Riparia

A Center where science informs policy and practice in wetlands ecology, landscape hydrology, and watershed management

This Center would be supported by the departments of Geography and Geosciences, the Earth and Environmental Systems Institute, the College of Earth and Mineral Sciences, and the Penn State Institutes for Energy and the Environment, and by grants, contracts, and gifts.

"If there is magic on this planet, it is contained in water." Loren Eiseley

The Center

Within Riparia, natural and social scientists, students, and practitioners will study the science, policy, and practice for transition areas between waters and lands in hydrologic, ecologic, geomorphic, and societal contexts. We will investigate and communicate concepts regarding the ecological and geophysical processes where water is the driving force. There will be broad integration horizontally across spatial scales from plots to landscapes, and equally broad integration vertically from deep aquifers to atmospheric influences on ecosystems. Riparia is broadly conceived to include physical, chemical, and biological fluxes between the atmospheric boundary layer, surface water (streams, wetlands, lakes, coasts), and groundwater (interflow, aquifers). We will investigate the spatial and temporal characteristics of local, regional and global water resources and the impact humans have on these systems. Human activities and attitudes will be integral to – part of, not apart from – these investigations and communications.

We want to facilitate interactions not only among participating faculty and staff, but with undergraduate and graduate students from diverse majors, collaborators (e.g., public agencies, universities, research institutions, non-governmental organizations), and sponsors (e.g., agencies, industries, foundations). Personnel in this center will lead and encourage these interdisciplinary and multi-institutional collaborations. Over half of existing and requested funds will be used in support of student-centered activities (see Center Needs).

We are requesting funding and support for enhancement of an existing center – the Penn State Cooperative Wetlands Center (CWC) – to better reflect the current extent of work performed, which addresses many issues beyond wetlands, and to broaden faculty and student expertise in the geophysical aspects of hydrologic sciences. The faculty, staff, and students of the CWC have learned how to lead effectively, large, complex, multi-institutional research projects involving many players outside the University (see section on Funding Opportunities); these strengths will be key to the development of Riparia. By involving additional expertise in water resources that is available within EMS and elsewhere within the University, we will link the historic strengths that the CWC has in coupling wetlands and surface waters within the context of their terrestrial surroundings with stronger connections to subsurface hydrologic fluxes. The enhanced center will be known, simply, as Riparia.

The Name

Riparia was selected for name of the center because it is simple, yet representative and adaptable. This name will raise questions and elicit conversations. This name is about creating recognition and building endowments. University funding for centers is characteristically nominal, so providing sustained funding for Riparia that goes beyond grants and contracts will require alternative strategies and appeals to potential sponsors. We believe that the choice of Riparia is stimulating and bold, and thus, will help us meet these goals.

Rationale

With increasing demands for freshwater (e.g., drinking water, agricultural and industrial demands, sustainability of aquatic ecosystems), continued threats to water quality, and growing concerns about climate change, the processes controlling water quantity and quality are of paramount concern. Stream-aquifer interactions, sediment transport in streams, nutrient cycling in aquatic ecosystems, habitat function for water-dependent species, geologic isolation of radioactive waste, and water policy decisions all require an understanding of fluxes of water at multiple spatial and temporal scales from a multidisciplinary point of view. As studies of the fundamental processes controlling fluid flow move forward, we recognize that these processes are complex at all scales, and that physics, chemistry, and biology are tightly coupled, and together impact policy decisions. Consequently, our ability to simultaneously protect and recover water supplies, predict biological responses to climate change, predict contaminant transport, or model flows in situations with limited data remain poor. As regional demands and world population continue to grow, water science will drive and inform issues of critical scientific, technological, and societal importance.

We propose the establishment of Riparia, which will integrate horizontally across spatial scales from plots (m) to landscapes (km), and vertically from deep aquifers to atmospheric influences on aquatic ecosystems. Our proposal maintains existing linkages with Geography and the Penn State Institutes of Energy and the Environment (PSIEE), and strengthens relationships with Geosciences, the Earth and Environmental Systems Institute (EESI), and the College of Earth and Mineral Sciences (EMS). By encouraging the involvement of more faculty associates/affiliates and students within EMS and across the University, we can address science, engineering, policy, practice, and social science issues concerning water more holistically. Based on discussions with leaders in other units, increasing synergies are not only possible but desirable. By promoting cooperation and mutually beneficial sharing of limited resources, we expect exchanges and collaborations with other water-related institutes, centers, and laboratories at Penn State to be more frequent and more productive.

Riparia would help integrate field experimentation, theoretical analysis, numerical modeling, observational studies, monitoring and assessment, and experiential learning to develop and communicate scientific concepts regarding water. Many of the scientific issues associated with water also represent significant educational opportunities, and the Center would help integrate teaching and learning objectives across campus through a sponsored student symposium and promoting a system of laboratory/field site rotations for graduate students, coupled with an equipment-sharing program for ecological and hydrological field instrumentation and laboratory analyses.

Riparia, as proposed, would meet the guidelines of the Graduate School and EESI for centers. Toward these goals, we briefly describe initial areas of concentration and focused activities:

Wetlands Science and Policy. No other ecosystem type is regulated as intensively, and few other habitats offer such a wide range of ecological services as wetlands, broadly defined. Research conducted by the CWC has been directed at understanding how these integrated systems function ecologically, and how they are perturbed by human activities. Wetlands are an important part, but only one part, of much broader watershed and landscape palettes, where understanding and protecting the linkages among surface waters (i.e., wetlands, streams,

estuaries), contributing subsurface sources (i.e., local and regional groundwater flow networks, discharge-recharge dynamics, hydraulic connectivity) and their adjoining terrestrial lands, are essential. We will build linkages to aqueous geochemistry, geophysical processes, hydrologic modeling, and water resource policies to further the integration of our science-based knowledge.

Landscape Hydrology. Landscape Hydrology is broadly conceived here to include physical, chemical, and biological fluxes between the atmospheric boundary layer, surface water, and groundwater, spatial and temporal characteristics of regional and global water resources including water quantity, residence times, and the pathways between various reservoirs, and the impact humans have on these systems. Goals of this concentration area are to quantify processes and build functional relationships between geology and hydrology, and predict how these flow processes may change in the presence of external forcings, such as climate change at the global scale, or contaminant transport on the regional scale.

Water-Land Interface. We would assist in the coordination of this proposed interdisciplinary initiative in Geography that seeks to further understand ecological processes operating across the boundaries between aquatic and terrestrial ecosystems. Often, human activities are located at these junctures, thus, examining the resultant changes in fluxes is critically important when addressing issues of water quantity and quality.

Coordinate an Ecological and Hydrological Analysis and Equipment Program, with direct benefits to graduate students. As a way of increasing opportunities for collaboration across campus, we would establish a program to promote access to laboratory and field methods, techniques and instrumentation. By compiling a database of water-related analytical tools and approaches, we would be able to: 1) coordinate graduate student rotations through cooperating laboratories and projects; 2) coordinate proposals for large equipment grants; and 3) increase the efficiency and accessibility of analytical practices for ecology and hydrology at Penn State.

Instruction. The faculty and staff of Riparia could both participate in and coordinate several water-related graduate and undergraduate programs as they choose:

- EMS Minor in Watersheds and Water Resources (Gregory Knight, Professor in charge)
- On-line Certificate Program in Wetlands Science and Policy (proposed in Geography)
- On-line Master's of Science in Water Resources degree (concept for EMS to consider)

In addition, this Center would promote graduate and undergraduate research, symposia, field experiences and internships, by arranging teaching and advising by participating faculty and staff. Center funds would be used to recruit and support a cadre of highly-qualified students, and initiate a student symposium that brings together students in water science and policy from across campus.

Outreach. The personnel of Riparia will provide objective information on water resources to a variety of audiences, including agencies, organizations, schools, and citizens using traditional and non-traditional media. We will continue the tradition of leadership by CWC personnel in academic, agency, and professional organizations, and departmental, college, and university committees, and encourage involvement by all personnel. As appropriate, we would develop and distribute products (e.g., educational posters, technical manuals, publicly available datasets),

develop and offer short courses and workshops, and advise agencies and organization as requested.

During its research, outreach and service activities, the CWC served and interacted with a broad range of clientele from peer research institutions and research sponsors, to resource agencies and non-governmental organizations, to industries, schools and citizens. These interactions benefited both the stakeholders and the CWC through information exchanges and funding opportunities. We expect that these interactions will continue in the enhanced center. As water quantity and quality issues continue to come to the forefront, scientists, policy-makers and citizens will demand more refined knowledge about these essential systems, and Riparia will be able to respond to those inquiries.

Funding Opportunities

With an enhanced center, we believe we can build upon past successes making us more competitive for a wider breadth of opportunities, expanding expertise and increasing the number of investigators working together and water-related issues.

A landmark publication in 2001 entitled *Envisioning the Agenda for Water Resources Research in the Twenty-First Century* (NRC 2001) eloquently and succinctly identified our nation's water research needs. The report identifies 43 issues under the general headings of water availability, water use, and water institutions. The proposed center could address some of these independently, but by working with other units across campus, we would be competitive for addressing most of these issues. The federal sources of water resources funding are spread over a number of agencies, implying a diversity of issues and questions, including NSF, DOE, USGS, USEPA, USDA and others (NRC 2004). We should not, however, constrain funding applications to federal sources alone. Other sources have been secured in the past, and offer substantial opportunities, including state, foundation, industry, and private funds. In Appendix A we list examples of past performance in securing and managing extramurally-funded projects along with a few currently advertised RFPs.

Interest in integrated water science has burgeoned over the past few years given the development of the National Ecological Observatory Network (NEON), Collaborative Large-scale Engineering Analysis Network for Environmental Research (CLEANER), and the Consortium of Universities for the Advancement of Hydrologic Science (CUAHSI). The goals of these programs are to develop infrastructure and services for the advancement of hydrologic/ecologic science and education. The recent $4.2M award to Penn State scientists within the Colleges of EMS, Engineering, and Agriculture for a NSF-Critical Zone Observatory (CZO) will bring together a large group of investigators interested in advancing our understanding of the integration and coupling of Earth surface processes as mediated by the presence and flux of freshwater. Interfacing with the new CZO is likely, and in fact, faculty from both the CZO and the current CWC are already collaborating on complementary research projects. Additionally, Penn State is directly connected with the Susquehanna River Basin Hydrologic Observing System (SRBHOS) supported by CUAHSI and the NSF-supported WATERS Test Bed in the Chesapeake Bay, providing fertile ground for solving multidisciplinary problems in our immediate geographical sphere.

Two of the principal areas of focus for fiscal year 2008 within the National Science Foundation are the global water cycle and land-use and land-cover change, both of which dovetail nicely with the research emphases of Riparia personnel, and with potential collaborators like the Center for Environmental Informatics (D. Miller). Additionally, NSF Geosciences is

placing emphasis on interdisciplinary research, including "Emerging Topics in Biogeochemical Cycles (ETBC)". The researchers brought together by Riparia can take advantage of calls such as this to create strong and innovative research proposals. Since we will consist of investigators in physical, chemical and biological sciences, we can easily cross directorate boundaries to create transformative interdisciplinary science. Also of interest to the new center is the collaborative and crosscutting Dynamics of Coupled Natural and Human Systems (CNH) program, which promotes quantitative analyses of interactions between human and natural system processes. Other examples of current RFPs that would be appropriate targets of new proposals are listed in Appendix A.

Participants/Management Structure

The initial personnel are as follows (resumes of all personnel are available at www.wetlands.psu.edu, www.geosc.psu.edu or www.geog.psu.edu)

Executive Director – Robert P. Brooks, Ph.D., Professor of Geography and Ecology
currently CWC Director; expanded administrative structure is based on added responsibilities anticipated with the enhanced center (vita attached as Appendix B)

Director – Denice Heller Wardrop, P.E., Ph.D. Associate Professor of Geography and Ecology
currently CWC Associate Director and Senior Research Associate; would co-administer Wetlands Science and Policy section, administer Ecological and Hydrological Analysis and Equipment Program, and interface with engineering community

Associate/Assistant Directors and Program Coordinators – positions are available as needed and appropriate for optimizing center operations.

Associate Faculty (confirmed, others are considering joining-):

- C. Gregory Knight, Ph.D., Professor of Geography, Ph.D. – water resources, impacts of climate variability and change on water resources, integrated regional assessments; Professor in Charge, EMS Minor in Water Resources.
- Kamini Singha, Ph.D., Assistant Professor of Hydrogeology - coordinate investigations in Landscape Hydrology, administer selected student programs, and interface with hydrologists across campus
- Erica Smithwick, Ph.D., Assistant Professor of Geography and Ecology – research interests in landscape and ecosystem ecology, disturbance ecology & disturbance synergies, ecosystem simulation models, climate change and ecosystem carbon storage, fire and soil nitrogen, microbial community composition and function, spatial statistics
- Ecohydrologist – An anticipated tenure-track faculty position being proposed by Geography and EESI; provide a technical bridge between hydrogeomorphic and aquatic ecology fields.

Affiliates (confirmed, others are considering joining)

- Macalady, Jennifer, Ph.D., Assistant Professor of Geosciences - geomicrobiology of cave formation, astrobiology, microbial role in weathering and soil processes, stable isotope tools for geomicrobiology and environmental geochemisty, chemistry and evolution of microbial membranes, ecological interactions in microbially dominated ecosystems.

Current CWC faculty and staff to continue in Riparia with existing or expanded assignments:

- Joseph A. Bishop, Ph.D., Research Associate - Geospatial Coordinator – coordinate spatial databases and analysis; interface with other GIS units across campus and externally
- Mary M. Easterling, Senior Research Assistant - Projects Coordinator – coordinate operations for projects, conduct analyses on selected projects
- Gian L. Rocco, Ph.D. - Research Associate in Herpetology – may coordinate biological investigations; lead selected projects; supervise field crews
- Sarah Miller, Senior Research Assistant in Botany – coordinate botanical collections, sampling, and analyses; may coordinate outreach efforts; conduct plant taxonomy workshops & courses
- Susan Yetter - Research Assistant in Aquatic Ecology – coordinate aquatic invertebrate collections, sampling, and analyses; conduct aquatic macroinvertebrate workshops & courses
- Hannah Ingram – Research Technician – lead field sampling efforts; conduct selected GIS analyses

Graduate Students –Graduate students will have opportunities to participate in lab/center rotations and in the annual student symposium. They will be beneficiaries of several financial incentive programs (see Center Needs). If the online graduate courses and programs are successful, then an additional cadre of off-site students will become part of the expanded community. There are currently 5 graduate students in the existing CWC, and we expect many more involved with the new interdisciplinary center.

Undergraduate Students –Selected undergraduate students will be encouraged to participate in independent studies, internships, and summer field experiences. They will benefit from several financial incentive programs (see Center Needs). At least 6 interns will participate in CWC projects in summer 2008, and we envision expansion in future years.

Advisory Committee – Envisioned to be composed of 3-5 internal and external persons with significant experience and understanding of the fields; convene on-site once per year.

Administrative Oversight –Geography & Geosciences heads of departments; EESI Director, EMS Dean, PSIEE Director.

Center Needs

Riparia will have dedicated physical space managed through the Department of Geography in Walker Building. This space has been used for the existing CWC, and can meet modest expansion needs for Riparia. We request access to common facilities in EESI's existing spaces, as per other centers, on an as-needed basis. We anticipate that participating faculty will make their laboratories available to collaborating faculty, staff, and students, and that departments with participating faculty will consider space requests as needed to serve center-related activities (e.g., office space for graduate students, storage space for field equipment, etc.). Operating funds currently available to the CWC through department and college sources will be leveraged for activities of Riparia including and beyond the requests listed below.

We are requesting $20,000 per year in annual operating funds to support the enhancement of the new center to cover costs of some new initiatives and support the expanded number of

personnel. To achieve our goals we request resources from EESI for the following student-centered activities:

1) early and enhanced stipend awards to attract high-quality graduate student applicants (top-up awards for 2-3 students at $2,000-3,000 each; $6,000)
2) support for an annual student research symposium (organizing costs and modest cash awards of up to $500 each; $4,000)
3) summer intern wages and/or summer graduate student wages ($4,000, in addition to funds from specific investigator projects)
4) supplemental travel funds for center members, including students that make presentations and/or supporting guest speaker visits ($4,000, in addition to existing CWC funds)
5) publicize our efforts through an expanded website ($1,000)
6) support development of an online database for tracking laboratory capabilities and available and instrumentation for the Ecological and Hydrological Analysis and Equipment Program ($1,000)

Existing CWC annual funds will be used to further the availability of travel funds, provided additional summer wages, cover modest costs for supplies, and cover other miscellaneous costs.

Appendix A

Past performance and examples of extramural funding opportunities for Riparia participants.

Riparia's proposed directors, Brooks and Wardrop, have a strong track record in competing for extramural funding and successfully leading interdisciplinary and multi-institutional projects. A few are listed here as evidence of this type of project (* current):

- Atlantic Slope Consortium – USEPA 5 years, $6 M, 6 institutions, 40 investigators
- Watershed Classification – USEPA 3 years, $875K, 2 institutions, 10 investigators
- *Ecological Thresholds – USEPA 3 years, $300K, 3 institutions, 7 investigators
- *Climate Change Project – USEPA 3 years, $900K, 3 colleges, 6 investigators
- *Bog Turtle Habitat Conservation Plan – USDI 4 years, $575K, 12 investigators
- *BMP performance in Spring Creek – USDA 3 years, $640K, 4 institutions, 8 investigators
- *Mid-Atlantic State Wetlands Assessment – USEPA 5 years, $960K, 2+ institutions, 4+ investigators

Current RFPs of interest:

USEPA - Consequences of Global Change for Water Quality
URL: http://es.epa.gov/ncer/rfa/2008/2008_star_gcwq.html
Summary: The Environmental Protection Agency (EPA) Office of Research and Development (ORD) National Center for Environmental Research (NCER), in cooperation with the EPA Global Change Research Program, announces a competition for projects supporting research into the consequences of climate change for U.S. water quality to support human and aquatic life uses. EPA is interested in the hydrologic and other watershed processes that affect water resources that may be altered by a changing climate…(current, submission likely).

USDA - FY 2008 National Integrated Water Quality Program (NIWQP). The Request for Applications (RFA) is now available at <http://www.csrees.usda.gov/fo/waterqualityicgp.cfm>http://www.csrees.usda.gov/fo/waterqualityicgp.cfm <http://www.csrees.usda.gov/fo/waterqualityicgp.cfm> . One of two areas of special emphasis in the 2008 solicitation includes the impacts of bioenergy development on water use and water quality. What sources of water (quality and quantity) can be used or will be needed to expand bioenergy development for crop growth and in the energy production process? What will be the changes in water quantity and quality that result from converting conservation reserve lands or changing cropping patterns or practices (e.g. tillage, residue management, and nutrient management)? … Multi-disciplinary teams that include expertise on water, engineering, forestry, rangelands, agronomy, economics, policy, and other relevant disciplines are encouraged… (current, possible collaboration with COAS-ENRI)

Appendix B

Robert P. Brooks, Ph.D.
Professor of Geography and Ecology
Director, Penn State Cooperative Wetlands Center (www.wetlands.psu.edu)

contact information
302 Walker Building, Department of Geography, Pennsylvania State University, University Park, PA 16802
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education

University of Massachusetts, Amherst	Wildlife Biology	Ph.D.
	Wildlife Biology	M.S.
Muhlenberg College, Allentown, PA	Biology	B.S.

professional activities
Dr. Brooks has developed a widely recognized wetlands and wildlife research and education program. Current research projects include:

- developing hydrogeomorphic functional assessment models for riverine, depression, and slope wetlands
- developing ecological indicators for wetlands, streams, riparian areas, and forests, based on plants, macroinvertebrates, amphibians and birds
- monitoring protocols for reference wetlands and mitigation projects
- habitat modeling for wetland-riparian and forest wildlife
- wetlands restoration and creation on altered and damaged landscapes
- watershed cumulative impacts in wetland and riparian portions of landscapes.

He has taught over a dozen different undergraduate and graduate courses in the ecology and management of wetlands, humans and the environment, field geography, wildlife management and conservation, and restoration ecology. Since 1978, he has published over 125 technical papers, books, and book chapters, and presented over 140 technical presentations at conferences and meetings. Dr. Brooks has been the senior principal investigator on 89 of 123 grants and contracts funded between 1981-2007, totaling $19M. He has served as the Director of several interdisciplinary and multi-institutional research projects, including the Atlantic Slope Consortium, Watershed Characterization and Prioritization, Bog Turtle Habitat Conservation Plan, and Best Management Practices for Agricultural Watersheds.

Dr. Brooks has studied numerous wetland and river systems in the U.S. and other countries, including emergent marshes, peatlands, shrub and forested wetlands, large rivers, and headwater streams. He and his graduate students (35 graduated) have studied all major vertebrate taxa. He attends 3-4 national and regional wetlands meetings per year, and is familiar with current federal and state policies and regulations regarding the protection and mitigation of rivers and wetlands. He has worked with agencies (e.g., U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Department of Agriculture, U.S. Bureau of Mines, U.S. Fish & Wildlife Service,

National Park Service, PA Department of Environmental Protection, PA Department of Conservation and Natural Resources) and industries (e.g., coal mining, forestry, industrial development authorities, utilities).

Dr. Brooks is a member of the Otter Specialist Group of the IUCN, seeking to protect otters and their aquatic habitats worldwide. He has been a consultant and collaborator on wetlands for the U.S. Environmental Protection Agency since 1987. He is a member of the Mid-Atlantic Wetlands Working Group, sponsored by USEPA and the states. Dr. Brooks served as Chair of Pennsylvania's DEP Wetlands Protection Advisory Committee for all 8 years of its existence. He is also a member of Pennsylvania's DCNR Ecosystem Management Committee, the Millbrook Marsh Nature Center Advisory Committee, and recent Chair of a municipal planning commission.

professional employment - Pennsylvania State University

2003-present - Professor Geography and Ecology, Department of Geography, College of Earth and Mineral Sciences
1998-2003 - Professor of Wildlife and Wetlands School of Forest Resources, College of Agricultural Sciences
1993-present - Director, Penn State Cooperative Wetlands Center
1986-1997 - Associate Professor of Wildlife Ecology - Wetlands and Wildlife School of Forest Resources (SFR)
1985-1988 - Chairman, Wildlife and Fisheries Science Program (SFR)
1983-1985 - Assistant Professor of Wildlife Ecology (SFR)
1980-1983 - Assistant Professor of Wildlife Technology, DuBois Campus Wildlife Technology Program Leader (1982/83)(SFR)

selected professional organizations

Society of Wetland Scientists - member, Certified Professional Wetland Scientist (1995), Associate Editor for Wetlands (2003-2005)
The Wildlife Society - Certified Wildlife Biologist (1983), Associate Editor for Journal of Wildlife Management (1989-91); member National, Section, and Pennsylvania Chapters; Advisor to Penn State Student Chapter (1991-present), Board Member PA Chapter (1991-1994), President PA Chapter (1993)
Association of State Wetland Managers - member
American Association of Geographers - member

selected awards and certifications

1983 Certified Wildlife Biologist, The Wildlife Society
1995 Certified Professional Wetland Scientist, Society of Wetland Scientists
1996 Teaching Award of Merit, National Association of Colleges and Teachers of Agriculture
1996 Penn State Teaching Awards – Finalist
1999 Edward D. Bellis Award – Intercollege Graduate Program in Ecology, PSU
2001 John Pearce Memorial Award, Northeast Section of The Wildlife Society Northeast Section, for commitment to wildlife conservation as a scientist and educator.

selected publications – 2002-2007

Brooks, R. P., G. P. Patil, S. Fei, A. I. Gitelman, W. L. Myers, and E. D. Reavie. 2007. Next generation of ecological indicators of wetland condition. EcoHealth 4(2):176-178 (Editor: Special Section of EcoHealth featuring 6 papers on emerging wetland indicators).

Wardrop, D.H., M. E. Kentula, D. L. Stevens, Jr., S. F. Jensen, and **R. P. Brooks**. 2007. Assessment of wetland condition: an example from the Upper Juniata Watershed in Pennsylvania, U.S.A. Wetlands 27(3):416-431.

Wardrop, D.H., M. E. Kentula, D. L. Stevens, Jr., J.M. Rubbo, K. Hychka, and **R. P. Brooks**. 2007. The condition of wetlands on a watershed basis: The Upper Juniata Watershed in Pennsylvania, U.S.A. Wetlands 27(3):432-445.

Hychka, KC., D.H. Wardrop, and **R.P. Brooks**. 2007. Enhancing a landscape assessment with intensive data: a case study in the Upper Juniata watershed. Wetlands 27(3):446-461.

Rheinhardt, R.D., M.M. Brinson, **R. P. Brooks**, M.M. Easterling, J.M. Rubbo, J. Hite, and B. Armstrong. 2007. Development of a reference-based method for identifying and scoring indicators of condition for coastal plain riparian reaches. Ecological Indicators 7(2):339-361.

Brooks, R. P., D. H. Wardrop, and C. A. Cole. 2006. Inventorying and monitoring wetland condition and restoration potential on a watershed basis with examples from the Spring Creek watershed, Pennsylvania, USA. Environmental Management 38:673-687.

Brooks, R. P., D. H. Wardrop, K. W. Thornton, D. Whigham, C. Hershner, M. M. Brinson, and J. S. Shortle (eds.). 2006. Ecological and socioeconomic indicators of condition for estuaries and watersheds of the Atlantic Slope. Final Report to U.S. Environmental Protection Agency STAR Program, Agreement R-82868401, Washington, DC. Prepared by the Atlantic Slope Consortium, University Park, PA. 96pp. + attachments (CD).

Miller, S. J., D. H. Wardrop, W. M. Mahaney, and **R. P. Brooks**. 2006. A plant-based index of biological integrity (IBI) for headwater wetlands in central Pennsylvania. Ecological Indicators 6:290-312.

Brooks, R. P., C. Snyder, and M. M. Brinson. 2006. Structure and functioning of tributary watershed ecosystems in the Eastern Rivers and Mountains Network: Conceptual models and vital signs monitoring. Natural Resources Report NPS/NER/NRR-2006/009. National Park Service, Philadelphia, PA. 88pp.

Myers, W., J. Bishop, and **R. Brooks**. 2006. Landscape-level habitat moding and mapping for conservation planning: use of GAP Analysis. Pages 113-126 in McKinstry, R. B., C. Ripp, and E. Lisy (eds.). Biodiverstiy Conservation Handbook. State, Local,

and Private Protection of Biological Diversity. Environmental Law Institute, Washington, DC. 651pp. (book chapter)

Brooks, R. P., D. H. Wardrop, C. A. Cole, and D. A. Campbell. 2005. Are we purveyors of wetland homogeneity?: A model of degradation and restoration to improve wetland mitigation. Ecological Engineering 24(4):331-340.

Walls, Ramona L., D. H. Wardrop, **R. P. Brooks**. 2005. The impact of experimental sedimentation and flooding on the growth and germination of floodplain trees. Plant Ecology 176:203-213.

Niemi, G., D.H. Wardrop, **R.P. Brooks**, S. Anderson, V. Brady, H. Paerl, C. Rakocinski, M. Brouwer, B. Levinson and M. McDonald. 2004. Rationale for a new generation of ecological indicators for coastal waters. Environmental Health Perspectives 112(9):979-986.

Brooks, Robert P., Denice Heller Wardrop, and Joseph A. Bishop. 2004. Assessing wetland condition on a watershed basis in the Mid-Atlantic region using synoptic land cover maps. Environmental Monitoring and Assessment 94:9-22.

Brooks, R. P. (ed.). 2004. Monitoring and Assessing Pennsylvania Wetlands. Final Report for Cooperative Agreement No. X-827157-01, between Penn State Cooperative Wetlands Center, Pennsylvania State University, University Park, PA and U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, DC. Rep. No. 2004-3 Penn State Cooperative Wetlands Center, University Park, PA.

Mahaney, W. M., D. H. Wardrop, and **R. P. Brooks**. 2004. Impacts of sedimentation and nitrogen enrichment on wetland plant community development. Plant Ecology 175:227-243.

Mahaney, Wendy M., Denice H. Wardrop, and **Robert P. Brooks**. 2004. Impacts of stressors on the emergence and growth of wetland plant species in Pennsylvania, USA. Wetlands 24(3):538-549.

Campbell, D. A., C. A. Cole, and **R. P. Brooks**. 2002. A comparison of created and natural wetlands in Pennsylvania, USA. Wetlands Ecology and Management: 10:41-49.

Cole, C. A., **R. P. Brooks**, P. W. Shaffer, and M. E. Kentula. 2002. A comparison of the hydrology of wetlands in Pennsylvania and Oregon (USA) as an indicator of the transferability of hydrogeomorphic (HGM) functional models between regions. Environmental Management 30(2):265-278.

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April 17, 2008

Dr. Susan Brantley, Director
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Dear Sue,

This letter is in support of Dr. Rob Brooks' proposal to form the Riparia Center. I have read the proposal for the new Center and believe this could be an excellent way to form ties between the water scientists in Geography with those in Geosciences. I fully support the development of this Center and look forward to the interdisciplinary collaborations that will be formed within it.

Sincerely,

Timothy Bralower
Professor and Head
Department of Geosciences

PENNSTATE

Kamini Singha
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16 April 2008

Robert Brooks
Dept of Geography
302 Walker Building
Pennsylvania State University
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Dear Rob:

This letter is written to indicate my support for the development of Riparia, a Watershed Research Center, at PSU. Riparia will give students within Earth and Mineral Sciences (and beyond) a chance to interact, present and discuss their research at a local forum, provide professional development opportunities, and offer the opportunity to communicate with others interested in chemical, biological, and physical processes connected to the hydrologic cycle.

Riparia will also allow faculty to coordinate plans for writing proposals. The ability to generate a team of scientists suited to a given call-for-proposals is a key to success for large, multi-disciplinary grants. Riparia will generate discussions among individuals across the College, which will make creating teams and writing proposals a more straightforward task. I look forward to participating in the Center with you.

Sincerely,

Kamini Singha

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C. Gregory Knight
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April 14, 2008

Prof. Robert Brooks
Wetlands Center
Penn State University
University Park, PA 16802

Dear Rob:

I want to convey that I enthusiastically endorse the proposal for RIPARIA as a center for hydrological and related land use studies here at Penn State.

I have long felt that Water has remained a whole-less-than-parts here, and RIPARIA takes this issue in a very positive direction.

It would make good sense that the Watersheds and Water Resources Minor be administered in RIPARIA as part of RIPARIA's educational outreach.

In addition, I'm pleased to confirm my personal support for RIPARIA and my willingness to be associated with the exciting new development. I see tremendous opportunities for us in EMS to gain from this initiative, but I also see that RIPARIA offers opportunity as well for the evolution of an environmental track in the School of Environment Affairs.

With best wishes for success in your RIPARIA proposal.

Sincerely yours,

C. G. Knight

Erica A.H. Smithwick
318 Walker Building
Department of Geography
Pennsylvania State University
University Park, PA 16802

April 17, 2008

Attn:Susan Brantley

Director, Earth and Environmental Systems Institute
The Pennsylvania State University
2217 Earth & Engineering Sciences Building, 225B
University Park, PA 16802

Dear Sue,

I am writing on behalf of the proposed EESI center, ***Riparia.*** A primary goal of mine is to seek out opportunities for interdisciplinary linkages with faculty of the College of Earth and Mineral Science that are based on mutually beneficial areas of interest. Water is clearly one of these areas where both geochemists and biophysical scientists can ask interesting, synthetic questions that lead to new insights about earth system dynamics that may also lead to sustainable ecosystem management. Water dynamics across landscape surfaces is a critical research need that is at the interface of biotic and abiotic perspectives in earth system science, and specifically, landscape ecology. This is a general opportunity for EESI to lead this effort, with specific attention to the scales at which water management decisions are being applied. There is also a great opportunity to integrate cross-scale syntheses at landscape scales, using knowledge gained at broader and finer spatial and temporal extents.

In particular, my effort to establish a laboratory of Landscape Ecology At Penn State (LEAPS), within the Department of Geography, would benefit from such a center. Currently, I have a M.S. student from the Inter-College Graduate Program in Ecology that is working closely with the existing Cooperative Wetlands Center (CWC) to develop a research plan that is based on sites established by the CWC but whose research is broader in scope and scale than previous efforts. We will be exploring nitrogen availability in forests adjacent to headwater complexes in the Juniata watershed. Our goal is to develop landscape characteristics, by watershed, that help define biogeochemical "hydroscapes." Access to equipment, symposia, and integrated research opportunities would greatly enhance this student's (and presumably future students') experience.

I also envision that my research program will increasingly be focused on the influence of landscape factors on watershed biogeochemistry. Development of a center that could serve as a site that fosters collaborative research (in conjunction with other efforts across campus, such as with those faculty involved with the CZO, for example) is critical to this effort. Specifically, the integration across

scales is a key component of my work in landscape and ecosystem ecology and is a stimulating core research area of the proposed center. I also view integrative modeling approaches as part of the research agenda for ***Riparia*** that brings together ecosystem and hydrological models to answer integrative water-related questions of flow, transport, and export across biogeochemical landscapes. Being successful in these efforts (integration across scales, merging of terrestrial, aquatic, geological, and social factors) will require faculty and students have the auspices of a center to provide structured exchanges of ideas and resources to support external and internal cross-fertilization. It is my view that these needs extend beyond current capacity of the CWC. A new center (***Riparia***) is needed to focus these efforts and ask transformative questions that are at the forefront of current funding opportunities and will most benefit society.

Thank you for the opportunity to provide input on this proposed center. If you have any further questions, please do not hesitate to contact me.

Sincerely,

Erica A.H. Smithwick, Ph.D.
Asst. Professor of Geography and Ecology, Department of Geography
Graduate Faculty member of the Inter-College Graduate Program in Ecology