1. (a) β is the ratio of sensible heat transfer to latent heat, or evaporation energy transfer.

   (b) When $\beta \simeq -1$, the calculation of the evaporation energy $\simeq \frac{R_n - G}{\beta + 1}$ becomes unbounded rather than approaching zero as it should.

2. (a) water balance problem - using total accumulated values @ 800 days

$$(AW + Rain) = ET + Recharge + Runoff + Interception$$

$$63.0 + 56.0 = ET + 12.5 + 25.0 + 0.12(56.0)$$

total $ET = 119 - 44.2 = 74.78$ in during 800 days $\Rightarrow \overline{ET} = 0.093 \frac{in}{d}$

(b) Using the Jensen - Haise Eq. and correcting for the avocados ($K_c \simeq 0.7$; p.101 Serrano)

$$\overline{ET} = 0.7\, ET_o = 0.7\left[C_T (T - T_x) R_n / \rho_w L\right] = 0.093 * 2.54 = 0.237\ cm/d$$

$$(T - T_x) = \frac{0.237}{0.7} \cdot \frac{\rho_w L}{C_T R_n} = \frac{.237}{.7} \frac{583(1)}{0.025(625)} = 12.7\ ^\circ C$$

$$\overline{T}_{air} = 12.7 + 3 = \underline{15.7\ ^\circ C}$$

3. Energy Balance - $v = \frac{Q}{A} = \frac{0.02\ m^3/s}{\frac{\pi}{4}(0.08\ m)^2} = 3.98\ m/s \Rightarrow \frac{v^2}{2g} = 0.81\ m$

@ Reservoir ; $H_1 = 0$

@ gage A ; $H_A = H_1 + H_{pump} - \Delta h_{sand} = \frac{p_A}{\gamma} + 3.7 + 0.81\ m$

@ gage B ; $H_B = H_1 + H_p - \Delta h_s - \Delta h_c$

@ outlet ; $H_2 = \frac{2.5\,kPa}{\gamma} + 3.7\,m + \frac{v^2}{2g} = 4.76\ m = H_B \Rightarrow p_B = \underline{2.5\ kPa}$

$$\frac{p_A}{\gamma} = H_p - \Delta h_s - 4.51\ m = \frac{1554000\ W}{(0.02)(9800)}\ (7928.6\ m) - \Delta h_s - 4.51\,m = 5660.6\ m$$

darcy Eq. $\rightarrow$ $\Delta h_s = \frac{Q L_s}{A K_s} = \frac{(20\,000)(20)}{(\frac{\pi}{4} \cdot 225)(10^{-2})} \cdot \frac{m}{100\ cm} = 2263.5\ m$

$$p_A = (9800)(5660.6) = \underline{55.5\ MPa}$$

4. (a) from part D of the impoundment example; $\theta_{dg} = (\theta_m - \theta_i)\left(\frac{q}{K_f}\right)^{1/\eta} + \theta_i$

$$\left(\frac{q}{K_f}\right) = \left(\frac{\theta_{dg} - \theta_i}{\theta_m - \theta_i}\right)^{\eta/\lambda} = \left(\frac{0.40 - 0.20}{0.50 - 0.20}\right)^{\eta/\lambda} = \left(\frac{2}{3}\right)^4$$

or $q = K_f \Theta_e^{\eta/\lambda} = 0.1975 \times 10^{-5}\ m/sec$

$q = \underline{0.17\ in/day}$

(b) $$q = \frac{(24'' + 4'' + L_f) - (-h_f)}{\frac{4''}{0.8 \times 10^{-4}} + \frac{L}{7.5 \times 10^{-7}}}$$ where $h_f = h_{dg}\left(\frac{K_{dg}}{q}\right)^{1/\eta} = 12''\left(\frac{10^{-5}}{q}\right)^{1/8} = 14.7''$

$$= \frac{28'' + L_{fs} + 14.7''}{50\,000 + \frac{L}{7.5 \times 10^{-7}}} = 0.198 \times 10^{-5}$$ solving for $\underline{L = 26.1''}$