CE 3354 Engineering Hydrology
Exercise Set 1

Exercises

1. The mean annual precipitation for a certain 132 square-mile watershed is 26 inches. Assume that 21 percent of the annual precipitation reaches the watershed outlet as streamflow.

   Determine:

   a) The mean streamflow rate in acre-feet per year.

   b) The mean streamflow rate in cubic-feet per second.

2. Figure 1 is a schematic of a 600-hectare farm; the land receives annual rainfall of 2500 mm. There is a river flowing through the farm land with inflow rate of 5 m^3/s and outflow rate of $4m^3/s$. The annual water storage in the farm land increases by $2.5\times10^6 m^3$. Using the water budget concept, estimate the annual evaporation amount in millimeters.[1]

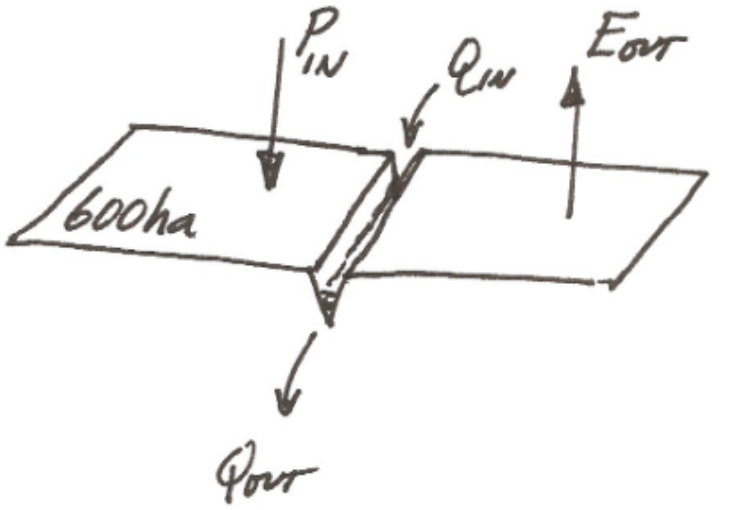

Figure 1: Schematic of Farmland

[1] 1 hectare = 10,000 m^2

3. A reservoir has a surface area of 690 acres. Figure 2 shows the monthly inflow of surface water, outflows as releases from the reservoir via the spillway, direct precipitation into the reservoir, and evaporation from the reservoir. The reservoir water surface elevation was 701.0 feet on January 1. Determine the reservoir water surface elevation at the end of each month (i.e. complete the table)

Lake Woodlands
Average Surface Area = 690 acres

Month	Inflow (acre-feet)	Outflow (acre-feet)	Precipitation (inches)	Precipitation (acre-feet)	Evaporation (inches)	Evaporation (acre-feet)	Storage Net Change (acre-feet)	Elevation Change (feet)	Water Surface Elevation (feet)
December									701.00
January	1732	175	2.75	158.13	1.05	60.38	1654.75	2.40	703.40
February	1755	190	3.05		1.55				
March	872	232	3.76		2.05				
April	955	375	4.11		2.80				
May	708	525	2.70		3.75				
June	312	955	1.05		4.25				
July	102	1720	0.75		5.15				
August	37	2250	1.25		5.76				
September	175	1575	1.55		4.92				
October	575	550	3.79		3.02				
November	1250	175	4.53		1.75				
December	1875	125	5.01		0.60				

Figure 2: Tabular Water Budget Values

4. The equation $k\frac{dQ}{dt} + Q(t) = I(t)$ is used to describe the response of streamflow to a constant rate of precipitation applied indefinitely on some watershed. Suppose that $Q(0) = 0$ and the watershed characteristic time constant is $k = 2$ hrs. $I(t) = 2$ for $t = [0, 12)$ hrs and then $I(t) = 0$ for $t = [12, 24]$ hrs.

   Determine:

   (a) Plot the values of $I(t)$ over the 24-hour perios, in 1-hour increments.

   (b) The necessary equation(s) to predict the response $Q(t)$ over the 24-hour period.

   (c) Plot the values of $Q(t)$ over the 24-hour period, in 1-hour increments.