

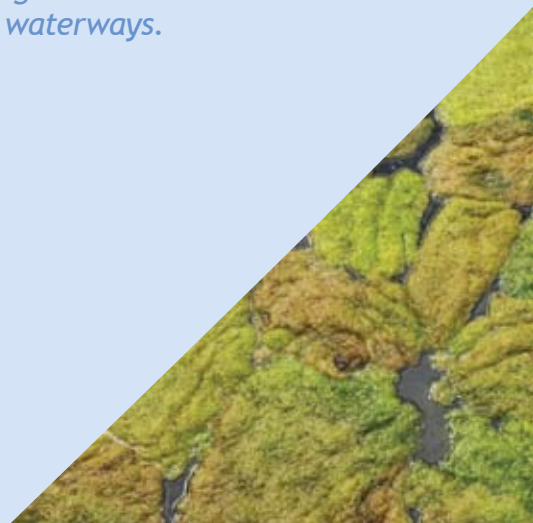


# Trade Wars

## WILL NUTRIENT TRADING SAVE OR SPOIL OUR STREAMS?

*As water quality continues to decline across the country, many states are hoping that nutrient trading programs can deliver on their promise of cleaner waterways.*

BY SUZANNE TELLER



One of the most striking characteristics of U.S. geography is the country's massive system of rivers and lakes. Few other places on earth have been blessed with such an extensive network of fresh water resources, and none has utilized this resource so thoroughly. From the Colorado and Columbia River systems in the west to the mighty Mississippi and the Great Lakes of the Midwest and the Chesapeake Bay on our eastern shore, we have harnessed the raw power of our waterways and capitalized on their natural wealth.

Some of America's rivers and lakes serve as vital thoroughfares for inland navigation. Others provide irrigation water or generate electricity. Not only have these waterways moved our goods, fed our population, and powered our industries, they have also inspired our awe and admiration. It is no wonder that the growth of our largest cities and most prosperous industries has historically been centered along rivers and lakes. Unfortunately, this concentration of people and commerce also marked the beginning of the decline of our nation's waterways.

Luna Leopold, renowned hydrologist and son of famous ecologist Aldo Leopold, once wrote that "the health of our waters is the principal measure of how we live on the land." A quick glance at the vital signs of some of our most important waterways indicates that we are living well beyond our

means. The Chesapeake Bay, once described by author and literary critic H.L. Mencken as "an immense protein factory," is in critical condition and its legendary fish and shellfish populations have dwindled to unsupportable numbers. The Mississippi River, which drains a whopping 40 percent of the continental United States, is suffering from bacterial contamination so severe that large stretches are deemed too dangerous for swimming. The white, sandy beaches of Lakes Erie and Michigan are now often covered by mats of foul-smelling green algae and scores of dead fish. These and many other symptoms plaguing our ailing lakes and rivers can be traced to a single source: nutrient pollution.

### Too Much of a Good Thing

Just as our bodies can be sickened by excess amounts of essential vitamins and minerals, lakes and rivers can suffer from too much of a good thing.

Nitrogen and phosphorus are essential for plant growth and are applied regularly to lawns and croplands. Small amounts of these nutrients are not harmful to rivers and lakes. However, when large amounts of nitrogen and phosphorus enter a waterway, they can cause excessive algae growth known as an "algal bloom." Increased algae growth results in a greater amount of dead and decaying vegetation in the water. This, in turn, causes bacterial populations to skyrocket and oxygen levels to plummet — a process that, over time, depletes fish and shellfish populations.

This excess of nutrients in the water and the resulting water quality problems are called "nutrient pollution."

If asked to visualize where this pollution is coming from, many of us would conjure up the image of sewage pipes and factory outflows. Forty years ago, the birth of the modern environmental movement brought widespread public awareness to the chemical soup being released into our nation's waterways by wastewater treatment plants, oil refineries, and other industries. These industries began to face strict regulations. As a result, the largest threat to our waterways is no longer coming from the end of a pipe; it comes from green suburban lawns and picturesque farm fields.



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### What's Your Point?

Nutrient pollution that enters the Chesapeake Bay from sewage treatment facilities and industrial plants is called “point source” pollution because it comes from a single “point” — a pipe, ditch, or other discernible source carrying waste from these facilities. These nutrient sources can be easily observed, monitored, and regulated.

However, fertilizers applied on farm lands or suburban lawns, oil and grease on roadways, and bacteria from livestock or pet waste can be carried into waterways by rainwater or snowmelt. This nutrient-laden runoff is termed “nonpoint source” pollution. Because it does not originate from a single identifiable source, nonpoint source pollution is more difficult to quantify and very difficult to regulate.

Since the passage of the Clean Water Act in 1972, the U.S. Environmental Protection Agency (EPA) and state agencies have had great success in controlling pollutant discharges from industrial facilities, sewage treatment plants, and other point sources. However, programs established to address nonpoint source pollution — including the Nonpoint Source Management Program and the Coastal Nonpoint Pollution Program — have made little progress in stemming the flow of pollutants from nonpoint sources. Because the Clean Water Act does not give EPA authority to directly regulate nonpoint source discharges, the responsibility for tackling our most serious water pollution problem largely rests on the shoulders of state and local authorities. Lack of funding and enforcement, however, has plagued state and local efforts to curb this growing threat, prompting a major shift in how today's nutrient reduction strategies are being formulated.







*Nutrient trading is one of the tools EPA has proposed to help reduce the total amount of nutrient pollution entering our rivers and streams.*



## Nutrient Trading 101

Nutrient trading is one of the tools EPA has proposed to help reduce the total amount of nutrient pollution entering our rivers and streams. A nutrient trading program establishes a “market” in which point and non-point source polluters buy and sell rights to discharge nutrients.

For example, wastewater treatment plant A, which currently meets its nitrogen discharge limit, installs new technology that further reduces the levels of nitrogen it releases into a nearby river. Under a nutrient trading program, each extra unit of nitrogen removed from Plant A’s water discharge can be sold as a credit to another discharger located in the same watershed. Wastewater treatment plant B located downstream, which is working out

how to meet water quality requirements, may find that it is cheaper to buy nitrogen credits from Plant A than to upgrade its equipment to fully meet its own nitrogen discharge limits.

Under this scenario, the total amount of nitrogen discharged into the waterway decreases, and Plant A and Plant B worked together to negotiate an economically beneficial way to do it.

In the example above, both the seller and buyer of pollution credits are considered point sources. However, trading can also take place between a point source and a nonpoint source. For example, farmers who participate in a nutrient trading program would be able to earn credits for utilizing nutrient management techniques that lower the levels of nitrogen and phosphorus leaving their lands. Industries that release these nutrients in

excess of their permit levels could then purchase credits from the farmers to avoid making cost-prohibitive upgrades to their own facilities.

The underlying principle of a nutrient trading program is that it does not matter *where* the nutrient reductions within a watershed are taking place. It only matters that the total amount of nutrients entering the watershed remains below a pre-determined limit.

## Testing the Waters

The United States began experimenting with nutrient trading in the early 1980s. The Fox River Watershed in Wisconsin and the Dillon Reservoir in Colorado were two of the very first nutrient trading programs in the country. These early trading programs were very limited in scope, but they illustrated the potential of trading to substantially reduce nutrient reduction costs while still meeting environmental goals. This prompted U.S. policy makers to re-examine the benefits and feasibility of water quality trading.

In January 1993, EPA finalized a national Water Quality Trading Policy, which established basic ground rules for nutrient trading such as what pollutants can be traded, when trading can occur, and elements of credible trading programs. Later that year, the Izaak Walton







League passed a resolution against nutrient trading on the grounds that it undermined the goals of the Clean Water Act. According to the League's policy resolution, EPA's nutrient trading program "would be susceptible to manipulation and special privilege, would not be supported by required data sets, would rely on non-existent nonpoint source pollution data, and would improperly allow degradation of water quality." (Read our conservation policies online at [www.iwla.org/publications](http://www.iwla.org/publications).) Environmental groups and economists debated the potential of nutrient trading to solve the nation's water quality woes, many of them joining the League in opposition of EPA's Water Quality Trading Policy.

Since then, nutrient trading programs around the country have gained momentum, and state environmental protection agencies have stepped in with additional guidance on putting together a trading program that is protective of water quality. In 1996, EPA released a draft framework to encourage and guide the development of state-wide trading programs that meet the requirements set forth in the Clean Water Act. By 1999, more than 25 nutrient trading trials had been set up. In 2001, the Chesapeake Bay Program — a regional partnership that directs restoration of the Chesapeake Bay — published its own nutrient trading principles and guidelines, intended to encourage Bay states and the District of Columbia to establish nutrient trading programs of their own. In early 2003, EPA released its final Water Quality Trading Policy, which built on the original 1996

policy, incorporating lessons learned and identifying general provisions necessary to create credible watershed-based trading programs, including establishing nutrient limits for each watershed.

### Chesapeake Bay on a Diet

As a river winds its way to the ocean, it becomes wider and more shallow, forming transitional zones where fresh and salt waters intermingle. These unique ecosystems, called *estuaries*, are among the most productive natural habitats in the world — and the most heavily populated by fish and wildlife. The Chesapeake Bay is the largest estuary in North America and the third largest in the world. More than 100,000 streams, creeks, and rivers drain into the Chesapeake Bay and its 64,000-square-mile watershed, which spreads across the District of Columbia and large sections of Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia.

Since 1950, the population of the Chesapeake Bay watershed has more than doubled, causing sprawling development in place of forests and wetlands. Excess nutrients from sewage treatment plants, agricultural land, and urban and suburban runoff have slowly suffocated this vast network of waterways and degraded its streams, rivers, and wetlands. Almost three decades of state-led efforts have failed to restore the health of the Chesapeake Bay watershed, prompting EPA to step in. The mighty Chesapeake Bay has been put on a diet.

Formally known as the Chesapeake Bay Total Maximum Daily Load (TMDL), the Chesapeake Bay “pollution diet” was released by EPA in December 2010. This rigorous, multifaceted plan calls for increased pollution-reduction efforts over the next 15 years by all the Chesapeake Bay states, with federal intervention if states fall behind in meeting clean-up goals and deadlines. The Chesapeake Bay TMDL sets watershed-wide limits of 185.9 million pounds of nitrogen, 12.5 million pounds of phosphorus, and 6.45 billion pounds of sediment per year, which represent 20- to 25-percent reductions from current levels. These pollution limits are further divided into major river basins and jurisdictions.

The TMDL requires that all pollution control measures needed to fully restore the Chesapeake Bay and its tidal rivers be in place by 2025, with at least 60 percent of the actions completed by 2017. In addition, it requires the six states within the watershed boundaries plus the District of Columbia to develop Watershed Implementation Plans (WIPs) that detail how the jurisdictions will meet the 2025 pollution allocations and 2017 interim targets for each major basin. The new WIPs are expected to be a major improvement over previous cleanup plans, called Tributary Strategies, mandated by the federal government. Unlike the Tributary Strategies, WIPs will include a lot of detail about how the plans would be implemented, including how funding and staffing needs would be met. States that fail to come up with an adequate WIP or fall short of meeting their WIP targets will face federal penalties, including more stringent point-source pollution reduction requirements and the potential loss of federal grant money.

With Bay states now facing strict pollution control deadlines and penalties for noncompliance, there has been renewed interest in looking at a Bay-wide nutrient trading program.

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## Trading Chesapeake Bay Nutrients

Since 1983, the restoration of the Chesapeake Bay has been spearheaded by a unique regional partnership called the Chesapeake Bay Program. The partnership — composed of EPA staff; the governors of Maryland, Virginia, and Pennsylvania; the mayor of the District of Columbia; members of several citizen advisory groups; and a tri-state legislative body known as the Chesapeake Bay Commission — identified reducing nutrient pollution as a top priority in Bay restoration.

*Waterkeepers worry that a Bay-wide nutrient trading policy would create “hot spots” of pollution in areas where industry chooses to buy credits rather than reduce their discharges.*

Soon after the Chesapeake Bay Program released its trading guidelines, four of the six Chesapeake Bay states started moving forward with their own state-level nutrient trading programs. In 2006, Virginia and Pennsylvania became the first states in the watershed to set up nutrient trading programs to help achieve nutrient reduction goals outlined in their Tributary Strategies, and both states are now expanding these programs to reflect the new, more stringent WIP targets. Maryland began a nutrient trading program for point sources of pollution in 2008 and expanded it to include nonpoint sources in 2010. West Virginia has developed final trading guidance documents and submitted them for public comment.

A Bay-wide nutrient trading market would build on the existing state-level trading programs, allowing credits to be traded across state lines and among the watershed's nine major river basins. With the fate of this unique watershed in the balance and several other critically important watersheds heading in the same direction, the entire country is watching — and hoping lessons learned in the Chesapeake Bay can help achieve water



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quality goals around the country. The concept of a Bay-wide nutrient trading program has been endorsed by all the Chesapeake Bay Program partners as well as the Chesapeake Bay Foundation, World Resources Institute, Environmental Defense Fund, Resources for the Future, and several other environmental organizations.

Yet this concept has also garnered plenty of criticism. Thirteen chapters of the Waterkeepers Alliance, a global coalition of local advocates for individual waterways, staunchly oppose a Bay-wide nutrient trading program on the grounds that it could have unintended, detrimental affects on water quality protection efforts. Waterkeepers are concerned that nutrient trading could establish “allowable” pollution levels, which would encourage industries to buy “the right to pollute” rather than implement pollution reduction measures as required by the Clean Water Act. Waterkeepers also worry that a Bay-wide nutrient trading policy would create hot spots of pollution in areas where industry chooses to buy credits rather than reduce their discharges. Critics warn that problems associated with the verification and accountability of agricultural credits could turn the management of a Bay-wide trading program into a logistical nightmare. They are also concerned that allowing nutrient traders to discharge pollutants into an already impaired waterway would be contrary to Clean Water Act goals and policy.

### Challenges and Opportunities

Supporters of nutrient trading point out that industries are facing increasingly expensive upgrade costs to comply with point source pollution limits and that these costs are ultimately passed on to consumers. At the same time, they say, relatively cheap techniques to reduce nonpoint source pollution are not being realized. According to the World Resources Institute (WRI), a nutrient trading program that allows point source polluters to trade credits with nonpoint source polluters would allow communities to meet their pollution reduction goals in the most cost effective way possible — it makes economic sense for industry and provides farmers with much-needed extra income. But there are some serious legal and technical challenges in establishing point-to-nonpoint trading programs.

The potential to create localized “hot spots” has formed the basis for serious concern regarding nutrient trading programs around the country. Many existing trading programs were developed to address the water quality degradation of major river basins and estuaries and do not adequately take into account local, small-scale water quality concerns. Some trading programs try to avoid creating hot spots by mandating that credit purchases can only take place upstream of the point source discharger. EPA’s trading guidelines and many other state trading programs include language that explicitly prohibits nutrient credit trades that would result in any local water quality degradation. However, trading programs that encompass



a larger area, particularly those that cross state boundaries, carry greater risk that the water quality of one watershed would be improved at the expense of another.

Pennsylvania’s Lower Susquehanna Riverkeeper Michael Helfrich points to interstate manure trading as just one example of the dangers of watershed-level trading. Currently there are no legal barriers to moving manure across state lines. In fact, the U.S. Department of Agriculture’s Environmental Quality Incentives Program (EQIP) splits more than \$1 billion among states each year to help defray the costs of activities such as transporting manure from distressed watersheds. With nutrient trading initiatives gaining momentum around the country, many states are now looking at these programs as a mechanism for moving manure, which would free up EQIP funds for other state needs. According to the Pennsylvania Department of Environmental Protection (PADEP) 2010 Credit Registry, Pennsylvania is already poised to transport 1.3 million pounds of nitrogen, in the form of poultry manure, out of the Chesapeake Bay watershed and into neighboring watersheds. “This practice could explode with passage of interstate nutrient trading,” Helfrich warns in a letter to EPA, “causing loads to those waterways to increase.” Although most of the manure involved in credit-generating proposals is being shipped to nutrient-poor lands such as strip mines, many environmentalists are concerned that including manure transport in nutrient trading programs could result in simply shifting nutrient pollution problems from one watershed to another.



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But Jan Jarrett, president of Citizens for Pennsylvania's Future (PennFuture), believes that a Bay-wide trading program is a necessary step toward improving nutrient reduction efforts in the Chesapeake Bay. "The fact that the sheer amount of nutrients is increasing just goes to show that the programs that address the ways nutrients are handled just aren't up to the task of limiting nutrient pollution in the watershed," Jarrett says. However, she emphasizes that important safety nets must be built in to prevent local water quality from worsening. For example, to avoid creating hot spots, credits traded between different watersheds must be limited. "There needs to be built-in assurance that nutrient removal [from one watershed] doesn't contribute to nutrient generation elsewhere," Jarrett says. She also points out that it is important to limit the use of point-to-nonpoint trades in interstate trading programs. Because of the difficulty in verifying many agricultural pollution-reduction practices, a trading program that relies too much on agricultural credits could increase the risk that local water quality would remain impaired or even potentially worsen.

### Monitoring Progress

The uncertainty associated with agricultural credits brings up one of the most important concerns that nutrient trading programs need to address: Monitoring and verifying agricultural practices that generate nutrient credits.

Offering payments to farmers who implement conservation practices is not a new idea.

The Conservation Stewardship Program (CSP), Wildlife Habitat Incentive Program (WHIP), and Wetlands Reserve Program (WRP) are just a few examples of federally funded programs that reward landowners for adopting land management techniques that benefit the environment and fish and wildlife. In addition, many states offer their own incentive programs that encourage landowners to improve wildlife habitat, conserve wetlands, and prevent nutrients from being carried into neighboring waterways. Trading advocates point out that a nutrient trading program can augment these state and federal programs and provide incentives for farmers to further improve nutrient retention on their lands.

However, a nutrient trading program that allows point sources to purchase credits from farmers would require an accurate monitoring and verification process that does not yet exist. PennFuture's Jan Jarrett emphasizes that to ensure accountability, agricultural credits should be verified by an independent entity, such as a private consulting company. Some nutrient trading programs already rely on private firms that buy nutrient credits from many farmers in a watershed and offer a sort of "one stop shop" for point sources seeking to offset nutrient discharges. Not only do these credit aggregators facilitate sales between smaller credit-generating farms and credit purchasers, they also arrange for the credits to be certified, verified, and registered.

Another way to limit the uncertainty associated with agricultural credits is to limit credit-generating practices to those that are easily measurable, verifiable, and permanent. In most states with nutrient trading policies, only agricultural best management practices (BMPs) that have passed rigorous verification processes qualify for credit generation – and only after the farmer has already achieved a level of nutrient reduction known as a "baseline." Some states, including Maryland, require a state-approved nutrient management plan from farmers wanting to generate credits for sale. If the farm meets the TMDL requirements for the local watershed, it is then eligible to generate credits for sale by installing additional BMPs.

There is no methodology that can put an *exact* number on how many nutrients are prevented from entering a waterway as a result of a particular nutrient management technique. However, there are several thoroughly tested BMPs already in wide use that have documented and well-understood nutrient removal efficiencies. These methods have been evaluated and approved by both the scientific and regulatory communities as legitimate credit-generating BMPs. Examples include stream-side forest buffers, continuous winter cover cropping, and no-till harvesting. Nutrient reduction estimates are assigned to each of these BMPs that take into account many local variables, including soil type, rainfall, slope, and proximity to a waterway. These models allow regulators to estimate how much nutrient pollution is being reduced when a farmer implements one of these BMPs.

However, the accuracy of nutrient reduction modeling is hotly debated. Riverkeeper Michael Helfrich sees the nutrient reductions claimed by agricultural credit generators as potentially unreliable. "Unlike air quality trading programs that relate easily measured discharges from one

smokestack to another,” Helfrich explains, “nonpoint-to-point-source trading occurs between a model estimate and a measured discharge.” Fueling the controversy are recent reports suggesting that agricultural BMPs may not be as effective as models had predicted. According to a 2010 analysis by the U.S. Geological Survey, onsite monitoring revealed that purported reductions in nutrient pollution from farms on Maryland’s Eastern Shore had not been realized.

### Measuring Uncertainty

Another way that water quality trading policies seek to address the uncertainty of nonpoint source nutrient reductions is through the use of “trading ratios.” The underlying concept behind a trading ratio is to minimize the risk that more nutrients will be released into the watershed as a result of a point-to-nonpoint trade.

One type of trading ratio, called an uncertainty ratio, requires that point sources purchase more nutrient credits than they are seeking to offset. For example, an uncertainty ratio set at 2:1 requires that a wastewater treatment facility purchase two pounds of nitrogen credits for every pound of nitrogen it needs to offset. By requiring a point source to buy more credits than it is seeking to offset, a state can help ensure that the amount

of nutrient reduction resulting from the trade is at least the same as the reduction that would be required without the trade. Ohio takes this example a step further by basing uncertainty ratios on pre-existing water quality conditions. Credit buyers that are discharging into water bodies that are impaired are assigned an uncertainty ratio that is higher than those assigned to a company discharging into water bodies that already meet water quality standards.

Many nutrient trading programs employ additional trading ratios to ensure not only that water quality standards are being met but that nutrient reduction levels end up being greater than what is being paid for.

### Success Stories

So are there any nutrient trading success stories? Ann Roda, Market-Based Programs Coordinator at the Pennsylvania Department of Environmental Protection’s (PADEP’s) Water Planning Office, points to a nutrient trading







project that resulted not only in cleaner water but also serious savings for local ratepayers.

In 2005, the Mount Joy Borough Authority (MJBA) in Lancaster, Pennsylvania, became the first wastewater treatment facility to explore and adopt nutrient trading as a cost-effective way to meet nitrogen discharge limits. Finding itself seeking options to comply with nitrogen load limits set by PADEP, MJBA contracted with a local farmer and invested in 930 acres of continuous no-till agriculture at a fraction of the cost of additional upgrades to the facility. A total of 11,718 nitrogen credits were sold to MJBA for \$44,645 per year for three years, resulting not only in a much lower cost to the wastewater treatment facility but also a financial boon to the landowner.

“There have been water quality improvements, although I cannot confirm that these improvements are from nutrient trading alone,” says Roda. Significant downward trends in nitrogen and phosphorus levels have recently been recorded at five out of six long-term monitoring stations located along the Susquehanna River. “The success of programs like Mount Joy demonstrates that nutrient trading can meet environmental goals at much less expense than traditional command-and-control approaches,” Roda says.

Dusty Hall, manager of program development at Ohio’s Miami Conservancy District, agrees. The nutrient trading pilot project he coordinates in the Great Miami River watershed has met with similar success. Also in operation since 2005, the Great Miami River Watershed Water Quality Credit Trading Program is a region-wide nutrient trading pilot project that focuses on reducing nutrient levels in the Great Miami River watershed. Rather than using a watershed model, the program uses site-specific measurements to determine the number of credits that a nutrient management technique generates. Miami Conservancy District staff measure variables like soil type, slope, and fertilizer application rate when estimating nutrient losses and reductions from nonpoint sources. To encourage early participation, they set uncertainty ratios at lower levels for wastewater treatment facilities that purchase credits before TMDLs for the Great Miami River are established. For unimpaired waterways, the ratio is 1:1; for waterways not meeting their water quality standards, the ratio is set at 2:1. However, once TMDLs are established, uncertainty ratios will increase to 2:1 for unimpaired waterways and to 3:1 for waterways that do not meet TMDL standards.

Now in its sixth year, the Great Miami River Watershed Water Quality Credit Trading Program has spawned 275 agricultural nutrient-reduction projects, resulting in an estimated 460 tons of nitrogen and phosphorus reductions. In addition to reductions in nutrient discharges from agricultural lands, Hall points to other benefits that wastewater treatment upgrades alone can’t provide. “Not only do agricultural projects generate nutrient reductions at a much lower cost,” Hall says, “they provide ancillary benefits like streambank stabilization, reduction of other pollutants, and improved wildlife habitat.” An emphasis on citizen involvement has also resulted in an unprecedented level of cooperation among stakeholders. “The benefits go well beyond trading,” Hall says. “This program has created a type of dialogue between urban and rural residents that just hasn’t happened here before.”

## What Next?

For decades, federal, state, and local authorities have been working to reduce the level of nutrient pollution discharged into our nation's waterways. The Clean Water Act provided a context for regulating direct discharges by point sources. These methods, which have proven highly effective in dealing with industrial and municipal waste, have not been able to offer clear guidance on the more challenging problem of nonpoint source pollution.

Many experts are looking at nutrient trading as one way to meet nutrient pollution reduction goals, especially for nonpoint sources. Most organizations working with nutrient trading programs recognize that it is not a cure for the water quality problems that plague so many of our waterways. However, when safeguards are in place to prevent backsliding and ensure water quality improvements, many prominent environmental groups express cautious optimism when talking about nutrient trading. The Natural Resources Defense Council (NRDC), for example, opposed nutrient trading when EPA released its draft framework in 1996, primarily over concerns about "hot spots." More recently, however, NRDC endorsed some trading programs when "subject to strict oversight and carefully crafted rules keyed to environmental performance targets." The Sierra Club also voiced early opposition to EPA's nutrient trading guidelines but later offered guarded support for some state trading programs. In its 2007 newsletter, the Ohio Chapter of the Sierra Club praised the Great Miami River Watershed Water Quality Credit Trading Program when it was proposed and fully endorsed nutrient trading, stating that "the result is cleaner water without fines or heavy costs for cities struggling under bad economic times."

Verna Harrison, Executive Director of the Keith Campbell Foundation, which is working to improve water quality in the Chesapeake Bay, believes that broad stakeholder participation is crucial to developing a nutrient trading program that can successfully address water quality issues. "The best way to move forward is to get involved in crafting baseline qualifications and verification processes that ensure water quality goals are met," Harrison says. "With three out of four Bay states having already adopted state statutes, plus new state WIPs that are laden with nutrient trading goals, the horse has already left the barn, so to speak."

Nutrient trading is still in its infancy, and the projected large-scale economic and environmental benefits of state-wide trading programs are yet to be seen. However, successes at the watershed level in Pennsylvania,

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Ohio, and several other states are fueling optimism that nutrient trading may be a big part of the answer to our water quality woes. Stakeholder participation and citizen involvement are viewed by trading proponents as a crucial part of a successful nutrient trading program, and many environmental organizations are weighing in on the processes with their own recommendations.

With states in the Chesapeake Bay watershed and beyond already moving forward with nutrient trading programs, key questions need to be answered — including how to effectively measure reductions in nonpoint source pollution, how best to establish geographic boundaries for nutrient trading, and how to ensure nutrient trading results in an overall reduction of the amount of nutrients discharged into local waterways. These questions need to be addressed to evaluate whether nutrient trading can reliably provide pollution reduction and water quality improvements.

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