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Modeling of Groundwater Flow and Contaminant Migration

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Groundwater is an invisible resource of water supply. As a result, both the dynamics of the resource base and the services it produces are often poorly understood. The proper management of groundwater resources even on a small scale is very difficult. There are a large number of quality criteria to be considered and in most cases; the level of each criterion is the resultant of complex interactions. The situation is further exacerbated by the difficulties of any experimental approach for forecasting the water quality. This has led to the growth of modeling and the development of numerical methods of solution has led to increase interest in modeling. Models have been applied to investigate a wide variety of hydro-geologic conditions.

The main objective of the study was to develop groundwater model to determine the well flow (Well function and Drawdown) for Leaky and Non-leaky confined aquifer and contaminant migration in one and two dimension using programming Language FORTRAN 77 and C Graphics. The model has been developed using simplified assumptions and numerical approximations (polynomial approximation) to the governing equations of well function and drawdown under unsteady state condition. The drawdown of the aquifer for various simulation periods was calculated by forming a uniform grid over the area under consideration. The contaminant migration model describes 1 and 2-D contaminant concentration distribution from a continuous and slug point source in a form in which all error functions and integrals were approximated. Then the final describing equation can be used to obtain concentration profiles directly by inserting the appropriate parameter values.

The drawdown calculation from a pumping well enables us to estimate the yield of a well and its influence over the other wells nearby. Using the model, the concentration of the contaminant plume at observation well can be computed before field experimental work is undertaken. In general, mathematical models are used to predict the groundwater flow and in some cases the solute and/or heat transport. Predictive simulations must be viewed as estimates, dependent upon the quality and uncertainty of the input data. Models may be used as predictive tools; however field monitoring must be incorporated to verify model predictions. The best method of eliminating or reducing modeling errors is to apply good hydro-geological judgment and to question the model simulation results.

Keywords: Groundwater model; aquifer, contaminant migration; well function; drawdown; 2-D dynamics; numerical approximations; water quality simulation; groundwater management