CE 5364 Groundwater Transport Phenomena
Exercise Set 1

Exercises

1. A sand column has the following characteristics[1]:

$$K = 10^{-4}\frac{cm}{s};\;\; A = 75cm^2; \qquad \frac{dh}{dl} = 0.01;\;\; n = 0.20 \tag{1}$$

   Determine:

   (a) Sketch the system.

   (b) The discharge velocity.

   (c) The seepage velocity.

   (d) The volumetric flow rate through the column.

2. Three geologic formations overlie one another with the characteristics listed below.[2]

$$\begin{aligned} b_1 &= 50\ ft \qquad K_1 = 0.0002\frac{ft}{s} \\ b_2 &= 20\ ft \qquad K_2 = 0.000005\frac{ft}{s} \\ b_3 &= 210\ ft \qquad K_3 = 0.001\frac{ft}{s} \end{aligned} \tag{2}$$

   A constant velocity vertical flow field exists across the three formations. The hydraulic head at the top of the formations (top of formation 1) is 33 feet. The hydraulic head at the bottom of the formations (bottom of formation 3) is 21 feet.

   Determine:

   (a) Sketch the system.

   (b) The hydraulic head at the internal boundary between formation 1 and 2.

   (c) The hydraulic head at the internal boundary between formation 2 and 3.

   (d) Approximate time for a tracer to flow (vertically) through the three layers if the porosities n_1, n_2, and n_3 are 0.30,0.42, and 0.35, respectively

[1] Problem 2-3, pg. 578 in Bedient, et. al.
[2] Problem 2-12, pg. 579 in Bedient, et. al.

3. Figure 1 below shows a piezometric map for a shallow sand aquifer.[3] The hydraulic conductivtiy is estimated to be 1.5×10^{-2} $\frac{cm}{s}$, the saturated thickness is 40 feet, and the effective porosity is 0.3.

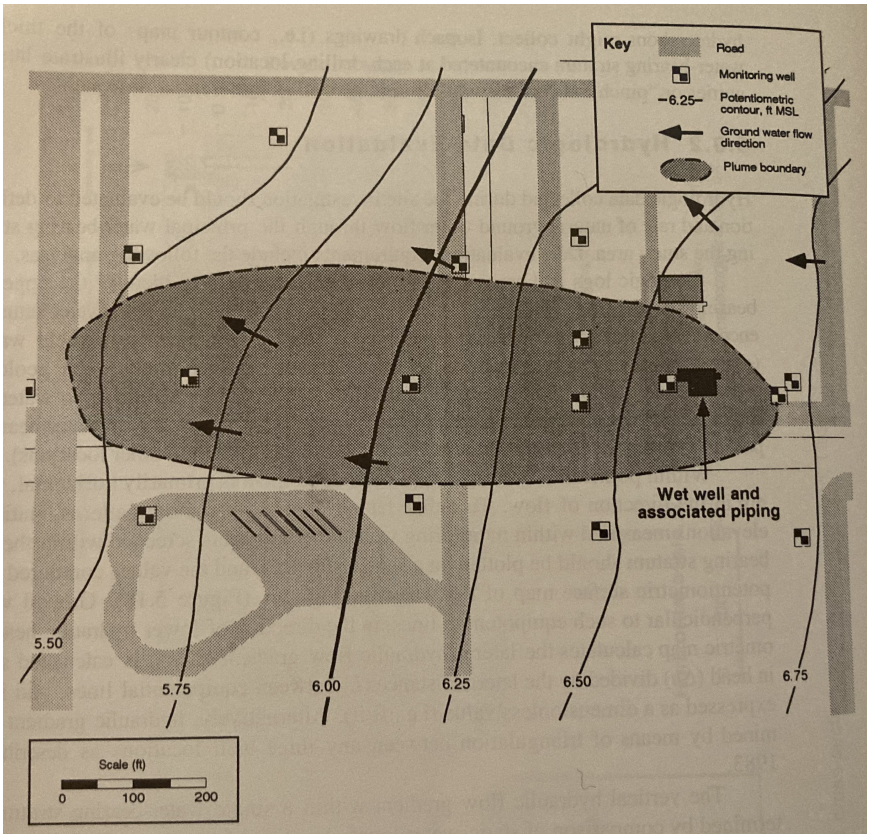

Figure 1: Plume Map (plan view)

Determine:

(a) Which well is expected to be the most contaminated.

(b) The groundwater velocity and seepage velocity across the plume.

(c) The duration that the source has been contaminating the aquifer (neglect dispersion, diffusiom, and adsorption).

(d) The flow rate across the plume.

(e) An explaination for contamination upgradient of the source zone.

[3]Problem 2-8, pg. 578 in Bedient, et. al.