

SWS 4245/5246 WATER RESOURCE SUSTAINABILITY

3 credits/Spring Semester

COURSE MOTIVATION AND DESCRIPTION

This course is about the global water crisis: the challenge of providing sufficient and equitable water supply for all people while also supporting ecosystem functions. Four key themes are maintained: hydrology, ecological protection, social equity, and economic opportunity.

Global demand for freshwater resources grows continuously, while at the same time there is increasing emphasis on preventing pollution and leaving enough water for natural ecosystem functions. These combined pressures define the need for sustainable water resource management. This course describes the effects of human impacts on hydrologic ecosystems (aquifers, rivers, coastal zones, lakes, and wetlands) with quantitative measures of impacts and mitigation/attenuation efforts. Case studies from around the world are used to illustrate both the detrimental effects of unsustainable resource utilization and the benefits of implementing sustainable resource management strategies.

This course is intended for graduate and advanced undergraduate students interested in the interactions between human civilization and hydrologic systems and should be of interest to environmental and agricultural scientists and engineers, and natural resource managers.

Instructor

James W. Jawitz, Professor
2191 McCarty Hall
352-294-3141, jawitz@ufl.edu
Office hours: T/R 4th period, or by appointment

Teaching assistant

Melika Yavari Nia, PhD student
1166 McCarty Hall
melika.yavarinia@ufl.edu

BRIEF OUTLINE

Topic	Weeks
1. Water resource sustainability	1
2. How do water resources underpin human society?	2-3
3. Where are the world's water resources? Equitable water allocation (meeting present and future minimum water needs)	4
4. Groundwater sustainability	6-7
5. Rivers, humans, transport, and transfer	7-8
6. Water quality (groundwater and surface water)	9-10
7. Urban water services	11
8. Floods and water control infrastructure (including dams)	12
9. Water institutions (including large-scale management)	13

ASSIGNMENTS

Your success as a professional will require you to effectively synthesize facts and opinions to understand their combined social, environmental, and economic implications. We all need practice to develop and improve these skills.

1. All students: Weekly readings from scholarly research articles, news analyses, and commentaries are assigned for each module. New for 2026: In-class quizzes will be conducted weekly based on both the

reading assignments and lecture content. In-class discussion will follow the quizzes (usually Fridays). You are likely to be called upon in class to share your critical evaluation and synthesis of the week's readings, including discussion of assigned questions related to the readings.

2. **All students:** Reports on site visits to hydrologic/hydraulic features related to concepts and topics discussed in class. Site visits must be during the semester. Credit can only be received through coordination with the instructor. In preparing your report, take note of the points allocated in comparison to the points for weekly quizzes. Due by the end of Week 13.
3. **Graduate students:** Enhanced expectations for graduate students are 1) show leadership during weekly discussions, and 2) complete an individual research assignment on a water resource topic chosen with consent of the instructor.

GRADING SYSTEM

To reflect the different skills required for professional success, the final grade in this course is based on analytical reading/writing assignments, thoughtful and consistent participation, formal essay exams, and interesting individual and group projects.

Course components	Points for grade	
	SWS4245	SWS5246
Weekly quizzes (5 points each)	50	50
Exam 1	100	100
Exam 2	100	100
Individual field trip	30	15
Class engagement/leadership, part 1	10	10
Class engagement/leadership, part 2	10	10
Individual research assignment		15
Total points	300	300

Exams

- are primarily essay questions linking concepts with specific information from case studies,
- exam grades are historically highly correlated to class attendance,
- exam dates and times are fixed FIRMLY.

Class participation

- entails regular, on-time attendance and engagement, and active interaction in periodic small-group discussions in rotating roles (discussion leader, reporter)
- participation points will be assigned separately for each half of the semester.

Late assignments will be penalized in proportion to the time since the due date, with zero credit after two weeks.

Grade Scale

A ≥ 92 > A- ≥ 89 > B+ ≥ 86 > B ≥ 83 > B- ≥ 80 > C+ ≥ 77 > C ≥ 74 > C- ≥ 71 > D+ ≥ 68 > D ≥ 65 > D- ≥ 62 > E

The mind does not require filling like a bottle, but rather, like wood, it only requires kindling to create in it an impulse to think independently.

- Plutarch, c. 100 AD, *Moralia, On Listening to Lectures* 48C (Loeb Classic Library 1.259)

The greatest obstacle to discovery is not ignorance - it is the illusion of knowledge.

- Daniel J. Boorstin, 1983, *The Discoverers*

COURSE SCHEDULE

Topic 1 Getting serious about sustainability

1. How do water resources intersect with people's lives? Which people?
 2. What are the implications of rivalrous vs excludable resources?
 - 2.1. Which resources are subject to overconsumption or degradation?
 - 2.2. What are the potential remedies for resource depletion or degradation?
 3. What is it we wish to sustain?
 - 3.1. What are the relationships between the components of sustainability?
 4. What explains resource consumption rate trends?
 - 4.1. What is a demographic transition?
 - 4.2. Who is doing the consuming, and how will that change?
 5. What are the limits to peak use of renewable vs nonrenewable resources?
 - 5.1. How does local depletion relate to globalization?
1. Ostrom E et al., 1999. Revisiting the commons: Local lessons, global challenges. *Science*, 284(5412), 278-282.
 2. *The Economist*, 2025. Humanity will shrink, far sooner than you think, 11 September, <https://www.economist.com/interactive/briefing/2025/09/11/humanity-will-shrink-far-sooner-than-you-think> (*The Economist* is free for UF students: <https://businesslibrary.uflib.ufl.edu/wsj-nyt-economist>)
 3. Gleick PH and Palaniappan M, 2010. Peak water limits to freshwater withdrawal and use, *Proceedings of the National Academy of Sciences*, 107(25): 11155–11162.

2 Hydraulic societies: Then and now

6. What is a hydraulic society?
 7. What are the key elements of 'control' of water resources?
 8. How are water resources connected to societal development and decay in...
 - 8.1. Egypt, West Asia, Rome?
 - 8.2. Modern industrial and post-industrial societies?
 9. How has the importance of rivers as transport corridors changed over time?
 10. What is the global relationship between rivers and human settlements?
 - 10.1. How have changing transport modes affected the relationship between human settlements and rivers?
 11. How are ancient societies relevant today?
 - 11.1. How have human interventions in the hydrologic cycle evolved with time?
4. Hall P, 1998. *Cities in Civilization*, Chapter 22: The Imperial Capital: Rome 50BC – AD 100, Pantheon, NY. (pp. 621-656)
 5. Godfrey MC, and Catton T, 2011. Ch. 5 Flexing the Environmental Muscle: The Cross-Florida Barge Canal, the Everglades Jetport, and Big Cypress Swamp, In *River of Interests: Water Management in South Florida and the Everglades, 1948-2010*, US Army Corps of Engineers, [pp. 69-74]
 6. *The Economist*, 2020. Follow the bottle: How to get beer around Congo, a country with hardly any roads, 18 January
 7. Alderman L, 2024. In France, the Future Is Arriving on a Barge, *New York Times*, March 26, <https://www.nytimes.com/2024/03/26/business/france-seine-carbon-emissions.html>. (NYT is free for UF students)

3 Water availability: Uneven in space, time, and among people

12. Where is the world's fresh water?
 - 12.1. How is water distributed among the major water storages?
 - 12.2. What are the determinants of the spatial distribution of the major water flows?
 - 12.3. What are the important temporal components of these fluxes?
 13. How does the global spatial distribution of people relate to water availability?
 - 13.1. How much water do humans need?
 - 13.2. What is the spatial distribution of human water use?
 - 13.3. Which human activities use the most water?
 14. Does everyone have access to enough water?
 - 14.1. Why is there water scarcity?
 - 14.2. How does economic power relate to water stress?
 15. What progress was made from the Millennium Development Goals?
 16. How do the Sustainable Development Goals compare to the MDGs?
8. United Nations, 2024. *The United Nations World Water Development Report 2024: Water for Prosperity and Peace*. UNESCO, Paris. **Prologue: pp. 10-19**
9. Gifford R, 2011. Phnom Penh's feat: Getting clean tap water flowing, *National Public Radio*, 2 June, <http://www.npr.org/2011/06/02/136394058/phnom-penhs-feat-getting-clean-tap-water-flowing>
10. Pathak A, 2024. How fetching water is holding back India's women, BBC, 7 July, <https://www.bbc.com/news/articles/c2e47zgz2v7o>
11. de la Cruz, B, 2023. Waiting for water: It's everywhere in this Colombian city — except in the pipes, *National Public Radio*, 3 December, <https://www.npr.org/sections/goatsandsoda/2023/12/03/1216561130/colombia-water-scarcity>
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4 Groundwater: The shouting present vs the whispering future

17. Who uses groundwater?
 18. What are the important physical characteristics of aquifers related to storage and flow?
 19. What are the major groundwater resources in Florida?
 20. How is groundwater accessed?
 21. What are the effects of pumping groundwater?
 - 21.1. What are the pumping implications for confined vs unconfined aquifers?
 - 21.2. Where is regional groundwater depletion important?
 - 21.3. Where are the links between groundwater and surface waters important?
12. Rojanasakul M, Flavelle C, Migliozzi B, and E Murray, 2023. America is using up its groundwater like there's no tomorrow, *New York Times*, 28 August. <https://www.nytimes.com/interactive/2023/08/28/climate/groundwater-drying-climate-change.html>
13. Searcy D, 2024. Indiana's plan to pipe in groundwater for microchip-making draws fire, *New York Times*, 2 January. <https://www.nytimes.com/2024/01/02/climate/indiana-leap-groundwater-pipe-microchips.html>

MIDTERM EXAM 27 FEBRUARY

5 Watersheds and water transfer: Local consumption, distant impacts

- 22. How do watersheds connect people and ecosystems?
 - 23. What are the beneficial uses at the destination of transferred water?
 - 24. What are the detrimental impacts at the origin of water transfer?
 - 25. Where have historic water transfers been most significant?
 - 26. Where are important current water transfers?
 - 27. What is the future of large-scale water transfer?
14. *China Daily*, 2017. South-to-north water diversion benefits 50 million Chinese, 14 September, http://www.chinadaily.com.cn/china/2017-09/14/content_32000250.htm
15. *The Economist*, 2018. China has built the world's largest water-diversion project, April 18
16. Radio Free Europe, 2024. Could A Taliban Canal Project Start Water War In Central Asia? 2 April, <https://www.youtube.com/watch?v=W0WFKbodUwg&t=194s>
17. Kruzman D, 2021. U.S. Southwest, already parched, sees 'virtual water' drain abroad, *Undark*, 31 May, <https://undark.org/2021/05/31/foreign-farms-virtual-water/>
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6 Water quality: Impacts and societal response

- 28. Why does water get contaminated?
 - 28.1. What are the impacts?
 - 28.2. Who is responsible?
 - 28.3. How should we respond?
 - 28.4. What conceptual frameworks can help us understand these questions?
- 29. How do we expect trajectories of water quality impairment and societal response to evolve through time?
 - 29.1. Historical examples in surface water and groundwater
 - 29.2. Current examples in surface water and groundwater
 - 29.3. Sanitation gap as a synthesis of historical and current cases
18. Paviour B, 2016. In Phnom Penh, a looming sewage crisis, *The Cambodia Daily*, April 16, <https://english.cambodiadaily.com/editors-choice/111364-111364/>
19. Loewenberg S, 2017. The poisoning of Bangladesh: How arsenic is ravaging a nation, *Undark*, 16 August, <https://undark.org/2017/08/16/bangladesh-arsenic-poisoning-drinking-water/>
20. Maag C, 2009. From the ashes of '69, a river reborn, *New York Times*, 21 June.
21. *The Memory Palace* [podcast], 2016. Oil, Water. Episode 92: 14 July. <https://thememorypalace.us/oil-water/>
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SPRING BREAK

16-20 March

7 Urban water services

- 30. What are the elements of the hydraulic cycle vs the hydrologic cycle?
- 31. What are the foundational roles of urban water services?
- 32. What are the key elements of urban water infrastructure?
- 33. How have urban water services evolved over time?
- 34. What are current and future challenges related to regeneration and renewal?

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22. 99% Invisible [podcast], 2013. Reversal of fortune, Episode 86: August.
<https://99percentinvisible.org/episode/episode-86-reversal-of-fortune/>
23. Kimmelman M, 2022. Remaking the river that remade L.A., *New York Times*, November 10,
<https://www.nytimes.com/interactive/2022/11/10/magazine/la-river-redesign.html>
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8 Infrastructure: Dams and flood protection structures

35. What is the nature of flood risk?
35.1. Where are risks highest?
35.2. Who is most at risk?
36. Why are dams built?
36.1. What benefits are provided?
36.2. Are there alternatives for providing these benefits?
36.3. Where are dams important?
37. What are the societal costs of large-scale river regulation?
38. What is the future of large-scale infrastructure?
24. Bearak M and Raghavan S, 2020. Africa's largest dam powers dreams of prosperity in Ethiopia — and fears of hunger in Egypt, *Washington Post*, 15 October,
<https://www.washingtonpost.com/world/interactive/2020/grand-ethiopian-renaissance-dam-egypt-nile/>
25. O'Connor et al., 2015. 1000 dams down and counting, *Science*, 348:496-497.
26. Yee V, 2023. Years of graft doomed 2 dams in Libya, leaving thousands in muddy graves, *New York Times*, 27 September, <https://www.nytimes.com/2023/09/27/world/middleeast/libya-flooding-derna-corruption.html>
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INDIVIDUAL PROJECTS DUE THURSDAY 16 APRIL

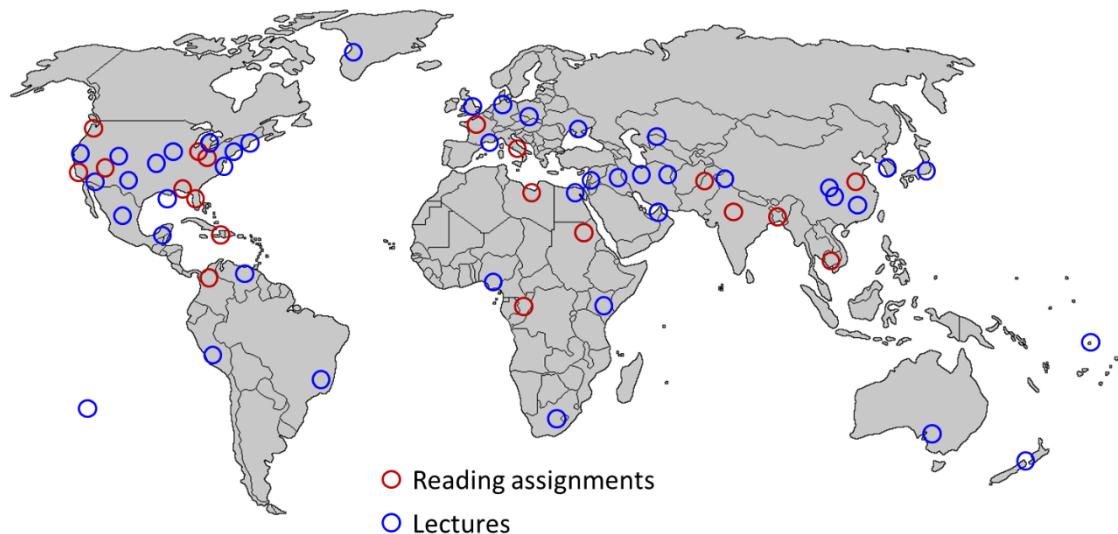
9 Institutions: Spatiotemporal scales of water management

39. How does climate relate to societal development?
40. Where will future climate change be important?
41. What rules are used to allocate water among competing demands?
41.1. What are the origins of regionally varying rule systems?
42. What are the foundational elements of Florida's water management system?
43. How do asymmetries in political/economic/military power affect water allocation?
44. What are the likelihoods of conflict vs cooperation in transboundary water management?
45. What strategies should water managers pursue to support water resource sustainability?
27. Amy J, 2024. After victory over Florida in water war, Georgia will let farmers drill new irrigation wells, AP News, December 18. <https://apnews.com/article/flint-river-georgia-florida-water-war-wells-8cb8ec3478491e1358a2720fc17d988f>
28. Flavelle C and Rojanasakul M, 2023. As groundwater dwindles, powerful players block change, *New York Times*, 24 November,
<https://www.nytimes.com/interactive/2023/11/24/climate/groundwater-levels.html>
29. Félix V, 2023. A controversial irrigation canal is a new symbol of hope for Haiti, *New Lines Magazine*, 27 November, <https://newlinesmag.com/spotlight/a-controversial-irrigation-canal-is-a-new-symbol-of-hope-for-haiti/>
30. Joles B, 2025. With Indus Waters Treaty in the balance, Pakistan braces for more water woes,
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National Public Radio, 8 July, <https://www.npr.org/2025/07/08/g-s1-73122/pakistan-india-indus-waters-treaty>

FINAL EXAM: 27 APRIL 3:00 PM (this date is set firmly by UF)

30 readings. Global coverage. Median publication year = 2021.



UF Academic Policies and Campus Resources (updated August 2025)
<https://syllabus.ufl.edu/syllabus-policy/uf-syllabus-policy-links/>