The Establishment and Application of the Relationship between Effective Porosity and Specific Capacity of Sediments, using Data from Well Drilling Records

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ABSTRACT

This research was conducted 1) to determine if a relationship exists between specific capacity and effective porosity, and 2) to establish a direct relationship between specific capacity and effective porosity, and 3) to calibrate and test the relationship between specific capacity and effective porosity with a variation of sedimentary and rock environments, and 4) to confirm the reliability of this direct relationship between specific capacity and effective porosity. Conceptually the relationship between specific capacity and effective porosity existed. A thorough review of academic literature indicated that a direct relationship between specific capacity and effective porosity does not exist, although effective porosity has been studied and is one of many parameters that determine the flow of groundwater. However, effective porosity can not be measured from field studies. When a well is drilled, a drillers log is recorded with the construction details, usually including the depth of the well, screened sections, and water levels under static and pumping conditions, etc. From these data, we can easily calculate the specific capacity. Data obtained from direct measurement and simulated pump tests with a variety of sediment sizes in a laboratory were used to define the initial relationship between specific capacity and effective porosity. The equation that describes that relationship was further modified to determine the best solution for the laboratory test data. The equation developed in the laboratory experiments were subsequently applied to a field well database of 609 selected wells which penetrate a range of a variety of sediments and rocks. Through an

iterative process, the relationship developed in the laboratory was applied successfully to field data.

The final resultant equation that describes the relationship between specific capacity and effective porosity was successfully determined and calibrated using field data and revised for application to the selected wells which met the criteria to be used for this research. Individual values of effective porosity were calculated for each well using only the calculated specific capacity. The equation accurately produced effective porosity results that reflect conditions in the groundwater system of 9 layers of aquifers and aquitards of various lithologic descriptions ranging from unconsolidated sediments to volcanic rocks. The result is that this relationship to calculate effective porosity directly from specific capacity was confirmed and can be applied without knowing any details of the well construction or lithology. This is a major breakthrough in understanding the direct relationship between specific capacity and effective porosity and is shows that effective porosity can be easily calculated and used to determine aquifer characteristics. The result shows a significant advance over traditional methods of determining effective porosity from field data, making parameter estimation for groundwater flow models and simulations much simpler.