

HUAZHONG AGRICULTURAL UNIVERSITY
ECOLOGY AND LAND USE PLANNING

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July 24-28, 2017
<http://todd.bendor.org/wuhan2017>

Course Description

Ecology and Land Use Planning focuses on understanding the functions of ecosystems, the land development activities that impact such functions, and the land use management tools that can be used to create strategies for mitigating and restoring environmental damage. While urban land use change and environmental planning have many implications for ecological systems, water is increasingly becoming a key link between ecological health and quality and urban development. This course is essentially an introduction to watershed planning, where we examine the functions of, threats to, and strategies for protecting watersheds and wetlands.

The impacts of urbanization on watershed health can be dramatic and potentially harmful to human interests, and include flooding and declining water quality. As development continues and low-density urban growth converts open space into impervious surfaces, it is imperative that decision makers, planners and citizens assess, monitor, and mitigate these effects. A key theme throughout the course will be to explore how the scientific knowledge of ecological relationships can be integrated into an environmental planning framework. The fundamental goal is to assure natural ecosystem integrity is sustained over the long-term, while accommodating human use and occupancy within natural ecological limits.

Course Objectives

- 1) Apply watershed assessment techniques to evaluate existing conditions and estimate the impacts of future development;
- 2) Evaluate how urban development impacts urban ecosystem functions;
- 3) Identify the important role of watershed planning and undertake specific tasks in preparing watershed plans;
- 4) Create environmental plans for mitigating the impacts of land development while protecting and restoring urban ecosystems; and
- 5) Formulate watershed management policies and actions that protect the natural system functions of watersheds, while mitigating the impacts of future development on watershed health.

Course Schedule

July 24, 08:00-10:45: *Course Overview and Introduction to Environmental Planning*

July 24, 11-12:15, 14:30-15:45: *Physical Attributes of Watersheds*

July 24, 16:00-17:15: *Impervious Cover*

July 25, 08:00-09:15: *Urban Green Infrastructure and Best Management Practices*

July 25, 09:30-10:45: *Land Suitability Analysis*

July 25, 11:00-12:15: *Habitat impacts and assessments*

July 25, 14:30-15:45: *Visioning and scenario building; formulating a policy framework*

July 25, 16:00-17:15: *Plan Implementation Tools*

July 26, 08:00-09:15: *Identification of Wetlands and Impacts of Urbanization*

July 26, 09:30-10:45: *Wetland Classification*

July 26, 11:00-12:15, 14:30-15:45: *Assessment of Wetland Functions*

July 26, 16:00-17:15: *Application of Water Quantity and Quality Models to Land Use Planning*

July 27, 08:00-9:15: *Sub-watershed and Stream Evaluation*

July 27, 09:30-10:45: *Riparian Zones and Urbanization*

July 27, 11:00-12:15: *Watershed Impact Mitigation and Restoration Measures*

July 27, 14:30-4:00, 4:15-5:45: *Seminars*

July 28, 08:00-9:15, 09:30-10:45, 11:00-12:15: *Aquatic Ecosystem Mitigation Policy*

July 28, 14:30-15:45, 16:00-15:30: *Course Assessment, Seminar*

Readings:

July 24, 08:00-10:45: *Course Overview and Introduction to Environmental Planning*

- USEPA. 1996. Why Watersheds? (EPA800-F-96-001). US Environmental Protection Agency: Washington, D.C.
- Robert B. Jackson, Stephen R. Carpenter, Clifford N. Dahm, Diane M. McKnight, Robert J. Naiman, Sandra L. Postel, and Steven W. Running. 2001. Water in a Changing World. Issues in Ecology, Issue 9. Ecological Society of America: Washington, D.C. [Online]: <http://cfpub.epa.gov/watertrain/pdf/issue9.pdf>
- Tom Daniels and Katherine Daniels. 2003. "Ch. 1: Taking Stock of the Local Environment and Creating an Environmental Action Plan," in *The Environmental Planning Handbook for Sustainable Communities and Regions*. APA Planners Press: Chicago: pp. 11-36.
- Costanza, Robert, et al. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387 (6630): 253-260.
- Tetra Tech, Inc. 2004. Morgan Creek Local Watershed Plan: Targeting of Management Report. North Carolina Ecosystem Enhancement Program: Raleigh, NC
- USEPA. 2017. Catalog of Federal Funding Sources for Watershed Protection. US Environmental Protection Agency: Washington, D.C. [Online]: <https://ofmpub.epa.gov/apex/watershedfunding/f?p=fedfund:1>

July 24, 11-12:15, 14:30-15:45: *Physical Attributes of Watersheds*

- Riley, Ann L., 1998, "Ch. 1: The Basics," in *Restoring Streams in Cities: A Guide for Planners, Policymakers, and Citizens*, Washington, D.C.: Island Press, pp. 1-13, 27-33.
- Christopher J. Walsh, Allison H. Roy, Jack W. Feminella, Peter D. Cottingham, And Peter M. Groffman. 2005. The Urban Stream Syndrome: Current Knowledge and the Search for a Cure. *Journal of the North American Benthological Society* 24(3): 706–723
- Christopher A. Frissell, William J. Liss, Charles E. Warren, and Michael D. Hurley. 1986. A Hierarchical Framework for Stream Habitat Classification: Viewing Streams in a Watershed Context. *Environmental Management* 10(2): 199-214
- William Marsh. 1991. Chapter 4: Topography, Slopes and Land Use Planning, Chapter 9: Watersheds, Drainage Nets, and Land Use, in *Landscape Planning: Environmental Applications*, John Wiley and Sons: New York. pp. 54-59, 132-135.
- Michael J. Paul and Judy L. Meyer. 2001. Streams in the Urban Landscape. *Annual Review of Ecological Systems* 32: 333–65
- Overview of chemical and geomorphic characteristics of urban streams

Recommended:

- Karen Capiella and Lisa Fraley-McNeal. 2007. The Importance of Protecting Vulnerable Streams and Wetlands at the Local Level. Center for Watershed Protection and US Environmental Protection Agency: Ellicott City, MD and Washington, D.C.
- Great information source on headwater streams and definitions of intermittent streams
- Natural Resources Conservation Service. 2007. National Engineering Handbook: Part 630 Hydrology. Hydrologic Soil Groups (Chapter 7) (10–VI–NEH). USDA: Washington, D.C.

July 24, 16:00-17:15: *Impervious Cover*

Thomas Schueler. 2003. Chapter 2: Hydrologic Impacts of Increased Impervious Cover. In: Impacts of Impervious Cover on Aquatic Systems: Watershed Protection Research Monograph No. 1. Center for Watershed Protection: Ellicott City, MD.

- An authoritative volume on urban hydrology
- Focus on Chapter 2.

Chester Arnold and C. James Gibbons. 1996. Impervious Surface Coverage: The Emergence of a Key Indicator. *Journal of the American Planning Association* 62: 243-258.

- Lends a historical perspective to the emergence of impervious surface as a driver of environmentally-related planning thought

Ryznar, Rhonda and Philip R. Berke. 2001. "Testing the Applicability of Impervious Surface Estimates Based on Zoning Categories in Watersheds," UNC Department of City and Regional Planning: Chapel Hill.

Recommended:

Carol R. Jacobson. 2011. Identification and quantification of the hydrological impacts of imperviousness in urban catchments: A review. *Journal of Environmental Management* 92: 1438-1448.

Linda R. Exum, Sandra L. Bird, James Harrison, and Christine A. Perkins. 2005. Estimating and Projecting Impervious Cover in the Southeastern United States (EPA/600/R-05/061).

- Skim, lots of interesting information.

Mary Battiata. 2005. Silent Streams. *Washington Post*: Sunday, November 27, 2005. [Online]: <http://www.washingtonpost.com/wp-dyn/content/article/2005/11/22/AR2005112202165.html>

- Washington Post magazine article describing how impervious cover associated with sprawl is threatening streams nationwide)

David N. Lerner and Bob Harris. 2009. The relationship between land use and groundwater resources and quality. *Land Use Policy* 26S: S265–S273

July 25, 08:00-09:15: *Urban Green Infrastructure and Best Management Practices*

Michael E. Dietz. 2007. Low Impact Development Practices: A Review of Current Research and Recommendations for Future Directions. *Water Air and Soil Pollution* 186:351–363

Stacey Berahzer. 2015. Crosswalking between Gray and Green Infrastructure – Considerations for Budget Officers. Center for Watershed Protection: Baltimore, MD

Girling, C. and R. Kellert. 2002. Comparing Stormwater Impacts and Costs on Three Neighborhood Plan Types. *Landscape Journal*, 21: 100-109.

Line, D. E., Brown, R. A., Hunt, W. F., & Lord, W. G. 2011. Effectiveness of LID for commercial development in North Carolina. *Journal of Environmental Engineering* 138(6), 680-688.

Thomas E. Low. 2010. *Light Imprint Handbook: Integrating Sustainability and Community Design*. New Urban Press: Charlotte. [Online]: <http://lightimprint.org/>

- Light Imprint is the New Urbanism push for new stormwater techniques
- Contains matrix of stormwater BMPs, with information on which transect they're suitable for, their cost, and their maintenance requirements

Hamel, P., Daly, E., & Fletcher, T. D. 2013. Source-control stormwater management for mitigating the impacts of urbanisation on baseflow: A review. *Journal of Hydrology* 485: 201-211.

City of Portland. 2010. *Portland's Green Infrastructure: Quantifying the Health, Energy and Community Livability Benefits [Specifically Sections 1 & 2]*. City of Portland Environmental Services: Portland, OR. [Online]: <https://www.portlandoregon.gov/bes/article/298042>

- Zielinski, Jennifer. 2001. The Benefits of Better Site Design in Residential Subdivisions, *Watershed Protection Techniques* 3(2), pp. 633-646.
- Peter T. Weiss, John S. Gulliver, and Andrew J. Erickson. 2007. Cost and Pollutant Removal of Storm-Water Treatment Practices. *Journal of Water Resources Planning And Management* 133(3): 218-229.
- See the NC Department of Environmental Quality Stormwater Best Management Practices Manual:
<https://deq.nc.gov/sw-bmp-manual>
- Alsharif, K. (2010). Construction and stormwater pollution: Policy, violations, and penalties. *Land Use Policy* 27(2): 612-616.
- Letunic, Niko. 2007. Beyond Plain English: Ten Best Practices for Creating Citizen Friendly Planning Documents. *Planning Magazine*, October, pp. 40-43.

July 25, 09:30-10:45: *Land Suitability Analysis*

- Malczewski, J. (2004). GIS-based land-use suitability analysis: A critical overview. *Progress in Planning* 62(1): 3-65.
- Berke, Philip, David Godschalk, and Edward Kaiser, 2006, "Analyzing Environmental Information," in *Urban Land Use Planning*, 5th edition, Chicago: University of Illinois Press, pp. 33-41.
- Collins, M. G., Steiner, F. R., & Rushman, M. J. (2001). Land-use suitability analysis in the United States: Historical development and promising technological achievements. *Environmental Management* 28(5): 611-621.

July 25, 11:00-12:15: *Habitat impacts and assessments*

- Sharon K. Collinge. 1996. Ecological consequences of habitat fragmentation: implications for landscape architecture and planning. *Landscape and Urban Planning* 36: 59-77.
- Pavel Kindlmann and Françoise Burel. 2008. Connectivity measures: a review. *Landscape Ecology* 23:879–890

July 25, 14:30-15:45: *Visioning and scenario building; formulating a policy framework*

- USEPA. 2013. A Quick Guide to Developing Watershed Plans to Restore and Protect Our Waters (EPA 841-R-13-003). US Environmental Protection Agency: Washington, D.C.
- Philip Berke, David Godschalk, Ed Kaiser and Daniel Rodriguez. 2006. Ch. 9: State of Community Report: Scenarios and Visions, pp. 1-26; Ch. 10: Direction Setting, pp. 1-10," In *Urban Land Use Planning* (5th Edition), University of Illinois Press: Chicago.
- NC Division of Water Resources and Triangle J Council of Governments. 2014. A simplified guide to writing watershed restoration plans in North Carolina. TJCOG: Durham, NC
- Berit Junker, Mattias Buchecker, and Ulrike Mueller-Boker. 2007. Objectives of public participation: Which actors should be involved in the decision making for river restorations? *Water Resources Research* 43: W10438.

July 25, 16:00-17:15: *Plan Implementation Tools*

- John Randolph. 2003. "Ch. 6: Design with Nature for People: Sustainable, Livable, and Smart Land Use Development," "Ch. 7: Local Government Smart Growth Management," in *Environmental Land Use Planning and Management*. Washington, D.C.: Island Press, pp. 106-140, 141-168.
- Tom Schueler. 2000. The Economics of Watershed Protection. *Watershed Protection Techniques*. 2(4): 469-481. [Center for Watershed Protection]
- USEPA. 2004. Protecting Water Resources with Smart Growth (EPA 231-R-04-002). US Environmental Protection Agency: Washington, D.C.

- William Baer. 1997. General Plan Evaluation Criteria: An Approach to Making Better Plans. *Journal of the American Planning Association* 63(3): 329-344.
- Berke, Philip, David Godschalk, and Edward Kaiser with Daniel Rodriguez. 2006. *Plan Quality Protocol* in Ch. 3: Making a Good Plan, in *Urban Land Use Planning* (5th Edition). University of Illinois Press: Chicago.
- Charlie MacPherson and Barry Topping. *Getting in Step: A Guide to Effective Outreach in your Watershed*. US Environmental Protection Agency: Washington, D.C.

July 26, 08:00-09:15: *Identification of Wetlands and Impacts of Urbanization*

- Richard Whisnant. 1999. Wetlands in North Carolina. *Environmental and Conservation Law*, Issue 6: 1-9. The University of North Carolina at Chapel Hill, Institute of Government: Chapel Hill, NC.
- Wright, Tiffany, Jennifer Tomlinson, Tom Schueler, Karen Capiella, Anne Kitchell, and Dave Hirschman. 2006. *Direct and Indirect Impacts of Urbanization on Wetland Quality*, U.S. Environmental Protection Agency: Washington, D.C.

July 26, 09:30-10:45: *Wetland Classification*

- Meiyin Wu, Dennis Kalma, and Carol Treadwell-Steitz. 2014. Differential Assessment of Designations of Wetland Status Using Two Delineation Methods. *Environmental Management* 54: 23–29.
- Stacy Small-Lorenz. 2014. Wetlands Do Triple Duty in a Changing Climate. *Water Currents: Blog of the National Geographic Society*.
- ACOE. 1987. *Corps of Engineers Wetlands Delineation Manual* (Technical Report Y-87-1). US Army Corp of Engineers: Washington, D.C.
- ACOE. 2012. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region* (Version 2.0) ERDC/EL TR-12-9. U.S. Army Corps of Engineers: Washington, D.C.
- D. Dvoretz, Bidwell, J., Davis, C., and DuBois, C. 2012. Developing a hydrogeomorphic wetland inventory: reclassifying national wetlands inventory polygons in geographic information systems." *Wetlands* 32(1): 83-93.

July 26, 11:00-12:15, 14:30-15:45: *Assessment of Wetland Functions*

- Center for Watershed Protection. 2000. *Crafting Better Watershed Protection Plans*. [Watershed Protection Techniques. 2(2): 329-337]
- Kate A. Brauman, Gretchen C. Daily, T. Ka'eo Duarte, and Harold A. Mooney. 2007. *The Nature and Value of Ecosystem Services: An Overview Highlighting Hydrologic Services Annual Review of Environmental Resources* 32:67–98
- Government of Western Australia. 2007. *Guidelines checklist for preparing a wetland management plan*. Western Australia Department of Environment and Conservation: Perth, Australia.
- Becky Ward. 2008. *Mason Farm Wetland/Floodplain Restoration & Stream/buffer Enhancement Chapel Hill, Orange & Durham Counties, North Carolina: Restoration Plan*. NC Ecosystem Enhancement Program: Raleigh, NC
- NC Wetland Assessment Method (NCWAM):
<https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-quality-program-development/ncwam-manual>
- USEPA. 2013. *Wetlands Supplement: Incorporating Wetlands into Watershed Planning*. US Environmental Protection Agency (Region 5): Chicago, IL.
- M. Acreman & J. Holden. 2013. How Wetlands Affect Floods. *Wetlands* 33:773–786.

- Fennessy, M. Siobhan, Amy D. Jacobs, and Mary E. Kentula. 2004. Review of rapid methods for assessing wetland condition (EPA/620/R-04/009). US Environmental Protection Agency: Washington, DC.
- Sutula, Martha A., Eric D. Stein, Joshua N. Collins, A. Elizabeth Fetscher, and Ross Clark. 2006. A practical guide for the development of a wetland assessment method: the California experience. *JAWRA Journal of the American Water Resources Association* 42(1): 157-175.
- Wright, Tiffany, Jennifer Tomlinson, Tom Schueler, Karen Capiella, Anne Kitchell, and Dave Hirschman. 2006. Direct and Indirect Impacts of Urbanization on Wetland Quality, U.S. Environmental Protection Agency: Washington, D.C.

July 26, 16:00-17:15: *Application of Water Quantity and Quality Models to Land Use Planning*

- V. M. Jayasooriya, A. W. M. Ng. 2014. Tools for Modeling of Stormwater Management and Economics of Green Infrastructure Practices: a Review. *Water, Air, & Soil Pollution.* 225:2055
- A.H. Elliott and S.A. Trowsdale. 2007. A review of models for low impact urban stormwater drainage. *Environmental Modelling & Software* 22:394-405
- Keith E. Schilling and Calvin F. Wolter. 2009. Modeling Nitrate-Nitrogen Load Reduction Strategies for the Des Moines River, Iowa Using SWAT. *Environmental Management* 44:671–682

July 27, 08:00-9:15: *Sub-watershed and Stream Evaluation*

- Schueler, T., A. Kitchell. 2005. Desktop Analysis: Comparative Sub-watershed Analysis. In: *Urban Subwatershed Restoration Manual No. 2: Methods to Develop Restoration Plans for Small Urban Watersheds (Version 2.0)*. Center for Watershed Protection.: Ellicott City, MD.
- Eric A. Davidson, Mark B. David, James N. Galloway, Christine L. Goodale, Richard Haeuber, John A. Harrison, Robert W. Howarth, Dan B. Jaynes, R. Richard Lowrance, B. Thomas Nolan, Jennifer L. Peel, Robert W. Pinder, Ellen Porter, Clifford S. Snyder, Alan R. Townsend, and Mary H. Ward. 2012. Excess Nitrogen in the U.S. *Issues in Ecology: Report 15*. Ecological Society of America: Washington, D.C.
- WV DEP. 2006. West Virginia Nonpoint Source Program: Natural Stream Channel Design & Riparian Improvement Project Monitoring Protocol. WV Dept. of Environmental Protection Nonpoint Source Program: Charleston, WV
- Kitchell, A., Schueler, T. 2005. Manual 10: Unified Stream Assessment: A User's Manual. *Urban Subwatershed Restoration Manual Series*. Center for Watershed Protection, Ellicott City, MD.
- Ronald Bjorkland, Catherine M. Pringle And Bruce Newton. 2001. A Stream Visual Assessment Protocol (SVAP) For Riparian Landowners *Environmental Monitoring and Assessment* 68: 99–125.

July 27, 09:30-10:45: *Riparian Zones and Urbanization*

- Peter M. Groffman, Daniel J. Bain, Lawrence E. Band, Kenneth T. Belt, Grace S. Brush, J. Morgan Grove, Richard V. Pouyat, Ian C. Yesilonis, and Wayne C. Zipperer. 2003. Down by the Riverside: Urban Riparian Ecology. *Frontiers in Ecology and the Environment* 1(6): 315-321
- Leslie L. Orzetti, R. Christian Jones, and Robert F. Murphy. 2010. Stream Condition in Piedmont Streams with Restored Riparian Buffers in the Chesapeake Bay Watershed. *Journal of the American Water Resources Association* 46(3):473-485

July 27, 11:00-12:15: *Watershed Impact Mitigation and Restoration Measures*

- BenDor, Todd, and M.W. Doyle. 2010. Planning for Ecosystem Service Markets. *Journal of the American Planning Association* 76 (1): 59–72.
- Palmer Hough and Morgan Robertson. 2009. Mitigation under Section 404 of the Clean Water Act: where it comes from, what it means. *Wetlands Ecology and Management* 17:15–33.

- Erwin, Kevin L. 2009. Wetlands and global climate change: the role of wetland restoration in a changing world. *Wetlands Ecology and management* 17(1): 71-84.
- Young D. Choi. 2004. Theories for ecological restoration in changing environment: Toward 'futuristic' restoration. *Ecological Research* 19: 75–81.
- Rubec, C. D., & Hanson, A. R. 2009. Wetland mitigation and compensation: Canadian experience. *Wetlands Ecology and Management* 17(1), 3-14.
- Egan, D., Hjerpe, E. E., & Abrams, J. 2011. Why people matter in ecological restoration. In: *Human Dimensions of Ecological Restoration* (pp. 1-19). Island Press/Center for Resource Economics.
- M. Scholz. 2011. *Wetland Systems: (Chapter 2: Wetland Case Studies)* Pgs. 19-126. Springer: New York.
- Interagency Workgroup on Wetland Restoration. 2003. *An Introduction and User's Guide to Wetland Restoration, Creation, and Enhancement*. National Oceanic and Atmospheric Administration, US Environmental Protection Agency, US Army Corps of Engineers, US Fish and Wildlife Service, and Natural Resources Conservation Service: Washington, D.C. [Online]: http://www.habitat.noaa.gov/pdf/pub_wetlands_restore_guide.pdf

Recommended reference readings:

- Isobel W. Heathcote, John Richard Edwards, Hugh Greener, and Hugh M. Coombs. 1998. *Integrated watershed management: principles and practice*. Taylor & Francis: New York, NY
- John Randolph. 2004. *Environmental land use planning and management*. Island Press: Washington, D.C.