

HW Problem 7:**SOLUTION****2005**

Design a residential municipal solid waste curbside collection system for Scenarios A, B, and C.

Assume that residential MSW accounts for 85 % of the MSW coll. per person pe
(determined in earlier HWs). The other 15 % is commercial, institutional, etc.

Assume the data given below applies.

	3.3	persons/house		
		Specific weight of MSW is:		Total MSW collection rate is:
Scen A	168	lb/cu-yd		5.5 lb/person/day, as collec
Scen B	168	lb/cu-yd		4.9 lb/person/day, as collec
Scen C	169	lb/cu-yd		4.6 lb/person/day, as collec
Collection vehicle compaction ratio, r =				3.1
C _p =	7	days/collection period		
Maximum working days per week =			5	
Round trip haul time, h =	0.5	hrs/route		
Number of routes collection vehicle serves each day =				2
crew size =	1			
pickup time per pickup location =			1	collector-minute/residence
Travel time to first pickup location, t ₁ =			0.3	hrs/working day
Travel time back to parking facility, t ₂ =			0.3	hrs/working day
Off-route factor, W =	0.15			
At site time per trip, s =	0.25	hrs/route (time spent unloading)		

a. Determine the number of houses to be served in Dusseau's Folly

$$\text{number of houses} = \text{population} / \text{persons/house}$$

$$= 95000 / 3.3 = 28787.88 \text{ houses}$$

For 8 and 10 hour working days, complete parts b - f.

b. Determine the time available for each collection route.

$$P_{scs} = [H(1-W)-(t_1+t_2)]/Nd - (s+h)$$

$$\text{For 8 hrs, } P_{scs} = 2.4 \text{ hrs}$$

$$\text{For 10 hrs, } P_{scs} = 3.2 \text{ hrs}$$

c. Determine the number of pick-up locations (houses) that can be served per route.

$$N_p = 60 \times P_{scs} \times n / t_p$$

$$\text{For 8 hrs, } N_p = 141 \text{ houses per route}$$

$$\text{For 10 hrs, } N_p = 192 \text{ houses per route}$$

d. Determine the number of routes required per collection period.

$$R_{cp} = NOR / N_p$$

For 8 hrs, $R_{cp} = 204.2$ routes/collection period

For 10 hrs, $R_{cp} = 149.9$ routes/collection period

e. Determine the required number of collection vehicles, as a real number.

$$NOV = R_{cp} / (N_d \times C_{wp})$$

For 8 hrs, $NOV = 20.4$ vehicles

For 10 hrs, $NOV = 15.0$ vehicles

f. Determine the labor requirements.

$$LR = \{n [R_{cp} \times P_{scs} + R_{cpi} (s + h) + C_{wp} (t_1 + t_2)] \times 7\} / [(1 - W) H \times C_p]$$

Where C_{wp} is the maximum required number of working days to complete the route

For 8 hrs, $LR = 93.6$ collector days/week (8 hr days)

For 10 hrs, $LR = 70.0$ collector days/week (10 hour days)

g. For each scenario (and 8 and 10 hr work day), determine the required truck volume.

$$\text{Truck Volume} = FR \times V_r \times N_p \times SOR / r$$

$V_r = \text{lb MSW/person/d} \times \text{people/house} \times C_p / \text{Specific weight}$
and $FR = \text{fraction of waste that is residential}$

Scen A

for 8 hrs, 29 cu-yd

for 10 hrs, 40 cu-yd

Scen B

for 8 hrs, 26 cu-yd

for 10 hrs, 36 cu-yd

Scen C

for 8 hrs, 24 cu-yd

for 10 hrs, 33 cu-yd

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