

**SYLLABUS**  
**GROUNDWATER HYDROLOGY (476K)**  
**AQUIFER TESTING (191W) (28040)**  
**PHYSICAL HYDROGEOLOGY (391C) (28035)**  
**Fall 2013**

Instructor: Jack Sharp, EPS 3.150, JGB (GEO) 6.110 (jmsharp@jsg.utexas.edu)  
Office hours: W & F 11-12 or by appointment.

Teaching assistants: Their office hours and lab sessions will be available the first week of class.

Meeting times:

The lecture is from 10:00-11:00 AM MWF in JGB (GEO) 3.222.  
Time for the weekly literature/research discussion meeting for the graduate students will be arranged.

Laboratory: 476K labs and 191W will meet in EPS 2.104.

27670 T - 0800-1000 (27785) –  
27675 W – 0800-1000 (27790) –  
27680 W – 1300-1500 (27795) –  
27685 T – 1400-1600 (27800) –  
27690 M – 1700-1900 (27805) –  
27695 T – 1700-1900 (27810) –

Objectives: This course:

1. reviews/introduces the basic principles of groundwater hydrology/physical hydrogeology from geological, physical, mathematical, and geotechnical points of view;
2. (in 191W or the 476K lab) reviews/introduces students to basic computational and interpretative methods used in analyzing groundwater systems; scientific paper writing and presentation, and
3. examines promising new areas of hydrogeologic research through lectures, assigned readings, grant proposal writing, and project/term papers.

Meeting times:

The lecture is from 10:00-11:00 AM MWF in JGB/(GEO) 3.222.  
A weekly literature/research discussion meeting for the graduate students in 391C will be arranged.

Laboratory: 476K labs and 191W will meet in EPS 2.104.

Texts: Two required texts:

1. Sharp, John M., Jr., 2013, A Glossary of Hydrogeological Terms: Department of Geological Sciences, The University of Texas, Austin, Texas, 445p. [includes 476K/191W lab materials]
2. Sharp, J. M., Jr., 2013, Hydrogeology Notes: Department of Geological Sciences, The University of Texas, Austin, Texas, 86p.

Students should supplement the above materials with pertinent portions of the texts listed in the references cited. Additional papers will be assigned during the semester.

***“If you can read in the 21<sup>st</sup> century, you own the world”*** - Stephen King

Other talks/opportunities. Hydrogeology talks are given in a number of other venues - technical sessions and other seminars within the Department (including periodic hydrogeology brown bag seminars), at the BEG or UTIG, in other UT Departments (especially EER, PGE, CE, and Geography), at other agencies (e.g., USGS), and other venues (e.g., Austin Geological Society, SIPES, etc.).

I will inform you via email and in class about some of these other opportunities that make UT hydrogeology truly unique. Classroom instruction and assignments should not be the only source of your (scientific) education. If you know of other pertinent seminars/talks, please bring them to the attention of the class.

Field trips: Optional field trips will be offered. These may include some of the following ½ or 1-day field trips:

1. Carbonate aquifers and karst: the local Edwards aquifer – south of Austin
2. Sedimentary and alluvial aquifers – east of Austin
3. Igneous rocks and fractured media –west of Austin
4. A longer 4+ day trip to Trans-Pecos Texas may also be offered.

Because of student schedules and the size of this class, the field trips are not required, but extra credit is given for attendance. The exams will have optional questions that those who participate in the field trips may choose to answer.

Laboratory: All 476K students must attend a laboratory sessions. Graduate students who have not had previous classes in physical hydrogeology should take Geology 191. Graduate students who take 191W generally do better in the exams, have higher class rankings, and are more satisfied with the course. Geology 191W meets concurrently the 476K labs.

391C Graduate discussion: This consists of literature reviews of articles selected by faculty and student, an annotated bibliography, and a short (3-page) research proposal. Undergraduates are welcome to attend. The discussion session times will be arranged

Office hours: Formal office hours are: 11:00-noon - Monday and Wednesday or by appointment or feel free to come in and chat whenever the door to my office is open. *Informal* office hours:

1. when there are hydro speakers at Tech Sessions (typically, we take them out for a few beverages or dinner afterwards).
2. after the Hydrogeology Brown Bag Seminar (1:00PM on Fridays).
3. I will have a few 5:00 PM meeting times to review or discuss tests, etc.

Grading:

	<u>476K</u>	<u>391C</u>	<u>191</u>
2 examinations *	50%	60%	-
Final examination**	(25%)	(30%)	-
Lab problem sets –	25%	-	100%
Term paper – writing ***	25%	-	-
Annotated bibliographies (2) & Literature reviews	-	20%	-
Research proposal	-	20%	-

\* The examinations will be scheduled in the evening so plan your schedule accordingly. Each exam will cover vocabulary, concepts, and concept Application. There may be some simple numerical calculations required.

\*\* The optional final is comprehensive and can substitute for your lowest term examination or if you missed one of the term exams.

\* \*\*476K is a substantial writing component class. The term paper draft, outline, and final paper are 25%, but there are also writing components in the laboratory.

For each exam, be sure to bring pens & pencils, a ruler, and calculator, if you need one. The test calculation problems will be simple enough to do without a calculator, but...?

Grading policy: A (>90.5%); A- (89.5 -90.4%); B+ (88.0- 89.4%); B (80.5 -87.5%); B- (79.5 – 80.4%); C+ (78.0- 79.4%); C (70.5 -77.5%); C- (69.5 – 70.4%); D (59.50 -69.4%); F (< 59.4%). All with curving as necessary.

#### NOTE:

1) Information pertinent to the exams, schedule revisions, and announcements of opportunities (talks, job interviews, etc.) will be presented in class lectures. Guest lecturers in hydrogeology will present material in class that will be included on exams. We try to take advantage of the visitors to our program.

2) *This syllabus will be revised periodically* throughout the fall semester depending primarily upon the pace of the lectures, any University-mandated changes, and special opportunities (e.g., unexpected guest speakers in hydrogeology visiting the Department). Revisions will be distributed via the class email list and will be made available in class and in the lab.

### LECTURE/COURSE SCHEDULE FOR 2013 (subject to revision) ("He listens well who takes notes" - Dante Alighieri)

DATE:	TOPIC:	READINGS:
* Guest lecturer		** will be on library reserve or be handed out in lecture

#### INTRODUCTION - BASIC CONCEPTS

Aug. 28	The hydrological cycle Grad students meet briefly after class	1 - 16
30	Porosity 476K/191W students meet briefly after class LAB #0: Aquifer short reports & regional flow lab assignments Labs will not meet until the week of September 9	17 - 38
Sep. 2	<i>Labor Day - no class</i>	-
4	Darcy's law	39 - 58 Darcy, 1856**

6	Permeability	59 - 78
7	<i>Edwards aquifer field trip</i>	
9	Permeability and flow nets LAB #1: Porosity	79 - 94
11	Flow nets & Regional flow systems	95 - 120
13	Karst	321 - 334
16	Flow nets & Regional flow systems LAB #2: Darcy's Law	Wolaver et al.**
<i>First module:</i>		
18	I. Fractured rocks	187 - 200
20	II. Fractured rocks	handout
23	III. Fractured rocks LAB #3: Permeability	handout
<b>GROUNDWATER PHYSICS</b>		
25*	Concept of storativity; subsidence <b>Due:</b> at 10:00 AM (1000) in JGB 3.222, aquifer short reports assigned on 31 August.	121 - 136
25-31	West Texas Field Trip	
27*	Storativity; Safe yield; sustainability, & groundwater law	Pierce et al., 2013 293-308
30*	Continuity equation LAB #4: Flow nets	137-146
Oct. 1	<i>Water New Years Day</i>	
2	Aquifer tests	147-174
4	Aquifer tests <b>Due:</b> 391C annotated bibliography #1 by 5:00PM <b>Due:</b> 476K term paper rough first draft and outline by 5:00PM	
5	<i>Potential field trip date</i>	
7	Aquifer tests	
9	Review session <u>First exam</u> (7-9 PM in JGB 2.216)	--
11	Infitrometer & piezometer tests	

14	Vadose (Unsaturated) Zone LAB #6: Pumping Tests #2	175 - 186
16	Free convection	195 - 204 Simmons et al. **

TRANSPORT

18	Fresh-water / salt-water systems	205 – 212
19	<i>Potential field trip date</i>	
21	Mass transport LAB #7: Vadose zone	213 - 228
23	Diffusion and dispersion	229 - 250
25	Energy transport	251 -280
28-30	No lectures: GSA No LABs	-

*Second module:*

Nov. 1	I. Urbanization –walking field trip (if conditions are miserable outside, this will be switched with an urbanization lecture) <b>Due:</b> 476K term paper (2 paper copies, collated and stapled) plus pdf copy) final draft by 5:00PM	Wiles & Sharp** Sharp**
4	II. Urbanization LAB #8: Regional flow <b>Due</b> in your 476K/191W lab for this week; 2 copies. Assigned on 31 August)	handout
6	III. Urbanization	handout
8	Contaminant hydrogeology <b>Due:</b> 391C annotated bibliography #2 by 5:00PM	281 – 302
9	<i>Potential field trip date</i>	
11	<i>Veterans Day</i> NAPLS LAB #9: Consolidation & TE/BE	
14	Water law <b>Due:</b> 476K term paper student edits by 5:00PM	303 - 310
16	Groundwater geology LAB#10: Energy and mass transport	-
18	Geostatistics	443 - 455
20	Alluvial aquifers	Sharp ** Larkin & Sharp **

22	Streamflow hydrographs	349 – 364
25	Hydrogeological concepts in mineral exploration LAB #11: Contaminant & NAPL hydrogeology <i>Due:</i> 391C GSA grant applications by 1200 noon – 9 copies – collated and stapled	373 - 374
27	Springs <i>Due:</i> Final term paper with copies of all edits by noon – one printed copy and electronic copy (as a pdf). <i>Note:</i> Wednesday afternoon lab students should make arrangements to sit in on one of the other labs.	365 - 372
28-30	<i>Thanksgiving vacation</i>	
Dec. 2	Petroleum migration LAB (make up – lab final – tbd)	373 - 382
4	Review <u>Second exam</u> (7-9 PM in JGB 2.216)	
6	Return all papers exams, etc., except perhaps the make-up labs. Grades available. Decide if you want to take the final. Talk to TAs about your lab scores. Slide show of what we discussed this semester.	
Dec. ?	OPTIONAL FINAL (date, time, and site to be designated).	

Note the final is optional.

- If you are satisfied with your tentative grade, you may skip the final.
- If you missed an exam, you must take the final.
- If you are dissatisfied with your grade on one of the other two exams or your class ranking, the final will substitute for your lowest grade.

Final will consist of: 50 multiple choice – 50 points & 5 (out of 8) short answer/discussion/calculation problems – 50 points

Other (I apologize – I know that we all know or can infer these but there are UT directives that you are to be informed of the following):

1) *the honor code* (how it applies to each class, and develop a more thorough description of what constitutes acceptable practices in our classrooms.):

“The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity and responsibility. Each member of The University is expected to hold these values through integrity, honest *[sic]*, trust, fairness, and respect toward peers and community.”

No plagiarism or copying of others work for tests, term papers, pop quizzes, or laboratory problem sets is acceptable. Plagiarism or copying is subject to dismissal from the class with a zero grade. An explanation of plagiarism can be found at <http://registrar.utexas.edu/catalogs/gi09-10/index.html>.”

Group learning can be beneficial, so I encourage you to work with each other on occasion, and not always in isolation. However, if it assigned to 3 of your team up to analyze, for example, the data from a Guelph permeameter or the Theis curve matching, you owe it to yourself to do the calculations yourself again from scratch.

2) *students with disabilities*: “The University of ... [Texas] provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, <http://www.utexas.edu/diversity/ddce/ssd/>.” One year, I had a deaf student who was assigned two signers.

3) *classroom etiquette*: (Chana Lee, reported in the *Chronicle of Higher Education*, 27 March 1998): “Please do not hold conversations with classmates when the professor or another student is speaking. Also refrain from passing notes, reading ...[e.g., *The Daily Texan*], or participating in disruptive classroom behavior. Your undivided attention is a must. An atmosphere of mutual respect is in order...”

4) *religious holidays*: “By UT Austin policy, you must notify me [your instructor] of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.”

5) *writing component class*: “This course [i.e., 476K] carries the Writing Flag. Writing Flag courses are designed to give students experience with writing in an academic discipline. In this class, you can expect to write regularly during the semester, complete substantial writing projects, and receive feedback from your instructor to help you improve your writing. You will also have the opportunity to revise one or more assignments, and to read and discuss your peers' work. You should therefore expect a substantial portion of your grade to come from your written work.”

There will be a short paper on a selected aquifer and one on regional flow. This is followed by a term paper selected from a list of topics. The term paper is expected to be approximately 20+ pages long and follow a specified format. The final paper will be submitted both electronically and in hard copy. 2 paper copies of the outline and 3 of the draft are required. Each paper will have a student editor (drawn at random) and a professional editor (me and/or a TA) review the draft.

The UT Undergraduate Writing Center (UWC) asks that I provide you this on the syllabus:

“The UWC is a service that can help your students write more effectively--and more independently. Because we share your commitment to improving undergraduate writing, we ask that you: 1) encourage but not require students to come to the UWC. While requiring a visit works in the short term to get students through our door, the actual goals of the writing consultation suffer: students do not engage in the writing process or effectively work toward becoming better writers; ...2) download and refer your students to helpful writing handouts from our main website: <http://uwc.utexas.edu/handouts/>.”

6) *use of lap tops*: I have had complaints from students that the clatter of people typing on their laptops is very distracting or that the person next to or in front of the a student was answering email or playing video games (especially in large, beginning classes), which was distracting. Recall the story of Tom Sawyer, Joe Harper, and the tick! Also, it can be distracting to whoever is lecturing. We can discuss this if you wish. If you have a disability that requires you to use a laptop or a recording device, please see me and we shall reach an accommodation. .

## THE 10 COMMANDMENTS OF HYDROGEOLOGY

(courtesy of Mike Campana, slightly modified below)

Thou shall:

1. not assume isotropy, homogeneity, or a uniform hydraulic gradients without field evidence.
2. not assume that wells or streams fully penetrate or that flow systems are 2-dimensional without field evidence.
3. not use regional data to make site-specific judgments.
4. not use color graphics to enhance lousy science.
5. not employ geostatistics to obfuscate poor interpretations or weak conclusions.
6. not rely on stochastic methods to disguise insufficient field data.
7. not place geochemical or isotopic interpretations above hydraulic interpretations.
8. never regard geophysics or a numerical model as the truth.
9. never use a contouring program to make a water-table map (unless you hand contour it first to be sure that the program output is believable).
10. never use more than 3 significant digits.