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OLLSCOIL NA hÉIREANN, GAILLIMH

THE NATIONAL UNIVERSITY OF IRELAND, GALWAY

International Postgraduate Hydrology Courses

M. Sc. Degree (Hydrology) - Summer Examinations, 2000

APPLIED HYDROLOGY IV (EH 512)

Examiners: Professor P. E. O'Connell
Professor C. Cunnane
Professor M. Nawalany
Professor A. Brock
Mr. C. Abernethy

Time allowed is *three* hours. Attempt *any five* questions.

(Please use separate Answer Books for sections A, B and C)

Section A - Environmental Hydrology

(Professor M. Nawalany)

1. A polluted river has good hydraulic contact with an adjacent stagnant semi-infinite aquifer (i.e. no flow in the aquifer). The concentration of the polluting substance in the river is $C_o = 1$ mg/m^3. As a result of contact with the river, the polluting substance migrates within the aquifer by diffusion. There is a chemical reaction within the aquifer which causes pollution decay. The rate of decay is proportional to the actual concentration of the polluting substance at every point of the aquifer. As a result, a steady-state situation occurs in the aquifer, i.e. C = C(x) only. Assume that the chemical reaction acts like a sink term $w(x) = -\alpha C(x)$.

Given that the diffusion coefficient in groundwater is D = 10 m^2/s and taking $\alpha = 2.5$/s

(a) Find C(x), the steady state concentration of the polluting substance in the aquifer as a function of distance x from the river.

(b) Calculate the flux of the polluting substance that enters the aquifer (in mg/m^2/s).

2. An abstraction well operates within an infinite horizontal aquifer with a yield of Q = 1000 m^3/day. The aquifer is recharged by a constant infiltration rate of N = 0.5m^3/m^2/year. As the infiltrating water is being polluted with some conservative pollutant, it has been decided to build a protection zone around the well. What should be the value of the radius for the protection zone if the concentration in the well must be 2-times smaller than that in the infiltrating water.

(See Sections B and C overleaf.)

Section B - Geophysical Methods

(Professor A. Brock)

3. (a) Define *electrical resistivity* and list the main factors controlling the resistivity of rocks. Distinguish between *resistivity* and *apparent resistivity* and explain how the difference arises.

   (b) Outline the basic principles of the vertical electrical sounding (VES) method and describe how VES data are interpreted. Discuss the problem of equivalence and illustrate it with an example.

4. Compare and contrast the *seismic method* and the *electrical method* for shallow subsurface exploration and assess their relative importance in water geophysics.

Section C - Sedimentation Processes

(Mr. C. Abernethy)

5. (a) What is the *sediment delivery ratio* of a catchment?

   (b) What kind of information can we obtain from the Shields curve?

   (c) Discuss the relationship between water discharge and sediment discharge in a river.

6. Field measurements of erosion rates can be classified, according to the size of the land area used, as small plots, micro-catchments, and river basin scales.

   Explain :

   (a) The principles of each measurement technique ;

   (b) The different types of problems that can be studied at each of these scales.