8. (a) The ultimate subsidence after consolidation is about 6.4 cm = 0.064 m. The compressibility is (m, N units):

$$\begin{aligned} \alpha &= -\frac{db/b_0}{d\sigma_{ve}} \\ &= \frac{db/b_0}{\rho_w g\ dh} \\ &= \frac{(-0.064)/(5.0)}{(9810)(-7)} = 1.9 \times 10^{-7}\ \mathrm{m^2/N} \end{aligned}$$

(b) About half of the total consolidation (subsidence) occurred by $t \approx 45$ days. From Figure 5.19, 50% of consolidation corresponds to a time factor of $F_t = 0.20$. Using Eq. 5.22, the vertical conductivity is (m, N, day units):

$$\begin{aligned} K_z &= \frac{F_t \rho_w g \alpha (b/2)^2}{t} \\ &= \frac{(0.20)(9810)(1.9 \times 10^{-7})(5/2)^2}{45} \\ &= 5.2 \times 10^{-5}\ \mathrm{m/d} \\ &= 6.0 \times 10^{-8}\ \mathrm{cm/sec} \end{aligned}$$

9. The critical excavation depth is where, at the clay/sand interface, $\sigma_{vt} = P$. The pore pressure at the interface is (ft, lb units):

$$P = (h - z)\rho_w g = (18 - 4)(62.4) = 874\ \mathrm{lb/ft^2}$$

If the depth of the excavation is $d$, the total vertical stress at the clay/sand interface under the excavation is

$$\sigma_{vt} = (18 - d)\rho_{clay} g$$

Solving this for the maximum excavation depth $d$ gives (ft, lb units):

$$\begin{aligned} d &= 18 - \frac{\sigma_t}{\rho_{clay} g} \\ &= 18 - \frac{P}{\rho_{clay} g} \\ &= 18 - \frac{874}{123} = 10.9\ \mathrm{ft} \end{aligned}$$

10. Steady flow will occur when the boundary conditions are steady — when the reservoir and tailwater levels are kept steady. Transient flow occurs when these levels fluctuate, such as when the reservoir is drawn down rapidly or when it rises rapidly in a flood.

11. (a) The specific storage is (m, N, sec units):

$$\begin{aligned} S_s &= \rho_w g (n\beta + \alpha) \\ &= 9810\left((0.26)(4.5 \times 10^{-10}) + 2.0 \times 10^{-9}\right) = 2.1 \times 10^{-5}\ \mathrm{m^{-1}} \end{aligned}$$