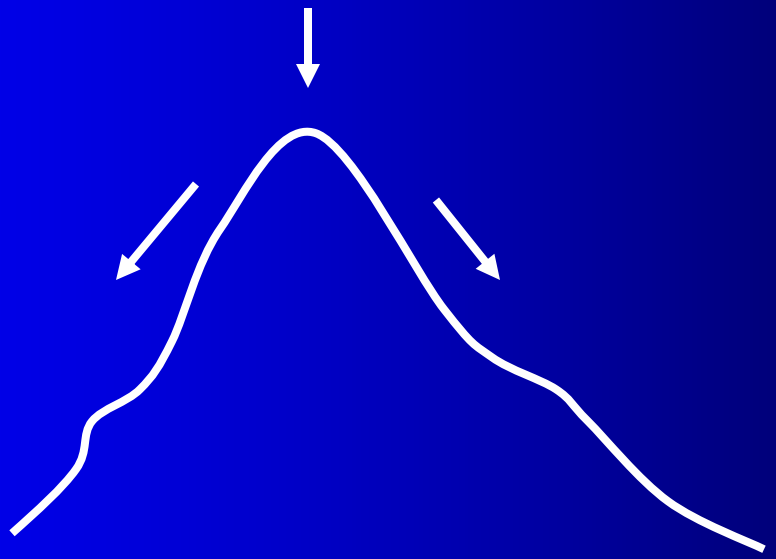
Stream Geomorphology

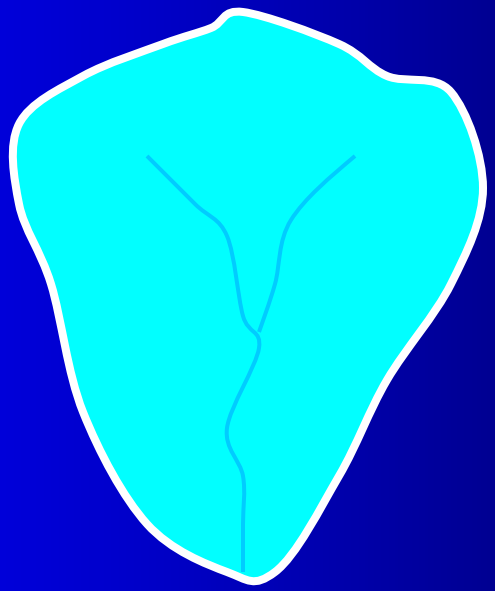
Watershed

- The line that demarcates the topographic "shedding" of the water across the landscape.



Catchment

- The area of a landscape within the watershed boundary that routes water to the river network.

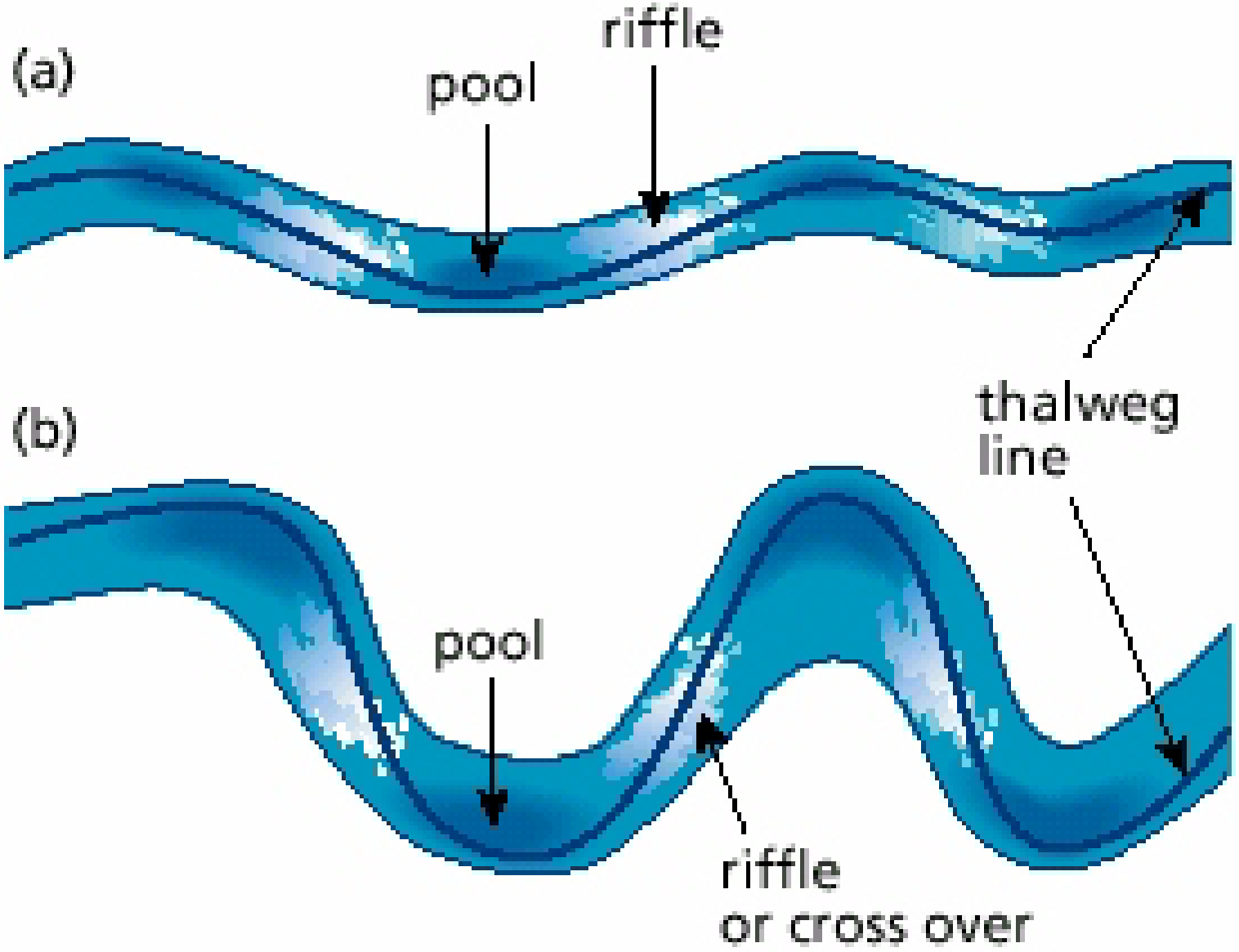


Basin Characteristics

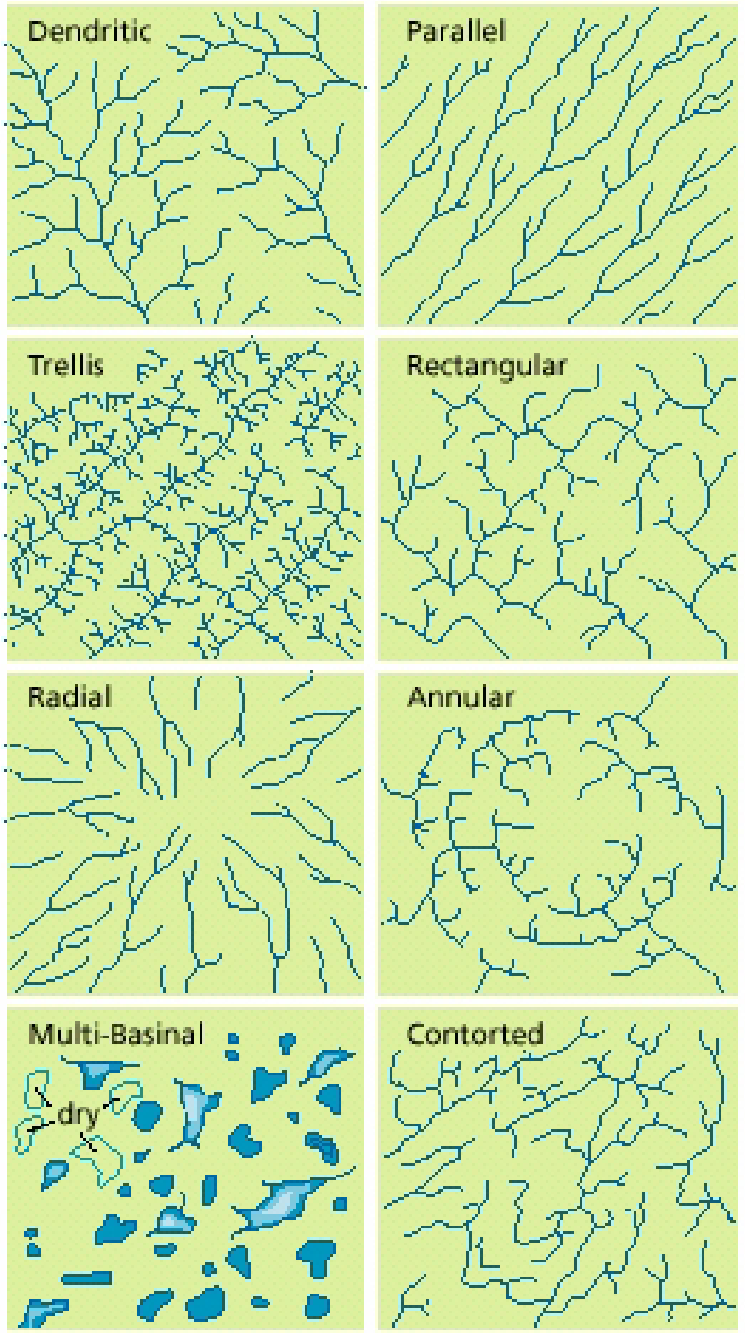
- **Drainage Area**
  - Area from ridge to ridge that contributes to the water supply of the stream
  - Usually determined from topographic maps
- **Drainage Density**
  - Length of perennial channels divided by drainage area

Basin Characteristics

- Stream length
  - Channel length
  - Thalweg length


(a)
pool
riffle
thalweg
line
(b)
pool
riffle
or cross over

Drainage Patterns



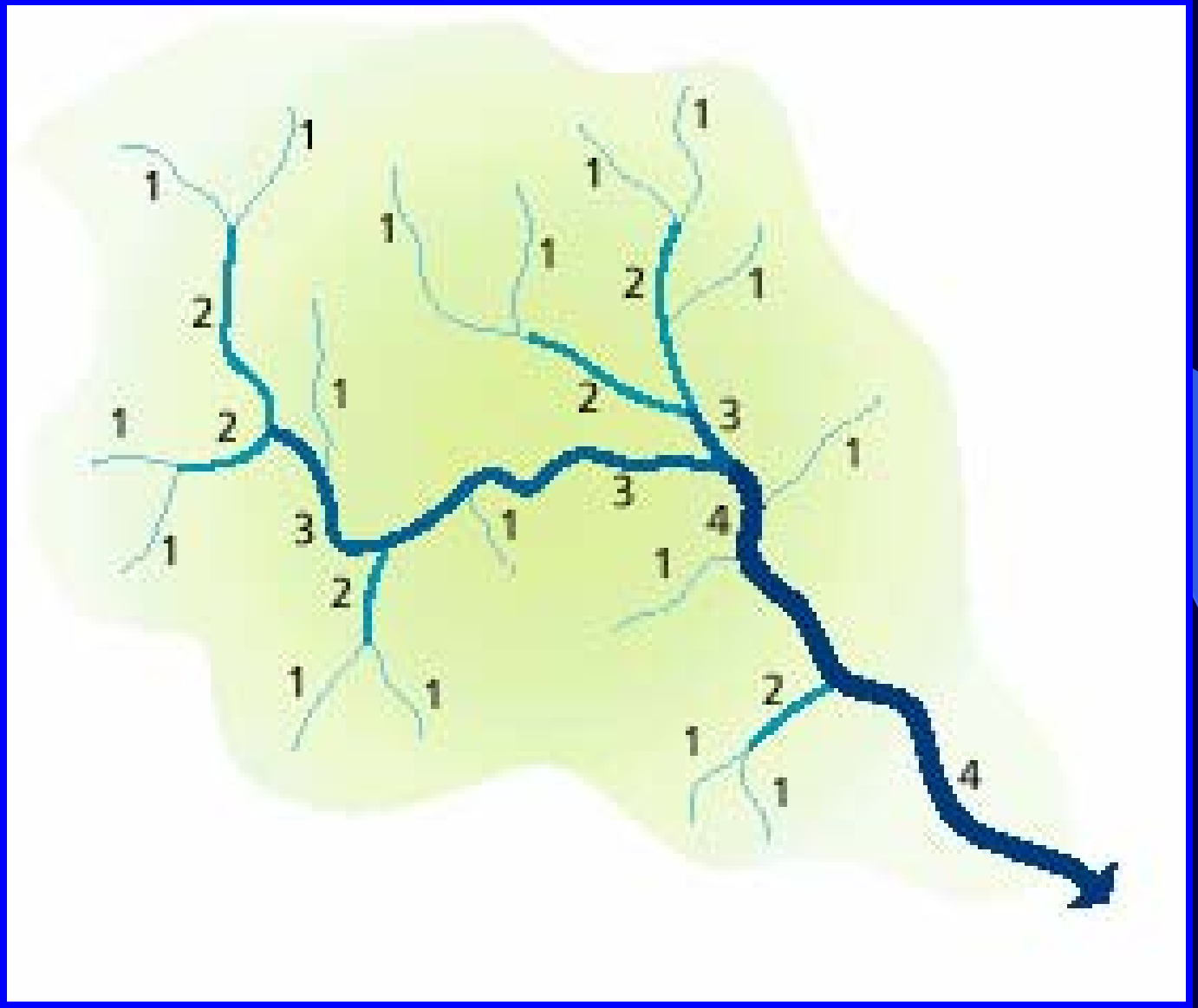
Stream Network- Order

- **Stream order** (Strahler 1952)
  - Horton 1932
  - Strahler 1952
  - Shreve 1967

Stream Network- Order

- **Stream order** (Strahler 1952)
  - Perennial streams without tributaries are termed first-order
  - When two streams of equal order come together, the downstream reach is increased one order

Stream Network- Order



Stream Network- Link Magnitude

- **Link Magnitude** (Shreve 1966)
  - Each junction is a link
  - Link magnitude is the sum of the links
    - Exterior link magnitude includes the lower channel (n)
    - Interior link magnitude is 1 less than exterior link magnitude (n-1)

Stream Network Comparison

- Bifurcation ratio

- R_b = # of segments of a given order / # of segments of next highest order
- Average R_b - 3.5
- Range is 2 – 5
- Trees – 3.2 Lightening – 3.5 Veins – 3.4

- Relief ratio
  - $R_r = h/L$
  - \h = Difference in elevation
  - L = Maximum length

- Mean Stream Slope

$$S = (E_s - E_m)/ L$$

Es = Elevation at source

Em = Elevation at mouth

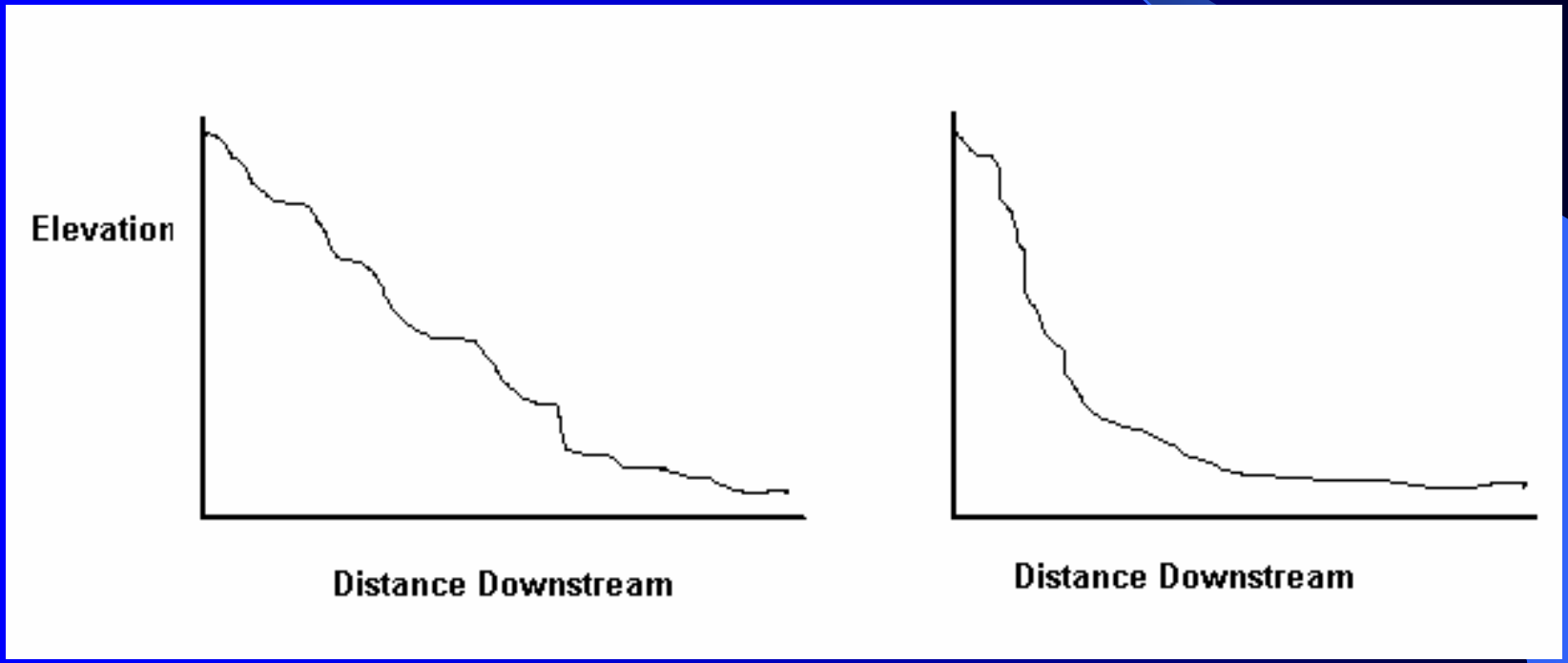
L = Length

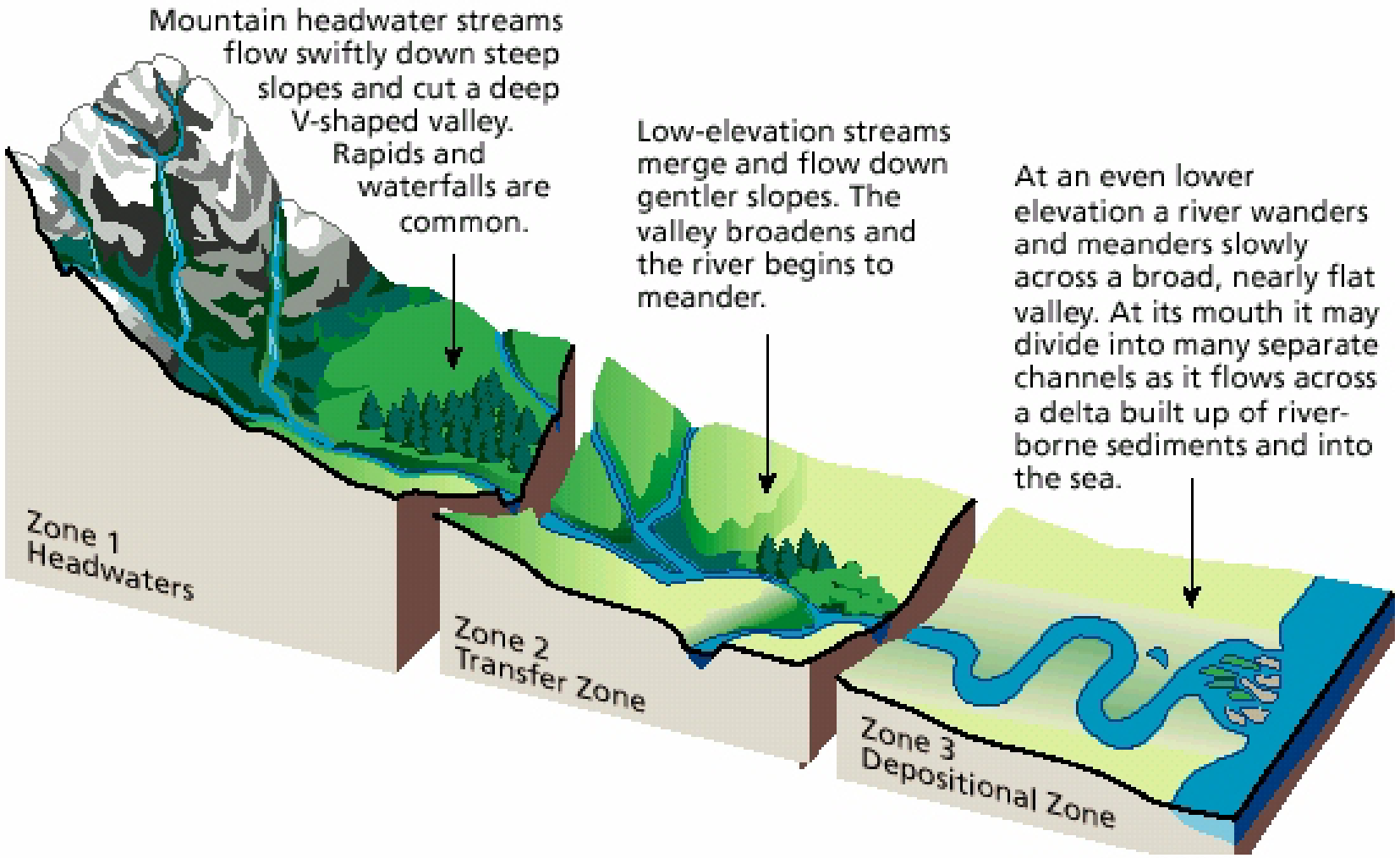
Longitudinal Profiles

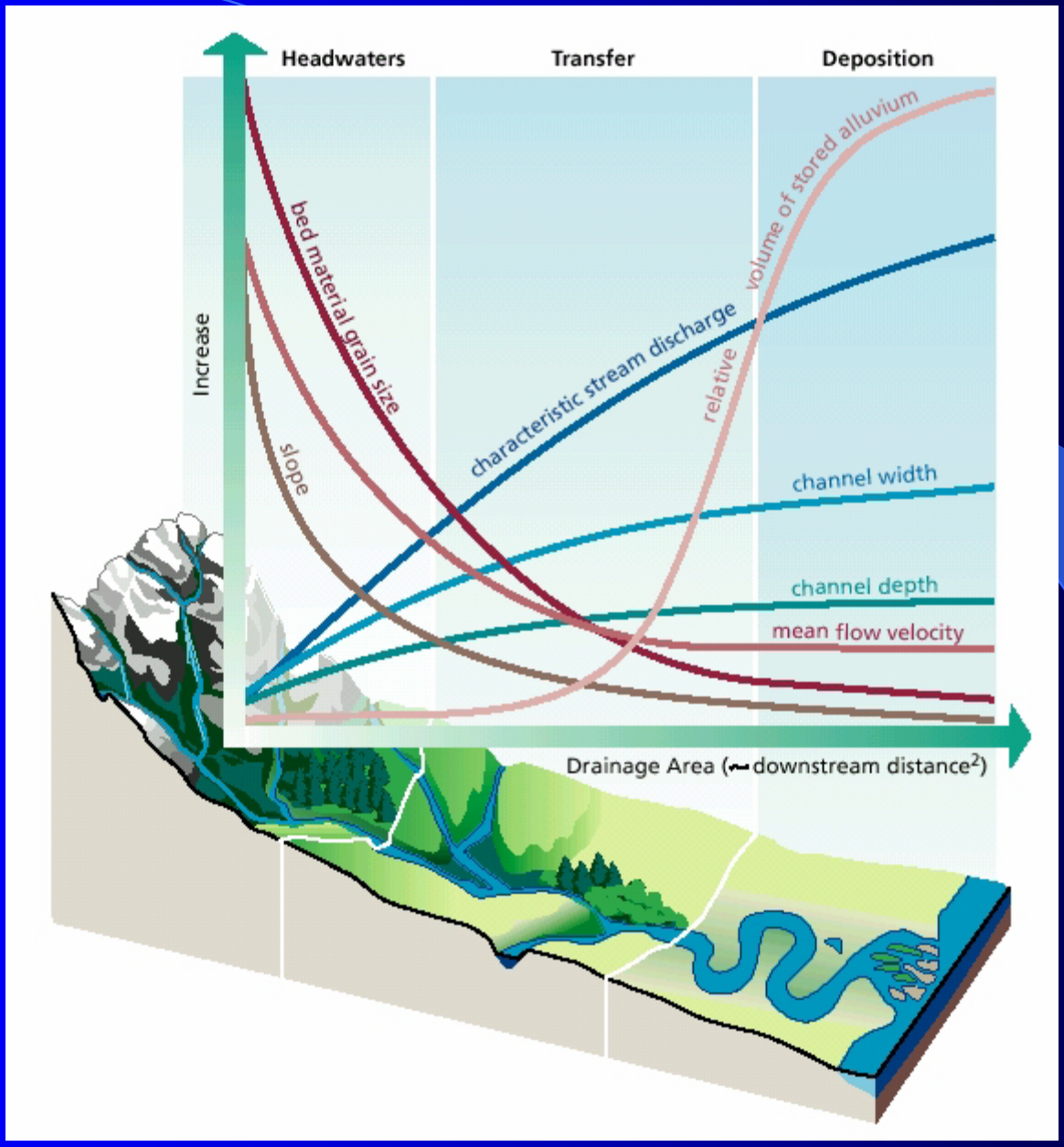
- Diagrammatic representation of change in elevation with distance
- Steeper slopes in the headwaters
  - Slope expressed as percent or degrees (100% = 45 degrees)

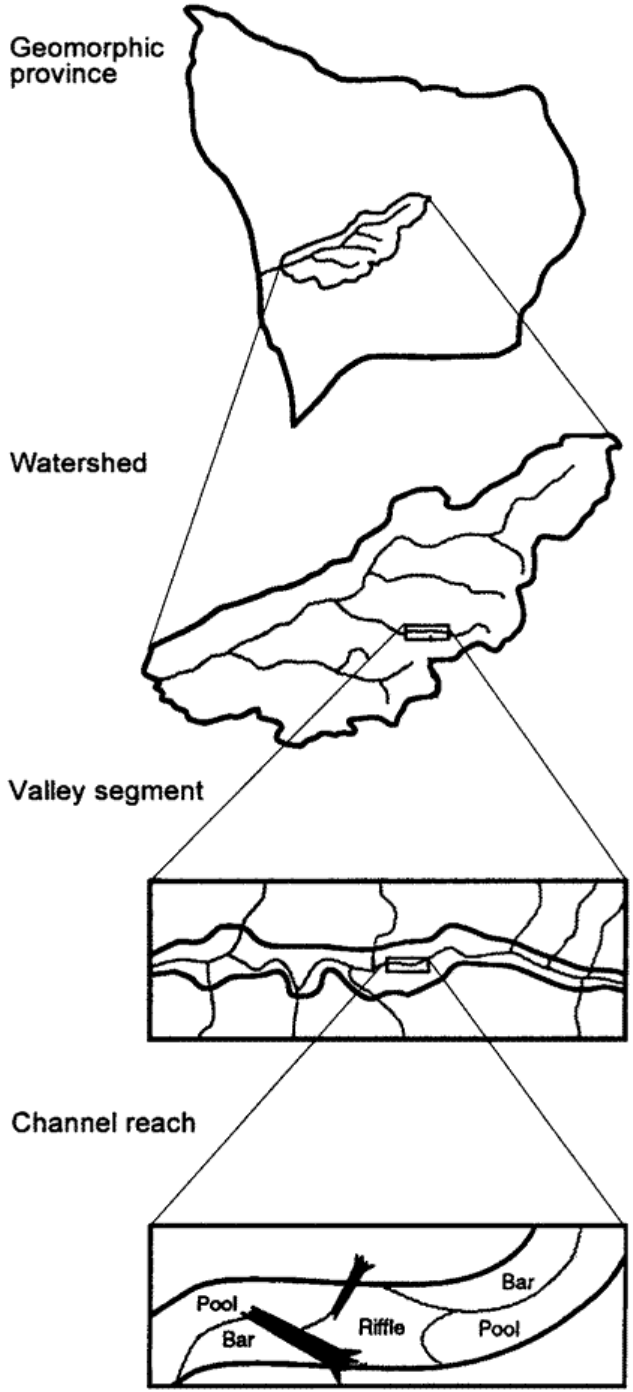
Channel Characteristics

Longitudinal Profiles

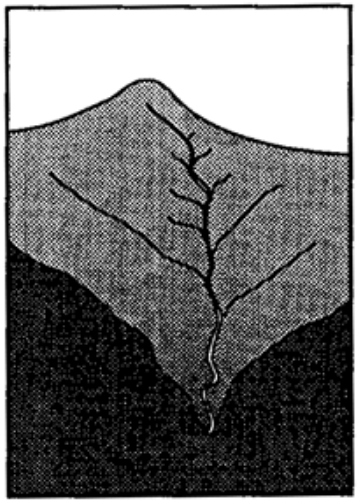



Mountain headwater streams flow swiftly down steep slopes and cut a deep V-shaped valley. Rapids and waterfalls are common.
Low-elevation streams merge and flow down gentler slopes. The valley broadens and the river begins to meander.
At an even lower elevation a river wanders and meanders slowly across a broad, nearly flat valley. At its mouth it may divide into many separate channels as it flows across a delta built up of river-borne sediments and into the sea.
Zone 1 Headwaters
Zone 2 Transfer Zone
Zone 3 Depositional Zone


Headwaters
Transfer
Deposition
Increase
bed material grain size
slope
characteristic stream discharge
relative volume of stored alluvium
channel width
channel depth
mean flow velocity
Drainage Area (~ downstream distance²)

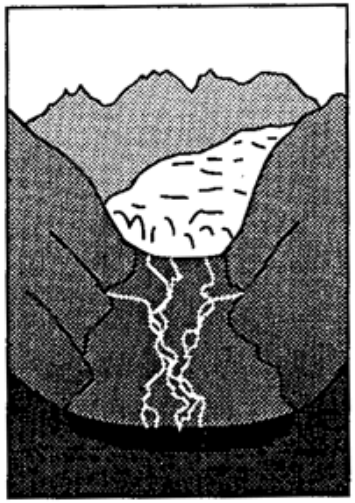

Geomorphic province
Watershed
Valley segment
Channel reach
Pool
Bar
Riffle
Bar
Pool

Valley Wall/Headwater



V-Shaped Valley, Moderate Gradient

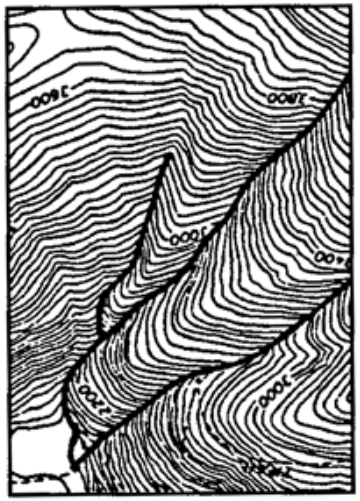
Active Glacial Valley



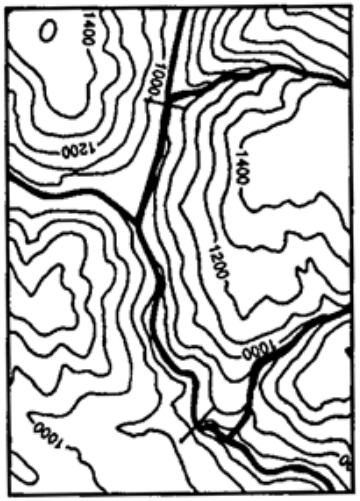
Alluviated Mountain Valley

Alluviated Lowlands

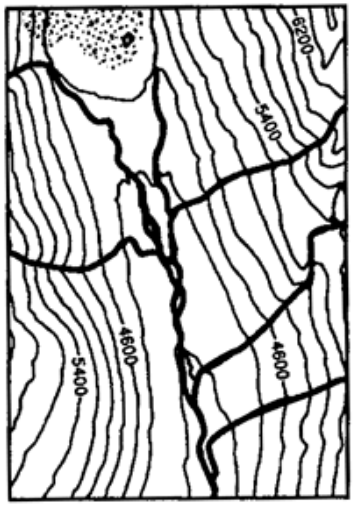
H3



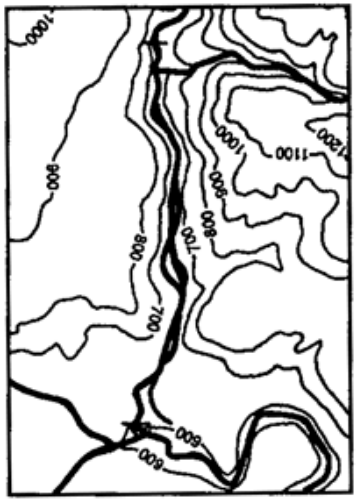
V1



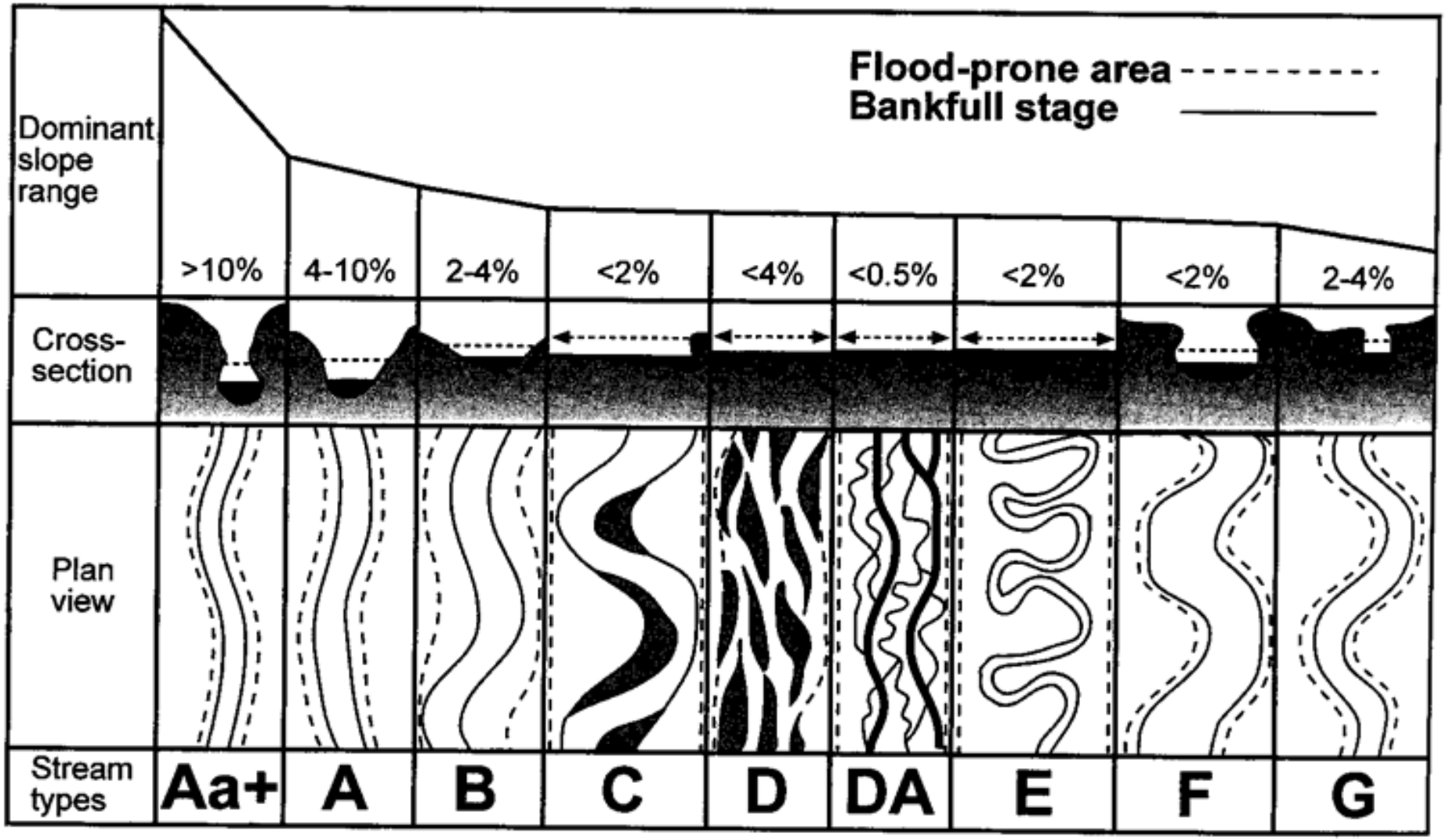
U4



V4



F2


Flood-prone area
Bankfull stage
Dominant slope range
>10%
4-10%
2-4%
<2%
<4%
<0.5%
<2%
<2%
2-4%
Cross-section
Plan view
Stream types
Aa+
A
B
C
D
DA
E
F
G

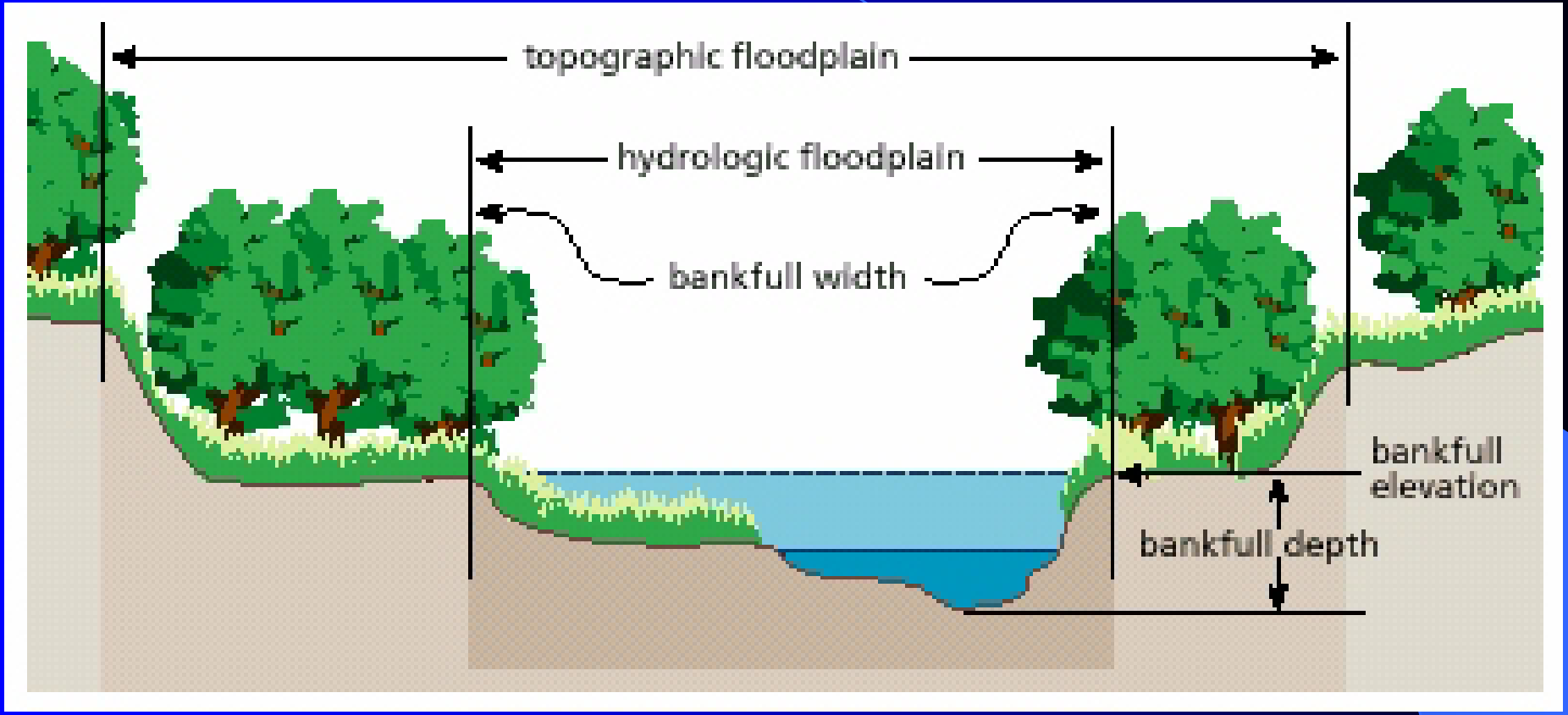

topographic floodplain
hydrologic floodplain
bankfull width
bankfull elevation
bankfull depth

Figure 1.19: Bankfull discharge. *This is the flow at which water begins to leave the channel and move onto the floodplain.*

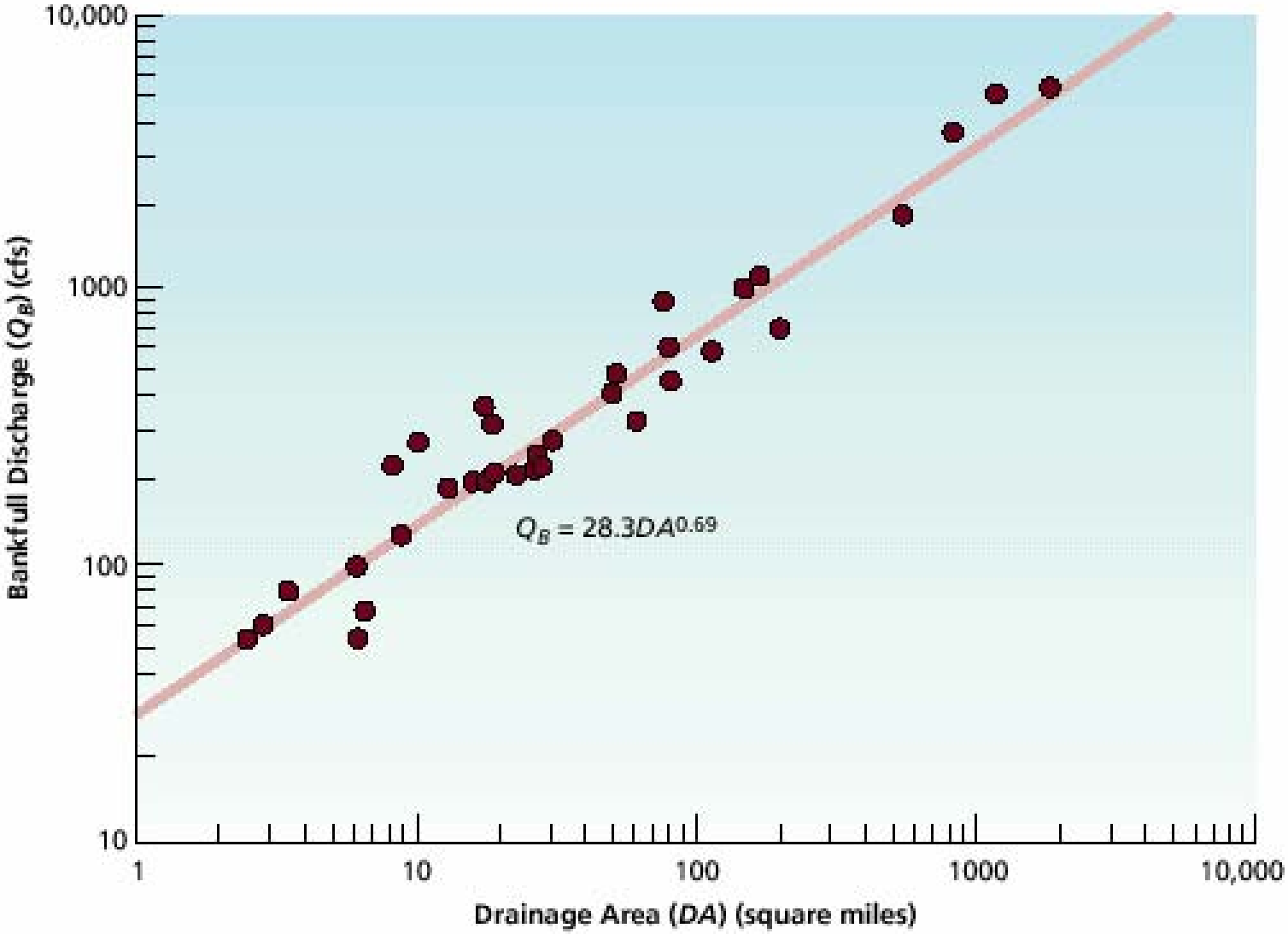


Figure 7.18: Bankfull discharge versus drainage area—Upper Salmon River area. *Curves based on measured data such as this can be valuable tools for designing restorations (Emmett 1975).*

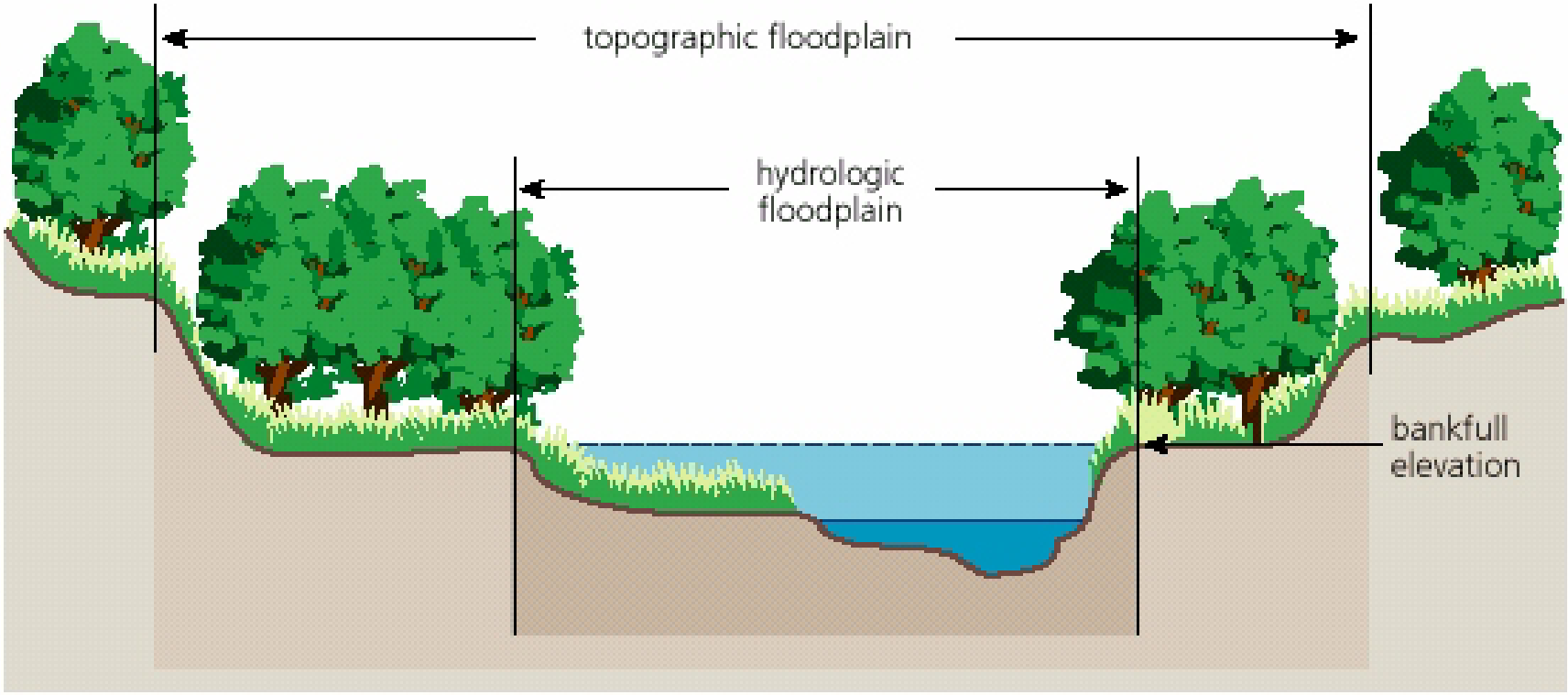


Figure 1.20: Hydrologic and topographic floodplains. *The hydrologic floodplain is defined by bankfull elevation. The topographic floodplain includes the hydrologic floodplain and other lands up to a defined elevation.*

Flood Recurrence Interval

- The average length of time within which a specific magnitude of flood will occur once.
- Predicted from the historic record and/or the site-specific runoff and climatic conditions of the contributing watershed.

Flood Recurrence Interval

- Important factors include variations in storm duration and the intensity of rain, rain-on-snow, and snow melt events.

- A one-in-200-year flood event is an event that has an average recurrence interval of 0.005.

Flood Recurrence Interval

- P = 1/T
- P = Exceedence probability
- T = Recurrence interval

Flood Recurrence Interval

- Recurrence Interval
- $T = (n + 1)/m$
- n = Number of years of record
- m = rank in record

Weibull Plot

Floods Over Time Range

- Probability that a flood with a recurrence interval of T will occur or be exceeded within a given number of years

- $P = 1 - [1 - 1/T]^n$

Floods Over Time Range

- 100-yr T in 70 yr = 50.5%
- 100-yr T in 30 yr = 26.0%
- 50-yr T in 70 yr = 75.7%