dual listed and co-taught course

CEE 6490
Integrated River Basins / Watershed Planning and Management

WatS 5330/6330
Management of Large Rivers

Class meetings: Tu/Th, 1:30-2:45p, ENGR 304

Instructors:

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Course Description

This class introduces students to the modern tools, strategies, and challenges involved in the management of large river basins. Typically, there are multiple objectives associated with river basin management, because there are many stakeholders with complementary and competing interests about how stream flow should be used for water supply, hydropower generation, flood damage reduction, recreation and human purposes and how much stream flow should be available to meet ecosystem needs. In some cases, different stakeholders are interested in different parts of the basin, and the same stream flow released from a single reservoir might need to meet different objectives in different places. In light of the long association between human societies and rivers, modern river management necessarily integrates natural science and engineering with political, historical, and social issues. In some situations, management decisions are based on objective engineering analysis, but in other cases, longstanding political and historical factors are the primary determinants of management decisions. Nevertheless, it is imperative to incorporate the best river science and river engineering into management decisions, regardless of whether these data are part of formal optimization analysis or only a component of an adaptive management program.

Students will develop and improve their scientific and engineering skills in topics such as planning approaches, water demand forecasting, water supply and storage alternatives, reservoir management and operations, river basin modeling, and multi-criteria decision analysis. Students will also learn about the organization and management of existing large river adaptive management programs and will learn how river science is currently used to inform decisions made by these programs. This course primarily focuses on the Colorado River but also considers examples from other river basins.

Students will apply their skills in a semester project where they select an existing river management rule, propose changes to the rule, and simulate the effect of those changes on important water management objectives such as water supply, river ecosystems, sediment transport, recreation, or hydropower generation.

The course includes a multi-day field trip to give students on-the-ground experience about the characteristics and operations of a large dam and downstream river. The course also includes meetings with many of the primary stakeholders who have management responsibility or conduct scientific research on the Colorado River system.

Organizing Theme

The organizing question of the course is: "***How does the existing system of institutions, compacts, operations, and rules constrain or enable management of the Colorado River for water supply, hydropower, riverine ecosystems, and other river values?*** Large river basins are palimpsest landscapes. In physical geography, a palimpsest landscape is one that is composed of landforms of different ages. In cultural geography, the landscape is sometimes viewed as containing evidence of previous cultures and land uses. In the context of large river management, the stakeholders in a watershed have different histories of connection with the river and have different values and priorities for how the river should be used. Modern, large river management not only requires application of best water resource engineering and river science practice, but also requires understanding and respect for the perspectives held by different river stakeholders. Engineering and scientific recommendations are provided within a political and historical context, and that context helps determine public policy outcomes. Our goal is to inspire students to develop techniques and skills in water resource engineering and river science, while also understanding the history and perspectives of different stakeholder groups. We will also provide students with our perspective of how to effectively contribute ideas and findings in engineering and natural science into the public policy arena.

Learning Objectives

Upon successfully completing this course, students will be able to:

a. Present quantitatively sound, politically sophisticated analyses of Colorado River management problems.
b. Describe similarities and differences between the Colorado River and other river systems.
c. Complete at least one iteration of a rational approach to planning.
d. Use Excel, river basin simulation, and other tools to quantitatively and programmatically analyze large river management problems.
    i. Identify how existing compacts, regulations, operations, and rules are represented in the RiverWare Colorado River Simulation System (CRSS) model
    ii. Use time series data to calculate reliability, resiliency, vulnerability, and sustainability criteria
    iii. Integrate data concerning historical inflows, water uses, consumptive use goals, and economic consequences to develop water management policy, and
    iv. Develop and quantitatively evaluate alternative management options in relation to various performance metrics.

e. Integrate multiple disciplines including engineering, economics, hydrology, law, social, and environmental considerations as part of river basin management activities.
f. Present work in a variety of formats required of practicing river basin managers, including short briefing reports, progress reports, webpages/sites, and technical presentations.
g. Provide constructive feedback to colleagues on ways to improve the technical content and presentation of their river management work.
h. Actively participate in your learning by selecting an existing Colorado River management rule, proposing changes to the rule, and simulating the effect of those changes on water and river management objectives

Texts

- Loucks et al. (2016). *Water Resources Systems Planning and Management: An Introduction to Methods, Models and Applications*. Springer [WRSPM, Available free online at https://link.springer.com/book/10.1007%2F978-3-319-44234-1]
- RiverWare User's Guides. Version 7.3. http://riverware.org/PDF/RiverWare/documentation/
- Additional required readings to be posted on the Canvas class schedule or distributed in class.

Approximate Grading

Individual Learning Opportunities (3)		30%
Field Trip Learning Opportunity (1)		10%
Group Project		50%
Progress report	10%	
Peer review	5%	
Final report	25%	
Final oral presentation	10%	
Class Participation		10%

CEE 6490 Class Schedule

See the course schedule at https://usu.instructure.com/courses/578978/pages/schedule-of-topics-and-assignments. This schedule will be updated as the course progresses.

Description of Required Course Work

Individual and Field Trip Learning Opportunities (ILOs)

Students will complete 3 individual and 1 field-trip learning opportunities (ILOs). Each ILO will pose a problem related to river basin planning and management, focus on engineering calculations, use of software, analysis, and political interpretation. ILOs will also represent several intermediary steps towards completion of the semester group project:

ILO-1. Where is Waldo? Find Law-of-The-River elements in CRSS (1-page)
ILO-2. Reliability, resiliency, vulnerability, and sustainability of releases from Powell and from Mead (2-pages)
ILO-3. River Basin and rule-based simulation for multiple objectives (3-pages)

ILO-4. Field Trip: Major observations and improvements to course project (1-page per question)

Turn in the answer to each ILO as a 1- (or 2- or 3-) page report/briefing paper. Each report should be fully self-contained to include an introduction to the problem, methods used, results, analyses, recommendations or conclusions so that a technically-versed reader not familiar with the problem statement can understand the rationale for and results of the work presented. The restriction to 1 or 2 or 3 pages is to encourage clear and succinct writing skills. References, figures, tables, and more detailed explanations can be included in appendixes which do not count towards the page limit. Students not satisfied with their performance on an ILO report may revise and resubmit it up to 1 week after we return the original submission.

Group Project

A large part of the course work will involve a semester-long group project. Groups of no more than 3 students will choose one or more existing Colorado River management operations or rules. Each group will gather background history and information related to the rules and identify stakeholders likely impacted by the rules or changes to rules. Groups will also propose one or more changes to the rules (alternatives). Groups will implement changes to rules in CRSS and use CRSS to simulate the effects of the proposed changes on water supply, river ecosystem, hydropower, recreation, and other objectives. Each group project will comprise the following components:

1. Topic: a paragraph describing the management problem and management rules that will be explored and the stakeholder(s) affected by the rules (not graded).
2. Progress report that summarizes:
    a. Management rules to be evaluated, the broader context for the management issue, stakeholders potentially affected, and stakeholder's objectives
    b. Available data
    c. Quantitative metric(s) to be used to evaluate the extent to which management alternative meets the stakeholder's objective(s)
    d. Proposed changes to existing rules and what those changes represent operationally and/or physically, and
    e. Major findings to date and future steps (for the remainder of the semester)
3. Peer review: provide feedback to another group on their progress report. Identify what has been done well and ways they can improve their work and the write-up of their work
4. Final report: Submitted as an online HydroShare resource to allow sharing with others. The final report will synthesize all project work for the semester. The project work will continue and expand based on feedback obtained from the progress report. The group project will focus on describing the rules evaluated, model results, tradeoffs among quantitative metrics and stakeholder objectives, management recommendations, and major findings. Online submission must also include electronic copies of model input data, modeling files, results, and directions to use so that the reader can reproduce the results present (see Rosenberg et al (2019) for further instructions to make results more reproducible). See the bottom of the main Canvas page for examples of student projects for prior CEE 6490 classes.

5. Final oral presentation: Overviews work done for the semester and highlights select, key results and findings.

Field trip

We will travel to the Glen Canyon Dam/Lees Ferry area. This field trip will involve camping. Because there is no course fee, you will be expected to share in the cost of rental vehicles, gas, and food needed for this trip. Students will need to bring a sleeping bag, camping pad, warm clothing, and footwear suitable for walking. All of this equipment can be rented from the USU Outdoor Program (https://www.usu.edu/campusrec/outdoor_programs/op_rentals). Students will present their project work to date with stakeholders and complete ILO-4 to describe key points they learned on the trip and improvements they will make to their group project. Students not attending the trip will complete an alternative assignment.

Class Participation

We expect everyone to read assigned readings ahead of time and come to class and share their impressions of the reading(s) or ask questions on points they do not understand. At times, we will discuss readings in a seminar format. During lectures or discussions, we pose many questions to the class and will, if needed, call on you individually to ensure everyone participates.

Grading of and Expectations for Submitted Work

Grading will be weighted for course work roughly as listed on page 3.

90 to 100% -- at least some sort of A
80 to 90% -- at least some sort of B
70 to 80% -- at least some sort of C
< 70% -- most probably some sort of F

Students registered in WATS 5330 may drop their lowest score among ILOs 1-3.

There is no curve. All submitted work that meets or exceeds standards listed in the grading rubrics will earn an "A".

We will grade all submitted work for technical correctness, organization, presentation, and other criteria according to the Grading Rubric available on the class website for the course work item. We will ask to meet with students who submit low quality work to discuss improvement strategies.

Submitted work must be:

- Original, typed with 1" margins, use a standard 12-point font, printed, and stapled (ILOs).
- Have a title page with title, student name(s), date, email address(es), class, and instructor.

- Submitted via Canvas by the **beginning** of class on the due date listed on Canvas.
- Turned in with the self-assessment portion of the Grading Rubric completed.
- Include a Group (and self) Rating Form completed (for group work items).
- For group work, only one paper and Canvas copy need be submitted.
- **We do not accept late assignments.** They will **earn a zero**. In extenuating circumstances (birth/death in the immediate family; grave illness with doctor's note), contact the instructor for your section **prior** to the due date and make alternative arrangements to submit.

Academic Integrity: We expect each student to uphold academic integrity. See https://studentconduct.usu.edu/studentcode/article6. For example, USU, the CEE and WATS departments, and we take plagiarism seriously and we will prosecute offending parties to the full extent of the USU Code. Acknowledge sources, cite references, and quote.

Course Modeling Software

The course will use the Bureau of Reclamation's RiverWare software and CRSS (Colorado River Simulation Software) model data set. CRSS is the model used by the Bureau of Reclamation for their Colorado River studies. You are expected to install and use the software and model on your computer (we will provide directions once we obtain student licenses from the Center for Advanced Decision Support for Water and Environmental Systems [CADSWES] that supports RiverWare).

RiverWare is a big software program and the CRSS model is complicated. ***This is the real deal!!*** Course activities will focus on using a select few software features; we do not expect you to learn every feature. This is the second year we are using CRSS for this class. Expect hiccups and complications. When in doubt, consult the RiverWare help guide, ask other students, ask the instructors, be patient, and plan ahead.

Electronic Policies

1. Canvas: We will post all class materials to Canvas including readings, lecture handouts, and descriptions of and grading rubrics for all course work. Submit electronic copies of all work and self evaluations to Canvas (to archive).
2. Email: **Include "CEE 6490" or "WATS 6330" or WATS 5330" in the subject line** of all email so that we can timely respond to emails. Unless you request otherwise, we may respond to the entire class.

Expectations of Students

- Be on-time to class and ready to learn / participate when class starts.
- Read assigned readings ahead of time and come to class prepared to share your impression(s) of the reading(s) and/or ask questions on points you do not understand.
- Turn off or keep silent all electronic devices that may distract us or other students.
- Contribute to class discussions, respect, and listen to other's points of view.
- Turn in all work on time in the required format.
- Bring questions and concerns forward during class, office hours, or by email.

- Put in approximately 2 – 5 hours outside of class for each 1 hour of in-class time.

Expectations of the Instructors

- Start class on time.
- Respect the value of student's time.
- Call equally on all students for class participation.
- Learn student names by some point through the semester.
- Facilitate an environment of inclusivity and non-discrimination.
- Respond to email within 30 hours when we are not traveling out of town.
- Return graded work within 1 week from when work is submitted.
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Disability/Special Accommodations

Please talk to us immediately if you require disability or other special accommodations.

Additional Resources for Students

- Canvas page: https://usu.instructure.com/courses/531043
- Past CEE 6490 group projects: https://usu.instructure.com/courses/531043
- Rosenberg's web page: http://rosenberg.usu.edu.

Please direct further questions or concerns about the syllabus or the course to the Instructors by email, in person, or phone