

① هيدروغراف الجريان Runoff Hydrograph

Runoff: the draining or flowing off the precipitation from a catchment area through a surface channel.

هو جريان أو تصريف المياه من الجابية وخلال قناة سطحية موجودة في .
It thus represents the output from catchment in a given unit of time. الناتج من الجابية في وحدة الزمن.

$$R = P - ET - IL - INF - DS \quad \text{①}$$

R = ^{الجريان} Runoff , P = ^{الهطول} receiving precipitation , ET = ^{التبخر} evapotranspiration
IL = ^{الخسارة الأولية} initial loss , INF = ^{التسرب} infiltration, and DS = ^{التخزين} detention storage

The excess precipitation moves over the land surfaces to reach smaller channels. This portion of runoff is called overland flow.
تتحرك الهطول الفائض فوق سطح الأرض إلى القنوات الصغيرة وهذا الجزء من الجريان يسمى جريان فوق سطح الأرض.

This flow involves building up a storage over the surface and draining off the same.
تتضمن هذا الجريان بناء مخزن فوق السطح وتصريفه.

The flow during overland discharge is laminar regime. The flow travels from small channels to bigger ones till the flow reach catchment outlet. The mode of flow where it travels all the time over the surface as overland flow and through channels as open-channel flow and reach outlet of catchment is called surface runoff.

يسمى الجريان فوق سطح الأرض والحاصل في القنوات والوصول إلى مخرج الجابية بالجريان السطحي.

A part of precipitation that infiltrates and moves laterally through upper crusts of the soil and return to surface at locations away from the point of entry into the soil. الجريان الجانبي
This component of runoff is known as interflow. الريان الجانبي
Subsurface storm flow. الجريان الجانبي تحت السطح
Storm seepage or quick return flow. تسرب مياه العواصف أو الجريان السريع.
أنظر المرفق (أ).

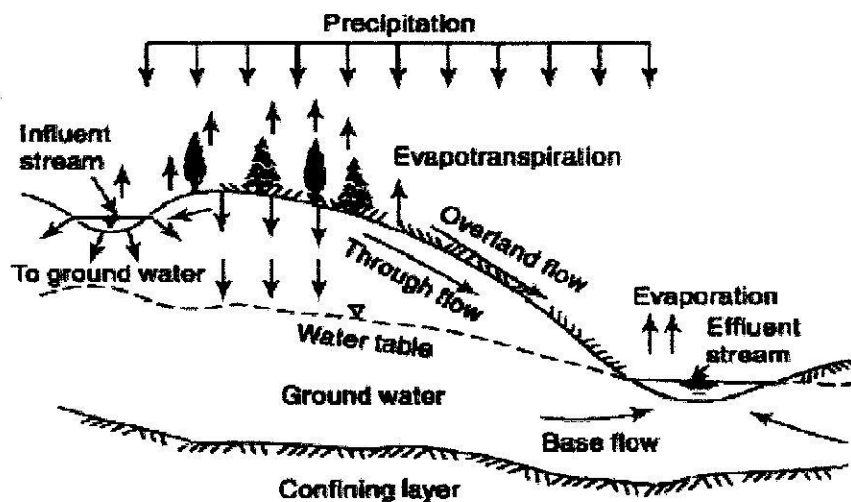


Fig. 1 - Different routes of runoff

The interflow sometimes is classified as prompt interflow *سريع الجريان* i.e., the interflows with least time lag (the difference between the time of interflow and the time of soil leaving).

Another route of the infiltrated water is to undergo deep percolation and reach the groundwater storage. The groundwater follows a complicated and long path of travel and ultimately reach the surface. The groundwater flow provides the dry-weather flow in perennial streams *الجريان الجوفي*.

The surface runoff is classified into :-

1. Direct runoff *الجريان المباشر* (storm runoff)
2. Base flow *الجريان الأساسي*

Hydrograph

It is a plot of the discharge in a stream against time chronologically. *مخطط يبين كمية المياه الخارجة من النهر في وقت محدد*

1. Annual Hydrograph: shows the variation of daily or weekly or 10 days mean flow over year.
2. Monthly hydrograph: shows variation of daily mean flow over month
3. Seasonal hydrograph: shows variation of discharge in a season.
- X 4. Flood hydrograph (storm hydrograph): due to a storm and representing stream flow of the storm over the catchment *مخطط يبين كمية المياه الخارجة من النهر في وقت محدد*

water year سنة المياه

③

The annual hydrograph shows the seasonal variation of the discharge over a year and forms a basic data for further analysis. Each country has fixed a define 12-month period to begin & end. In USA the water year starts 1st October to 30th September, In India is from 1 June to 31 May whereas In Iraq starts from 1 March and end at 30th September. In Egypt starts at 1 August to 31 July.

Runoff Characteristics of Streams

صفات الجريان

A study of the annual hydrographs of stream enable to classify the streams in three classes:

(1) Perennial stream: جريان دائم

It always carries some flow (Fig 2)

There is a considerable amount of groundwater flow throughout the year even during dry season (How?)

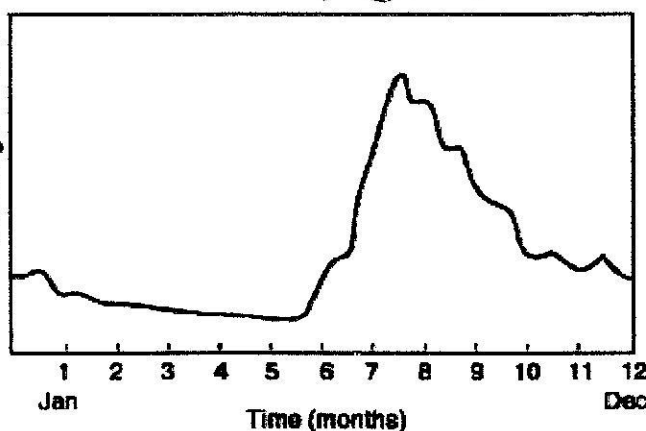


Fig. 2 Perennial stream

(2) Intermittent stream: جريان موسمي

The contribution of groundwater is limited. In wet season, the water table is above the streambed. In dry season the water table is below streambed and the stream dries up, unless storms that can produce a short-duration flow.

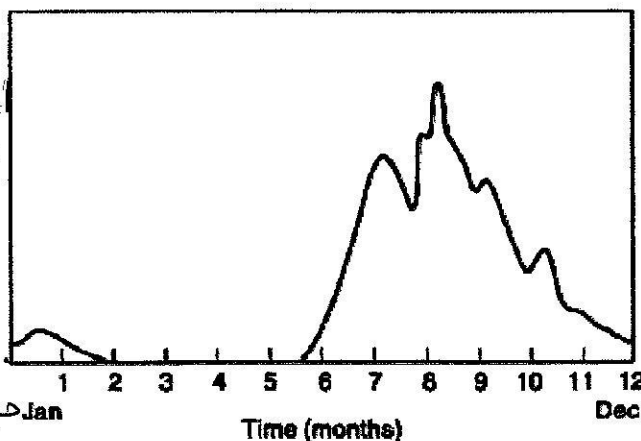


Fig. 3 Intermittent stream

(3) Ephemeral stream: جريان عابر

The base flow does not have any contribution. The stream becomes dry soon after the end of storm flow.

The annual hydrograph of such streams show series of short-duration fluctuations of storm.

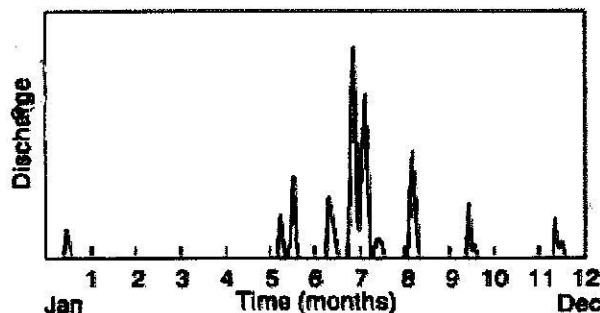


Fig. 4 Ephemeral stream

Rainfall-runoff Correlation

$R = aP + b$, a & b can be found by regression of Linear type as in regression of stage-discharge relation.

Flood Hydrograph (الهيدروغراف الفيض)

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Consider a concentrated storm producing a fairly uniform rainfall of duration D over a catchment. After the initial losses and infiltration losses are met, the rainfall excess reaches the stream through overland and channel flow. A certain amount of storage is built up in the overland and channel flow. This storage gradually depletes after cessation of the rainfall.

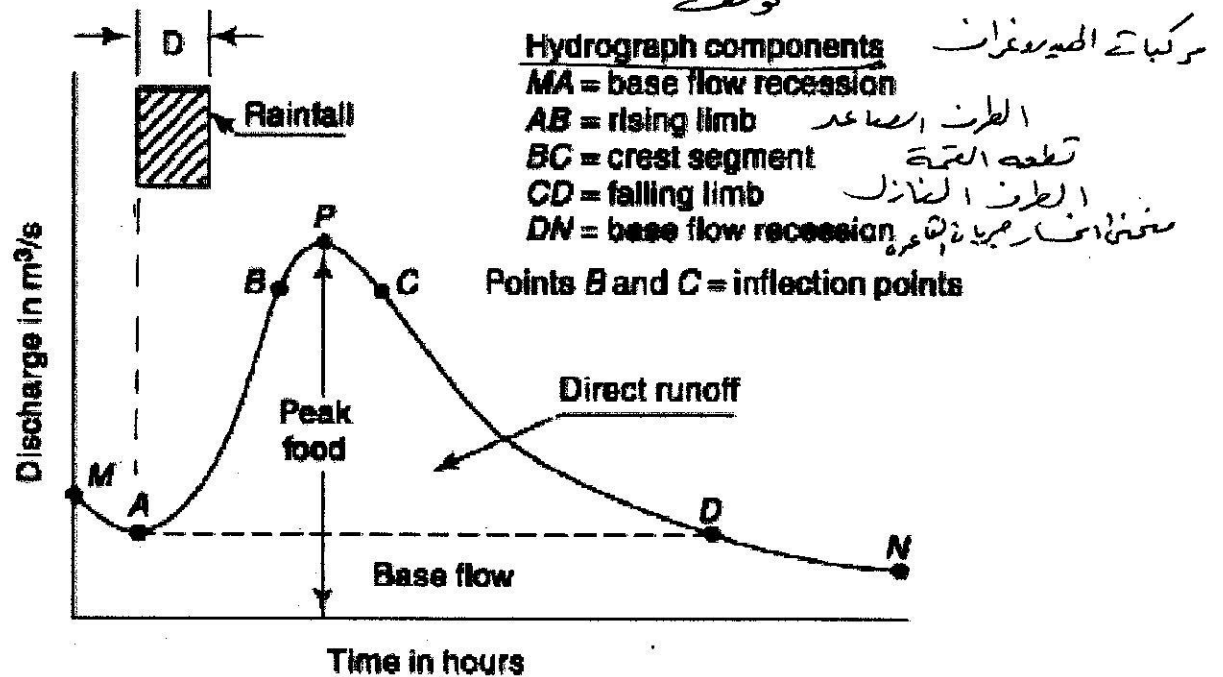


Fig. 5 - Elements of a Flood Hydrograph

There is a time lag between the occurrence of rainfall in the basin and the time when that water passes a gauging station at basin outlet. The runoff measured at stream-gauging station will give a typical hydrograph shown in Fig (5) above.

الزمن بين مركز كتلة الهيدروغراف وذروة التقريف (P) يُطلق عليه زمن التأخر (Lag time T_L). حيث مركز الكتلة (الم.م) هو:

$$X_c = \frac{\int x dA}{\int dA} = \frac{\sum x_i A_i}{\sum A_i} \quad (2)$$

إن الهيدروغراف عند حالة السج استجابة النهر (البحر المحيط) الجريان البيني والجريان القاعدي) وكذلك تتضمن خصائص الوضوح Basin وخصائص النافذ المطرية وهي صلبة من التداخلات المعقدة.