ENGE414
Applied Hydrogeology

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Department of Geological Sciences

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Course Description

The Applied Hydrogeology course provides postgraduate students in engineering geology and environmental science with a sound understanding of the nature and occurrence of groundwater, various techniques for resource evaluation, contaminant transport issues and an introduction to groundwater modelling. The course is an integrated one, developing both geological aspects of groundwater occurrence and chemistry, as well as pragmatic methods for quantifying flow parameters and aquifer characteristics. Classroom teaching of essential groundwater theory is balanced and supported by laboratory experiments, field activities and computer modelling.

Content

The following topics and activities are scheduled over 4 weeks in May. The first week is set aside for students to read a number of key journal articles as part of an assessable preparation module.

Class Schedule

Block #	Dates	Lectures
1a	1-5 May	*Independent study* Reading journal articles
1	8 May (9 to 12 am)	*Lecture* **Introduction to hydrogeology** What is hydrogeology? Occurrence of groundwater in New Zealand Aquifer types **Groundwater hydraulics** Storage, transmission, Darcy's experiment
	9 May (9 to 12 am)	*Lecture* **Groundwater hydraulics** Hydraulic head, Darcy's Law, groundwater flow equations Flow nets, steady-state flow
	10 May (9 to 12 am)	*Lecture* **Groundwater hydraulics** Flow to wells Aquifer test analysis
	11 May (all day)	*Lab* Permeability experiments
	12 May (all day)	*Tutorial*
2	15 May (9 to 12 am)	*Lecture* **Flow in the unsaturated zone** Overview, methods for estimating recharge **Regional groundwater flow** **Surface water - groundwater interaction**

		Modes of interaction, case studies
	16 May (9 to 12 am)	*Lecture* **Groundwater chemistry** **Groundwater contamination** Sources of contamination, contaminant transport, capture zone analysis
	17 May (9 to 12 am)	*Lecture* **Field techniques and Site evaluation**
	18 May (all day)	*Field work*
	19 May (all day)	*Tutorial*
3	22 May (9 to 12 am)	*Lecture* **Groundwater modelling** What is a model and what is its purpose? Groundwater modelling codes Management and regulatory issues Case studies
	23 May (all day)	*Lab* Computer modelling
	24 May (all day)	*Lab* Computer modelling
	25 May	*Independent study*
	26 May (9 to 12 am)	*Lecture* Poster presentations Course conclusion

Learning Outcomes

Students successfully completing this course will be able to:

1. Assess hydrogeological controls on groundwater storage and flow.
2. Use a selection of laboratory skills to estimate permeability.
3. Understand the principles and quantification of groundwater movement.
4. Design and interpret pump tests in simple aquifer systems.
5. Have a basic understanding of surface water – groundwater interaction; flow in the unsaturated zone; groundwater chemistry and contaminant transport.
6. Use hand calculations, computer modelling and physical modelling to simulate groundwater flow and contaminant transport in simple aquifer systems and explore management options.
7. Discuss groundwater resource issues constructively and show familiarity with key journal articles from the international literature.

Prerequisites

15 points of 100-level MATH

Prescribed Text

Fetter CW (2001) Applied Hydrogeology Fourth Edition, Prentice Hall.

Recommended Texts

Fetter CW (2004) Hydrogeology: A short history Part 1, *Groundwater* 42(5), 790-792.
Fetter CW (2004a) Hydrogeology: A short history Part 2, *Groundwater* 42(6), 949-953.
Simmons CT (2003) Happy 200th birthday Mr Darcy and our thanks for your law! *Hydrogeology Journal* 11, 611-614.
Bredehoeft JD (2001) The water budget myth revisited: Why hydrogeologists model, *Groundwater* 40 (4), 340-345.
Alley WM and Leake SA (2004) The journey from safe yield to sustainability, *Groundwater* 42(1), 12-16.
Gleeson T, Alley WM, Allen DM, Sophocleous MA and Zhou Y (2012) Towards sustainable groundwater use: Setting long-term goals, backcasting, and managing adaptively, *Groundwater* (50) 1, 19-26.

Assessment

Forum post on journal articles	10% (due 7 May 5 pm)
Permeability and sand-tank lab report	30% (due 26 May 5pm)
Field work poster	30% (26 May)
Computer modelling report	30% (due 2 June 5 pm)