Factors Affecting Runoff and Hydrograph Shape

The factors influencing runoff and the resulting shape of a hydrograph are divided into two main categories: Climatic Factors and Physiographic (Catchment) Factors.

1. Climatic Factors

A. Type of Precipitation

Precipitation can occur as rain or snow.

Rain: Produces immediate runoff.

Snow: Runoff is delayed because the snow must first melt into water before it can flow.

B. Rainfall Intensity

Runoff is directly proportional to intensity.

High Intensity: Increases runoff volume and leads to a conical (sharp) hydrograph because water reaches the outlet rapidly.

Low Intensity: Results in lower runoff.

C. Duration of Rainfall

Short Duration: Runoff may not occur due to initial losses like infiltration or interception.

Long Duration: Leads to a higher volume of water. If rain lasts a long time, the hydrograph peak occurs later and has a broader base.

D. Distribution and Movement of Storms

Distribution: Rain falling near the basin outlet (downstream) converts to runoff quickly, producing a higher peak. Rain falling far upstream takes longer to reach the outlet.

Movement: A storm moving downstream (toward the outlet) produces rapid runoff with a higher magnitude. A storm moving upstream produces runoff more slowly.

E. Other Climatic Variables

Temperature & Wind: High temperatures and wind speeds increase evaporation losses, thereby reducing runoff.

Humidity: High humidity decreases evaporation and transpiration, which can enhance runoff.

Frozen Ground: Low temperatures can freeze the soil, preventing infiltration and causing very high runoff.

2. Physiographic (Catchment) Factors

A. Soil Moisture Conditions (Antecedent Moisture)

Runoff is heavily affected by the amount of water already in the soil.

Dry Soil: Most rainfall is lost to infiltration, resulting in low runoff.

Saturated Soil: Rainfall produces high runoff almost immediately.

B. Drainage Density

This refers to the number of streams and channels in a given area.

High Density: Water enters the channels and reaches the outlet quickly, resulting in a narrow hydrograph with a steep recession limb.

Low Density: Water moves slowly across the land surface, resulting in a broader hydrograph.

C. Land Use and Vegetation

Dense vegetation (grass, trees, bushes) increases water loss through interception (leaves catching rain) and infiltration.

High Vegetation Density: Plants slow down the flow and absorb more water, which decreases the peak flow.

D. Surface Depressions

The presence of ponds, lakes, or marshy land acts as temporary storage.
These depressions delay the runoff and modify the hydrograph by decreasing the peak flow and creating a wider base because the water is released slowly over a longer period.