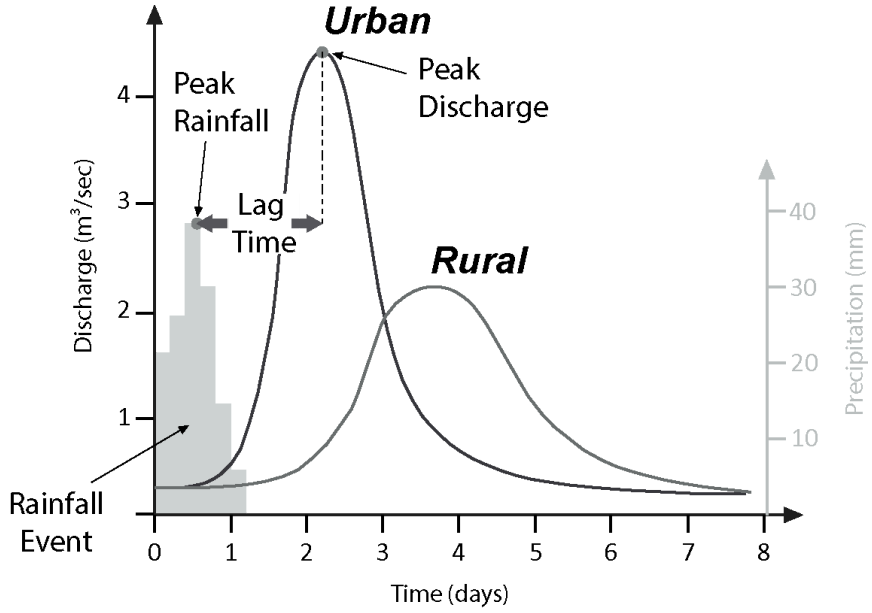
# First some review of Floods:

## Types of floods

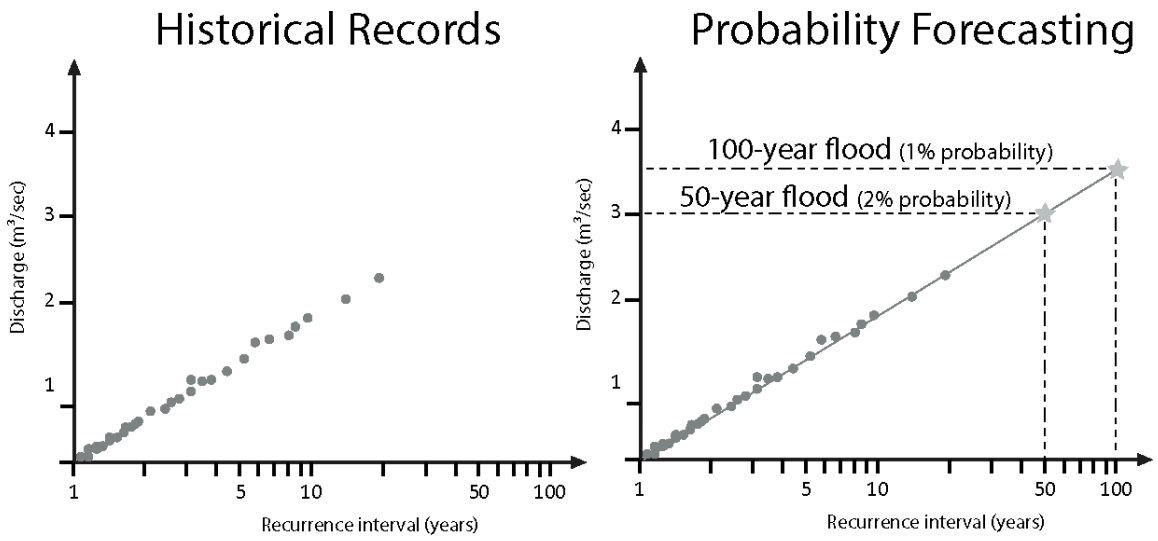
**Regional Floods** – seasonal flooding from extensive snow melt, or possibly from series of intense rain events.
**Flash Floods** – intense rain events in areas where runoff is concentrated quickly, such as a mountain canyon or an urban setting.
**Debris-jam** – natural dams may form from accumulated debris, such as ice or tree debris, causing water to quickly build behind the dam.
**Dam-failure** – the failure of natural or built water containments (dams and levees) can lead to flash flood events.

## Hydrograph




A hydrograph is used to plot the flow of a river (discharge) at a specific location in a river through time. In the hydrograph we can see that after a significant rainfall event, it takes some time for water throughout a drainage basin to flow into the river and increase discharge. The delay in time it takes to reach maximum (peak) discharge is known as lag time. Notice, the lag time is significantly shorter in urban environments where concrete infrastructure has limited infiltration into groundwater and increased runoff directly into the river.

## Recurrence Interval




The occurrence of floods of a given magnitude is random. However, we can use the frequency of floods (of varying magnitudes) in the past to predict their probability of happening in the future by using their *recurrence interval*. For a given river, the recurrence interval is derived mathematically:

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

where T is *recurrence interval,* n is the *number of years on record,* and m is the *magnitude ranking* of a given flood event.

By extrapolating the historical records, we can predict the size of potential larger floods that may not be in the historical record. Discharge $m^3$/sec

## Prevention

Flood control structures (levees and dams) may work to contain minor flood events, but can be overcome in large magnitude floods. Also, historically dams were built with the goal of controlling large flood events. More recently it has become evident that the environmental damage caused by dams may outweigh the benefits. Many argue that more sound land management within a floodplain is required.

# Now, test your knowledge:

Briefly define the following terms:

**discharge -**

**hydrograph -**

**flooding -**

**flood stage -**

**100-year flood -**

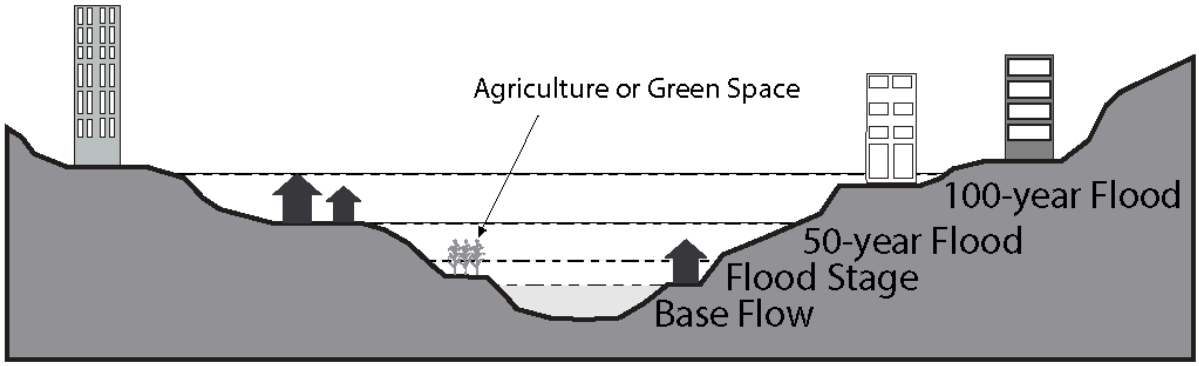
**flash flood -**

**regional flood -**

Answer the following:

1. A single large rainstorm event is more likely to cause which of the following flood types?
    A. Regional Flood
    B. Flash Flood
    C. Debris-jam Flood
    D. Dam Failure Flood

2. In the spring, when the snow melts and many of the regional rivers are at or near *flood stage*, *it* is known as a _____.
    A. Regional Flood
    B. Flash Flood
    C. Debris-jam Flood
    D. Dam Failure Flood




3. In the above image, the river level known as *flood stage,* is designated as such because _____.
    A. Any level above base flow is considered to be flood stage.
    B. At that level, personal property is potentially at risk.
    C. Technically any water in a river is considered to be a flooding of that river.
    D. It is above base flow but below the 50-year flood.

4. In the above image, what might be a good project to develop in the area highlighted as "Agriculture or Green Space"?
    A. Housing development
    B. Golf Course
    C. Apartment Complex
    D. Retirement Community

5. True/False. Preparing for a 100-year flood is as simple as looking up your local rivers most recent 100-year flood and counting ahead the remaining years.
    A. True
    B. False

6. A 100-year flood has the following probability of happening in a given year.
    A. 100%
    B. 50%
    C. 10%
    D. 1%

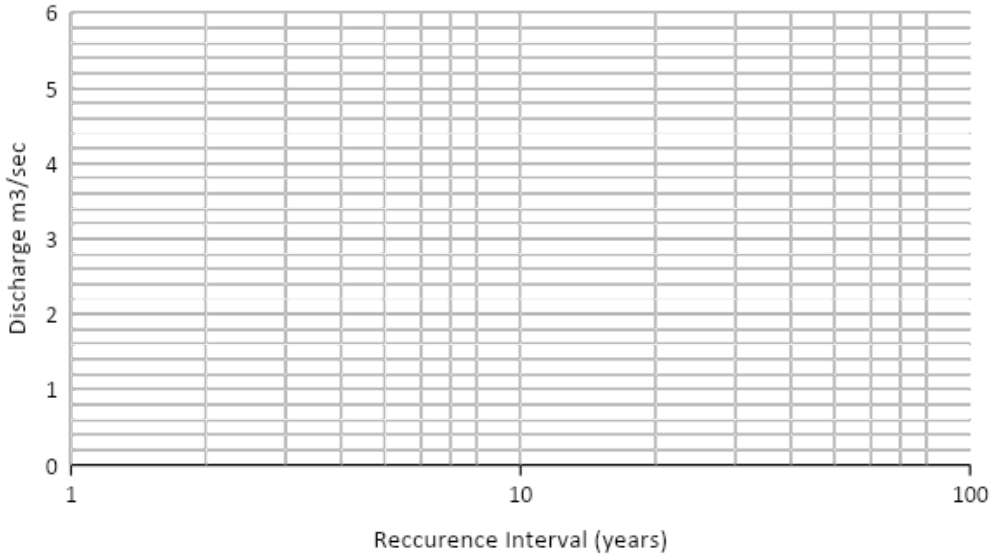
7. True/False. Only rivers that are un-dammed are subject to flooding events.
    A. True
    B. False

# Now, think deeper:

## On your own:

8. Determine the forecasted 50 and 100 year flood discharge levels for a hypothetical stream. Flood discharge records have been kept intermittently for this stream for 10 years.
    A. Fill in the remaining cells in the table. You will need to use the equation from the review section to calculate T. (T = (n+1)/m)
    B. Plot the data on the graph.
    C. Using a straight edge, draw a best fit line through the data, extending all the way to the end of the graph.
    D. Read the approximate discharge levels for the 50 and 100 year flood and report them below the plot.

| record # | Discharge (m^3/sec) | m | n | T |
|---|---|---|---|---|
| 1 | 1 | 5.5 | 10 | |
| 3 | 2.3 | 1.83 | 10 | |
| 4 | 0.3 | 10 | 10 | |
| 6 | 1.9 | 2.75 | 10 | |
| 7 | 2.1 | 2.2 | 10 | |
| 10 | 1.5 | 3.66 | 10 | |




50 year flood discharge: _____ 100 year flood discharge: _____

## Working in groups of 2 or 3:

9. Compare your results to question 8.