Estimating Hydraulic Conductivity

EVS 248 Environmental Geology and Hydrology

Fall, 2011

1 Well-Site Data Interpretation

The purpose of this lab is to increase your competence at the well site and to expand your understanding of hydraulic conductivity.

When drilling test borings and environmental monitoring wells, samples of unconsolidated soils are usually collected. These samples are often sufficiently disturbed to make them useless for permeameter measurements of hydraulic conductivity. However, the collection disturbance does not alter their grain-size distributions. Therefore this information may be useful for obtaining rough estimates of K.

Hydraulic conductivity estimates from grain-size distributions are usually based on one or more representative measurement that we discussed in previous labs, such as the median grain diameter, mean, and standard deviation.

Numerous studies have been performed to determine the relationship between grain-size distribution and hydraulic conductivity. Masch and Denny (1966) produced a set of curves relating median diameter, standard deviation and hydraulic conductivity (Fig. **??**). Shepherd (1989) studied published values of grain diameter and hydraulic conductivity and developed a chart relating depositional environment and grain size to hydraulic conductivity. Subsequent studies (Panda and Lake, 1994; Alyamani and Sen, 1993) use the entire grain-size distribution to estimate hydraulic conductivity. In future work, the approach you take will depend mainly on the standards of your organization. For today, we will work with the oldest.

Well-Site Exercise

In field studies, determining the direction of groundwater flow is crucial for estimating contaminant source and migration. Below in Table 1 are data for three wells installed on UNO's campus. Shown are the elevation of the top of casing (TOC) and the depth to water in the wells (DTW). Locations of wells are given in Table 2.

Well	TOC (ft)	DTW (ft)
B4	1.57	2.64
B5	2.44	3.47
B6	2.18	3.26

Table 1: Water level data.

Wells	Distance (ft)
B4-B5	75
B4-B6	76
B5-B6	36

Table 2: Distance between wells. The direction from well B5 to B6 is S65E.

Tasks

1. Create a simple sketch of the well locations.
2. Calculate the hydraulic head for each well.
3. Determine the direction and gradient of hydraulic head.
4. Assume for the aquifer a porosity of 30% and use $K = 150\frac{gpd}{ft^2}$, an estimate obtained from pumping tests at the site. Calculate a ground-water velocity. Pay attention to units.
5. Use the chart of grain size versus hydraulic conductivity to estimate a hydraulic conductivity for median grain size of ϕ_{50}=2.5 and standard deviation of σ=1.5.
6. How much different would the hydraulic conductivity estimates be if ϕ_{50}=2.0 and standard deviation of σ=1.0? How would this effect you velocity calculation? Use the Masch and Denny curves on the website.

Slug Tests

Grain-size data and permeameter values are not particularly representative of the aquifer as a whole. We need to sample larger volumes. A pumping test is ideal for this but not always practical because of expense or low aquifer yields. Instead we turn to a slug (bailer) test. We will go over the main ideas in lab this week and next, but the following will get us started: The following table

contains data from a slug test performed on well B–4 at the UNO Well Field. Use this data to estimate the hydraulic conductivity and transmissivity of the aquifer. You may need some of the following data:

Initial Depth to Water: 2.60 feet

Diameter of Casing: 4 inches

Length of Screened Interval: 20 feet

Thickness of Aquifer: approximately 20 feet

Diameter of Borehole: 12 inches

Type of Gravel Pack: 20–40 filtered sand

Volume of Slug: 0.134 ft^3 (? This value did not yield results agreeing with the measured initial drawdown of 0.86 feet. Try both.)

Time (sec)	Reading (feet)	Time (sec)	Reading (feet)
15		180	2.57
30	2.12	195	2.58
45	2.25	210	2.58
60	2.35	225	2.58
75	2.44	240	2.59
90	2.47	255	2.60
105	2.48	270	2.60
120	2.51	285	2.60
135	2.55	300	2.60
150	2.55	315	2.60
165	2.56		