Written Statement for the Record

Regarding:

The Role of Trading in Achieving Water Quality Objectives

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Committee on Transportation and Infrastructure
Subcommittee on Water Resources and Environment

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We appreciate the opportunity provided by Chairman Gibbs, Ranking Member Bishop, and Members of the Subcommittee to comment on water quality trading. The Electric Power Research Institute, Inc. (EPRI, www.epri.com) conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, health, safety and the environment. EPRI also provides technology, policy and economic analyses to drive long-range research and development planning, and supports research in emerging technologies. EPRI's members represent more than 90 percent of the electricity generated and delivered in the United States, and international participation extends to 40 countries. EPRI's principal offices and laboratories are located in Palo Alto, Calif.; Charlotte, N.C.; Knoxville, Tenn.; and Lenox, Mass. EPRI does not advocate any regulatory or policy action.

Among other research to confront pressing environmental issues, EPRI is testing Water Quality Trading (WQT) as an innovative way to manage nutrient pollution in the Ohio River Basin (ORB). As nutrient loading comes from many sources, this project facilitates broad non-traditional collaborations towards achieving a common goal of protecting and improving watersheds at lower overall cost to society. Properly designed and deployed, the trading program in the ORB may allow exchanges of credits for nitrogen and phosphorus to meet both voluntary sustainability commitments and regulatory compliance obligations.

EPRI's interest is to apply rigorous systems to test whether WQT can be economically, socially, and ecologically viable over the long run. EPRI research suggests that WQT may provide a cost-effective option for power companies to meet the water-quality based effluent limit (WQBEL) portion of their NPDES permits. Trading also may provide important ancillary benefits to farmers and ecosystems, which are not realized by installing technologies at point source locations. The EPRI pilot project in the ORB is attempting to build the most robust set of protocols to date and has thereby accelerated a national discussion regarding optimal design of WQT programs, whether at a local or regional scale. We have extensively studied WQT efforts across the United States, learned from what works and what does not work, and attempted to address key gaps through the design of the ORB project. The defensibility of WQT rests largely on the specific protocols of each program, which vary considerably across the country. Important EPRI findings to date include:

- WQT is a developing market and will benefit from research on best practices, tools, and elevated stakeholder understanding. EPRI is advancing this maturation via the ORB pilot effort.
- With the science, tools, and policies for WQT evolving, it is probably premature to make generalized conclusions about WQT in the absences of specific program elements.
- There are fundamental differences between point-point trading and a program where farmers are the credit generators - these differences will influence appropriate credit ratios, verification, and uncertainty.

- Working via local Soil and Water Conservation Districts (SWCDs) to contact and enroll producers can be appropriate in many cases, and appropriate compensation may be considered (there is some compensation provided to SWCDs during the EPRI pilot project as explained below). However, not all states have district staff with the engineering, planning, and design expertise to implement projects, and they will need support to get a significant number of projects installed with producers.
- The balance between a farmer's confidentiality and the public interest in verifying that a permit limit is being met continues to be a point of discussion. Further, questions regarding who holds liability for failed conservation projects that generate credits still needs to be discussed (credit buyer, credit seller/aggregator, farmer, verifying party, or other).
- Nonpoint source credits that are "real" and comparable to installing a point source technology require careful documentation, modeling, and science at a level that can be costly and require highly skilled training. Sharing of resources via public access and collaboration may help curb the burden on individual projects, reducing costs to establish rigorous programs in the future.
- EPRI is committed to an adaptive management approach and encourages input from all participants and stakeholders in the pilot project to inform the appropriateness of WQT.
- It remains to be determined whether, after applying necessary rigor and science, 1) the market will support the fully burdened price of credits, and 2) observing stakeholders will be satisfied that trading is an appropriate tool for compliance.
- Ultimately, whether credits are real is fundamental to buyers committed to ensuring that their permits are met, to stakeholders who deserve to have confidence in the system, and to the ecosystem.

Overview of the Ohio River Basin Trading Program

EPRI has been researching WQT since 2005, with a specific focus on the ORB since 2007. In August 2012, the state agencies in Ohio, Indiana and Kentucky signed a pilot trading plan for the ORB making it a first-of-its-kind interstate water quality trading program. Utilizing solid scientific foundations, this project may result in a multi-industry market that could accelerate cost-effective watershed improvements, provide important ancillary ecological benefits, and move previously untapped resources to farmers. Following years of establishing key protocols, the project began executing pilot trades in March 2014.

There are several reasons why the EPRI project is working on an interstate basis, the most fundamental of which is dictated by the watersheds themselves. First, the watershed boundaries cross state lines (Figure 1). To have the largest possible benefit in-stream, it is important to follow the actual functioning of the watershed units. Second, for WQT to be successful there needs to be an adequate number of credit buyers and sellers. The larger the area, the greater the number of potential buyers

and sellers, and the more viable the resulting market. Lastly, a regional program will benefit from shared infrastructure, tools, and models, reducing the burden of program costs to local entities. Indeed, to build defensible WQT programs supported by science and modeling, shared resources and robust stakeholder input are critical. The participating states agreed with the benefits of working on an interstate basis, and in August 2012, Indiana, Kentucky and Ohio signed a first-of-its-kind interstate pilot trading plan where the states can operate under the same rules so that a water quality credit generated in one state can be applied in another. The current project approach anticipates selling credits generated by an up-stream farmer, within a Hydrological Unit Code 4 (HUC 4) watershed. As the map shows, many of the HUC 4 watersheds cross state lines.

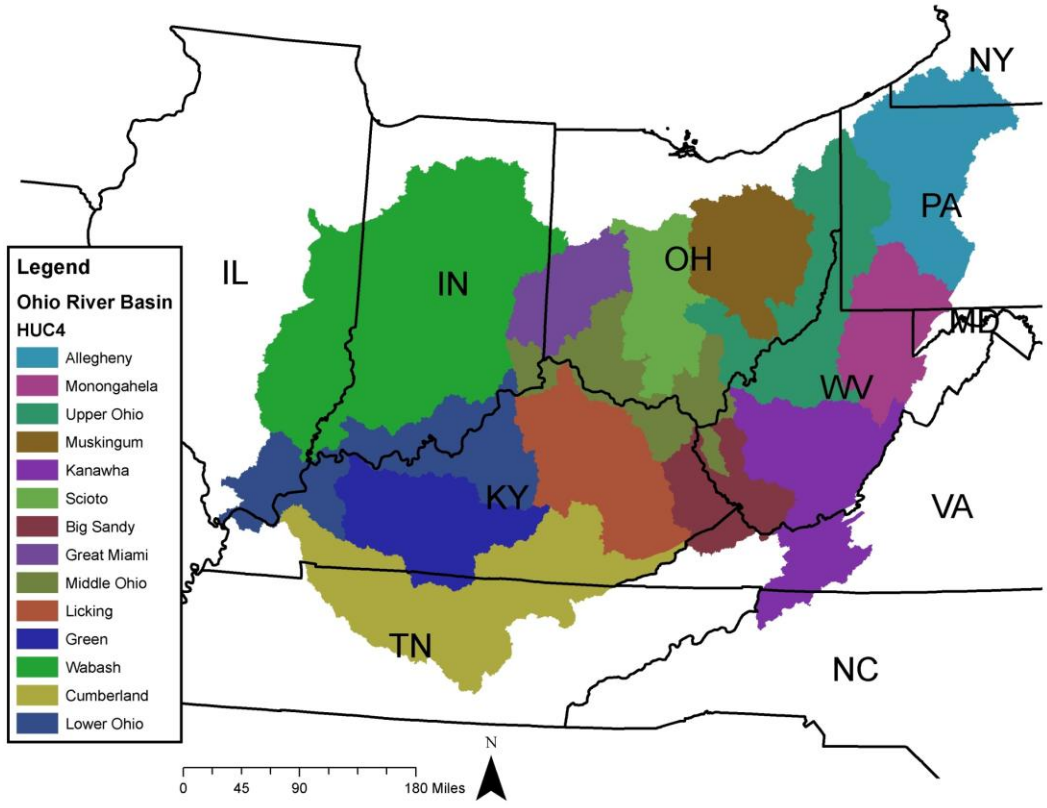

Figure 1: HUC 4 Watersheds in the Ohio River Basin.

Working with the States and SWCDs

To install practices and bring credits to market, EPRI is working directly with the state agriculture agencies and permitting authorities in all three states. EPRI has contracts with the three state agriculture agencies (Ohio Department of Natural Resources, Kentucky Division of Conservation, and Indiana State Department of Agriculture) to provide private financial support raised by EPRI to Soil and

Water Conservation Districts (SWCDs). Each state has received seed funds ($100,000) to remove 22,000 pounds of total nitrogen and 11,000 pounds of total phosphorus over a five-year period. The state agriculture agencies move these funds to SWCDs, who then contract with farmers to install approved U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) conservation practices to meet performance standards that are known to reduce nutrient loading. Examples of these practices include cover crops, heavy use areas, and cattle exclusion fencing, among others. Both the state agriculture agencies and the SWCDs are reimbursed for their time and effort (estimated for the pilot period at 10% of funds passed to the farmers). The real cost of these responsibilities is being tracked to inform the adaptive management of the project going forward.

During this initial pilot period, and based on input from the agriculture community, farmers are paid up to 75% of their documented costs (up to $10,000) after the practice is installed. The $10,000 cap on each project ensures that our current private funding is distributed across multiple farmers in each state, and reduces the overall impact if one particular project does not generate credits. Some of the SWCDs are identifying potential farmers by looking at unfunded applications for USDA-NRCS programs. There is no risk to the farmer that credits will be sold; they are paid after on-site confirmation of practice installation, regardless of whether or when the credits generated from those practices are, in fact, transacted. For the initial pilot trades, EPRI owns and aggregates the resulting credits and has the responsibility for transacting, donating, or retiring those credits. From a farmer perspective, the ORB pilot project offers a privately funded cost-share opportunity, using a simple contract, and is implemented via their local SWCD. EPRI intends to reinvest money raised from the sale of the pilot credits back into the project operation and research.

Credit Verification, Monitoring, and Reserve Pool

Before any credits are issued in the ORB project, all projects must be installed, verified, and certified. This requires the following steps: 1) SWCD completes a practice “Installation” form after on-site inspection, including before and after photos, 2) The state agriculture agency completes a “verification” form based on on-site inspection and confirmation that the practice meets NRCS practice standards, and 3) The state permitting authority completes a “certification” form based on a desk review of all project records, photos, baseline confirmation, and regulatory review. All projects (100% audit) are monitored annually with on-field verification by the state agriculture agency and annual desk-review by the permitting authority. All farmers who participate in the project must meet baseline requirements including compliance with all local, state, and federal law, AND implement practices that are additional to current conditions (based on 3 years of farm practice history). EPRI’s program will only issue credits after conservation projects have been implemented, verified, and certified. Before credit transactions (and application of a trading ratio), 10% of all credits are moved into a reserve pool, which can be tapped in the event of an unanticipated project gap or failure. Further, to ensure that the pilot project has a broader public benefit EPRI is voluntarily retiring 10% of all credits. Full

documentation, including on-site photos, is posted in the public view of the project's on-line credit trading registry (discussed below). The public can track every pound of reduction to a county level, but not all the way to a specific farmer.

Science, Modeling, and Ratios

EPRI's research on the appropriate quantification of credits in WQT has informed national discussions regarding ratios, uncertainty estimates, model calibration protocols, and credit equation factors. A fundamental challenge for water quality trading lies in understanding, quantifying, and managing the uncertainty associated with the implementation of on-the-ground practices and the associated water quality benefits over time and place. This challenge is especially pronounced when trading involves agricultural non-point sources as credit sellers, where there is no specific pipe from which to monitor or measure water quality. Trade ratios are used to ensure that the amount of reduction resulting from the trades has the same (or better) effect as would be required using a technology option at the point of compliance.

The ORB project is using a scientifically-based credit equation methodology that will account for location-specific nutrient attenuation factors, rather than a blanket trading ratio throughout the entire ORB. The ORB project utilizes two models for estimating nutrient reductions from the point of generation (credit seller) to the point of use (credit buyer). The models account for location-specific nutrient attenuation factors and ensure that the project pays for, and in fact delivers, performance (i.e. nutrient reductions, not simply conservation practices). The two models are: 1) the EPA Region 5 spreadsheet model for estimating nutrient reductions at the edge of the field (i.e., Point of Generation Credits); and 2) the Watershed Analysis Risk Management Framework (WARMF) model for estimating nutrient attenuation (reduction) from the edge-of-field to the point of use (i.e., Point of Use Credits).

The WARMF model is applied to predict attenuation from the edge of the field to the stream and the resulting in-stream responses to nutrient load reductions between credit sellers and credit buyers, thereby estimating the total nutrient reductions actually achieved at any particular point of compliance. These predictions account for a number of physical factors (e.g., location of buyer and seller, in-stream fate and transport, specific form of pollutant), as well as the uncertainty inherent in the model itself. In this way, the project calculates unique trade ratios for every single transaction, and accounts for the specific watershed characteristics between each buyer and seller. The further apart buyers and sellers are, the greater the uncertainty in the model, the higher the trade ratio and the greater the cost for each pound at the buyer location. Therefore, there is a driver for the market to self-select transactions that are "local," as that will provide the most favorable trade ratio. The seller (the farmer), however, does not absorb the "hit" of a distant buyer – it is the buyer's burden to purchase enough credits to meet their compliance obligation, wherever they happen to be in the watershed. The trading ratio is applied AFTER 10% of credits are moved to a reserve pool (see above discussion) and 10% of credits are voluntarily retired by EPRI.

While EPRI is not selling compliance credits at this time (hence, there is no "point of compliance" and no ratio applicable), the research has the scientific basis to support transactions occurring within a HUC 4 watershed.

Credit Registration and Tracking

A credit registry is a tracking system that follows a credit from creation to sale and ultimately to retirement. The credit registry customized for the ORB project provides checks and balances to ensure that each credit is created and used precisely as approved under the trading plan. The online registry provides security measures similar to online banking and provides transparency to the market. In one online location, information about each farm project is captured; agriculture agencies "verify" that best management practices have been implemented on the ground; permitting authorities "certify" that a credit is appropriate for regulatory compliance; credit buyers can search for credits available to purchase; and stakeholders can view public information on projects. Further, the registry utilizes EPRI's watershed model to calculate specific trade ratios for each transaction based on the location of particular buyers. The registry assigns a unique serial number for each pound of nutrient reduction, eliminating the risk of double counting. The serial number allows for tracking of the credit through its lifecycle. The registry is a key component of the ORB project and ensures the same process and protocols are applied across multiple states.

Credit Price and Definition

One credit is equal to one pound of total nitrogen (TN) or total phosphorus (TP) that, through voluntary action, is prevented from discharging into the ORB in a given year. EPRI chose to use a cost-based price model to support the first credit transactions in the program. The goal was to use a pricing method that incorporates the full cost of implementing the program assuming there was no government or state subsidy. At a summary level, EPRI included: 1) the cost of project activity done on the farm, 2) the cost of project administration (including burden to the SWCDs and state agriculture agencies), and 3) the cost of addressing project risk. The first transactions sold a 3-year stewardship credit for $10 each. Each stewardship credit represents a bundle of quantified nitrogen and phosphorus reductions, plus qualitative ancillary ecosystem benefits (pollinators, soil health, greenhouse gas reduction, etc). If the credits were unbundled and sold as individual pounds of nitrogen or phosphorus, each pound of either nitrogen or phosphorus would cost $10 under the pricing system. Going forward, as part of the research effort EPRI plans to use an auction to sell credits, where the credit price will be determined by traditional market supply and demand forces, and not subsidized by federal or state funding.

As a non-profit research organization, EPRI determined that during the pilot period it would not sell credits that are applied towards a National Pollutant Discharge Elimination System (NPDES) permit obligation. Given the general absence of numeric nutrient criteria, TMDLs or other water quality

regulatory "drivers" in the ORB, EPRI also lacked the impetus to transfer the project to another organization. Therefore, EPRI is currently testing all program design elements through the transaction of "stewardship credits." A "stewardship credit," like any other water quality credit, is a quantified and verified representation of a reduction of a pollutant. What makes a stewardship credit different is that it will be retired for the public benefit and not applied towards a regulatory permit obligation. Duke Energy, Hoosier Energy, and American Electric Power are the first buyers in the program and on March 11, 2014, the companies purchased 9,000 stewardship credits, agreeing to retire the associated nutrient and ecosystem benefits, rather than apply them towards possible future permit requirements. The buyers can use the credits to meet corporate sustainability goals and their voluntary participation may also be considered by the state permitting agencies when determining the need for flexible permit compliance options in the future.

Stakeholder Engagement

It has taken an array of collaborators from many sectors to make WQT possible at this scale. Some of the organizations that have and continue to work diligently to realize this project include the States of Ohio, Indiana, and Kentucky, American Electric Power (AEP), American Farmland Trust (AFT), Duke Energy, EPRI, Exelon Corporation, Hoosier Energy, Markit Environmental Registry, Ohio Farm Bureau Federation, Ohio River Valley Water Sanitation Commission (ORSANCO), Tennessee Valley Authority (TVA), Troutman Sanders, LLP, Mosaic Company Foundation, the U.S. Department of Agriculture, the U.S. Environmental Protection Agency, and the University of California at Santa Barbara. Additionally, the SWCDs and farmers are at the heart of the project, as well as all the committed contributors to the project's five advisory committees.

Because this project is so far-reaching and the largest of its kind, it has been important to identify and engage stakeholders so that concerns are appropriately identified and evaluated. Among other activities, the project convened a series of listening sessions with farmers and SWCDs in the ORB before developing the trading plan to identify potential barriers that might discourage them from participating. The early engagement of agriculture was critical to design a system that would work for both buyers and sellers. In addition, EPRI organized and maintains several stakeholder advisory committees to provide feedback on the emerging market including agriculture, environmental groups, power companies, wastewater treatment plants, and federal and state agencies. The project is committed to an adaptive management approach and greatly benefits from the ongoing input from these committees and the public in general.

Summary

EPRI's commitment to an adaptive management approach has been fundamental to the project, as well as the unwavering commitment to defensible science and transparency. Some of the details related to the pilot trades in the ORB will need to be revisited as they are informed by project

implementation. The next phase will include describing the remaining issues before credits can be used for permit compliance obligations, such as how to provide the public the ability to ensure permit obligations are being met when trading is used. We also are gaining important information on where failures can occur in the system, necessary safety factors, and whether a 10% reserve pool is sufficient in the long run. Risks from large-scale storms or natural disasters that eliminate farm conservation projects that generated credits still need to be addressed. It is critical to recognize that not all trading programs are equal, that flexibility is likely appropriate depending on program location, and that decisions regarding credit definition, verification, and quantification are currently defined largely at the individual project level.

For the EPRI pilot in the ORB, we have taken a particularly conservative approach in evaluating program decisions to ensure that credits are "real" and decisions are reviewed, discussed, and approved by the states involved. From an economic perspective, it is still to be determined if, after applying all necessary rigor and science, the market will support the fully burdened price of credits. Ultimately, it is that issue - whether credits are real - that is fundamental to buyers committed to ensuring that their permits are met, to other stakeholders who deserve to have confidence in the system, and for the ecosystem.

More project information and updates, including a link to the on-line credit trading registry, can be found on the project website: http://wqt.epri.com. In addition, a compilation of abstracts from EPRI reports related to Water Quality Trading is included below.

We would like to thank Chairman Gibbs and Ranking Member Bishop for this opportunity to submit testimony.

EPRI Abstracts Related to Water Quality Trading

Full reports can be found at www.epri.com using the report number as the search term. Direct links are also cross posted at http://wqt.epri.com under the Reference Shelf.

Case Studies of Water Quality Trading Being Used for Compliance with National Pollutant Discharge Elimination System Permit Limits. **EPRI, Palo Alto, CA: 2013. 3002001454**.

While there is a great deal of published work describing and analyzing water quality trading and explaining how to engage in it, research is lacking regarding permits that use water quality trading to meet compliance obligations. This report aims to provide transparency on National Pollutant Discharge Elimination System (NPDES) permits that incorporate water quality trading through a series of 18 case studies. The research does not attempt to provide comprehensive coverage of every NPDES permit that uses water quality trading. Rather, case studies of 18 NPDES permits are provided as a sample of permits known to allow water quality trading to meet compliance obligations. The case studies focus on the language within the permit itself, supplemented with external information that provides a context for water quality trading in the permit.

Implementation of the Watershed Analysis Risk Management Framework (WARMF) Watershed Model for Nutrient Trading in the Ohio River Basin: Analysis of Scioto, Muskingum, and Allegheny Watersheds. **EPRI, Palo Alto, CA: 2012. 1025820**

As part of the Ohio River Water Quality Trading Program, the Scioto, Muskingum, and Allegheny watersheds were analyzed, using the Watershed Analysis Risk Management Framework (WARMF) model, to determine their capacity for nutrient trading. For consistency across the Ohio River Basin, the watershed models were implemented using the hydrological unit code (HUC) 10 delineation available from the United States Geological Survey. Data from the Ohio Environmental Protection Agency, Pennsylvania Department of Environmental Protection, and United States Environmental Protection Agency for point sources and water quality monitoring were used to set up the model. Agricultural nutrient loading factors were based on the most recent United States Department of Agriculture crop survey.

Barriers and Solutions for Farmer Participation in the Ohio River Basin Water Quality Trading Program. **EPRI, Palo Alto, CA: 2011. 1023642.**

As part of a multiyear collaborative effort, American Farmland Trust (AFT) convened six listening sessions with approximately 150 agricultural producers (farmers) in the Ohio River Basin (ORB) to determine their readiness to sell nutrient credits in a regional water quality trading (WQT) market. In a WQT market, municipal wastewater treatment plants, industrial manufacturing plants, and electric power companies can purchase nutrient credits to meet their regulatory requirements. They pay farmers to implement best management practices that reduce the loss of nutrients (such as nitrogen and phosphorus) and soil sediments from farms; in exchange, the farmers are given nutrient offset credits. Participants in the agricultural listening sessions identified potential barriers to their participation as credit sellers in a regional WQT program and proposed solutions to overcome those barriers.

Use of Models to Reduce Uncertainty and Improve Ecological Effectiveness of Water Quality Trading Programs: Evaluation of the Nutrient Trading Tool and the Watershed Analysis Risk Management Framework. **EPRI, Palo Alto, CA: 2011. 1023610.**

Through a United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) Conservation Innovation Grant, collaborators working on the development of the interstate Ohio River Basin Water Quality Trading Program conducted a robust analysis to evaluate possible approaches for using water quality models for crediting nutrient load reductions from agricultural best management practices (BMPs). A credit estimation method that ensures reliable and repeatable results is a critical element in a successful water quality trading (WQT) program and is something that is not always scientifically informed. This effort considers one approach for creating a scientifically informed approach that uses a combination of field-scale and watershed-scale models for crediting agricultural conservation practices. The Nutrient Trading Tool (NTT) and the Watershed Analysis Risk Management Framework (WARMF) were selected to evaluate the non-point source load reductions at the field scale and watershed scale, respectively.

The project assessed both NTT (field-scale) and WARMF (watershed-scale) models to determine the strengths and weaknesses for use in WQT. NTT was also tested by a select group of Ohio agricultural Technical Service Providers, Certified Crop Advisors, and Soil and Water Conservation Districts for applicability, user-friendliness, information content, and reliability. The project showed that both NTT and WARMF have demonstrable uses for supporting essential elements of credit calculations and policy development in WQT programs. Recognition of benefits and limitations of these tools will be critical for realizing their full potential in a WQT context. Efforts must be made to gather sufficient data and literature support for model calibration and validation. While WARMF has been tested and applied in many locations across the United States, NTT has yet to receive a similar level of scrutiny and application. Vetting by local experts and knowledgeable program participants of both the data and assumptions used by modelers is highly recommended, especially for NTT, which relies on field-specific information. In addition, recommended NTT model improvements will enhance the accuracy and performance of the tool, the results of which will increase trust and use by program participants. WQT programs can adjust for introduced errors and uncertainties by using a combination of eligibility conditions and an explicit trade ratio. These decisions can be informed by sensitivity analysis of the calibrated models, incorporation of model "goodness of fit" results, and best professional judgment. Output of these tools can be combined to provide an appropriate level of user-friendliness and pragmatic use of best available science for crediting, policy decisions, and program administration. The project also considered characteristics of a future on-line trading registry.

U.S. National Opinion Survey on Stacking Environmental Credits: Definition, Status, and Predictions of Wetland, Species, Carbon and Water Quality Credit Stacking. **EPRI, Palo Alto, CA: 2011. 1024803**

This report summarizes and analyzes the responses of a national survey entitled "Evaluation of Credit Stacking" that was developed jointly by EPRI, the World Resources Institute, Stetson University College of Law and the University of Kentucky. The purpose of the survey was to collect opinions about credit stacking from practitioners currently involved in environmental credit markets. The survey was conducted in the first quarter of 2010 and was sent to approximately 1,500 individuals residing primarily in the United States. After verification and removal of duplicate inputs, responses were received from 309 individuals. Respondents were asked to identify themselves as credit sellers, researchers, policy-makers, credit buyers or credit

exchangers. Ninety-four percent of respondents identified themselves as either credit sellers, researchers or policy-makers, and the responses from these groups were analyzed in depth.

Ohio River Basin Trading Project Agricultural Stakeholder Listening Workshops: Sardinia, Ohio, October 14, 2010. **EPRI, Palo Alto, CA: 2011. 1023133.**

On October 14, 2010, American Farmland Trust held a listening workshop in Sardinia, Ohio, to provide information to and collect feedback from farmers and agricultural representatives on the Ohio River Basin Trading Project. The session began with a basic primer on water quality trading given by Jim Klang of Kieser & Associates. The presentation was followed by facilitated discussions. Participants were prompted with a variety of questions developed from earlier listening workshops held in other regions of the Ohio River Basin and addressed issues that producers will likely face in future water quality trading markets.

Ohio River Basin Trading Project Listening Workshops: Wabash River Watershed, Indiana, March 8-9, 2010. **EPRI, Palo Alto, CA: 2010. 1021543.**

In March 2010, American Farmland Trust held two listening workshops in the Wabash River Watershed to provide information and collect feedback on the Ohio River Basin Trading Project. Each session began with a basic primer on water quality trading given by Jim Klang of Kieser & Associates. The presentations were followed by facilitated discussions. Participants were prompted with several questions developed from earlier listening sessions addressing issues that producers will likely face in water quality trading markets.

The session held during the March 8 workshop in Bluffton, Indiana was coordinated with the Conservation Technology Information Center and the Indiana Farm Bureau to identify and invite producers, Soil and Water Conservation District (SWCD) staff, and others in the Upper Wabash with an interest in water quality. The Indiana Farm Bureau also participated in identifying attendees for the March 9 workshop in Terre Haute, Indiana, which was targeted to producers within the Wabash River Basin with an interest in water quality trading.

Ohio River Basin Trading Project Soil and Water Conservation District (SWCD) Informational Meeting: Columbus, Ohio, July 6, 2010. **EPRI, Palo Alto, CA: 2010. 1021539.**

On June 17, 2010, an invitation for an informational meeting was sent jointly by the executive director of the Ohio Department of Natural Resources, Dave Hanselmann, and the president of the Ohio Federation of Soil and Water Conservation Districts (SWCDs), Lawrence Burdell. This invitation was sent to all SWCDs in Ohio as well as a few additional interested parties. On July 6, 2010, project collaborators met with the invitees at the Ohio Department of Natural Resources in Columbus, Ohio. Nearly 80 attendees representing 39 SWCDs discussed the project, captured concerns, and considered various costs and benefits for SWCD participation in this effort.

Ohio River Basin Trading Project Joint Session Air, Water, Climate: March 15, 2010–Orlando, Florida. **EPRI, Palo Alto, CA: 2010. 1021502**.

Electric Power Research Institute (EPRI) project managers in air, water, and climate programs are working together to address the complex, interrelated issues associated with water and air quality in the United States. This session provided background and told the story of the pilot effort in the Ohio River Basin to develop broad, nontraditional collaborations that will support multi-stakeholder programs for water quality trading, carbon trading, and ecosystem services

protection. Through this pilot effort, EPRI Environment Sector programs are providing leadership in addressing difficult ecological problems.

***Watershed Modeling in the Ohio River Basin: Scientific Foundations*. EPRI, Palo Alto, CA: 2010. 1021542.**

Under funding from the U.S. Department of Agriculture (USDA) and the U.S. Environmental Protection Agency (EPA), academic collaborators are calibrating the Watershed Analysis Risk Managment Framework (WARMF) to be used during the design and implementation of the Ohio River Basin Trading Project. The WARMF model will be instrumental in simulating the water quality benefits of various rules in the trading program. In addition, the model will be useful for adaptively managing the trading program, once trading begins, to optimize the water quality benefts and improve project implementation. This effort will help ensure that the primary goal of a water quality trading program is achieved—to improve the quality of water and reduce nutrient loading in a cost-effective manner.

***Developing Greenhouse Gas Emissions Offsets by Reducing Nitrous Oxide (N_2O) Emissions in Agricultural Crop Production: Final Project Report.* EPRI, Palo Alto, CA: 2009. 1020546.**

This final project report describes a three-year long EPRI supplemental project entitled *"Developing Greenhouse Gas Emissions Offsets by Reducing Nitrous Oxide (N_2O) Emissions."* This EPRI-sponsored project investigated an innovative approach to developing large-scale, cost-effective greenhouse gas (GHG) emissions offsets that potentially can be implemented across broad geographic areas of the United States and internationally.

***Program on Technology Innovation: Ohio River Water Quality Trading Pilot Program — Business Case for Power Company Participation, 2008.* EPRI, Palo Alto, CA: 2010. 1018861.**

Nitrogen discharges to surface waters from power plants are increasing as technologies such as selective catalytic reduction units, electrostatic precipitators, and flue gas desulfurization systems are installed to comply with more stringent air emission requirements. The nitrogen generated by these processes is being transferred to surface water discharges. Concurrently, water quality impairments by nitrogen, new instream nutrient criteria, and anticipated effluent limitations on total nitrogen discharges are now actively being pursued by regulatory agencies. Although only a few power plant National Pollution Discharge Elimination System (NPDES) permits reviewed during this 2008 feasibility assessment contain nitrogen limits (or monitoring requirements), the promulgation of nutrient criteria (which will be followed by effluent limitations), is anticipated for Ohio in 2008, Kentucky and along the main stem of the Ohio River by 2010, and West Virginia by 2011. A preliminary feasibility analysis, described in this report, presents a strong business case for power company participation in the development and promotion of a water quality trading program in the Ohio River Basin. Such a program has the potential to reduce the costs of complying with water discharge restrictions.

***Program on Technology Innovation: Modeling Nutrient Trading in the Ohio River Basin; Theoretical and Practical Consideration*. EPRI, Palo Alto, CA: 2009. 1018691.**

Nutrient trading to achieve water quality objectives has the potential for achieving environmental objectives and ecological outcomes in a cost-effective manner. An important driver for a nutrient trading program is to provide a means for major dischargers to meet the effluent objectives

using more cost-effective trades with other dischargers or with non-point sources. Key to the success of a trading program is a thorough understanding of the watershed, its various components, the key stakeholders and their emissions, as well as the expected watershed response. A modeling framework that supports development of the trading program can provide some important insights for areas that are not meeting objectives that may not be detected by a monitoring program. These conditions can result in exceedance of the objectives, as well as the potential benefits of different trades. The current project developed the WARMF model for two watersheds in the Ohio River Basin: the Muskingum and Scioto watersheds. The model was used to identify water quality hotspots, understand the temporal pattern of water quality exceedances, determine the likely extent of local/regional trading areas, assess the magnitude of loads in a given trading area, determine the sensitivity of different regions to load reductions, and evaluate specific trades and trading ratios. The current approach is at a large scale, useful for scoping the potential for trading. A more detailed WARMF model can be set up for more local trading scenarios using the current model to provide the boundary conditions for the detailed local model.

***Methodologies for Cross-Pollutant Trading*. EPRI, Palo Alto, CA: 2008. 1014025**.

Cross-pollutant trading expands the range of cost-saving opportunities by allowing dischargers to earn credits for reducing loads to the watershed of complementary pollutants that contribute to the same common water quality impairment. This report technically evaluates methodologies for cross-pollutant trading in the context of opportunities for the electric power industry. The report is of value to environment managers within power companies, as well as regulators, water resource managers, and environmentalists.

***Program on Technology Innovation: Water Quality Trading Pilot Programs—Review of Catawba River Basin, Chesapeake Bay, and Ohio River Pilot Projects.* EPRI, Palo Alto, CA: 2007. 1015409.**

Water quality trading (WQT) has potential as an alternate means for power facilities to meet compliance goals with nutrient discharge limits, particularly for nitrogen. EPRI is working to identify and conduct a feasibility study for a WQT pilot project involving one or more power companies. This white paper summarizes general information on three potential pilot project locations, describes the screening criteria used to evaluate the potential of each project location, and completes a SWOT (strengths, weaknesses, opportunities, and risks) analysis for each.

***Program on Technology Innovation: Water Quality Trading Program for Nitrogen.* EPRI, Palo Alto, CA: 2007. 1014646.**

Anthropogenic releases of nitrogen have greatly increased environmental fluxes of biologically available nitrogen and contributed to serious ecological problems, such as algal blooms that cause waters to become severely depleted of oxygen. Power plant sources of nitrogen include NO_x air emissions, the ammonia required for the Selective Catalytic Reduction (SCR) and Selective Non-Catalytic Reduction (SNCR) systems that are used for NO_x reduction, and the ammonia used for SO_x control and ash pond conditioning. As part of its efforts to manage nitrogen pollution and improve water quality in the United States, the EPA has issued a Water Quality Trading Policy that enables and supports the adoption of market-based programs for improving water quality by allowing for the trade of credits that represent net nutrient reductions, including nitrogen. EPRI Technical Update 1013193, *Water Quality Trading Opportunities for Electric Power Companies: EPRI White Paper*, presented the background and concept of water quality trading, introduced potential opportunities for power companies related to managing

nitrogen, and identified the primary information gaps that need to be filled in order for EPRI members to benefit from EPA-endorsed water quality trading programs. This technical report is a follow-up to that Technical Update and provides more details regarding the drivers for trading, characteristics of successful trading programs, and the process for establishing a trading program.

***Program on Technology Innovation: Water Quality Trading Opportunities for Electric Power Companies: EPRI White Paper*. EPRI, Palo Alto, CA: 2006. 1013193.**

With electric utilities contributing to nutrient loading in waterways, it is important to identify the most effective options for reducing this environmental impact while still accommodating business goals. In the past, these two goals—business performance and environmental protection—have competed. However, water quality credit trading, a strategy supported by the U.S. Environmental Protection Agency, provides an alternative approach for utilities to simultaneously meet economic and ecological objectives.

***Water Quality Trading Guidance Manual: An Overview of Program Design Issues and Options,* EPRI, Palo Alto, CA: 2002. 1005179.**

The U.S. Environmental Protection Agency (EPA) actively promotes water quality trading (WQT) as a tool for more cost-effectively attaining water quality standards, which are currently not met in nearly half of the nation's streams and water bodies. This market-based approach builds on the success of emission trading programs for sulfur dioxide and nitrogen oxides. The water quality context, however, differs in many important respects from the air quality context, and there is as yet little experience with successful WQT programs. This report provides WQT program developers with an overview of issues they will need to address and summarizes relevant lessons from existing WQT programs.