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Modeling Fractured Rock Aquifer System

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The groundwater flow problem in hard rock region is a complex one and as such the development of models to represent the fractured media has always been and will continue to be of interest to hydrologists. Evolving conceptual model of a fractured system requires either a gross simplification or a detailed description of the aquifer properties controlling the groundwater flow. Presently, there is only a basic conceptual understanding of flow in the vicinity of weathered and fractured hard rock aquifers. Normally this conceptual understanding is not translated in to the quantitative interpretation procedures; often, simple continuum models are applied to analyze pumping test data, and the results then used to produce quantitative calculations on a regional scale. Even if the regional system can be represented using the continuum equivalent approach, it is unlikely that the results of applying continuum models at the local scale have any general validity, and also aquifer parameters so derived, may be different to the aquifer parameters appropriate for describing regional flow in quantitative terms. Hence, there is a need to develop appropriate methods for analysis of pumping test data and appropriate simulation technique to improve the success rate and yields of wells in fractured rock. The analysis should provide cost-benefit analysis for new and/or in fill wells. To do this, it is necessary to investigate the flow in the vicinity of a pumping borehole, and to apply appropriate non-continuum models. Fractured hard rock systems are typically using one or more of the following conceptual models: (i) Equivalent porous medium (EPM), (ii) Dual porosity medium (DP), (iii) Discrete fracture network (DFN) model, (iv) Channel flow model (CN) and (v) Stochastic continuum (SC) model. This paper deals with the characterization of fracture geometry and various approaches used to simulate hard rock (fractured) aquifer system. The first case study in Ireland to identify suitable boreholes and optimal pumping in a lime stone aquifer by applying Discrete Fracture Network (DFN) modeling approach is also presented.

Keywords: Modelling, Hard rock aquifer, Discrete fracture network (DFN) and Stochastic Continuum (SC)