Riparia – 23 Years a Center

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

This Center is supported by the Department of Geography, the Earth and Environmental Systems Institute, the College of Earth and Mineral Sciences, 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

2. Director – Robert P. Brooks, Ph.D., Professor of Geography and Ecology, has led Riparia since it was established in 1993. He will continue to lead the center and selected research projects.

3. Current participants

Associate Director – Denice Heller Wardrop, P.E., Ph.D., Professor of Geography and Ecology Dr. Wardrop is currently on leave as the Interim Director of the University's Sustainability Institute. She is anticipated to return to half-time involvement with Riparia in Fall 2017, which would include the following responsibilities: advising graduate students, leading selected research projects, and interfacing with the broader University community and external stakeholders on student engagement, outreach, and research.

Geospatial Coordinator – Corina Fernandez, M.S., Research Associate. Her technical expertise is in the area of GIS applications to environmental topics and analysis of water resources data. Ms Fernandez has proven to be a valued member of the team (even while working at 50% time) over the past two years. She will continue to be in charge of producing and applying geospatial data for Riparia, and is assuming more responsibility for database management and the website. We anticipate she will become an Instructor in the Geography's MGIS and GIS Certificate Programs beginning in either Fall 2017 or Spring 2018.

Botanist – Sarah Chamberlain, M.S., Senior Research Assistant, will continue to lead projects, serve as our botanist and as database coordinator. In Fall 2015, she was appointed Curator (50% time) of the PAC Herbarium at Penn State, where she has raised the visibility and utility of this valued unit. She has submitted several grants to support the Herbarium to NSF, and other potential sponsors. She is the coordinator for the Mid-Atlantic Wetlands Work Group (MAWWG), an interstate research, outreach, and management organization.

Other Faculty and Staff –

Michael Nassry, Ph.D., Research Associate, Ecological Engineer, teaching sections of GEOG 431 – Geography of Water Resources and CAUSE 2016 (Alaska & Peru); renewed for 2017); research analyses and reporting;

Gian Rocco, Ph.D., Research Associate, Herpetologist, teaches GEOG 313 – Field Geography, each fall semester, although his role is likely to change in Fall 2017;

Susan Yetter, M.S., Research Assistant, Invertebrate Biologist, Project Coordinator for the new Center for Nutrient Solutions.

Riparia Associates – Following the EESI template, we began inviting Riparia Associates to enhance the breadth of our Center. Colleagues with mutual interests in collaborations are considered, both within and external to Penn State. To date, two have been invited and accepted 3-year appointments, and one or two more are being considered in 2017.

4. Rationale

Riparia has proven to be a productive and collaborative venture for over 23 years (1993present). Through two decades, Riparia's research has taken an arc of becoming progressively more complex and more comprehensive in the scope of our investigations, beginning with the first characterizations of wetlands in the Commonwealth, to theoretical advances in the effects of disturbances in the physical geography of aquatic systems, to the measurement of biogeochemical processes at multiple scales, to contributing to advances in mitigation policy and practice.

The features that make wetlands fascinating places also contribute to their controversial status. No other land type is regulated as intensively, and few other habitats offer such a wide range of ecological services – floodwater storage and desynchronization, nutrient transformation, carbon sequestration, and valued biodiversity. Wetlands are part of a larger hydrologic system composed of other wetlands, streams, and riparian areas within an encompassing watershed. Research conducted by Riparia at Penn State is directed at understanding how these integrated systems function and how they are perturbed by human activities. We are also at the forefront of providing science in defense of protective laws and policies and wetlands and other aquatic ecosystems. Court challenges to the Clean Water Rule, wetland delineation procedures, and TMDLs are increasing, making our scientific findings all the more valuable to decision-makers.

Our "bread and butter" continues to be the establishment of a collection of 222 natural reference wetlands throughout the major ecoregions of Pennsylvania. We have leveraged the data from Riparia's Reference Wetland collection and database for many grants and contracts, and more than a dozen graduate students have added to the value of these reference wetlands as a long-term, dispersed research set. A program of re-sampling selected sites every 10 years has led to increased value. Each year we return to 10 of the original sites to gather data for the 3rd sampling period of these reference wetlands – 20 years later.

Currently, we are making these reference data available, along with reference data from other Mid-Atlantic states through a publicly-accessible, interactive database, with the intent of improving wetlands restoration and mitigation. When combined with value-added services, such as the newly released Floristic Quality Assessment Index calculator, we will continue to play a vital role in the region (both built by CEI). Our latest endeavor is to promote, or perhaps develop and host, a national Reference Wetland Registry to provide metadata to direct users to the varied sources of reference wetland data.

Where do we see Riparia's work going in the future?

As regional, national, and global demands for freshwater water continue to grow, water science and policy will continue to drive and inform issues of critical scientific, technological, and societal importance. Riparia intends to remain a long-term, valued asset to the Department, College, and University, and maintain its role as a leader in understanding and assessing freshwater ecosystems. In the immediate future, we hope to serve as a primary node in a network of water-based faculty across campus. We'll continue our commitment to offering quality wetland and water courses in the University resident education program, with continuing forays

into offering similar courses online in World Campus programs (two new courses and a water certificate program are in the works).

We maintain strong linkages across multiple departments, colleges, centers, and institutes across campus. By encouraging the involvement of more faculty 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 meets the guidelines of the Graduate School and EESI for centers.

5. Funding Opportunities

We will continue to build upon past successes which makes us competitive for a wide breadth of funding opportunities, despite a difficult funding environment. 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. We will 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.

Currently, we are focused on research projects and extramural sponsors that can help us move toward further understanding of our Riparian Disturbance Hypothesis. Several integrated projects are investigating multiple dimensions of riparian buffers throughout the Mid-Atlantic Region – applying ecological indicators and their translation into measures of ecosystem services, optimal locations and designs to increase nutrient and sediment removal, and performance evaluation using mixed methods (i.e., hydrologic modeling, field sampling, watershed-level implementation).

6. Center Needs and Past Expenses

As an established center, Riparia is reasonably well-situated with regard to space and equipment, although the Ecosystem Geography group will likely need additional collaborative laboratory and work spaces in the near future. Discretionary funds continue to be severely limited for a center with Riparia's level of activities. Funds from EMS and Geography sources were renewed in 2015 for another 3-year period, but at a reduced amount (\$20,000/year). <u>Continued funding of \$10,000 from EESI</u> would be used primarily for three purposes that enhance center operations:

- Recruitment of high quality graduate students (primarily with "top-up" funds, used as necessary). (\$2,000)
- Travel funds to support trips to conferences and meetings by faculty, staff, and graduate students. In general, these funds are used for national and/or international meetings where papers are presented, or where networking opportunities could prove fruitful, or for personnel that are serving in leadership roles in professional organizations. (\$5,000)
- Support for center activities. These funds are used to supplement various center activities as needed, including support for summer interns, outreach activities, purchase of new software or licenses used for research activities, and filling gaps in funding for current personnel. (\$3,000)

Funds in 2014-2016 were used primarily to support travel to conferences; and for wages for interns/students on collaborative projects; to provide connectivity between grants for selected faculty and staff salaries; and for purchasing equipment, software, and licenses to support on-going projects.

7. Management Structure and Center Operations

Riparia has dedicated physical space managed through the Department of Geography in Walker Building. This space can be used to meet modest expansion needs for Riparia. The Ecosystem Geography group has reconfigured office and laboratory space on the 2nd floor of Walker Building to promote collaboration and efficiency. Operating funds currently available to Riparia through department and college sources will be leveraged for activities of Riparia, including and beyond the requests amounts. Our interactions with other faculty are primarily at the project level, with less need to interact on administrative matters.

8. Selected Accomplishments from 2014-2016

- Brooks was appointed Ruby S. and E. Willard Miller Professor of Geography and Ecology (2015)
- Brooks served on Chesapeake Bay Program's Wetlands Expert Panel member formed to establish quantitative measures on the efficiency and efficacy of buffers for wetlands and streams (2014-2015)
- Denice H. Wardrop, Senior Scientist, is nearing completion of a successful term as the Interim Director of the Sustainability Institute.
- Riparia participants attended annual meetings of the Society of Wetland Scientists, botanical meetings, aquatic ecology conferences, reference wetlands workshops, and international travel.
- Graduated one student per year: Townsend (Geog MS, '14), Tyrna (Geog PhD, '15), Hirt (Geog MS, '16); 3 graduate students currently in residence.

Research and Scholarship. Research projects and scholarly activities continue to be the focus of Riparia. Faculty, staff, and students continue to lead interdisciplinary, multi-institutional projects, compete successfully for extramural funds, publish in journals and other outlets, make presentations at regional, national, and international conferences. Recent evidence of our success and leadership in Research and Scholarship includes:

- Papers and presentations continue at a respectable rate, including publication in a diversity of journals (including Wetlands, Ecological Indicators, Landscape Ecology, IBIS, Biology Letters, Conservation Biology see selected publications at end of renewal), and attendance at a variety of regional, national, and international conferences.
- Riparia, in collaboration with other units, secured about \$1.3M in new funds from 2014-2016 after an diligent effort to write and submit proposals, during a period of more intense competition (14 proposals awarded, 11 rejected),
- Personnel from Riparia participated in the second National Wetlands Condition Assessment during summer 2016. Sarah Miller and Hannah Ingram led a team of student interns that sampled about 40 sites in Pennsylvania and Maryland, contributing to the 1,200 sites sampled nationally by USEPA and their partners.
- We continue to work with scientists and managers from multiple states and agencies (PA, MD, VA; USDA-NRCS, ARS, FSA; PADCNR Riparian Buffer Advisory Committee)

in applying our Stream, Wetland, Riparian Index assessment methodology throughout the region to evaluate performance of riparian forest buffers. Supports two post-docs.

• We have increased our inclusion of undergraduate interns in research projects, with 3-9 hired/year, depending on needs.

Outreach and Service. Riparia has an outstanding reputation in the mission of Outreach and Service. Whenever possible, we respond to requests for information and assistance. These include requests from the University students and faculty, the University's Office of the Physical Plant, federal and state agencies, non-governmental organizations, consulting firms, industries, schools, and citizens. Much of our effort has depended upon volunteerism, with a modest amount of discretionary resources used to encourage and support these activities. 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. Recent evidence of our commitment and achievement in Outreach comes in many forms:

- Sarah Chamberlain continues to serve as Co-Director of the Mid-Atlantic Wetlands Work Group
- Sarah Chamberlain secured a book contract for her original field guide *Guide to Grasses of the Mid-Atlantic Region* (Penn State Press)
- Selected outreach events:
 - 1/14 Brooks, RP. Science informs policy and practice for wetlands protection and conservation. Delaware Wetlands Conference: Conserving Wetland Resources through Science and Education, 30 Jan 2014, Dover, DE. (Invited plenary speaker)
 - 5/15 Brooks, RP. Building a better wetland: Reference data and tools for enhancing wetland projects. USDA Natural Resources Conservation Service – <u>Science and Technology Webinar</u> 20 May 2015. Participants n = 412! <u>http://www.conservationwebinars.net/webinars/building-a-better-wetland-reference-data-and-tools-for-enhancing-wetland-projects</u>
 - 5/15 Brooks, RP. Headwater wetlands and streams: providing essential connectivity to downstream waters. A commentary. Consortium of Aquatic Science Societies and Environmental Law Institute Panel: Understanding the connections between streams, wetlands, and downstream waters. 21 May 2015 Washington, DC. (presented to Congressional staffers and agency personnel)
 - 5/16 Brooks, RP, WL Daniels, and E Stein. Establishing Reference Conditions for Performance Standards and Long Term Monitoring Results: Soils, Hydrology and Vegetation. Association of State Wetland Managers <u>Webinar</u>, 10 May 2016.
 - 1/16 Brooks, RP. The art and science of translating ecological indicators to ecosystem services for wetlands, streams, and riparian corridors. Bernard and Susan Master Moonlight on the Marsh Distinguished Lectures, 27-29 Jan 2016. Everglades Wetland Research Park, Naples, FL. (Invited seminar speaker)
 - **Brooks, RP**, with C Fernandez. Wetlands of Spring Creek Watershed. Spring Creek Watershed Atlas (atlas published online)
 - 11/16 Brooks, RP and S. Chamberlain. Joint Meeting Mid-Atlantic Wetlands Work Group and New England Biological Assessment of Wetlands Work Group, 1-3 November 2016, Galloway, NJ. Organized meeting and made presentations.

- Susan Yetter, as Project Coordinator, organized and/or delivered multiple outreach events in the Susquehanna/Chesapeake watershed.
- Brooks continues to represent Penn State as its representative to the Board of the Chesapeake Research Consortium, which recently added a 7th member (VaTech).

Upcoming Outreach Events.

Centred Outdoors EXPO, 24 April 2017, State College Municipal Building; GEOG 550 (Graduate wetlands class) provided ecosystem services analyses of 9 outdoor sites in Centre Co. targeted for Health and Environmental Challenge for citizens and families throughout the region for Summer 2017.

Center for Science and the Schools (CSATS) Workshop, 29 April 2017; Aquatic Ecosystems workshop for two dozen teachers held at Millbrook Marsh Nature Center, State College, PA.

Instruction. Brooks continues to work with the Dutton e-Education Institute, as a Board Member for the MGIS Graduate Program, and on bringing an existing resident education and online course, to the World Campus catalog. The faculty and staff of Riparia both participate in and coordinate several water-related and ecological graduate and undergraduate programs. In addition, Riparia promotes graduate and undergraduate research, symposia, field experiences and internships.

9. Selected Publications, 2014-2016

- Brooks, RP, D Faber-Langendoen, G Serenbetz, J Rocchio, ED Stein, and K Walz. 2016. Toward creating a national Reference Wetlands Registry. National Wetlands Newsletter 38(3):6-10.
- Poeske, R, and RP Brooks. 2016. Reference wetlands as benchmarks for assessing climate change effects. National Wetlands Newsletter 38(3):15.
- Julian, JT, VA Gould, GW Glenney, and RP Brooks. 2016. Seasonal infection rates of *Batrachochytrium dendrobatidis* in populations of northern green frog *Lithobates clamitans melanota* tadpoles. Diseases of Aquatic Organisms 121:97-104. doi: 10.3354/dao03046
- Chamberlain, SJ, and RP Brooks. 2016. Testing a rapid Floristic Quality Index on headwater wetlands in central Pennsylvania, USA. Ecological Indicators 60:1142-1149.
- Goerman, D, RP Brooks, and G Podniesinski. 2016. Aquatic Resource Protection and Management Action Plan for the Commonwealth of Pennsylvania 2011-2020. PA Dept. Environmental Protection, Harrisburg, PA. 37pp.
- Miller, T, R Brooks, M Lanzone, D Brandes, J Cooper, J Tremblay, J Wilhelm, A Duerr, T Katzner. Limitations and mechanisms influencing the migratory performance of soaring birds. 2016. Ibis 158(1):116-134. <u>http://onlinelibrary.wiley.com/doi/10.1111/ibi.12331/abstract</u>
- Peper, ST, GV Kollias, DH Mitcheltree, RL Peper, RP Brooks, SS Stevens, and TL Serfass. 2015. Utility of two modified-live virus canine vaccines in wild fishers (*Martes pennanti*). Veterinary Quarterly (2015):1-6 DOI:10.1080/01652176.2015.1114193

- Brooks, RP et al. 2015. Refining Landscape and Field-Based Indicators in Support of Pennsylvania's Wetland Program Plan. Final Report to USEPA-Region 3, CD96312001, Philadelphia, PA.
- Julian, JT, RP Brooks, GW Glenney, and JA Coll. 2015. Ranavirus and *Batrachochytrium dendrobatidis* surveys of amphibian populations in mitigated and natural wetlands in Pennsylvania. Final Report to Wild Resource Conservation Program, Project No. WRCP-012459, Harrisburg, PA. 42pp.
- Miller, TA, RP Brooks, M Lanzone, D Brandes, J Cooper, K O'Malley, C Maisonneuve, J Tremblay, A Duerr, and T Katzner. 2014. Assessing risk to birds from industrial wind energy development via paired resource models. Conservation Biology 28(3):745-755. doi: 10.1111/cobi.12227
- Calhoun, AJK, J Arrigoni, RP Brooks, ML Hunter, and SC Richter. 2014. Creating successful vernal pools: a literature review and advice for practitioners. Wetlands 34:1027-1038.

10. Budgets 2014-2016

RIPARIA 20014/2015	Beginning Balance*			\$11,343.00
Expenses	Description	Encumbered	Actual	Total
Salaries				\$0.00
Wages	Gallagher, Ryan		\$300.00	\$300.00
Supplies & Mat'l	Cover deficit on 73PB Match		\$417.00	\$417.00
Travel	Brooks, Portland, OR, May 2014		\$1,920.54	\$1,920.54
	Brooks, LA, Nov 2014 Brooks, Traverse City, MI, Apr 2015		\$1,401.20 \$1,253.12	\$1,401.20 \$1.253.12
	Brooks, Providence RI, May 2015		\$2,176.95	\$2,176.95
	Tyrna, Providence RI, May 2015 Yetter, Milwaukee, WI, May 2015		\$533.33 \$1,450.91	\$533.33 \$1,450.91
	Britson, Providence RI, May 2015 Bishon, Providence RI, May 2015		\$1,183.35	\$1,183.35
	Bishop, Peru, March 2015		\$1,011.84	\$1,011.84
Total Spent				\$12,248.24
BALANCE REMAINING				(\$905.24)

RIPARIA 2015/2016	Beginning Balance*				\$	9,094.00
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Expenses	Description	Encumbered	Actual		Total	
Salaries					\$	-
					\$	-
Wages	Gallagher, Ryan		\$	120.00	\$	120.00
					\$	-
Supplies	3 cases for transporting equip		\$	667.71	\$	667.71
Travel - Out of State	Fernandez, Wilm DE, Feb16		\$	611.51	\$	611.51
	Chamberlain, Edgewater MD, Apr 16		\$	647.42	\$	647.42
	Ingram, Edgewater MD, Apr 16		\$	406.00	\$	406.00
	Brooks and Gould, Corpus Christi, TX,					
	Jn 16		\$	5,303.32	\$	5,303.32
	Chamberlain, Cambridge MD, Jn 16		\$	173.69	\$	173.69
	Chamberlain, Lancaster, Jn 16		\$	552.87	\$	552.87
					\$	-
Total Spent					\$	8,482.52
BALANCE REMAINING					\$	611.48

Riparia – EESI Center proposal for renewal – 17 April 2017

RIPARIA 2016/2017	Beginning Balance*			\$	10,611.88
as of 2/9/17					
Expenses	Description	Encumbered	Actual	Total	
Salaries				\$	-
				\$	-
Wages				\$	-
				\$	-
Travel - Out of state	Mazurczyk, SWSC, Corpus Cristi, Jn 16		\$ 1,334.40	\$	1,334.40
	Chamberlain, Savannah, GA, Aug 16		\$ 1,115.78	\$	1,115.78
				\$	-
				\$	-
Total Spent				\$	2,450.18
BALANCE REMAINING				\$	8,161.70

* Balance of 2016-17 to be spent on travel to international meeting & intern wages.

11. Support Letters attached (Shortle, Taylor, Gall) - on following pages:



Environment and Natural Resources Institute

The Pennsylvania State University 111 Ferguson Building University Park, PA 16802-5600

April 17, 2017

Susan Brantley Director, Earth-Environmental Systems Institute Distinguished Professor 2217 EES Building University Park, PA 16802

Dear Sue:

I want to express my enthusiastic support for Riparia and endorse Rob's request for continued funding. I applaud their accomplishments and continue to see Riparia as an excellent investment for EMS and PSU, especially as water emerges as priority at Penn State, as well as in the world beyond.

Riparia has been invaluable to the work of the EPA funded Center for Nutrient Pollution Solutions, and added greatly the Center's development as a leader in nutrient pollution management practice and policy for the Chesapeake Bay region. The value of Riparia's work in advancing and connecting wetlands science to policy and decision making has been tremendous in other ways. Although there are many examples, his work with Farm Services Agency and USDA's Agricultural Research Service have the potential to transform federal policy for riparian buffers - a huge landscape and nutrient management issue in the Mid-Atlantic region and elsewhere.

I would also like to note a new role I have seen in Rob as the Riparia director in recent years - and this is as a mentor of young faculty as research leaders. As we have discussed at IEE meetings, Penn State has a research leadership gap among mid-career faculty. I have seen Rob actively reach out to encourage and help faculty step up from being followers and participants, to being organizers and leaders.

Riparia gives EMS and the University an excellent and unique presence that provides leadership as well as core talent to Penn State's water research community. It is also one of a few Penn State ventures which effectively connects Penn State science to the broader world to advance science based policy and management.

Sincerely,

Jomes Shorth

James S. Shortle Distinguished Professor of Agricultural and Environmental Economics Director, Environment and Natural Resources Institute



Department of Geography College of Earth and Mineral Sciences The Pennsylvania State University 302 Walker Building University Park, PA 16802-5011 814-865-3433 Fax: 814-863-7943

16 April 2017

Professor Robert Brooks Department of Geography The Pennsylvania State University University Park, PA 16802.

Dear Rob:

I am happy to support renewal of your center proposal for Riparia to the Earth and Environmental Systems Institute. Riparia has excelled at developing successful interdisciplinary teams at Penn State in conjunction with other partners to tackle challenging environmental research. Riparia's research agenda is linked directly to science-based decision making that is needed by policy makers and regulatory agencies to manage landscapes that can maintain key ecosystem services such as biodiversity, terrestrial and aquatic habitat for species of concern, water quality, and carbon sequestration. The outreach component of Riparia's mission is particularly noteworthy, and it is undoubtedly strengthening the environmental outcomes of the research effort.

The research accomplishments of the center in the last three years have been significant including external funding from a variety of sources, support of graduate students, and publication on a wide range of topics. These are good indicators of the centers success. You and the center have also led efforts across campus to secure large interdisciplinary grants that bring together researchers from the social and natural sciences. These teams focus on answering critical research questions that will then be used by agencies and other stakeholders to address pressing environmental problems. Over the next several years, Penn State is slated to build capacity in research related to the theme of water-writ large. Riparia's research focus on wetlands, water quality, and watersheds in working landscapes is in a strong position to help shape and lead this effort as it moves forward. I expect you will be busy doing that!

Sincerely

Alan H- Taylor

Alan H. Taylor Professor of Geography and Ecology



Department of Agricultural and Biological Engineering College of Agricultural Sciences College of Engineering The Pennsylvania State University 249 Agricultural Engineering Building University Park, PA 16802-1909 814-865-7792 Fax: 814-863-1031 abe.psu.edu

April 17, 2017

Susan Brantley Director, Earth-Environmental Systems Institute Distinguished Professor 2217 EES Building University Park, PA 16802

Dear Dr. Brantley,

I am writing to express my enthusiastic support for Riparia and Dr. Brooks' request for continued funding. Given the importance of water security in the food-energy-water nexus that has become a critical need across all scales from local to global, support to Riparia is an excellent use of resources at Penn State.

When I began my career at Penn State in 2013, I reached out to Riparia shortly after I began. Dr. Brooks was more than willing to help me in my endeavor to locate vernal pools near campus. This laid the foundation for my first PhD student to successfully design a project that studied the presence of pharmaceuticals and personal are products in vernal pools across a human impact gradient. Without Riparia's help, this project would have taken a lot longer to launch. Riparia ensure that we could "hit the ground running" to take our ideas and turn them into reality. This has become a very exciting project for my research group, and I am so grateful to Dr. Brooks and Riparia for helping us to get execute our ideas over the past few years.

This year, Dr. Brooks and I were awarded a \$500,000 USDA project to conduct research related to riparian buffers and filter strips. The project was ranked as "outstanding" during the review process, and it brings together a range of expertise across multiple colleges at Penn State. Without the expertise and data that Riparia brought to the project, it is unlikely that we would have been awarded the grant. Given that Pennsylvania plans to implement 95,000 acres of riparian buffers to meet its Watershed Implementation Plan goals for the Chesapeake Bay restoration, our project and Riparia will contribute to the research that can help determine where those buffers should be located and how best to design them in a way that provides multiple ecosystem services beyond water quality improvement.

Riparia gives EMS and Penn State an excellent source of data, collaboration, and expertise that allows us to remain competitive in an increasingly tight and competitive grant atmosphere. It also allows us to have a connection to a broader community so that our research can translate into policy and management changes. I look forward to continuing my collaborations and projects with Riparia.

Sincerely,

Matters Hall

Heather Gall Assistant Professor Department of Agricultural and Biological Engineering Penn State University