

CE 473/573 Groundwater Fall 2008

Learning objectives

While the goals of the class are quite general, the learning objectives specify what you will be able to do. They are constructed on six levels: (1) listing and defining, (2) explaining and describing, (3) calculating and solving, (4) deriving and analyzing, (5) designing and formulating, and (6) evaluating and choosing. Use these objectives to focus your study.

1. List properties of soils. Define porosity. Compute porosity for simple geometries. Estimate porosity for various soil types and explain how sorting affects porosity. Explain how results from a groundwater model depend on the properties of the soil.
2. Define hydraulic conductivity, discharge (or flow), specific discharge, and average linear velocity. Explain why the average linear velocity is larger than the specific discharge. List and explain the factors that affect hydraulic conductivity. Estimate hydraulic conductivity for various soil types. Explain the measurement of hydraulic conductivity. Design a permeameter. Define transmissivity. Compute effective conductivity.
3. State Darcy's law. Explain the terms in Darcy's law. Explain the limitations on Darcy's law. Determine whether Darcy's law applies to a given flow. Use Darcy's law to explain how the head should vary in an aquifer.
4. Define water table, aquifer, aquifuge, aquitard, confining layer, confined aquifer, unconfined aquifer, artesian aquifer, phreatic aquifer, saturated zone, and perched aquifer. Explain how the water table relates to surface topography. Explain features of maps of the potentiometric surface. Draw and interpret contours of the piezometric surface.
5. Define specific yield, specific storage, and storativity and explain the differences between them. Compute specific storage. Explain why storativity is larger in unconfined aquifers than in confined aquifers. Estimate specific yield for various soils.
6. Explain the difference between homogeneity and isotropy. Give examples of both.
7. Explain terms in a general conservation law. Derive flow equations for groundwater flow in confined and unconfined aquifers by applying conservation of mass and Darcy's law. Explain the significance of terms in the flow equations. Simplify the flow equations for various conditions.
8. Derive solutions for one-dimensional steady flow in confined and unconfined aquifers under various conditions. Sketch and explain profiles of piezometric head. Explain refraction of streamlines. Define groundwater divide and compute its properties.
9. Explain the finite-difference approach. Formulate a finite-difference model of steady groundwater flow. Solve a groundwater problem using a spreadsheet and Modflow. Interpret the results from a groundwater model.

10. Derive solutions for simple cases of flow to a well. Explain solutions for steady flow to a well in confined and unconfined aquifers. Determine aquifer parameters from steady pump tests.
11. Explain solutions for unsteady flow to a well in confined and unconfined aquifers. Explain the steady solution for flow to a well in a leaky confined aquifer. Determine aquifer properties from pump tests. Construct more complex solutions by superposition. Design pump tests and dewatering systems.
12. List sources of groundwater contamination. List and explain processes of contaminant transport in groundwater. Compute contaminant concentrations and design simple systems to control contamination. Compute plume lengths.