

<b>Ground Water Hydrology</b> CVEG 52403
---

**Instructor:** Thomas Soerens  
Adjunct, University of Arkansas Civil Engineering  
Cell phone: (717) 315-1737  
[tsoerens@uark.edu](mailto:tsoerens@uark.edu)

**Text:** Course notes available on Blackboard

Required:

Uliana, M. M. (2025). **Basic hydrogeology: An introduction to the fundamentals of groundwater science**. The Groundwater Project.  
Available free online at: <https://gw-project.org/books/basic-hydrogeology/>

Optional: Some material and exercises adapted from this text below, which is a good source for fate and transport.

Ground Water Contamination, Transport, and Remediation, Bedient, Rifai, and Newell, Prentice Hall, 2<sup>nd</sup> ed., 1999. Out of print. Look for copy online.

**Objectives:** To learn the principles of ground water flow, subsurface transport and fate processes, and their application to remediation technologies.

<b>Grading:</b>	8 Homework assignments	400 pts	900 - 1000 pts	A
	and exercises: 50 pts each		800 - 899	B
	3 Exams: 150 pts each	450 pts	700 - 790	C
	Term paper	<u>150 pts</u>	600 - 699	D
		1000 pts	below 600	F

**Homework:** Submit homework via Blackboard. You may also email homework to me.

**Artificial Intelligence:** Students are permitted to use generative AI for assistance in writing their reports. I ask that you not use AI for calculation assignments. This would inhibit learning and I have found that AI is quite often wrong on these calculations.

**Exams:** Three exams will be given. Each exam is allowed 2 hours.

- Exam 1 on Darcy's law and quantities is closed-book, closed-notes, with some reference material provided.
- Exam 2 on aquifer tests is open-book, open-notes.
- Exam 3 on transport and fate processes in closed-book, closed-notes, with some reference material provided.

Study guides are provided for each exam.

**Term Paper:** Each student will write and present a paper on a ground water topic. Possible topics include: simple drilling methods, selection of well pumps, treatment methods for iron or arsenic, unsaturated/karst flow, and various remediation methods.

## Recommended Course Schedule

	<u>lecture</u>	<b>Topics</b>	<u>Text</u> <u>Ch.</u>	<u>Homework</u>
Week 1	1	Aquifers	1	
	2	Hydrostatic Head	2	
	3	Darcy's Law	4	Exercise 1
	4	Aquifer Properties	3	HW #1
Week 2	5	Equilibrium Well: Confined	6	
	6	Equilibrium Well: Unconfined	6	HW #2
	7	Potential Flow: Laplace Equation	6	
	8	Finite Differences 1	10	
	9	Finite Differences 2	10	HW #3
Week 3		<b>Exam 1</b>		
	10	Transient Flow, Storativity	7	
	11	Aquifer Test: Theis Curve-Matching	8	
	12	Aquifer Test: Cooper-Jacob	8	
	13	Aquifer Test: Slug Test	Notes	HW #4
Week 4	14	Multiwell and Image well	4	Exercise 2
		<b>Exam 2</b>		
	15	Transport and Fate Intro	Notes	
	16	Dissolution and Solubility		
	17	Volatilization and Henry's Law		<b>Project topic due</b>
	18	Sorption and Partitioning	12	
Week 5	19	NAPLs	12	
	20	Mass Calculation		HW #5
	21	Biodegradation		
	22	Advection and Dispersion	12	
Week 6	23	Retardation		<b>Project abstract due</b>
	24	ADR Equation	12	
	25	Breakthrough Curves and Plumes	12	Exercise 3
	26	Remediation	12	HW #6
Week 7	27	Remediation		
		<b>Exam 3</b>		
Week 8	28	Unsaturated and Karst Flow	14, 17	
		Term Paper		
		Term Paper		<b>Project paper due</b>

**Course Outcomes:** By the end of this course, the student should be able to:

1. Use Darcy's law to relate ground water velocity, head loss, and hydraulic conductivity.
2. Calculate porosity, bulk density, and solid density from soil volume and weight.
3. Use steady-state well equations to relate drawdown, transmissivity or hydraulic conductivity, flow rate, and radial distance from the well.
4. Use image wells to calculate boundary effects.
5. Use the Theis method of curve-matching to calculate aquifer properties.
6. Use the Cooper-Jacob method to calculate aquifer properties.
7. Determine hydraulic conductivity from a slug test.
8. Create a conceptual model of a ground water contamination site.
9. Describe the fundamental mechanisms of unsaturated and karst flow.
10. Calculate sorption effects by relating  $k_d$ ,  $f_{oc}$ ,  $k_{oc}$ , and  $R$ .
11. Calculate a degradation rate constant from concentration data.
12. Calculate the mass of contaminant in the soil, water, air, and NAPL phases.
13. List and describe remediation technologies.