

Analysis of time-drawdown data from heterogeneous leaky aquifer systems

CAGRI GOKDEMIR¹, NADIM K COPTY¹, MATTHEW WATERMAN² & ANGELOS N FINDIKAKIS²

*1 Institute of Environmental Sciences, Bogazici University, Bebek, Istanbul, Turkey
ncopty@boun.edu.tr*

2 Bechtel National Inc., San Francisco, California, USA

Abstract The analysis of drawdown data from pumping tests is often performed using graphical techniques that are based on the assumption of aquifer homogeneity. However, natural subsurface formations are heterogeneous with complex patterns of spatial variability. In this paper, we describe a novel interpretation method that uses the time derivative of the drawdown to infer information about the spatial variability of the flow parameters in heterogeneous leaky aquifer systems. The method uses the observed drawdown and its time-derivative at a single point to estimate the hydraulic parameters. By applying the procedure to different portions of the time-drawdown data, variations in the flow parameters with radial distance from the pumping well are detected. The method can also be used as a tool to identify the type of aquifer system present. For demonstration the method is applied to pumping test data from an alluvial leaky aquifer in California, USA. Various data smoothing and differentiation techniques were evaluated for the estimation of the time-drawdown derivative. Because of the noise typically observed in field data, optimal estimates of the drawdown derivative were obtained by first fitting the drawdown data to high order polynomials and splines and then differentiating the fitted functions with respect to time. Results of the analyses show that the proposed methodology is a viable tool for the interpretation of pumping test data and that it may yield important information about the heterogeneity of the aquifer, which is generally ignored in conventional pumping test analysis techniques.

Key words well hydraulics; analysis of pumping test; groundwater flow modelling; heterogeneity; transmissivity; leaky aquifers