Hydrograph and Unit hydrograph, Lecture 6, 04/18/2013

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Adapted from textbook and notes of Philip B. Bedient, David Maidment and Areeya Rittima

Hydrographs

Videos

- **Flash Flood in Southern Utah**

(http://www.youtube.com/watch?v=ORZQUlk8vxg)

- **Flash flooding in a small creek**

(http://www.youtube.com/watch?v=cxAUoXTUtS8)

- **The Toga River flash flood, Kobe, Japan, July 28 2008**

(http://www.youtube.com/watch?v=FEF02Cl49RY)

Hydrographs routed to the outlet of the watershed

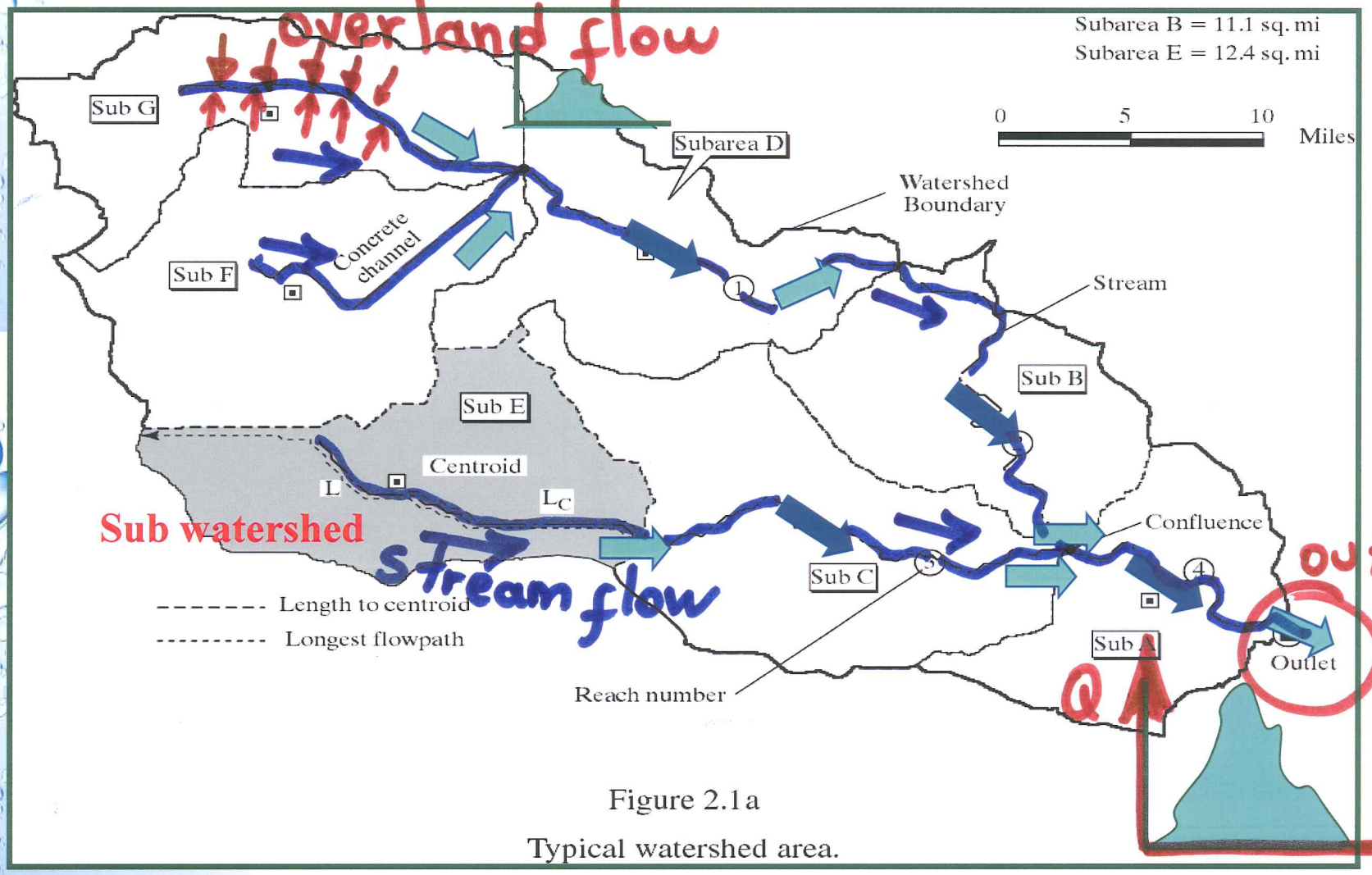

Figure 2.1a

Typical watershed area.

Distribution of uniform rainfall presented with a runoff hydrograph

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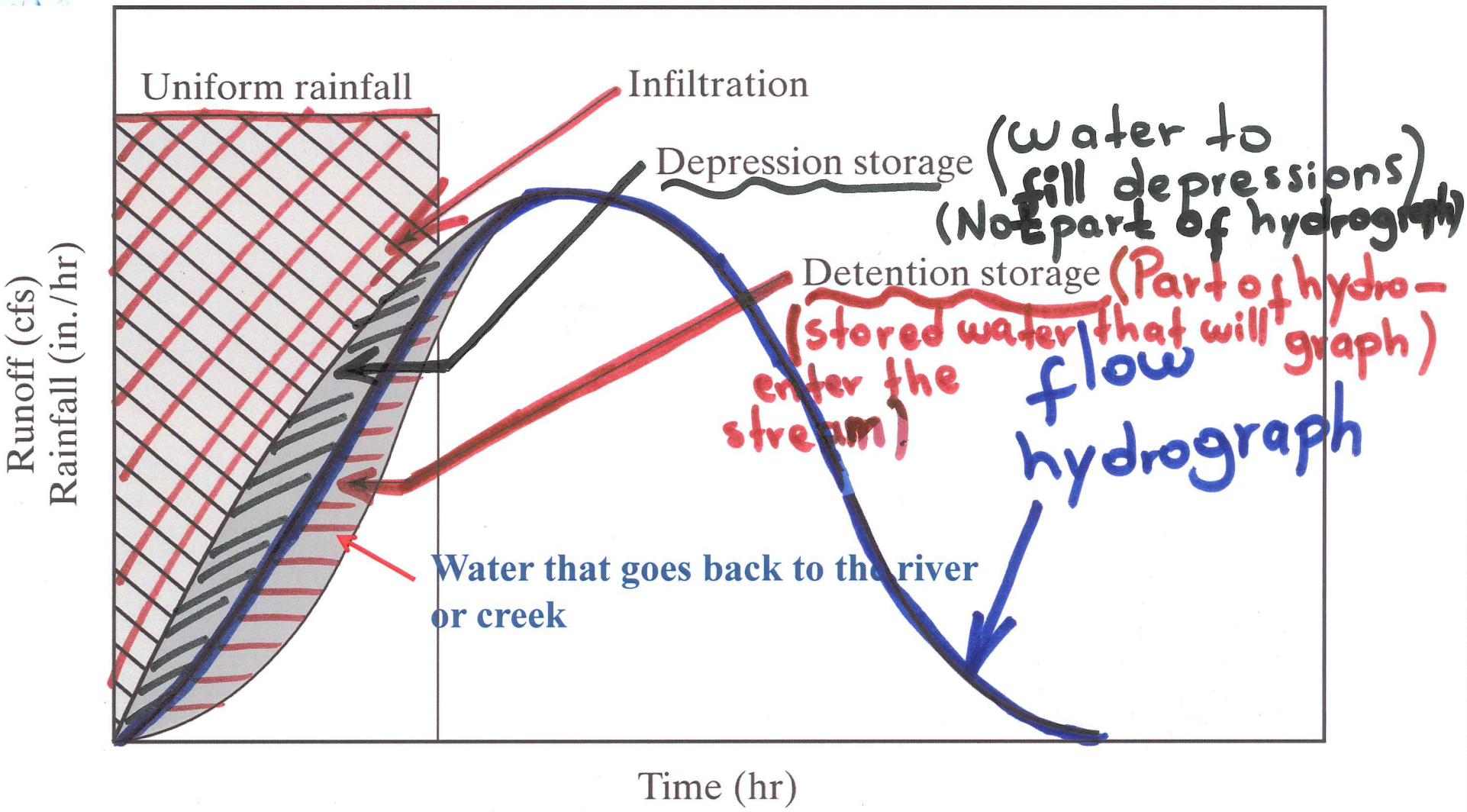
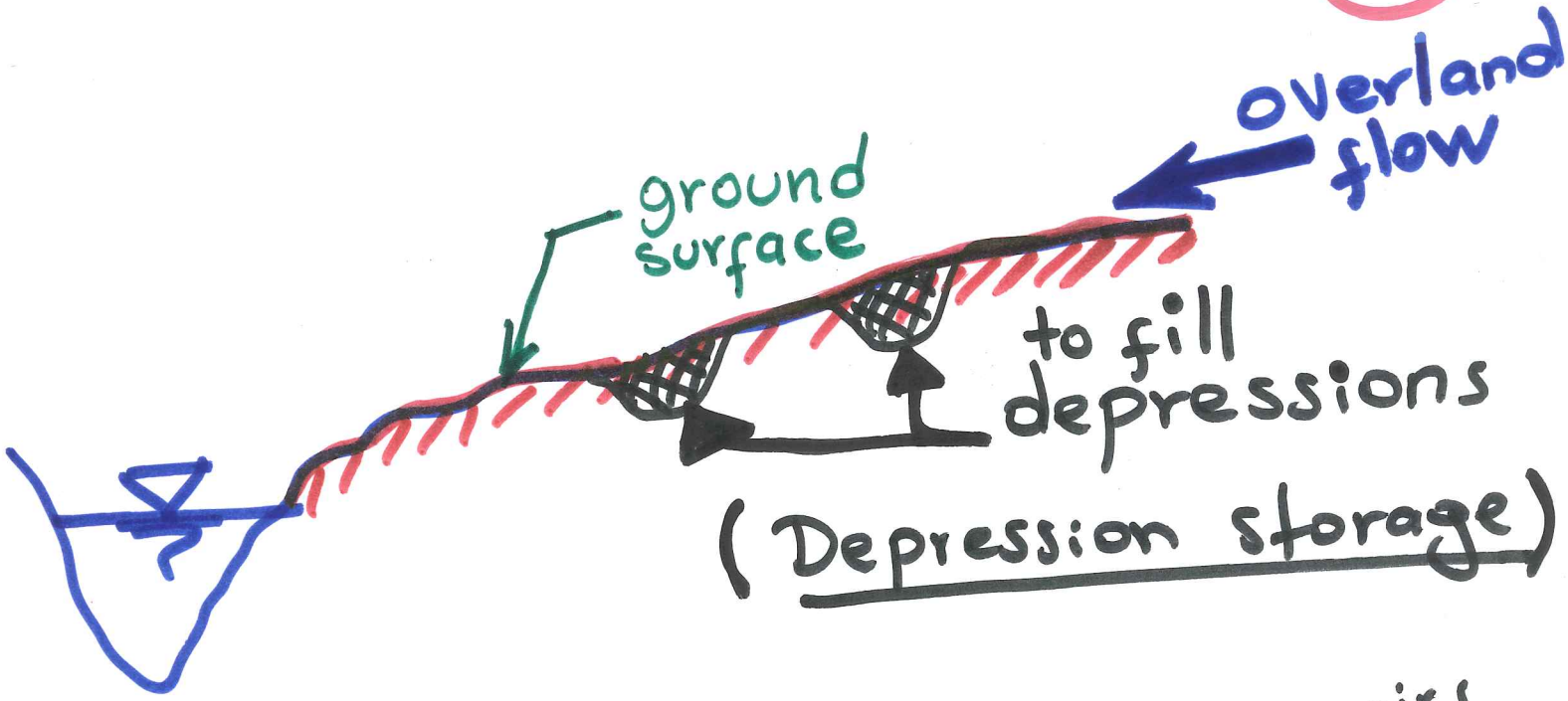
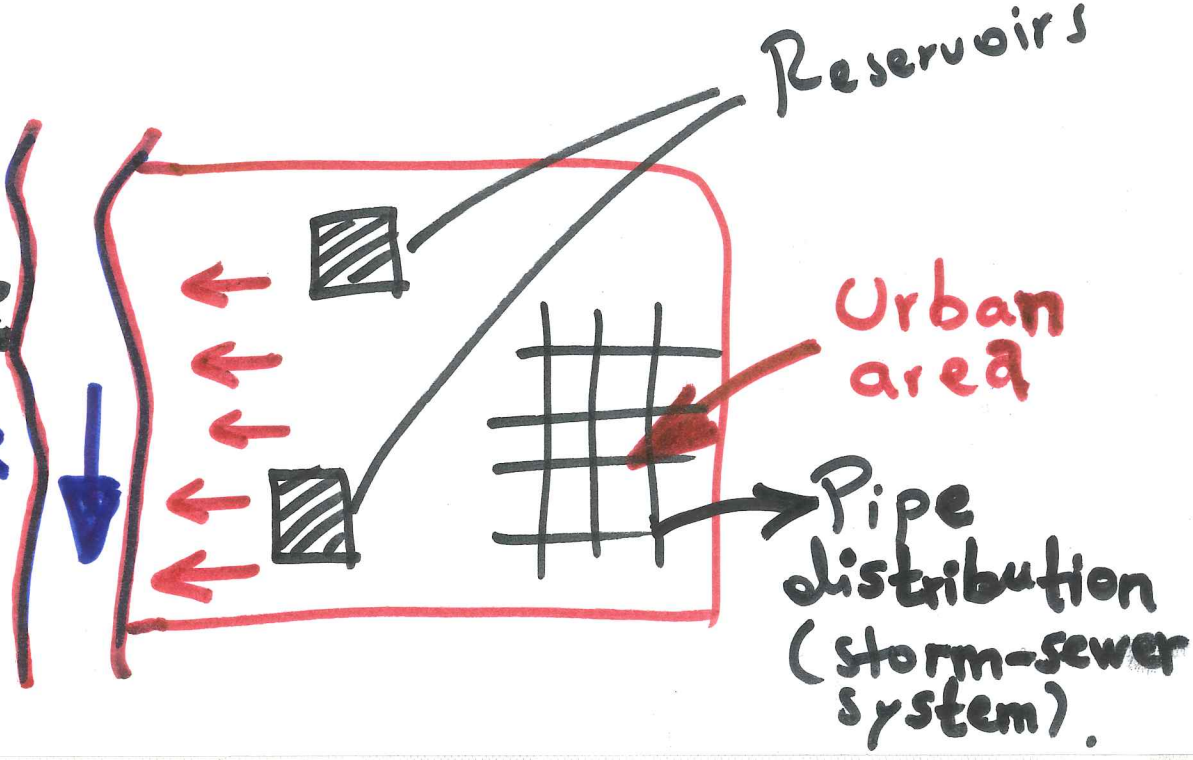




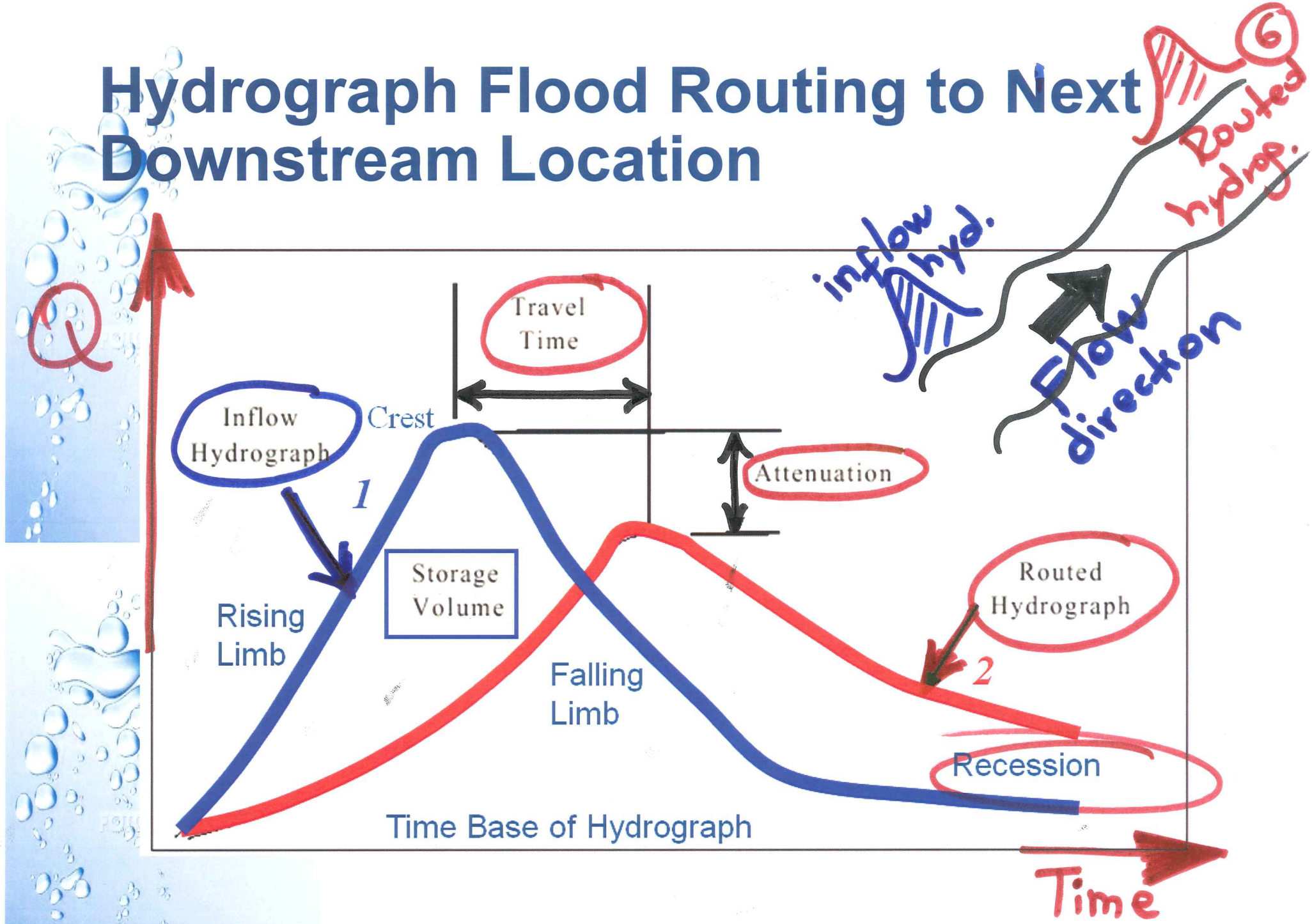
(Depression storage)

Detention storage

Will enter creek or river at a later time

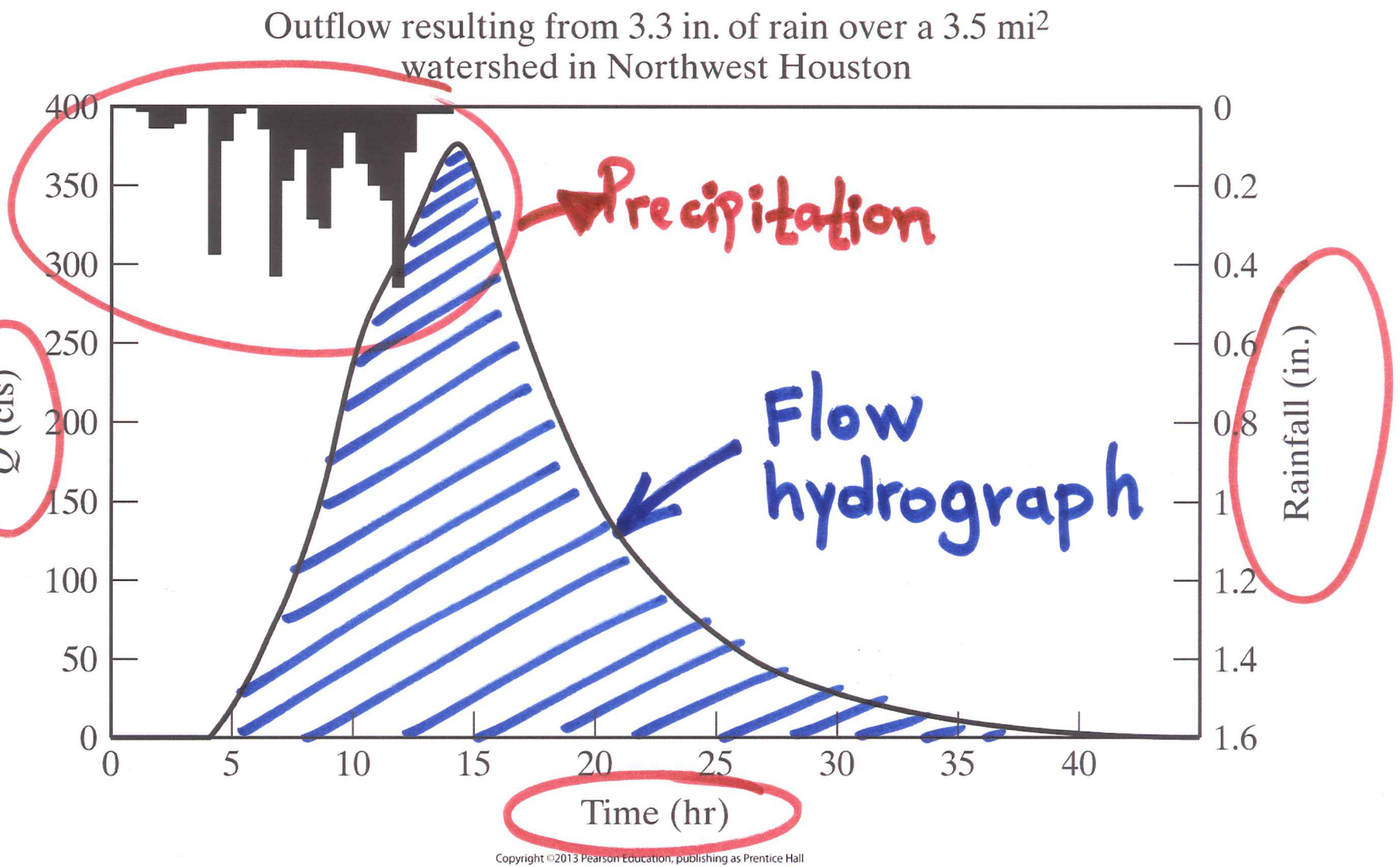


Hydrograph Flood Routing to Next Downstream Location

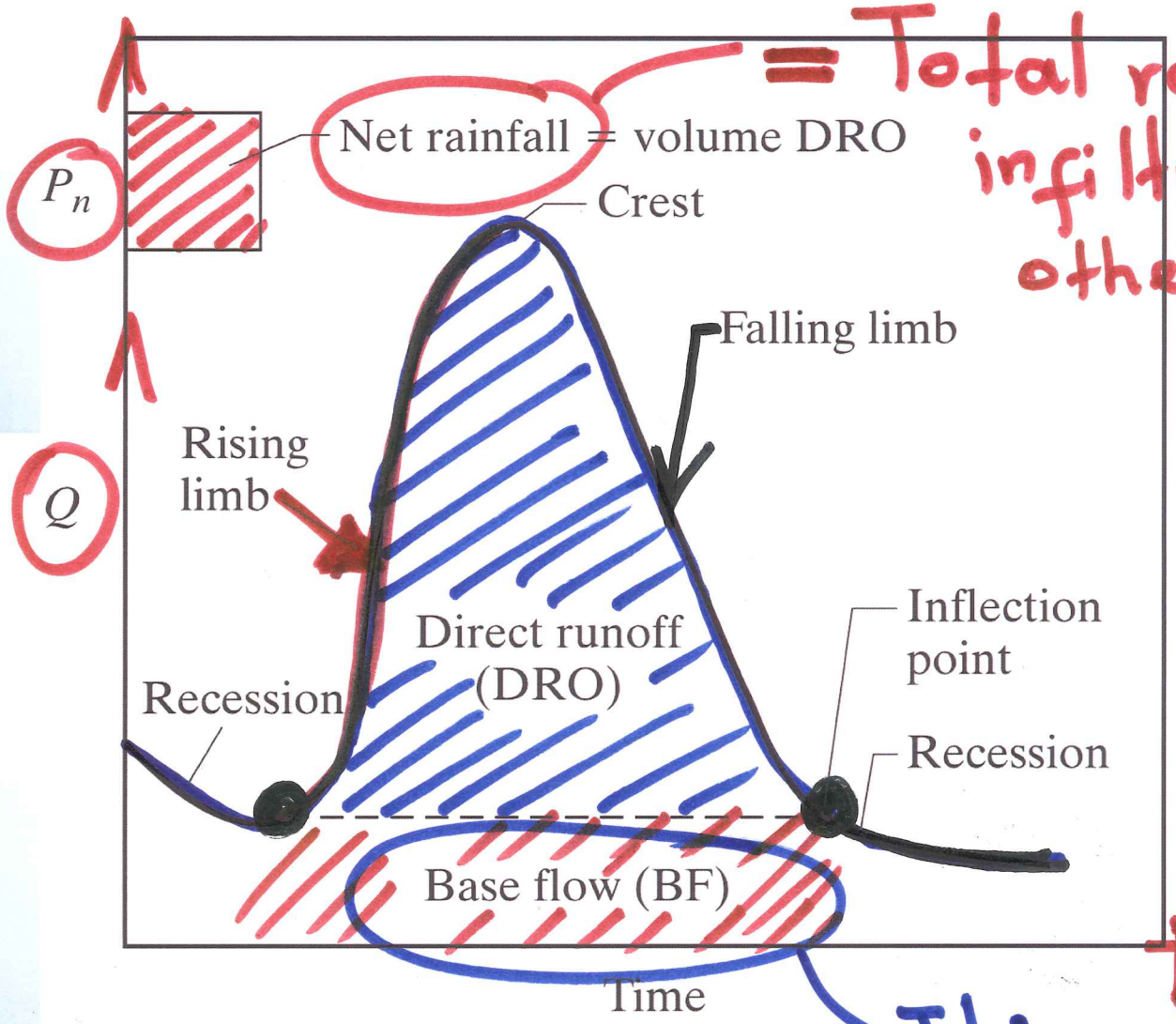


Flood wave is <u>lagged</u> and <u>attenuated</u> as it moves downstream

Actual rainfall and hydrograph resulting from 3.3 in. of rain for little Cypress Creek, Houston



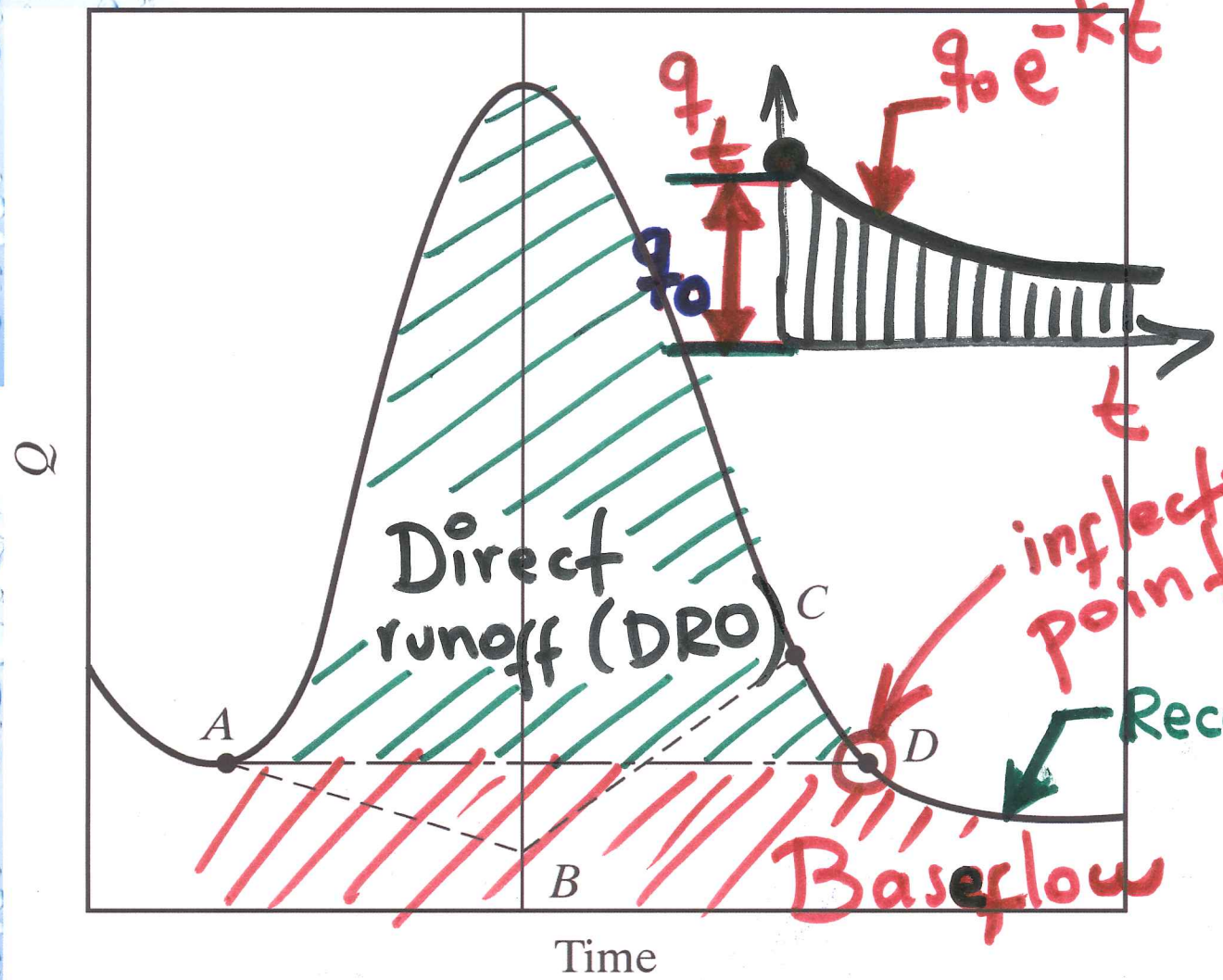
Components of an outflow hydrograph. When base flow is removed, the result is the direct runoff outflow (DRO).

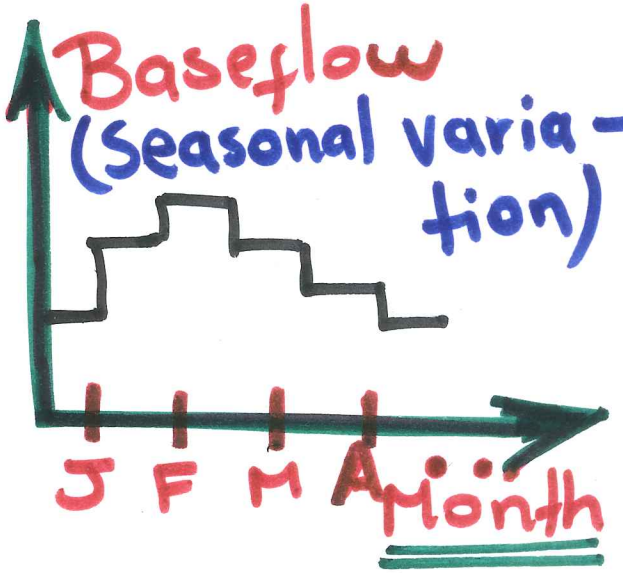


= Total rainfall − infiltration − other losses.

It is not associated with the precip. under analysis

Two methods for base flow separation (Straight line and Concave)





Recession curve exponential depletion

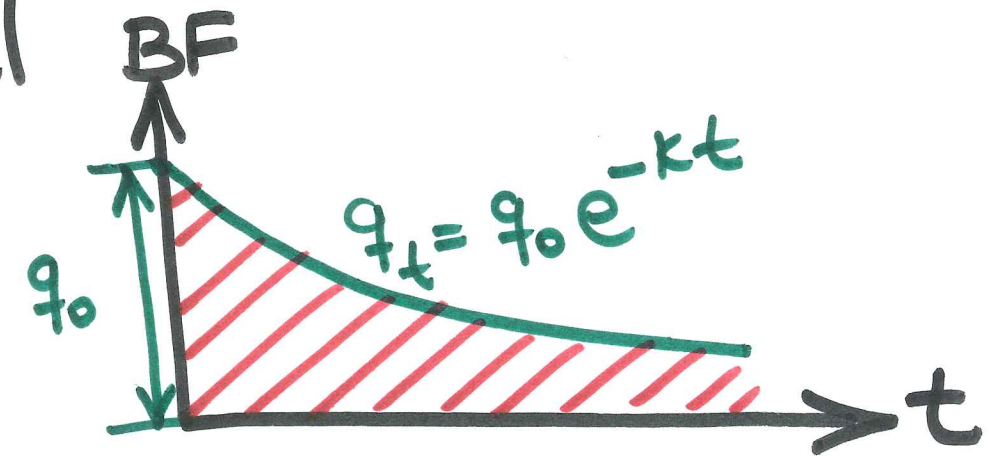
$$q_t = q_0 e^{-kt}$$

Baseflow (BF)

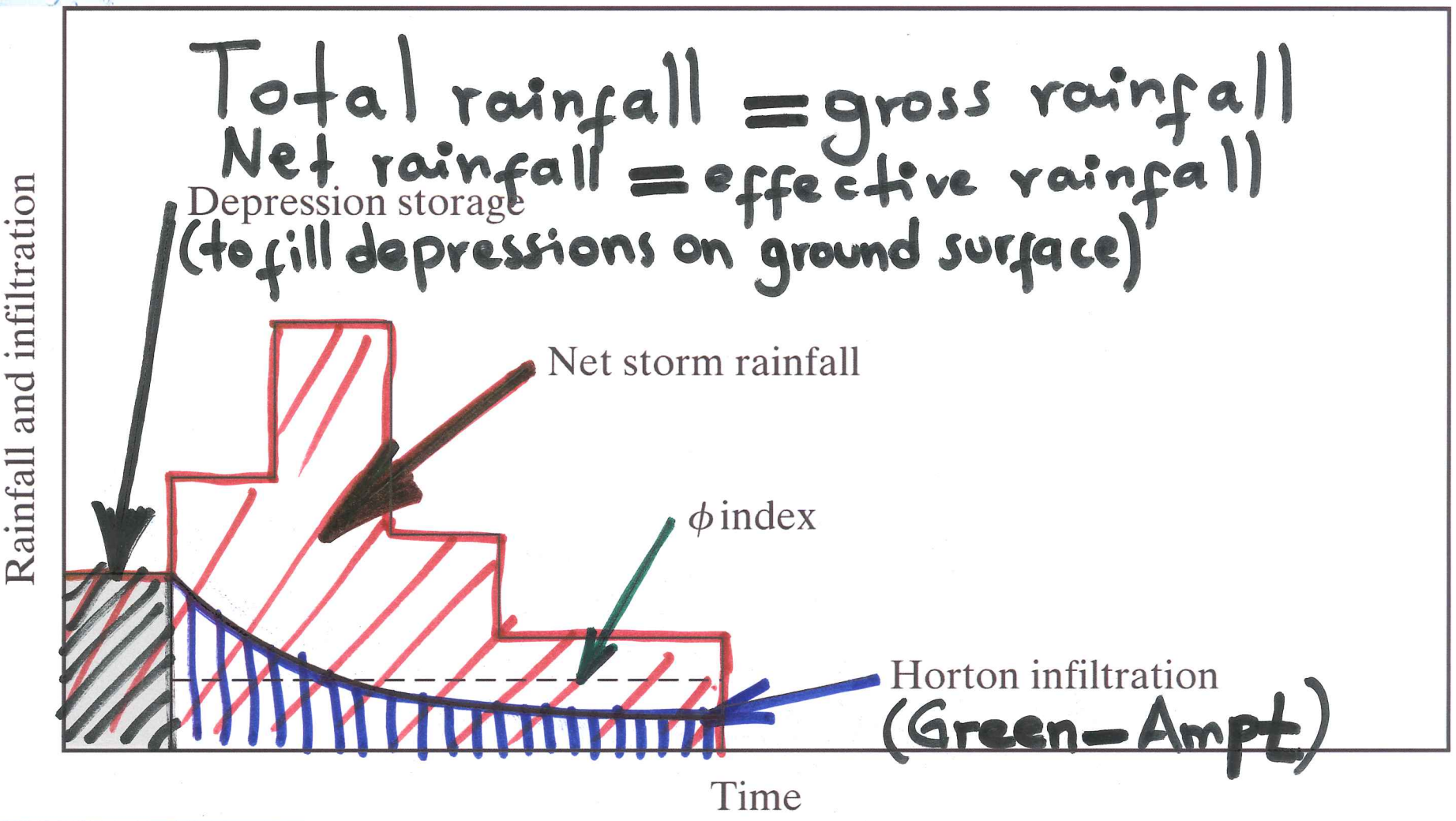
① Constant

② Seasonal

③ Exponential depletion



Infiltration loss curves used to find rainfall excess. Horton's infiltration curve and the phi index with initial loss for depression storage.



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Unit Hydrograph (UH)

1 inch of net rainfall

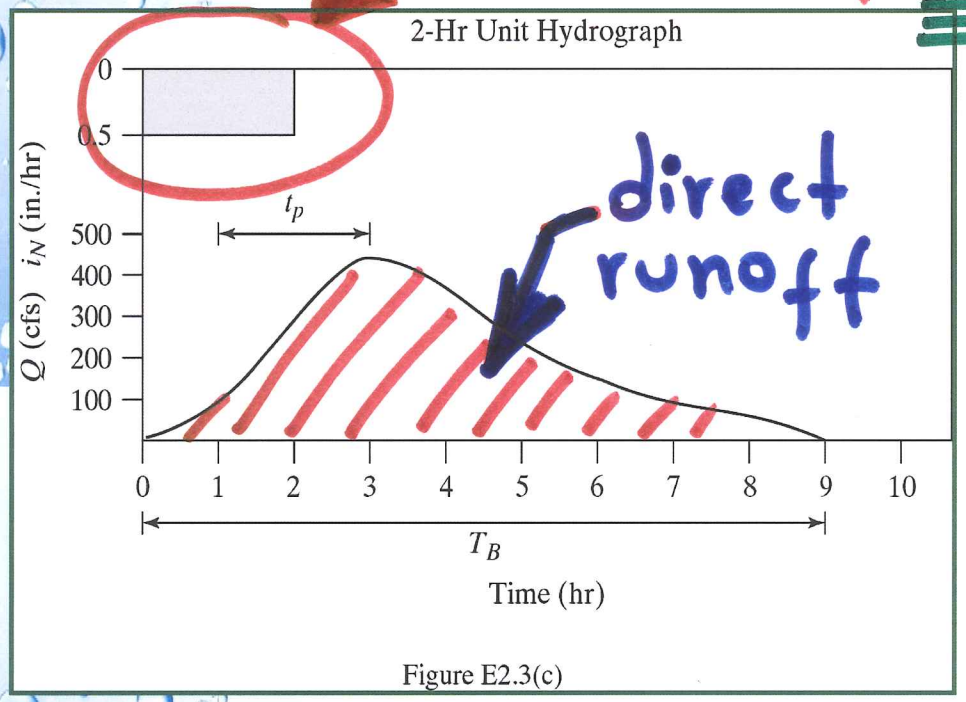
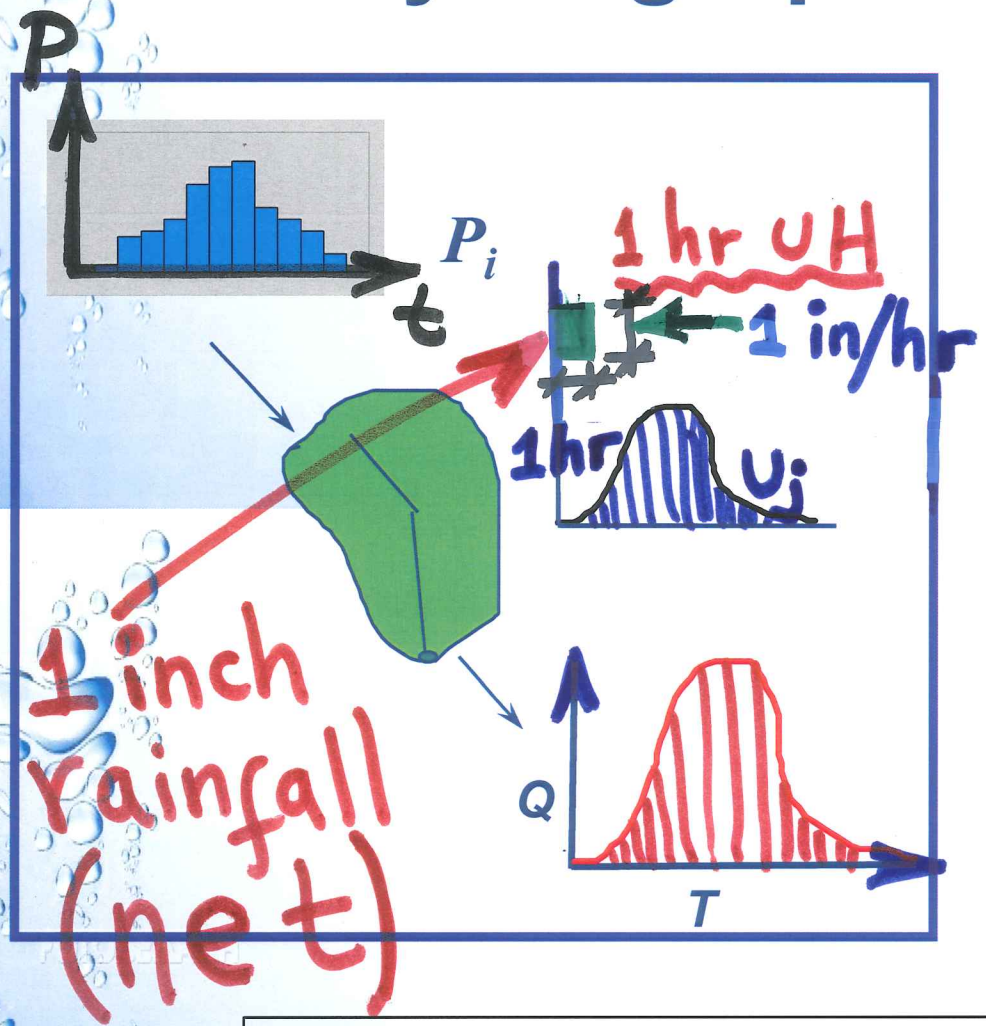


Figure E2.3(c)

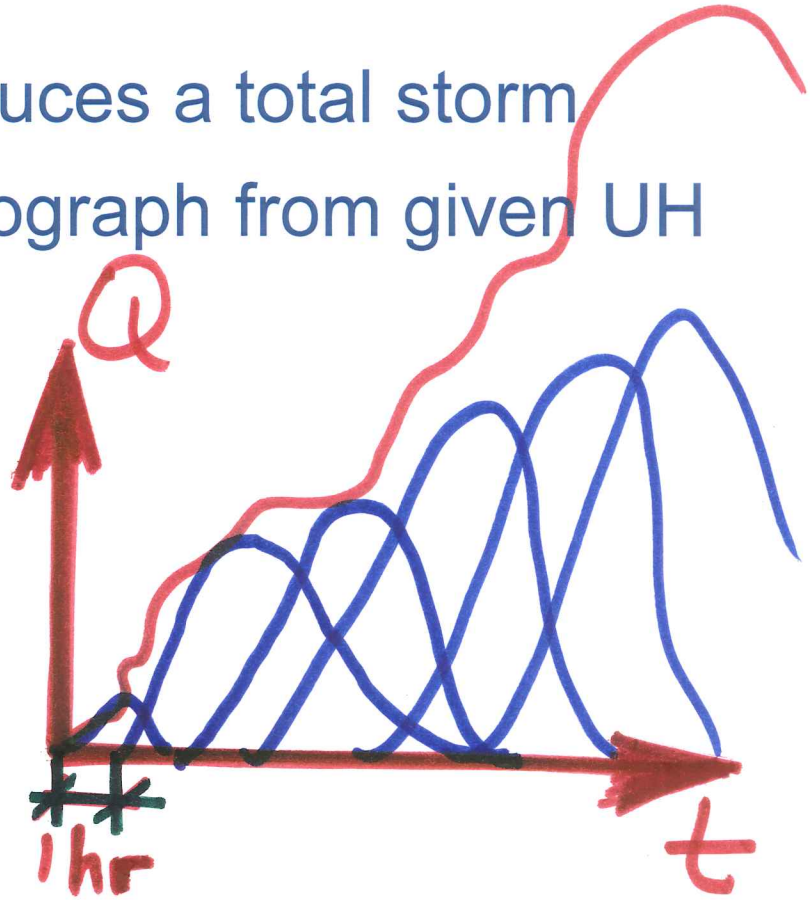
- Linear Transformation Methods
- Tested in numerous Watersheds
- Regional calibration
- Still most used approach

Basin response from 1 inch of uniform rainfall of given duration, D

Unit Hydrograph Method (Cont.)



Produces a total storm hydrograph from given UH

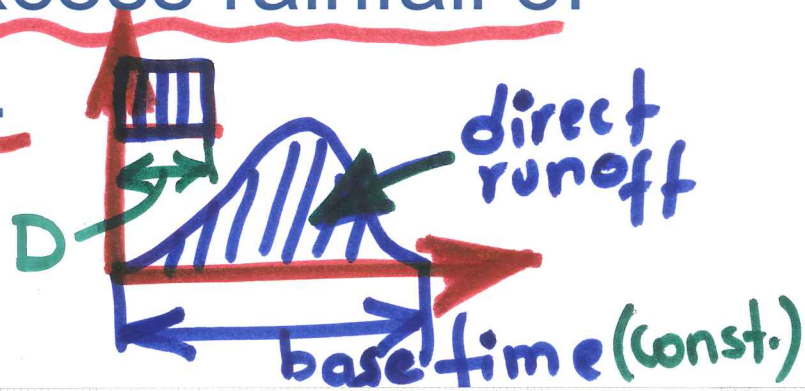


$$Q_n = P_n U_1 + P_{n-1} U_2 + P_{n-2} U_3 + \ldots + P_1 U_j$$

Unit Hydrograph

Assumptions

- The excess rainfall has a constant intensity within the effective duration.
- The excess rainfall is uniformly distributed throughout the whole drainage area.
- The base time of the duration of direct runoff resulting from an excess rainfall of given duration is constant.



Measured Hydrograph Adjusted for Net Rainfall (RF)

2hr UH?

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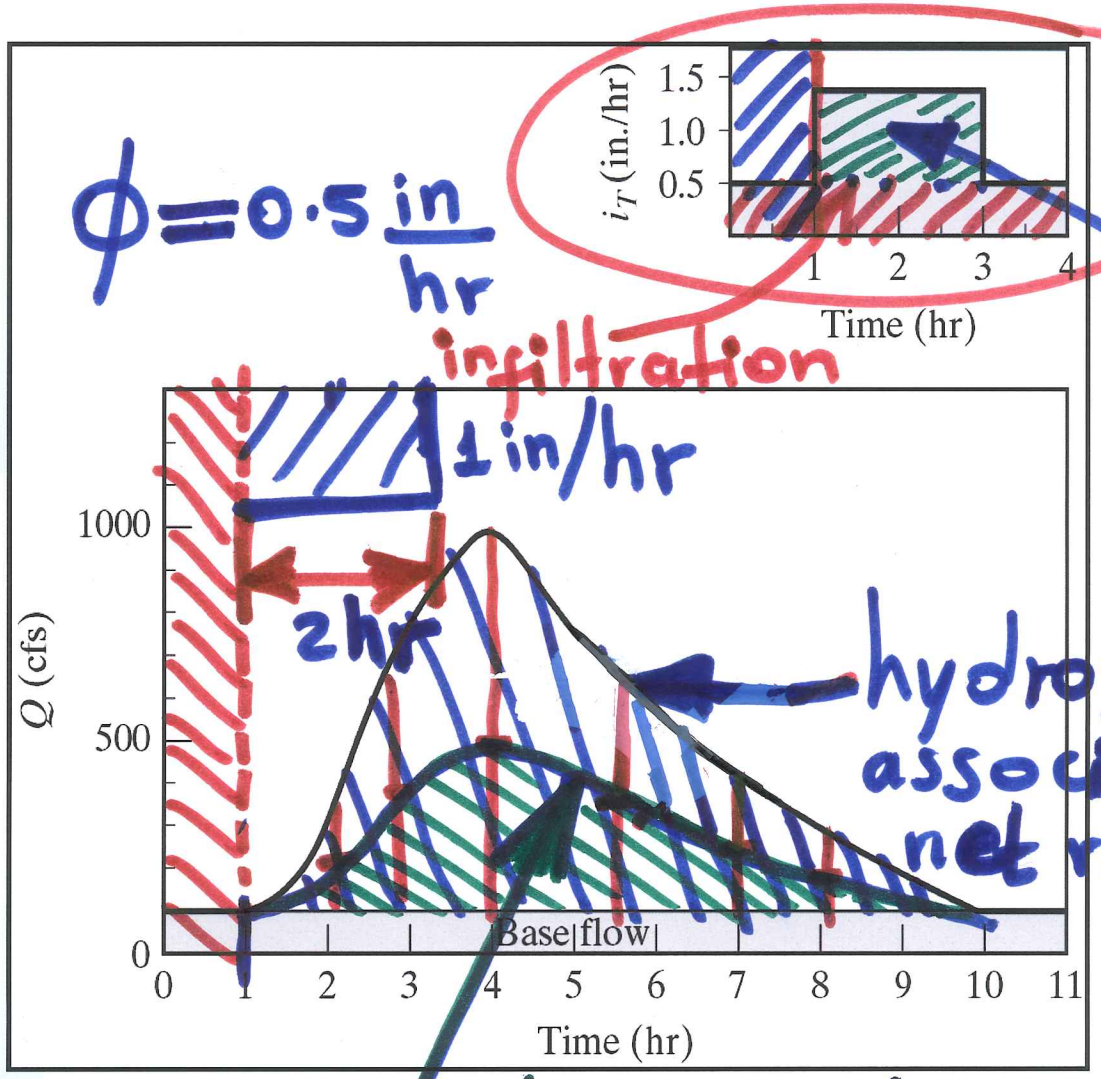


$\phi = 0.5 \frac{in}{hr}$

Total rainfall

infiltration

net rainfall

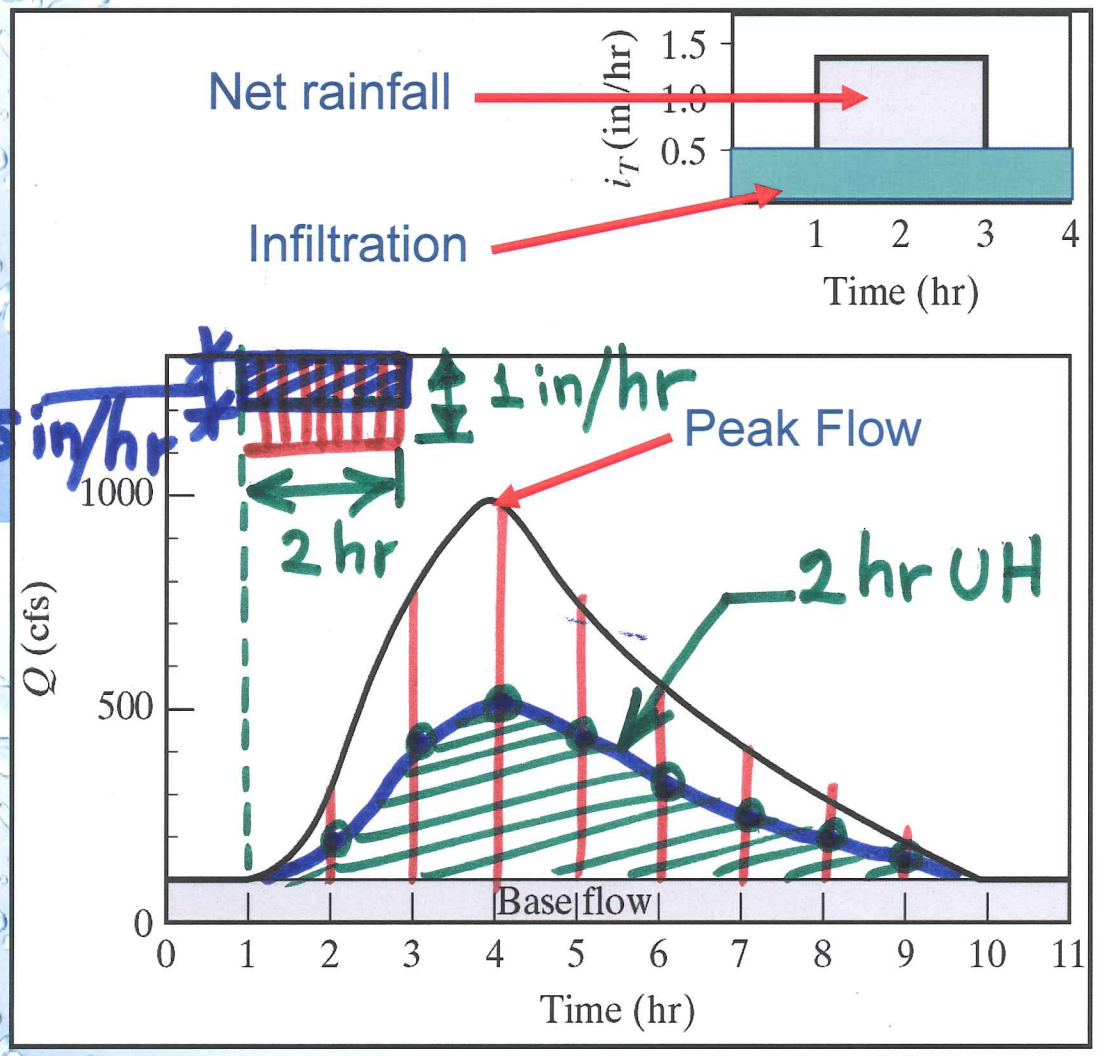
1 in/hr

2hr

hydrograph associated to net rainfall only.

2hr UH

Base Flow and Infiltration



- Subtract BF
- Subtract Infiltration
- Determine Net Rain
- Integrate hydrograph
- Adjust hydrograph ordinates to match net rainfall Volume
- Determine UH