Water Supply and Urban Drainage

Assignment1

1. Over a period of ten years, the population of a community has grown in the following manner:
   - January 1, 1979 : 12100 inhabitants
   - January 1, 1984: 15078 inhabitants
   - January 1, 1989 : 18790 inhabitants

   Evaluate the population of the community for January 1, 1999. Use geometric increase method
2. In 1950, 1970 and 1990, the population of a city was 30000(p1), 172000(p2), and 292000(p3), respectively. In 1940, the population was zero. Assuming that the population growth is decreasing rate of increase, calculate the saturation population and the population in 2010.
3. Adwa has the following population census data obtained from central statistical agency. Analyze the data and select appropriate forecasting method to calculate the current (2014) and 2020 population of the town.

Year	1984	1994	2007
Population	13,823	24,515	40,500

4. A city with a present population of 108,546 persons used a total of 18,624,600 m^3 of water during the last 12 months. On the maximum day during that period 87,000,000 liters of water were used. Estimate the average and maximum daily flows to be expected in 15 years, when the population is estimated to be 175,000.

5. The estimated municipal water demand for the community of 150,000 people with a per capita demand of 150 l/d. Calculate the fire flow, design capacity of the water treatment plant, and design capacity of the water distribution system. Use NBFU formula for fire flow. Assume appropriate peaking factor.

6. A city of 85,000 residents has an average per capita water demand of 170 l/c/d. The average size of institutional and commercial areas is 323 ha and that of industrial areas is 210 ha. The expected unit water demands are 24 m^3/ha/d for institutional and commercial areas, and 17 m3/ha/d for industries. The public water demand and unaccounted for system losses are estimated to be 4 % and 12% of the total water demand, respectively. Calculate the total water demand, including fire flow.

7. City A has a population of 10000 and supplies water for its citizens and for the 2000 inhabitants of neighboring city B. from the water-treatment plant, a main pipe crosses City A and brings water to the limits of City B. this pipe is City B's sole water supply. Total average consumption is 400L (person/day), including 10%in water losses (average

consumption +losses=total consumption). Let us assume that 20% of the water losses of city A occur on the main pipe, which stretches from the treatment plant to City B, and that these losses are split between the two cities as a function of their respective total consumption rates. Calculate the annual volume of water that City A must produce to meet the needs of City B. what is the annual amount that City A must charge City B if the cost for production and transportation of water is 15 birr per 4000L?

8. The per capita water demand of a small town having population census records indicated in Table 1, is given by
   q = 150 – 99.6e-0.04t; where, q = per capita demand [l/c/d]
   t is time in years starting from 1976.

Table 1 Population census records

Year	1976	1986	1996
Population(in 1000's)	10	12	14.5

Moreover, from historical water usage data the peaking factors for maximum day and peak hour water demands are estimated to be 160% and 200% of the average day demand, respectively. Determine

a. The design capacity of a treatment plant if it is to serve the town until the end of 2024.

b. The design capacity of the distribution main

Use the decreasing rate of increase method for population forecasting and assume a fire demand of 2.5 m^3/min.