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AN ANALYSIS OF THE FLOW OF WATER IN A SHALLOW, LINEAR AQUIFER, AND OF THE APPROACH TO A NEW EQUILIBRIUM AFTER INTAKE

Discussion by

Morton W. Bittinger

Colorado State University
Fort Collins, Colorado

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June 15, 1960

Professor J. A. Peoples, Jr.
Editor, Journal of Geophysical
Research
Geology Department
University of Kansas
Lawrence, Kansas

Dear Professor Peoples:

I am enclosing, for your consideration, a discussion of the paper entitled "An Analysis of the Flow of Water in a Shallow, Linear Aquifer, and of the Approach to New Equilibrium after Intake," which appeared in the Journal of Geophysical Research, May 1960, pages 1573-1576.

Sincerely yours,

Morton W. Bittinger
Assistant Civil Engineer

MWB:jd

Enclosure

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ANALYSIS OF THE FLOW OF WATER IN A SHALLOW, LINEAR AQUIFER, AND OF THE APPROACH TO A NEW EQUILIBRIUM AFTER INTAKE[a]

Discussion by Morton W. Bittinger
Colorado State University
Fort Collins, Colorado

This paper represents another significant contribution to the rapidly growing literature in the field of transient ground-water hydraulics.

It is worthy of note, however, that simply the complement of the error function sufficiently describes water table levels in the aquifer from time zero until the water begins to flow from the outlet end of the aquifer for the conditions set forth by the authors.

A solution of the differential equation (1), neglecting the term A/ℓ, for an aquifer of infinite extent is:

$$\Phi = \Phi_L \frac{2}{\sqrt{\pi}} \int_{\frac{x'}{\sqrt{4Kt}}}^{\infty} e^{-u^2}\, du = \Phi_L \operatorname{erf c} \frac{x'}{\sqrt{4Kt}} \qquad (8)$$

where $x' = \ell - x$ in the authors' notation.

Equation (8) meets the following initial and boundary conditions:

$\Phi = 0$, $\quad 0 < x' < \infty$, $\quad t = 0$
$\Phi = \Phi_L$, $\quad x' = 0$, $\quad t > 0$
$\Phi = 0$, $\quad x' = \infty$, $\quad t > 0$

Up until the moment the water reaches the discharge point at distance ℓ from the intake end, the aquifer may be considered infinite in length and equation (8) may be used to estimate the water-table surface with time. The ratio Φ/Φ_L may be computed with two-place agreement ~~with~~ using

(a) Paper by J. N. Luthin and J. W. Holmes (Jour. Geo. Res., V65, No.5, May 1960, pp 1573-76).

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equation (8) when the parameter $\ell/\sqrt{4Kt} \geq 2.0$. When t becomes large enough for $\ell/\sqrt{4Kt} < 2.0$, equation (7) of the authors' paper becomes more appropriate than equation (8) above. However, for the authors' example this situation is reached only after some 476 years.