

## PLAN 641: ECOLOGY AND LAND USE PLANNING

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Office Hours: 2:00 – 3:00 T and by appointment

Office: New East 307

Fall 2015

12:30 – 1:45 T + TH (Phillip 222)

<http://sakai.unc.edu>

### 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 land use planning has many implications for ecological systems, water is increasingly becoming a key link between ecological health and quality and urban development. The course acts as a semester-long 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) To apply watershed assessment techniques to evaluate existing conditions and estimate the impacts of future development;
- 2) To evaluate how urban development impacts urban ecosystem functions;
- 3) To identify the important role of watershed planning and undertake specific tasks in preparing watershed plans;
- 4) To create environmental plans for mitigating the impact of land development while protecting and restoring urban ecosystems; and
- 5) To formulate watershed management policies that protect the natural system functions of watersheds, while mitigating the impacts of future development on watershed health.

### Class Format and Readings

This course will meet twice per week. Class sessions will involve lectures, guest speakers, and extensive class discussion. Field trips will also aid our observation of ecosystem functions and how these functions are influenced by urban development. ALL Course readings (required and recommended), as well as assignment details are located the course website, hosted at <http://sakai.unc.edu>.

## Course Grading/Requirements

Five cumulative plan documents:

1) State of the watershed report	15%
Completed ESRI GIS Module (Due Sept 1)	5%
2) Watershed plan-policy framework	20%
3) Wetland management plan	20%
4) Sub-watershed management plan	20%
5) Complete Booker Creek watershed management plan + presentation	20%
Total: 100%	

- Your group work will be weighted by your teammates' evaluations of your contributions

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Policy on Late or Incomplete Work: According to Department policy, and in order to be fair to your fellow students, *late assignments will not ordinarily be accepted*. Grades of incomplete may be given in the event of a medical or other emergency. A written application for an incomplete on any assignment must state the reasons for the request and propose a new deadline. A grade of F will be assigned for presentations and written assignments not completed on time.

The University's Honor Code is in effect. Please consult with the instructor if you are uncertain about your responsibilities under that code with respect to this course. I expect assignments to be completed in your groups, and groups are not permitted to work together. Discussions with classmates outside of your assignment group are encouraged, but all final work must be entirely the product of your group.

Any student who feels s/he may need an accommodation based on the impact of a disability should contact me privately early in the semester to discuss your specific needs. Students with documented disabilities should contact the Department of Disability Services at 919-962-8300 (SASB North, Suite 2126) to coordinate reasonable accommodations.

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Readings, course content, and schedule may change over the course of the semester. Therefore, this syllabus could be subject to change!

### Summary of Due Dates:

- Sept. 29: Assignment 1: State of the watershed report and poster.
- Oct. 22: Assignment 2: Vision and plan-policy framework.
- Nov. 3: Assignment 3: Wetland evaluation and plan-policy frameworks.
- Nov. 17: Assignment 4: Watershed field evaluations, modeling, and plan-policy frameworks
- December 1/4: Assignment 5: Final Booker Creek Watershed Management Plan Presentation/Report

\*Indicates required reading. Please complete required readings before scheduled class period.

Good 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.  
Center for Watershed Protection, Online Watershed Library (OWL): <http://www.cwp.org/online-watershed-library/>

## Introduction to Environmental Planning

*Objectives:*

- 1) To identify and evaluate land use management tools that can be used for impact mitigation and restoration; and
- 2) To evaluate how land use management tools are used to formulate comprehensive ecosystem protection strategies.

### Aug. 18: *Introduction and Course Overview*

USEPA. 1996. Why Watersheds? (EPA800-F-96-001). US Environmental Protection Agency: Washington, D.C.  
[Online]: <http://water.epa.gov/type/watersheds/why.cfm>

- Asks the question, "Why manage watersheds?"
- Answers with benefits of management

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>

- Global overview of water problems
- Justifications for urban water management

### Aug. 20: *The Environmental Plan*

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.

Town of Chapel Hill. 2012. Snapshot of the Town of Chapel Hill. Town of Chapel Hill: Chapel Hill, NC. [Online]: <http://www.townofchapelhill.org/home/showdocument?id=12177>

- This booklet is a snapshot in time about the Town of Chapel Hill and provides data projections for the future.
- This will give you a better understanding of Town's capabilities, planning, data, etc.

USEPA. 2014. Watershed Central: EPA Watershed Funding Sources. US Environmental Protection Agency: Washington, D.C. [Online]: <http://water.epa.gov/type/watersheds/datait/watershedcentral/funding.cfm>

- Information about funding sources for watershed plans

### Aug. 25, 27: *Introduction to GIS techniques: Part I and II* (Led by Philip McDaniel, GIS Librarian; Davis Library 247)

Larz Anderson. 2000. Chapter 2: Maps and Chapter 3: The Constraints of Slope on Land Development, in Planning for the Built Environment. APA Planners Press: Chicago, pp. 9-32, 239-240, 245-246.

Tim Sutton. 2009. A Gentle Introduction to GIS. Chief Directorate: Spatial Planning & Information, Department of Land Affairs, Eastern Cape, South Africa (DLA). [Online]: [http://download.osgeo.org/qgis/doc/manual/qgis-1.0.0-a-gentle-gis-introduction\\_en.pdf](http://download.osgeo.org/qgis/doc/manual/qgis-1.0.0-a-gentle-gis-introduction_en.pdf)

- This is a tutorial created using QuantumGIS, a free and open-source alternative to ESRI's ArcGIS hegemony.
- Great worksheets and information on GIS concepts

Harvard Map Collection. 2009. GIS Tutorials and Exercises: Introduction to Geographic Information Systems (GIS) Tutorial. Harvard University: Cambridge, MA. [Online]: <http://hcl.harvard.edu/libraries/maps/gis/tutorials.cfm>

- This is a tutorial created by Harvard based in the ESRI ArcGIS environment.

Many books exist on this topic. I recommend review of: Michael Law and Amy Collins. 2013. Getting to Know ArcGIS Desktop [Third Edition for ArcGIS 10]: ESRI Press: Redlands, CA.

## Part I: State of Watershed Report

- Objectives:*
- 1) *To map a watershed, identify drainage networks, and compute watershed slopes and area.*
  - 2) *To evaluate land development impacts on upland and riparian zones of watersheds.*
  - 3) *To create a state of the watershed report and vision for the future.*

### Sept. 1: *Physical Attributes of Watersheds*

DUE: Completion of ESRI Module "Getting Started with ArcGIS." Turn in copy of completion certificate by the end of class.

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

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

### Sept. 3: *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. [Online]:

[http://clear.uconn.edu/projects/TMDL/library/papers/Schueler\\_2003.pdf](http://clear.uconn.edu/projects/TMDL/library/papers/Schueler_2003.pdf)

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

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)

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.

#### Sept. 8: *Urban Green Infrastructure and Best Management Practices*

*Important note: There will be an in-class assignment on selecting BMPs for development sites.*

Perrine Hamel, Edoardo Daly, and Tim D. Fletcher. 2013. Source-control stormwater management for mitigating the impacts of urbanization 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>

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

- Snippets of the book are available online – copied onto Sakai.
- 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

Environmental Finance Center BLOG ("How you pay for it matters"): <http://efc.web.unc.edu/category/wetlands-stormwater/>

#### Sept. 10: *UNC Green Infrastructure Field Trip*. Led by Sally Hoyt, UNC Stormwater Engineer

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 Division of Water Quality Stormwater Best Management Practices Manual:

<http://portal.ncdenr.org/web/lr/bmp-manual>

- Review Sections 1 (Introduction), 4 (Selecting the Right BMP), and 5 (Common BMP Elements)

#### Sept. 15: *Field Trip to Booker Creek Watershed*

Letunic, Niko. 2007. Beyond Plain English: Ten Best Practices for Creating Citizen friendly Planning Documents. *Planning Magazine*, October, pp. 40-43.

- A good guide for making group reports easily read by a diverse group

Creating Effective Poster Presentations: <http://www.ncsu.edu/project/posters>

Steven M. Block. 1996. Do's and Don'ts of Poster Presentation. *Biophysical Journal* 71: 3527-3529

#### Sept. 17: *Land Suitability Analysis*

*Important note: Any non-DCRP master's students – please make sure to give me your onyen and email address so we can get you an account for the 2nd floor computer lab (New East 201)*

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.

## PART II. Creating a Vision and Policy Framework

- Objectives:*
- 1) *To elicit and formulate watershed issues and opportunities.*
  - 2) *To formulate a watershed visioning.*
  - 3) *To set goals and policies linked to the goals, and then integrate them into a "vision statement" and policy framework*

Sept. 22: *Visioning and scenario building; formulating a policy framework*

*Important note: Today you will be assigned to a group to review the plan-policy framework of an example plan for the following week.*

- 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. [Online]: [http://water.epa.gov/polwaste/nps/upload/watershed\\_mgmnt\\_quick\\_guide.pdf](http://water.epa.gov/polwaste/nps/upload/watershed_mgmnt_quick_guide.pdf)
- 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.

Sept. 24: *Suitability Analysis Computer Lab Session (New East 201)*

- 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.

Sept. 29: *Plan Implementation Tools*

**ASSIGNMENT 1 DUE: Posters and reports are due in class.**

See compilation of plan implementation tools from PLAN 744: Development and Environmental Management in Assignments directory on Sakai. Lots more detail in Small chunks of:

Randolph, John. 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.

- Great reference text on development tools. Lots more detail

USEPA. 2014. 8 Tools of Watershed Protection in Developing Areas. US Environmental Protection Agency: Washington, D.C. [Online]: [http://cfpub.epa.gov/watertrain/pdf/modules/new\\_eighttools.pdf](http://cfpub.epa.gov/watertrain/pdf/modules/new_eighttools.pdf)

Tom Schueler. 2000. Center for Watershed Protection 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.

- Longer document, but very valuable to skim.
- Review headings to get a good sense of diverse tools available to planners and policy-makers at different levels of government.

Oct. 1: *NO CLASS MEETING. Group reviews of example plans.*

Oct. 6: *Student plan reviews and discussion.* Reviews of illustrative vision statements, goals and objectives, policies, and other components of policy frameworks in a sample of environmental plans

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* (5<sup>th</sup> Edition). University of Illinois Press: Chicago.

See APA Efforts to certify comprehensive plans: <https://www.planning.org/sustainingplaces/compplanstandards/>

- Includes scoring matrix: <https://www.planning.org/sustainingplaces/compplanstandards/scoringmatrix.doc>

Oct. 8: *Simulated visioning exercise: "What do we want for the future of our watershed?"*

Charlie MacPherson and Barry Tinning. *Getting in Step: A Guide to Effective Outreach in your Watershed*. US Environmental Protection Agency: Washington, D.C. [Online]:

<http://cfpub.epa.gov/watertrain/pdf/modules/NEWgettinginstep.pdf>

### Part III: Wetland Evaluation and Mitigation

*Objectives:*

- 1) *To identify the scientific and political issues involving wetland delineation;*
- 2) *To identify how land development threatens wetland functions;*
- 3) *To apply a field method to evaluate the functions of wetlands and rate their value;*
- 4) *To create a wetland protection strategy.*

Oct. 13-15: *FALL BREAK – CLASS DOES NOT MEET*

Oct. 20: *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 Cappiella, Anne Kitchell, and Dave Hirschman. 2006. *Direct and Indirect Impacts of Urbanization on Wetland Quality*, U.S. Environmental Protection Agency: Washington, D.C.

- See Pages 13-56.

Oct. 22: *Wetland Classification*

*ASSIGNMENT 2 DUE: Vision and plan-policy framework.*

ACOE. 1987. *Corps of Engineers Wetlands Delineation Manual* (Technical Report Y-87-1). US Army Corp of Engineers: Washington, D.C. [Online]: <http://el.erdc.usace.army.mil/elpubs/pdf/wlman87.pdf>

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. [Online]: [http://www.usace.army.mil/Portals/2/docs/civilworks/regulatory/reg\\_supp/EMP\\_Piedmont\\_v2b.pdf](http://www.usace.army.mil/Portals/2/docs/civilworks/regulatory/reg_supp/EMP_Piedmont_v2b.pdf)

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.

Oct. 27: *Assessment of Wetland Functions*

*Important note: In-class wetland evaluation case study*

See urban evaluation checklists in Assignment 3 directory

- USEPA. 2013. Wetlands Supplement: Incorporating Wetlands into Watershed Planning. US Environmental Protection Agency (Region 5): Chicago, IL. [Online]: <http://www.epa.gov/region5/agriculture/pdfs/wetlands-in-watershed-planning-supplement-region-5-201302.pdf>
- Focus on Pages 1-40
- M. Acreman & J. Holden. 2013. How Wetlands Affect Floods. *Wetlands* 33:773–786. See NC Wetland Assessment Method (NCWAM): <http://portal.ncdenr.org/web/wq/swp/ws/pdu/ncwam-manual>
- 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. [Online]: <http://epa.gov/wed/pages/publications/authored/EPA620R-04009FennessyRapidMethodReview>. Pdf.
- Wright, Tiffany, Jennifer Tomlinson, Tom Schueler, Karen Cappiella, Anne Kitchell, and Dave Hirschman. 2006. Direct and Indirect Impacts of Urbanization on Wetland Quality, U.S. Environmental Protection Agency: Washington, D.C.
- See Pages 1-12

Oct. 29: *Wetland Field Trip in Booker Creek Watershed (Carolina North).*

- Center for Watershed Protection. 2000. Crafting Better Watershed Protection Plans. [Watershed Protection Techniques. 2(2): 329-337]
- 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
- 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

Part IV: Watershed Field Evaluation and Modeling

Nov. 3: *Application of Water Quantity and Quality Models to Land Use Planning*

Reviews of urban stormwater models are now very popular. Reviews from 2007, 2011, and 2014 chronicle the rapid recent development of stormwater models.

- 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
- 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
- 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

Nov. 5: *Sub-watershed and Stream Evaluation*

*ASSIGNMENT 3 DUE: Wetland evaluations and plan-policy frameworks*

- 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. *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.

Nov. 10: *Riparian Zones and Urbanization*. Guest Speaker: Prof. Danielle Spurlock, UNC City and Regional Planning

*Important Note: In class assignment - be prepared to analyze Chapel Hill's Resource Conservation District (RCD) ordinance*

- 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

#### Part V: Ecosystem Restoration and Restoration Planning

Nov. 12: *Ecosystem Restoration Field Trip – Chapel Creek and Mason Farm Restoration Sites*.

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](http://www.habitat.noaa.gov/pdf/pub_wetlands_restore_guide.pdf)

- Focus specifically on Pages 4-34, although the entire document is useful.

Nov. 17: *Ecosystem Restoration* – Guest speaker: George Howard, Co-founder and CEO, Restoration Systems

<i>ASSIGNMENT 4 DUE: Watershed field evaluations, modeling, and plan-policy frameworks.</i>
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- 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.

Nov. 19: *Watershed Impact Mitigation and Restoration Measures*

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

Nov. 24 and 26: *Thanksgiving Break – Class does not meet.*

Dec. 1: *Student presentations of Booker Creek Watershed Management Plan*

<i>ASSIGNMENT 5 DUE (Friday, December 4<sup>th</sup>): Booker Creek Watershed Management Plan</i>
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