SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution Coimbatore – 35

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DEPARTMENT OF AGRICULTURAL ENGINEERING

19AGE308
WATERSHED PLANNING AND MANAGEMENT

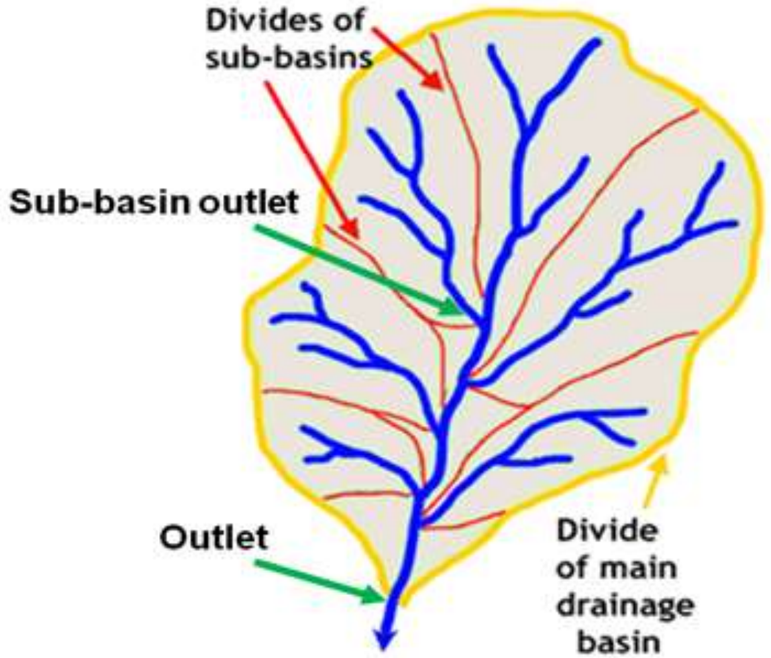
Types of Watersheds

Definition of Drainage Basin

•It is defined as, “any portion of the earth's surface within a physical boundary defined by topographic slopes that divert all runoff to the same drainage outlet.”

•The physical boundary of the drainage basin is called the drainage divide.The watershed area includes all the points that lie above the elevation of the outlet and within the drainage divide that separates adjacent watersheds.

•Other terms synonymous with drainage basin are watershed, catchment, basin, river basin, runoff area, and stream basin. Watershed, catchment and basin are most commonly used terms by hydrologists.



Classification of Watersheds by Size

Three types of watershed are distinguished according to size:

1. Small size: < 250 km^2
2. Medium size: between 250 km^2- 2500 km^2
3. Large: >250 km^2

This classification is vague, but the implication is in terms of spatial heterogeneity and dampening (averaging) of hydrological processes.

Runoff generation on these watersheds can be considered in two phases: i) land phase and ii) channel phase. Each phase has its own storage characteristics.

Classification of watershed.

Large Watersheds

1) They have well-developed channel networks and channel phase, and, thus, channel storage is dominant.
2) They are less sensitive to high-intensity rainfalls of short duration.

Small Watersheds

1) They have dominant land phase and overland flow, have relatively less conspicuous channel phase.
2) They are highly sensitive to high-intensity, short-duration rainfalls.

Two watersheds of the same size may behave very differently if they do not have similar land and channel phases.

Size (ha)	Classification
50,000-2,00,000	Watershed
10,000-50,000	Sub-watershed
1,000-10,000	Mili-watershed
100-1,000	Micro-watershed
10-100	Mini-watershed

Classification of Watersheds by Land Use

1) Urban watersheds
2) Agricultural watersheds
3) Forest watersheds
4) Mountainous watersheds
5) Desert watersheds
6) Coastal watersheds
7) Wetland/marsh watersheds

Watershed Characteristics: Physical and Geomorphologic Characteristics associated with Watersheds

•The morphological Characteristics of watershed may Broadly be classified as

A. Linear aspects (one dimensional)
B. Aerial aspects (two dimensional)
C. Relief aspects (three dimensional)

Linear aspects:

Linear aspects of watershed is concerned with the streams and its network. In general, these are one dimensional property. The important characteristics are watershed length& width, stream order, stream number, bifurcation ratio &stream length ratio.

Areal aspects:

Areal aspects of watershed include the description of areal elements such as watershed area, Watershed slope. watershed shape, watershed perimeter, drainage density, stream frequency, is reflected by some parameters such as shape factor,form factor, elongation ratio, circulatory ratio and compactness coefficient. In general, these are two dimensional properties.

Relief aspects:

Relief aspect is related to elevation difference between reference points in watershed. In general, these are three dimensional properties. Few important characteristics are watershed relief, relative relief, channel slope, law of stream slope & ruggedness number.

Watershed Characteristics: Physical and Geomorphologic Characteristics associated with Watersheds

•Watershed geomorphology refers to the study of the characteristics, configuration and evolution of land forms and properties; developing physical characteristics of the watershed.

• It comprises of the characteristics of land surface as well as the characteristics of the channels within the watershed/basin boundary.

• These properties of watersheds significantly affect the characteristics of runoff and other hydrological processes. The principal watershed characteristics are:

1. Basin Area
2. Basin Slope
3. Basin Shape
4. Basin Length

Watershed Characteristics: Physical and Geomorphologic Characteristics associated with Watersheds

Basin shape is reflected by a number of watershed parameters as are given below.

1.Form Factor
2.Shape Factor
3.Circularity Ratio
4.Elongation Ratio
5.Compactness Coefficient

Along with the surface characteristics of a watershed, the channel characteristics are important in transiting the runoff water from the overland region to channels (streams) and also from the channel of one order (primary) to the other higher order (e.g. river stream). The most common and important channel characteristics of the watersheds are:

1.Channel Order
2.Channel Length
3.Channel Slope
4.Channel Profile
5.Drainage Density

The quantification of these physical and geomorphologic properties of watershed/basin are important for estimating the watershed hydrologic processes.

Watershed Length Lb&Width Lw:

•Watershed length has been defined in several ways however the most appropriate may be as the longest straight length parallel to main stream of watershed and watershed width may be measurement perpendicular to the direction of watershed length.

•In the given figure straight line 3 is the most appropriate watershed length.

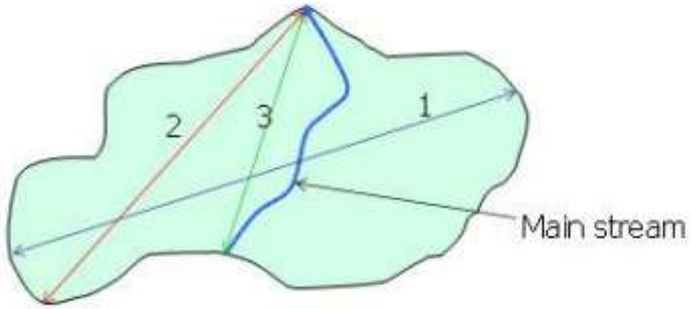


Fig. 5. Diagram Defining Basin Length. (Source: Zavoianu, 2011)

Watershed Perimeter (Pp):

•Watershed perimeter is the outer boundary of the watershed that enclosed its area.

•It is measured along the divides between watersheds.

•It is the indicator of watershed size and shape.

Stream Order:

•There are two systems of stream order.

➢First Strahler stream order and
➢second Shreve stream order

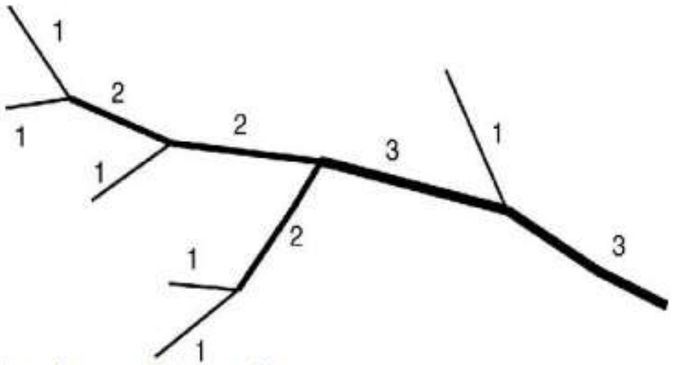


Fig. 6. Strahler stream order system.

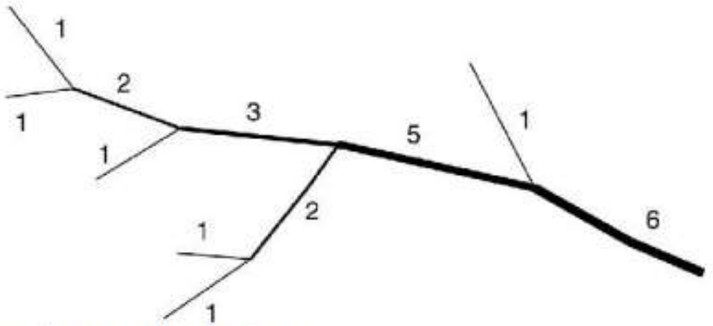


Fig. 7. Shreve stream order system.

Stream Number Nu:

•The number of segments of a particular order is counted and expressed as number of that particular order.

•If we consider the Fig. 6. then the number of first order stream N1is 6, the number of second order stream N2 is 2 and the number of third order stream N3 is 1 only.

• It is related to bifurcation ratio

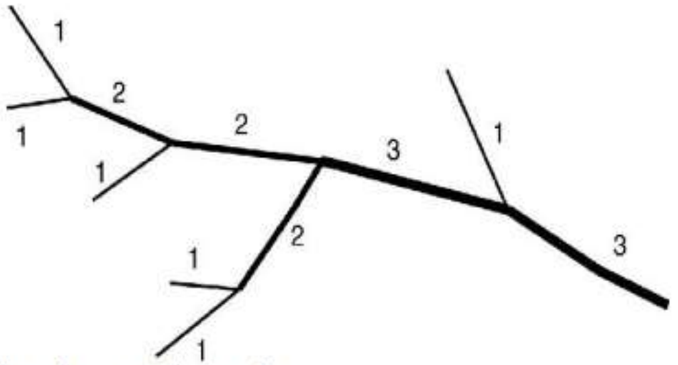


Fig. 6. Strahler stream order system.

Bifurcation Ratio (Rb):

•The bifurcation ratio expresses the branching pattern of the stream network and is a measure of drainage density.

•The numerical value is in general more than 1.

•It is defined as the ratio of number of streams of a particular order (Nu) to number of streams of next higher order (Nu+i).

• Rb = Nu / Nu+1

Stream Length Lu:

•Stream length is an important morphological property and is used to determine drainage density.

•It is the length of stream / channel of each order.

•The total length of any particular stream order is the length of that stream order.

•The mean length of stream of each higher order increases in geometric sequence.

•The mean length of first order stream is shorter than second order stream.

•Similarly, the mean length of second order stream is shorter than third order stream and so on.

Stream Length Ratio (RL)

•It is defined as the ratio of mean stream length (Lu) of a particular stream order to mean stream length of the next lower order (Lu-1).

•Thus RL = Lu / Lu-1