Bass says. As a result, green-roof advocates successfully lobbied the City of Toronto for a bylaw that mandates that every city-owned building will get a green roof unless physical reasons preclude it.

"When you look at the big-picture impact of green roofs, when you find out that they can reduce the urban heat island by 1–2 °C, and you further find out that a 1 °C reduction in the temperature of the city in Toronto reduces peak [electrical] demand by 5%—we're starting to talk about hundreds of millions of dollars," Peck points out.

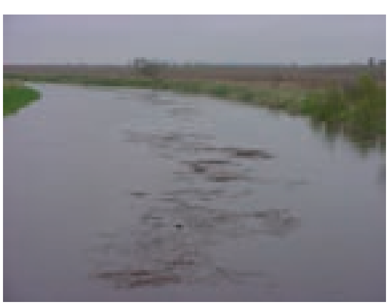
Meanwhile, the University of Toronto has declared that every new building on its campuses will be designed to be "green-roof-ready", according to Bass. "If the roof can support it and the budget is there, there are more benefits with an intensive roof. You get social benefits, and you may get even a stronger energy benefit too," he adds. Peck agrees. Emphasizing the need to integrate green roofs into design, he says, "The roofs of our cities are the last great opportunity we have to generate a positive impact from that space."
—BARBARA BOOTH

Nutrient pollution slips under regulatory radar

While U.S. regulators are looking the other way, winter floods and spring downpours are washing large amounts of nutrients off Midwestern farms, according to new research published in this issue of *ES&T* (pp 4126–4131). These nutrients end up in streams feeding the Mississippi River and ultimately in the Gulf of Mexico, where they drive its oxygen-starved "dead zone". In order to mitigate this dead zone, regulators of Midwestern streams must start targeting the mass of nutrients exported in winter, experts say.

The new study, which focuses on 3 Illinois watersheds, shows that 97–98% of the year's total runoff of dissolved nitrogen and 98–99% of the year's dissolved phosphorus runoff occurs when stream flow is greater than the yearly median, says Todd Royer, a biogeochemist at Indiana University and the lead author of the research. These high flows occur mainly from January through June, according to data from >2000 water samples collected from October 1993 through September 2005. The geographic size of the study and the large number of data points make this work a valuable addition to a growing body of research showing that nutrient releases peak during high river flow, says Gene Turner, a coastal ecologist at Louisiana State University.

The work by Royer and his colleagues validates other research showing that water flow in May at the mouth of the Mississippi is the best predictor of the size of the dead zone, Turner says. The mass of nutrients, especially nitrogen,



TODD ROYER

The Lake Fork of the Kaskaskia River in Illinois carried >20× as much nitrogen on April 21, 2002 (left), when it was flooding, as on July 2, 2002 (right).

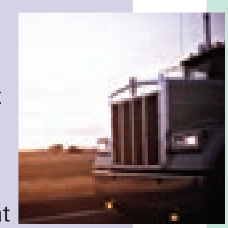
News Briefs

2006 Tyler Prize

David Schindler, a professor of ecology at the University of Alberta (Canada), and Igor Shiklomanov, the director of Russia's State Hydrological Institute, were awarded this year's Tyler Prize for Environmental Achievement. The Prize is a premier award for environmental science: It includes gold medals and a $200,000 cash award—which this year's recipients will share. Schindler was honored for experimentation on entire lake systems that revealed problems such as eutrophication, acid rain, and persistent toxic chemicals. His experiments were key to the ban of phosphorus in detergents. Shiklomanov published the first global estimate of renewable freshwater withdrawals in 1974. He also predicted disastrous consequences from massive dam projects and large-scale irrigation practices. His work is of utmost importance for balanced world development.

Reducing heavy-duty truck idling

While grabbing a few winks during federally required rest periods, long-haul truck drivers in the U.S. typically idle their diesel engines to operate electrical appliances. However, a new truck stop electrification station locator should help more truckers find public rest stops where they can plug into an electrical outlet and cut off their engines. The facilities can substantially cut fuel use while reducing air emissions. The National Renewable Energy Laboratory estimates that such idle-reduction technologies could trim fuel consumption by 800 million gal annually and decrease annual NO_x and particulate matter emissions by 150,000 and 3000 t, respectively. Almost 50 stations are currently available, and more should open in the near future.



PHOTODISC

dumped in the Gulf in May feed the growth of excess algae that die, sink to the bottom, and ultimately absorb oxygen in late summer, he explains.

Most of these nutrients originate in upper Midwestern farms, particularly those with underground tile drainage systems, Royer says. "Roughly 20 million hectares of farmland in the Mississippi River basin are drained by tile systems," he says. Practices such as fertilizing bare fields in the fall, before the next summer's plants have a chance to absorb the nutrients, leave nitrogen and phosphorus free to be washed off fields during winter and spring rains and floods, he adds.

Currently, the nutrient-laden floods that take place outside the growing season receive little regulatory scrutiny, Royer says. The federal Total Maximum Daily Load (TMDL) program, which determines the amount of pollution that can be tolerated by healthy water bodies, tends to focus on summers, when excess algae can foul local streams, he says.

Because Midwest summers tend to be relatively dry, that is the time of year when nutrient runoff into the Mississippi is the lowest. In fact, a TMDL for the Stillwater River in western Ohio allows nitrogen loads to more than double, from 3122 kg-N/d in October to 6700 kg-N/d for December through June, Royer says.

"Our job is to derive nutrient standards to protect Illinois water. Right now, we're definitely not thinking of what we need to do to protect the Gulf of Mexico," adds Bob Mosher at the Illinois EPA.

Excess nitrogen is not seen as a problem for freshwater streams, Dennis McKenna of the Illinois Department of Agriculture explains. Even if the state were to set water-quality standards for nitrogen, they are usually based on concentrations averaged over a 3-month period and might be meaningless in a situation where most of the nitrogen comes off during a handful of storm events, he says. —JANET PELLEY

Nanoparticles remove arsenic from water

Researchers at the U.S. Department of Energy's Idaho National Laboratory (INL) have developed a new material that uses nanosized particles to remove arsenic from drinking water and that promises to be easy to use and cheaper than the current alternatives.

At least three technologies—activated alumina, ion exchange, and coagulation—are capable of enabling utilities to meet the U.S. EPA's drinking-water standard of 10 µg/L for arsenic, which went into effect this past January.

But all of the alternatives come with caveats. For example, activated alumina technology, which is broadly considered to be the best available technology and is also the one most commonly used, works best in the pH range of 5.5–6. It therefore requires utilities to install a pH adjustment unit that can cost a few thousand dollars.

INL's new technology is made of nanosized polymer beads infused with hydrous iron oxide, according to its developer, Troy Tranter. He refused to be more specific about the particle size, claiming that the information is proprietary. Laboratory testing of Idaho groundwater—which contains 20 µg/L of arsenic, a concentration typical for waters in the western U.S.—shows that the technology can remove 100% of the arsenic.

Both INL's new technology and activated alumina work because they are able to sequester arsenic by attaching themselves, or adsorbing, the toxic metal. Such adsorbent technologies are sensitive to the pH of water, and the amount of arsenic they can adsorb decreases as the pH goes up. Therefore, the fact that the Idaho groundwater used in the tests had a pH >7 and contained silica is significant, says Patrick Brady with Sandia National Laboratories, which is also developing arsenic removal technologies. But he is waiting for the field tests that Tranter says he hopes to conduct "soon."

A few other companies have also made resins that remove arsenic by capitalizing on its affinity for iron oxide. But INL's new material surpasses the others on more than one count, Tranter says.

"We have created nanoparticles [that] have a lot higher surface area . . . increased by a factor of 3–4 over current technologies," Tranter explains. That means more reactant sites for arsenic to adsorb on the iron oxide. The material also contains much more adsorbent—85% iron oxide by mass, compared with 20–40% for competing technologies. In Tranter's lab tests, 10–12 mg of arsenic were sorbed on each gram of resin.

This is a fairly high adsorbing capacity, says Paul Westerhoff, a civil and environmental engineering professor at Arizona State University, who calls the INL technology "promising." Depending on the water an adsorbent is treating, he says, capacities can go up to 20 mg/g. The spent adsorbent passes the U.S. EPA's Toxicity Characteristic Leaching Procedure test; this means it is not a hazardous waste and can be safely disposed.

The resin should be cheap to make because the raw material is inexpensive, Tranter adds. The INL says that using it will cost utilities ~$0.10/1000 gal water. Plus, operating costs will be lower compared with other adsorbents.

The higher cost of water resulting from the use of arsenic treatment technologies that meet the EPA standard is an "acute" problem in rural communities, Brady says. —PRACHI PATEL-PREDD