STATEMENT OF RICHARD H. MOORE
EXECUTIVE DIRECTOR
ENVIRONMENTAL SCIENCES NETWORK
THE OHIO STATE UNIVERSITY

BEFORE THE
WATER RESOURCES AND ENVIRONMENT SUBCOMMITTEE
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
UNITED STATES HOUSE OF REPRESENTATIVES
ON

THE ROLE OF TRADING IN ACHIEVING WATER QUALITY OBJECTIVES

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I am Richard H. Moore, executive director of the Environmental Sciences Network and associate director of academics for the Office of Energy and the Environment at The Ohio State University (OSU). I am also a professor in the School of Environment and Natural Resources. However, the views provided are my own, and I am not testifying on behalf of The Ohio State University.

Thank you for inviting me here today. I have been asked to provide the context of the Alpine and Muskingum water quality trading programs in Ohio.

I will begin by describing these trading systems, followed by lessons learned that serve as recommendations for the future of water quality trading programs. I'll conclude with a restatement of these recommendations, but in short, they are:

1). The water quality trading programs in Ohio and perhaps nationally should focus on minor (rather than large-scale) NPDES permit holders.
2). Community-based water quality trading programs at either the HUC 8 level or county level provide benefits over larger-scaled programs.
3). Trading should focus on areas of most impact: headwaters and critical source areas.
4). Locally based programs are likely to have creative solutions to achieve water quality objectives.

The Alpine Cheese Nutrient Trading Plan is a water quality trading example of a point source cheese company paying non point source farmers to install conservation measures in return for receiving credit on its NPDES pollution permit. It is one of approximately 24 active water-quality-trading programs in the United States (Willamette Partnership, 2012) although the actual figure may be fewer if we consider whether or not they are truly functioning in tandem with the NPDES system. The Alpine Plan was the first trading plan in the State of Ohio that served as part of a fully functioning NDPES permit. The success of the Alpine Plan led to the creation of the Muskingum River Watershed Quality Trading Plan in 2011 which has become one of the larger trading plans in the country to be described later in this testimony.

The Alpine Plan was part of the overall Sugar Creek Project headed by a team of researchers at the Ohio Agricultural Research and Development Center (OARDC) at The Ohio State University who teamed up with local agencies such as the Soil and Water Conservation Districts (SWCDs). This project started in 2000 when the Ohio Environmental Protection Agency (OEPA) labeled

the Sugar Creek Watershed the second most impaired watershed in Ohio (second only to the Cuyahoga River, which burned in 1969). Over 20 researchers from OARDC teamed up with several local farmer groups throughout the Sugar Creek Watershed to learn together about watersheds and water quality. At the suggestion of the farmers who questioned the validity of data from the Technical Support Document collected in preparation for the Sugar Creek total maximum daily loads (TMDL), researchers at OARDC tested water quality at the suggestion of the farmers at a high density of 1 sampling site per 1-2 square miles every other week throughout the watershed. It has been through the teamwork of researchers and farmers along with a close relationship with Soil and Water Conservation Districts (SWCDs) in Holmes, Wayne, and Tuscarawas Counties, that the initiative and self-reliance forming the "Sugar Creek Method" for pollution remediation emerged. The "Sugar Creek Method" is a community-based approach to watershed management that emphasizes local action and decision-making based on scientific data. It has six main characteristics: 1). Treat each stream as unique physically, biologically, and socially. 2). Focus on headwaters and benchmark water quality. 3). Catalyze participatory learning communities at the local level that seek their own sub-watershed visions. 4). Collaborate with downstream teams with the help of Extension and Soil and Water Quality professionals. 5). Build on the concept that a healthy environment leads to healthy people and profitable agriculture. 6). Seek to find more sustainable approaches at the family, property parcel, sub-watershed, community, and watershed levels through a holistic approach.

In 2005, the Alpine Cheese Company, based in the Sugar Creek watershed in Wayne County, Ohio, came to my group at the OARDC with a problem. Their business was successful enough that they needed to expand their operation, but they were facing multi-million dollar technology upgrades in order to bring the wastewater from an expanded processing system into compliance with OEPA regulations. Although by this time water quality in the Sugar Creek was improving, OEPA was not willing to green-light Alpine's expansion without pollution reduction provisions. OEPA suggested that Alpine do a partial facility upgrade and look to water quality trading to reduce its concentration to the permit goal of 1 mg phosphorus per liter of water (1 mg/L).

What we at OARDC helped to do was to create the spark to get various groups talking—Alpine Cheese Company, Ohio EPA, the Holmes County SWCD, and most importantly the farmers—to figure out how reducing non-point source pollution in the region could be coupled with cleaning up Alpine's waste stream. To this end, the SWCD and OSU partnered with Alpine and a group of 25 farmers in the area by which Alpine paid $800,000 over 5 years to support the implementation of a list of farm conservation measures. These conservation practices were in many cases quite straightforward— fencing off cattle from the streams, managing manure, and so forth—so putting them in place cost Alpine much less than the funds needed to upgrade their wastewater treatment technology. Our research and extension group then acted as an impartial body to monitor the streams in the area and determine changes.

The plan set up a trading ratio (the Ohio ratio between non point source and point source is 3:1), meaning that for every three pounds of phosphorus remediated by conservation practices upstream the permit holder downstream will get credit for one pound. In the end, the ratio was more like 2:1 because we received 1:1 credits for capturing milk house waste that had an outflow directly through a pipe into the ditch or stream so was treated as a point source. Point sources in Ohio can trade on a 1:1 basis if the one upstream remediates below the NPDES permit limit. We achieved our five-year reduction goal (5500 lbs of phosphorus) in three years, and by year five the actual amount of phosphorus remediated was 7133 lbs.

Water quality in the region improved in more than just nutrient load. By the end of the first five-year NPDES permit cycle, biological indicators in the Middle Fork of Sugar Creek, located just

downstream from the cheese factory outflow, went from “Partially Impaired” to “Full Attainment” status as independently evaluated by the Midwest Biodiversity Institute report of late 2010. Due to the success of the first five years, the plan NPDES permit was renewed in 2012.

But the real success was the collaboration between all of the partners—the Holmes, Wayne and Tuscarawas County SWCDs, the Ohio Environmental Protection Agency, the Alpine Cheese Company, the Ohio Department of Natural Resources, Ohio Farm Bureau, Ohio Department of Agriculture, USDA–NRCS and of course, the farmers many of whom were Amish and who came to be known as the Sugar Creek farmer partners and with whom we share our research data on a regular basis. Holmes County is home to the largest population of Amish in the U.S., and almost half of the county is Amish. The Amish population typically does not participate in federally funded conservation programs. But since the start of the Alpine trading plan, we see many Amish at the annual SWCD dinner as a direct result of the solid partnerships forged with this plan.

There are a number of characteristics about the Alpine Nutrient Trading Program that make it unique. First, it is a minor NPDES permit. Minor permits are classified as having less than 1 million gallons per day (MGD) design flow. Alpine Cheese Company's permit is for 0.14 MGD. Typical of minor permits which are common for small towns throughout Ohio and the US, the cost per gallon for a facility upgrade is very expensive (several times as much) compared to major permits that have design flows of over 1 MGD.

A second feature of the Alpine Nutrient Trading Plan is that it has been funded 100% by the Alpine Cheese Company. There were no federal or state tax dollars spent on the program. The original plan paid for an extra employee and administrative costs at the Holmes County Soil and Water Conservation District office and funded sampling and other research by The Ohio State University at OARDC. Because Ohio EPA required extensive "voluntary sampling" as part of the regulatory permit, the initial cost of the program--$800,000 over five years—was high. Although we are still required to conduct "voluntary sampling" during the second NPDES permit cycle, we can now get it done with about half the cost ($318,000 for the second five years). We expect that a further reduction of perhaps as much as half could be achieved if Ohio EPA will agree to have the program stop conducting voluntary sampling and if the program starts to sell nitrogen credits. Assuming sales of nitrogen, no voluntary monitoring, and full administrative and staff cost recovery at the SWCD and OSU, the price per credit would be in the $20-25 range. From the viewpoint of the factory, the plan cost about half as much as a full facility upgrade to the 1mg/L level. The plan also bought time for the partial facility upgrade to be gradually improved to come closer to the target reduction at a lower cost. By the end of the first permit in late 2011, the cheese factory was getting very close to the required permit level so hopefully trading might not be necessary by the third permit renewal.

The third salient feature of the Alpine Cheese Nutrient Trading Plan is that the front-end investment has long-lasting economic benefits. The reduction in cost of the program from the first five-year permit to the second is largely due to the fact that long-term (15-20 year useful life) conservation measures were used in the majority of the credits and were paid for during the first five years, leaving only a minimal maintenance cost for the second five-year permit. This would be true for a third and perhaps 4th permit cycle or as long as the conservation measures can be proven to be functioning. Because the watershed has a high concentration of animal agriculture, conservation measures that deal with manure are predominant. These include carrying out a comprehensive nutrient management program (CNMP) which reallocates nutrients appropriately on the farm acreage, installing heavy use pads, containing milk house waste, diverting barn roof runoff, and creating manure storage facilities. One of the leading

conservation measures was milk house waste which for the community was very symbolic of farmers doing their part to fix the pollution related to the cheese factory since milk is needed to make cheese. OARDC, Holmes County SWCD and ODNR worked together to add this conservation measure to the ODNR load reduction spreadsheet used for calculating credits. The conservation measure usually entailed capturing the effluent in a subsurface tank and land applying it back onto the field. Because OEPA had considered milk house waste a direct point source violation since it came out of a pipe, an agreement to proactively classify this conservation measure for a 1:1 ratio was reached.

Fourth, externalities of the project—besides improved river ecosystem health—included increasing the herd health of the cows, the productivity of the local dairy economy and community development. From the local community viewpoint, the plan made symbolic sense because both sides of the pollution problem (the factory and the farmers) worked together to solve it. There were also direct economic benefits to both parties. The somatic cell bacteria count and rates for mastitis dramatically decreased when farms fenced cows out of the stream using a conservation measure called "fencing exclusion." Because the local cheese factory paid a premium for lower somatic cell counts per hundredweight (cwt) of milk, farmers received approximately $0.75/cwt more in milk premiums because the cheese factory was able to produce more cheese from it. In addition, and partially as a result, the cheese factory was able to expand its production, creating 12 new jobs at the factory, which also helped to foster the eco-friendly cheese niche of the area.

Fifth, the Alpine plan was a model for the Holmes County owned Walnut Creek Wastewater Treatment Plant (WWTP) Water Quality Trading Plan, which is being used as insurance in the event that their facility upgrades were insufficient to achieve the targeted phosphorus reductions required in their NPDES permit. Walnut Creek WWTP is financed and managed through the county commissioners. So, from a county level, it makes sense to save money on the WWTP upgrade and share those savings to finance the county SWCD while returning tax savings to the citizens.

Sixth, the plan used a combination of trusted community partners with the cheese company. The broker for the plan was the Holmes County Soil and Water Conservation District, who consistently has scored at the top of most trusted organizations according to surveys that we have conducted with the local community. Because the SWCD staff has a good relationship with the community, it was easy to ask influential farmers to host small community meetings on farms to explain the program, and word of mouth within the Amish community increased participation. The first step was asking the farmer to fill out a self-assessment form, which indicated which conservation practices were needed. After determining how many credits could be generated on the farm and balancing that with the ones that the farmers preferred, the farmer was offered up to $30/credit to install the practices, which he agreed to maintain for five years. The university was the other partner in the plan. Our surveys in this community placed OARDC and Ohio State Extension as the next highest trusted groups in the community. The role of the university was to make impartial recommendations for the program, collect water samples, conduct research on water quality, and act as a neutral third party in facilitating relationships with agencies such as the Ohio EPA. For example, OSU helped the Holmes SWCD, the Ohio Department of Natural Resources, and the Ohio EPA agree to a memorandum of understanding on how to verify the credits. When we started, the Ohio EPA did not have trading rules, so their Northeast District office was helpful in creating the program. However, several times negotiations stalled and Representative Bob Gibbs was instrumental in helping to move the project along. The Ohio Farm Bureau also helped out with suggestions in the early planning stages. All of this activity fostered stronger relations between the Amish dairy farmers and the

SWCD. In fact, after the program started, one Amish farm invited all the county 5th graders to visit his farm to learn about agriculture first hand.

The Alpine trading plan was founded on the above principles and had strong community support from the start and these ideals spread into the creation of the Muskingum River Watershed Quality Trading Plan. Because of the local popularity of the program and increased budget constraints from ODNR and local counties which together fund SWCDs in Ohio, news spread among neighboring county Ohio SWCD offices and county commissioners about how the Holmes County SWCD office had created a new revenue source for conservation. Wayne County Commissioner Ann Obrecht called a meeting of neighboring county commissioners and SWCD managers and supervisors in 2009. Subsequent meetings created the 21 county Muskingum River Watershed Joint Board of Soil and Water Conservation Districts which was approved by the Ohio Commission on Soil and Water. The group met for the first time in June 2010. The ODNR program specialists provided invaluable facilitative and organizational assistance. The Muskingum Plan is still in its early stages but has created application forms for the farmers and permit holders that will be posted on their website. The original Alpine trading model has been incorporated into the Muskingum plan by keeping county SWCDs as sub-brokers responsible for brokering between farmers and point sources where trades can be kept within their counties. When cross-county trades occur, a Technical Advisory Committee ranks the intra and inter county bids. When ranking point source bids, a point system is used which values county conservation targeted priorities, prior compliance history, stream attainment level, upstream land uses, headwaters, economic and ecological significance, and public health. The program is still in its infancy but there is presently interest by three point sources. At this point there is widespread interest by farmers in the Tuscarawas HUC 8 watershed of the Muskingum Watershed so it is expected that the program will take off in 2014. The Ohio DNR funded a $50,000 grant to the Holmes County SWCD to prepare proposed plans for the remaining sections of the Muskingum plan. These were submitted to OEPA and are pending approval.

Specific Recomendations:

1). The water quality trading programs in Ohio and perhaps nationally should focus on minor NPDES permit holders.

In Ohio there are 3341 active NPDES permits according to Ohio EPA. As shown in Table 1 below about half the amount of water treated by NPDES permits comes from minor permits with a design flow of less than 1 MGD. However, it is the level of phosphorus and nitrogen being monitored and treated that is of greater significance. Major permit holders tend to have more monitoring, more limits, and are closer to their limits than minor permit holders. Thus, it is clear that more pollution is available for trading from minor point sources. Furthermore, there is a general trend that minor permits are located in the headwaters of watersheds so there is a multiplier effect as described in Recommendation 3 below.

Table 1: Major and Minor NPDES Active Permits in 2013

	Count	Approx. Avg. Daily Flows
Major:	300	10.6 billion gallons per day
Minor:	3041	10.7 billion gallons per day
Total:	3341	21.3 billion gallons per day

Source: Information provided by Ed Swindall from Ohio EPA in the Division of Surface Water and the Permit Compliance Unit. These data are approximate 2013 values for total average daily flows after adjusting for outliers and for flows that were reported incorrectly.

In the Tuscarawas HUC 8 Watershed of the Muskingum trading plan (Phase 1), 56% of the 16 major permits had phosphorus and nitrogen limits compared to only 9% and 49% for the 295 minor permits. For the large number of minor permits that did not have phosphorus limits or monitoring, it is not uncommon to find phosphorus levels at 3 mg/l instead of the 1 mg/l more commonly found among the major permit holders. In a survey of wastewater treatment plants of both major and minor permit holders in the Upper Scioto Watershed (2012) we found approximately 75% of the treatment plants were willing to consider partial upgrades plus trading to achieve their permit levels for phosphorus. We also found that 70% of the majors and 50% of the minors were willing to consider lowering their level below the permit level if they could sell the credits downstream.

One of the strongest arguments for focusing water quality trading on the minor permit holders is the higher cost per gallon of treatment. According to Hartman and Cleland (2007), the cost for facility upgrades for minor permits is anywhere between 2 and 7 times as great as majors depending on the phosphorus and nitrogen regulatory limit.

Because of the high cost of treatment per gallon, minor permit holders are able to offer higher prices for nutrient credits if transaction costs can be kept low. This is why the Alpine plan was so effective even though the cost per credit was relatively high. At the same time, when trading programs are started to solely benefit major permit holders, there is a drive to keep the cost per credit low, such as through reverse auctions, in order to match the low cost per gallon associated with large-scale facility upgrades.

2). Community-based water quality trading programs at either the HUC 8 level or county level provide benefits over larger-scaled programs.

First, trading success depends on having a trusted broker. Surveys conducted by my team and others show that the local SWCDs and land-grant universities rank high on trust by both the WWTPs and the farmers. These scored significantly higher in trust than other agencies or NGOs.

Second, within the same county jurisdiction it is possible for county commissioners who control the budget for the county WWTP and the county SWCD to save money if they can fund county SWCD's through having their county WWTP's participate in trading. 100% of the Upper Scioto HUC 8 watershed WWTP sample of 19 major and minor permits said that they would be more inclined to participate in trading if the county SWCD could be funded through the program.

3). Trading should focus on areas of most impact: headwaters and critical source areas.

Water quality trading should target the largest sources of pollution whether it is for buyers or for sellers of credit. Headwaters have a multiplier effect. The work by Alexander et al (2007) documents that first-order headwater streams contribute approximately 70% of the mean annual water volume and 65% of the nitrogen flux in second-order streams. Progressing further downstream, they contribute about 55% and 40% in fourth-order and higher-order rivers that include navigable waters and their tributaries.

Knowing the location of critical source areas of nutrients can make trading more efficient and lower the cost. My doctoral student Yina Xie was able to identify critical source areas of nutrient concentrations in her doctoral dissertation (2014). By using SWAT modeling of the Upper Scioto Watershed in Ohio, she documented that 22% of the land accounted for over 31% of the

phosphorus nutrients. Zones featuring large slopes, application of manure, non-conservation tillage methods, corn-soybeans rotation, and installation of systematical tile drains contributed disproportionately high nutrient loads compared to other zones.

4). Locally-based programs are likely to have creative solutions to achieve water quality objectives. As in the Alpine case, local people from different public and private agencies can effectively create new solutions that work well with the goals of local economic development. Also it is recommended that trading not be limited to NRCS approved conservation measures. While these have a proven track record, sometimes they are too rigid or insufficient. The addition of a clause in trading rules of using "scientifically proven innovative conservation measures" such as the Alpine milk house waste case could utilize the expertise of each state's agricultural experiment station which all have the goal of creating new scientific solutions for agriculture.

Improved modeling techniques are making targeted trading at the local county level a reality. For example, the APEX model developed by Texas A&M, is appropriate for small watershed trading and can evaluate site-specific conservation measures within a watershed at appropriately small scales. Such models provide the opportunity for pre-trading analysis of nutrient production and transport at field to farm to small watershed scales and to evaluate the utility and costs of potential nutrient trades.

Local solutions are also likely to create appropriate suites of complementary conservation practices such as we did in the Alpine cheese case. For example, we usually coupled CNMP's, milk house waste, and other manure management practices such as manure storage facilities. In the Upper Scioto Watershed research by Xie, we found that the suite of nutrient management, conservation tillage, and cover crops was associated with well-educated, managed farms which specialized in grain production with high rates of rental land often using GMO technologies. In the Corn Belt tenancy rates of 60-70% are common. We have found that for tenant farmers adoption of practices that are compatible with the short-term farm profitability, such as conservation tillage, are popular whereas nutrient management, cover crops, lengthening crop rotations, or putting in infrastructure such as systematical drain tiles are less favored.