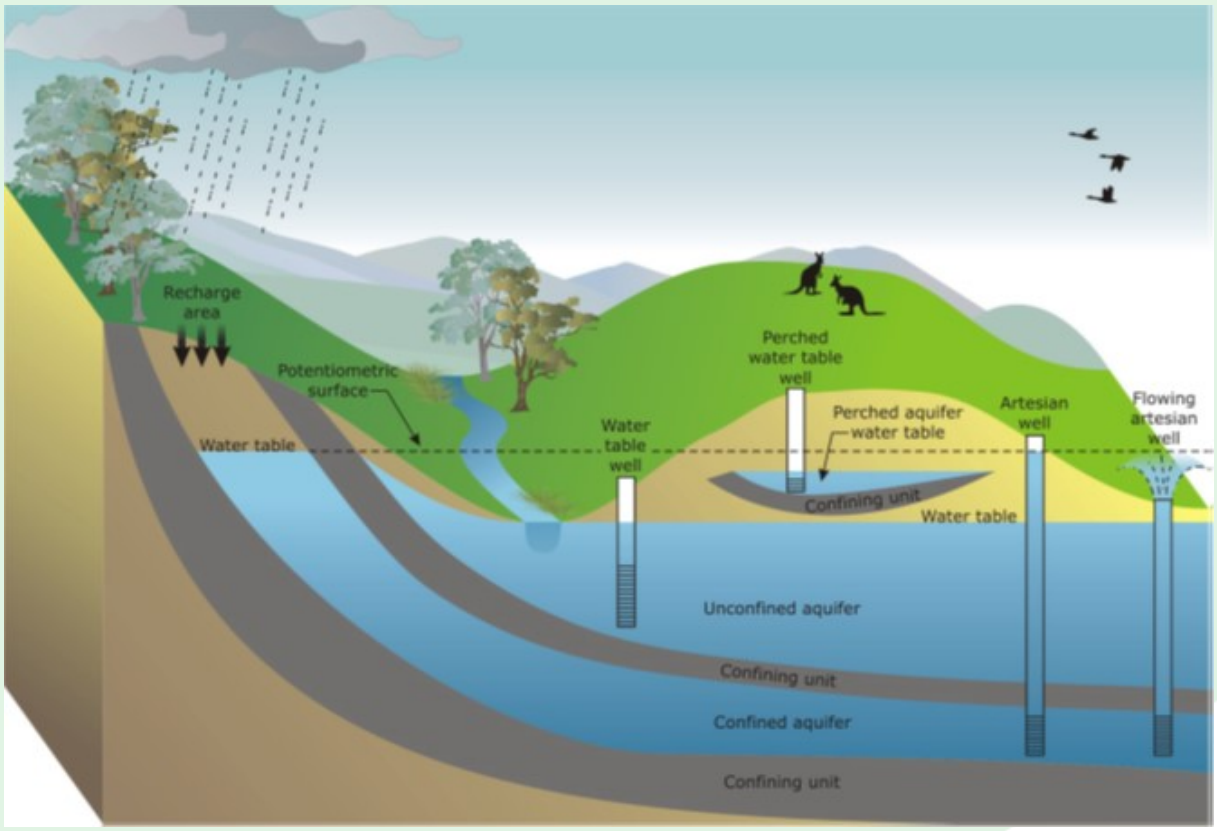
CVEN9630

Groundwater Hydrology and Resources Analysis

Term 2, 2022



Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Martin Andersen	m.andersen@unsw.edu.au	By appointment via Moodle	CE303	

Lecturers

Name	Email	Availability	Location	Phone
Mahmood Sadat-noori	m.sadat-noori@unsw.edu.au	By appointment via Moodle		

School Contact Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

Course Details

Units of Credit 6

Summary of the Course

This course covers the properties of soil and water; the principles of hydraulic head, hydraulic conductivity and Darcy's Law; physics of groundwater movement; introduction to groundwater modelling; groundwater storage and impacts of groundwater withdrawal; groundwater hydrograph analysis, barometric and tidal efficiencies; water in the unsaturated zone; groundwater in the hydrological cycle and recharge calculation; surface water groundwater connectivity; use of geochemistry and isotopic tracers; groundwater resource evaluation; drilling methods, bore design and maintenance; geophysical logging; pumping test design and interpretation.

Course Aims

The main aim of this course is to develop a student's understanding of groundwater hydrology and how it is interlinked with surface water. The student will be introduced to methods of groundwater investigations and the assessment of groundwater resources.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Have an ability to understand the occurrence of groundwater	PE1.1, PE1.3, PE3.1
2. Understand the connectivity of surface water and groundwater resources	PE1.1, PE1.2, PE2.1
3. Understand how to investigate and develop groundwater resources	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE3.1, PE3.2

Teaching Strategies

The course consists of two 2-hour weekly lectures combined with discussions and question sessions for assistance on assignments. The practical part of the course (workshops) will focus on solving of common groundwater resource problems. This will be done via four assignments that are all assessed. Hence there is no final exam for this course.

Additional Course Information

This course is an advanced groundwater hydrology course catering for postgraduate students and people from industry. Prior knowledge in hydrology is therefore desired. If you don't have this background knowledge and you feel you are struggling with the course material and assignments, you are strongly encouraged to do independent reading in the additional material provided on Moodle. Also please contact the course coordinator to discuss other options.

As the course caters to people already working in the industry, the course is delivered online in two

lectures, with one lecture slot on Wednesday evenings (18:00 to 20:00) and one during working hours on Thursdays (14:00 - 16:00). You are strongly encouraged participate real-time in the online lectures. If you are unable to participate online in real-time, then you can review the recorded lectures.

Assessment

*The four assignments contain specific tasks and questions to be answered by each individual student in their own time **after** the scheduled online class times. Please note that the assignments do require significant time to complete, as they form the core part of assessing a student's understanding of the knowledge provided in this course.* The purpose of these exercises is to enable students to develop the necessary skills and depth of understanding of groundwater resources so that they can enter the workforce and contribute accordingly.

The final grade is calculated based on the weights of individual assessments. Passing this course requires a final grade of 50%. Please note that the Course Coordinator reserves the right to adjust the final scores by scaling if agreed to by the Head of School.

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Assignment 1	15%	15/06/2022	1
2. Assignment 2	40%	13/7/2022	1, 2, 3
3. Assignment 3	30%	29/7/2022	1, 2, 3
4. Assignment 4	15%	12/8/2022	1, 2, 3

Assessment 1: Assignment 1

Start date: 01/06/2022
Submission notes: Submission via Moodle
Due date: 15/06/2022
Deadline for absolute fail: Submissions late by 5 days
Marks returned: Marks returned before census date

The correctness of answers to questions about the fundamentals of hydrogeology including: groundwater in a geological context using geological maps; calculating hydraulic heads and deriving equipotential maps and flowlines; applying Darcy's Law in various configurations. This assignment is designed to capture the students understanding of the course material delivered in Lecture note Chapters 1-2.

Assessment 2: Assignment 2

Start date: 16/06/2022
Submission notes: Submitted via Moodle
Due date: 13/7/2022
Deadline for absolute fail: 5 days after submission date
Marks returned: 26/07/2022

The correctness of answers to questions of increasing difficulty is quantified. The students will apply technical knowledge and engineering principles to: steady state groundwater flow model; groundwater storage; transient flow to wells and hydraulic test interpretation. Questions are designed to develop and capture the student's in-depth knowledge of the material delivered in the Lecture note Chapters 3-8.

Assessment 3: Assignment 3

Start date: 13/7/2022
Submission notes: Submission via Moodle
Due date: 29/7/2022
Deadline for absolute fail: 5 days after the submission date
Marks returned: 5/8/2022

The correctness of answers to questions of increasing difficulty is quantified. The students will apply technical knowledge and engineering principles to: hydrogeochemical and isotopic knowledge and methods for groundwater investigations. Questions are designed to develop and capture the student's in-depth knowledge of Chapters 14 and 15.

Assessment 4: Assignment 4

Start date: 27/7/2022
Submission notes: Submission via Moodle
Due date: 12/8/2022
Deadline for absolute fail: 5 days after the submission date
Marks returned: 31/8/2022

The correctness of answers to questions of increasing difficulty is quantified. The students will apply technical knowledge and engineering principles to: aspects of bore design; geophysical well-logging; geo-electrical and seismic survey interpretation. Questions are designed to develop and capture the student's in-depth knowledge of the material delivered in the Lecture note Chapters 9-13.

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

View class timetable

Timetable

Date	Type	Content
Week 1: 30 May - 3 June	Lecture	**Wednesday:** Lecture 1 - Introduction to Hydrogeology (Chapter 1)
	Lecture	**Thursday:** Lecture 2 - Physical properties and Darcy's Law (Chapter 2) **Assignment 1 Guidance**
Week 2: 6 June - 10 June	Lecture	**Wednesday:** Lecture 3 - Transport equations and steady-state flow (Chapter 3)
	Lecture	**Thursday:** Lecture 4 - Aquifer storage and abstraction impacts (Chapter 4) **Assignment 1 Guidance**
Week 3: 13 June - 17 June	Lecture	**Wednesday:** Lecture 5 - Groundwater modelling fundamentals (Chapter 5)
	Workshop	**Thursday: Assignment 2 Guidance**
Week 4: 20 June - 24 June	Lecture	**Wednesday:** Lecture 7 - Drilling techniques (Chapter 11) Lecture 8 - Abstraction bore design and maintenance (Chapter 13)
	Lecture	**Thursday:** Lecture 9 - Well hydraulics and pumping test design (Chapter 7)
Week 5: 27 June - 1 July	Lecture	**Wednesday:** Lecture 10 - Pumping test interpretation (Chapter 8)
	Workshop	Thursday: **Asignment 2 Guidance**
Week 6: 4 July - 8 July	Lecture	***FLEXIBILITY WEEK □ NO LECTURES***
Week 7: 11 July - 15 July	Lecture	**Wednesday:** Lecture 11 - Recharge, discharge and surface water-groundwater interaction (Chapter 6)
	Lecture	**Thursday:** Lecture 12 - Groundwater

		isotopes (Chapter 15)
Week 8: 18 July - 22 July	Lecture	**Wednesday:** Lecture 13 - Groundwater chemistry (Chapter 14)
	Workshop	**Thursday: Assignment 3 Guidance**
Week 9: 25 July - 29 July	Lecture	**Wednesday:** Lecture 14 - Geophysical techniques: Electrical (Chapter 9) Lecture 15 - Geophysical logging (Chapter 12)
	Lecture	Thursday: Lecture 16 - Geophysical techniques: Seismic (Chapter 10) **Assignment 4 Guidance**
Week 10: 1 August - 5 August	Lecture	**Wednesday:** Guest lecture - to be confirmed.
	Workshop	**Thursday: Assignment 4 Guidance**

Resources

Prescribed Resources

Comprehensive groundwater lecture notes are provided on the Moodle site. Relevant chapters for each week is indicated in the course schedule. Lecture recordings and Powerpoint presentations will also be made available on Moodle as the course progresses.

Recommended Resources

Recommended groundwater textbooks:

- Applied Hydrogeology - Fourth Edition (2001) by C.W. Fetter; published by Prentice Hall - For a basic introduction.
- Groundwater hydrology (2005) by Todd, D. K., & Mays, L. W. Wiley, New Jersey.
- Hydrogeology: Principles and Practice (2014) Kevin M. Hiscock & Victor F. Bense. Published by Wiley-Blackwell.
- Groundwater Science (2012) by Charles Fitts. Published by Elsevier.
- Physical and Chemical Hydrogeology - Second Edition (1997) by Domenico and Schwartz; published by John Wiley and Sons - More detailed theoretical discussion of many aspects.
- Groundwater Hydrology - Conceptual and Computational Models (2003) by K.R. Rushton; published by Wiley - Excellent practical and theoretical approach to groundwater resource assessment.
- Water Wells and Boreholes - Misstear, Banks and Clark (2006); published by Wiley
- Geochemistry, Groundwater, and Pollution (2005); Appelo, C.A.J., Postma, D.; 2nd ed. A.A. Balkema, Rotterdam. 649 pp. ISBN: 04 1536 428 0 - Best textbook on the market for groundwater chemistry! It can be ordered via website **www.crcpress.com**

The UNSW Connected Waters web site provides a portal to the groundwater world. This can be accessed at **http://www.connectedwaters.unsw.edu.au**

The Hydrogeology Journal is the academic publication of the International Association of Hydrogeologists.

The web address for the IAH is **http://www.iah.org/**.

Journal articles are at **http://link.springer.de/link/service/journals/10040/index.htm**

Additional materials may be provided on Moodle during the course.

Course Evaluation and Development

We are always looking for ways to improve the course. If you have ideas for improvement, please raise these anytime during class, on the Moodle forum, via email to the course coordinator, or, if you would like to be annonymous, via the MyExperience survey. We always carefully analyse the results of the MyExperience survey to incorporate your feedback where sensible and possible.

Laboratory Workshop Information

Online class workshops will be held during the two lecture timeslots as indicated in the schedule.

Variations to schedule will be announced on Moodle. The workshops are meant to introduce the assignments and provide answers to questions you may have in relation to the assignments and the general course content.

Submission of Assessment Tasks

Please refer to the Moodle page of the course for further guidance on assessment submission.

UNSW has a standard late submission penalty of:

- 5% per day, for all assessments where a penalty applies, capped at five days (120 hours), after which a student cannot submit an assessment, and no permitted variation.

Academic Honesty and Plagiarism

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise are also liable to disciplinary action, including exclusion from enrolment.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at:

https://student.unsw.edu.au/plagiarism

Academic Information

Final Examinations:

Final exams in T2 2022 will be held online between 12th - 25th August 2022 inclusive, and supplementary exams between 5th - 9th September 2022 inclusive. You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

ACADEMIC ADVICE

- Key Staff to Contact for Academic Advice (log in with your zID and password): https://intranet.civeng.unsw.edu.au/key-staff-to-contact-during-your-studies-at-unsw
- Key UNSW Dates - eg. Census Date, exam dates, last day to drop a course without academic/financial liability etc.
- CVEN Student Intranet (log in with your zID and password): https://intranet.civeng.unsw.edu.au/student-intranet
- Student Life at CVEN, including Student Societies: https://www.unsw.edu.au/engineering/civil-and-environmental-engineering/student-life
- Special Consideration: https://student.unsw.edu.au/special-consideration
- General and Program-Specific Questions: The Nucleus: Student Hub
- Book an Academic Advising session: https://app.acuityscheduling.com/schedule.php?owner=19024765

Disclaimer

This course outline sets out description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle should be consulted for the up to date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline (as updated in Moodle), the description in the Course Outline/Moodle applies.

Image Credit

UNSW CWI graphics (design by Anna Blacka).

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	✓
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	✓
PE2.2 Fluent application of engineering techniques, tools and resources	✓
PE2.3 Application of systematic engineering synthesis and design processes	
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	✓
PE3.2 Effective oral and written communication in professional and lay domains	✓
PE3.3 Creative, innovative and pro-active demeanour	
PE3.4 Professional use and management of information	
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	