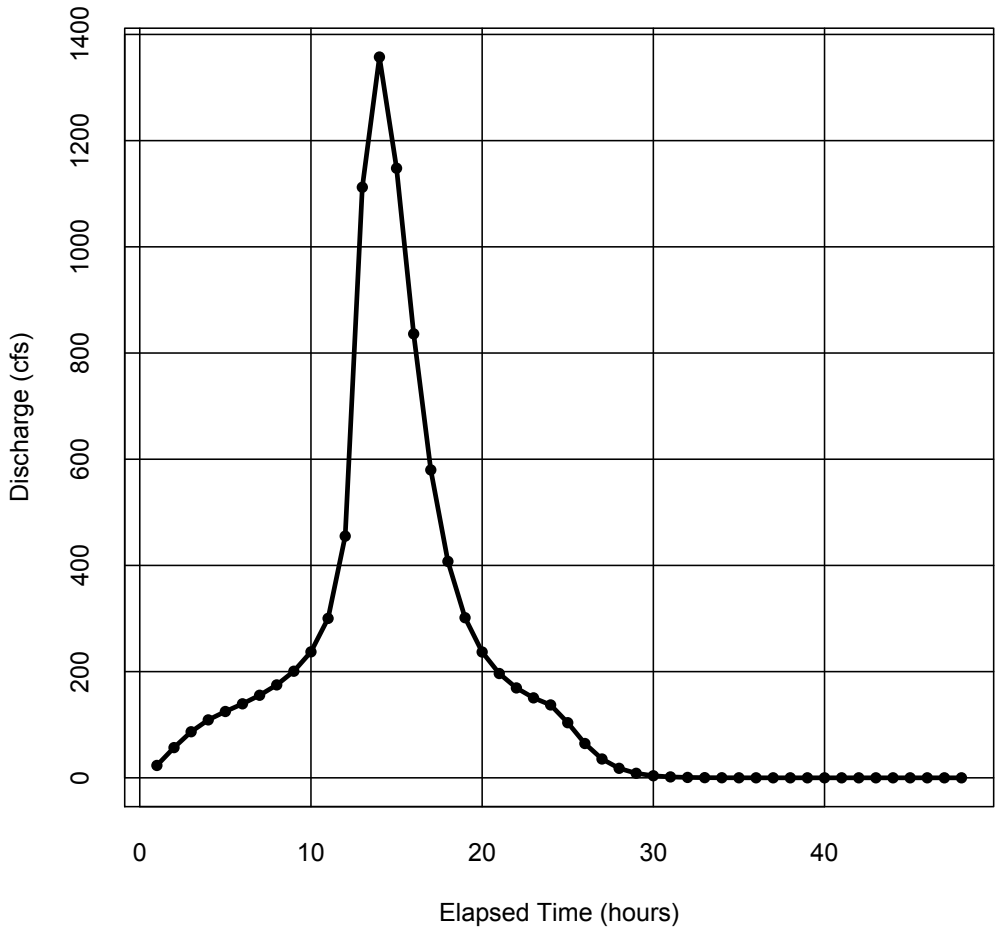

Figure 4: Observed runoff hydrograph for rainfall in Table 1

Determine the following:

(a) What fraction of rainfall in total is converted into runoff?

(b) What is the watershed response time from peak rainfall to peak runoff ?

Work Area