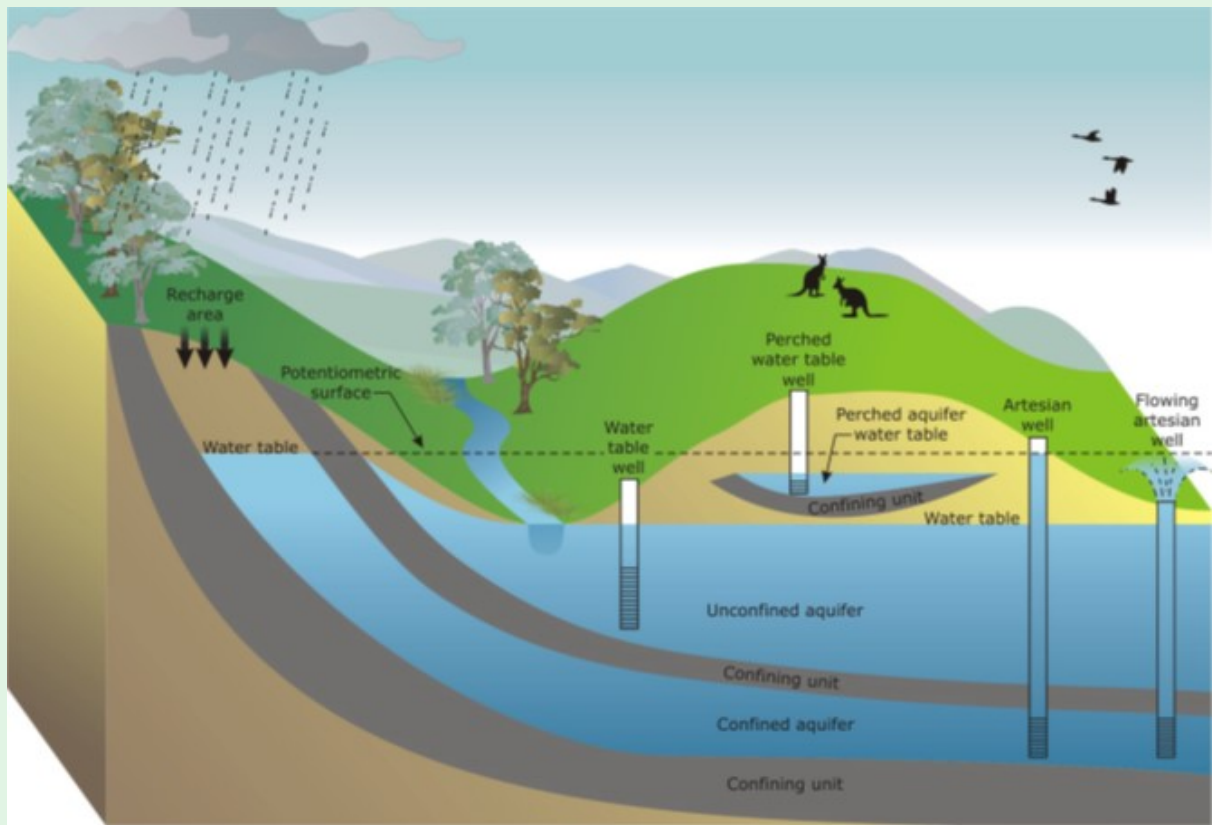


CVEN9630

Groundwater Hydrology and Resources Analysis

Term 2, 2023



Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Martin Andersen	m.andersen@unsw.edu.au	By appointment via Moodle	CE203	

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

The course introduces the properties of soil and water; hydraulic head, hydraulic conductivity and Darcy's Law; physics of groundwater flow; introduction to groundwater modeling; groundwater storage and geotechnical 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; Groundwater resource evaluation - drilling methods; geophysical logging; pump- and aquifer test design and interpretation; radial flow modeling; borehole efficiency and maintenance; groundwater chemistry and isotopes.

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, one lecture slot is scheduled on

Wednesday evenings (17:00 to 19:00) and one during working hours on Thursdays (13:00 - 15:00). You are strongly encouraged participate in the inclass lectures and workshops. If you are unable to participate inclass for legitimate reasons, 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 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%	14/06/2023	1, 2, 3
2. Assignment 2	40%	12/7/2023	1, 2, 3
3. Assignment 3	30%	28/7/2023	1, 2, 3
4. Assignment 4	15%	11/8/2023	1, 2, 3

Assessment 1: Assignment 1

Start date: 31/05/2023

Submission notes: Submission via Moodle

Due date: 14/06/2023

Deadline for absolute fail: 5 days after the due date

Marks returned: Before census date: 25th of June

This assignment focuses on the fundamentals of hydrogeology including:

- Groundwater in a geological context using geological maps;
- Calculating hydraulic heads and deriving equipotential maps and flowlines;
- And applying Darcy's Law in various configurations.

This assignment is designed to capture the students understanding of the course material delivered in Lecture notes Chapters 1-2.

Assessment 2: Assignment 2

Start date: 15/06/2023

Submission notes: Submitted via Moodle

Due date: 12/7/2023

Deadline for absolute fail: 5 days after due date

This assignment focuses on more advanced solutions to groundwater hydrology problems, including:

- Steady state groundwater flow modelling;
- Groundwater storage problems;
- Transient flow to wells and hydraulic test interpretation.

These 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 criteria

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Assessment 3: Assignment 3

Start date: 13/7/2023

Submission notes: Submission via Moodle

Due date: 28/7/2023

Deadline for absolute fail: 5 days after due date

The focus of Assignment 3 is to apply:

- Hydrogeochemical and
- Isotopic knowledge and methods for groundwater investigations.

These questions are designed to develop and capture the student's indepth knowledge of Chapters 14 and 15.

Assessment 4: Assignment 4

Start date: 26/7/2023

Submission notes: Submission via Moodle

Due date: 11/8/2023

Deadline for absolute fail: 5 days after due date

This assignment the students will apply technical knowledge and engineering principles to aspects of:

- Bore design;
- Geophysical well-logging;
- Geoelectrical
- 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

Campus locations for lectures and workshops are:

Wednesday: 17:00-19:00 Quad G040

Thursday: 13:00-15:00 Quad G034

For daily schedule of lectures and workshops see below

[View class timetable](#)

Timetable

Date	Type	Content
Week 1: 29 May - 2 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: 5 June - 9 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: 12 June - 16 June	Lecture	Wednesday: Lecture 5 - Groundwater modelling fundamentals (Chapter 5)
	Workshop	Thursday: Assignment 2 Guidance
Week 4: 19 June - 23 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: 26 June - 30 June	Lecture	Wednesday: Lecture 10 - Pumping test interpretation (Chapter 8)

	Workshop	Thursday: Assignment 2 Guidance
Week 6: 3 July - 7 July	Lecture	<i>FLEXIBILITY WEEK</i> □ NO LECTURES
Week 7: 10 July - 14 July	Lecture	Wednesday: Lecture 11 - Recharge, discharge and surface water-groundwater interaction (Chapter 6)
	Lecture	Thursday: Lecture 12 - Groundwater isotopes (Chapter 15)
Week 8: 17 July - 21 July	Lecture	Wednesday: Lecture 13 - Groundwater chemistry (Chapter 14)
	Workshop	Thursday: Assignment 3 Guidance
Week 9: 24 July - 28 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: 31 July - 4 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:

- Investigating Groundwater - First Edition (2019) by R.I. Acworth, CRC Press - Many Australian examples.
- Applied Hydrogeology - Fourth Edition (2001) by C.W. Fetter; published by Prentice Hall - For a basic introduction and engineering applications.
- 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 anonymous, 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

Workshops will be held during the two lecture timeslots as indicated in the schedule. Variations to schedule will be announced in class and 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 2023 will be held on campus between Friday 11th and Thursday 24th August (inclusive), and Supplementary Exams between Monday 4th and Friday 8th September (inclusive). You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

For students enrolled in the distance offering of a postgraduate course, and who reside further than 100km from UNSW Kensington campus, will be contacted regarding sitting an external exam. The school's External Exam Policy can be found on the Intranet.

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://unswengacademicadvising.as.me/schedule.php>

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	