Factors affecting Hydrograph — العوامل المؤثرة على الهيدروجراف (5)

A) Physiographic factors — عوامل الجغرافية الطبيعية

(1) Basin characteristics:

(a) shape (b) size (c) slope (d) Nature of valley (e) elevation (f) drainage density

(2) Infiltration characteristics:

(a) land use and cover (b) soil type and geological condition (c) lake & storage

(3) Channel characteristics:

(a) roughness (b) storage capacity

(B) Climatic factors — العوامل المناخية

(1) Storm characteristic:

(a) intensity (b) duration (c) storm movement

(2) Initial loss

(3) Evapotranspiration

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1. Shape of the Basin

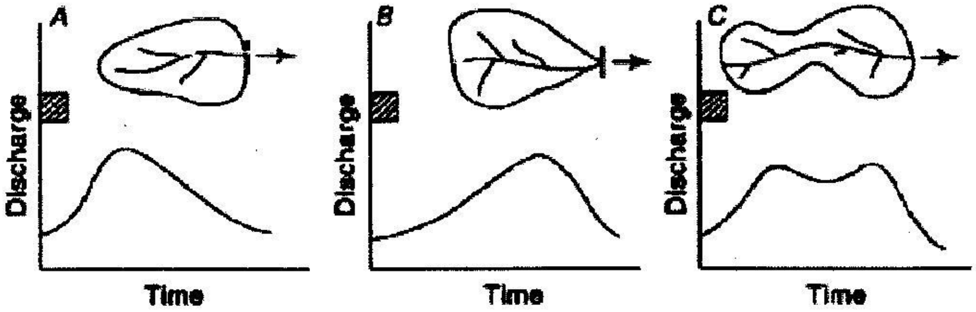

Fig. 6 Effect of Catchment Shape on the Hydrograph

2. Size:

Small catchment → overland flow is dominant.

Large catchment → Channel flow is dominant.

$Q_p \propto A^n$ $n \approx 1/2$ $(n<1)$ } $t_p \propto A^m$; $m \approx 0.2$ بالوادي الكبيرة

$T_{Base}|_{small} < T_{Base}|_{large}$

3. slope

Large slope → quick depletion of storage (steeper recession limb)

Large slope → large peak of discharge.

4. Drainage density كثافة البزل

high density → large peak
low density → low peak
as shown in Fig (7)

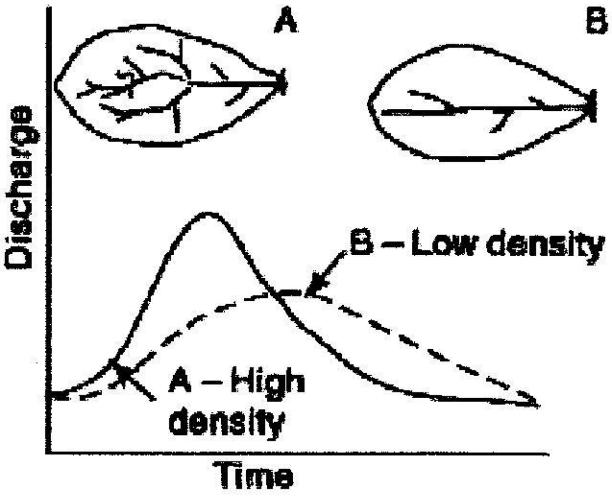

Fig. 7 Role of Drainage Density on the Hydrograph

5. Land use

Vegetation cover increases the infiltration and causes a considerable retardance in overland flow.

⇒ V.C. → Low peak especially in catchment of $A < 150 km^2$.

Components of Hydrograph مركبات الهيدروغراف

1- Rising Limb الطرف الصاعد from start to inflection ①
2- Crest segment قطعة القمة between two inflections
3- Recession Curve منحنى الانحسار from inflection ② to ground water flow

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Hydrograph Separation فصل الجريان في الهيدروغراف

Method 1

Joining the beging of surface runoff to apoint of the end of direct runoff on the rising limb. (A ⟶ B)

Point B canbe evaluated by an empircal equation calculated from peak as;

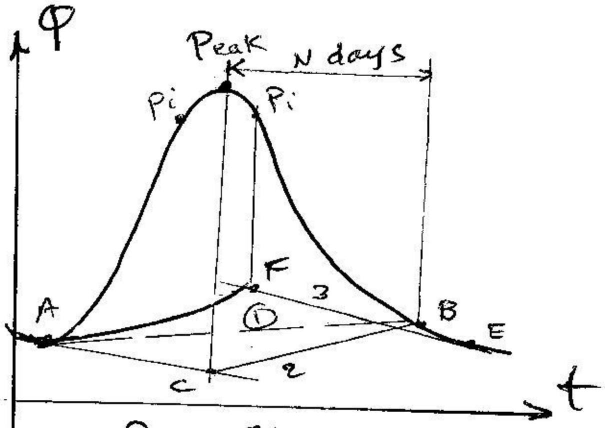

Fig. 8 - Base flow separation

$$N = 0.83\, A^{0.2} \qquad (3)$$

A: drainage area Km^2, N: period in days

Method 2

Extend the hydrograph curve prior to point A till it intersects the ordinate drawn from peak point (point C). This point is jointed to point B.

Method 3

The recession curve is extended backwards till it intersects the ordinate from inflection point at point F. Joining point A and F by an arbitrary smooth curve

Storage of Water in the Basin — الخزين المائي في الحابية

The storage of water in the basin exists as;

(i) surface storage (surface detention & channel storage) — الخزن السطحي (الحجز السطحي + خزن القناة)

(ii) interflow storage — الخزن البيني

(iii) Groundwater storage (base-flow storage) — الخزن القاعدي

Bannes, in 1940, showed that the recession of storage can be expressed as;

$$Q_t = Q_0 K_r^t \qquad (4)$$

Q_t = discharge at a time t.
Q_0 = discharge at time $t = 0$.

Equation (4) is equivalent to:

$$Q_t = Q_0 e^{-at} \qquad (5)$$

where $a = -\ln K_r$

K_r : recession constant ($K_r < 1$), this constant can be considered to be made of three components;

$$K_r = K_{rs} \cdot K_{ri} \cdot K_{rb}$$

K_{rs} = recession constant for surface storage — ثابت الانحسار للخزن السطحي
K_{ri} = recession constant for interflow — ثابت الانحسار للجريان البيني
K_{rb} = recession constant for base-flow — ثابت الانحسار للجريان القاعدي

$K_{rs} \approx 0.05 \rightarrow 0.2$, $K_{ri} = 0.5 \rightarrow 0.85$, $K_{rb} = 0.85 \rightarrow 0.99$

كلما قلت قيمة الثابت ازدادت أهمية التصريف المرتبط به ، ولنا عندما يراد إهمال قيمة التصريف البيني يعطى للثابت (K_{ri}) قيمة واحد ،

Equation (4) or even (5) can be plot as a striaght line when drawn on semi-Log paper (Q on log scale). The slope of this line represents the recession constant.
The storage S_t reimaining at any time is;

$$S_t = \int_0^\infty Q_t \, dt = \int_0^\infty Q e^{-at} dt = \frac{Q_t}{a} = \frac{-1}{\ln K_r} Q_t \qquad (6)$$

نستخدم صورة المعادلة (4) الثانية (أي المعادلة ⑤) لسهولة التكامل