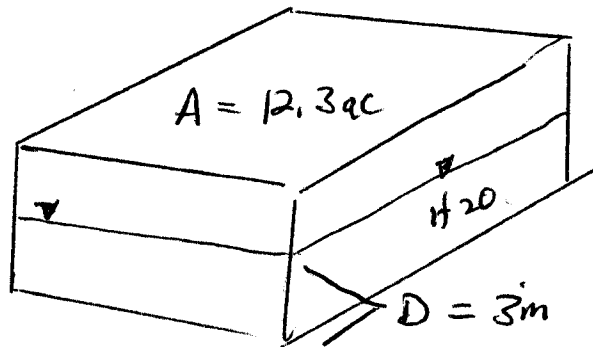


HW2 Key. PDF PAGE 1

Hydrology HW #2 Key - INK TO APPLIED PROBLEMS IN HYDROLOGY

1. RESERVOIR



AT END OF RAINY SEASON:

$$\text{TOTAL VOL. H}_2\text{O} = A \cdot D =$$

$$A = (12.3 \text{ ac}) \left(\frac{0.4047 \text{ HA}}{1 \text{ ac}} \right) \left(\frac{1 \times 10^4 \text{ m}^2}{\text{HA}} \right) = 497,781 \text{ m}^2$$

$$D = 3 \text{ m}$$

ORIGINAL Vol H₂O = $A \cdot D = (497,781 \text{ m}^2) (3 \text{ m}) = 1,493,343 \text{ m}^3$

DRY SEASON...

$$\text{EVAPORATION RATE} = \left(\frac{3.5 \text{ IN}}{\text{WK}} \right) \left(\frac{1 \text{ m}}{39.37 \text{ IN}} \right) = 8.89 \times 10^{-2} \text{ m/WK}$$

$$\text{PUMP RATE} = \left(\frac{100 \text{ GAL}}{\text{DAY}} \right) \left(\frac{7 \text{ DAY}}{\text{WK}} \right) \left(\frac{1 \text{ m}^3}{264.17 \text{ GAL}} \right) = 2.65 \text{ m}^3/\text{WK}$$

$$\text{EVAPORATION VOLUME} = \left(\frac{8.89 \text{ m}}{\text{WK}} \right) \left(\frac{497,781 \text{ m}^2}{\text{ac}} \right) = 4.42 \times 10^6 \frac{\text{m}^3}{\text{WK}}$$

$$\text{WEEKLY LOSS} = \text{PUMP RATE} + \text{EVAP RATE} = 2.65 \frac{\text{m}^3}{\text{WK}} + 4.42 \times 10^6 \frac{\text{m}^3}{\text{WK}} \approx 4.42 \times 10^6 \frac{\text{m}^3}{\text{WK}}$$

$$\text{TOTAL LOSS} \left(4.42 \times 10^6 \frac{\text{m}^3}{\text{WK}} \right) (3 \text{ WK}) = 1.33 \times 10^7 \text{ m}^3$$

$$\text{TOTAL STORAGE AFTER 3 WKS} = 0 \text{ m}^3 = 0 \text{ GAL.}$$

2. Pump RATE = $25 \frac{\text{GAL}}{\text{MIN}} \left(\frac{1 \text{M}^3}{264.17 \text{GAL}} \right) = 9.46 \times 10^{-2} \frac{\text{M}^3}{\text{MIN}}$

TANK VOL. = 60 M^3

$Q = \frac{Vol}{t}$; $t = \frac{Vol}{Q} \left(\frac{\frac{\text{M}^3}{\cancel{\text{MIN}}} = \text{min}}{\frac{\text{M}^3}{\text{MIN}}} \right)$

$t = \frac{60 \text{M}^3}{9.46 \times 10^{-2} \frac{\text{M}^3}{\text{MIN}}} = 634.25 \text{ MIN}$

3. WATERSHED AREA = $(20.5 \text{mi}^2) \left(\frac{4.01 \times 10^9 \text{m}^2}{\text{mi}^2} \right) = 8.22 \times 10^{10} \text{m}^2$

Summer Stream Vol = AREA x DEPTH = $(8.22 \times 10^{10} \text{m}^2)(2.5 \text{m}) = 2.06 \times 10^{11} \text{m}^3$

A. RUNOFF = $(0.65) (\text{Stream Vol.}) = (0.65) (2.06 \times 10^{11} \text{m}^3) = 1.34 \times 10^{11} \text{m}^3$

B. RUNOFF = $(1.34 \times 10^{11} \text{m}^3) \left(\frac{1 \text{ft}^3}{1728 \text{m}^3} \right) = 7.75 \times 10^7 \text{ FT}^3$

C. RUNOFF = $1.34 \times 10^{11} \text{m}^3 \left(\frac{1 \text{M}^3}{61,023 \text{m}^3} \right) = 2.19 \times 10^6 \text{ M}^3$

4. Q LEE VINING CREEK $\text{Runoff} = 87.3 \text{ ft}^3/\text{sec} \left(\frac{1 \text{ m}^3}{35.31 \text{ ft}^3} \right) = 2.70 \text{ m}^3/\text{sec}$

Q RUSH CREEK $44.8 \text{ ft}^3/\text{sec} \left(\frac{1 \text{ m}^3}{35.31 \text{ ft}^3} \right) = 1.27 \text{ m}^3/\text{sec}$

Q MILL CREEK $37.0 \text{ ft}^3/\text{sec} \left(\frac{1 \text{ m}^3}{35.31 \text{ ft}^3} \right) = 1.05 \text{ m}^3/\text{sec}$

TOTAL ~~Runoff~~ $Q = 5.02 \text{ m}^3/\text{sec}$

TOTAL ANNUAL Runoff =

$$5.02 \frac{\text{m}^3}{\text{sec}} \frac{60 \text{ sec}}{\text{min}} \frac{60 \text{ min}}{\text{hr}} \frac{24 \text{ hr}}{\text{day}} \frac{365.25 \text{ day}}{\text{year}} =$$

$$\boxed{1.58 \times 10^8 \text{ m}^3/\text{yr}}$$

5. TOTAL DIVERSIONS = $\left(105,305 \frac{\text{ac-ft}}{\text{yr}} \right) \left(\frac{1233.5 \text{ m}^3}{1 \text{ ac-ft}} \right) =$

$$1.30 \times 10^8 \text{ m}^3/\text{yr}$$

EFFECTIVE ANNUAL FLOW INTO MANSO LAKE =

TOTAL Runoff - TOTAL DIVERSIONS =

$$1.58 \times 10^8 \frac{\text{m}^3}{\text{yr}} - 1.30 \times 10^8 \frac{\text{m}^3}{\text{yr}} = 2.8 \times 10^7 \frac{\text{m}^3}{\text{yr}}$$

6. Andy Thompson Creek

EMPIRICAL WEIR CALCULATION: $Q = 2.54 h^{5/2}$ UNITS
(cfs & ft)

$$h = 6.9 \text{ in} \left(\frac{1 \text{ ft}}{12 \text{ in}} \right) = 0.58 \text{ ft}$$

$$Q = 2.54 (0.58 \text{ ft})^{5/2} = 2.54 (0.58 \text{ ft})^{2.5} = 0.65 \frac{\text{ft}^3}{\text{SEC}}$$

$$Q = \left(0.65 \frac{\text{ft}^3}{\text{SEC}} \right) \left(\frac{1 \text{ m}^3}{35.31 \text{ ft}^3} \right) = 0.018 \frac{\text{m}^3}{\text{SEC}}$$

ANNUAL RUNOFF THROUGH WEIR:

$$\left(0.018 \frac{\text{m}^3}{\text{SEC}} \right) \left(\frac{60 \text{ SEC}}{\text{MIN}} \right) \left(\frac{60 \text{ MIN}}{\text{HR}} \right) \left(\frac{24 \text{ HR}}{\text{DAY}} \right) \left(\frac{365.25 \text{ DAY}}{\text{YR}} \right) =$$

$$5.8 \times 10^5 \text{ m}^3/\text{YR}$$

7. $Q = 3.33 (L - 0.2h) h^{3/2}$ $L = 3 \text{ ft}$ $h = 3.5 \text{ in} \left(\frac{1 \text{ ft}}{12 \text{ in}} \right) = 0.29 \text{ ft}$

$$Q = 3.33 (3 \text{ ft} - 0.2(0.29 \text{ ft})) (0.29)^{3/2} = (3.33)(2.94)(0.16) = 1.57 \frac{\text{ft}^3}{\text{SEC}}$$

$$\text{ANNUAL } Q = \left(1.57 \frac{\text{ft}^3}{\text{SEC}} \right) \left(\frac{1 \text{ m}^3}{35.31 \text{ ft}^3} \right) \left(\frac{3.15 \times 10^7 \text{ SEC}}{\text{YR}} \right) = 1.4 \times 10^6 \frac{\text{m}^3}{\text{YR}}$$

8. SPRING RUNOFF = $5530 \frac{\text{GAL}}{\text{MIN}}$

ANNUAL SPRING DISCHARGE =

$$\left(5530 \frac{\text{GAL}}{\text{MIN}}\right) \left(5.256 \times 10^5 \frac{\text{MIN}}{\text{YR}}\right) \left(\frac{1 \text{ m}^3}{264.17 \text{ GAL}}\right) = 1.1 \times 10^7 \frac{\text{m}^3}{\text{YR}}$$

9 TOTAL MOUND LAKE RUNOFF BUDGET (ANNUAL)
(FROM Q. 4, Q. 5, Q. 6, Q. 7, Q. 8)

TOTAL RUNOFF-INPUT:	LIFE VINING CK RUSH CK MILL CK	}	$1.58 \times 10^8 \text{ m}^3/\text{yr}$ (Q. 4)
	THOMPSON CK		
	LARGE STREAM		$1.4 \times 10^6 \text{ m}^3/\text{yr}$ (Q. 7)
	SPRINGS		$1.1 \times 10^7 \text{ m}^3/\text{yr}$ (Q. 8)

TOTAL INPUT $1.71 \times 10^8 \text{ m}^3/\text{yr}$

(Q. 5) TOTAL DIVERSION - $2.8 \times 10^7 \text{ m}^3/\text{yr}$

TOTAL INPUT: $1.43 \times 10^8 \text{ m}^3/\text{yr}$

10.

PAGE 6

$$Vol = \frac{1}{3} \pi h (r_1^2 + r_1 r_2 + r_2^2)$$

$$h = (6406.9 \text{ ft} - 6391.2 \text{ ft}) = 15.7 \text{ ft}$$

$$\text{Area of Circle} = \pi r^2$$

$$r^2 = \frac{A}{\pi}$$

$$r = \sqrt{\frac{A}{\pi}}$$

$$1954 \text{ Area} = 89.4 \text{ mi}^2$$

$$1964 \text{ Area} = 77.0 \text{ mi}^2$$

$$r_1 = r_{1954} = \sqrt{\frac{89.4 \text{ mi}^2}{3.14}} = 5.34 \text{ mi} = 28,195.2 \text{ ft}$$

$$r_2 = r_{1964} = \sqrt{\frac{77.0 \text{ mi}^2}{3.14}} = 4.95 \text{ mi} = 26,136 \text{ ft}$$

$$Vol = \frac{1}{3} \pi 15.7 \text{ ft} \left((28,195.2 \text{ ft})^2 + [28,195 \text{ ft} \times 26,136 \text{ ft}] + (26,136 \text{ ft})^2 \right)$$

$$= 16.3 \text{ ft} \left[7.94 \times 10^8 \text{ ft}^2 + 7.37 \times 10^8 \text{ ft}^2 + 6.8 \times 10^8 \text{ ft}^2 \right]$$

$$= 3.60 \times 10^{10} \text{ ft}^3$$

$$\text{VOLUME LOSS } 1954 \rightarrow 1964 =$$

$$3.6 \times 10^{10} \text{ ft}^3$$