

UAPP 611-010: Regional Watershed Management

Syllabus for Spring Semester 2008

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Spring 2008
 Wed 2:00 – 4:45 pm
 Graham Hall
 Room 176

Texts & Resources

Cech, Thomas V., *Principles of Water Resources, History, Development, Management, and Policy*.
 John Wiley and Sons, Inc. 2005.

For supplementary resources, visit the library of the Water Resources Agency at the DGS Annex on Academy Street.

Important related web sites:

www.wr.udel.edu	University of Delaware Water Resources Agency
www.udel.edu/dgs/	Delaware Geological Survey
www.udel.edu/chep/	College of Human Services, Education, and Public Policy
www.dnrec.state.de.us	DE Dept. of Natural Resources and Environmental Control
www.drbc.net	Delaware River Basin Commission
www.epa.gov	U.S. Environmental Protection Agency
www.usgs.gov	U.S. Geological Survey
www.nationalatlas.gov	U.S. Geological Survey GIS Mapping Site
www.udel.edu/leathers/stclim.html	Department of Geography, Center for Climatic Research
www.udel.edu/nsdi	University of Delaware National Spatial Data Inventory

Catalog Description

This course is designed to review the practical application of watershed planning as a tool to manage land, water, and ecosystem resources. Students will explore the public policies and practices of watershed planning by examining case studies in water supply, water quality, drought, floodplain, and stormwater management in the State of Delaware and the mid-Atlantic region. The watershed management curriculum will utilize a multi-disciplinary approach involving the fields of geography, environmental science, geology, public policy, urban and regional land planning, geographic information systems (GIS) and engineering. 3 credits.

Course Objectives

This course will enable students to:

1. Define goals and objectives to address water resources problems.
2. Understand Federal, State, regional, and local policies as they apply to watershed management.
3. Delineate a watershed utilizing GIS mapping techniques.
4. Develop and implement a watershed management plan.
5. Examine the various institutional, governance, legal, and financial frameworks needed for successful implementation of a watershed management plan.

Grading

Final grades will be based on the following criteria:

Participation/quizzes Mid-term exam Final exam Mid-term project Final Term paper

Learning is enhanced when students can cooperate, rather than compete, with each other. Therefore, grading will not be on a curve. If every student does excellent work, everyone will earn a high grade in this class. Quizzes may be given. No make-up exams will be scheduled except due to hardship with the consent of the instructor. No project will be accepted for grading after its due date.

Class Schedule

Wed Feb 13, 2008 - Introduction to Watershed Management. What is a watershed? Defining watershed goals, objectives, problems, and stakeholders

I. Introductions

- * Hand out student information sheets.
- * Identify home on watershed maps.

II. Review of Syllabus

- * Texts/Resources * Course Objectives
- * Grading * Class Schedule
- * Class Format * Project Assignments

III. Introduction to Watershed Management

- * What is a watershed? * History of watershed management
- * Watershed problems (water supply/quality/flooding, etc.)
- * Goals/Objectives * Stakeholders (governments/environmentalists/businesses)

Break

IV. Watersheds: Connecting Weather to the Environment, University Corporation for Atmospheric Research

V. Policy and Media Perspective/Discussion – Chattahoochee River (AL, FL, GA)

- * Discuss the Federal dispute process.
- * Form a committee, students assume roles.
- * Problem: Georgia Governor wants to conserve water in Lake Lanier. AL and FL desire releases for oyster fishery. Establish goals/objectives to address problem. Recommend governance solution.

VI. Homework (Dworsky)

- * Reimold, R. J., 1998. *Watershed Management Practices, Policies, and Coordination*. Chapter 1. pages 1 - 9 and Chapter 3 pages 35 - 53.
- * Center for Watershed Protection, 2001. *Rapid Watershed Planning Handbook*. Chapter 1. Basic Concepts of Watershed Protection. pages 1.1 - 1.33.

* US Environmental Protection Agency. *Top 10 Watershed Lessons Learned*.
<http://www.epa.gov/owow/lessons>.

VII. Class Dismissed

Wed Feb 20 - Compiling a GIS watershed inventory: geology, soils, topography, land use, zoning, political boundaries, point and nonpoint source pollutants

I. Class Business

* Quiz * Syllabus Feedback * Watershed Team Selection * Current Events Discussion

II. GIS Watershed Inventory Laboratory/Technical Exercise/Discussion

* Delineate a watershed by hand using contour map

* Aerial photo interpretation of land use/soils mapping

* How to build a watershed using ARCVIEW (Christina Basin)

* State boundaries, municipalities

* Hydrology/watersheds

III. Top 10 Watershed Lessons Learned

Break

IV. GIS Watershed mapping using GOOGLE EARTH

V. Video – *Stormy Weather: Clean Water Begins and Ends with You*, Philadelphia Water Department

VI. Homework

* Develop map of a country, state or province where the political and watershed boundaries coincide.

* National Academy of Sciences. *New Strategies for America's Watersheds*. 1999. Chapter 1. Why Watersheds. pages 13 - 36. Chapter 2. Spatial and Temporal Scales for Watersheds. pages 37 - 55. <http://bob.nap.edu/books/0309064171/html/>

* Smith, W. J., December 2002. *The Clearinghouse Approach to Enhancing Informed Public Participation in Watershed Management Utilizing GIS and Internet Technology*. *Water International*. Volume 27. Numbers 4. pages 558-567.

* Cech, T.V., 2005. *Principles of Water Resources, History, Development, Management, and Policy*. Chapter 3. pages 55 - 81.

VII. Class Dismissed

Wed Feb 27 - Watershed delineation using ARCVIEW GIS

I. Class Business

* Quiz * Review watershed/political boundary homework * Discuss Mid-term Class Project No. 1

II. Watershed GIS Laboratory

* GIS Delineation of Watershed – Jenny's Run watershed.

* GIS as a Watershed Tool

Break

III. GIS and Powerpoint Basics for Watershed Management

IV. Homework (Dworsky)

* Ward, R., February 2003. *Walking the Fine Line Between Water Science and Policy*. *Colorado Water. Newsletter of the Water Center at Colorado State University*. pages 3-4. .

* Goldfarb, W., April 1997. *Teaching Water Resources Policy to University Science and Engineering Students: Opportunities and Challenges*. *Journal of the American Water Resources Association*. Volume 33. No. 2. pages 255 -259.

* Cech, T.V. *Principles of Water Resources, History, Development, Management, and Policy*, 2005.

Chapter 9. Federal Water Agencies. pages 247-284 and Chapter 10. Local, Regional, State, and Multistate Water Management Agencies. pages 285-319.

V. Class Dismissed

Wed Mar 5 - Federal and state watershed policies, programs, and regulations. Local, municipal, and county watershed programs and ordinances

I. Class Business

* Quiz * Finalize Field Recon. Schedule * Finalize Class Roster/Background Sheets

* Review of Watershed Project No.1 Teams * Watershed Current Events Discussion

II. The Federal, State, Local Political Structure/Watershed Civics

III. Federal Watershed Regulations and Programs

* Safe Drinking Water Act * Clean Water Act (Section 404/305b, TMDL)

* Delaware Estuary Program * Wild and Scenic Program

Break

IV. State Watershed Regulations and Programs

* DE Whole Basin * Section 319

* Inland Bays * DE Stormwater and Sediment Control Regulations

V. Local Watershed Regulations and Programs

* Water Resource Protection Area Ordinance

* Naamans/Shellpot Creek * New Castle County Unified Development Code

VI. Assigned Reading

* Reimold, R.J., 1998. *Watershed Management, Practices, Policies, Coordination*. Chapter 4. Developing a Watershed Management Plan.

* *Seventh Report to the Governor and General Assembly Regarding the Progress of the Delaware Water Supply Coordinating Council*, 2006. www.wr.udel.edu.

* Cech, T.V., 2005. *Principles of Water Resources, History, Development, Management, and Policy*. Chapter 5. Water Quality. pages 112 – 145.

* U.S. Environmental Protection Agency, Office of Water, February 1996. *Why Watersheds?* EPA 800-F-96-001.

* Purdue University. Local Government Assistance Network. *Land Use Impacts on Water Quality*. www.ecn.purdue.edu/runoff/lthianew.

VII Class dismissed

Wed Mar 12 - Water supply, water quality, and drought management issues and problems. Floodplain, stormwater, habitat, land use, and riparian corridor issues and problems

I. Class Business

* Quiz * Review of March, 2008 Field Reconnaissance 1:30 - 5:00 pm Christina Basin by van

II. Water Quality Issues and Alternatives

* Floodplain, Stormwater, Habitat, Land Use, Riparian Issues

* Point and Nonpoint Source BMP Solutions, Structural and Nonstructural

* Water Quality Models

III. Water Supply Issues and Alternatives

* Water Supply, Water Quality, Drought Issues

* Storage, Groundwater, Pipeline, Technology Alternatives

Break

IV. Spatial and Temporal Scales of Watersheds.

V. Watershed Debate

* Global warming

* Watershed teams debate pro and con.

VI. Homework

* Schueler, T. R., Holland, H. K. Center for Watershed Protection. *The Practices of Watershed Protection*. Article 27. The Tools of Watershed Protection. pages 133 - 144.

* Kauffman, G. J., Wozniak, S. L., and Vonck, K. J. June 2003. *A Watershed Restoration Action Strategy (WRAS) for the Delaware Portion of the Christina Basin*. pages 1 - 77.

* Prepare One Page Watershed Plan (Title, Mission Statement, Problems Statement, Goals/Objectives)

VII. Class dismissed

Wed Mar 19 - Development of a draft watershed management plan

I. Introduction

* Quiz * Review of Christina Basin Field Trip * Review for mid term exam

* Review of watershed (computer vs. student) digitizing exercise

II. Development of a Watershed Management Plan

* Title * Mission Statement

* Problems/Issues * Goals/Objectives

* Regulations/Ordinances * GIS Watershed Inventory

* Alternatives Analysis * Conclusions/Recommendations

V. Break

III. Watershed Planning Processes

IV. Video – After the Storm, The Weather Channel and USEPA

V. Homework Assignment

* Watershed teams continue Project No. 1 for presentation

* Schueler, T. R., Holland, H. K. Center for Watershed Protection. *The Practices of Watershed Protection*. Article 1. The Importance of Imperviousness. pages 7 - 17.

* Kauffman, G. J., 2002. *What if... the United States of America Were based on Watersheds?* *Water Policy Journal*. pages 57 - 68. Issue 4..

VI. Class dismissed

Wed Mar 26 - Field Reconnaissance to Watershed Projects in the Christina River Basin

Field Trip to Christina River Basin, An Urban and Rural Watershed Reconnaissance

I. Van leaves from front of UDWRA, DGS Annex 1:30

II. Wilmington Riverfront, Barclays Bank Green roof, Woodlawn Library porous paving.

III. Hoopes Reservoir

IV. Woodlawn Trustees/Brandywine Creek State Park

V. Wyeth Property Stream Restoration

VI. Pike Creek Stream Restoration Project

VII. Back to UDWRA 5:00

Reminder to continue work for in class presentations.

Wed Apr 2 – Spring Break

Wed Apr 9 -**Mid Term Project Due - Verbal presentation to class. Mid-term examination**

I. Each watershed team delivers watershed management plan presentation to class (45 minutes each).

II. mid-term exam due 2:00 pm Apr 16, 2008.

III. Homework

* Read Schueler, T. R., Holland, H. K. Center for Watershed Protection. *The Practices of Watershed Protection*. Article 128. Choosing the Right Watershed Management Structure. pages 639 - 645.

Article 30. The Economics of Watershed Protection. pages 171-181.

Wed Apr 16 - **Watershed governance and institutional issues. Watershed funding strategies.**

I. Class Business

* Quiz * Self appraisal on watershed presentations * Mid-term exam due

II. Watershed Governance and Institutional Options

* Government Agencies * Councils/Committees

* Water Districts * Nonprofit Watershed Organizations and Associations

III. Watershed Funding Strategies (Kauffman)

*Federal/State Grants and Loans * Polluter Pays

* Capital Programs * Fees/Taxes/Utilities

Break

IV. Think, Pair, and Share Activity Governance/Funding

* Break up into paired groups

* Devise a governance and funding strategy

* Select a watershed

* Share with class using one page of notes

V. Homework (Kauffman)

* Dzurik, A. A. and Theriaque, D. A., 1996. *Water Resources Planning*. Chapter 3 Water Law. pages 27 - 43 and Chapter 7. Economic Analysis. pages 121 - 151.

* Cech, T.V., 2005. *Principles of Water Resources, History, Development, Management, and Policy*. Chapter 8. Water Allocation Law. pages 211 – 241 and Chapter 13. The Economics of Water. pages 381 – 392.

* Kauffman, G.J., 2006. *Perspectives on Ethics and Water Policy in Delaware*. Journal of Philosophical Research. Special issue: Ethics and the Life Sciences. Pages 93-126..

* Harris, H. J., and Scheberle, D. *Ode to the Miners' Canary: The Search for Environmental Indicators*. pages 177 - 200.

* Delaware River Basin Commission, Cornell University, Pennsylvania State University, Rutgers University, University of Delaware, Partnership for the Delaware Estuary, Draft March 2008. DRBC State of the Basin Report.

VI. Class dismissed

Wed Apr 23 - **Water Law, Watershed Economic Analysis. Use of Environmental indicators.**

I. Class Business

* Quiz * Upcoming Field Trip

II. Water Law and Ethics

* Environmental Ethics

- * Eastern Riparian Rights
 - * Western Prior Appropriation
 - III. Watershed Economic Analysis
 - * Supply and Demand
 - * Discounting
 - * Benefit/Cost Analysis
 - Break
 - IV. Watershed and Environmental Performance Indicators
 - * Impervious Cover
 - * Water Quality
 - * Report Cards
 - * Habitat
 - V. Homework (Dworsky)
 - * Develop one page environmental indicators for selected watershed
 - VI. Class dismissed
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Wed Apr 30 - Case Studies in Interstate and Statewide Watershed Management

- I. Class Business
 - * Quiz * Midterm Exam Appraisals * Review of Environmental Indicator Homework
 - II. Case Studies in Interstate Watershed Management
 - * Delaware River Basin
 - * Susquehanna River Basin (Kauffman)
 - Break
 - III Case Studies in State-wide Watershed Management
 - * Murderkill River Tributary Action Team (Joseph Farrell, University of Delaware Sea Grant)
 - * Delaware Watershed Assessment Branch (Kathy Bunting Howarth, Delaware DNREC)
 - IV. Homework
 - * View Movie, *Inconvenient Truth*, 2006
 - IV. Class Dismissed
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Wed May 7 - Field Reconnaissance to American Museum of Natural History Water Exhibit, New York City

- Homework
 - * Read Schueler, T. R., Holland, H. K. Center for Watershed Protection. *The Practices of Watershed Protection*. Article 127 On Watershed Education. pages 629 -635.
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Wed May 14 - Case studies in local watershed management.

- I. Class Business
 - * Quiz * Term paper requirements
- II. Watershed Education
- III. Nonprofit Local Watershed Management
 - * Brandywine Valley Association
 - * Chesapeake Bay Program
- IV. Local Watershed TMDLs
 - * Appoquinimink River Watershed

* Inland Bays Watershed

V. Homework

* Cech, T.V. *Principles of Water Resources, History, Development, Management, and Policy*. Chapter 15. Emerging Water Issues. pages 414 – 430. 2005.

VI. Class Dismissed

Wed May 21 - Last day of class. Review of semester, final exam, and term paper requirements.

Term Paper Due 2:00 pm

Field Recon of Brandywine Creek by kayak

Wed May 28 - Final Exam In Class.

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Class Format

Learning about watersheds is an active process where students participate in class discussions and hands-on exercises. We will be meeting in a classroom with projection equipment. We will be utilizing this equipment for course presentations and demonstration of computer GIS methods. Some of the course involves field trips and discussions of case studies to explore actual applications of watershed management. You are highly encouraged to ask questions regarding any topic on watershed management. Class participation and attendance for the quizzes is strongly recommended as it counts for 20% of your grade. The course work will be rigorous but completion of the course will properly prepare you for a possible career in watershed management. The recommended class size is 18 students.

Project Assignments

Everyone will be assigned to watershed project teams of 3-4 students this semester. These groups will function independently during class and outside of class.

Mid Term Project - Development of a Watershed Plan

DUE: Apr 9, 2008

Each group will prepare a draft, preliminary watershed plan for a real or hypothetical watershed. For Project #1, each team will prepare a one-page summary sheet suitable for duplication as a class handout. All written work for the projects must be word-processed (typed, spell-checked, etc. Each team is responsible for a 30 -minute presentation of one project to the class. Students will delineate the watershed on maps using ArcView GIS. Each group will define the problem, i.e. water quality, flooding, etc., and the goals and objectives for addressing the problem. The group will characterize the watershed and provide recommended actions such as best management practices to address the defined problem. The report should be no longer than 10 pages single-spaced with tables and graphs and include at least 2 GIS watershed maps.

Final Term Paper - The Origins of Watershed Management

DUE: May 21, 2008

Students will prepare a 15 - page, double-spaced, term paper researching the origins of watershed management. The paper should be in two parts. The first part should focus on the history and evolution of watershed management. The second part should present a specific watershed demonstrating an application of approaches that you have learned in class. The focus may be on tenets and trends in watershed management in the United States or internationally. The watershed that you choose may be sub-state, state, interstate, or regional.