

# Rivers and Floods

Slides from lecture preceding  
Sulphur Springs Floods Exercise

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# The Hydrologic Cycle

**Def: movement of water among several *reservoirs*:**

- **Oceans**                      **97.5%**                      **salty**
- **Glaciers**                      **1.7%**                      **fresh but not usable**
- **Groundwater**                      **0.75%**                      **fresh & usable**
- **Rivers/lakes**                      **0.04%**                      **fresh & usable**
- **Atmosphere**                      **0.01%**                      **water vapor**

# Reservoirs of the Hydrologic Cycle

[https://commons.wikimedia.org/wiki/File:Point\\_Arena\\_Light\\_2014-07-10\\_4559.jpg](https://commons.wikimedia.org/wiki/File:Point_Arena_Light_2014-07-10_4559.jpg)



[https://commons.wikimedia.org/wiki/File:Perito\\_Moreno\\_Glacier\\_Patagonia\\_Argentina\\_Luca\\_Galuzzi\\_2005.JPG](https://commons.wikimedia.org/wiki/File:Perito_Moreno_Glacier_Patagonia_Argentina_Luca_Galuzzi_2005.JPG)



[https://commons.wikimedia.org/wiki/File:La\\_Sorgue\\_Fontaine-de-Vaucluse.JPG](https://commons.wikimedia.org/wiki/File:La_Sorgue_Fontaine-de-Vaucluse.JPG)

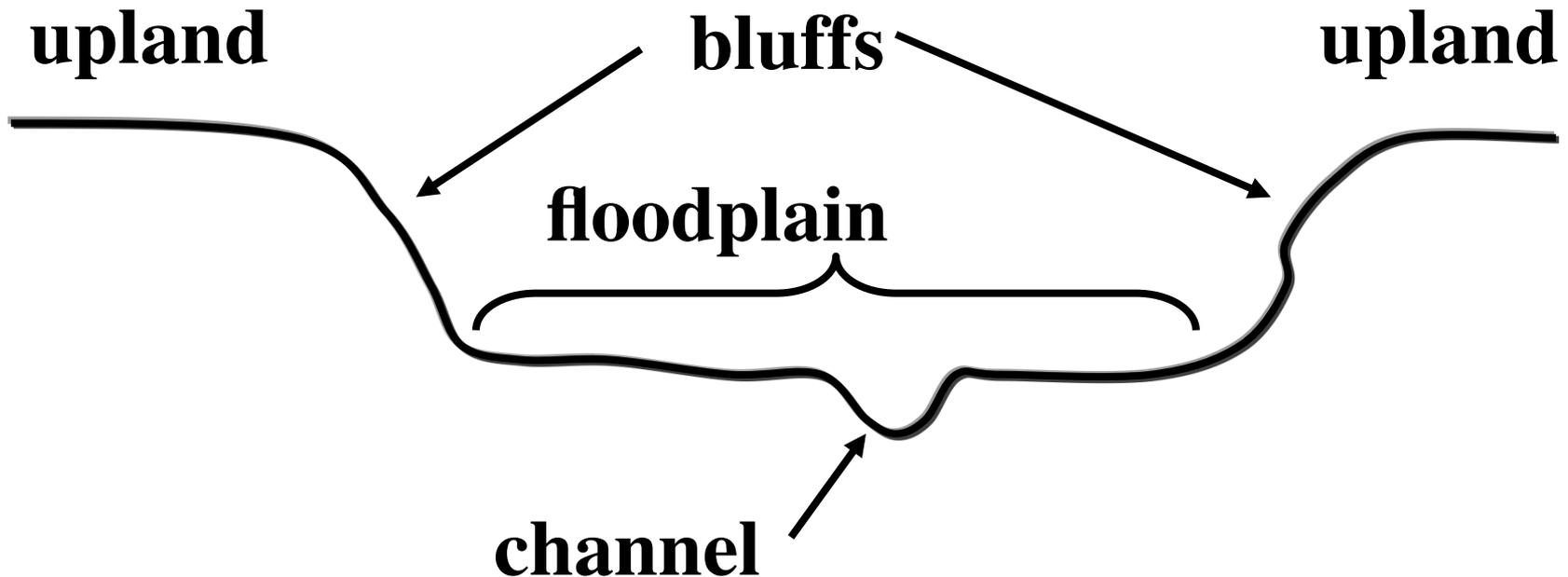


[https://commons.wikimedia.org/wiki/File:River\\_oxbows\\_scenics.jpg](https://commons.wikimedia.org/wiki/File:River_oxbows_scenics.jpg)

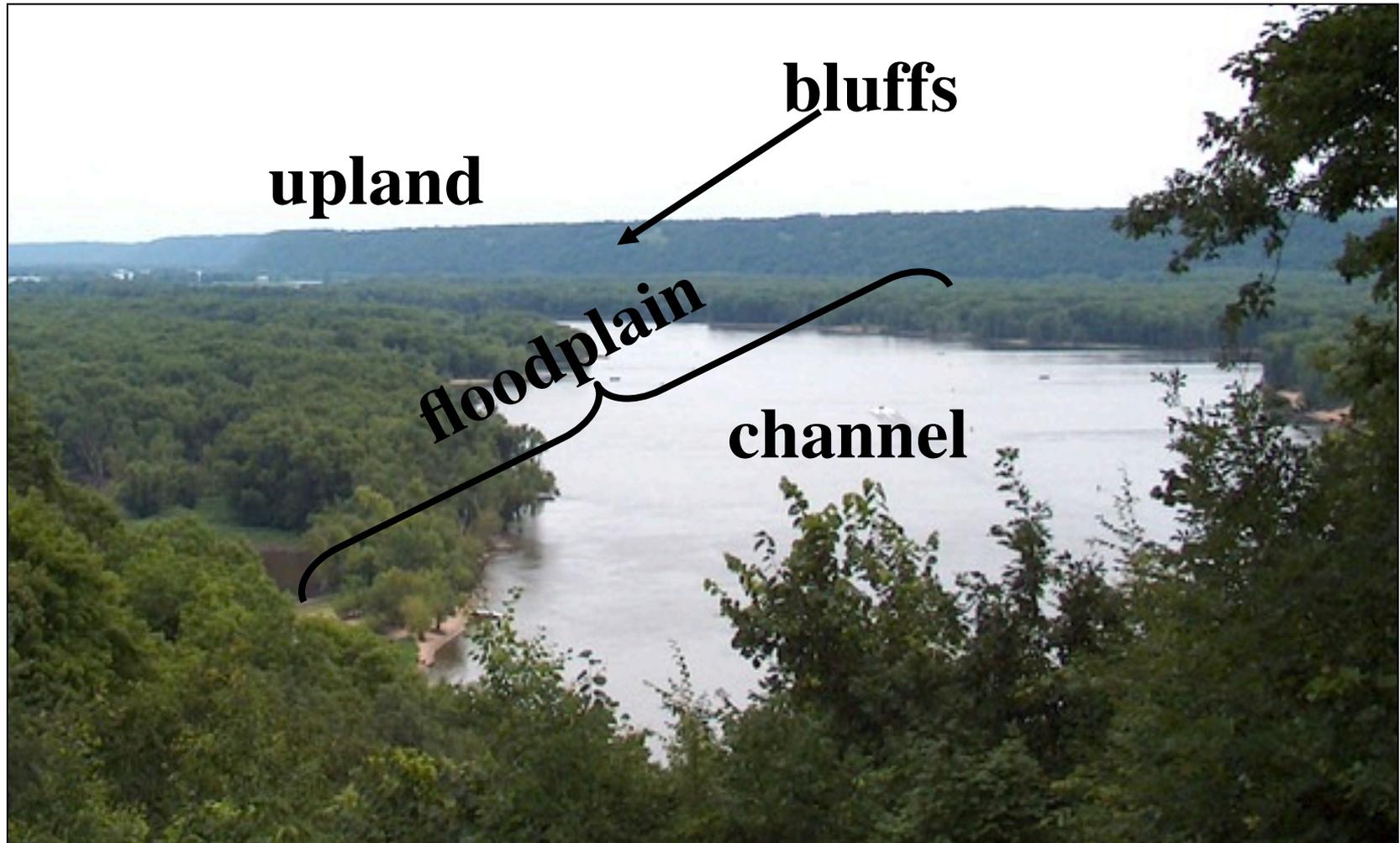


# River Basics

- **Def: flowing surface waters from precipitation**
  - **In a *channel***
  - **Flows downhill (because of gravity)**
- **A typical river valley:**



# A River Valley Illustrated



Source unknown

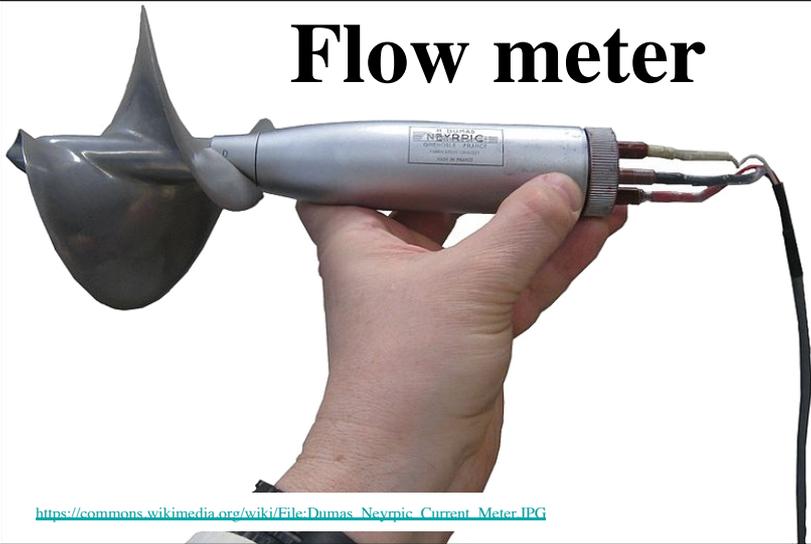
# Drainage Basins

- **Def:** area drained by river + *tributaries*
  - *Source:* where river begins (*upstream*)
  - *Mouth:* where river ends (*downstream*)
- *Divide:* high ground between drainage basins

# River Flow

- ***Discharge***: volume of water flowing past a given point in a specified length of time
  - Cubic feet per second (cfs)**
  - **Increases downstream**
    - **Water added by tributaries**
  - **Measured at *gaging station***
- **Records of flow can be used for planning**

# Flow meter



[https://commons.wikimedia.org/wiki/File:Dumas\\_Neyxpic\\_Current\\_Meter.JPG](https://commons.wikimedia.org/wiki/File:Dumas_Neyxpic_Current_Meter.JPG)

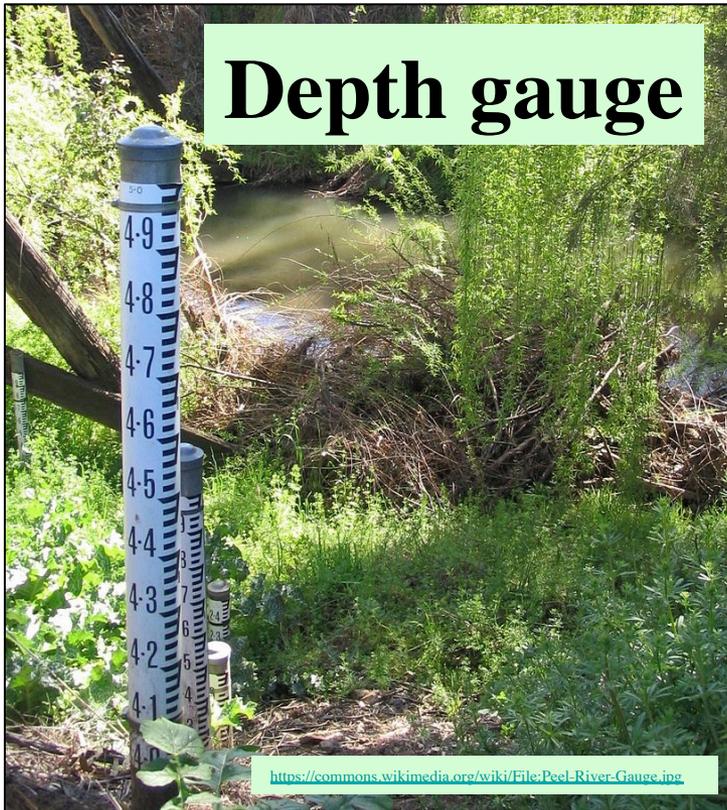
# Measuring Flow

## Gaging station



[https://commons.wikimedia.org/wiki/File:Snoqualmie\\_Gaging\\_Station\\_04135.JPG](https://commons.wikimedia.org/wiki/File:Snoqualmie_Gaging_Station_04135.JPG)

# Depth gauge



<https://commons.wikimedia.org/wiki/File:Peel-River-Gauge.jpg>

# Cost of Floods in US

- ~ \$8 billion annually

**Costliest flood**

- **1993: Mississippi & Missouri Rivers**

- **Floods in MO, IA, IL**

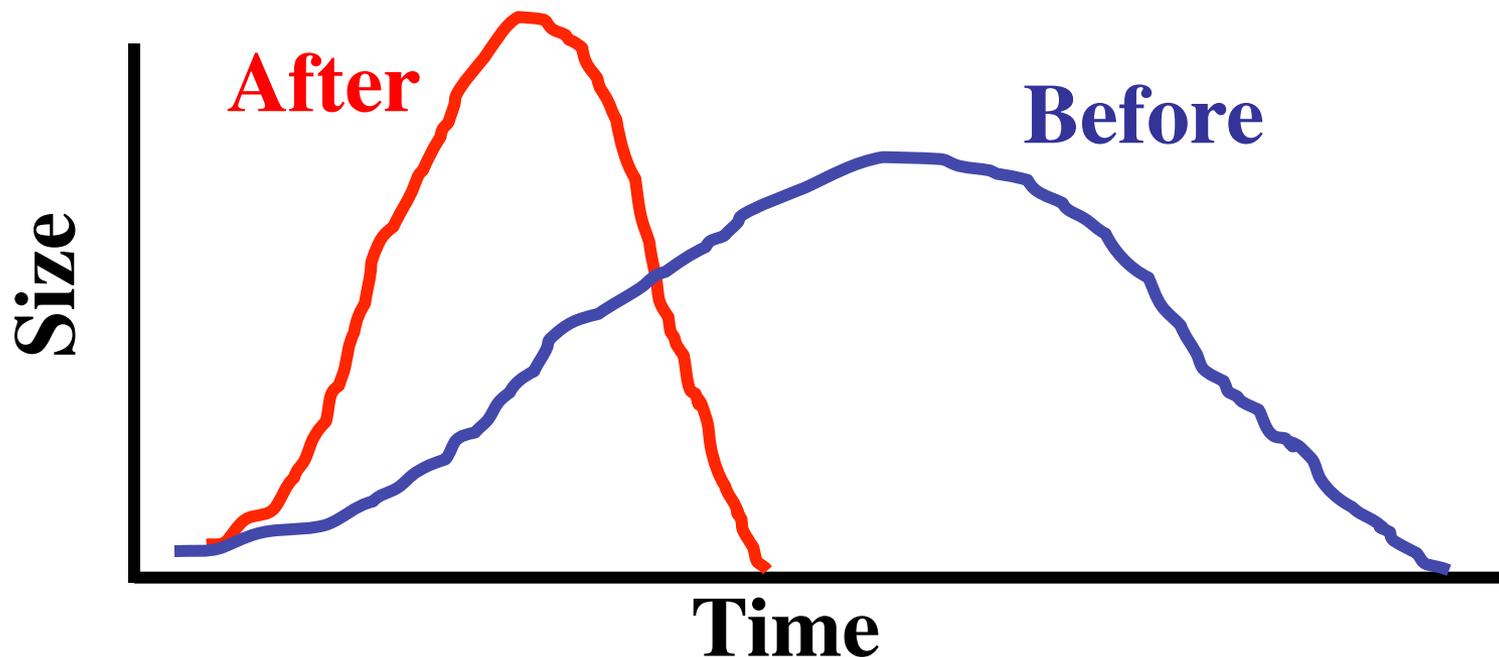
- **> \$30 billion in damages (adjusted for inflation)**

- **2008: somewhat less extensive (> \$11 billion)**

- **2013 in Colorado (September): ~ \$2 billion**

# People and Floods

- **Urbanization intensifies flooding:**
  - **Pavements, buildings stop water from infiltrating**
  - **More rapid runoff**

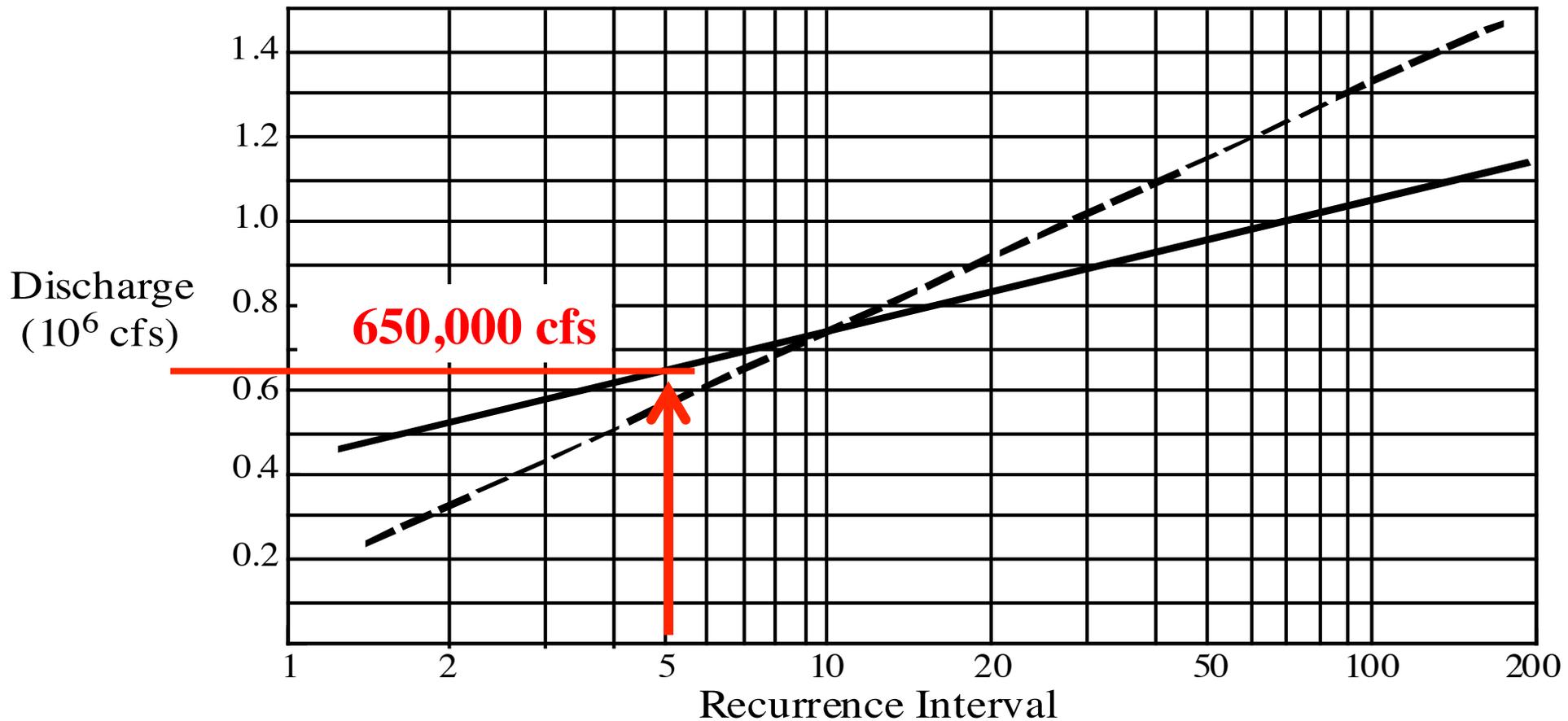


# Flood Frequency Analysis

- **Data needed:**
  - **Size of flood**
    - **Maximum discharge**
    - **Water depth**
  - ***Recurrence interval*: average number of years between occurrences of a certain size flood**

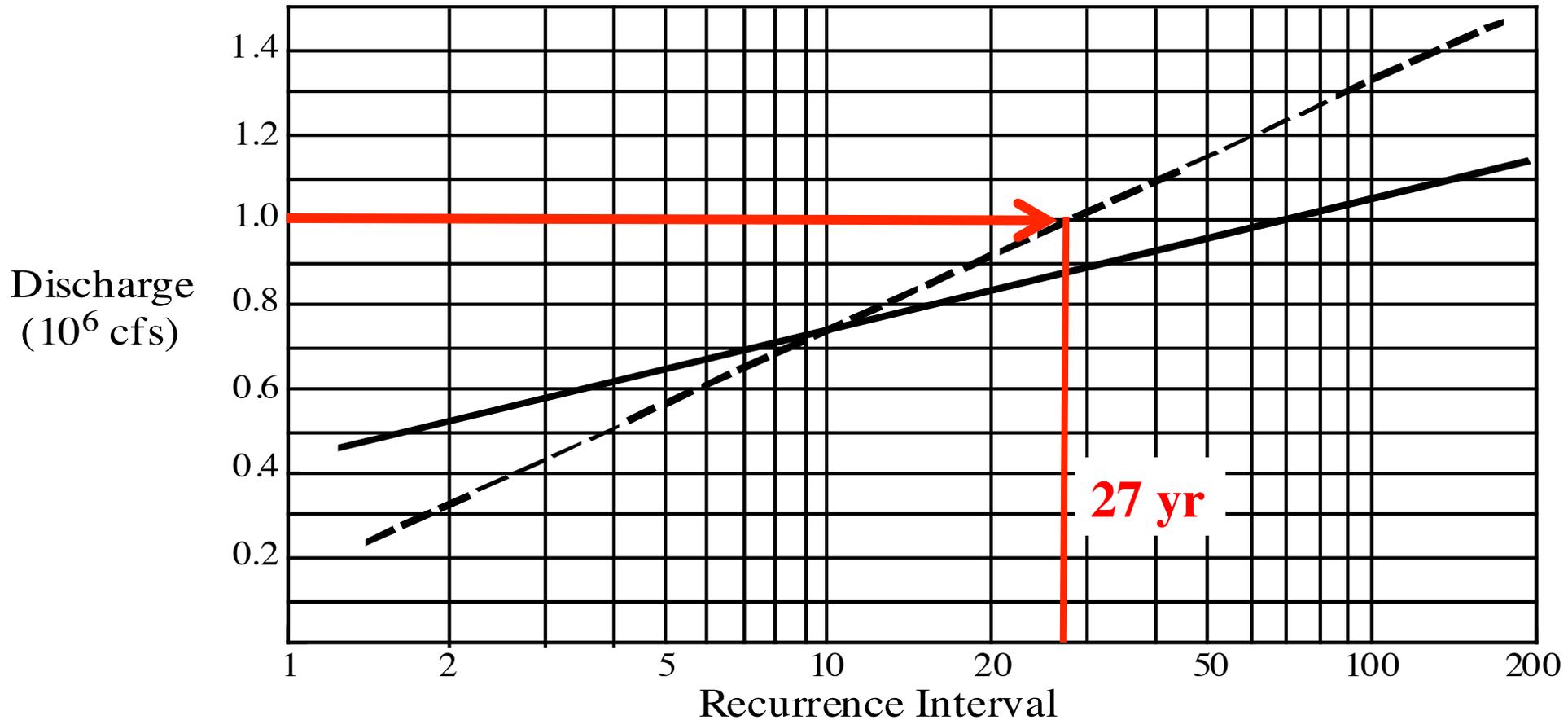
# Recurrence Curve 1

- What is the discharge for a 5-yr flood (solid line)



# Recurrence Curve 2

- What is the recurrence for a discharge of 1,000,000 cfs (dashed line)?



## **Teaching Notes and Tips**

This exercise is divided into three complementary sections. The exercise may be completed in one extended laboratory period, or individual sections may be assigned as separate, shorter activities or as homework.

Note that students need access to a printer to complete this exercise, as they must print the sketch map in the Student Instructions for Part I. Alternatively, the instructor may provide copies of the map as a handout.

Some students have difficulty visualizing the landscape from a topographic map on a computer screen. Making physical maps available helps with this problem. The electronic maps provided with the teaching materials use the 1995 version of the quadrangle.

Because computer software changes so rapidly, the steps for accomplishing certain tasks with Excel might differ from those given in the student instructions. Thus, the instructor should be aware of possible difficulties using Excel.

Updating the spreadsheets annually is recommended. Please note that if the spreadsheets are updated, then the answers to questions about rank, recurrence interval, and weather events may also need to be changed. For example, Part III formerly used data from the passage of Hurricane Frances in 2004, but as of 2018, this section was changed to use data from Hurricane Irma in 2017.