Ollscoil *na* hÉireann, Gaillimh
National University *of* Ireland, Galway

SUMMER EXAMINATIONS 1999

FOURTH SCIENCE EXAMINATION - HYDROLOGY

Examiners: Professor P.E. O'Connell
Professor C. Cunnane
Mr. T. Henry

Time allowed is *three* hours.

Attempt *five* questions.
Answer Question 1 (Section A), and two questions each from Section B and Section C.
All questions carry equal marks.

SECTION A

1. Answer any *eight* of the following:

   (a) Write brief notes on *three* of the hydrological consequences of reforestation.
   (b) Briefly explain how the *accuracy of measurement* of a variable can affect the *accuracy of estimation* of a water balance.
   (c) What is the Permanent Wilting Point?
   (d) What is the difference between *available soil moisture* and *available water capacity*?
   (e) Briefly explain the guidelines developed by Malin Falkenmark to evaluate the adequacy of global water supplies.
   (f) What is *tortuosity*? Explain why its value in porous media is *always* greater than one.
   (g) The two-dimensional spread of a pulse of tracer in a unidirectional flow-field results in an elliptically-shaped concentration distribution. Explain why this occurs.
   (h) What are the three source control measures used to deal with leachate arising from solid waste? Write a brief note on each.
   (i) What is the difference between *insular* and *pendular saturation*?
   (j) In terms of pumping wells, what is a *capture zone*?

   [*2.5 marks each*]

SECTION B

2. Discuss the importance of climate, vegetation and soils as controls of evaporation. Use specific examples to illustrate your answer.

   [*20 marks*]

3. What is intensity-duration frequency analysis of rainfall? Explain how the information obtained from this sort of analysis can be used.

   [*20 marks*]

4. Answer *either* (a) or (b). Not both.

(a) A recent editorial in The Guardian suggested that "the Aral Sea is a continuing disaster of planning." Explain the present condition of the Aral Sea, in context of location, climate and history, and offer some suggestions for future actions.

[*20 marks*]

or

(b) According to US Secretary of the Interior Bruce Babbitt "communities dependent on the Colorado River are facing a crisis." Explain the nature of this crisis, and give a historical perspective on its development.

[*20 marks*]

5. Compare and contrast the various methods available for calculating potential evapotranspiration. Your answer should include a discussion of the strengths and weaknesses of each method.

[*20 marks*]

SECTION C

6. *In situ* bioremediation is widely used in remediating contaminated soils and aquifers. Explain the theory and methodology involved in using this approach, and outline the advantages and disadvantages (as well as the limitations) of its use as a remediation strategy.

[*20 marks*]

7. There are six broad categories of groundwater contamination. List them, and discuss two in detail.

[*20 marks*]

8. In a US EPA report entitled *Basics of Pump-and-Treat Groundwater Remediation Technology* the authors write, "properly designed and accurately located extraction wells are effective for containing and/or remediating groundwater contamination, but have limitations." Using specific examples, explore this statement in relation to the limitations of pump and treat as a groundwater remediation technique.

[*20 marks*]

9. An aquifer is contaminated as a result of a contaminant spill. Your company has been contracted to deal with the problem. Assuming the legal aspects have been dealt with, you are asked to devise a strategy to deal with the problem. Outline this strategy, providing specific action options that could be used.

[*20 marks*]