

# Flood effects

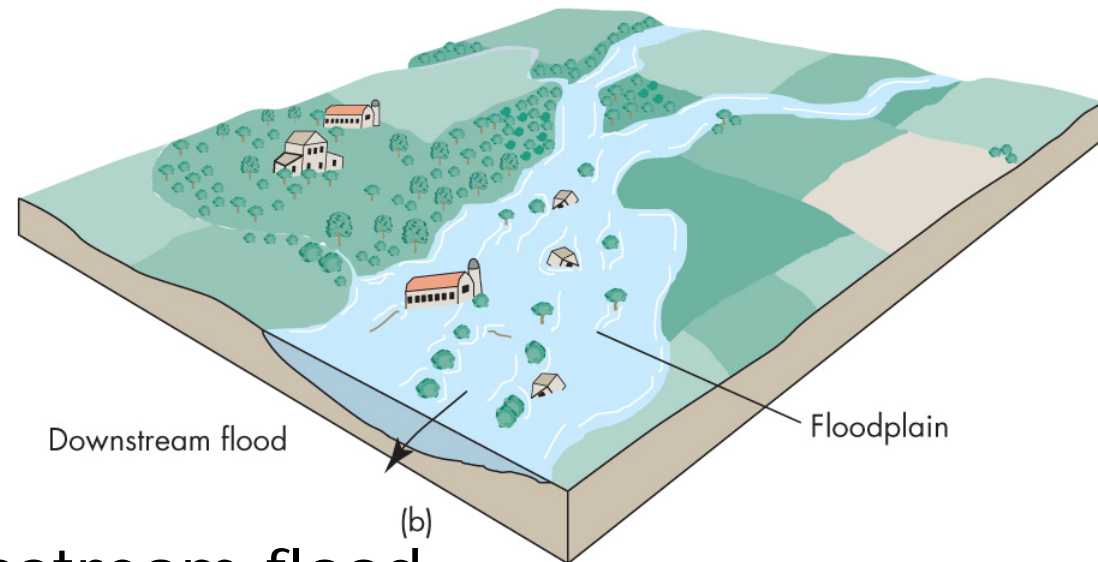
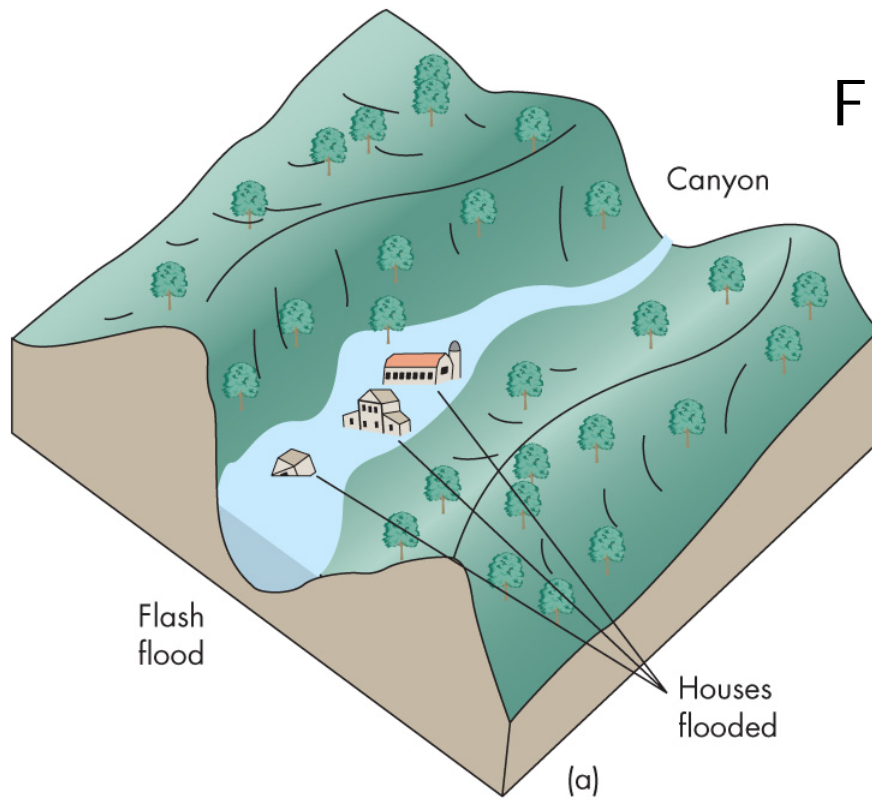


# Flood deposits



West Virginia flash flood – boulder bars

# Flash flood



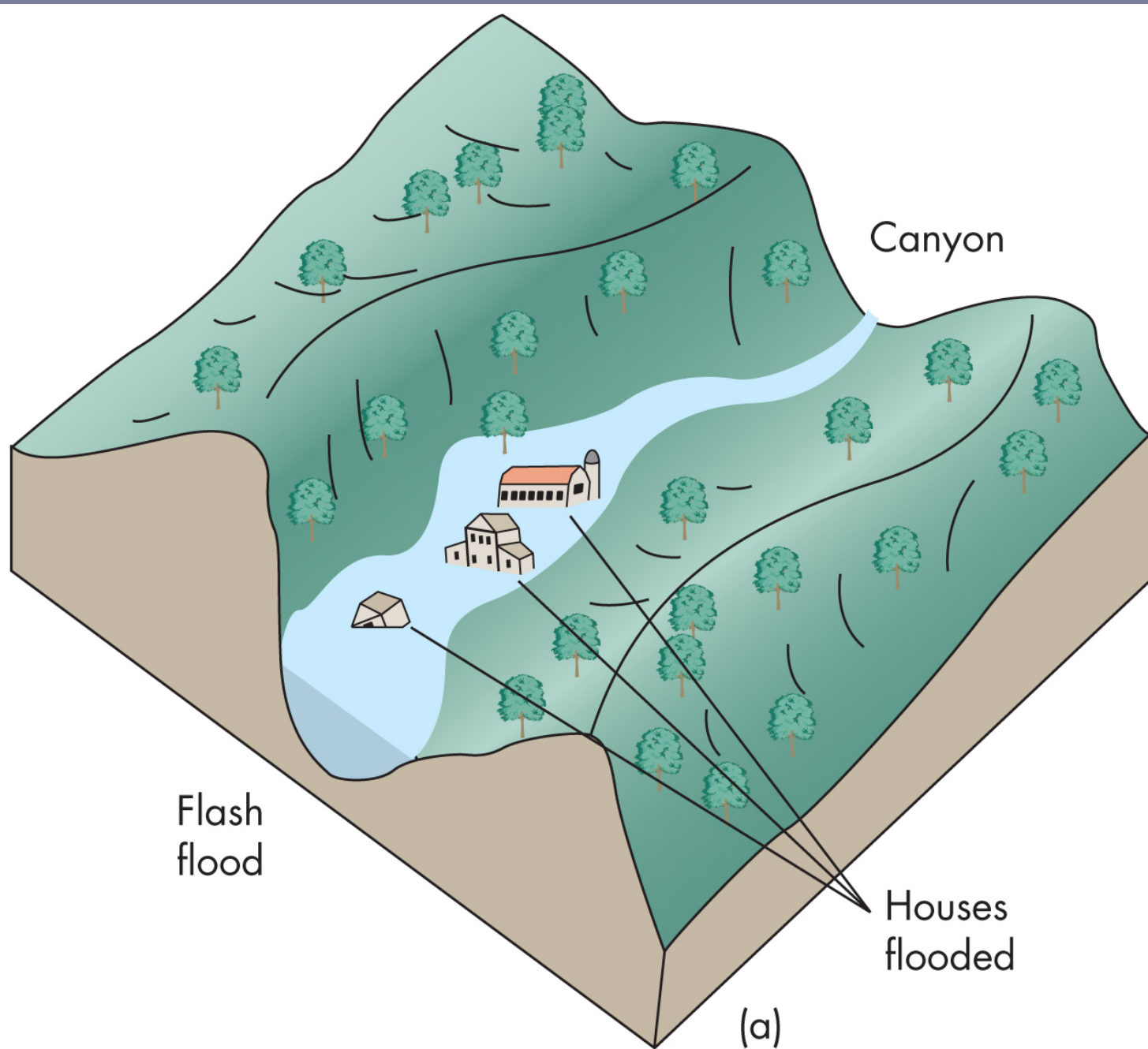
# Downstream flood

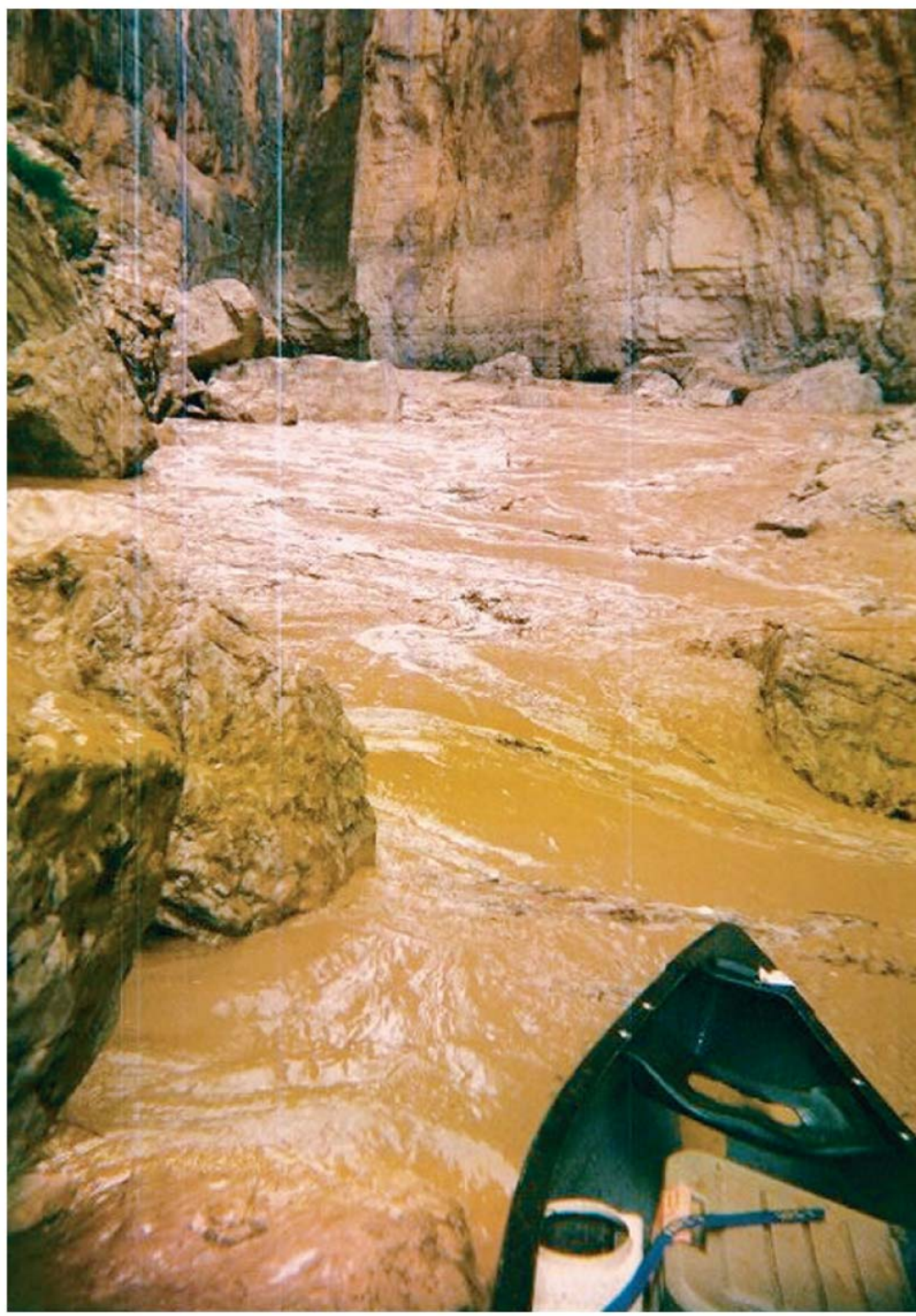


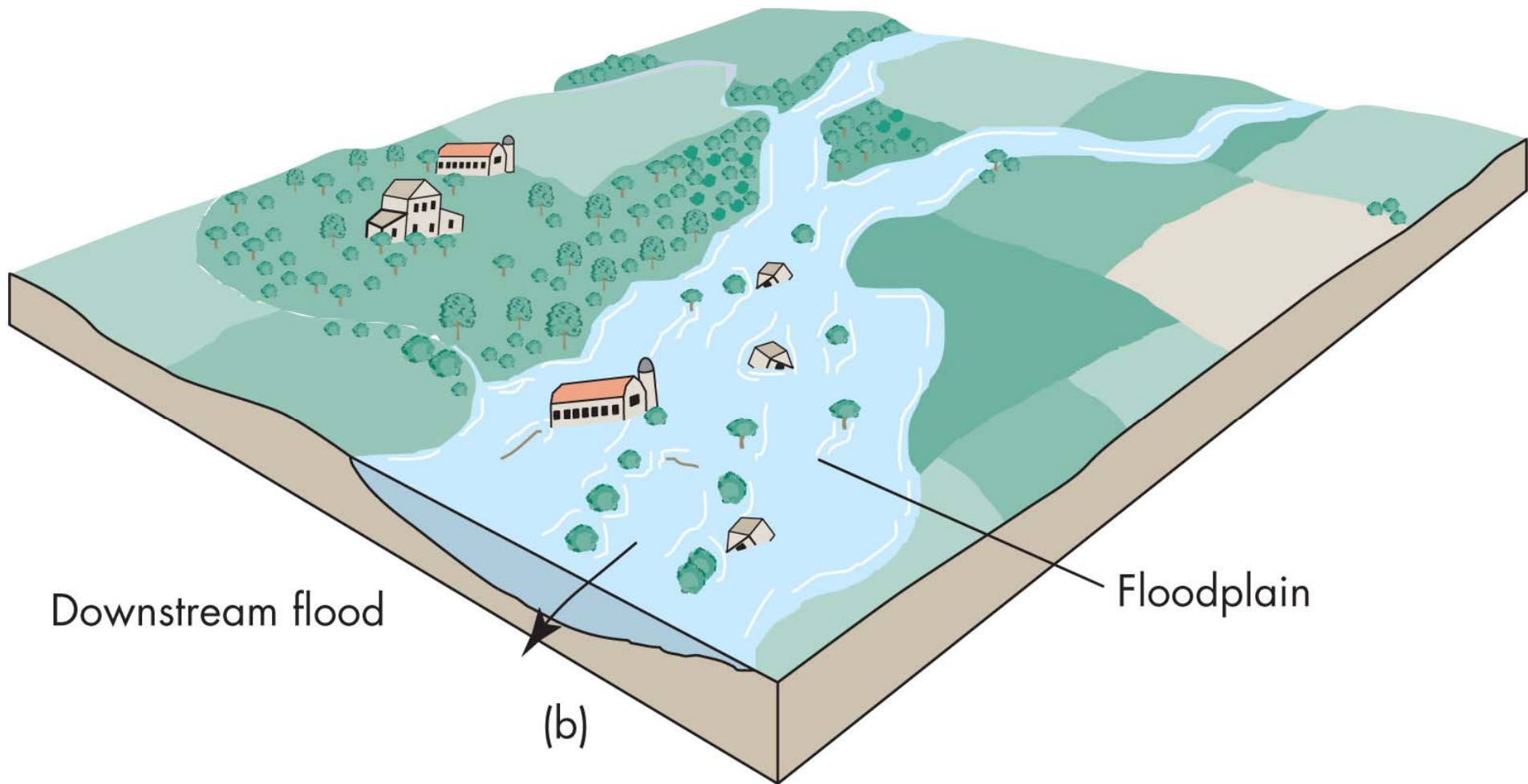
(a)



(b)





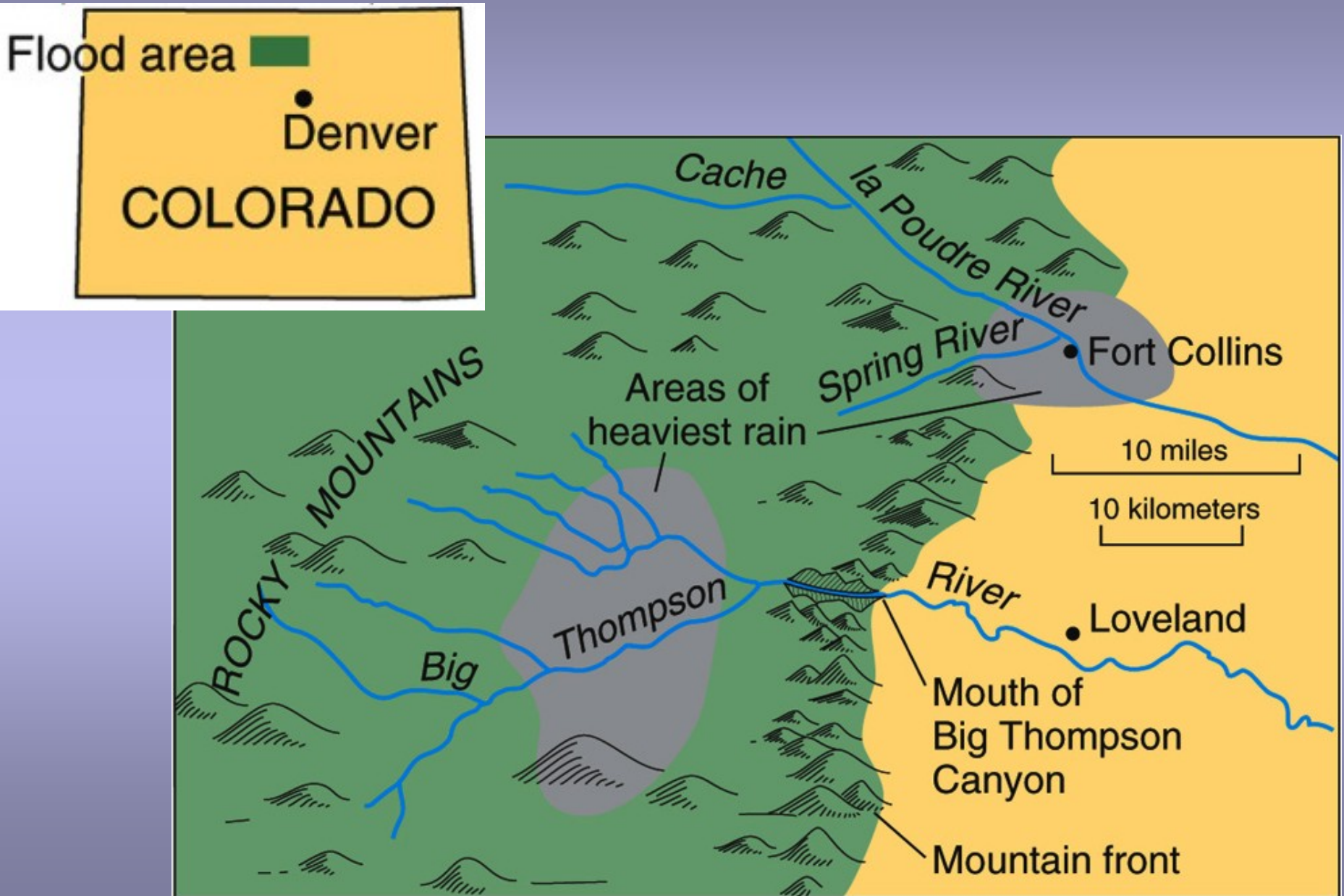








# Setting for major floods



# Big Thompson Canyon 1976



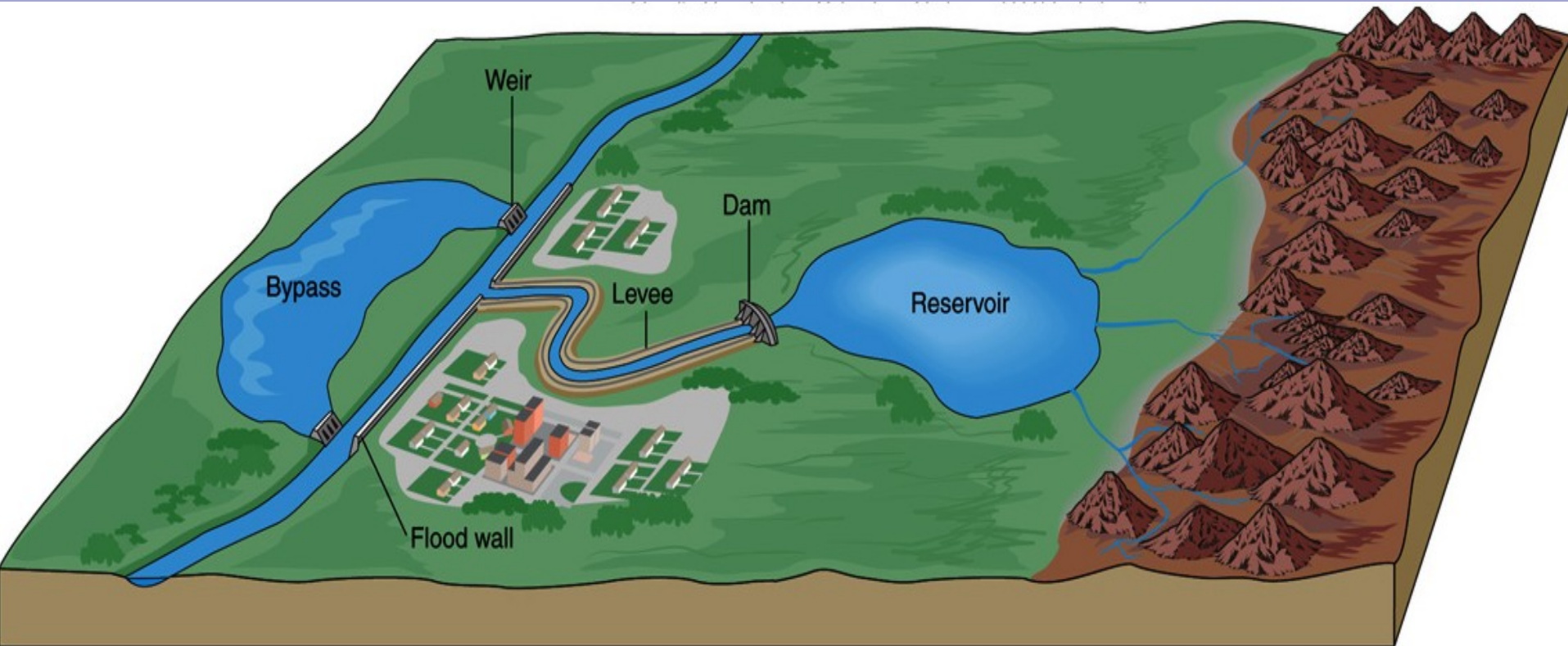
# Fort Collins 1997

Increasing problem with major development along the Colorado Front Range over the last 15 years



# Engineering for flood control

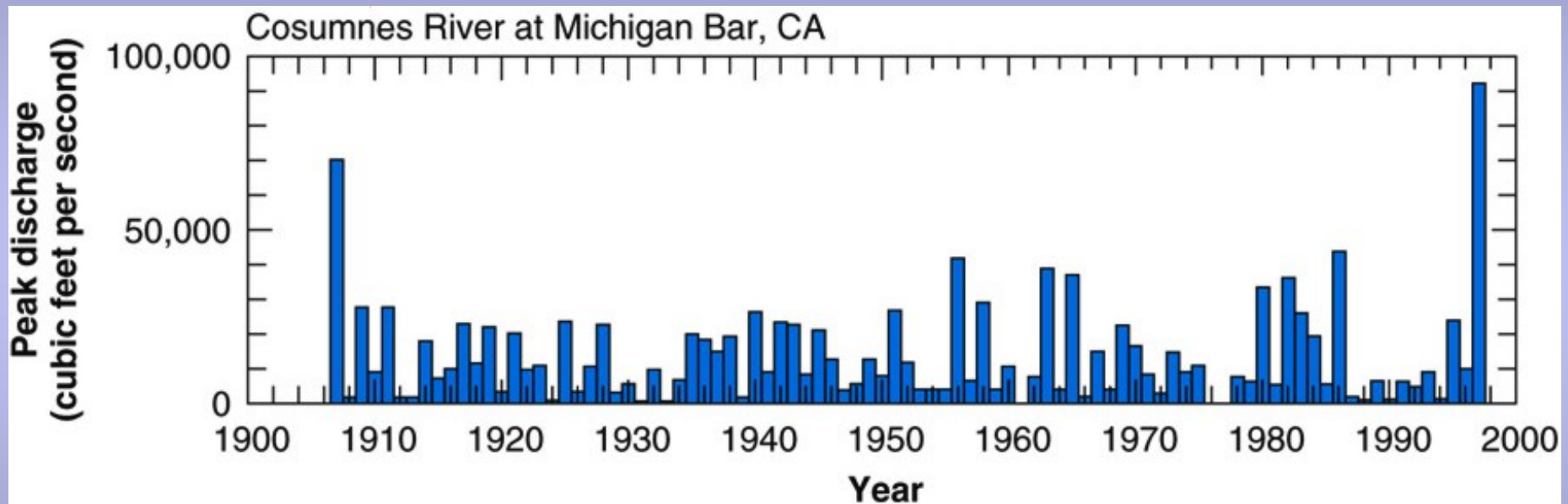
Many flood-prone municipalities are now adding flood-control structures



For example, eastern suburbs of Salt Lake City are built on alluvial fans

# Determining the flood recurrence interval

Floods, like earthquakes and storms, follow a *power-law distribution*



Which means, many small floods, fewer moderate floods, and very few major floods

# Ranking the floods for a river

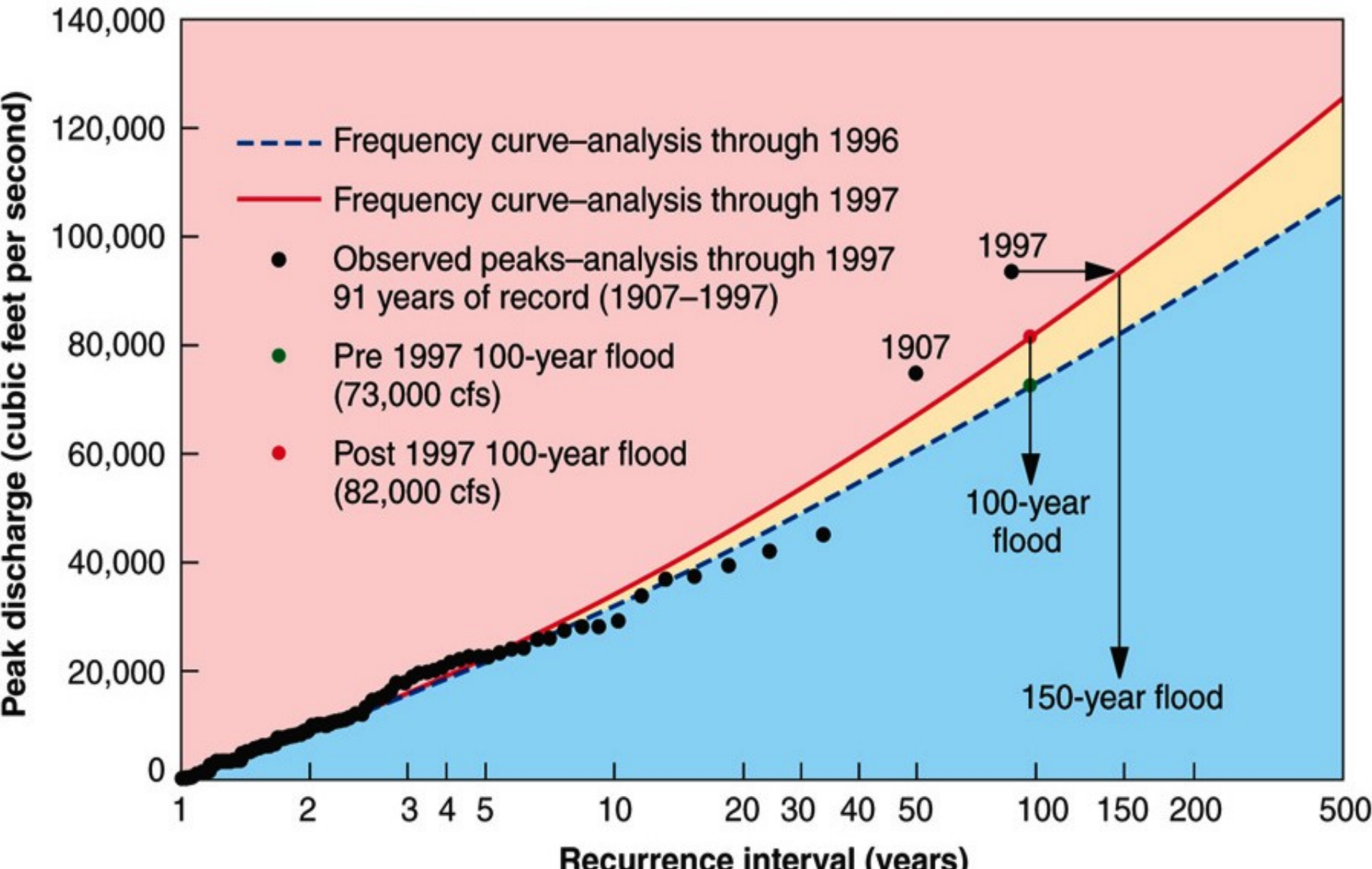
\*\* the recurrence intervals are probabilities \*\*

**Box 10.2** Annual Peak Discharges and Recurrence  
**Table 1** Intervals in Rank Order for the Cosumnes River at  
Michigan Bar, California.

Year	Peak Discharge (cfs)	Magnitude Rank (m)	Recurrence Interval
1997	93,000	1	91.0
1907	71,000	2	45.5
1986	45,100	3	30.33
1956	42,000	4	22.75
1963	39,400	5	18.42
1909	28,400	10	9.20
1943	22,900	20	4.60
1970	16,800	30	3.07
1960	11,200	40	2.30
1971	8,590	50	1.84
1991	6,670	60	1.53



Sometimes,  
the predictions must be recalculated



# The Great Flood of 1993

## Mississippi and Missouri Rivers



# Conditions

Wetter than normal spring, soils saturated

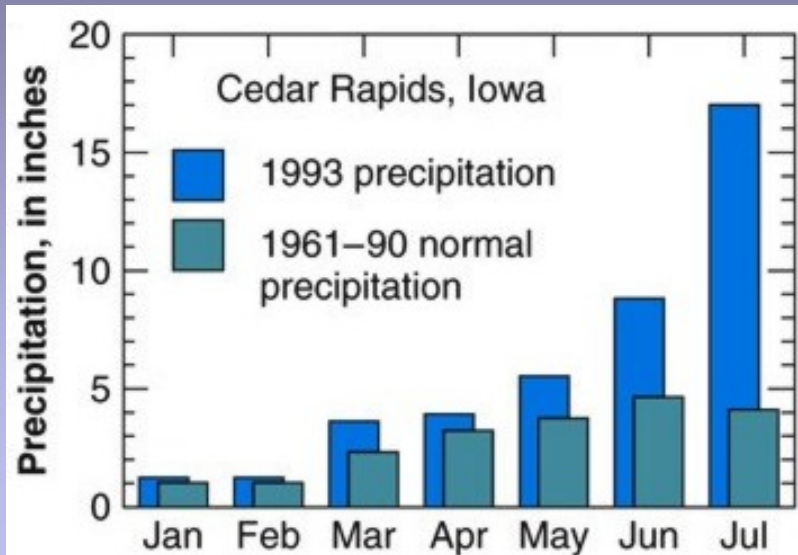
Starting in late May, through July, a persistent low pressure system sat over Iowa

Peak rainfall exceeded 4 inches per hour

Several tributary rivers exceeded 100-year discharges – Missouri, Iowa, Platte, Raccoon

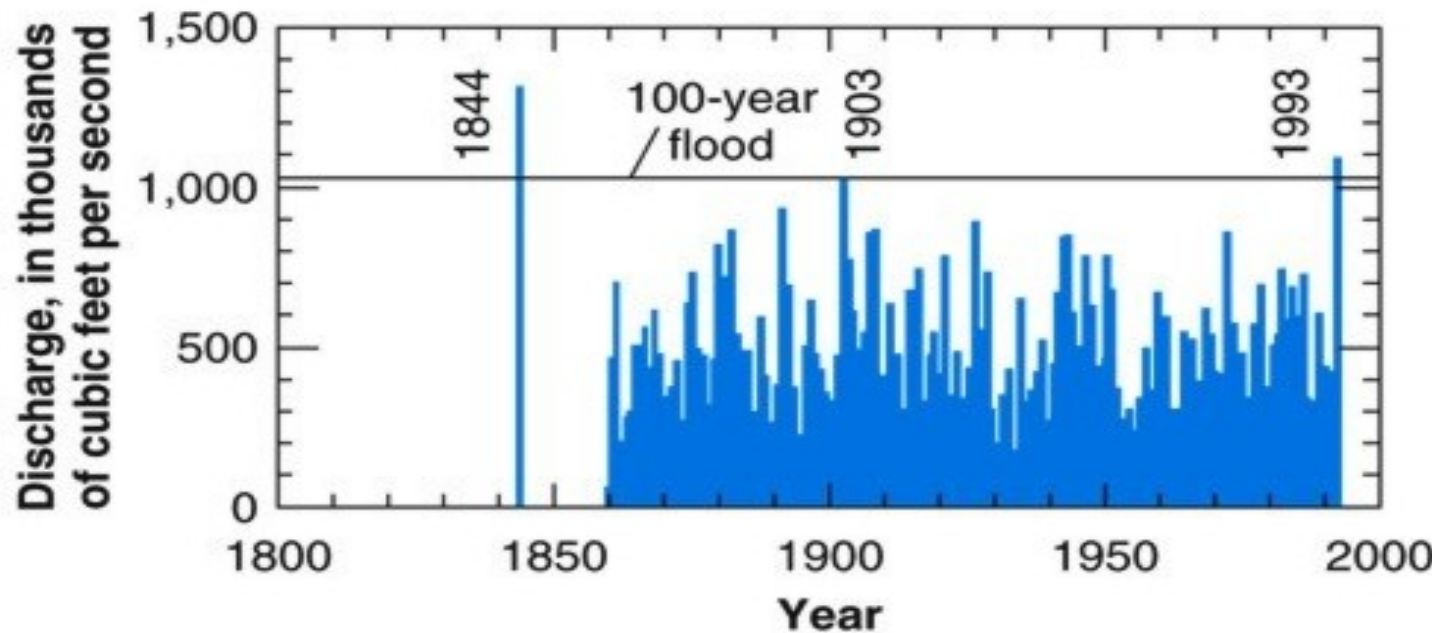
Discharge of the Mississippi River at St. Louis exceeded 1 million cfs  
(a cube of water 100 x 100 x 100 feet)

# Precipitation and river discharge



An aside: Many of the greatest floods in U.S. history occurred in the mid 1800s.

*Any guesses why?*



# Effects of the 1993 flood

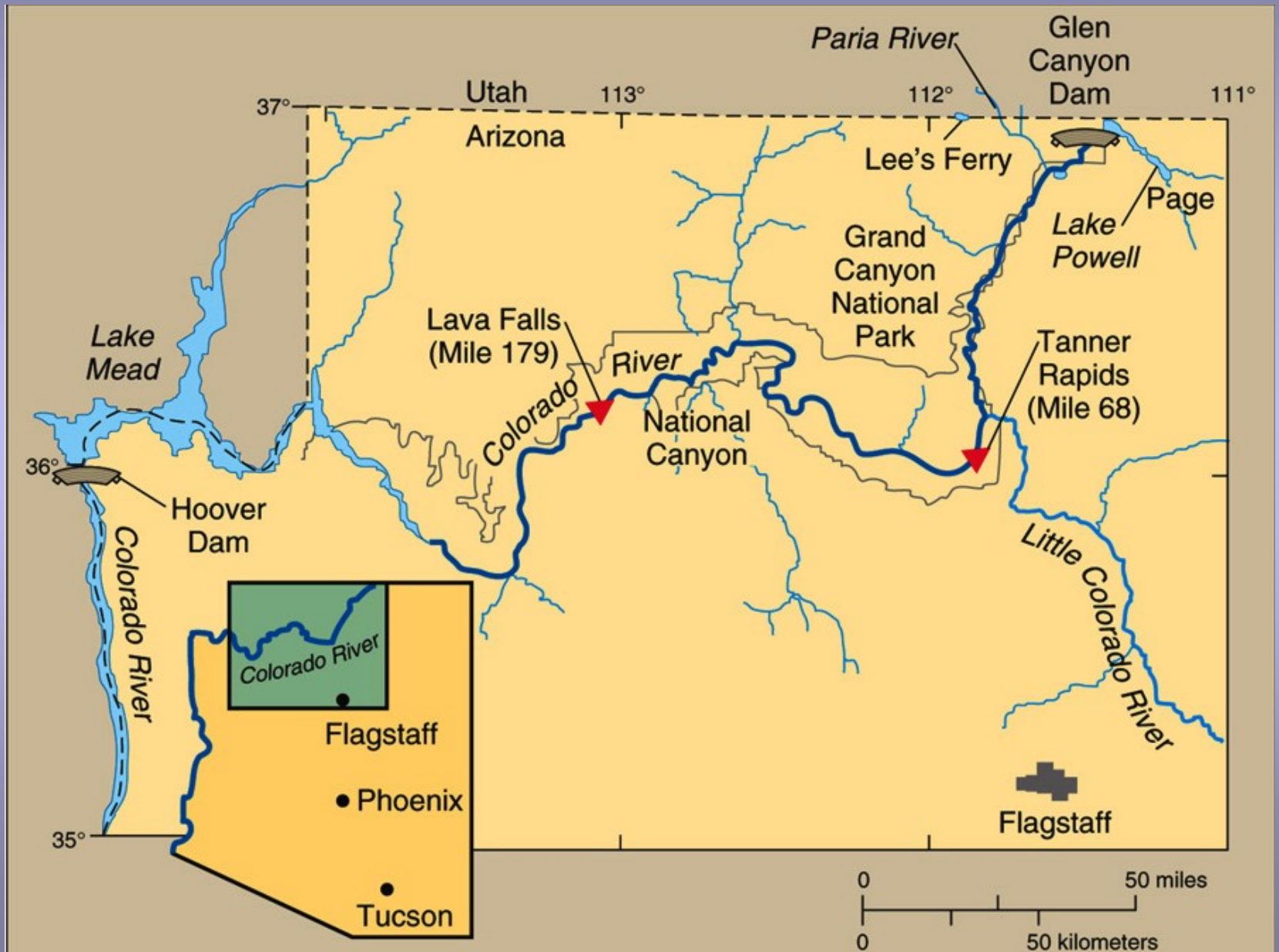
Discharge downstream of the confluence of the Missouri and Mississippi Rivers exceeded the predicted 500-year flood height

Breaches of levees resulted in flooding farms and developed areas in the flood plain

6.6 million acres flooded in 9 states

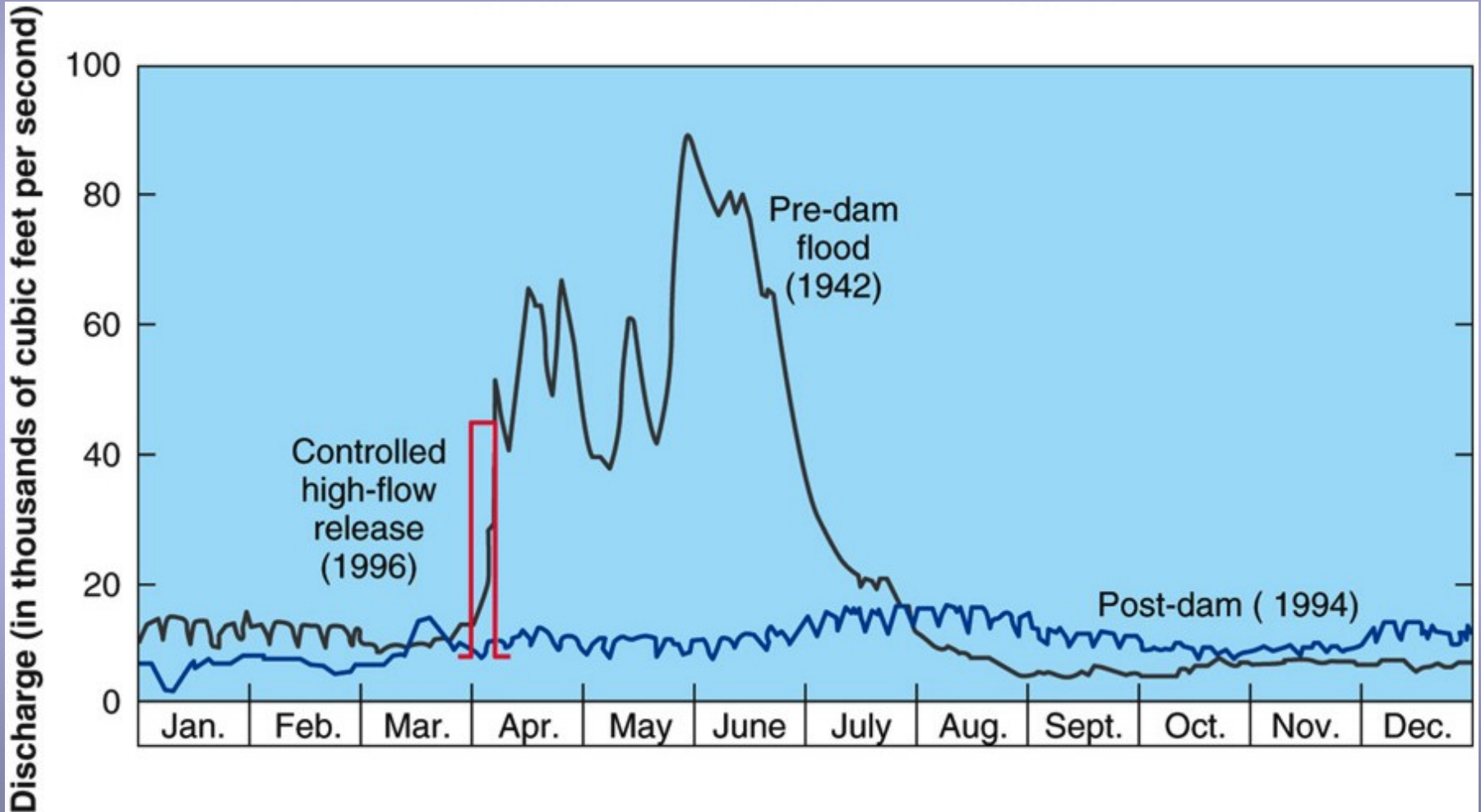
\$20 billion in damage to property & crops

# Colorado River experiment 1996



# Colorado River hydrographs

Glen Canyon Dam was completed in 1963



The upstream dams cut off the sand supply

The only input of sediment was from the smaller tributaries – Paria and Little Colorado Rivers

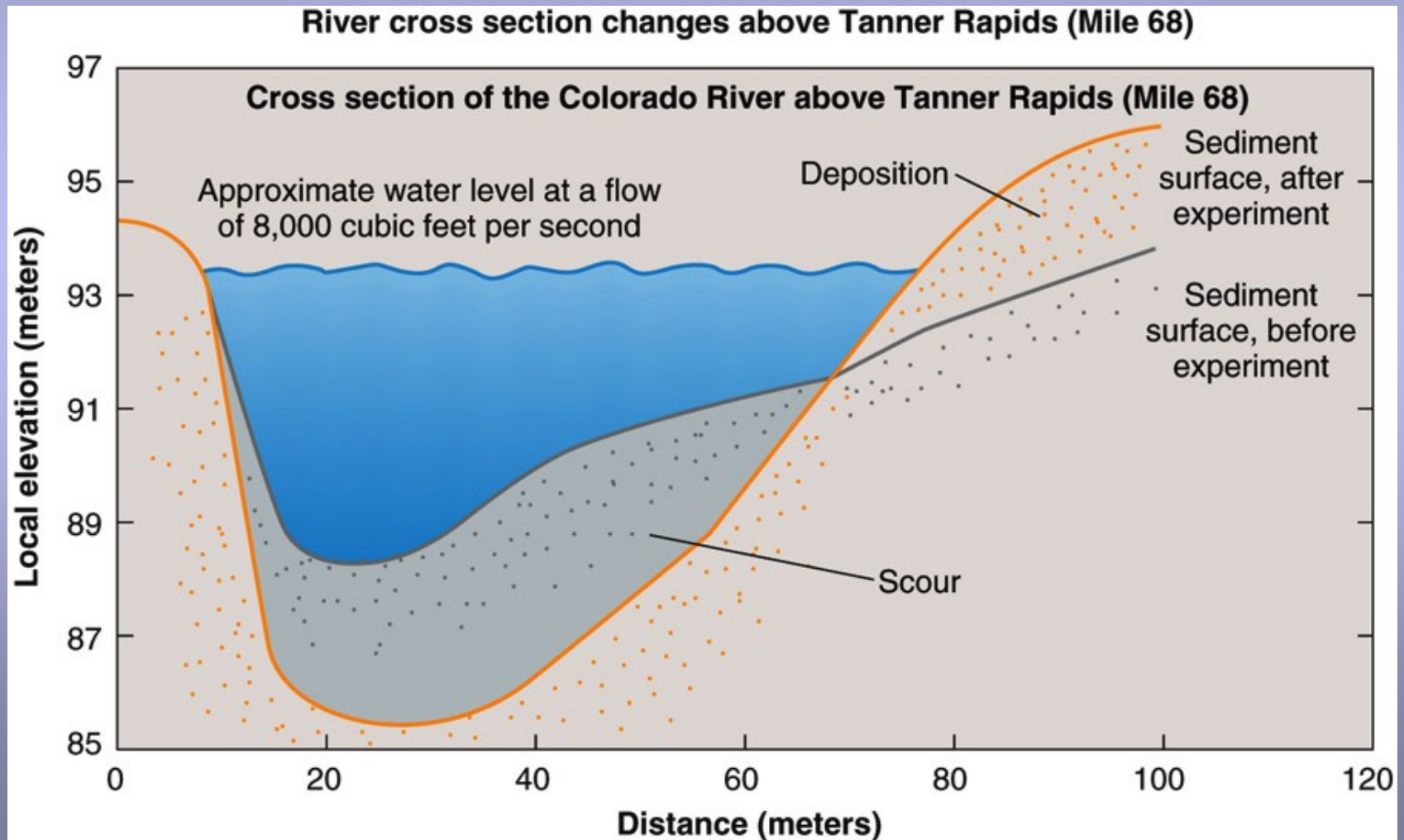
Two major floods had deposited over 10 million tons into the Colorado River

The idea was to redistribute this sand and create new habitat



# Effects of the controlled flood

Sand removed from channel, deposited in beaches and bars along the banks



# Other aspects of the experiment

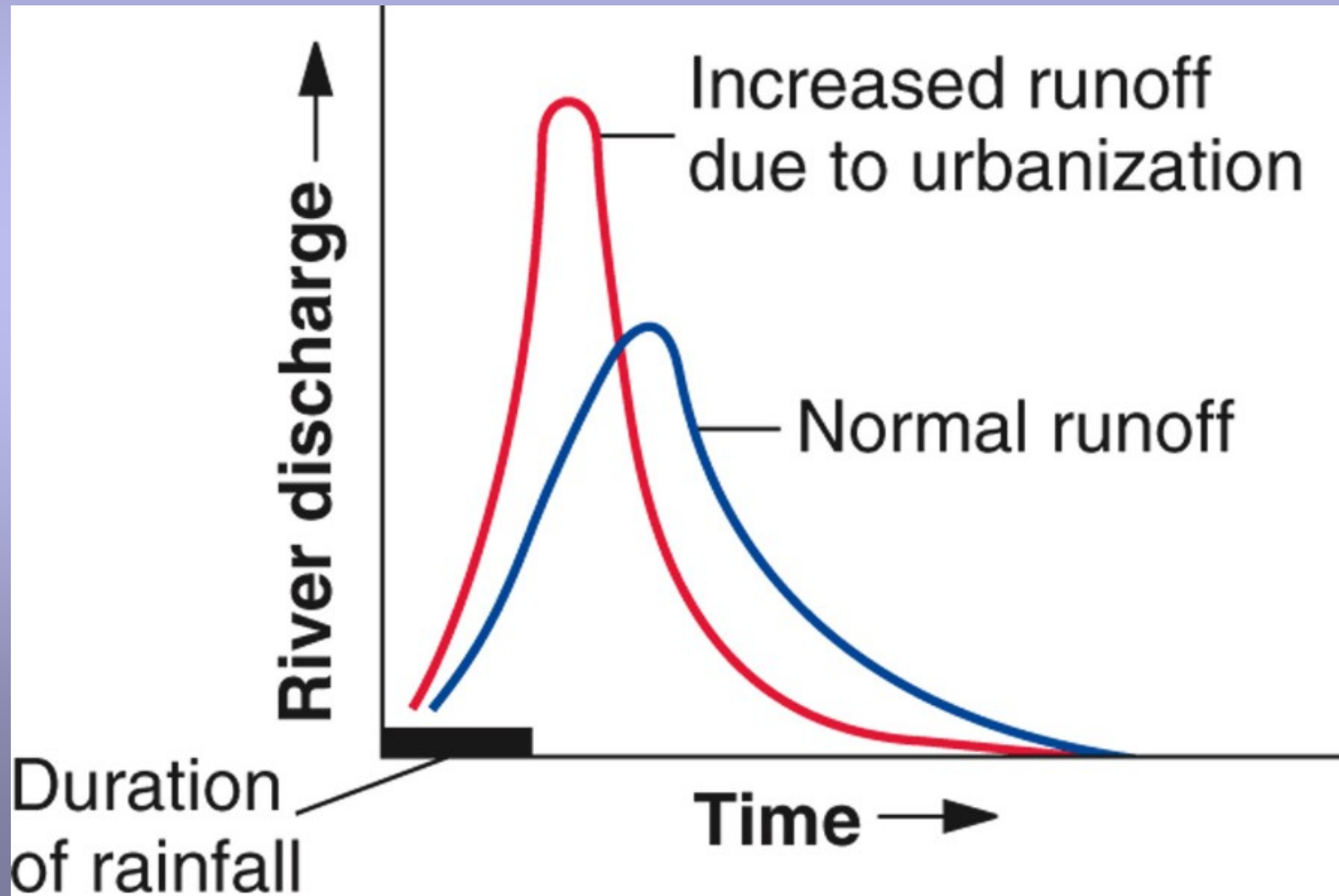
Dye released to track the flood water

Many measurements of water level & velocity

Radio transmitters inside boulders, to see when they moved

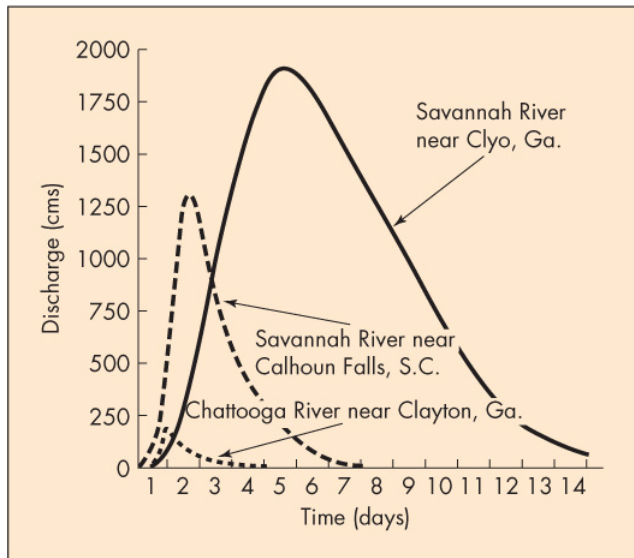
Impermeable surfaces increase peak discharge

*What is now at the corner of almost every newly constructed parking lot?*

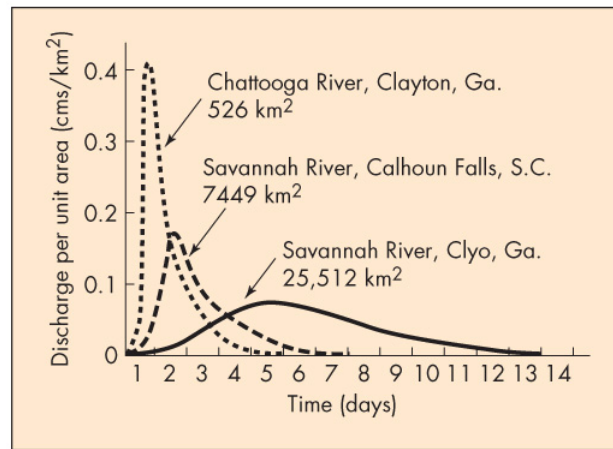




(a)



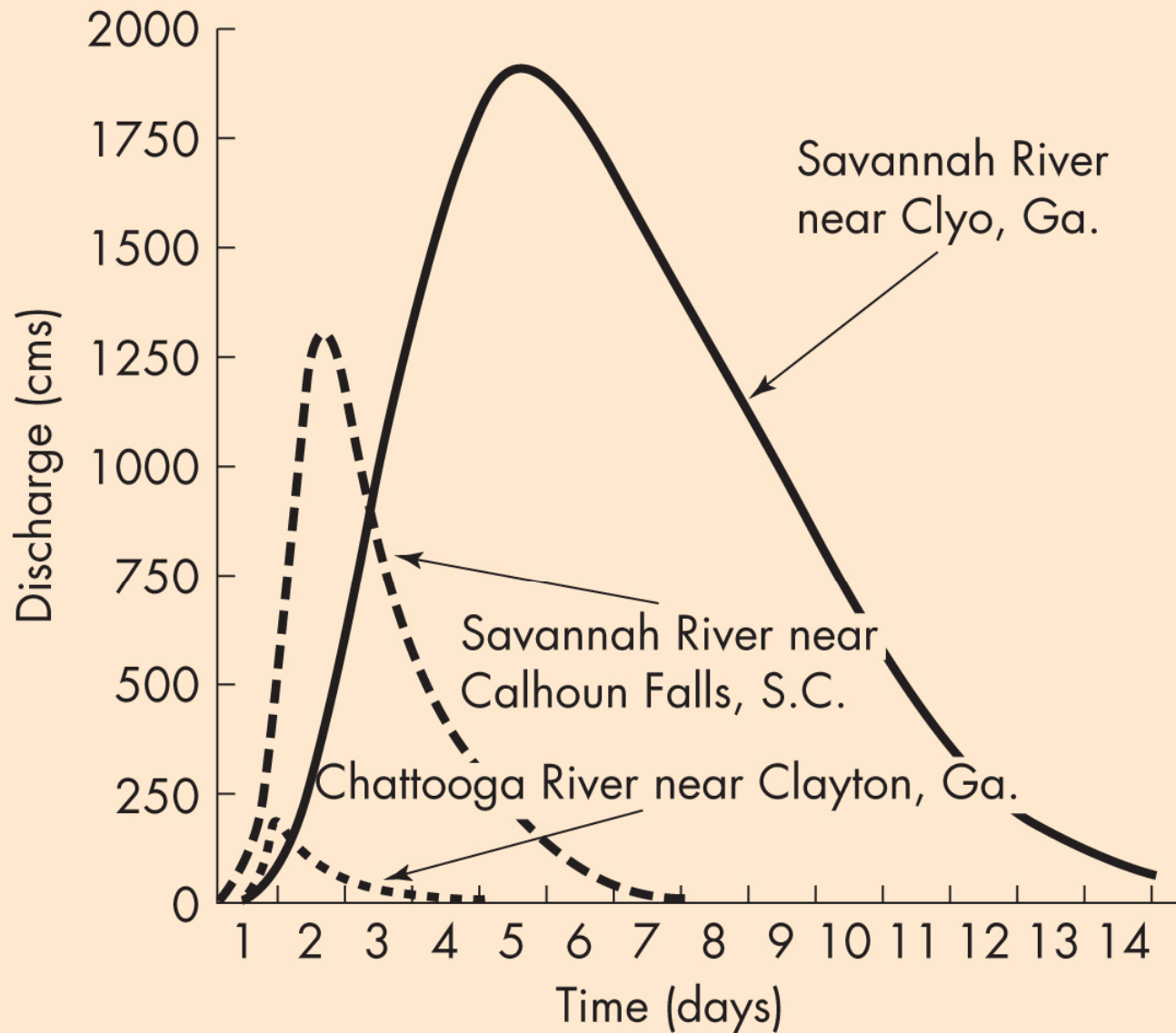
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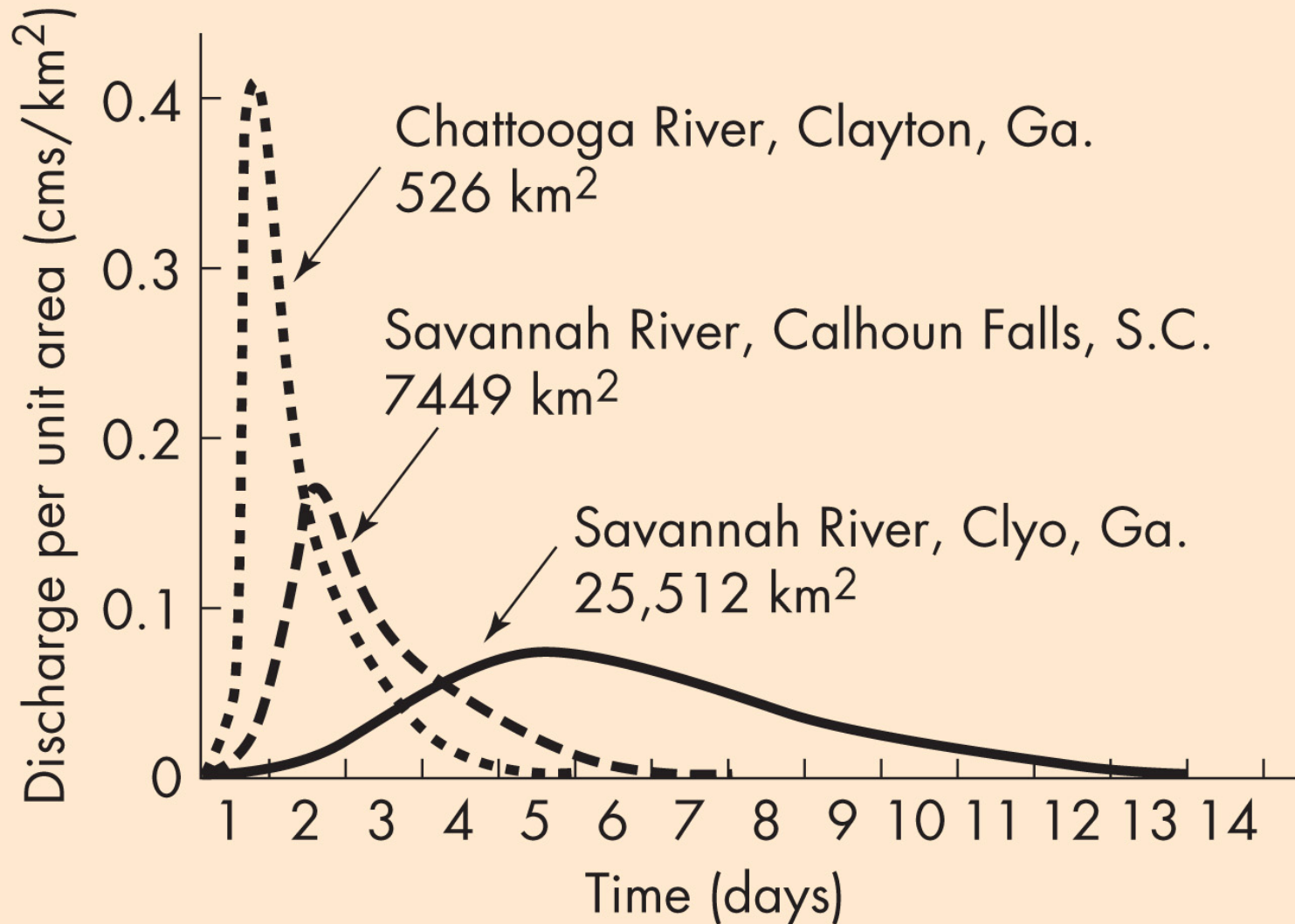
(c)



(a)



(b)



(c)