

CVG3120-FALL 2015 – Assignment 1

Due Date: October 7, 2015

Please post the solution online in Word format by 12:00PM on the due date.

Problem One:

A rainfall of 105 mm happened for an hour and half on a 150 hectare catchment. The watershed was dry before the rainfall, and after the storm it experienced a 10 hours runoff with a 2 CMS discharge.

- 1) What is the volume of water which was lost as a result of infiltration, evaporation and transpiration?
- 2) What is the ratio of direct runoff to precipitation?

Problem Two:

Compute the time of concentration and runoff volume for 5 inches of rainfall for a watershed (L= 7500ft; slope = 0.0012) that is fallow with a straight row and the soil is group A. How different is the runoff volume and the time of concentration when the soil group is changed to B, C, or D?

Problem three

Figure 1 is a simplified representation of a watershed where storage above soil surface is represented by two reservoirs (interception storage and surface storage) and storage below the soil surface by two reservoirs (shallow aquifer and deep aquifer; *aquifer means groundwater storage*). Evaporation is neglected as we focus here on short rainfall events of less than 24h.

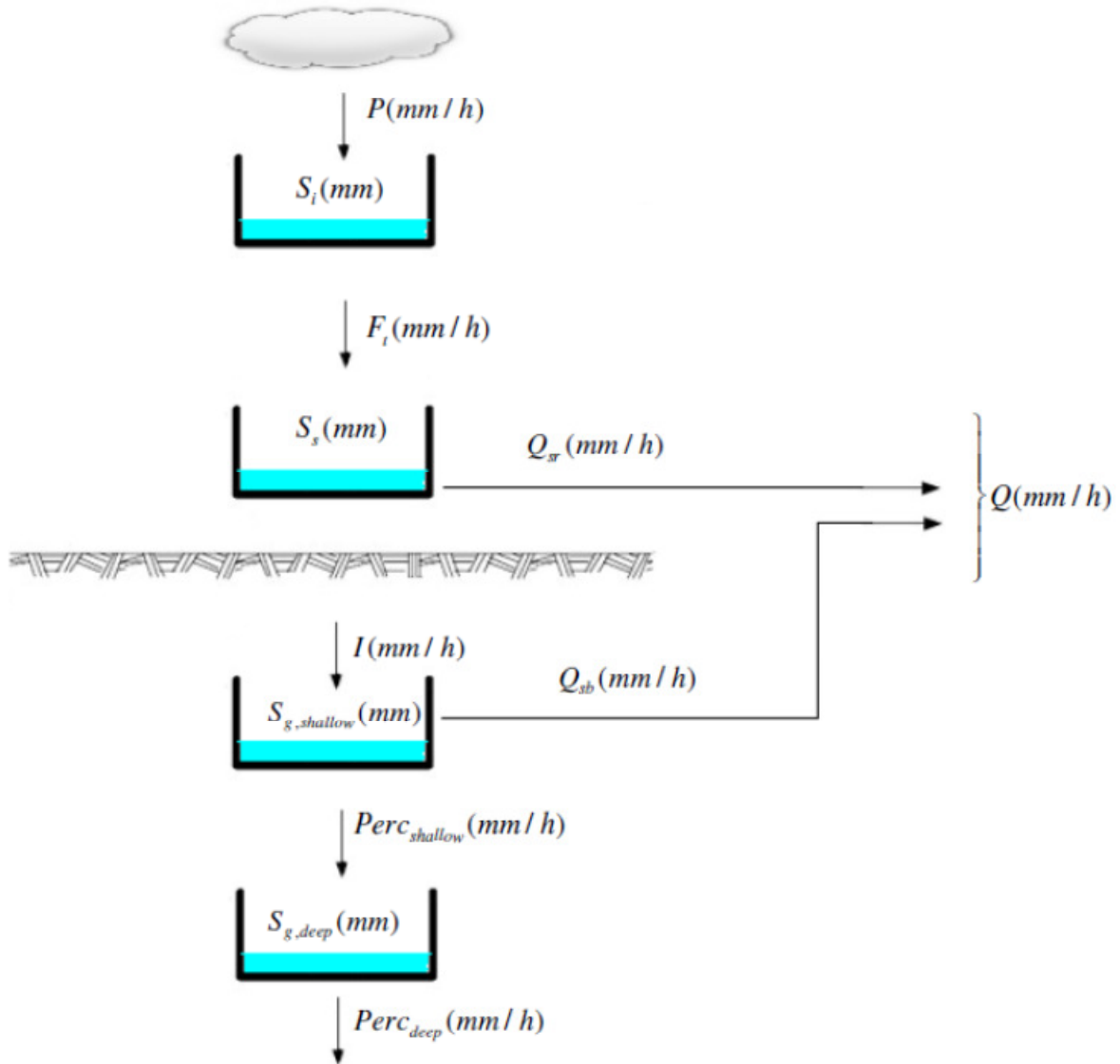
Definition of the storages and fluxes in figure 1:

$P(mm/h)$: precipitation	$S_i(mm)$: interception storage
$F_t(mm/h)$: throughfall	$S_s(mm)$: surface runoff
$I(mm/h)$: infiltration	$S_{g,shallow}(mm)$: storage in the shallow aquifer
$Q_{sb}(mm/h)$: subsurface flow (mm/h)	$Q_{sr}(mm/h)$: surface runoff (mm/h)
$Perc_{shallow}(mm/h)$: percolation from the shallow aquifer	$S_{g,deep}(mm)$: storage in the deep aquifer
$Perc_{deep}(mm/h)$: percolation from the deep aquifer	$Q(mm/h)$: streamflow

The following assumptions are made:

- Precipitations starts by filling the interception storage S_i first; when S_i reaches its maximum value, precipitations bypasses the interception storage and becomes throughfall (F_t)

- F_t is zero until interception storage is completely full
- Streamflow is the sum of the outflows from surface storage (Q_{sr}) and from the shallow aquifer storage (Q_{sb}).



Questions:

1. Apply the water balance equation to all storage components in the equation and provide an equation for the variation of storage during a time step of 10min
2. Calculate and plot the variation of all storages and fluxes in the system for 24h assuming that all reservoirs are empty at the beginning of the rainfall, and that:

$$P = 5 \text{ mm / h}; S_i^{\text{max}} = 12 \text{ mm}; S_s^{\text{max}} = 5 \text{ mm}; I(\text{mm / h}) = 0.1 S_s;$$

$$Q_{sr}(\text{mm / h}) = 0.2 S_s; Q_{sb} = 0.01 S_{g, \text{shallow}}; Perc_{\text{shallow}}(\text{mm / h}) = 0.01 S_{g, \text{shallow}};$$

$$Perc_{\text{deep}}(\text{mm / h}) = 0.01 S_{g, \text{deep}}$$

use a time step of 10min; it is strongly recommended to use excel for this question as the calculations are repetitive.