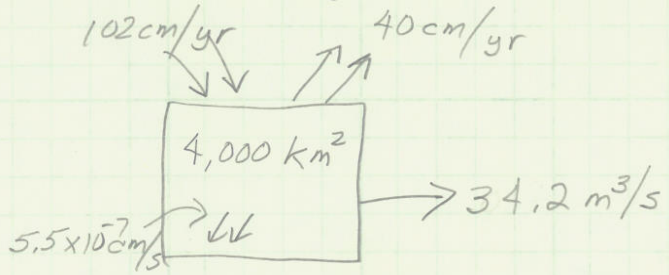
3-3) A 4000 km^2 watershed receives 102cm of precipitation in one year. The average flow of the river draining the watershed is 34.2 m^3/s. Infiltration is estimated to be 5.5×10^{-7} cm/s & evaportranspiration is estimated to be 40cm/yr. Determine the change in Storage in the watershed over one year. The ratio of runoff to precipitation (in cm) is termed the runoff coefficient. Compute the runoff coefficient for the watershed

David Dammon

a) mass balance diagram



b) mass balance equation

ΔStorage = Precepitation - Runoff - Evaportransportation - Infultration

$$\text{RunOff} = \frac{\text{flow of river}}{\text{watershed}} = \frac{\left(34.2\frac{m^3}{s}\right)\left(\frac{86400s}{d}\right)\left(\frac{365d}{yr}\right)\left(\frac{100cm}{m}\right)}{\left(4000km^2\right)\left(\frac{1000,000\ m^2}{km^2}\right)}$$

$$\text{outflow} = \frac{1.078 \times 10^{11}\ cm \cdot m^2/yr}{4 \times 10^9\ m^2} = \boxed{26.96\ cm/yr}$$

$$\text{Infiltration} = \left(5.5 \times 10^{-7}\ cm/s\right)\left(\frac{86,400s}{d}\right)\left(\frac{365d}{yr}\right) = \boxed{17.34\ cm/yr}$$

ΔStorage = 102cm/yr - 26.96 cm/yr - 40 cm/yr - 17.34 cm/yr = $\boxed{17.7 cm/yr}$

c) runoff coefficient = $\frac{\text{runoff}}{\text{precipation}} = \frac{26.96\ cm/yr}{102\ cm/yr} = \boxed{0.26}$

3-9) Prepare IDF curve for a 2yr storm at Dismal Swamp using data in Tbl 3-2. Hint: curve should intersect 98.7 mm/hr @ 15 min duration.

$T = 2yr$

$n = (1999 - 1954)_{\text{years of record}} = 45 yrs$

a) $T = \frac{n+1}{m} \quad \therefore m = \frac{n+1}{T} = \frac{45+1}{2yr} = 23 yr$

m = Storm ranking

read ranking from Tbl 3-2 for 5min

5m	Intensity	120		140
	Ranking	49	← 23 →	16

$140 - 120 = 20 \qquad \frac{20}{33} = \frac{x}{23-16} \quad x = 4.24$

$49 - 16 = 33$

$140 - 4.24 =$ **5min = 135.76 mm/hr**

10min	Intensity	100		120
	Ranking	64		15

$\frac{20}{49} = \frac{x}{23-15} \quad \therefore x = 3.26$

$120 - 3.26 =$ **10min = 116.74 mm/hr**

15 min	80	100
	94	18

$\therefore \frac{20}{76} = \frac{x}{23-18} \quad \therefore x = 1.32$

$100 - 1.32 =$ **15min = 98.68 mm/hr**

20min	60	80
	36	10

$\therefore \frac{20}{26} = \frac{x}{23-10} \quad \therefore x = 10$

$80 - 10 =$ **20min = 70 mm/hr**

30 min	30	40
	44	17

$\therefore \frac{10}{27} = \frac{x}{23-17} \quad \therefore x = 2.22$

$40 - 2.22 =$ **30min = 31.43 mm/hr**

3-9 cont) 40min $\frac{30}{31}$ $\frac{40}{8}$ $\therefore \frac{10}{23} = \frac{x}{23-8}$ $\therefore x = 6.52$

$40 - 6.52 =$ **40min = 33.48 mm/hr**

50 min $\begin{matrix} 20 \\ 30 \end{matrix}$ $\begin{matrix} 30 \\ 12 \end{matrix}$ $\therefore$ $\frac{10}{18} = \frac{x}{23-12}$ $\therefore x = 6.11$

$30 - 6.11 =$ **50min = 23.89 mm/hr**

T = 2

n = 1999-1954 = 45

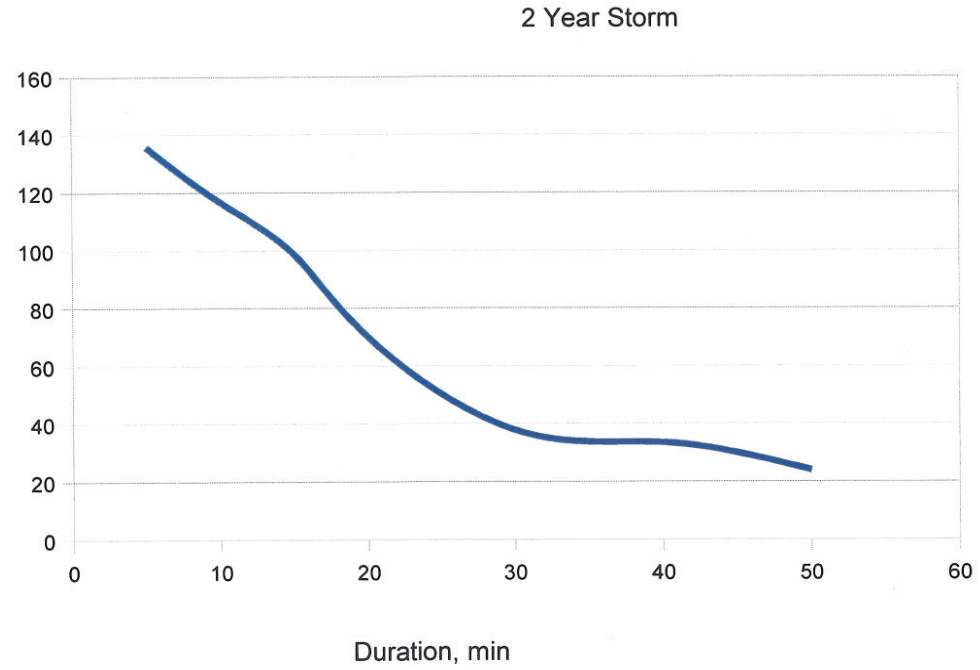
T=(n+1)/m m= (n+1)/T m= 23

From Tbl 3-2

Duration				
5 min	Intensity	120 140	20	4.24
	Storm Ranking	49 16	33	
10 min	Intensity	100 120	20	3.27
	Storm Ranking	64 15	49	
15 min	Intensity	80 100	20	1.32
	Storm Ranking	94 18	76	
20 min	Intensity	60 80	20	10
	Storm Ranking	36 10	26	
30 min	Intensity	30 40	10	2.22
	Storm Ranking	44 17	27	
40 min	Intensity	30 40	10	6.52
	Storm Ranking	31 8	23	
50 min	Intensity	20 30	10	6.11
	Storm Ranking	30 12	18	
60 min	Intensity			
	Storm Ranking			

2 Year Storm

Duration (min)	Intensity
5	135.76
10	116.73
15	98.68
20	70
30	37.78
40	33.48
50	23.89
60	0



3-25) Determine the unit hydrograph ordinates for the Verde River with the stream flow data shown in Table below that resulted from a 5-hr storm of uniform intensity. The basin area is 64 km^2.

Time (hr)	Flow (m^3/s)	Time (hr)
0	0.55	
5	0.50	0-5
10	0.45	5-10
15	1.98	10-15
20	4.82	15-20
25	6.24	20-25
30	6.86	25-30
35	5.77	30-35
40	5.02	35-40
45	4.29	40-45
50	3.5	45-50
55	2.72	50-55
60	2.19	55-60
65	1.64	60-65
70	1.10	65-70
75	0.79	70-75
80	0.47	75-80
85	0.25	80-85
90	0.25	85-90