

Killing the Dead Zone

A coalition of Illinois farmers, sewage districts, municipalities, conservationists and regulators have joined forces to check the surge of nutrients flowing down the Mississippi.

Kris Reynolds took a chance when he planted his first acres of cereal rye last year. The 17-year veteran of farming has employed a variety of tactics during that time to prevent nutrients—particularly phosphorus—from washing off his soybean field and into nearby waterways. But planting the cover crop was more of an experiment.

“I knew it would help hold soil in place and retain nutrients for the next season,” said Reynolds, who also serves as a resource conservationist for the Montgomery County Soil and Water Conservation District. “But I needed to see if I could justify spending a minimum of \$20 an acre on a cover crop.”

The answer was a resounding “yes.” The rye grew in thick mats that choked-off weeds, reducing the need for increasingly-expensive chemical herbicides.

Those same acres had some of the highest yields of the season—averaging 75 bushels an acre in soils that normally produce two-thirds that.

“I’m impressed,” he added. “That’s hard to do.”

Reynolds’ story is far from unique. The list of growers and ranchers using conservation practices has grown steadily longer since the state began work on a comprehensive plan to keep phosphorus and nitrogen out of the water.

Released in July 2015, the Illinois Nutrient Loss Reduction Strategy was developed in response to the 2008 Gulf Hypoxia Action Plan, which calls for states in the Mississippi River basin to cut nutrient loading to rivers by 45 percent.

The U.S. Environmental Protection Agency is looking for the results of these cuts downstream in the Gulf of Mexico, where a “dead zone” the size of Connecticut forms every summer and decimates marine life.

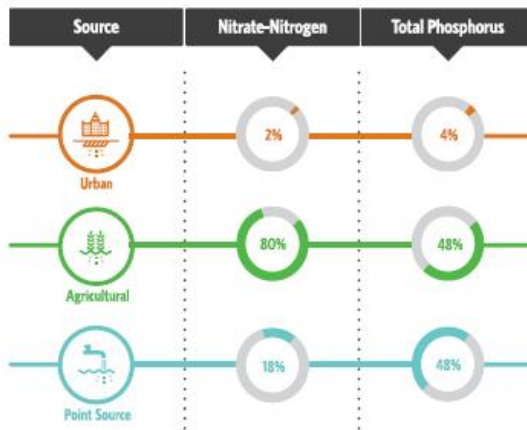
In Illinois, state officials, environmental groups and others hope the strategy will align more lakes, rivers and streams with the Clean Water Act’s fishable and swimmable goal.

The science

By most estimates, Illinois is the largest contributor of nutrients to the Gulf. More than 400 million pounds of nitrate-nitrogen leave the state through the Mississippi River system each year. And another 38 million pounds of phosphorus are carried with them.

When these nutrients reach the Gulf, they jump-start algal growth, creating a massive bloom that blocks sunlight to underwater plants and sucks up oxygen when it decomposes.





Breakdown of Illinois nutrient loads entering the Mississippi River system. *Illinois-Indiana Sea Grant*

The Prairie State owes its first-place ranking to its unique mix of urban and agricultural land.

Illinois is home to nearly 13 million people and the third largest city in the nation. A population that high—and that dense—means large wastewater treatment plants and other industrial sources of nutrient pollution. Chicago’s Stickney Water Reclamation Plant alone discharges an average of 2.3 million pounds of phosphorus a year.

At the same time, 74,300 farms and livestock operations rely on nitrogen and phosphorus—whether naturally in soil or applied as fertilizer—to maintain the state’s roughly \$19 billion agricultural industry.

But those nutrients don’t always stay on the field. In northern and central Illinois, large quantities of nitrate-nitrogen are carried away through underground drainage systems. Further south, phosphorus-laden soil washes into nearby waterways with every rainstorm.

Nutrient recovery at the Stickney Water Reclamation Plant will transform phosphorus and nitrogen into fertilizer. *Metropolitan Water Reclamation District of Greater Chicago*



A blueprint for reduction

The Illinois Nutrient Loss Reduction Strategy outlines a suite of voluntary and mandatory practices for sewage districts, municipalities and the agriculture industry.

Practices build on existing state and industry programs and align with the results of a University of Illinois-led assessment of current nutrient loads and cost-effective reduction strategies.

“This is the most comprehensive and integrated approach to nutrient loss reduction in the state’s history,” said Brian Miller, director of the Illinois Water Resources Center (IWRC), which facilitated strategy development. “But what really sets the plan apart is how it was developed. Representatives from state agencies, agriculture, non-profit organizations, universities and sanitation districts were all at the table working together to create this plan.”

The effort was spearheaded by the Illinois Environmental Protection Agency (Illinois EPA) and the Illinois Department of Agriculture (IDOA).

Strategy components are being implemented statewide, but initial funding, outreach and implementation programs will focus on 13 watersheds where nutrients pose the greatest risk to local water quality. These regions, which include the Big Muddy, Vermilion and upper Fox rivers, also contribute some of the highest loads to the Gulf of Mexico.

The plan in action

Requirements and recommendations for sewage districts are relatively straightforward. The largest reductions will come from the planned expansion of a permit condition that caps the amount of phosphorus treatment plants are allowed to release.

The Metropolitan Water Reclamation District of Greater Chicago (MWRD) voluntarily agreed in 2013 to

lower the concentrations of phosphorus discharged from their three largest plants. They've pledged to get those numbers below a monthly average of 1 milligram per liter by 2023—a shift expected to cut total annual loads by more than 3 million pounds.

"As utilities, it's important that we take a lead on water quality issues," said David St. Pierre, MWRD executive director. "And as the largest utility in Illinois, we felt it was critical that we accept these limits."

To meet the new standard, the district has turned to innovative technologies for managing nutrients. In 2014, they broke ground on a new facility at the Stickney Water Reclamation Plant that will recover roughly 10,000 tons of a phosphorus-rich product—along with nitrogen and magnesium—each year to be recycled and sold as fertilizer.

Scientists are also conducting tests to determine if commercially-marketable algae can be used to knock back nitrogen and phosphorus levels at the O'Brien Water Reclamation Plant. And a process known as enhanced biological phosphorus removal, which relies on a special group of bacteria that store phosphorus in their cells, will be rolled out at the Stickney, O'Brien and Calumet plants.

For farmers, livestock owners and others working in agriculture, the plan is much broader. Members of these groups are being asked to voluntarily implement conservation practices like installing buffer strips along stream banks, planting cover crops and applying nitrogen fertilizer in smaller treatments throughout the season.

These practices aren't new. But they need to become routine to have the necessary impact on nutrient losses.

"It is going to take at least one new management practice on every acre of agricultural land to meet the reduction goals," said Mark David, a University of Illinois biogeochemist and one of the researchers behind the strategy science assessment.

So IDOA, IWRC and groups like the Illinois Farm Bureau, Illinois Soybean Association, Illinois Pork Producers Association, Illinois Corn Growers Association and Illinois Fertilizer & Chemical Association got to work to raise the strategy's profile and encourage the adoption of recommended practices.

"Illinois' agricultural organizations and product retailers support the science assessment conducted by the Nutrient Loss Reduction Strategy team," said Laura Gentry, director of water quality research for the Illinois Corn Growers Association. "We are individually and collectively engaging farmers with educational opportunities,

calls to action and new programming designed to address the most challenging concerns our farmers face when making decisions about conservation practices."

The Illinois Council on Best Management Practices (CBMP), a coalition of agricultural organizations and agribusinesses supporting sustainable agriculture, took this message of support on the road last summer with 11 meetings focused on regionally-specific nutrient concerns and management practices. More than 1,000 people attended the Nutrient Loss Reduction Strategy Roadshow.

CBMP, its member groups and the state are also continuing to support research on practices that keep nutrients on the field and reduce runoff into streams and rivers. The Illinois Nutrient Research & Education Council—funded by a state-mandated fee on bulk fertilizer sales—invested more than \$4 million in 2013–2014 alone.

"This is an opportunity for us to find new, more innovative ways to use nutrients more efficiently," said Todd Wibben, a crop specialist at Evergreen FS Inc. in Maroa, Illinois.

Measuring success

Demonstrating reductions in phosphorus and nitrogen losses is a task for the Nutrient Monitoring Council.

Representatives from federal and state agencies, sewage districts, agriculture commodity groups, environmental organizations and universities will combine the results of individual monitoring programs to regularly estimate the



Colin Peake installs a nitrate sensor at a U.S. Geological Survey super station site. Kelly Warner, U.S. Geological Survey Illinois Water Science Center

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amount of nutrients leaving priority watersheds and the state as a whole. The council is also in charge of plotting trends over time and documenting improvements in local water quality.

“It’s not enough to know that nutrient loads are down,” said Gregg Good, manager of the Illinois EPA Surface Water Section and co-chair of the council. “In priority watersheds especially, we want to know whether a decline is connected to fewer water quality standards violations and healthier fish and insect populations.”

Data for statewide estimates will come primarily from U.S. Geological Survey (USGS) super stations that measure nitrate and turbidity every 15 minutes and phosphate every two hours.

“Most nutrient loading occurs during storm events when it is difficult to collect samples,” said Kelly Warner, a hydrologist with the USGS Illinois Water Science Center. “But these new stations will be sampling concentrations continuously, allowing us to calculate loads that might have been missed with periodic discrete sampling. Officials and the public will also be able to see the results online within hours instead of having to wait days, weeks or months for laboratory analysis.”

The super station on the Illinois River—one of the first in the country—has been part of state and federal monitoring programs since 2012. A new agreement between Illinois EPA and USGS added seven additional stations to the Rock, Green, Kaskaskia, Embarras, Vermilion, Big Muddy and Little Wabash rivers.

The project is slated to end in five years, but Illinois EPA hopes to extend that date if funding is available.

USGS has also begun talks with other organizations to extend Illinois’ nutrient monitoring approach to the upper Mississippi River basin.

Setting numeric limits

Perhaps the biggest challenge issued in the Illinois Nutrient Loss Reduction Strategy has little to do with the Gulf of Mexico.



Applying phosphorus fertilizer based on soil test results is one way Illinois farmers are helping reduce nutrient losses to streams and rivers. U.S. Department of Agriculture Natural Resources Conservation Service

To meet its obligations under the Clean Water Act, the state must establish numeric nutrient criteria—standards that say how many milligrams of phosphorus or nitrogen can be present in every liter of water. And officials are relying on the newly-formed Nutrient Science Advisory Committee to help them pin down the numbers.

Illinois EPA has searched for criteria appropriate for the state’s diverse rivers and streams for roughly 15 years. Numeric standards do exist—a 10 milligram per liter nitrate-nitrogen cap for drinking water sources and a 1 milligram per liter phosphorus discharge limit for specific wastewater treatment plants, for example. But statewide caps have yet to be set.

“To set a numeric criterion, we have to know how much of a compound can be present before it starts harming aquatic life,” said Bob Mosher, manager of the Illinois EPA Water Quality Standards Section. “We haven’t been able to find that threshold for phosphorus and nitrogen.”

Potential impacts on wildlife, Mosher added, have more to do with physical characteristics like slope and sediment type than the amount of phosphorus or nitrogen flowing into the ecosystem. A numeric standard needed to reduce algal blooms in one river may be completely unnecessary in another.

Illinois EPA has asked the Nutrient Science Advisory Committee to use data collected by the agency and others to determine whether watershed-specific standards are a better fit for the state. The group has roughly two years to answer this question and recommend particular limits.

In the meantime, Illinois EPA plans to propose a rule to the state Pollution Control Board that would allow the agency to limit nutrient discharges when excess algal growth accompanies broad swings in dissolved oxygen concentrations.