CEE3361 **Water Resources Management** **S.P.Simonovic**

Assignment 1: PART A Solution

1. A fire hydrant in front of a residence is measured to have a minimum discharge of 160 gallons per minute. How many liters/sec is that?

   Note: 1 gallon=3.785 liters

$$Discharge = 160gpm * \frac{3.785liter}{gallon} * \frac{1min}{60\ seconds} = 10.093 \text{ liters/sec}$$

2. For a city of 450,000 people and an annual average water use of 350 liters per capita per day. How many million cubic meters do they use in a year?

$$Annual\ average\ water\ use = 450{,}000 * \frac{350L}{day} * \frac{1m^3}{1000L} * \frac{365days}{1year} = 5{,}748{,}7500\frac{m^3}{year}$$
$$= 5.749\ (10^6 m^3)$$

3. The Fanshawe reservoir contains 12 billion liters of water. How many million cubic meters is that?

$$Fanshawe\ Volume = 12\ * 10^9 * \frac{\frac{1m^3}{1000L}}{10^6} = 12\ (10^6 m^3)$$

4. What is the water usage of a house during February if there are four persons using an average of 300 liters each per day?

$$Water\ Usage = \frac{300L}{day} * 4\ persons * 29day = 34{,}800\ L$$

5. Find
   a. What is the average rate of water flow required for a city of 350,000 population, with a per capita use of 350 liters per capita per day? Express in cubic meters per day.

$$Average\ Water\ Flow = 350{,}000 * \frac{350L}{day} * \frac{1m^3}{1000L} = 122{,}500\frac{m^3}{day}$$

   b. The same city's peak day and peak hour will be important in designing storage and treatment facilities. Factors for these vary, but if peak day ratio is 2.5 and the peak hour ratio is 6.0 times the average hour, what will be the peak day and peak hour demands?

$$Peak\ Hour\ Demand = 6 * 122{,}500\frac{m^3}{day} * \frac{1day}{24hr} = 30{,}625\frac{m^3}{hr}$$
$$Peak\ Day\ Demand = 2.5 * 122{,}500\frac{m^3}{day} = 306{,}250\frac{m^3}{day}$$

6. It is common to convert rates of flow, which may be given in units such as average m^3/sec during a day, week, or month to volumes of water that flow in the same time period or an accumulation of time periods. Mean monthly flows of Thames River hydrometric station "North Thames River near Thorndale" which provides more than 95% of the inflows for the Fanshawe reservoir are given below in m^3/sec. Find the total flow volume for the year in million cubic meters.

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Mean flow (m^3/sec)	18.80	23.50	46.66	35.35	13.89	6.58	4.96	4.18	6.93	9.76	18.09	23.21

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Mean flow (m^3/sec)	18.8	23.5	46.66	35.35	13.89	6.58	4.96	4.18	6.93	9.76	18.09	23.21
Days in month	31	28	31	30	31	30	31	31	30	31	30	31
Total Month Flow (10^6m^3)	50.35	56.85	124.97	91.63	37.20	17.06	13.28	11.20	17.96	26.14	46.89	62.17
Total Yearly Flow (10^6m^3)	555.70											

Sample Calculation for January:

$$Flow\ Volume = \frac{18.80m^3}{s} * 60s * \frac{60min}{s} * \frac{24hr}{day} * \frac{31days}{10^6} = 50.35\ (10^6m^3)$$

7. The following are annual discharges in m^3/sec reported for some rivers: Mississippi – 17,555 m^3/sec; Nile – 11,890 m^3/sec; Amazon – 203,882 m^3/sec; Danube – 6,500 m^3/s. Convert the flows to km^3/year.

River	**Flow(m^3/s)**	**Flow(km^3/year)**
Nile	11890	374.963
Amazon	203882	6429.623
Danube	6500	204.984
Mississippi	17555	553.6145

Sample calculation:

$$Flow = \frac{6{,}500m^3}{s} * \frac{1km}{1000^3 m^3} * 60s * \frac{60min}{s} * \frac{24hr}{day} * \frac{365days}{year} = \frac{204.984km^3}{year}$$

8. A reservoir has a capacity of 5,000 acre-feet. How many gallons is that? How many cubic meters?

$$Volume = 5{,}000acre - feet * 325{,}851.43 \frac{gallons}{acre - feet} = 1{,}629{,}257{,}150\ gallons$$

$$Volume = 5{,}000acre - feet * 1233.5 \frac{m^3}{acre - feet} = 6{,}167{,}500m^3$$