



# AT THE CENTER

News and Notes from the  
Center for Earth and Environmental Science

Fall 2010

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## *Director's Note*

CEES has been extremely busy this field season, particularly with our blue-green algae work. So busy, in fact, that we had to skip a newsletter so we have a lot of great information to share with you! The CEES team and I have been diligently sampling central Indiana waterways, analyzing data, and presenting to multiple stakeholder groups and at professional research conferences, nationally and internationally. It is exciting work and we are continually delving deeper into this complex issue. In this edition of *At the Center*, we highlight our blue-green algae research work along with providing updates from our affiliated watershed stakeholder groups (the Upper White River Watershed Alliance and the Eagle Creek Watershed Alliance), CEES' *Discovering the Science of the Environment* science education program, a new mitigation initiative with IndyParks and INDOT, and graduate student research. We also welcome a new chair to the IUPUI Department of Earth Sciences, Dr. Kevin Mandernack, who began his position in early August. Please read more about his background and research below.

We are continually grateful for the collaboration and support we receive for our ongoing work. We strive to make a difference in central Indiana and beyond through sound science and research practices, innovative collaborations, and civic engagement experiences for students. Many components of our programs are based on grants and philanthropy. Your contribution goes a long way in supporting these efforts. Enclosed is our annual *Friends of CEES* return envelope. We appreciate your consideration of our programs and look forward to new and exciting endeavors!

Thank you again and stay in touch. Enjoy the autumn weather!

Dr. Lenore P. Tedesco, Director

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## *Blue-green Algae in Indiana and the Midwest: an ongoing update*

A lot has happened in algae world since the last time I wrote to you about it. As you can imagine – and now that you are all quasi-expert on the issues – the incredibly hot summer we had caused algal populations to be very high – statewide and even regionally. I am happy to report that CEES is working closely with the State of Indiana, through our partners at IDEM and the Indiana State Department of Health, to help launch the state's pilot blue-green algae and algal toxin (microcystin) monitoring program. CEES is working to train IDEM scientists in algal identification techniques and running algal toxin analyses while IDEM establishes their own in-house expertise in both algae identification and toxin analysis. This is really a big step for those of us concerned about the human health risks from blue-green algae. Additional great news comes from the commitment and engagement from the Indiana State Department of Health. Colleagues there have set up information hotlines regarding blue-green algae, and working with IDEM, we have all updated and upgraded the information on the IDEM algae web page ([www.algae.in.gov](http://www.algae.in.gov)), and produced an informational poster about how to recognize an algal bloom and what steps people should take around lakes and streams with algal blooms – both for themselves and their pets. These are great results for those of us that have been raising concerns and seeking clear messages and monitoring efforts around this issue for years. So pat on the back – and thanks to all of you reading this that know you have had an important role in making this turn out well.

In June, CEES along with our partners at Veolia Water Indianapolis, The Upper White River Watershed Alliance, and the Eagle Creek Watershed Alliance, hosted a free symposium focused on "blue-green algae and the nutrients that cause them". There were a series of talks from some national experts about blue-green algae and the causes and risk of blooms, a panel discussion about ways Indiana can reduce nutrients in our waterways, and the launch of our Clear Choices Clean Water campaign (see the accompanying article in this newsletter). We had more than 200 attendees and a blue-ribbon panel that really addressed the issues, pros and cons, associated with nutrient management. It was a really great day – and the start of an annual symposium that we will host. So look for next year's topic and event!

So back to the algae update. This has been an interesting year so far. Central Indiana saw taste and odor issues in the finished drinking water supply at levels never before seen. April was the month when your tap water just didn't taste very good. Remarkably, the problem was a massive algae bloom in Prairie Creek Reservoir, located just outside of Muncie. Basically, smelly and bad tasting water was being released from the reservoir, into the White River, traveling downstream some 60 miles to the drinking water supply intakes on the White River in Indianapolis. Folks at the water company did an amazing job of reducing the taste and odor compounds, which are not harmful but definitely unpleasant, but even their incredible efforts still left taste and odor levels too high to ignore. This is a really great example of the concept of a watershed and that we all live downstream!

The heavy June rains helped to flush algae out of the reservoirs and created conditions that are not conducive to their growth and development so we got a reprieve from the blooms throughout the month of June. Then came the hot and dry summer months when the algae did unfortunately really well. Mississinewa Reservoir, Patoka Lake, and Eagle Creek, Geist and Morse Reservoirs all had very high levels of algae. Thankfully, the levels of actual algal toxins (microcystin) remained low. Nonetheless, all of these reservoirs have had health advisories for recreational contact posted by the Indiana State Department of Health.

Nicolas Clercin, CEES staff, and I sampled the Indianapolis reservoirs biweekly through the spring and summer months, working with IDEM on the 5 lakes they are monitoring monthly, as well as Patoka Lake that we monitored monthly. Our data sets are getting to be really excellent and we are beginning to have some understanding of which species of algae are responsible for taste and odor episodes, which are responsible for algal toxin production, and perhaps even what the specific triggers are that drive a bloom in a given place and time.

So stay tuned for more algae updates and we'll keep sampling and analyzing. We feel really good about our research and our efforts to inform the public about blue-green algae and the associated risk. ~ Lenore

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### ***IUPUI Department of Earth Sciences Welcomes New Chair, Dr. Kevin Mandernack***

Excerpt from School of Science Press Release

<http://www.science.iupui.edu/news>

Kevin Mandernack, Ph.D., an internationally respected researcher and teacher whose research impacts a variety of critical areas including climate change, deep ocean drilling, water pollution, and the biochemical processes of the geological record, has been named chair and professor of earth sciences at the School of Science at Indiana University-Purdue University Indianapolis.

A geomicrobiologist and biogeochemist poised at the intersection of the physical and life sciences, Mandernack comes to IUPUI from the faculty of the Colorado School of Mines, where he held a joint appointment in the Department of Chemistry and Geochemistry and the Department of Geology and Geological engineering. From 2008 to earlier this year, he served as program director of the Ocean Drilling Program at the National Science Foundation. He earned a doctorate in marine biology, with emphasis on marine biogeochemistry, at the Scripps Institution of Oceanography after graduating with B.S. degrees in geology and zoology from the University of Wisconsin-Madison.

Mandernack's current research focuses on the emerging field of geomicrobiology as he studies the interactions between the biosphere (those parts of the earth's surface, water, and atmosphere that support life), the chemosphere (the atmospheric regions where chemical activity occurs), and the lithosphere (earth's crust and upper mantle). He has extensive experience in the biochemical cycles bacteria use for processing carbon dioxide and other organic substances in the environment. He has investigated ocean systems devoid of oxygen, the frigid waters of Antarctica, deep crustal aquifers and minute bacteria visible only under high-powered microscopes.

Mandernack is the author of more than 25 peer-reviewed studies, including publications in *Science* and *Nature*. He has received research funding from the U.S. Department of Energy, the National Air and Space Administration (NASA), the National Science Foundation, the U.S. Department of Agriculture and others.

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### ***Watershed Alliance Updates***

#### ***Upper White River Watershed Alliance (UWRWA) Moves Into Primetime Cable***

The UWRWA broke into new territory this summer with the launch of its first mass media social marketing campaign for clean water! The UWRWA's regional stormwater education program receives financial and technical support from all of the cities and towns in Hamilton County, as well as Zionsville and Pendleton. The Alliance uses this support, along with insights gained from public surveys, to craft educational messages that will reach key target audiences. The result of this year's efforts was a 30 second animated television spot that aired on dozens of cable channels during the months of July and



August. Based on the scheduled air time, the spot delivered 1,437,145 impressions/exposures to adults ages 35 to 64 throughout the course of the campaign. Maybe you saw it? The TV spot focused on the interconnectedness of storm drains, streams, and drinking water. It suggested that the viewer make a choice to help promote clean water, namely using phosphorus free fertilizer. The Alliance along with two other charter sponsors (CEES and the Tippecanoe Watershed Foundation) then created a call to action via a web-based resource center and pledge campaign to supplement the efforts of the TV spot.

To learn more about the focus of this year's campaign on no-phosphorus fertilizer use, visit [www.ClearChoicesCleanWater.org](http://www.ClearChoicesCleanWater.org) and TAKE THE PLEDGE! The website allows residents and/or businesses to take the no-P pledge, get on the map, and even compete between neighborhoods or businesses by putting together Clean Water Teams. The website also houses important information such as where to purchase phosphorus free products, dozens of common questions and answers about fertilizer use and lawn care, educational information and data on water quality, and even a coupon center that will continue to grow as the campaign increases in strength.

The campaign's focus and action pledge will change annually, as will the associated TV spot. The UWRWA is now working to find additional sponsors for the advancement of more Clear Choices campaigns and even larger media coverage. Lastly, the Alliance again participated in the major White River Clean Up on September 11<sup>th</sup>. This year's event included groups across five counties and drew around 1,500 volunteers. Visit the website for Clean Up details and discoveries! [www.UWRWA.org](http://www.UWRWA.org).

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### *Eagle Creek Watershed Alliance (ECWA) Embarks on \$655,375 Project to Advance Its Efforts*



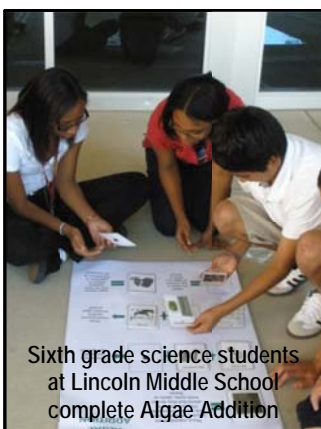
Harold Thompson at an agricultural field day promoting the Eagle Creek Watershed cost-share program.

The ECWA (under the sponsorship of CEES) is into the first year of a new three year grant to continue its implementation work in the Eagle Creek Watershed. The three standing committees have regrouped and haven't missed a step in terms of delivering programs and seeking applications for best management projects (pollution prevention projects). The education committee has conducted events and workshops with two more held this fall – Water Quality Awareness Day at Eagle Creek Park (targeting 5<sup>th</sup> grade student education) and a Project WET workshop and reservoir tour (targeting educators throughout the watershed). The committee recently utilized a pre and post test type survey at the June 17<sup>th</sup> Nutrient and Algae Symposium to help determine what participants knew prior to, and learned from, the Symposium. This type of evaluation is helping the committee plan its next steps in outreach efforts and event planning.

The Technical Committee is pleased to have added a new Agricultural Liaison, Mr. Harold Thompson, to the team. Harold comes with 39 years of experience in conservation and is already busy working with farmers in the watershed to get projects implemented. Thanks to the ECWA's recent participation in several agricultural field days with partners at the local Soil and Water

Conservation Districts, interest is growing in an important best management practice (BMP) called 'cover crops'. Cover crops are planted in mid-Fall after fields are harvested of corn and soybeans. The cover crops help hold soil in place and take up nutrients, particularly nitrogen, during the winter and early spring seasons. A variety of crops can be used including wheat, rye, turnips, radishes, clover, and peas. The Technical Committee is reviewing applications for cost-share funds to help encourage the adoption of this practice on nearly 3,000 acres in a few critical subwatersheds.

Finally, a subcommittee (with participation from all three standing committees) is working on the development of a set of educational graphics that will be developed with the help of a consultant. These graphics will show flow paths, pollution sources, and possible best management practices on a variety of landscapes. The graphics will be used in the ECWA's outreach program, including presentations to groups and printed materials. No doubt the end product will be picked up by many of our partners and similar watershed groups once complete. The Alliance is excited to have these new powerful educational tools in the fight for improved water quality!



Sixth grade science students at Lincoln Middle School complete Algae Addition

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### *Discovering the Science of the Environment*

Since launching the Discovering the Science of the Environment (DSE) mobile technology trailer program in August 2007, the DSE program has been able to reach 7500 students in 290 classrooms throughout central Indiana. Thanks to fantastic, mild spring weather, 1225 4<sup>th</sup> – 12<sup>th</sup> grade students from Forest Glen Elementary, Perry Meridian Middle School, Franklin TWP MS East, Franklin Central High School, Lincoln Middle School, Clay Middle School and South Grove Intermediate were able to explore the ecosystems available on their school grounds, conduct scientific experiments, collect scientific data, and learn about important environmental processes. The fall programming season is currently underway and we are on track to work with approximately 1800 students from nine central Indiana schools!

As the DSE program travels head-long into its fourth year of programming, CEES is pleased to welcome new additions to the program. Jessica Silas, the new DSE Education Program Assistant, is a recent graduate of the University of Illinois Urbana-Champaign where she earned a Bachelor's of Science in Earth Systems, Environment and Society. She brings a wealth of energy, organization and a love for science that will prove invaluable for the program! The DSE program also welcomes new Earth Sciences IUPUI Urban Educators GK-12 Fellows, Julie Crewe and Amy Smith. In the upcoming months, through this fellowship opportunity and the DSE program, the GK-12 Fellows will be able to create unique DSE programs that will make their graduate research accessible to hundreds of middle and high school students. With a very small staff running the program, we are extremely proud of the number of students we are able to reach each season and the quality of their DSE program experiences!

The fourth annual DSE Summer Institute for Teachers was held June 28- July 2 at the Earth Discovery Center of Eagle Creek Park. Seventeen participants from three teams, Brook Park School of Environmental Studies (Lawrence Township), Doe Creek Middle School (Hancock County), and Oaklondon Elementary School of Environmental Studies (Lawrence Township) attended the week-long training session focused on strategic planning and curriculum and instruction development for school ground outdoor laboratories and interdisciplinary environmental education programs. We are pleased to announce that each of the 2010 teams successfully submitted grant applications to the Dr. Laura Hare Charitable Trust Environmental Learning Labs program to fund their school's action plans developed during the week-long institute. Congratulations to all!

For more information related to DSE, including the IUPUI Urban Educators GK-12 fellowship program, DSE school programs, and the Summer Institute for Teachers, please visit: [www.cees.iupui.edu](http://www.cees.iupui.edu). Click on IUPUI Urban Educators GK-12 Program or Discovering the Science of the Environment.

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### *Graduate Student Updates*

#### **Combining Multivariate Statistical Methods and Spatial Analysis to Characterize Water Quality Conditions in the White River Basin, Indiana, U.S.A.**

*Drew Gamble, MS Student / Dr. Meghna Babbar-Sebens, Advisor*

My research is a comparative study that combines spatial analysis and multivariate statistical methods. The motivation for this study is to be able to rapidly estimate water quality conditions at unmonitored locations without using expensive and time consuming mechanistic models. The study has been performed on the entire White River basin in central Indiana, and uses sixteen physical and chemical water quality variables collected from 44 different monitoring stations in the Indiana Department of Environmental Management's (IDEM) fixed station monitoring network, along with various spatial data related to land use – land cover, soil characteristics, terrain characteristics, eco-regions, etc. The study compares the use of various statistical estimates (mean, geometric mean, trimmed mean, and median) of monitored water quality variables to represent annual and seasonal water quality conditions. The relationship between these estimates and the spatial data is then modeled via linear and non-linear multivariate methods. The linear statistical multivariate method uses a combination of principal component analysis, cluster analysis, and discriminant analysis, whereas the non-linear multivariate method uses a combination of Kohonen Self-Organizing Maps, Cluster Analysis, and Support Vector Machines. The final models were tested with recent and independent data collected from stations in the Eagle Creek watershed, within the White River basin. In 6 out of 20 models the Support Vector Machine more accurately classified the Eagle Creek stations, and in 2 out of 20 models the Linear Discriminant Analysis model achieved better results. Neither the linear or non-linear models had an apparent advantage for the remaining 12 models. This research provides an insight into the variability and uncertainty in the interpretation of the various statistical estimates and statistical models, when water quality monitoring data is combined with spatial data for characterizing general spatial and spatio-temporal trends.

#### **Nutrient and Atrazine Removal in a Constructed Wetland Bioswale Complex Capturing Agricultural Tile Runoff**

*Amy Smith, MS Student / Dr. Lenore Tedesco, Advisor*

Previous studies have shown that intensive agricultural practices in the Midwest contribute significant levels of nutrients, such as nitrogen and phosphorus, and herbicides, such as atrazine, to downstream waters. When nitrogen and phosphorus become excessive in aquatic environments they cause water quality problems such as algal blooms and eutrophication. High levels of the herbicide atrazine have been shown to adversely affect the reproductive development of amphibians and fish. The effect of this herbicide on human populations is still being studied, but is believed to cause health problems in humans when present in high levels in drinking water.

My research will consist of examining the efficiency of a hybrid constructed wetland and bioretention swale in removing nitrogen and phosphorus and the herbicide atrazine from agricultural tile runoff. The wetland will be designed to maximize removal of these contaminants via interactions with the soil and vegetation. To determine the efficiency of the wetland in removing these contaminants, water samples will be taken at the inflow and outflow of the wetland and analyzed. Soil samples will be taken throughout the wetland to determine the amounts of nutrients and atrazine retained within the wetland soil and to determine the processes involved in nitrogen and phosphorus transformation and removal. The goal of this study is to examine a potential best management practice that farmers can apply to their field tile runoff to reduce nutrient and herbicide export to downstream waters.





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### *Announcing the IndyParks and INDOT Mitigation Initiative and CEES' Role*

For the last 4 years CEES has worked with Indianapolis Parks and Recreation (IndyParks), the Indianapolis Parks Foundation (IPF), and the Indiana Department of Transportation (INDOT) to develop a partnership whereby INDOT would preferentially mitigate for water resource impacts on IndyPark properties. The partnership is designed to meet the needs of both IndyParks and INDOT. In spite of attempts to minimize impacts, road construction can significantly impact water resources. In accordance with Section 404 of the Clean Water Act, INDOT must mitigate impacts. In developed areas like the greater Indianapolis region, one of the biggest challenges in successful mitigation is locating and acquiring a suitable site. IndyParks manages over 11,000 acres of public space, including miles of stream corridor along Greenways, and former agricultural fields that were wetland areas prior to being drained for agriculture. In response to public demands, IndyParks has had an ambitious natural areas restoration program that has depended on in-kind support and private funding to continue their restoration activities during times of limited public funding. IndyParks efforts at naturalization are limited by funding and INDOT needs mitigation sites. The solution was obvious. IndyParks and CEES have spent the last 2 years reviewing Park properties for potential wetland and stream mitigation areas. While potential sites were being mapped and assessed, IndyParks, IPF, and INDOT negotiated the contractual agreements to allow INDOT to mitigate on Park properties. Because the mitigation is going to take place on Park property, the site requirements are often more restrictive than standard mitigation sites. IndyParks manages the Parks as a public trust, and while traditional mitigation is often deemed successful after 5 years, IndyParks manages Park space in perpetuity. INDOT is excited to see the environmental change that their mitigation dollars can bring to park properties. IndyParks and CEES watershed mapping of potential wetland and stream mitigation sites provides a landscape-scale naturalization strategy for the city's water resources. These watershed scale maps of mitigation sites serve as templates for the management of city waterways. The INDOT/IndyParks Mitigation Initiative comes at the same time that Mayor Ballard is encouraging the creative management of storm water and the reduction of storm water flows into the streams and the Department of Public Works (DPW) is working on an aggressive Long Term Control Plan to minimize raw sewage overflows into Indianapolis waterways, greatly improving the water quality in city streams. Those efforts combined with IndyParks working to restore the physical and biological integrity of Indianapolis streams, will change the way the City looks. Streams sections that are now littered with debris and lined by sections of dangerous unstable banks will be cleaned and naturalized. Native vegetation will be planted in the stream corridors to help stabilize the streams and to keep out invasive exotic plant species that both promote erosion and obscure the stream. The Director of IndyParks, Stuart Lowry, has said that it is IndyPark's goal to naturalize all publically owned stream corridors, exclusive of those areas where the historic Kessler plan dictates a modified landscape. CEES' continuing role in this transformation of Indianapolis natural areas is to work with both INDOT and IndyParks to provide science-based restoration strategies. We welcome the opportunity.

The accompanying photographs show areas of Pleasant Run Golf Course (photo to left) that will be naturalized and nearby reference areas that show what a more stable Pleasant Run will look like (photo to right). The Pleasant Run project is the first project from this remarkable partnership of DPR, IPF, the INDOT and CEES. The Pleasant Run project provides mitigation for impacts to another tributary of White River that occurred as the result of highway work on the northeast side of Indianapolis. Work on Pleasant Run begins November 1st and will be completed in time for spring play on the course. While work starts on the first section of Pleasant Run; INDOT, IndyParks, IPF, and CEES continue to work on mitigation plans for over 100 acres of wetlands and 5 miles of stream corridor. Four years of background work was time well spent!



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