



With the effects of global climate change becoming increasingly noticeable, how will the United States be affected?

CHANGING CLIMATE

Global warming. We've all heard of it, but what does it really mean for us as a community? According to a report titled "Global Climate Change Impacts in the United States" (published by the United States Global Change Research Program and available online at <http://downloads.globalchange.gov/usimpacts/pdfs/executive-summary.pdf>), "observations show that warming of the climate is unequivocal" and that "global warming over the past 50 years is due primarily to human-induced emissions of heat-trapping gases." The report summarizes what is already known about observed climate changes and the projected effects of those changes, which could "challenge the ability of society and natural systems to adapt." In fact, adaptation is one of the two actions that society can take to deter potential effects of climate change. The other is mitigation, which involves reducing heat-trapping emissions or removing some of the heat-trapping gases from the atmosphere.

The following are key findings as presented directly from the report:

1. "Global warming is unequivocal and primarily human-induced.
2. Climate changes are underway in the United States and are projected to grow.
3. Widespread climate-related impacts are occurring now and are expected to increase.
4. Climate change will stress water resources.
5. Crop and livestock production will be increasingly challenged.

6. Coastal areas are at increasing risk from sea-level rise and storm surge.
7. Risks to human health will increase.
8. Climate change will interact with many social and environmental stresses.
9. Thresholds will be crossed, leading to large changes in climate and ecosystems.
10. Future climate change and its impacts depend on choices made today."

Global climate change can cause temperature increases and longer spans between rainfall events. When those factors combine with increased demands from society, water availability will decrease, which can affect the economic infrastructure through a breakdown in ecological ecosystems that are so valuable economically and culturally.

Through research aimed specifically at Bangladesh, Center faculty associate and hydrologist Faisal Hossain is playing an active role in the climate change issue. Hossain is involved in research to improve Bangladesh's structural capacity to adapt to the effects of climate change. His work, being conducted jointly with Ohio State University's Douglas Alsdorf, looks at how developing countries like that one could benefit by using cost-effective, shared satellite technology to measure and better understand surface water flow and storage changes. Hossain says it's important to help developing countries adapt to climate change because those people will feel its impact most directly. He believes that satellite technology has the potential to provide a lot of assistance.

INSIDE THIS ISSUE

Researchers Evaluate Swimming Performance of the Endangered Roanoke Logperch to Understand Barriers to Their Movement/ Faculty & Support.....Page 2

Fisheries Society Hosts Kids Outreach Program/Center Director Dennis George Appointed to Serve on Dry Cleaners Environmental Response Board.....Page 3

Farmers and Educators Make Spring Come Early Through Season-Extending Growing Techniques.....Page 4

Center Co-sponsors Wetland Workshop/ Researchers Examine Peat as a Tool for Simazine Removal.....Page 5

Donor Spotlights/Veolia Water and Sanitary Treatment Plant Sponsors Webcast on Tertiary Treatment/ Environmental Chemist and Chemical Engineer Win Awards at Student Research Day.....Page 6

Biologist Jim Layzer Wins Lifetime Achievement Award/ Simazine Removal (cont.).....Page 7

Water Reuse 2008 Survey Results.....Page 8

Researchers Evaluate Swimming Performance of the Endangered Roanoke Logperch to Understand Barriers to Their Movement

In a project funded by the U.S. Fish and Wildlife Service, Vince Neary, hydrologist, Hayden Mattingly, fisheries biologist, and their students, including mechanical engineering graduate student Sreekanth Bangaru, are studying the swimming performance of the endangered Roanoke logperch fish to understand their movement patterns and what may be impeding their travel. A laboratory flume is being used to determine the burst and sustained swimming performance of juvenile and adult Roanoke logperch.



Researchers evaluate the swimming performance of the endangered Roanoke logperch. (Photo courtesy of Sreekanth Bangaru)

According to research by Robert Jenkins and N.M. Burkhead, the Roanoke logperch is known only from the Roanoke and Chowan River drainages in Virginia and is represented by only a few small, discontinuous populations.

The project team is using logperch that are already maintained in captivity to help identify barriers, like low head dams, spillways, weirs, culverts and other similar features, that may be inhibiting their movement. The presence of barriers in stream ecosystems can be a threat to most aquatic organisms. Man-made constructed barriers, like improperly designed road crossings, prevent or impede the stream organisms' natural movements that are needed to fulfill seasonal or annual ecological requirements for reproduction or feeding. When aquatic organisms are free to move about, their long-term population health is greater because they are better able to recolonize following droughts, and gene flow is freer among different populations of a given species.



The endangered Roanoke logperch. (Photo courtesy of Sreekanth Bangaru)

According to the researchers, swimming performance studies like this one are necessary to evaluating the presence of barriers that partially or fully block logperch passage. The results of this project are an important part of efforts to conserve and protect imperiled species.

Download previous issues of *Water Currents* at www.tntech.edu/wrc/publi.htm. Send address changes or requests to be removed from the mailing list to akknox@tntech.edu.

If you are an alumnus of the Center, please help us update our records by sending an e-mail to cmupwr@tntech.edu with your current address and employer information.

Faculty & Support

Faculty

Dennis B. George, director and environmental engineering professor
Phone: 931/372-3507
E-mail: dgeorge@tntech.edu

Sharon Berk, microbiology professor
Phone: 931/372-3451
E-mail: sberk@tntech.edu

G. Kim Stearman, soil science professor
Phone: 931/372-3528
E-mail: gkstearman@tntech.edu

Martha J.M. Wells, environmental chemistry professor
Phone: 931/372-6123
E-mail: mjmwells@tntech.edu

Administrative Support

Mary Williford, financial analyst
Phone: 931/372-3938
E-mail: mwilliford@tntech.edu

Sandy Dodson, secretary II
Phone: 931/372-3507
E-mail: sdodson@tntech.edu

Sandra Pigg, secretary III
Phone: 931/372-3519
E-mail: spigg@tntech.edu

Glenda Shanks, grants fiscal clerk
Phone: 931/372-3810
E-mail: gshanks@tntech.edu

Analytical Support

Daniel Dodson, Environmental Quality Lab manager
Phone: 931/372-3061
E-mail: ddodson@tntech.edu

Phillip Burr, research technician I
Phone: 931/372-3507
E-mail: pburr@tntech.edu

Ginger Ensor, research assistant II
Phone: 931/372-3538
E-mail: gensor@tntech.edu

Michael Kuley, research assistant I
Phone: 931/372-3067
E-mail: mkuley@tntech.edu

Editorial Support

Amy Knox, editor
Phone: 931/372-3464
E-mail: akknox@tntech.edu

GIS Support

Yvette Clark, research & development engineer
Phone: 931/372-3004
E-mail: yrclark@tntech.edu

Fisheries Society Hosts Kids Outreach Program



Graduate student Alisha Pendergrass demonstrates water chemistry through experiments that elementary school children can do at home.
(Photo courtesy of Alisha Pendergrass)

Tennessee Technological University's Student Fisheries Society hosted a Fall 2008 Kids Outreach Program. Alisha Pendergrass, a doctoral student working with the Center's environmental chemist Martha J.M. Wells, contributed to the program by talking to the third graders at Northeast Elementary School.

The Student Fisheries Association separated into groups, and each group talked about different aspects of fisheries and aquatics.

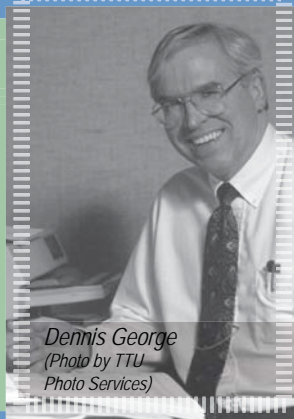
"We talked to each class for about 30 minutes," Pendergrass said. "Since I was the only chemist in the group, we focused on water chemistry. My partner, Shane Billings, and I provided the students with experiments that they could demonstrate to their parents at home."

One such demonstration was to show how and why different liquids such as water and corn syrup will sometimes mix and other times separate into layers. The students learned that adding different substances to liquids can change that liquid's density. One example showed that a carrot slice will sink in freshwater but float when salt is added to the water because salt makes the water more dense. Another demonstration showed that a regular soda can sinks in water, but a diet soda can will float because of the density differences.

To wrap up the presentation, Pendergrass and Billings discussed how truly deadly the Dead Sea can be and also demonstrated the importance of trash preparation before disposal, such as cutting up six-pack soda can holders.

Pendergrass and Billings make an effort to speak to elementary-age kids at least once a year.

Center Director Dennis George Appointed to Serve on Dry Cleaners Environmental Response Board



Dennis George
(Photo by TTU
Photo Services)

"I'll be learning a lot," George said. "Dry cleaner operations use organic solvents, which are tightly regulated, but those chemicals can enter waste streams."

George holds a doctorate in environmental systems engineering from Clemson University and a master's and bachelor's in civil engineering from New Mexico State University.

"This is an area where I can contribute," George said of his appointment. "The dry cleaning industry has challenging waste systems, and they do a good job policing themselves to protect the environment and employees. It's in their best interest to have a group to help when there are problems and to be a watchdog."

The Dry Cleaners Environmental Response Board works with the Tennessee Department of Environment and Conservation to respond when the chemical solvents have impacted the environment in the area of a dry cleaning operation. Owners and operators of dry cleaning facilities, current or prior owners or operators of abandoned dry cleaning facilities, and third parties may be eligible for reimbursement of costs to investigate and clean up their site. It is funded in part by annual registration fees for active dry cleaning facilities and surcharges on dry cleaning solvents.

from the *Herald-Citizen*

Center director and environmental engineer Dennis George has been appointed to serve on the Tennessee Dry Cleaners Environmental Response Board where he will work with other members from across the state to help ensure the environment is not negatively affected by dry cleaning chemicals.

"Dry cleaning is a service we often take for granted, and we don't appreciate the environmental effects it could have," George said. "This is a great way for me to serve the state, the citizens and the industry."

This is the first time he has been appointed to serve on the Dry Cleaners Environmental Response Board, where he will serve a three-year term and act as the board's environmental engineer and scientist.

Farmers and Educators Make Spring Come Early Through Season-Extending Growing Techniques

Although spring is already here, a group of local farmers and educators are trying to make the growing season come even earlier by learning special season-extending growing techniques.

To do that, the group recently took a farm tour, hosted by Paul Wiediger of Au Naturel Farms in Bowling Green, Kentucky, to learn about season extension for fruits and vegetables through the use of techniques like high tunnels, which not only can allow farmers to grow produce throughout the year but can also increase sales potential in local markets.

The farmers and educators who joined in the tour are part of a group working on a \$100,000 Cooperative State Research, Education and Extension Service, United States Department of Agriculture Grant, which was funded by the Agricultural Prosperity for Small- and Medium-Sized Farms program led by S. Sureshwaran in Washington, D.C.

"Through the College of Agriculture and Human Ecology, projects like this one are showing that TTU is gradually becoming an organic research center," said Dennis George, director of the Center through which the grants are run.

"If farmers can utilize organic techniques to build soil quality, this will help improve the yields of the farmers and also reduce runoff and improve water quality in the streams and rivers," said Kim Stearman, professor of soil science and co-project investigator.

According to Michael Best, professor of agricultural economics and project director, a major goal of the project is to develop educational programs to get farmers involved in high-tunnel techniques.

High tunnels are not conventional greenhouses because, unlike in greenhouses, crops are planted directly in the soil. On the Wiedigers Au Naturel Farms, high tunnels have been used for year-round growing for more than eight years. The farm's Web site (<http://aunaturelfarm.homestead.com/>) documents what happens to lettuce when the temperature in the high tunnel goes below freezing. The lettuce can actually have ice on it but recovers as temperatures rise in the high tunnel.

For decades, the agricultural industry had been moving toward growing foods where there was a comparative advantage to do so and then shipping them to the consumption centers. Technological advancements in processing and cooling preservation and low transportation costs made that possible.

"But now, the industry seems to be moving back somewhat toward more localized food production, which could boost the profitability and sustainability of the small- and medium-sized farms that are so abundant in Tennessee," Best said. "This trend may be attributed to the high fuel prices of last year, environmental concerns over fuel used for shipping, and more recently, the health concerns associated with the safety of products that are produced on large-scale farms in distant states and countries."

"This industry [organic farming] is growing fast," Stearman said. "For the last 10 years, it's been growing at 20 percent per year. It's important for us to get involved in this field of research, and we appreciate the support that the Center and College of Agriculture and Life Sciences have provided already."

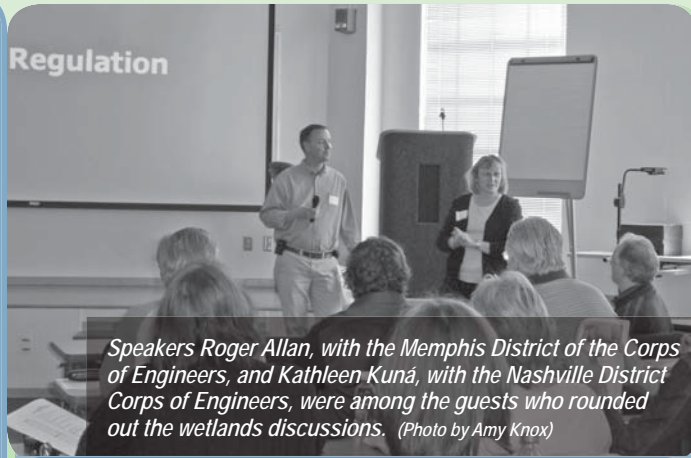
"We are fortunate to have the Waters Farm that utilizes organic farming techniques under the guidance of horticulturist Randy Dodson."



Farmer advisory panel and TTU educators involved in the Agricultural Prosperity grant on a farm visit in Kentucky. (Photo courtesy of Michael Best)

There is also a high school educational component of the project that is being prepared by Ben Byler, professor of agricultural education. He is organizing a group of regional high school teachers that will meet on the TTU campus to help plan new teaching modules. It will be determined how teachers will teach these new production methods and what tools they will need to do so.

"As interest grows in these types of production methods, there will be a need for the development of markets for the produce," Best said. "With Tennessee's climate, farmers have the potential to extend the current growing season dramatically with these innovative production techniques, and extending the growing season makes local marketing channels a more viable option."



Speakers Roger Allan, with the Memphis District of the Corps of Engineers, and Kathleen Kuná, with the Nashville District Corps of Engineers, were among the guests who rounded out the wetlands discussions. (Photo by Amy Knox)

Center Co-sponsors Wetland Workshop

The Tennessee Department of Environment and Conservation, the U.S. Army Corps of Engineers, TTU and the Center hosted a meeting from May 19 through 20 on the TTU campus to discuss current wetland issues in Tennessee. State agency representatives and consultants from across the state met to hear presentations and engage in discussions on a plethora of subjects relevant to the theme.

"Workshops like this one probably promote better relationships among all the parties and, overall, should result in improvement in the ways wetlands are regulated in

Tennessee," said Tom Roberts, biology professor and one of the workshop coordinators. Ken Morgan, biologist; Sandra Pigg, secretary III; Amy Knox, editor; and Dennis George, Center director, were also coordinators of the event.

According to Roberts, the meeting was well-attended and had good participation from the audience.

"The discussions helped clarify some touchy regulatory issues and determine ways to improve the mitigation process," he said.

Speakers and participants also discussed the Tennessee Stream Mitigation Program, the "Regional Wetland Delineation Manual," various wetland assessment methods and stream legislative issues.

"I thought the workshop was very successful and seemed to be what the agencies and the consulting community are interested in," Roberts said.



Agency representatives and consultants from across the state attended the meetings on mitigation and other wetland issues. (Photo by Amy Knox)

Researchers Examine Peat as a Tool for Simazine Removal

Christopher Eisler recently completed a project that focused on simazine removal using a subsurface flow constructed wetland cell amended with *Sphagnum* peat. Simazine is an herbicide used worldwide and one of the top five most commonly detected pesticides in U.S. waters.

"Triazine herbicides like simazine can have a wide range of influence at low or environmental concentrations due to the endocrine-disrupting and herbicidal properties," Eisler said.

Erosion of salt marshes, changes in freshwater aquatic community structure, and pesticide-induced hermaphroditism in American leopard frogs have been linked to environmental concentrations of triazine herbicides such as simazine.

Researchers including soil scientist Kim Stearman, environmental engineer and Center Director Dennis George, and former biology graduate student

The constructed wetland cell used to remove simazine from the water during the summers of 2006 and 2007 consisted of one-third *Sphagnum* peat, with the other two-thirds made up of quartz gravel. The constructed wetland removed an average of 97.8 percent of the applied simazine, within 24-hour periods, during summer 2007 field trials. Simazine normally takes months to degrade in surface waters such as rivers and can even take years to degrade in groundwater.

"This type of removal rate in the wetland cell is phenomenal," George said.

To better understand the processes occurring within the wetland cell, the *Sphagnum* peat was subjected to: laboratory batch adsorption studies, desorption studies, specific surface area measurements, state of decay measurements, and microbial degradation studies within the Center's lab. The laboratory batch adsorption studies examined the capacity of peat to remove simazine from the water using different particle diameters, solution pH, and sterilization procedures.

"A rigorous gas chromatography method with quality control checks was developed to determine simazine concentration

(cont. on Page 7)

6 Donor Spotlights

The Center's goal is to increase the graduate student endowment to \$50,000 over the next five years. Pledged contributions are already at \$21,000, but your support is needed. To donate, please contact the Center at 931/372-3507 or P.O. Box 5033, Cookeville, TN 38505. Thank you to those who already contributed, including the following people and industries:

■ Builders Supply	■ Rosemary Merwin
■ Scott Adkisson	■ Thomas C. Neel
■ Melanie Byers	■ Katherine O'Brien
■ Geoffrey Call	■ Anthony Pegel
■ Kristofer Carlson	■ John Pescatore
■ Deborah Condo	■ James Pipas
■ Richard Driver	■ Paul Piszczek
■ General Cable Industries	■ Tazio Qubeck
■ Pam George	■ Thenmozhi Ramar
■ John Gifford	■ John Richardson
■ Alberta Griggs	■ Ruth Riter
■ Judith Hubbs	■ Rotary Foundation
■ Amy Knox	■ William Treanor
■ Hayden Mattingly	■ Julie Williams

Veolia Water and Sanitary Treatment Plant Sponsors Webcast on Tertiary Treatment



*Front row (l to r): Barry Turner, City of Ckville engr.; Tom Graham, City of Ckville chief plant operator
Second row (l to r): Darian Dykes, Veolia Water N. Amer.; Clark Annis, Veolia Water N. Amer. Proj. Mgr.; Kiran Thota, chem. engr. grad. student;
Third row (l to r): Karina Bynum, TDEC engr./WPC Ckville; Martin Smith, TDEC engr./WPC Ckville (Photo by Amy Knox)*

Last fall, the Center teamed with Veolia Water to sponsor an on-campus viewing of a webcast titled "Design and Operation of Tertiary Membrane Plants," offered through the Water Environment Federation's Distance Learning webcast Series. The panel focused on key issues related to the development and management of large tertiary membrane plants. Design and start-up issues and operational benefits were among the topics discussed by speakers including Karla Kinser, from MWH; Mehul Patel, from the Orange County Water District; Richard Bergman, from CH2M Hill; and moderator Paul Schuler, from GE Water & Process Technologies.



l to r: Clark Annis, Karina Bynum, Martin Smith (Photo by Amy Knox)

Environmental Chemist and Chemical Engineer Win Awards

Student Research Day at TTU is designed to showcase, in a poster format, the research and other scholarly activities of undergraduate and graduate students. The 2009 Student Research Day was held March 31, 2009, and continued to grow from the previous year's event. More than 120 students showcased their posters at the event.



*Alisha Pendergrass
(Photo by Amy Knox)*

This year, two Water Center students took home honors from the contest. Doctoral student Alisha Pendergrass, advised by Professor Martha J.M. Wells, won first place in the environmental sciences division of the contest. Their work, titled "Extraction and Chromatographic Analysis of Eicosanoids in Fish Tissues," is funded by a scholarship through the Office of Research; the Chemistry Department; the Environmental Sciences program;

and the Center. Her equipment is part of the project titled "MRI/RUI — Acquisition of a Liquid Chromatography Mass Spectrometer for Biochemical and Environmental Analysis," funded by the National Science Foundation.

Doctoral student Vasanta Pallem, advised by chemical engineering Assistant Professor Holly Stretz and Professor Wells, won first prize

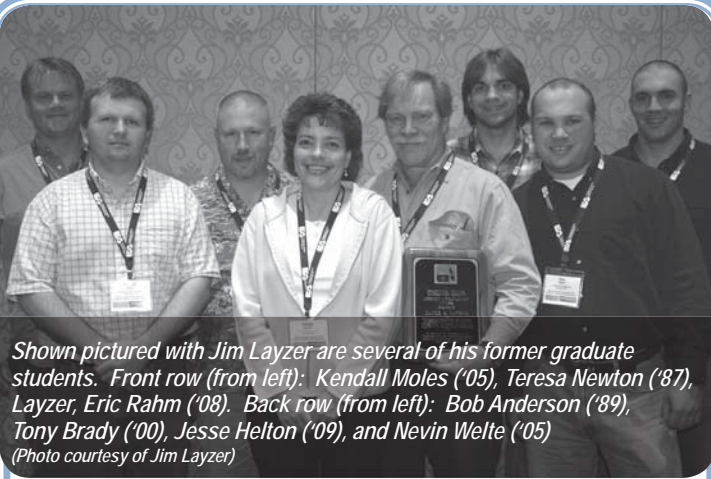
in the chemical engineering division of the poster contest. In their work, the researchers are looking at the effects of gold nanoparticles — which can be used in drug delivery, biomedical imaging and chemical sensing processes — when they are found in the environment.

Because the fate and transport of those nanoparticles in the environment are relatively unknown, researchers are trying to determine how those processes are affected when the nanoparticles interact with environmental entities like humic substances found in natural aquatic systems. If researchers can understand how nanoparticles are dispersed in surface waters, potentially damaging environmental effects can possibly be prevented.



*Vasanta Pallem
(Photo by Amy Knox)*

at Student Research Day



Shown pictured with Jim Layzer are several of his former graduate students. Front row (from left): Kendall Moles ('05), Teresa Newton ('87), Layzer, Eric Rahm ('08). Back row (from left): Bob Anderson ('89), Tony Brady ('00), Jesse Helton ('09), and Nevin Welte ('05)
(Photo courtesy of Jim Layzer)

Biologist Jim Layzer Wins Lifetime Achievement Award

Biology Professor Jim Layzer was recently recognized for his many years of dedication to the field of mollusk conservation when he received the Freshwater Mollusk Conservation Society Lifetime Achievement Award, presented April 22 in Baltimore, Maryland, at the International Symposium of the Freshwater Mollusk Conservation Society.

Layzer's research has spanned more than two decades and has been funded by agencies ranging from the U.S. Geological Survey to the Tennessee Wildlife Resources Agency. Many of those projects have been administered by the Center. He and his research team have developed specialized techniques to propagate and culture freshwater mussels, and their work has proven to be monumental.

"It was an unexpected honor to receive this award, especially knowing the individuals who have earned it over the past 10 years," Layzer said. "I have never considered that I made the same magnitude of contributions to mussel conservation as those individuals did. I owe much of my recognition to the wonderful graduate students and research staff that I have had the pleasure to work with."

This is not the first time that Layzer's work has been recognized. Last summer, he was one of 16 U.S. Fish and Wildlife Service partners honored with the 2007 Southeastern Regional Director's Conservation Awards, given for accomplishments toward fish and wildlife conservation. The USFWS Southeastern Regional Director Sam Hamilton applauded those winners' efforts "given in service to the natural world."

Layzer earned his bachelor's and master's from the University of Massachusetts and his doctorate from Oklahoma State University. He leads the Tennessee Cooperative Fishery Research Unit on campus, and his research interests include fish ecology, instream flow needs, evolutionary ecology, endangered species and mussel ecology. His current research projects include work in the life histories of endangered mussels and fish, determining instream flow needs of fish and mussels, propagation of mussels, and recovery of endangered species.

(cont. from Page 5)
in both water and peat extract," Eisler added. In addition, an environmental scanning electron microscope was used to further characterize removal processes occurring in both the laboratory and wetland cell.

During the laboratory batch adsorption studies lasting 24 hours, a maximum simazine removal of 63 percent, mainly due to sorption and/or hydrolysis processes, was possible.

"The lower removal in the laboratory as compared to the field is opposite of what we traditionally encounter in mineral-derived soils during laboratory batch adsorption studies," Stearman said.

"When we began testing peat from the constructed wetland in microbial degradation studies in the lab, simazine removals of more than 99 percent could be obtained," Eisler said.

Another intriguing finding of the laboratory batch adsorption research was that *Sphagnum* peat particle diameters of 75 μm or less actually lost surface area.

"Initially, I wondered why the smallest particle diameters of peat were showing decreased simazine removal and lower surface area measurements than the larger diameters," Eisler said.

"When the peat particles were subjected to environmental scanning electron microscopy, it began to make sense."

According to Eisler, at the 75 μm or less diameter, the porous cellular structures in *Sphagnum* begin to collapse and compress together, which limits the available surfaces for simazine to adsorb.

"Normally, as a mineral soil decreases in size, the surface area will increase; however, this finding for *Sphagnum* peat is counter to the established trend and may alter our understanding of how organic matter functions in soil," Stearman said. "The one noticeable disadvantage we've found with using peat filters is that if they dry out, it is hard to re-wet because of its hydrophobic properties."

"My great hope for this wetland research is that one day it will be used worldwide, wherever simazine runoff occurs, and that further studies will discover other pesticides or pollutants that can be easily removed using these unique low-cost treatment systems," Eisler said.



A constructed wetland cell
(Photo courtesy of Christopher Eisler)

Water Reuse 2008 Survey Results

2008 Survey

The Center teamed with the Tennessee Department of Environment and Conservation (TDEC) to initiate a survey of Tennessee wastewater treatment utilities to find out which ones were using water conservation and water reuse practices and to encourage those that didn't reuse to start implementing those techniques. In 2008, the Center distributed the third annual survey to those utilities that are legally allowed to handle 0.1 million of gallons or more of water per day [mgd].

A survey like this is important to Tennessee as it faces strong pressures on its water resources from human use. The 2008 results are shown here. You may also view the results from the Center's site at <http://www.tntech.edu/wrc/WaterReuseSurvey.htm> and the Tennessee Department of Environment and Conservation's Web site links at <http://www.state.tn.us/environment/dws/> and <http://www.state.tn.us/environment/wpc/other.shtml>.

Reuse Systems

- King's Creek Golf Course, Maury County
Travis Massey, Superintendent
3893 Mahlon Moore Rd., Spring Hill, TN 37174
- Murfreesboro Water and Sewer Repurified Water System,
Rutherford County, Joseph Kirchner, Director
P.O. Box 1477, 300 NW, Broad Street, Murfreesboro, TN 37133
- Sewanee Utility District, Franklin County, Ben Beavers, General
Manager, P.O. Box 3211, Sewanee, TN 37375

System Highlight

Murfreesboro Water and Sewer Repurified Water System
Rutherford County, Joseph Kirchner, Director
P.O. Box 1477, 300 NW Broad Street, Murfreesboro, TN 37133

A completely new wastewater treatment plant was placed in operation in 2000. The plant utilizes a biological process to convert pollutants to settleable solids, which are then removed by settling, then dewatered and sent to the landfill. The water is then defiltered, disinfected by ultraviolet light, and aerated before being discharged to the West Fork Stones River. The resulting reclaimed water is of very high quality, on par with drinking water standards of the 1970s. Reclaimed water is used on-site at the treatment plant. At the Murfreesboro Water and Sewer Repurified Water System, repurified water is used for irrigating public right-of-ways in the heavily landscaped median of Medical Center Parkway. A large commercial retail site, The Avenue, uses it for irrigation. The Siegel Soccer Complex, a City-owned park, is also irrigated with repurified water.

www.2.ci.murfreesboro.tn.us/default.aspx?ekmenu=42&id=3780

Murfreesboro Wastewater Treatment Plant
(Photo courtesy of the City of Murfreesboro)



TDEC Environ. Field Office	No. of Reuse Systems	Area of Residences Irrigated	Area of Golf Course Irrigated	No. of Parks Irrigated	Area of Other Public Access Irrigated	Area of Grass, Pasture, Other Crops Irrigated
Chattanooga	0	0	0	0	0	0
Columbia	2	0	154 acres	0	0	68 acres
Cookeville	0	0	0	0	0	0
Jackson	0	0	0	0	0	0
Johnson City	0	0	0	0	0	0
Knoxville	0	0	0	0	0	0
Memphis	0	0	0	0	0	0
Nashville	0	5 acres	221 acres	2	124 acres	600 acres
2008 Total	3	5 acres	375 acres	2	124 acres	668 acres

Summary of Reuse Activities

Reuse Type	Number of Systems	Capacity (mgd)	Flow (mgd)	Area Acres
Public Access Areas & Landscape Irrigation				
Golf Course Irrigation	2		1.5	375
Residential Irrigation	1		0.013	5
Other Public Access Areas	1		0.177	124
Subtotal	4		1.69	504
Agricultural Irrigation				
Edible Crops	0			0
Other Crops	1		0.31	600
Subtotal	1		0.31	600
Totals	5		2.0	1104

**None of the systems reused water for groundwater recharge and indirect potable applications, industrial applications, or any other applications.*