Population: 9000 Peak Q $= (105 \text{ gpdc})(9000)(1.8) = \boxed{1.70 \text{ MGD}}$

↑ Typical, but any value near this OK

↑ Recommended 180% peak day (yearly) Other peaking factors for peak day (not hour) are OK.

Retention Pond

Can design for either peak or average flow. Assignment says 4-h AVERAGE flow, but could be more conservative & size for peak day.

Going metric here: $\left(1.70\times10^{6}\ \frac{gal}{d}\right)\left(3.78\times10^{-3}\ \frac{m^3}{gal}\right) = 6{,}430\ m^3/d$ PEAK FLOW

$$A_s = \frac{Q t_d}{d} = \frac{(6{,}430\ m^3/d)(4\ h)(1/24\ \frac{d}{h})}{2\ m} = \boxed{540\ m^2 \text{ PEAK FLOW}}$$

OR → $\boxed{300\ m^2 \text{ AVE. FLOW}}$

I° CLARIFIER:

$$V_s = 30\ m/d \Rightarrow A_s = \frac{Q}{V_s} = \frac{6{,}430\ m^3/d}{30\ m/d} = \boxed{214\ m^2}$$

Given { L/W Ratio from 3:1 → 5:1; W either 4 m OR 5 m }

Try smaller 4 m: $L = \frac{A_s}{W} = \frac{214\ m^2}{4} = 54\ m \quad \frac{L}{W} = \frac{54}{4} = 13$ WAY TOO LONG

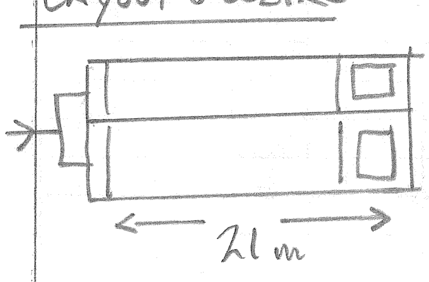
If we use 2 basins, each 4 m, still $L/W = \frac{13}{2} = 6.5$, too long

So, use 2 basins, each 5 m: W = 10 m TOTAL

The $L = \frac{A_s}{W} = \frac{214\ m^2}{10} = \boxed{21\ m} \quad \frac{L}{W} = \frac{21}{5} = \boxed{4.2}$ (OK)

↖ EACH BASIN is 5 m

LAYOUT & WEIRS

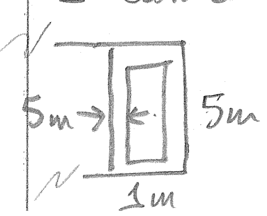


MAX. WEIR LOADING $250\ m^3/m\,d$

MIN. WEIR LENGTH $= \frac{6{,}430\ m^3 d^{-1}}{250\ m^3/m\,d} = \boxed{26\ m}$

Too long for a single weir across 10 m Total W.

ANY Geometry of weirs that gets you to > 26 m is OK. I came up with simple & conservative layout.



This gets you ↙ $L_T = (5 + 5 + 5 + 1 + 1)\ m = 17\ m$

× 2 TANKS

34 m

LOADS of Effluent BOD & TSS:

Average Loads for 35% removal of BOD & 50% for Solids

BOD_5: $(200\ mg/L)(1-0.35) = \boxed{130\ mg/L}$ conc.

$(130\ mg/L)(1.70\ MGD)(8.34) = \boxed{1840\ lb/d\ BOD}$ LOAD

TSS: $(200\ mg/L)(1-0.5) = \boxed{100\ mg/L}$ conc.

$(130\ mg/L)(1.70\ MGD)(8.34) = \boxed{1{,}420\ lb/d\ \text{SOLIDS-DRY}}$

SLUDGE: 1% solids, so wet weight is 100 times dry weight

$(1{,}420\ lb/d)(100) = \boxed{142{,}000\ lb/d\ \text{SLUDGE-WET}}$

PEAK LOADS Assignment did not ask for peak loads but you can calculate some estimates using the so-called "Generic" (regression) equations in lecture notes.

PEAK DAY

$$B_d = B\left(\frac{4.08}{B^{0.0732}}\right) = (1840)\left(\frac{4.08}{1840^{0.0732}}\right) = 1840 \times 2.35$$

B, S = ann. averages, lb/d

$$= \boxed{4{,}330\ lb/d}$$

$$S_d = S\left(\frac{5.98}{S^{0.0716}}\right) = (1420)\left(\frac{5.98}{1420^{0.0716}}\right) = 1{,}420 \times 3.56$$

$$= \boxed{5{,}050\ lb/d}$$

For comparison to 180% used above, check Q_d peaking factor by this method:

$$Q_d = Q\left(\frac{1.96}{Q^{0.0366}}\right) = 1.70\left(\frac{1.96}{1.70^{0.036}}\right) = (1.70\ MGD)(1.92) = \boxed{3.3\ MGD}$$

QUITE CLOSE: 190% vs 180%