Moving Forward on Gulf Hypoxia

Annual Report 2011

Mississippi River
Gulf of Mexico
Watershed Nutrient
Task Force

Members of the Hypoxia Task Force

State Agencies

Arkansas Natural Resources Commission

Illinois Department of Agriculture

Indiana State Department of Agriculture

Iowa Department of Agriculture and Land Stewardship

Kentucky Department for Environmental Protection

Louisiana Governor's Office of Coastal Activities

Minnesota Pollution Control Agency

Mississippi Department of Environmental Quality

Missouri Department of Natural Resources

Ohio Department of Natural Resources

Tennessee Department of Agriculture

Wisconsin Department of Natural Resources

Federal Agencies

U.S. Army Corps of Engineers

U.S. Department of Agriculture

U.S. Department of Commerce (National Oceanic and Atmospheric Administration)

U.S. Department of the Interior (U.S. Geological Survey)

U.S. Environmental Protection Agency

Federally Recognized Tribes

USDA NRCS

Shorebirds.

Kathryn Smith, USGS

Coastal wetlands of Louisiana.

Cover Photo: Shrimp fishing boat with its nets out. *Source:* ©iStockphoto

Note from the Hypoxia Task Force Co-Chairs

This is the third year that the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (Hypoxia Task Force or HTF) has issued an Annual Report. The purpose of the report is to highlight progress in implementing the 2008 *Gulf Hypoxia Action Plan* to reduce nitrogen and phosphorus pollution in the Mississippi/Atchafalaya River Basin (MARB) and hypoxia in the Gulf of Mexico. The Annual Report includes relevant quantitative indicators of programmatic outputs and environmental outcomes tracked by individual HTF federal member agencies. It also showcases some of the successes of individual HTF member states and federal agencies, as well as their partners.

During fiscal year (FY) 2011, the HTF as a body made notable progress toward advancing implementation of the primary goal of the 2008 Action Plan—development of statewide nutrient reduction strategies. HTF members agreed that developing and implementing statewide nutrient reduction strategies (Action Plan Action Item 1) will continue to be their top priority for the next several years as they work together to reach the Action Plan 2013 goal of having strategies in place in all 12 states. To assist the HTF states in their ongoing progress toward developing statewide reduction strategies, the HTF has focused its efforts on targeted and well-coordinated federal support for timely strategy development and implementation.

Also during FY 2011, the HTF worked with the Gulf Coast Ecosystem Restoration Task Force to incorporate key messages into the Gulf Restoration Strategy, including the following: (1) hypoxia, fed by nitrogen and phosphorus pollution in the MARB, is an obstacle to a healthy and sustainable Gulf ecosystem, and (2) the key to curbing oxygen starvation in the Gulf is effective nutrient management planning and targeted implementation of best management practices in upriver and coastal priority watersheds.

Looking forward, the HTF's FY 2012 priorities will continue to include supporting state nutrient strategy development aimed at (1) sharing "lessons learned" among the states, (2) enhancing collaboration among relevant agencies within each HTF state and also between HTF states and federal agencies, and (3) identifying opportunities for leveraging financial and technical support. In addition, the HTF will complete a reassessment, which has traditionally been done every five years.

We believe that the HTF has taken some significant steps in the past year to implement the goals of the 2008 Action Plan, and we intend to continue that progress into the future. We look forward to our continued collaboration in reducing Gulf hypoxia.

Signed,

Nancy Stoner
Federal Co-Chair and Acting Assistant Administrator for Water, U.S. Environmental Protection Agency

Trudy Fisher
State Co-Chair and Executive Director, Mississippi Department of Environmental Quality

Indicators

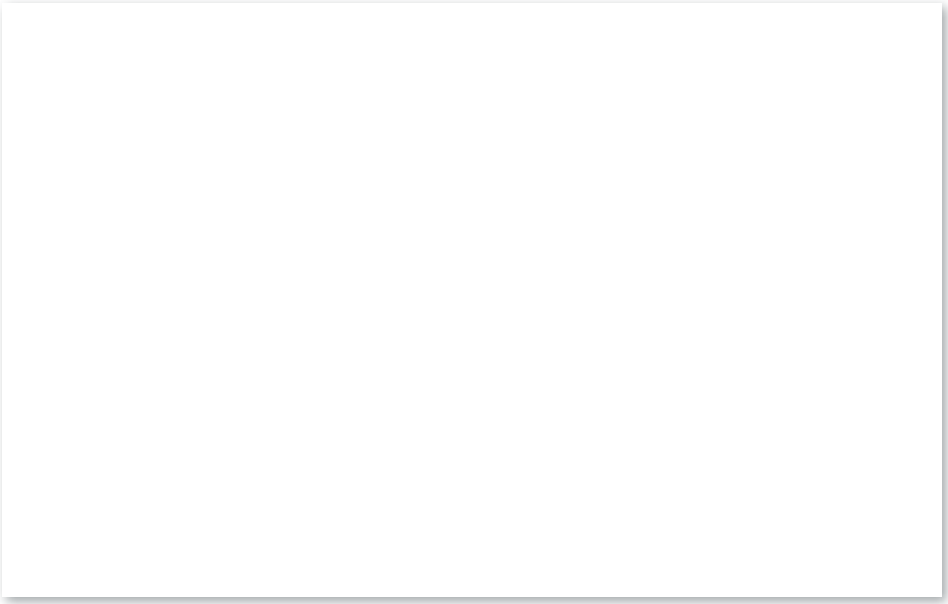
Extent and Severity of the 2011 Gulf of Mexico Hypoxic Zone (NOAA)

The northern Gulf of Mexico (NGOM) hypoxic zone, also known as the "dead zone," is fueled by nutrient loadings, primarily in various forms of nitrogen and phosphorus, from agricultural and other human activities in the MARB. The nutrient loadings stimulate an overgrowth of algae, which over time die, sink to the seafloor, and are decomposed by bacteria. It is that decomposition process that ultimately consumes the life-giving oxygen supply in the bottom waters of the NGOM. The NGOM dead zone is of particular concern because it threatens valuable commercial and recreational Gulf fisheries, which generate about $2.8 billion annually.

Successfully addressing hypoxia requires an understanding of the complex interactions among nitrogen and phosphorus, climate, weather, basin morphology, circulation patterns, water retention times, freshwater inflows, stratification (layering), and mixing. Nutrient loadings from the MARB, coupled with temperature- and density-induced stratification, are the primary causes of hypoxia in the NGOM. Variations in year-to-year inputs of freshwater, nitrogen, and phosphorus from the MARB make it difficult to identify the relative importance of increased algal growth, known as eutrophication, versus increased stratification in any given year over the recent past.

Scientists supported by NOAA and led by Nancy Rabalais, Ph.D., Executive Director of the Louisiana Universities Marine Consortium, measured the size of the 2011 Gulf of Mexico dead zone at 6,765 square miles. Their cruise, which occurred in July 2011, is considered the official survey measuring progress toward the *Gulf Hypoxia Action Plan* (2008) goal—reducing the 5-year average size of the hypoxic zone to no more than 5,000 square kilometers (about 1,930 square miles).

Researchers had predicted the potential for a record-sized dead zone of between 8,500 and 9,421 square miles. Their prediction was based on the spring flooding of the Mississippi River and the associated large loads of nitrogen and phosphorus entering the Gulf. Fortunately, a shift in winds, as well as the effects associated with Tropical Storm Don, disrupted portions of the dead zone, resulting in a less-than-record-breaking hypoxic zone. The models used to forecast the area of the dead zone, and to inform management of its underlying causes, currently do not incorporate short-term variability due to weather patterns, which can affect the specific timing or positioning of the hypoxic zone. The average size of the dead zone over the past five years is 6,688 square miles. Last year's dead zone measured approximately 7,722 square miles.



Prior to the Louisiana Consortium's cruise, a NOAA-supported Texas A&M survey in June 2011, led by Steven DiMarco, Ph.D., found a moderately sized dead zone. Subsequent measurements taken during the NOAA Southeast Monitoring and Assessment Program's summer survey indicated that the dead zone was growing larger. Texas A&M conducted a NOAA-funded follow-up cruise in mid-August 2011 to provide an update on the size of the dead zone as scientists worked to understand size fluctuations and the duration of hypoxic conditions in the Gulf. In addition to surveys in the traditional region of the dead zone, Rabalais's research team and a team from the University of Southern Mississippi (led by Stephan Howden, Ph.D.) both documented a large area of hypoxia east of the Mississippi River in mid-July. The results are consistent with expansion of the dead zone by spring floods as a result of diversions of the Mississippi River.

Findings from NOAA-sponsored Research

Low Oxygen Is Causing Female Fish to Become Masculinized

Emerging research from a University of Texas project, funded by the National Oceanic and Atmospheric Administration (NOAA) and led by Peter Thomas, is finding that female Atlantic croakers exposed to low oxygen are producing fewer female sex hormones and are becoming more masculine. Previous research showed that these fish avoid the Gulf hypoxic zone, where oxygen concentrations are below 2 mg/L, and congregate at the edge of the zone. The dissolved oxygen along this edge, though not officially considered hypoxic, is still lower than what is required for optimal function and can lead to stress in many fish species. It is along this edge that both female and male croakers suffering reproductive problems have been found.

P. Thomas and M.S. Rahman, *Proceedings of the Royal Society B* (doi: 10.1098/rspb.2011.0529), 2011

Ovary samples from Gulf of Mexico Atlantic croakers. *(top: Normal oxygen conditions, bottom: Hypoxic conditions)*

Using a combination of laboratory and field studies, researchers have identified a specific mechanism through which exposure to low dissolved oxygen can disrupt the female endocrine system, which is critical for reproduction. In female croakers exposed to hypoxia, the female reproductive hormones are decreased, leading to masculinization of the ovaries and production of sperm. As a result, there are more males than females along the edge, and the females produce fewer hatchlings. Hypoxia has also affected male croakers, although to a lesser degree than females. This differs from the well-documented sex change in freshwater male fish that become feminized because of water-borne chemicals that mimic female sex hormones.

The long-term effects of this low-oxygen-induced phenomenon on croaker populations are unknown, but researchers are concerned that it could result in future population declines. Future research under this project will assess croaker population responses through ecological modeling, led by Kenny Rose of Louisiana State University. In addition, while croaker are currently a common bottom-dwelling fish and the only species targeted in this project, this research suggests that other species of fish, including those of commercial significance, might also be susceptible to similar sublethal effects of hypoxia. Ongoing research will determine the broader implications of these findings for the Gulf of Mexico ecosystem.

Annual Total Nitrogen Load (USGS)

From 1996 to 2007 there was a general *decrease* in the five-year average TN load delivered to the NGOM, but recently the five-year average has been increasing. The 2006–2010 average is 12 percent below the baseline, but it remains well above the 45 percent reduction target. This disparity highlights the importance of implementing targeted nitrogen pollution reduction activities.

Annual Total Phosphorus Load (USGS)

Since 1996 there has been a general *increase* in the five-year average TP load delivered to the NGOM. The 2006–2010 average is 17.5 percent greater than the baseline. Note that these findings are inconsistent with the decreases observed in TN load.

2011 Spring Nutrient Load (USGS)

Freshwater runoff and nutrients delivered by the MARB are the primary controls on the size of the Gulf hypoxic zone. Sources of the nutrients include fertilizers applied to agricultural fields, golf courses, and suburban lawns; atmospheric deposition; animal manure; erosion of soils containing nutrients; and industrial and sewage treatment plant discharges. The amount of nutrients delivered to the Gulf each spring depends, in large part, on precipitation and the resulting amounts of nutrient runoff and streamflow in the MARB. For the purposes of estimating the extent of the hypoxic zone for a given summer, researchers report that nutrient loads in the month of May are more critical than those in any other month because of the time lag between nutrient delivery to the Gulf and the peak development of the hypoxic zone (Turner and others 2006).

During May 2011 streamflow rates in the Mississippi and Atchafalaya rivers were nearly twice those under normal conditions. The excessive rates substantially increased the amount of nitrogen transported by the rivers to the Gulf. According to U.S. Geological Survey (USGS) estimates, the Mississippi and Atchafalaya rivers transported nearly 180,000 metric tons of nitrogen (in the form of nitrite plus nitrate) to the northern Gulf, an amount that exceeds by 35 percent the average May nitrogen loads estimated in the last 32 years.

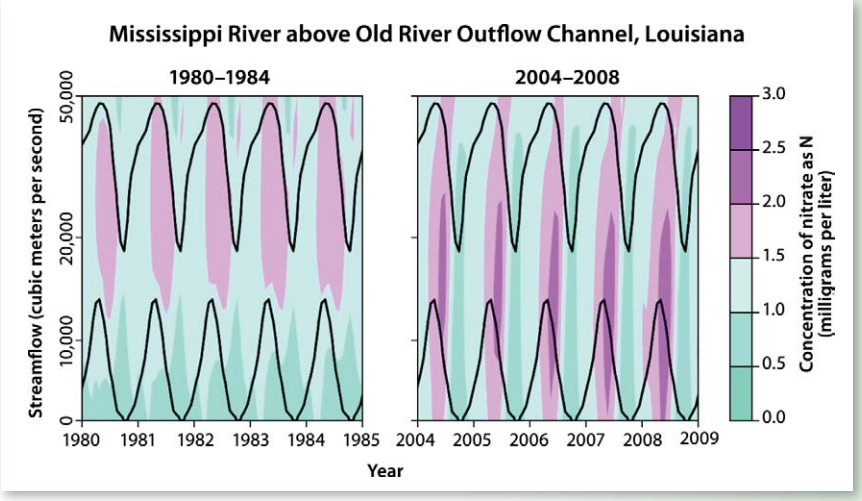
New Understanding of Nitrate Levels in Streams (USGS)

USGS developed a new method that accounts for variation in river flows in order to gain an accurate understanding of long-term trends in water quality (Sprague and others 2011). This new method can be used to help distinguish between the effects of natural changes in precipitation and streamflow and the effects of purposeful changes in the management of nitrate in the MARB.

Flow-normalized nitrate concentrations at the Mississippi River above the Old River Outflow Channel in Louisiana increased about 10 percent between 1980 and 2008. Nitrate concentrations increased at low and moderate streamflows but decreased at high streamflows. The decreases at high streamflows were comparable to the increases at low and moderate streamflows, particularly in the spring and summer. Notably, concentrations decreased at high streamflows in the spring, when nitrate loads were highest. These results reflect the cumulative changes in nitrate sources over time, as well as the conservation practices implemented throughout the MARB. They also highlight the need for comprehensive nutrient management strategies that will reduce nutrients in both streams and groundwater.

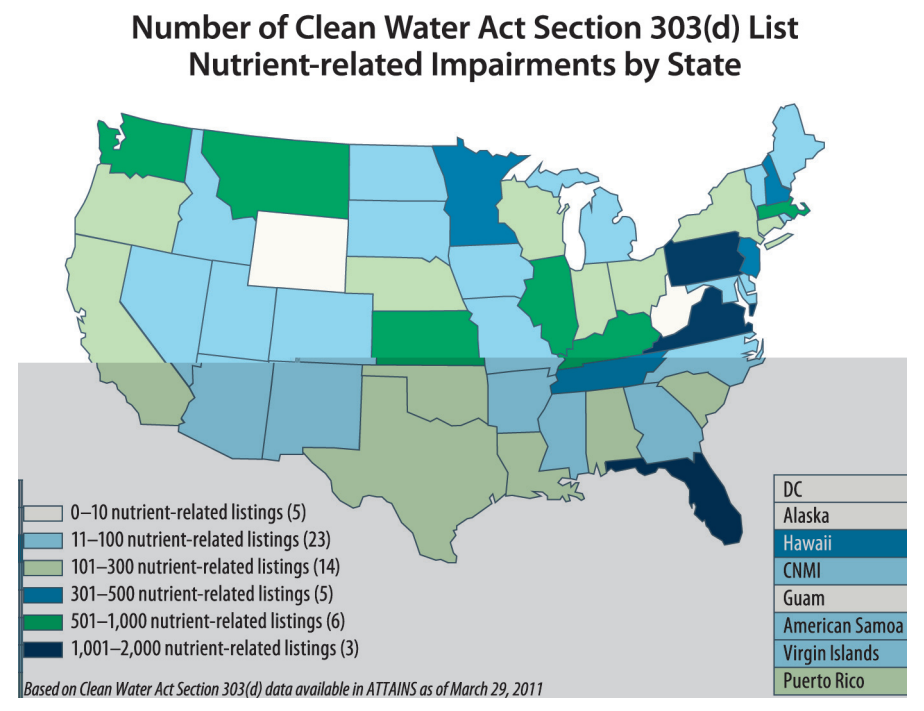
For similar information on other stream sites in the MARB, visit *http://water.usgs.gov/nawqa/pubs/nitrate_trends*.

The contour plots at right show model estimates of concentration as a function of time and streamflow for two five-year snapshots in time—an early period from 1980 to 1984 and a recent period from 2004 to 2008. Any *vertical* line shows how concentration would have varied with streamflow on a particular day of a particular year; any *horizontal* line shows how concentration would have varied over time (seasonally and annually) at a particular streamflow. Because the probability distribution of streamflow changes from day to day, smoothed estimates of the 5th and 95th percentiles of streamflow on each day are plotted as black lines.

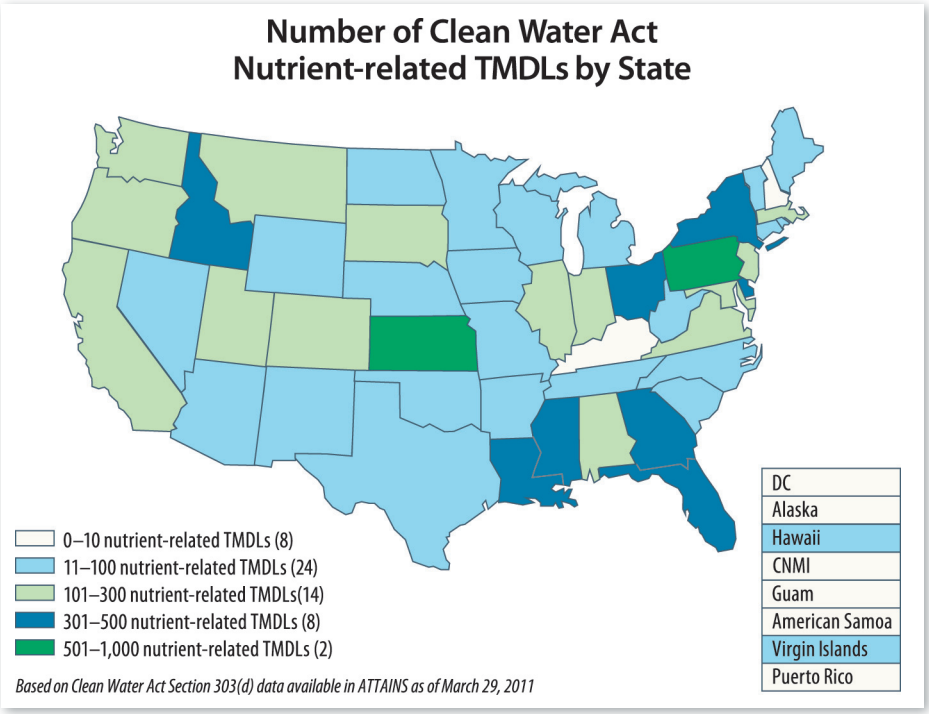


Status of Clean Water Act Impaired Waters and Total Maximum Daily Loads (EPA)

Under section 303(d) of the Clean Water Act (CWA), states, territories, and authorized tribes are required, every two years, to develop lists of impaired waters that require total maximum daily loads (TMDLs). Impaired waters are those that do not meet applicable water quality standards. A TMDL is a planning tool that identifies the maximum amount of a pollutant that a water body can receive and still meet applicable water quality standards with a margin of safety, and it allocates that amount to the point and nonpoint sources of that pollutant. The U.S. Environmental Protection Agency (EPA) provides oversight of the CWA section 303(d) program and is required to review and approve state-submitted lists of impaired waters and TMDLs. If EPA disapproves a list or a TMDL, it must establish a new list or TMDL.



Over the past two decades, more than 15,000 nutrient-related impairments have been identified nationally on states' EPA-approved section 303(d) lists. The majority of the impairments (67 percent) are in MARB states. Thirteen of the 31 MARB states have identified fewer than 100 nutrient-related impairments on their 303(d) lists. In general, states do not monitor and assess all of their water bodies during each two-year 303(d) reporting cycle. As a result, states' 303(d) lists might not identify the full extent of nutrient-related impaired waters.



Over the past two decades, more than 8,000 TMDLs have been developed for nutrient-related impairments nationally. These impairments are no longer included on states' 303(d) lists because TMDLs have been completed. Most (68 percent) of the nutrient-related TMDLs developed nationally are in MARB states. Sixteen of the MARB states have developed fewer than 100 TMDLs for nutrient-related impairments.

Note: For this analysis, nutrient-related 303(d) impairments and TMDLs are defined by the following impairment categories: algal growth, ammonia, noxious aquatic plants, nutrients, and organic enrichment/oxygen depletion.

EPA's National Aquatic Resource Surveys: National Lakes Assessment in the MARB (EPA)

EPA's National Lakes Assessment (NLA), published in 2009, provides the first statistically defensible summary of the condition of the nation's lakes and reservoirs. It is one of four National Aquatic Resource Surveys that EPA has issued or will issue to report on the environmental condition of major water body types in the United States. As part of the NLA, data on TN and TP, among other parameters, were collected as indicators of the health of the nation's lakes. Analyses show that when levels of TN and TP are high, lakes are two-and-a-half times more likely to have poor biological condition than those with low levels.

Percentage of Lakes Exceeding Threshold Values for Nitrogen and Phosphorus[a]

	Nitrogen	Phosphorus
Total U.S. (lower 48)	19.1%	18.2%
Total Mississippi/Atchafalaya River Basin	30.27%	33.97%
Upper Mississippi Subbasin	13.53%	25.83%
Ohio Subbasin	23.5%	24.67%
Upper Missouri Subbasin	80.36%	68.62%
Lower Missouri Subbasin	25.12%	23.72%
Arkansas Subbasin	22.59%	9.74%

[a] The Tennessee and Lower Mississippi subbasins are not included because each has fewer than 30 assessed sites, which increases the percentage of error and lowers the confidence values. (Source: EPA)

Excess TN is one of the most pervasive stressors measured in lakes for the nation overall. Nationally, the results of the NLA reveal that 53.8 percent of lakes had low TN concentrations and 58.1 percent had low TP concentrations, while 19.1 percent of lakes had high TN concentrations and 18.2 percent had high TP concentrations.

Further analysis of NLA data completed in FY 2011 shows that, within the MARB, 30.3 percent of lakes had high levels of TN while 37.7 percent had low levels. Within the MARB, 50.3 percent of lakes were characterized as being in good biological condition, 21.4 percent were in fair biological condition, and 27.3 percent were in poor biological condition.

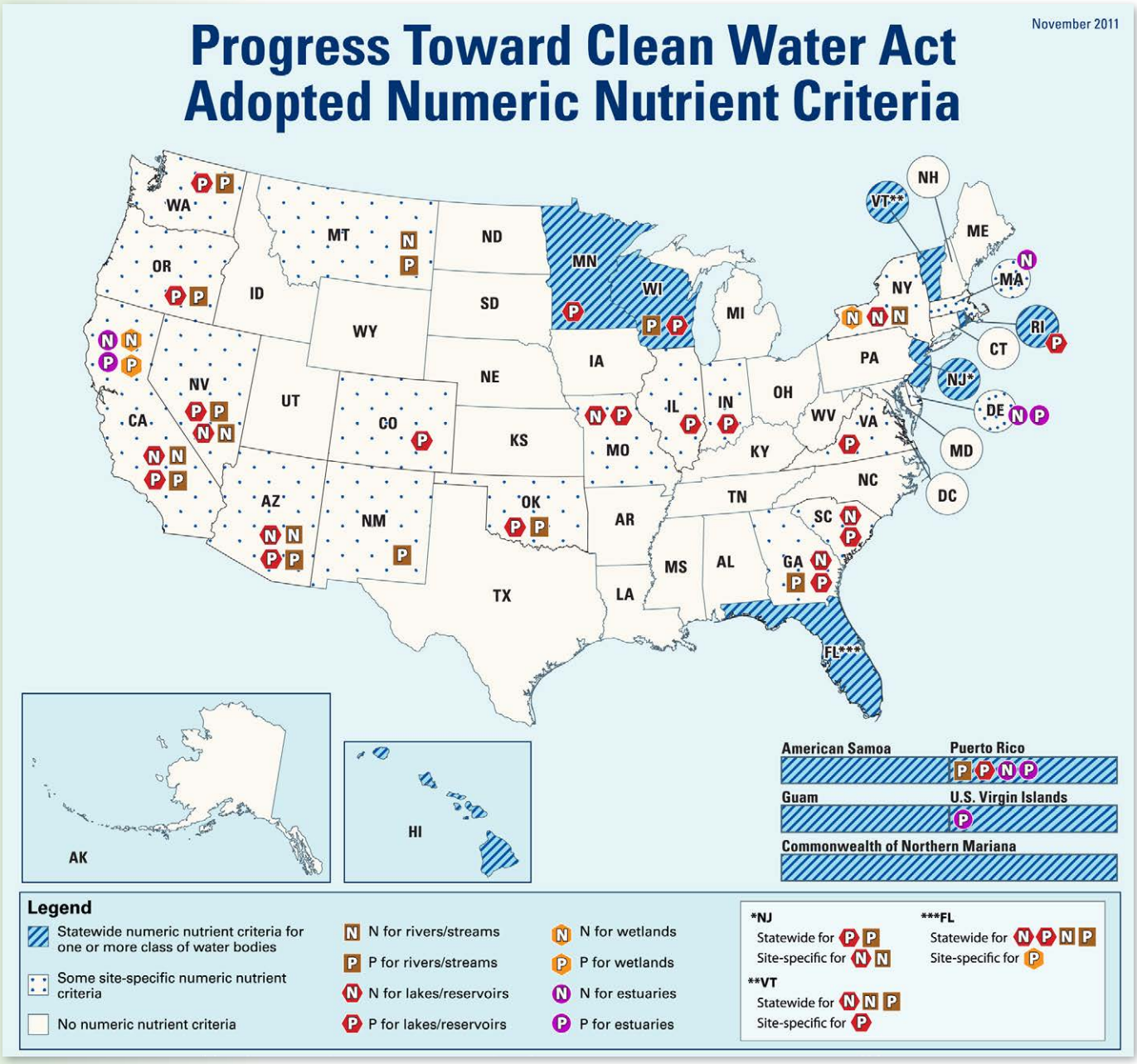
Sampling team for EPA's National Lakes Assessment.

State Adoption of Numeric Nutrient Criteria (EPA)

Water quality standards are the foundation for protecting the quality of the nation's surface waters and are the cornerstone of the water quality-based control program mandated by the CWA. All waters require water quality standards, and EPA must approve state/tribal standards for them to be effective under the CWA. The standards describe the desired condition of a water body and consist of three principal elements: (1) the *designated uses* of the state's waters (e.g., fishing, swimming, drinking water); (2) *criteria* specifying, in numeric or narrative form, the amounts of various pollutants that may be present in those waters without impairing the designated uses; and (3) *antidegradation policies* providing for the protection of existing water uses and limitations on degradation of high-quality waters.

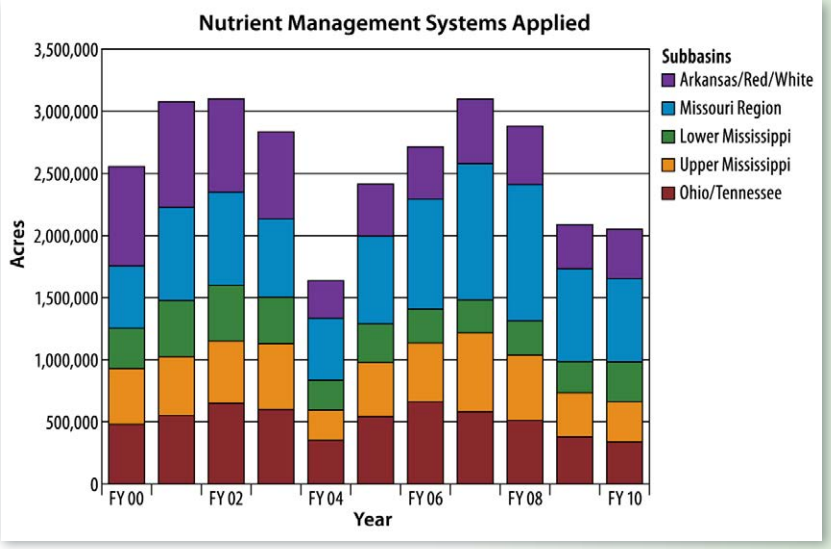
During FY 2011, EPA approved numeric nutrient criteria in two Mississippi River Basin states—Wisconsin, for statewide phosphorus criteria for rivers/streams and lakes/reservoirs (including the Great Lakes; see page 15 for more information on the Wisconsin criteria), and Missouri, for site-specific nitrogen and phosphorus criteria for 25 lakes/reservoirs. The map below provides the current state-by-state status of EPA-approved numeric nitrogen and phosphorus criteria. To learn more about the resources EPA has made available to facilitate the process of state adoption of numeric nutrient criteria, visit EPA's new website on nutrient pollution at *epa.gov/nutrientpollution*.

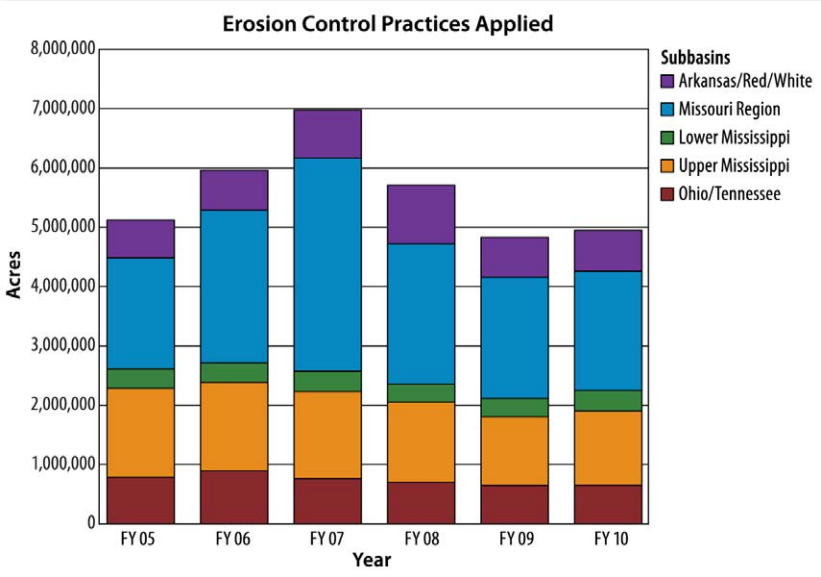
USEPA



Nutrient Management Systems Applied (USDA)

Nutrient management consists of managing the amount, source, placement, form, and timing of the application of plant nutrients and soil amendments. Twenty-eight million acres of land have come under nutrient management systems within the MARB since 2000, including 4 million acres added in FY 2009 and 2010.



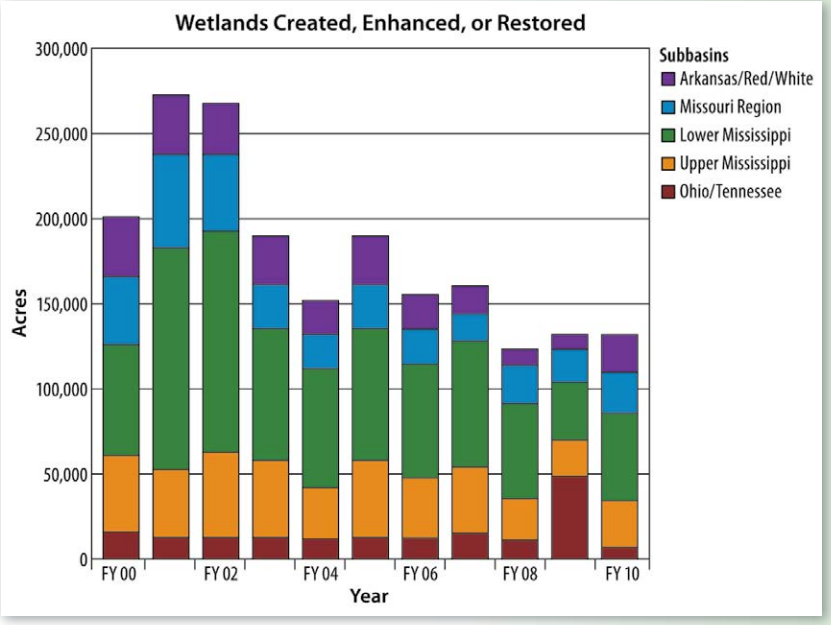


Erosion Control Practices Applied (USDA)

Erosion control practices associated with crop production help to reduce the potential of off-site impacts from sheet and rill erosion while improving soil fertility, soil health, and sustainable crop production. Data on crop erosion have been collected since FY 2005, when phosphorus was identified as a nutrient of concern associated with Gulf hypoxia. Conservation practices were applied to 34 million acres of land for erosion control from FY 2005 to FY 2010, including 10 million acres added in FY 2009 and 2010.

Wetlands Created, Enhanced, or Restored (USDA)

Wetlands provide quality habitat for migratory birds and other wildlife, protect water quality, and reduce flood damages. Within the MARB, 2 million acres of wetlands have been created, enhanced, or restored since 2000; almost 300,000 acres were added in FY 2009 and 2010.



Success Stories

Throughout the MARB, nutrient-related water pollution significantly affects human health and aquatic life. Both governmental and nongovernmental groups and individuals are engaging in a wide variety of projects and programs to reduce nutrient pollution in the MARB. The stories that follow provide a sample of successful efforts aimed at addressing nutrient pollution and reducing the size of the hypoxic zone.

The Indiana Conservation Cropping Systems Initiative

INDIANA

The Indiana Conservation Cropping Systems Initiative (CCSI) is reaching Indiana farmers and getting conservation practices implemented on agricultural land. The Initiative promotes no-till, nutrient management, cover crops, precision management, and riparian buffers, implemented together as a profitable and environmentally beneficial system. Implementation of the CCSI conservation practices controls erosion, improves soil quality, and reduces nitrogen and phosphorus losses to rivers and streams.

No-till corn (left) and conventional corn (right) at the Roger Wenning farm in Greensburg, Indiana.

Through local partnerships, the CCSI provides technical assistance to producers during the transition phase from conventionally tilled farming to conservation cropping systems (CCS). A statewide effort to promote the program has reached some 8,000 producers in 131 local meetings. Since the CCSI began in late 2009, cover crop acres have increased by 400 percent. In addition, a group of CCS "mentors" is being formed to assist farmers through the system transition. An active website (*http://CCSIN.org*) provides the latest information on CCS, including videos of farmers who have made the switch. Partnering with the recently launched Indiana On-Farm Network, where interested crop producers engage in adaptive management and develop strategies that ultimately increase profitability and protect and restore water quality, the Initiative will be able to show the on-farm benefits of CCS to farmers.

By concentrating its message on economics and soil quality, the CCSI is reaching large numbers of conventional farmers, who previously would not have considered using no-till and other conservation practices. The use of hands-on demonstrations, such as rain simulators, slake tests, cover crop plots, planter setup and soil pits, has increased the active participation and excitement of farmer audiences.

Funding and oversight of the CCSI is provided by the Indiana Conservation Partnership, which includes the Indiana Association of Soil and Water Conservation Districts; Indiana Department of Environmental Management; Indiana Department of Natural Resources; Indiana State Department of Agriculture, Division of Soil Conservation; Purdue Cooperative Extension Service; State Soil Conservation Board; and U.S. Department of Agriculture (USDA), Farm Service Agency and Natural Resources Conservation Service (NRCS).

Iowa CREP Wetlands

IOWA

The Iowa Conservation Reserve Enhancement Program (CREP) is a joint effort of the Iowa Department of Agriculture and Land Stewardship (IDALS) and USDA's Farm Service Agency, in cooperation with local soil and water conservation districts (SWCDs). The program provides incentives to landowners to voluntarily restore shallow, semi-permanent wetlands in the heavily tile-drained regions of Iowa to improve surface water quality while providing valuable wildlife habitat and increased recreational opportunities.

The goal of the program is to reduce nitrogen loads and the movement of other agricultural chemicals from croplands to streams and rivers by targeting wetland restorations to "sweet spots" on the landscape that provide the greatest water quality benefits. CREP wetlands are positioned to receive tile drainage by gravity flow; they remove nitrate and herbicides from the water before it enters streams and rivers. Excess nitrogen not only affects Iowa's waters but is also one of the leading causes of hypoxia in the Gulf of Mexico. CREP wetlands are one strategy to help reduce nitrogen loading to those waters.

Iowa Department of Agriculture and Land Stewardship, Division of Soil Conservation

An Iowa CREP wetland, restored in 2006. The 4.5-acre wetland lies within a 20-acre easement.

Targeted results. To ensure that wetlands are sited in the most advantageous locations, IDALS uses advanced geographic information system (GIS) analyses to find locations that are properly sized and situated to provide large nitrogen removal benefits. The CREP wetland criteria are based on over two decades of research and monitoring conducted by Iowa State University.

This research and monitoring has demonstrated that strategically sited and designed CREP wetlands remove 40 to 70 percent of nitrates and over 90 percent of herbicides from cropland drainage waters. Nitrogen reduction is achieved primarily through the denitrifying bacteria that occur naturally in wetlands. Through denitrification, the bacteria remove nitrate from the water and release it into the air as nitrogen gas (N_2), an innocuous end product.

The highly targeted nature of this program has led to 72 wetlands either currently restored (54) or under development (18) over the past 10 years. During their lifetimes, these wetlands are expected to remove more than 54,000 tons of nitrogen from 86,000 acres of cropland. These 72 targeted restorations total more than 700 acres of wetlands and 2,500 acres of surrounding buffers planted to native prairie vegetation.

More than nitrogen removal. Even with the impressive results so far, Iowa continues to explore and develop new technologies to optimize wetland performance by incorporating additional considerations for habitat, hydraulic efficiency, and temporary flood storage benefits. CREP wetlands are already providing high-quality wildlife habitat and recreational opportunities in addition to water quality benefits. Studies conducted by USGS have shown dramatic increases in the presence of several frog species at CREP wetland sites. The high-quality buffers, in conjunction with the shallow wetland habitats, have proven to be a tremendous boon to a multitude of wildlife species commonly found in these areas.

Several landowners use their sites not only for their personal enjoyment but also as a revenue source by leasing them out for hunting. CREP wetlands are particularly popular with duck and pheasant hunting enthusiasts and are widely used for such activities. Populated by birds ranging from trumpeter swans to shorebirds, these areas have shown that targeting wetland restoration for water quality benefits does not come at the expense of mutual habitat and recreational benefits.

Wisconsin Enacts Numeric Water Quality Criteria for Phosphorus

In 2010 the Wisconsin Department of Natural Resources (WI DNR) took significant steps toward reducing phosphorus loadings to the Upper Mississippi River Basin watershed—the enactment of numeric water quality criteria for phosphorus (which EPA approved on December 30, 2010) and other revisions to state administrative rules. The phosphorus numeric criteria are the culmination of a planned series of steps initiated over a decade ago with multi-year scientific monitoring studies of more than 240 streams and 42 rivers in Wisconsin. WI DNR used the studies, along with the results of earlier studies in Wisconsin and newer studies in nearby states, to develop the criteria.

The criteria establish an upper limit for phosphorus levels in lakes, rivers, and the Great Lakes that will maintain the designated uses the state has identified for each of these waters, which include fishing and recreation. Numeric levels are set for five categories of lakes, impoundments and reservoirs; rivers and streams; and the Great Lakes. The criteria then form the basis for setting numeric limits on the amount of phosphorus that permitted facilities may discharge to Wisconsin surface waters.

Wisconsin Department of Natural Resources

Algae mats on Pool 8 below Horseshoe Island. A total phosphorus criterion of 100 µg/L is established in the new water quality criteria for the Mississippi River.

In addition, rule revisions to state performance standards covering agricultural runoff require nearly all Wisconsin farms to:

- Use the Wisconsin Phosphorus Index (PI) on all fields to evaluate phosphorus source and transport factors and set limits on the amount of phosphorus that may run off croplands and pastures over a crop rotation annually.
- Provide a setback from water bodies in agricultural fields where no tillage is allowed in order to maintain stream bank integrity and avoid soil deposition and phosphorus loading into state waters.

To reduce phosphorus in stormwater runoff, WI DNR also modified its performance standards for construction site erosion control, post-construction stormwater management, and developed urban areas. In addition, WI DNR revised the cost-share eligibility requirements for two BMP grant programs so they would better align with its enforcement process.

NRCS' Mississippi River Basin Healthy Watersheds Initiative (MRBI): Examples of Projects in Hypoxia Task Force States

Illinois: Conservation Systems Are a Focus in the Indian Creek Watershed

The Indian Creek Watershed Project is designed to illustrate the efficacy and value of agricultural conservation systems and their impact on watershed environmental health. Through this high-profile watershed project, local farmers will help demonstrate and test innovative conservation practices, including conservation tillage, nutrient management, water management, and beneficial cover crop use.

USDA NRCS

Conservation systems in the Indian Creek watershed will benefit water quality and farm profitability.

The Indian Creek watershed, covering 52,480 acres and flowing to the South Fork of the Vermilion River, is one of the focus areas of the MRBI, an initiative of USDA–NRCS. Agriculture dominates the watershed: 95 percent of the land is tillable, and the average farm size is 500 acres. Implementing conservation solutions over the planned six-year project will benefit watershed water quality and farm profitability. NRCS, the Livingston County Soil and Water Conservation District, and the Conservation Technology Information Center are leading the project, in conjunction with the Illinois Environmental Protection Agency, Agri Drain Corporation, Agrium, John Deere and other partners.

Arkansas: Producer Protects Resources through Program Assistance

Historically, fluctuating water levels and flooding have caused erosion problems on the Willow Bend Farm in Conway County. "My dad used the Soil Conservation Service when I was a kid to help deal with erosion problems," said Ruth Spiller, manager of the farm. "I also need technical and financial help with the erosion issues. I read a lot, but I needed the expertise of the NRCS to figure out what works best on this farm," she noted.

USDA NRCS

Conway County District Conservationist Ronnach Day (left) discusses the monitoring project planned on a Willow Bend Farm wetland with Ruth Spiller, farm manager.

To address her specific natural resource concerns, Spiller recently enrolled more than 1,400 acres of the farm in the MRBI project through the Farm Bill's Environmental Quality Incentives Program (EQIP). Her conservation plan calls for monitoring and evaluation of nutrient runoff, waste transfer and utilization, cover crop planting, nutrient management with grid sampling, a structure for water control, wetland enhancement, conservation crop rotation, and the fencing of a wetland area.

Through the project , NRCS and its partners will help agricultural producers in 15 sub-watersheds of the Lake Conway–Point Remove Basin to address a range of water quality issues by implementing nutrient runoff and water management conservation systems—all of which will help to improve water quality in the Mississippi River Basin.

Kentucky: Precision Nutrient Management Protects Water Quality

Randy Deweese, a Kentucky corn, wheat, and soybean producer, has upgraded his farming equipment to be able to precisely apply anhydrous ammonia using global position system (GPS) technology. In 2010 Deweese was accepted into the EQIP portion of the MRBI. Through EQIP, he worked with NRCS to develop a conservation plan that outlines his goals for reducing excessive nutrients and organics in the surface water, targeting nitrogen applications to specific areas, and improving soil quality.

USDA NRCS

Producer Randy Deweese uses equipment like that shown for precision nutrient management.

The MRBI conservation plan and EQIP contract cover 568 acres of cropland and include cover crops, as well as field borders along perennial streams. Through the Kentucky State Cost-Share Program, administered by the Kentucky Division of Conservation, precision nutrient management will also be implemented. NRCS and the Kentucky Division of Conservation have partnered on Kentucky's three MRBI focus watersheds.

These efforts will improve water quality by targeting nutrient applications to meet field-specific cropland yield capabilities. Deweese's overall goals are to grow his yield potential, protect the water quality in his local watershed and the Mississippi River Basin, cut his anhydrous ammonia use, and improve his net income per acre.

Louisiana: Precision Agriculture Provides Recipe for Improving Watershed Health

Ranked third in the nation in production, Louisiana's rice farmers use best management practices (BMPs) to maintain production levels while conserving the state's natural resources.

USDA NRCS

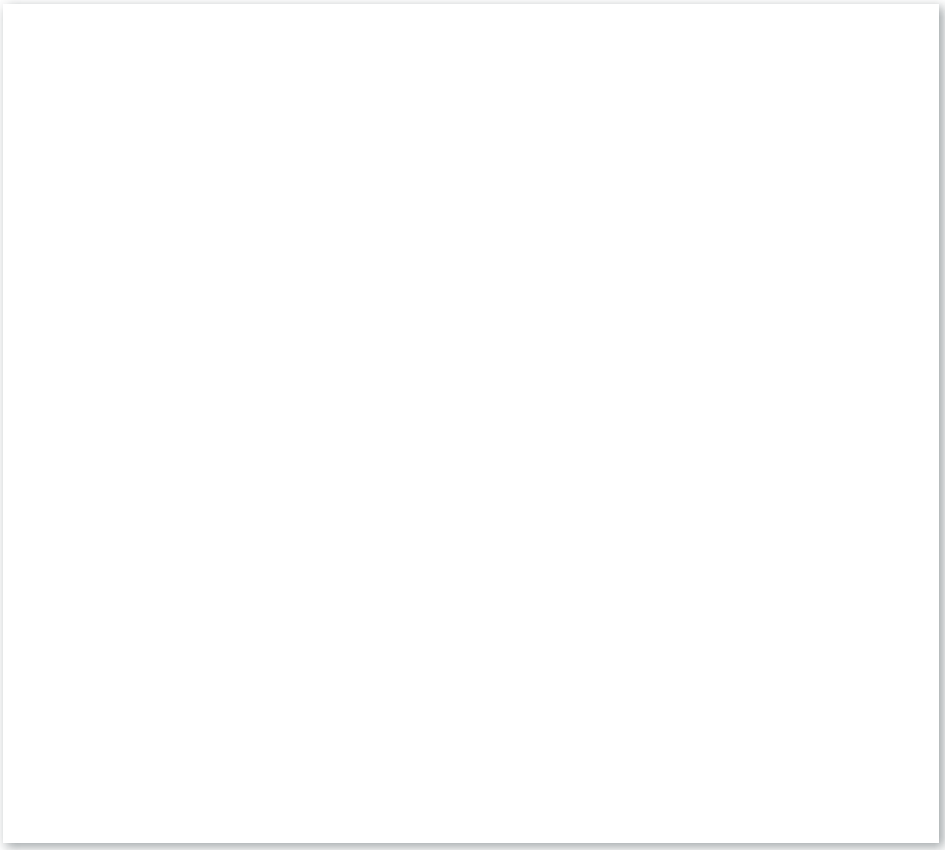
Precision agriculture technology increases efficiencies for rice production while conserving natural resources.

Recognizing the broader natural resource impacts of farming in the Mississippi River Basin, the Chris Krielow Farm and Bayouland Farms recently enrolled more than 990 acres in the MRBI. Both farms apply precision agriculture technology to collect crop nutrient needs more precisely, evaluate production input factors, accurately predict crop yields, and precisely apply variable rates of nutrients across their fields. This technology focuses on the application of nutrients, reducing nutrient runoff, and improving water quality.

The farms also use no-till drills to plant their crops. Their conservation tillage systems increase the efficiency and productivity of their rice operations by using less fossil fuel, reducing runoff and erosion of soils, and increasing the amount of organic matter in the soil. One part rice + one part precision agriculture + one part no-till drill = a recipe for natural resource conservation success in the Mississippi River Basin and its local watersheds.

"Boots on the Ground"—NRCS in Missouri Employs Strategic Watershed Action Teams to Accelerate Implementation of Missouri's MRBI Projects

USDA–NRCS in Missouri received $345,000 in annual Farm Bill funding in 2011 to implement Strategic Watershed Action Teams (SWATs). Through a Partnership Contribution Agreement with the state of Missouri, the SWATs will provide additional "boots on the ground" to accelerate implementation of Missouri's 2010 MRBI projects. The state of Missouri, through the Missouri Department of Natural Resources' Soil and Water Conservation Program (SWCP), pledged its support and commitment to this effort by providing nonfederal matching funds of $115,000 to the SWCDs to cover personnel expenses for the additional full-time temporary district technicians. These positions are unique, and NRCS will be working with the SWCD boards to prepare contracts between the boards and the new district employees to ensure that expectations and timelines are clearly communicated. The Partnership Contribution Agreement will cover six of the 12 Missouri MRBI projects that NRCS funded in 2010.



Missouri Department of Natural Resources

Locations of the 2010 MRBI projects in Missouri.

EPA Region 7 Partners with State of Missouri in Support of Missouri's MRBI Projects

EPA's Kansas City regional office (Region 7) is partnering with the Missouri Department of Natural Resources (MDNR) to provide monitoring support for Missouri's MRBI projects. At the request of MDNR, EPA Region 7 is identifying, selecting, and monitoring wadeable reference streams in the Lower Grand watershed, which contains six of Missouri's 12 MRBI projects awarded funding by USDA–NRCS in 2010. (Reference streams are streams that are relatively unimpacted by anthropogenic stressors and, as a result, provide an ideal endpoint water quality condition to strive to achieve.)

EPA Region 7's monitoring team and GIS group are collaborating with MDNR's monitoring program to identify reference watershed candidates and eventually to select wadeable stream reference sites. Once the reference watersheds have been selected, the EPA Region 7 monitoring team will monitor three new reference sites for biological, chemical, and physical constituents. The monitoring will include fish and macroinvertebrate community sampling and identification, algal sampling and taxonomic identification, in-stream and near-stream habitat assessment, watershed condition assessment, and water and sediment chemistry sampling and analysis.

Field work began during the summer of 2011 and will continue through spring 2012. EPA Region 7 is contributing an estimated $67,200 of in-kind-services in support of Missouri's MRBI projects in the Lower Grand watershed.

Missouri Department of Natural Resources

Macroinvertebrate sampling in a Missouri stream.

Farmers in Grand Lake St. Marys Watershed Step Up

OHIO

Mercer and Auglaize counties, in west-central Ohio, have been in the conservation spotlight for the past two years because of impaired water quality in Grand Lake St. Marys (GLSM). GLSM, Ohio's largest inland lake, is situated in both counties. The lake drains into the Wabash River, which flows into the Ohio River, and directly into the Mississippi River.

The Water Quality Concern. Over the years, GLSM has become increasingly enriched by nitrates and phosphates from a number of man-made and natural sources, contributing to the decline of water quality and the occurrence of harmful algal blooms. Soon after Memorial Day in 2009, the Ohio Environmental Protection Agency (OEPA) found high levels of algal toxins in the lake. Then in July 2010, a lake-wide bloom of blue-green algae halted all recreational activity, severely hampering the local economy, and attracting national attention.

The Conservation Partnership. For over 10 years, a broad partnership that includes the Grand Lake/Wabash Watershed Alliance, Mercer and Auglaize SWCDs, Ohio Department of Natural Resources' Division of Soil and Water Resources (ODNR-DSWR), OEPA, and other lake protection groups and local government entities have worked to advance conservation efforts and improve awareness of GLSM water quality issues. For several years prior to 2008, the SWCDs, ODNR-DSWR, and USDA's NRCS and Farm Service Agency provided funding for conservation practices and related technical assistance supporting water quality improvement projects.

Conservation Assistance and Increased Oversight. The lake-wide algal bloom and ensuing water quality issues at GLSM attracted nationwide attention, and also resulted in increased efforts from conservation partners to bolster funding and technical assistance for water quality efforts. From 2008 to 2011, NRCS allocated more than $5.6 million of USDA EQIP funding for use in the GLSM watershed to improve water quality. The state also used existing conservation programs and federal grant funding to hire additional state and federal staff to provide technical assistance for installing BMPs.

Another result of the 2010 lake-wide algal bloom was increased state oversight. ODNR–DSWR issued new rules effective January 2011 applicable to agricultural operations within watersheds. For example, large livestock operations (i.e., those handling more than 350 tons and/or 100,000 gallons of manure) are required to follow the NRCS 633 standards for land application. All livestock operations are required to prepare nutrient management plans and submit them to ODNR–DSWR for approval. Beginning January 1, 2013, all agricultural operations will be restricted from applying manure between December 15 and March 1.

On January 18, 2011, ODNR–DSWR determined that GLSM meets the criteria for designation as a "distressed watershed" because of the excessive nutrient loading and resulting algal blooms. In response to the requirement for nutrient management plans

for all livestock operations in a "distressed watershed," the Mercer SWCD provided additional staff to help applicable producers develop the plans. This designation and the associated rules, combined with the voluntary efforts of individual producers represent important steps toward improved water quality in the lake. The goal is removal of the "distressed watershed" designation.

Ohio Department of Natural Resources

Steve McDevitt (USDA–NRCS) assisted Leon Heitkamp (right) with inspecting newly planted soybeans and explained the benefits of cover crop residue.

The Conservation Response. Farmers in the GLSM watershed responded to the "conservation call" in 2008 and 2009 thanks to the availability of special EQIP funding. Featured below are two examples of farmers implementing multiple nutrient-reducing BMPs on their farms.

- ***Mercer County.*** Brothers Mark and Paul Dahlinghaus, who both raise livestock and grow crops, have installed multiple conservation structures, including a grassed waterway, a milk house wastewater irrigation system, dry stack manure storage, hayland buffers, and a wildlife watering facility. They recognize the value of protecting their soil and keeping nutrients in place, and limiting bare ground exposure and reducing nutrient runoff by planting cover crops, which they also use as forage for their livestock.
- ***Auglaize County.*** Leon Heitkamp is a dairy farmer who has taken many steps to conserve nutrients and soil on his land. He has installed filter strips and cover crops, and uses no-till or "direct" planting. Heitkamp started his conservation work with filter strips along the 1.5 miles of creek that runs through his farm. He has also constructed both a dry stack facility and a manure holding pond in order to store manure through the winter months. His manure storage reduces the need to spread the manure on frozen ground, which is key for proper manure nutrient management.

Many other GLSM watershed farmers have installed or are planning to install practices to reduce nutrient runoff. Additional conservation efforts are under way in the nearby residential and business community. Much remains to be done to eliminate harmful algal blooms and excess nutrient loads. Farmers and other citizens in the GLSM watershed continue to work together to educate, plan, and implement conservation practices, including the use of new technologies to reduce nutrient loading into the GLSM and, ultimately, to the Gulf of Mexico.

Steele Bayou Watershed Project: A 20-year Record of Nutrient Reduction in a Flood Control/Sediment Reduction Project in the Mississippi Delta

USACE

Steele Bayou is an 8-digit Hydrologic Unit Code (HUC8) watershed in the southern portion of the Mississippi Delta. It was originally impaired by sediment, low dissolved oxygen, organic enrichment, and nutrients and was placed under a fish consumption advisory for legacy pesticides. Since the early 1990s, the U.S. Army Corps of Engineers (USACE) has been involved with a flood control/sediment reduction project in the watershed in which numerous sediment control and water management practices were installed. These practices included the installation of eight low-head weirs to maintain minimum water depths in the channels and 67 sediment control structures to prevent sediment from filling the channels. A one-year baseline water quality study established pre-project conditions from 11 monitoring stations. In 2005, USACE initiated monthly post-project water quality data collection from four monitoring stations located in areas where practices had been implemented, as well as two downstream stations. The initial post-project monitoring results indicated a large reduction in in-stream total suspended solids (TSS).

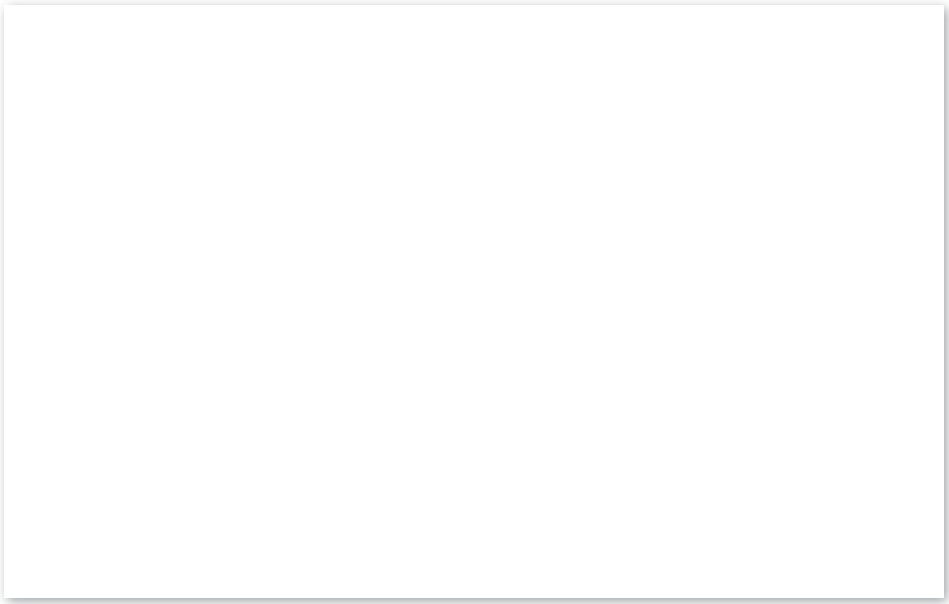
Project Expansion. Because of these results, USACE identified more than 100 additional sites where sediment control and water management practices were needed. USACE worked with the Mississippi Department of Environmental Quality (MDEQ), Delta F.A.R.M. (Farmers Advocating Resource Management), and local stakeholders to implement the practices. To date, 30 small structures and 76 larger structures have been installed. The total cost for implementing the practices since project inception is over $41 million. Concurrent with this latter effort, the Mississippi Soil & Water Conservation Commission, USDA–NRCS, and Ducks Unlimited also worked with stakeholders in the watershed to install numerous water management practices, such as sediment control structures, land leveling, containment dikes (pads), and overfall pipes.

U.S. Army Corps of Engineers

Aerial view of a sediment control structure.

Results. USACE developed a GIS model that correlates changes in water quality, as identified by over 20 years of monitoring data, to incremental changes in the area of installed sediment control and water management practices. At project inception during the early 1990s, pre-implementation monitoring established baselines for TSS, TN, and TP; land use analysis estimated that about 15 percent of the land area in the HUC8 watershed had conservation practices already installed. By 2010, about 50 percent of the watershed was protected by some type of sediment control structure or water management practice.

An analysis of the preliminary results from post-project monitoring in the three sub-watersheds within the larger Steele Bayou watershed revealed a 42 to 60 percent reduction in TSS concentrations over the past 15 years and an 8 to 35 percent reduction in TP concentrations (as shown in the table below)—a significant result of the flood control and sediment reduction project. The analysis also noted reductions in TN, although there did not appear to be a discernible pattern. In addition, the project resulted in the lifting of the fish consumption advisory for this water body. Correlation of the reductions to the areas of installed sediment control and water management practices shows that for every 1 percent increase in land area protected by the practices, there was a 2 percent reduction in TSS and a 1 percent reduction in TP concentrations.



Notes: Total phosphorus concentrations show a significant downward trend; 2008 and the third and fourth quarters of 2009 were very wet.

Wetlands, like this one in Iowa, trap nutrients and can help reduce hypoxia in the Gulf of Mexico.

Mississippi River Gulf of Mexico Watershed Nutrient Task Force

U.S. Environmental Protection Agency
Office of Wetlands, Oceans, and Watersheds (4501T)
1200 Pennsylvania Avenue, NW, Washington, DC 20460
E-mail: *ow-hypoxia@epa.gov*
Website: *www.epa.gov/msbasin*