Name:________________________________

Lab day: Tuesday Wednesday

ENVG/SC 10110L-20110L PLANET EARTH LABORATORY

Laboratory #9: Surface Hydrology & Map Scale

Readings: Chapter 9. http://www.nd.edu/~cneal/PhysicalGeo/Lab-SurfaceHydrology/index.html
Today's Lab is out of 90 points.

OBJECTIVE 1: Recognizing surface water features on maps and interpreting the significance of these.

OBJECTIVE 2: Understanding map scales (i.e., bringing the map to life!).

Introduction: Today, running water is the most important agent of erosion. When streams stay within their channels, they are often used as sources of fresh water, or transportation, and for recreation. However, when the discharge (volume of water per unit of time) increases beyond the capacity of the stream channel, flooding occurs. "Flooding is the leading cause of property loss from natural disasters…" (FEMA Acting Regional Director Tammy Doherty). Flooding is a serious potential threat in all parts of the United States.

Part I Characteristics of Three Stream Valleys

1) The following questions are drawn from Figures 8.10, 8.11, and 8.12 on pages 137-139 of your lab manual. **Note:** Early, Middle, and Late Stages of stream formation refers to changes in the evolution of a stream, characterized by increasing numbers of features such as meander belts and oxbow rivers. It does not refer to the *age* of a stream. For example, a geologically old stream may have very few features if erosion is slower than uplift of the surrounding landscape

1a) Using the maps (**Figures 8.10, 8.11, and 8.12**) in your lab manual, identify the following features. Note that these features may appear on **more than one** of the maps or may not appear on any of the maps. Fill out the following Table (33 Points).

Floodplain
Natural Levees
Yazoo streams
Cutoffs
Meanders
Back swamps
oxbow lakes

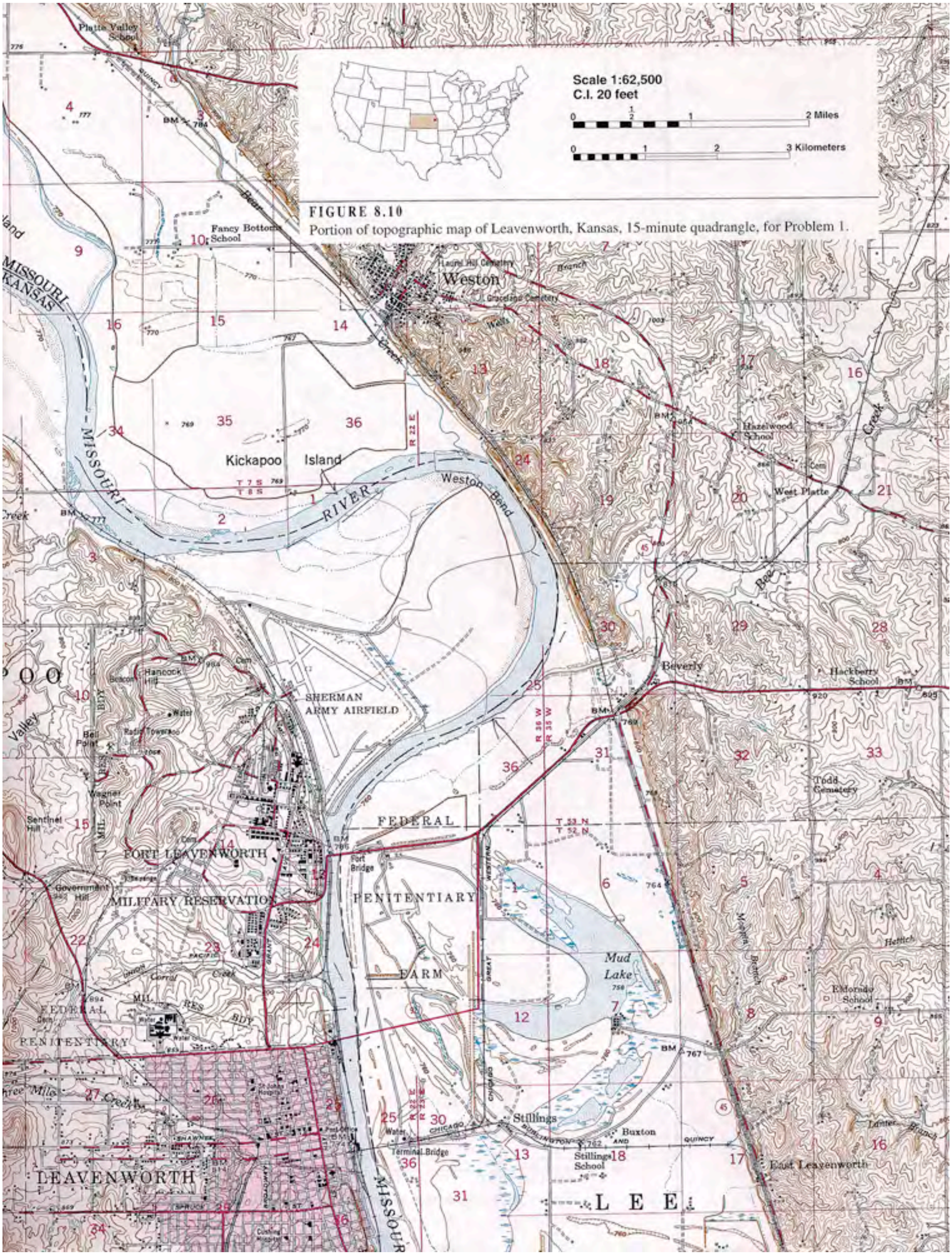


FIGURE 8.10
Portion of topographic map of Leavenworth, Kansas, 15-minute quadrangle, for Problem 1.

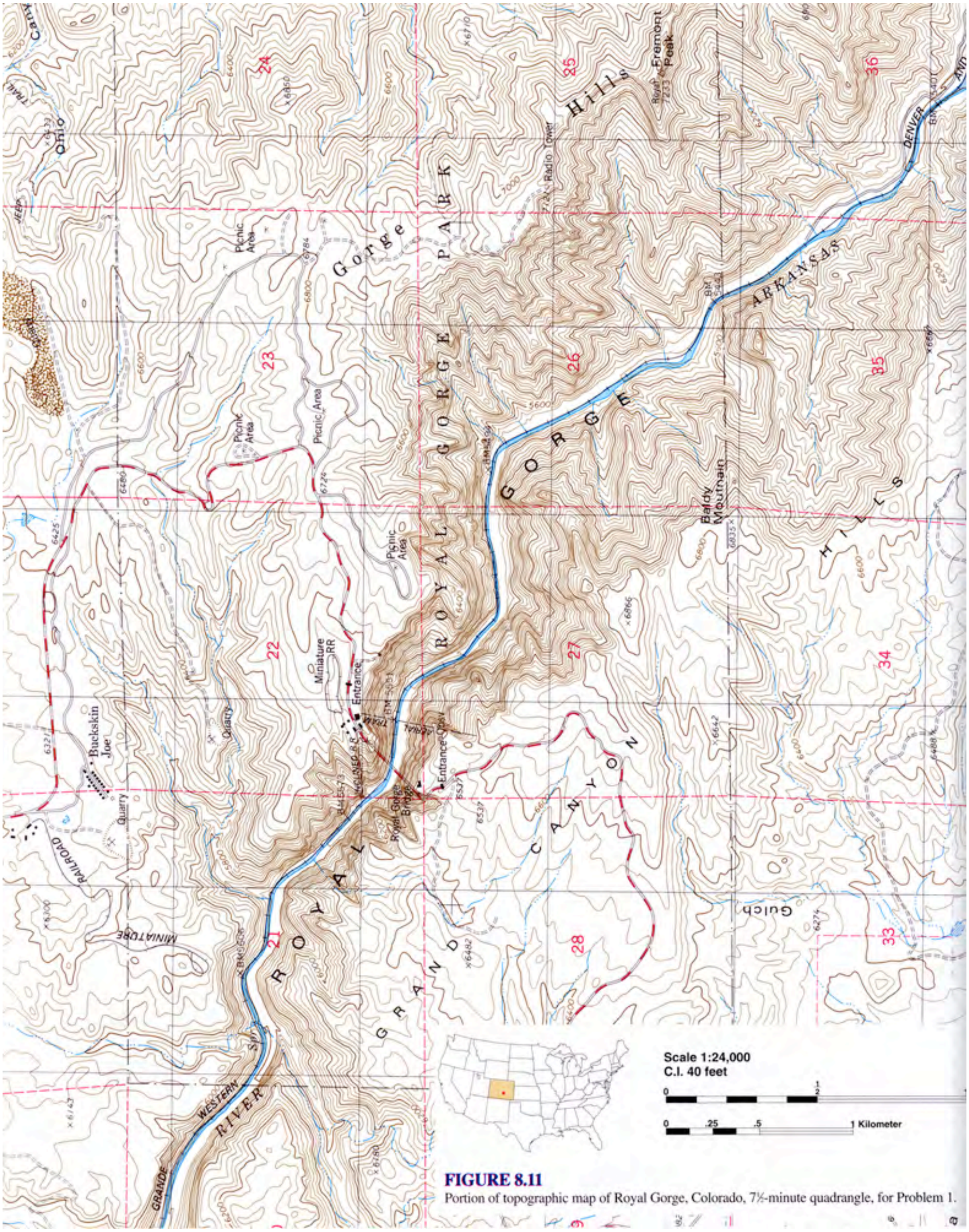


FIGURE 8.11
Portion of topographic map of Royal Gorge, Colorado, 7½-minute quadrangle, for Problem 1.

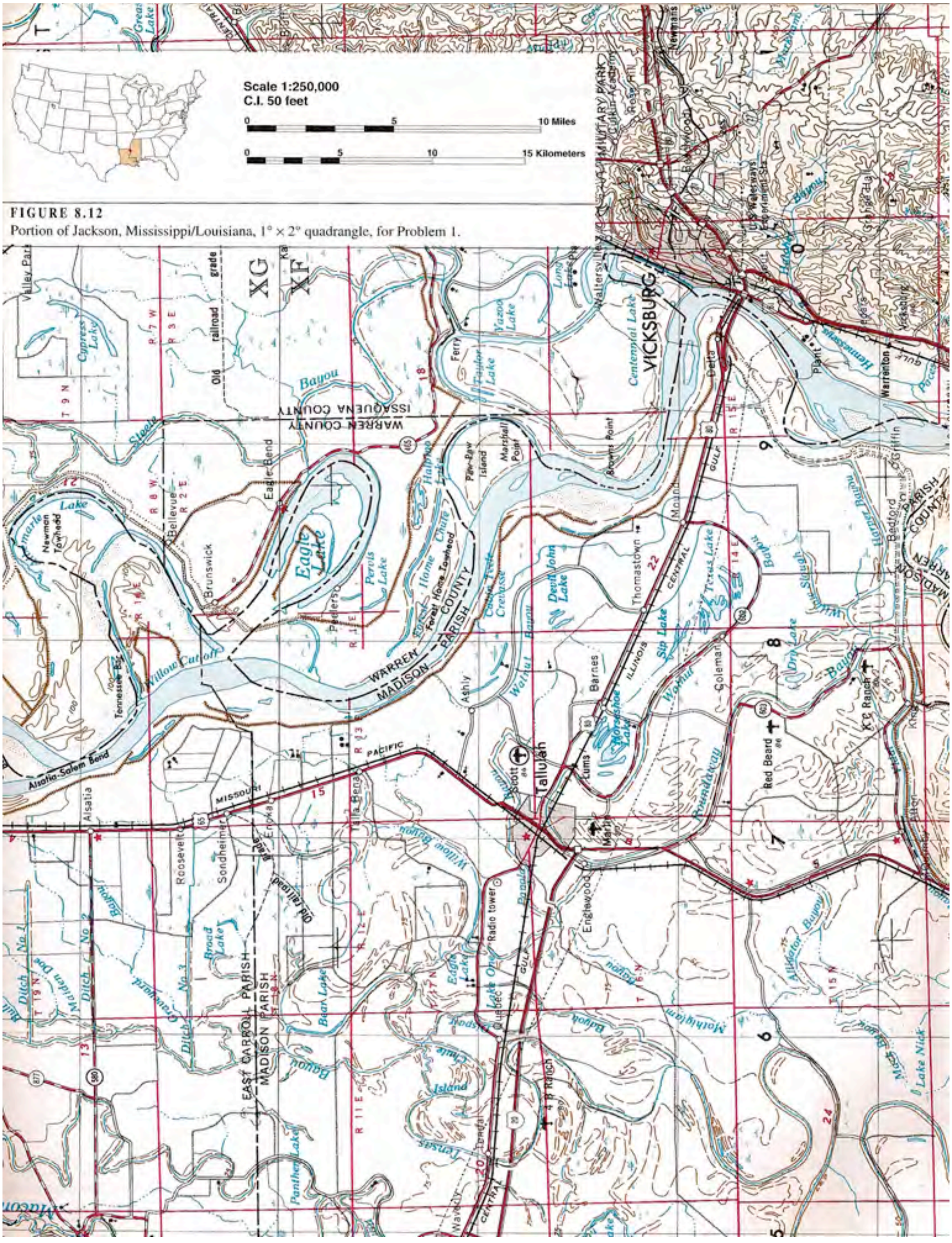


FIGURE 8.12
Portion of Jackson, Mississippi/Louisiana, 1° × 2° quadrangle, for Problem 1.

Table 1. Characteristics of Early, Middle, and Late Stage Stream Valleys

Stream Characteristics	Missouri River (Figure 8.10)	Arkansas River Figure 8.11	Mississippi River Figure 8.12
Presence of: (tick if present, cross if not) (1 pt each)			
Floodplain			
Meanders			
Natural Levees			
Back Swamps			
Yazoo Streams			
Oxbow Lakes			
Cutoffs			
Width of Floodplain (if present and measurable – if floodplain continues off the map, measure to the edge of the page) (1 pt each)			
Floodplain vs. meander-belt width (floodplain/meander belt) (1 pt each)			
Is vertical or lateral erosion more important (or are both equal?): (1 pt each)			
Is this river an example of early, middle or late stage development? (1 pt each)			

Part II Flooding

2) The broad valley containing the Minnesota River at Jordan, Minnesota was carved when much more water flowed down the river than is currently present. This event took place about 10,000 years ago during the melting of the continental ice-shield, and the draining of Glacial Lake Agassiz.

2a) The gaging station at the bridge north of Jordan monitors the *stage*, or level of the river, as well as the discharge and water quality. The stage here is the number of feet above the gaging-station of 690'. Table 2 shows the maximum stage reached during selected years from 1935 through 1994. A relative magnitude, *m*, has been assigned to each stage and is recorded in column 3 of Table 2. The highest maximum stage was reached in 1965, so its magnitude, *m,* is 1; the lowest stage was attained in 1940 (not shown on the table), and its magnitude is 60 (the table summarizes 60 years of records).

Table 2.0: Selected Data from the Gauging Station on the Minnesota River near Jordan, Minnesota, 1935-1994 (Source: USGS)

Year	Maximum Stage, Feet	Magnitude, *m*	Percent Probability of Occurrence *(P)*
1936	22.43	24	
1942	14.36	47	
1946	18.22	39	
1952	28.31	4	
1958	12.30	54	
1959	8.37	58	
1964	16.15	45	
1965	34.37	1	
1969	32.85	3	
1975	23.71	17	
1976	11.19	56	
1984	27.54	6	
1985	25.05	14	
1986	26.30	7	
1990	20.23	31	

Construct a ***flood-frequency curve*** as follows:

Calculate the *percent probability of recurrence*, ***P***, for each of the events listed in Table 2, and record it in column 4 of Table 2. *P* is the percent probability that a stage of a particular height will recur – be reached or exceeded – in a given year. It is determined by:

$$P=100 * m/ (n + 1)$$

Where *n* is the number of years for which records were kept, and *m* is the relative magnitude of the event. For example, for a stage that ranked 30^{th} in magnitude for a period of 60 years, P = 100 * 30/(60+1)= 49.2% (15 points)

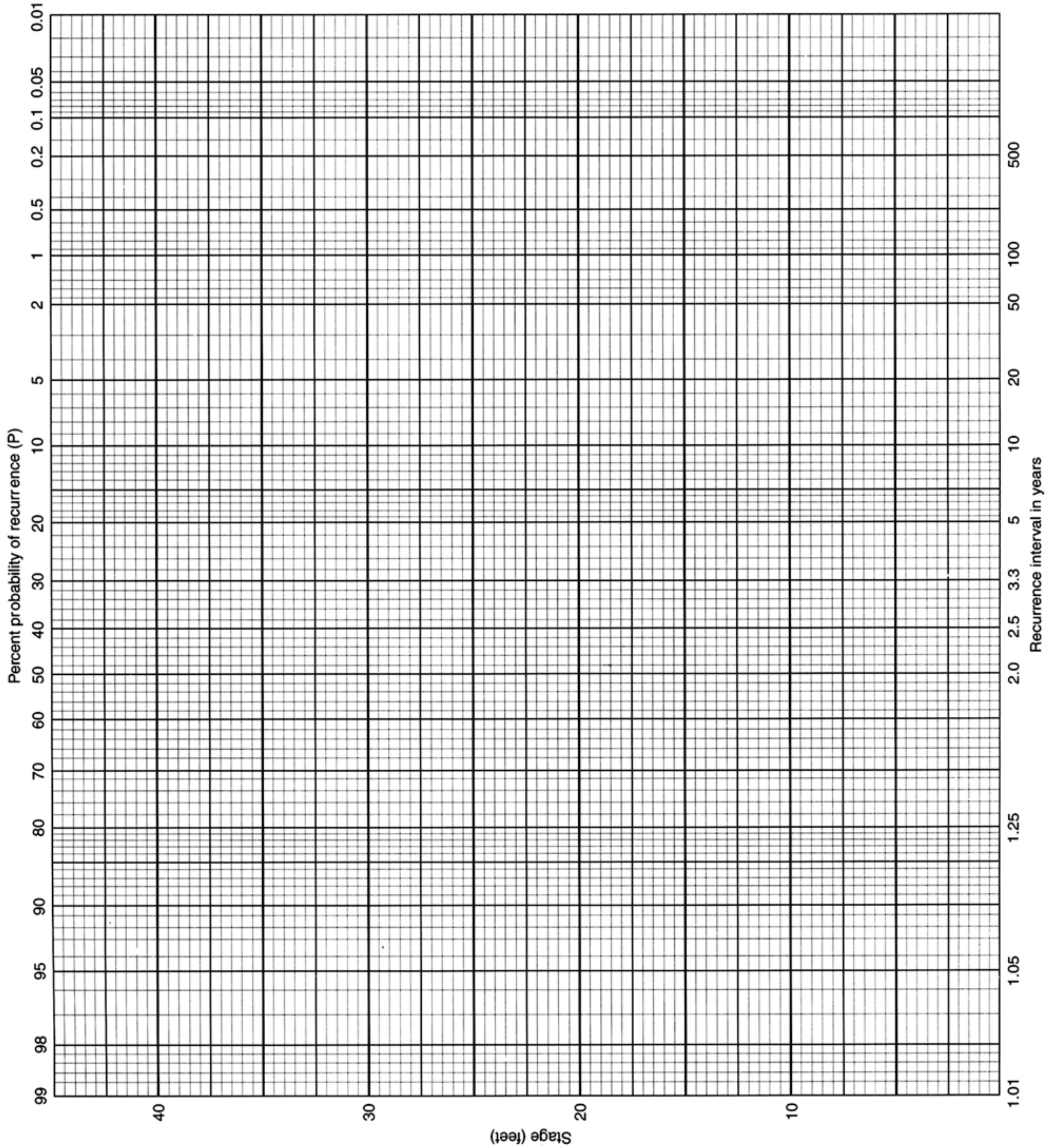
Plot the data in Table 2 on the graph paper provided. Be sure to use the scale at the top of the graph, labeled *Percent probability of recurrence (P)* when plotting your numbers. Then draw (estimate) a **best-fit** straight line through the data points to complete the flood frequency curve. The graph paper is called probability paper, because it can be used to determine the probability, or likelihood that the event plotted on it will occur. In the example above, there is a 49.2% probability that a stage equal to that reached during the *m*=30 event will be reached in any given year. (10 pts)

2b) The ***recurrence interval***, or average *time* interval between similar-flood events, is another way of describing recurrence. The recurrence interval, *RI*, is given by:

$$RI = (n + 1)/ m$$

And *RI*=100/*P*. Values for the recurrence interval are shown on the lowest part of the graph. Note that a 49.2% probability of recurrence also means that a stage of value would be reached, on average, about every two years. The probability of a 50-year flood (one with a recurrence interval of 50 years) in any given year is 0.02, or 2%. Thus, there is always a probability of a 50-year flood, even if one had occurred just the previous year. Conversely, there is no guarantee that a 50-year flood will re-occur every 50 years.

The maximum stage of the summer of 1993 flood was 33.52 feet. Using your flood-frequency curve and best-fit straight line, **determine** what the **recurrence interval** was for that flood in this location. (4 pts)



Part 3: 10 Points: Round to the nearest 0.25 mile or whole kilometer/foot. For each question, 1 point for each correct answer, 1 point for showing how you arrived at the answer (20 pts total).

Name *Section* *Date*

EXERCISE 8

PROBLEMS IN SCALE CONVERSION

1. Convert the following representative fractions to ground distances equal to one inch on a map. (Fill in the following blanks.)
   - (a) 1:24,000 1 inch = _____ feet
   - (b) 1:31,680 1 inch = _____ miles
   - (c) 1:48,000 1 inch = _____ miles
   - (d) 1:62,500 1 inch = _____ miles
   - (e) 1:250,000 1 inch = _____ miles
   - (f) 1:1,000,000 1 inch = _____ miles
   - (g) 1:1,000,000 1 cm = _____ km
2. A map of unknown scale shows two TV transmitting towers. On the map the towers are 1.2 inches apart and the actual ground distance between them is 1,000 feet. What is the R.F. of the map? ____________________
3. A straight stretch of road on an aerial photograph was found to be 500 yards long. The same road segment measured on the photograph was three-fourths of an inch. What is the R.F. of the photograph? RF is ____________________
4. A foreign map has an R.F. of 1:500,000. How many kilometers on the ground are represented by 10 centimeters on the map? ____________________ km.

SHOW YOUR CALCULATIONS:

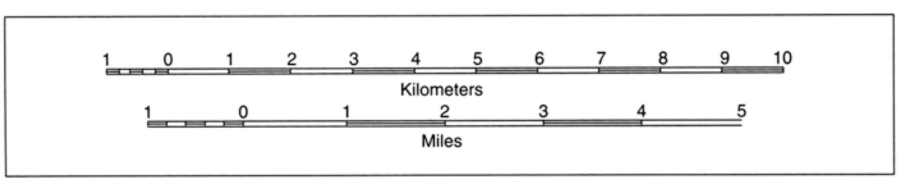


FIGURE 2.9

Two bar scales from a recent U.S.G.S. topographic map.

NOTE: R.F. = Representative Fraction.
1760 yards = 1 mile; 12 inches = 1 foot; 1 km = 1000 meters; 1 meter = 100 cm.