dual listed and co-taught course

CEE 6490
Integrated River Basins / Watershed Planning and Management

WatS 5330/6330
Management of Large Rivers

Instructors:

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Class meetings: Tu, Th (1:30-2:45p)

Spring Term 2018

Course description and objectives:

This class introduces students to the modern tools, strategies, and challenges involved in the management of large rivers where there are multiple goals, many stakeholders, inter-connected challenges, political, historical, and social considerations, as well as complicated solutions. The course primarily focuses on the Colorado River but will include examples from other rivers in the world. Students will develop scientific and engineering skills including planning approaches, water demand forecasting, water supply and storage alternatives, reservoir management and operations, river basin modeling, and multi-criteria decision analysis. Students will apply skills in a semester project where they define a management problem on the Colorado River, identify, and evaluate management options to improve environmental and ecosystem objectives while also meeting existing water supply and hydroelectric generation uses. The course includes a multi-day field trip to the Colorado River to give students hands-on experience with planning and management issues introduced in the course. The course also includes meetings with many of the primary stakeholders who have management responsibility or provide advice to river management programs of the Colorado River system.

Organizing Theme:

The central management question facing the modern Colorado River is: "***How can native aquatic and riparian ecosystems be maintained and rehabilitated in this large, over-allocated river despite the anticipated reduction in total annual stream flow and increase in human uses?"***

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, because these best practices are but one input to public policy decisions. Best practices are needed, but engineering and scientific recommendations are provided within a context, and that context helps determine public policy outcomes. Thus, our goal is to inspire students to learn techniques and skills in water resource engineering and river science, while also understanding the history and perspectives of the 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.

Required field trip:

The destination of his year's field trip is under discussion and will be determined before the beginning of the semester. We are considering a field trip to either the Glen Canyon Dam/Lees Ferry area to a trip to consider management of the Green River downstream from Flaming Gorge Dam. The field trip is tentatively scheduled to occur between April 13 and 15. This field trip will involve camping and your participation is required. Because there is no course fee, you will be asked to share in the cost of vehicles, gas, and food needed for this trip.

Preliminary Course Schedule and Outline

Week of January 8
[Ja 9] River basin planning in the past and today; overview of the Colorado River and issues concerning its management (*reading:* Schmidt, 2007*)*
[Ja 11] Water planning approaches

Week of January 15
[Ja 16] History of the Imperial Valley and creation of the Salton Sea (*reading:* deBuys 71-82, 85-121; Worster 194-212)
[Ja 18] Construction of Hoover and Glen Canyon Dams *(reading:* Stevens 3-46; Martin 7-19, 75-102) ; the Echo Park Dam controversy and the Colorado River Storage Project *(reading:* Harvey 23-49, 77-106, 181-205)

Week of January 22
[Ja 23] Irrigania Game; user competition, game theory,
[Ja 25] Water uses and demand forecasting

Week of January 29
[Ja 30] The Colorado Basin Planning Act, the Marble Canyon Dam proposal, and the Central Arizona Project *(reading:* Pearson 35-83)
[F 1] Modern allocation of the Colorado River (*reading:* MacDonnell et al, 1995)

Week of February 5
[F 6] Reliability, resiliency, vulnerability, and sustainability indicators; strategies for meeting stakeholder objectives
[F 8] Describing and quantifying stakeholder needs; Interactive multi-objective visualization

Week of February 12
[F 13] Single-purpose reservoir operations
[F 15] Physical changes caused by dams and diversions

Week of February 19
[F 22] Changes in aquatic and riparian ecosystems caused by dams (*readings:* Nilsson and Berggren, 2000; Vinson, 2001; Nilsson et al, 2005; Gloss et al., 2005, 69-101; Kennedy et al, 2016; Poff and Schmidt, 2016)

Week of February 26
[F27] River basin simulation (WEAP)
[Mar 1] River basin simulation software lab

Week of March 5 [Late Winter Break]

Week of March 12
[Mar 13] Application of the Endangered Species Act to the Colorado River system: the Upper Colorado River Endangered Fish Recovery Program, (*readings:* Brower et al., 2001)
[Mar 15] Glen Canyon Dam Adaptive Management Program, (Feller, 2008; Suskind et al, 2012)

Week of March 19
[Mar 20] Operating the Colorado River Storage Project for hydropower production ***(guest: Clayton Palmer, Environmental Specialist, CRSP Management Center, Western Area Power Administration)*** (*readings:* Gloss et al., 2005, 165-176)
[Mar 22] Managing sediment in Grand Canyon and the role of controlled floods (*readings:* Grams et al., 2007; Schmidt and Wilcock, 2008 (Intro/discussion/conclusions; Melis, 2011, 17-91) (*readings:* Rubin et al., 2002; Wright et al., 2008; Grams et al., 2015; *optional: Schmidt et al., 1999; Sankey et al., 2015*)

Week of March 26
[Mar 27] Operating Glen Canyon Dam: meeting multiple and competing objectives ***(guest: Katrina Grantz, Chief, Adaptive Management Group, Bureau of Reclamation)***
(readings: Gloss et al., 2005, 1-15., 207-220; Melis, 2011, 1-15*)*
[Mar 29] Reservoirs, water supply, and climate change (*readings:* Barnett and Pierce, 2008, 2009; Rajagopalan et al, 2009; Udall and Overpeck, 2017; *optional: Reclamation, 2007a, b)* (*readings: optional: Reclamation, 2016, Chapter 1 – skim, Chapter 2 – skim, Chapter 3; Ayers et al., 2016; Milly and Dunne, 2016*)

Week of April 2
[Ap 3] Structural & non-structural approaches for water supply
[Ap 5] Reservoir systems

Week of April 9
[Ap 10] Dam Removal

Field Trip – Flaming Gorge Dam and Environmental Resources of the Green River (April 13-15)

Week of April 16
[Ap 19] Planning for resiliency

Week of April 23
[Ap 24] The Colorado River's future – California's perspective ***(guest: Christopher Harris, Executive Director, Colorado River Board of California)*** (*readings:* Glenn et al., 2013; Flessa et al., 2013*; optional: Mueller et al, 2016*)
[Ap 26] Robust decision making and deep uncertainty