September 30, 1999

FINAL REPORT

Results of Water-Based Trading Simulations

For:

Dr. Mahesh Podar
Work Assignment Manager
Office of Science and Technology
U.S. Environmental Protection Agency
Washington, D.C. 20460

By:

Chuck Marshall, QEP
Philip Services
Fort Washington, PA 19034

Under Contract 68-C7-0011
Work Assignment I-70
Lisa Kulujian, Project Manager
Science Applications International Corp.
Reston, VA 20190

Final Report: Results of Water-Based Trading Simulations

EXECUTIVE SUMMARY

Simulations of potential trades between dischargers of wastewater were performed in this study using real sources and stream data and either real or assumed regulatory requirements reflecting the present regulatory status in the Commonwealth of Pennsylvania. The concept behind the work is that considerable learning about a subject can be gained through looking at examples or “what if” situations without conducting real trades. The purpose of the project was to develop insights about trading policies and standards, and quantitative issues, and to bring out the pros and cons on the many variables by which trades can be structured and evaluated. It is thought that this experience will be helpful to agencies contemplating a trading program or regulation. Also thought to be helpful is the process that was used to assemble the workgroup of diverse representatives that reviewed and evaluated the simulations.

The most difficult challenge in the simulation work resulted from Pennsylvania’s present stage of water quality management programs. Pennsylvania is in only the beginning phases of implementing the total maximum daily load (TMDL) program, is awaiting new load reduction initiatives from the Chesapeake Bay Program, and presently has no other regulatory programs that are going to require large incremental load reductions from sources. In addition, the voluntary nature of PA’s nonpoint source programs takes away some demand for potential trades. It was possible; however, to conduct interesting and informative simulations using real sources and stream data while making assumptions about the regulatory requirements that would create demand for trades.

This executive summary consists of reporting on the results from the simulations from, technical, economic, and policy viewpoints, and then reporting on the findings concerning the process of performing these simulations.

Simulations

Four simulations were conducted: 1) the Delaware River New Source Offset, 2) the Moshanon Creek coal mine drainage trades, 3) the Swatara Creek Publicly Owned Treatment Works (POTW) to nonpoint source (NPS) trade, and 4) the NPS to NPS trade potential on Spring Creek.

Delaware River New Source Offset. This simulation was a point source to point source trade for offsetting incremental pollutant loads from an expanded POTW in northeast PA. The simulation raised a lot of questions regarding the quantification of direct offsets because part of the expansion will replace existing POTW capacity and receive sewage from failing septic systems. A trading ratio of 1.1:1 up to 1.25:1 per pollutant was recommended. A precise solution was not found for whether or not the POTW is responsible for offsetting the incremental pollutants over the entire build-out period or all at the beginning. Complicating the simulation was the fact that the only point source available is across the Delaware River in New York State. This raised unresolved issues of whether or not the POTW could borrow from the PA's state revolving fund to pay for the credits of the New York facility. The Delaware River Basin Commission regulations also contain offset requirements for indirect pollutant loads in increased stormwater runoff in the expanded service area of the POTW. Indirect loads are in addition to the direct loads of pollutant discharged from the pipes of the POTW. They include, for example, sediment and oil and grease generated by runoff in the expanded service area of the POTW. The workgroup found reasons why increased loads from runoff might not occur, or if they occur, would be very difficult to calculate. For example, if, in the absence of sewers, the area developed as farmland, the sediment loads from sewered-development that replaces the farmland might reduce indirect sediment loads from the farmland.

Moshanon Creek Mine Drainage Simulation. Acid mine drainage is highly prevalent in PA. Federal and state funds to control mine drainage, especially from abandoned sites, will trickle in over the next two decades. Meanwhile many sources, like one of the mines on Moshanon Creek, will be treating drainage to a high degree and discharging it for a long time into a stream with little biological life. Under this simulation, treatment would be temporarily discontinued so that the freed-up monies could be used to install control systems further upstream to generate five miles of fishable waters. The issues in this trade were 1) going below technology-based permit limits at the mine where water is now treated, and 2) having to analyze the trade on the basis of stream miles improved instead of equivalent loadings of pollutants, (Under certain conditions the trade could also be based on the amount of freed-up funds that could be generated and how much improvement in stream-miles could occur.), and 3) whether the freed-up funds along with a watershed plan for managing all mine drainage would act as leverage to prioritize federal and state funds for this creek.

Swatara Creek POTW Nutrient Simulation. This simulation involved a POTW point source to nonpoint sources trade. It was assumed that phosphorous reductions are required by the POTW. The reasons for the reduction could either be low dissolved oxygen in the Swatara, or the need for Pennsylvania to reduce nutrient loadings in the Susquehanna River at the PA-MD border. Golf courses were investigated as a source of phosphorous credits; however, it would have taken over 30 golf courses in the area to provide loadings reductions equivalent to the POTW's need. Discussions also focused on whether or not nitrogen reductions would be tradable with phosphorous reductions at certain ratios for either dissolved oxygen improvements or nutrient reductions at the PA-MD border.

If nitrogen credits were substitutable for phosphorous at a 1:1 ratio and could also be sold to the POTW, only one golf course would be required for a trade. Agricultural land uses were also investigated for a trade. Up to 2,300 acres of farmland would have been required to install at least 80 percent effective BMPs for phosphorous removal under a 2.0:1 trading ratio. If substitutability were also available for nitrogen, only 373 acres would be required to have 80 percent effective BMPs at the same trading ratio.

Under both investigations, even if both nutrients can be substituted for one another, and qualify for credit, the economics of this simulation disfavored a trade. In this instance it would actually be better for the state to pay the POTW to install phosphorous controls rather than have a TMDL implementation plan include only the NPS. The economics of a trade would be more favorable if the POTW was required to reduce nitrogen because it is more expensive to control nitrogen at the POTW. The workgroup challenged the nutrient loadings figures that were contained in a reputable reference being used to estimate loadings from agricultural NPS. A member of the workgroup also pointed out a very cheap source of nutrient loadings reductions on farmlands, i.e., nutrient management plans. This raised the question of whether these would be “anyway credits” for farm practices that the farmers would be doing anyway in the future once the benefits of it become known. An argument that can be made that “anyway credits” would not occur is that the benefits of nutrient management plans have been around for a long time and farm owners have still not applied them to their properties.

Spring Creek Simulation. This simulation would have been a NPS to NPS trade. Each of five reasons for impairment of waters of Spring Creek and its tributaries were examined. The only likely trade would have been for siltation. There was only one large piece of property in the watershed and it was planning a riparian preservation and streambank restoration project. Conceivably that project could have provided credits for some downstream users. It would depend on what the large source would have had to do under a TMDL implementation plan and what the other buyers of credits would have to do regarding BMP on their properties. The workgroup also found it difficult to simulate a siltation trade. Complicating matters was whether or not credit would be given for the nutrients in the soils, in addition to the siltation, not eroded in the future.

General Results. A PADEP attorney felt that trades involving NPS could only occur with a point source subject to an NPDES permit so that enforcement could still be conducted along present lines. Under that interpretation, only PS to PS or PS to NPS trades would be allowed. On the other hand, EPA’s framework document would allow NPS to NPS trades where certain conditions can be met. Also, the workgroup prefers federal guidance to be general because so many varied local conditions may exist and flexibility in trading is needed. However, the workgroup also felt that the EPA guidance should have specific criteria for trading ratios. Also, using reference sources for NPS discharges of, for example, nutrients has a high degree of variability when considering specific trades.

Trades between point and nonpoint sources might be more likely for nitrogen instead of phosphorous. Phosphorous control at POTWs is relatively inexpensive, based on the simulation performed herein. Chemicals like ferric chloride will easily precipitate phosphorous down to about 1.0 mg/l. Phosphorous control by agricultural NPS is considerably more expensive. This is attributable to the low loadings rate for phosphorous on agricultural lands and a lower runoff or leaching rate than for nitrogen. Meanwhile, nitrogen control is more expensive at POTWs, sometimes requiring BNR, biological nitrogen removal. The cost per pound of nitrogen removed by BMPs is much lower than for phosphorous because the nitrogen application rates on land are higher and because a greater percentage of the load is leached or is runoff. The economics become more favorable if a POTW that installs BMPs on farmland or turf applications like a golf course, can obtain credit for both the nitrogen and phosphorous that BMPs reduce.

The need was expressed by the workgroup that there may be exceptions to EPA's framework document regarding the directionality element of trades. EPA states that in a trade water quality standards should not be violated. Therefore, the reductions would most likely to be upstream of the source that is purchasing the credits. The workgroup generally supports that rule on directionality but felt that an exception could be tolerated, for example, for two trading sources in a tidal area. The workgroup also believes that the definition of upstream needs to be worded to assure that inter-watershed trading for nutrients could occur, for example, in the case of nutrient reductions required for the Susquehanna River basin. In other words, if Pennsylvania has to meet a loadings limit for nutrients at the PA-MD border, then nutrient trading should be allowed between a source on a watershed west of the Susquehanna, for example, with a source in a watershed on the east side of the Susquehanna.

Lessons Learned from the Workgroup Process

Assembling and involving a workgroup such as the one assembled herein appears to be a good idea for developing a regulatory program or being a public sounding board. Simulations can play a part to help the workgroup towards developing a regulation, or by testing the regulation once it is nearly developed. The simulations help to identify many complex issues that a trading program needs to either specify or leave to implementation guidelines or case-by-case situations. The same criteria used in this study to structure and evaluate the simulations could also be applied to case studies of trades elsewhere that are being reviewed for regulatory development purposes. More specific conclusions about the workgroup process are also contained in the body of the report.

INTRODUCTION AND PURPOSE OF DOCUMENT

Water trading in this document is as defined in EPA's *Framework for Watershed Based Trading.* It occurs when a source faces additional control requirements and is allowed to control an equivalent or greater amount of discharge of the same pollutant in another portion of the watershed. The trade is intended to result in enhanced water quality while allowing sources to control pollution in a less costly or more flexible manner. The discharges of the buyer and seller cannot go below technology-based limits or violate any stream degradation regulations.

The trading of water discharges to achieve more environmental quality at less cost is a growing focus. Effluent fees and trading have been a long-favored goal of economists. Now many are thinking of trading as being an option in the implementation phase of the TMDL process for achieving water quality standards. In addition, EPA has recently proposed offset requirements for new loadings in impaired waters prior to TMDL development. The Chesapeake Bay Program is also considering adding a nutrient trading program as a complement to their anticipated new initiative of placing caps on nutrient discharges into the Bay.

Others have also applied the concept to the water supply arena by allowing upstream nonpoint source control in lieu of adding filtration to drinking water treatment plants.

The widespread work throughout the United States that is occurring now in developing TMDLs for impaired waters is spawning much of the interest in trading. A question that frequently occurs during the development of a TMDL implementation plan is whether least-cost control programs can best be achieved through highly customized allocations/load reductions to individual sources or whether a trading program between sources is needed to further achieve least control costs. In theory, if a TMDL implementation plan can customize allocations on the basis of equalizing marginal control costs per pollutant per facility, then a trading program cannot achieve further cost reductions and is not needed. On the other hand, if a TMDL implementation plan results in uniform percentage or quantity load reductions, then trading programs then have the potential to reduce compliance costs while still achieving the necessary loading reductions.

This document presents the results of four simulations that were performed to better understand the detailed and practical aspects of water trading programs at this early stage of interest and activity. There are several reasons for performing simulations as an input to the design of trading programs. Most organizations developing or contemplating a trading program use a top-down approach whereby a set of concepts and objectives are put forth as a proposed rule presented to groups of stakeholders. A bottom-up approach, using concrete case simulations, can also be used as a learning tool to help develop concepts and objectives for developing a trading program. and/or a good way to test the viability of a trading program developed under a top-down approach.

Although a lot of lessons learned from air pollution management can be applied to water pollutant trading, there are many aspects of wastewater management that will affect water pollutant trading in a unique manner. Simulations help anticipate these unique aspects in an objective way before an agency faces an actual proposed trade or a regulatory development process. In addition, the *Framework* cannot (and perhaps should not) deal with all the issues and intricacies that arise when considering trading at a state and local level. The simulations performed herein were varied and help in this regard to encounter more issues and intricacies. Some actual water pollutant trades have occurred in various parts of the country, or are being planned. Much can also be learned from the details and conditions for these trades. However, some of the issues in simulations that might arise elsewhere were not thoroughly discussed or addressed in these trades. In addition, by having a diverse workgroup discuss these simulations, the pros and cons of trading variables can be addressed and reported. This will assist agencies, traders, and all stakeholders to raise issues and to address trades thoroughly when, or if, trading is proposed. It is hoped that this document advances the dialogue on issues involved in trading.

The process of conducting these simulations was an important part of this work. A diverse group of stakeholders was assembled to discuss trades. A list of 19 variables for structuring and evaluating trades was developed and used as a checklist, to the extent time would allow, in the discussions about a specific simulation. This process allowed the opinions of the diverse group of participants to be revealed issue-by-issue. In many instances there was much commonality on issues and on a few matters there was disagreement. Not addressed in this document is how to resolve unresolved issues for decisions on specific trades or the development of a regulatory program of trading. One of the purposes of this work was to describe the range of opinions about each of these variables and to identify issues for which federal or state guidance may be prudent, or left to the agencies dealing with a trade on a case-by-case basis.

The simulations were performed in Pennsylvania. The simulations covered point and nonpoint situations involving municipal, coal mine, agricultural and other nonpoint discharges. Pollutants involved in these simulations included CBOD, phosphorous, nitrogen, suspended solids, ammonia, acid and metals. Criteria for choosing simulations were that they involve actual sources with a regulatory need for further control and that the trades would make technical and economic sense. Sometimes the regulatory need that would create interest in a trade had to be assumed. No actual trades occurred among the parties discussed in the simulations. Pennsylvania's control program for nonpoint sources is largely voluntary and requires public funds for those sources to meet water quality standards in impaired waters. This reality reduced the number of scenarios for trading, as did the early stages Pennsylvania is in developing TMDLs.

The next section of this document describes the process that was used in performing the simulations. The remaining parts of the document describe each of the four simulations.

WORKGROUP TRADING SIMULATION PROCESS

The approach followed in this work was to perform simulations of trades as if the partners to a trade were seeking official approval. It is recognized that simulations alone will not result in a regulation or policy. Simulations are intended to be both a complement to other developmental work and as a test of potential regulations or policies.

The contractor assembled the background information and presented each case to the assembled workgroup. The group discussed and then gave their opinion on 19 variables by which trades can be structured and evaluated. Instead of trying to reach consensus among the group, notes were kept on the issues on which agreement or disagreement occurred among the stakeholders. For this document to serve its purpose, it is believed that people putting together trading programs in the future will benefit by learning both sides of issues.

The workgroup consisted of approximately 26 people. An average of approximately 16 people attended the four meetings. The names and organizations of workgroup members are listed in Appendix B. By representation the breakdown was as follows:

- Environmental/conservation (3)
- Industry (1)
- Conservation Districts (2)
- Abandoned Mine Reclamation (1)
- Agricultural (2)
- PADEP (6)
- River Basin Commissions (5)
- EPA (2)
- Chesapeake Bay Program (1)
- Planning commission and land use consultant (2)
- Municipal wastewater treatment association (1).

The overall steps in this process were as follows:

- Obtain buy-in of the project by PADEP
- Conduct research on existing trading programs or trades
- Identify key stakeholders from Pennsylvania
- Invite stakeholders through personal communications and project discussions
- Hold an initial meeting with the stakeholders at DEP’s headquarters
- Develop notes from first meeting and send them to participants for corrections and additions
- Hold subsequent meetings to tackle each simulation

- Perform research and gather data between meetings to develop the case data
- Prepare a report on the process and the results of each simulation.

The first three meetings lasted approximately two to three hours each, while the fourth meeting lasted five hours. All meetings were held in Harrisburg, PA covering a time period from March 30, through August 12, 1999.

Project Buy-in. The first step in the process was to hold conversations with the Pennsylvania Department of Environmental Protection (PADEP) in order to get a buy-in from them on the project. The first discussion was with someone who performs TMDL assessments. A two-fold purpose of the discussion was to 1) understand PA's TMDL process, the schedule, and the amount of discretion there was in the actual implementation planning that could be construed as achieving the same objectives as trading, and 2) to learn who in PADEP would be the key managers for committing PADEP to the simulation process. Letters were then sent to the two key people, followed up with calls, and more detailed explanations provided. PADEP agreed to participate and host because they wanted to determine 1) how trading might be a part of their TMDL process, and 2) participate in another trading program development in addition to the one started by EPA's Chesapeake Bay Program.

Research on Actual Trading Programs. Research was conducted in many ways:

- EPA had another contractor contacting agencies throughout the country and developing a database on existing trading programs
- The EPA WAM and co-project manager provided references to contact
- The Chesapeake Bay Program contact was in turn helpful for additional contacts (in general contacts spawned new contacts until repeats started to occur).
- The Great Lakes Trading Network provided a web site of program descriptions
- Detailed discussions were held with an EPA person involved in the Passaic Valley Sewage Authority about trading by two pretreatment point sources.

Recruiting Stakeholders. From the start the aim was to gather a diverse and representative group of individuals. After PADEP agreed to the process, they were asked who to recommend. The contractor was also aware of influential organizations in PA. A key was to call each person individually and give them a full explanation of the objectives and process of the simulations. The contractor planned that four or five meetings would be a limit. It was believed that more meetings could have only been expected if the workgroup was actually drafting a state regulation.

Hold Initial Meeting. The agenda for the first meeting included the following:

- Description of the project and desired outputs

- Presentation by and EPA contractor on their work for EPA to identify and describe other trading programs in the country
- The expressions of individual or organizational hopes and concerns for the concept of trading
- Description of PA's TMDL process as it relates to the potential for trading
- How decisions would be made in the group, i.e., rather than forcing decisions, each side of issues would be recorded
- Brainstorming about situations in which trading might play a role.

A concern of the EPA contractor at the first meeting was to not only gauge the enthusiasm of the participants for the simulation, but to also begin to turn the process into a participation one that encouraged people to freely express opinions and share the responsibility of proposing and to some degree conducting the discussions on the simulations.

Major trading limitations identified at the first meeting were the need for nonpoint sources (NPS) to be required to achieve BMP (best management practices), and that PADEP was not going to perform TMDL assessments for complex streams (NPSs and PSs) until way beyond the contract period.

New participants/stakeholders were suggested at the first meeting: someone from the farming industry (the farm bureau representative invited did not attend the meeting), someone from the coal industry because coal mining discharges are the second biggest reason for impaired waters in PA, someone from a land use agency, and someone from industry. A request was also made that someone from PADEP give a presentation at the next meeting on special protection rules so that the compatibility of trading with these and antidegradation rules could be evaluated.

Hold Second Meeting. The second meeting was set for six weeks after the first. At that meeting three major tasks were accomplished: 1) discussion of the situations that might prompt trading, 2) hear about PADEP's legal interpretation for applying the framework, and 3) the nomination of candidates for trading.

Acknowledging that legal requirements on trading would have to be developed, the DEP legal representative felt that NPS to NPS trading should be illegal in Pennsylvania because there was no NPDES permit to be used as a hook to enable enforcement at a NPS site.

The nominations for trading are shown in Table 1. In the process of investigating the suitability of these simulations, several changes and deletions were made.

Table 1. Nominations for Water-based Trading Simulations

Stream	Sources	Pollutants
Delaware River	New POTW facing offset requirements in special protection waters	CBOD, TSS, Ammonia, Nitrogen, Phosphorous
Delaware River	Industrial chemical plant facing reduction requirements for chronic toxicity	DME, a specific chemical
Conodoguinet	PS (POTWs) and NPS (agriculture)	Nutrients, Sediment and Dissolved Oxygen
Spring Creek	PS (POTWs) and NPS (agricultural)	Nutrients, Sediments, and Dissolved Oxygen
Conestoga	Agricultural NPS	Nutrients, Sediments, and Dissolved Oxygen
Mill Creek	Coal mine drainage	Acids and metals
Wissahickon	PS (POTWs) and NPS (golf courses and agriculture)	Nutrients, Sediments, and Dissolved Oxygen

The final simulations were:

- Delaware River new source offset
- Coal mine drainage on Moshanon Creek
- Spring Creek
- Swatara Creek.

Pennsylvania's implementation of its TMDL program, while advancing, was not as far along to produce many situations suitable for simulations as envisioned. Most of the TMDLs in PA that have been performed are for simpler situations of impairments. Some TMDLs have concentrated on abandoned mine drainage, for example, where state and federal funds will be used to remediate existing and prominent nonpoint source discharges. Presumably, the state will be trying to use their monies to achieve least-cost controls for the appropriate stream segments and will not need to consider trades in these situations. The TMDLs for streams with a complex assortment of point and nonpoint sources are underway in PA, but far from completion. Consequently, certain assumptions were made about the loadings of pollutants that would have to be reduced in simulations involving TMDLs.

The Third Meeting. The third meeting was devoted entirely to discussing the Delaware River Basin offset simulation.

The Fourth Meeting. This meeting was longer that the first three in order to discuss the remaining three simulations. Extensive discussions were held on the Moshanon coal mine discharge simulation, the Spring Creek NPS to NPS simulation, and the Swatara PS to NPS simulation. The meeting concluded with a discussion about the value of the simulation and the process for conducting them.

Conclusions About the Process

Before the conclusion of the last meeting the attendees were asked to indicate what they thought were the good and weak parts of the simulation process. The remarks were limited by time available and no survey form was used. Several felt that the simulations were very interesting. Most of the comments were not about the process but on trading itself.

The need for flexibility in guidelines was recommended because of the large variety in sources and geophysical characteristics of sources. Sound local input and participation by the community is needed to gain acceptance for trading. The evaluation of a trade requires a lot of good accurate data that may depend on very local conditions. Using reference sources to calculate loadings has limitations over using localized data.

The contractor also developed these conclusions about the process:

- Overall, the process met the goals of capturing a variety of opinions on water-trading from a diverse group of participants.
- There was good variety in the simulations.
- People are much more interested now in exploring trading because of requirements such as offsets for new sources in impaired waters, TMDL, nutrient loading limitations for the Chesapeake Bay and potentially new federal nutrient water quality standards.
- The level of discussion did not require a facilitator; however, using a facilitator might be a good idea where consensus must be achieved on a specific regulation or trade.
- Identifying simulation candidates, gathering data for the simulations, and having to make assumptions about load reductions and regulatory drivers made the process quite difficult. However, the cases did provide insight into analogous tasks for a real trade.
- Thorough documentation of existing trades by the list of variables developed in this project would make a suitable alternative to simulations.
- Education about trading and TMDLs was required at the first meeting to try to bring people to a more similar level of knowledge.
- Stakeholders were not difficult to locate and include in the process.
- Thorough and personal invitations and discussion of the project was felt to be very important in obtaining stakeholder participation.
- Attendance at all meetings was difficult. It is recommended that each organization designate an alternate representative.

- Although the interest and energy level of the participants was very high, it would take an actual regulatory development to entice the participants of the workgroup to attend more or lengthier meetings.
- Respect for people expressing opposing ideas was high.
- Reminders had to be frequently provided as to the purpose of the project.
- PADEP attendance was good at the first two meetings and then tailed off considerably over the next two meetings.

SIMULATIONS

The vast majority of agencies considering water trading begin a top-down approach to consider or develop a program. Such a process is characterized by thinking of all the variables, structure, and procedures of a regulation that would have to be developed. The proposed program must then be ground-tested against real trade applications. Simulations, on the other hand, represent a bottom-up approach by examining realistic trading situations by going through the calculations and applying all the same variables, as under a top-down approach. During the simulations a lot of what-if questions can be raised. Concerns and fears about the trade can be discussed and analyzed in a somewhat non-threatening or non-pressing way. This approach was highly successful in preparatory work done under the New Jersey Open Market Emission Trading program. In theory, the outcomes from a top-down or bottom-up approach could result in the same regulation. A bottom-up approach was chosen here because of previous appreciation for the worth of simulating trades. In theory the basis for a regulation or program would emerge from resolution of issues raised by the simulations.

Simulations use the actual discharge parameters of facilities in a real stream setting. The simulations did not include water quality modeling to determine the effects of the trade. However, if in the context of an actual trade, one would need to assess the potential for causing localized exceedances of water quality standards. The EPA Framework for Watershed-Based Trading provides the initial guidance in qualifying facilities and in analyzing trading possibilities. The principles of the EPA framework were followed in structuring the trades that were subject to evaluation. The facts of the simulations prompted the raising of additional technical and economic questions and situations that the EPA Framework does not address and that may be very site-specific. In this study the four simulations contained a variety of trading situations involving point and nonpoint sources and did encounter situations where more guidance to others may be warranted.

The Pennsylvania simulations were managed by an EPA contractor with the help of PADEP and thoroughly evaluated by a workgroup of stakeholders. The simulations were conducted in Pennsylvania because of the contractor’s proximity, and because there are several examples of waters impaired by different pollutants and a good mix of point and nonpoint source challenges. Parts of Pennsylvania also lie within the Chesapeake Bay watershed, which creates additional driving forces for trading.

The steps used for conducting the simulations were to select actual sources on a stream that would need discharge reductions to achieve water quality standards or other regulations. The actual wastewater parameters of those sources were used to evaluate issues associated with water trading. In simulations involving NPS most did not include specific property owners as trading partners.

PA had tried to develop a very general rule that promised specific trading rules later on. This regulation was not proposed because many groups felt that it was too vague.

Variables for Structuring and Evaluating Trades

Depending on how one counts variables, there are a host of them that are necessary to consider to both structure a trade and to evaluate it. Variables used in these simulations are shown in Table 2. Not all variables apply in each simulation.

Table 2. Definition of Variables for Structuring or Evaluating Trading Programs

Variable	Description
Selection of Pollutants	The pollutants that are eligible to be traded.
Structure of Trade	Whether or not a trade is 1) conducted between two parties who apply to the agency for approval, 2) conducted between two parties who report to the agency as part of normal reporting, e.g., in DMR reports, 3) conducted through a watershed organization, 4) conducted through an agency.
Units of Trade and Minimum Quantities	Will pounds be the unit of trade and, if so, will there be a minimum quantity that needs to be traded or a minimum amount that the state can justify for having to process the approval?
Eligible Traders	Who can generate credits and who can buy them? Is it anyone who discharges covered pollutants who can generate credits? Is it only sources subject to allocations that can buy credits, or can third parties enter the market?
Directionality	Must buyers of allowances always be downstream of the source that reduces its pollutants? What distance limitations are there between buyers and sellers of allowances?
Size of Trading Area	This is related to directionality, but also includes references to whether or not inter-watershed trading can occur, e.g., for nutrients where PA has to meet a border limitation for nutrient discharges into the Chesapeake Bay.
Trading Ratio	How many credits must be generated for each credit purchased to account for net environmental improvement or uncertainty in outcome of the real reductions of pollutants? Trading ratios can also be influenced by the accuracy of the sampling and analytical equipment that is used by each party to a trade. For example, loads determined by a grab sample may be more inaccurate than loads determined by continuous

Variable	Description
	samplers or other sophisticated methods.
Monitoring Requirements	What source or stream monitoring needs to be done to assure compliance? How would nonpoint source reductions be monitored? (See also enforcement)
Banking	Could a source overcontrol in one period and use those credits in a following compliance period?
Inter-pollutant trades	Where more than one pollutant can cause an effect, can those pollutants be substituted for one another? For example, if downstream nutrient reduction is required, must reductions only occur for phosphorous or nitrogen or can both be reduced under certain potency ratios? If dissolved oxygen is the impairment, can CBOD, other oxygen-reducing substances, and nutrients be used in combinations to meet a dissolved oxygen standard?
Calculating loads	What calculations should sources use for determining the amount of credits they generate for the reduction of their discharges? Are the calculations based on past actual levels over a defined period of time? For offset transactions, is the need for credits determined on the design capacity of the new facility? (See also trading ratio)
Assuring real trades	How is it assured that transactions do achieve an equal or net benefit for the environment? How are source shutdowns handled? Do they qualify for generating credits? This assurance may require that trades be based on real, and not paper, reductions, that they are quantifiable, and surplus. Surplus means that the generating source does not have to achieve the reductions for other regulatory reasons.
Trade Approvals	Do trades have to be pre-approved by the state, or a watershed organization? What level of processing fees is required by the agency? Can trades just be reported within normal reporting systems, e.g., through NPDES reporting systems?
Enforcement and Responsibility	How can inspections be conducted to assure that the outcome of the trade is being achieved? What happens if things go wrong? Is the trade nullified? Is a contingency plan required and implemented? Who has what responsibilities? Is it with both parties to the trade or just the party where the problem exists?
Registration System	Should the state or watershed organization establish a registration system under which generators register their credits for sale so that the generation of credits can be monitored and tracked and in order to facilitate transactions between parties?
Verification of Credits	Can the public trust the number of credits the generator says that it has generated? Alternatively, should a third party

Variable	Description
	have to verify the derivation and qualification of credits?
Anyway Credits	Is it possible for sources to generate credits for reductions that they would have achieved anyway, i.e., if the trading program did not exist? Are credits eligible for sources if they reduce pollutants for economic rather than regulatory purposes? Are credits available for normal overcontrol that is part of a source designing a compliance system with more than enough capability to meet limits?
Public Information	Do trades have to be disclosed to the public? Is cost of the trade a necessary piece of public information? If pre-approval of trades is not required by the state, what rights to citizens have to knowledge of the trade?
Interstate Trading	Where a watershed crosses a state border, can interstate trades occur?

THE DELAWARE RIVER POINT SOURCE SIMULATION

Background and Simulation

The region of Westfalls Township, Pennsylvania developed a Section 537 plan calling for the expansion of its publicly owned sewage treatment works plant (POTW) from 90,000 gallons per day (gpd) to 800,000 gpd. The discharge site is in special protection waters of the Delaware River Basin Commission (DRBC). This is the highest water quality designation in the Basin. Waters under this designation include outstanding waters and wild and scenic waters. The DRBC requirements for new or expanded discharge plants call for offsets of both direct and indirect pollutants generated by, in this case, the expanded capacity of the POTW. Direct pollutants refer to the pollutants discharged via the POTW's pipe. Offsets represent the reduction in loadings of the same pollutant in amounts equal to or greater than the incremental loads from the expanded POTW. Loads refer to the amount of pollutant by weight per year. Indirect loads of pollutants are associated with the development enabled by the expanded service area of the POTW.

The expanded POTW would allow the retirement of 295,000 gpd capacity of older POTWs having actual flows of 205,000 gpd. The expanded service area would also include connections for septic systems that are, or have been, failing. Thus, 415,000 of the 800,000 gpd capacity would be available growth in the area with a projected build-out period of 20 years.

The DRBC regulations, policies, and precedents did not provide guidelines about how to calculate the increased pollutant loads from new sources, how to determine the amount of the offset required, or how that offset might be obtained. These matters became the topics of discussion for the trading simulation workgroup.

General Methodology to Estimate Increased Loadings

General consensus among the group was achieved for how the **direct** incremental loadings should be calculated. The general consensus for the calculation of **indirect** loadings of pollutants was that theoretical and practical application of the requirement would present enormous uncertainty. It was agreed that the area would grow in the absence of new sewers and a POTW and that a baseline of pollutant loadings from the unsewered growth would have to be compared with sewered growth. This was considered by the workgroup as having a very large amount of uncertainty. It was conceivable, in several workgroup members' minds, that higher pollutant runoff might occur from baseline agricultural and failed septic system growth than from the urban development for sewered growth. This would entitle the POTW to a credit for indirect loadings that would reduce the offset required for direct discharge loadings. There was agreement, however, that, at least in concept, the erosion of streambanks from increased runoff from urban growth and the increased POTW discharge would be loadings that are highly likely of occurring and which need to be estimated. For a river as large as the Delaware, the outcome of this calculation might be a relatively small amount, but that it could be significant for smaller rivers.

The formula for calculating increases in direct loadings as adopted by the workgroup is shown in Table 3.

Table 3. Derivation of POTW Loadings to Be Offset

Incremental Direct Loadings
POTW's load at plant's new design capacity and discharge limits for each applicable pollutant (CBOD, TSS, ammonia, P, and N
Less: Actual loads from replaced POTWs for each pollutant
Less: Load from failing systems for relevant pollutants (CBOD, TSS, N, P, ammonia)
Less: Design loads for existing capacity for each pollutant
Less: Load associated with the maximum amount of new source discharge that would cause no measurable change in water quality for each pollutant. The workgroup decided to give the source credit for the small quantity of pollutants that can be increased by a source before a measurable change of pollutant concentration occurs in the river.

POTW's Load for CBOD:

800,000 gpd X 10 mg/l X 365 days/year = 643,900 lbs.

Note: 10 mg/l is the discharge limit that DRBC would impose for the POTW's discharge. On the other hand, it is possible that the Commonwealth of Pennsylvania, when it issues the actual NPDES permit will require the source to achieve lower limits. For example, note later on that the Port Jervis facility is already achieving lower CBOD.

Actual loadings for Retired STPs (capacity 295,000 gpd):

205,000 gpd X 22 mg/l **X** 365 days/year = 362,999 lbs.

Note: 22 mg/l represents the actual discharge level under these plants' older and less stringent discharge permits. 205,000gpd is actual flow which is less than design capacities.

Actual Loadings from Connecting Failed Septic Systems:

Assumed value from literature of 1.00 kg/acre/year and 2,000 hectares = 4,400 lbs.

Design Loadings for Existing Capacity:

90,000 gpd X 10 mg/l X 365 days/year = 72,439 lbs.

No Measurable Change Quantity:

200,000 – 90,000 gpd X 10 mg/l X 365 days/year = 84,512 lbs.

Assumption: Amount is equal to the plant's flow at 200,000 gallons per day, which was approved by permit several years ago. This was an amount that was considered as producing no measurable change of pollutant levels.

Net Increased Loading: 643,900 – 362,999 – 4,400 -72,439 – 84,512 = 119,550 lbs.

An analysis of the above calculations shows the large influence played by the retirement of existing POTWs that have higher treatment limits in their permits and in actual loads. Although the design load for CBOD was 643,900 lbs., the net incremental load is 119,550 lbs.

No calculations are shown for the other pollutants, however, the magnitude of the results are likely to be similar.

For several reasons, no calculations were performed for the indirect loadings; 1) the size of this task went beyond the resources available for this project, and 2) the inability to determine whether the impact on indirect loadings would be positive or negative. In addition, the conclusion of the workgroup was that it was better (if one could justify it) to calculate indirect loadings as a percentage of the total direct loadings.and apply a trading ratio factor. The only other way that the workgroup could think of was to make assumptions about baseline land use in the absence of the POTW and what the runoff loadings would be after the built-out development. In addition, streambank erosion was not calculated for increased stormwater runoff.

Trading Ratio

A ratio of at least 1.1:1 was decided upon to provide a net environmental benefit. As for a trading factor for general uncertainty and for indirect loadings, the range of opinion was from 1:1 to about 1.25:1. This small range of factors was assumed because the trade would be with another POTW point source also controlled by permit. A significantly greater, although unspecified ratio, would probably have been selected by the workgroup if the trade was being made with nonpoint sources.

Options for Trading

The possibilities for trades to offset the 119,550 lbs. Per day were considered to be:

- With the Port Jervis, NY POTW across the river which has a capacity of 5 mgd and for which recent flow has been ~1.5 mgd, compared to the 0.8 mgd of the expanded POTW.
- Installations of BMPs on sites where they are not now required. (This would mostly apply for TSS, N, and P).

- Streambank reconstruction upstream of the new POTW to offset the TSS loads.
- Commitments to lower permit levels to help reduce the load for which offsets would have to be obtained.

A trade with Port Jervis was considered the only likely trading candidate. (While several pointed to the logical idea of building a pipeline under or over the Delaware River to Port Jervis and treating the loads there, this was considered unlikely to be approved. Under that concept Westfalls Township would pay Port Jervis for treatment. Port Jervis is not in a growth mode now and will have considerable unused capacity.) BMPs on NPS would not be offset CBOD discharges. Streambank reconstruction would also not affect CBOD. The concept of improving treatment beyond what the permit will require is a possibility for offsets that will have to be explored after PADEP sets the technology-based treatment requirements.

For CBOD, Port Jervis is presently discharging at 6.3 mg/l. The workgroup felt that a multi-year baseline would have to be established at Port Jervis taking into account wet and dry seasons. Under a trade Port Jervis would have to reduce that level to about 5.3 mg/l. (Calculations not shown). Table 4 presents work group's opinions on the trade variables considered.

Table 4. Consensus or Range of Opinions on Trade Variables

Variable	Workgroup Opinions
Selection of Pollutants	Those that would be contained in a POTW's permit
Structure of Trade	A trade between the two POTWs would not likely be conducted as a private trade subject to approval by the state authorities. Considerably more state involvement would be required because state revolving funds might be needed to pay for treatment in a New York facility and to help negotiate the trade with New York City (which owns the facility) to obtain offsets of incremental pollutants from the expanded POTW.
Units and minimum quantities	Lbs. of pollutant; no discussion about minimum quantities
Eligible Traders and participants	Only source available is Port Jervis, NY POTW
Directionality	Port Jervis facility is opposite the Westfalls Township facility and meets upstream directionality requirements.
Size of Trading Area	Limits not discussed; practically the length of the stream where offsets required
Trading Ratio	Between 1.1:1 and 1.25:1
Monitoring requirements	Through normal NPDES permits. Trade would have to be pre-approved by PADEP rather than just reported as a means of compliance.
Banking	Not applicable

Variable	Workgroup Opinions
Inter-pollutant trades	No
Permit, design, or actual loads	Actual discharges for replaced existing POTWs and failing septic systems but permitted discharges for expansion
Assuring surplus and real trades	Have to assure that Port Jervis, in anticipation of a trade, did not increase their discharges that were well under permit levels. Have to assure that neither treatment plant would be subject to foreseeable increased control requirements. Future control requirements would reduce availability of credits. Have to use correct loadings in trade.
Approvals and legal changes	Permit-issuing authorities of each state plus EPA.
Enforcement and responsibility	Same as for normal NPDES permits
Registration system for credits	Not applicable
Verification of reductions	Not necessary since states would conduct their own approval processes.
Anyway Credits	Handled through the variable of assuring proper baselines and assuring that Port Jervis would not have to lower its actual discharges from additional regulations
Cost Information	Would probably be a matter of public record
Interstate trading	Yes

MOSHANON CREEK COAL MINE DRAINAGE SIMULATION

Background

The Moshanon Creek is located in North Central Pennsylvania in the midst of large coal mine deposits. A long history of tunnel and open-pit mining in the watershed has left large portions of the Moshanon highly polluted from acid mine drainage. The headwaters of Moshanon are of a suitable quality to enable a fishery down to Roup Run. From Roup Run to the confluence of the Moshanon with the west branch of the Susquehanna, the Moshanon is highly impaired.

The Rushton mine pumps and treats water from a contaminated groundwater pool that underlies a small town. The pool occurred as a result of Rushton's past deep mining activities. The treated water is discharged to the Moshanon Creek seven miles below Roup Run and four miles below the town of Oceola Mills. The pumping capacity at Rushton is 5000 gpm with an annual average of pumping over the past year at 3,800 gpm. This volume of water makes Rushton the largest discharge in Pennsylvania of treated acid mine drainage.

The Simulation

The concept for a trade involving coal mine sources is to allow a source downstream to stop treating in return for upstream treatment that will show in-stream benefits. Rushton discharges treated water into the Moshanon where metals concentrations are much worse than water quality standards and higher than the concentrations of Rushton's discharge. Table 5 shows the data. PADEP personnel report that this is not an uncommon situation in Pennsylvania. Getting control of the many orphaned and abandoned mines in Pennsylvania may take decades of work and funds. If, and when, that reclamation happens the concept behind the trade is a re-continuation of treatment at Rushton.

Table 5. Water Quality Data for Treated Rushton Discharge and the Receiving Stream

	Iron (mg/l)	**Manganese**
Water quality standard	1.5 –total daily average	1.0 –maximum
Rushton treated water	0.29	0.84
L-1 in-stream monitor at point of Rushton discharge	7.32	3.47
L-4 in-stream monitor downstream	5.00	0.34
L-16 in-stream monitor upstream	0.21	0.28

In exchange for stopping treatment at Rushton, the simulation consisted of Rushton treating acid mine drainage on Roup Run. Successfully treated, Roup Run would become a fishery along with three miles of the Moshanon down to the town of Oceola Mills. At Oceola additional coal mine drainage, it is thought, would prevent fish from living further downstream. The water quality benefit from the trade would be five new miles of a fishery.

Despite increased treatment at Roup Run, the elimination of treatment at Rushton would result in a net increase in loadings of iron and manganese. The net effect over the length of Moshanon Creek would be increased loadings but more fishable miles of stream. This raises the question of whether loadings is always the essential determinant for a trade. The workgroup participants offered a range of opinions; 1) regardless of the increased loadings the five miles of a new fishery would be a worthwhile tradeoff, 2) Rushton should be required to treat up to an amount of loadings commensurate with the decreased net costs at Rushton, and 3) Rushton's permit limits are technology-based, therefore, no reductions in loads can be allowed under the present legal framework, including the anti-backsliding provisions of the Clean Water Act.

Regarding treatment cost, accurate estimates and comparisons would require considerable work. It is likely that Rushton would not save all the $500,000 per year that they now spend to pump and treat water. To prevent the underground pool from overflowing into the town, an unspecified amount of water would still have to be pumped into the Moshanon. Of the $500,000 operating and maintenance, $220,000 is for pumping. Any cost based trading decisions might have to be made on the basis of the assumption that pumping will still be necessary. The mine drainages on Roup Run, that would have to be treated, amount to roughly 1,000 gpm. The control costs for Roup Run cannot, however, be assumed as proportional to the Rushton discharge. PADEP thinks that passive treatment could be used for the Roup Run discharges. Passive treatment costs less than the chemical treatment (rule of thumb is 40 percent of active cost) that Rushton now uses on their much larger discharge. Some participants felt that, even though Rushton might still have to pump groundwater, they may still save enough money from passive treatment that they should treat additional mine discharges affecting the Moshanon between Roup Run and the Rushton discharge.

Three other comments were considered significant. One was that any trading proposal be developed with community leaders and active watershed people. It was pointed out that the support of people living downstream of Rushton would be needed for any trade to be approved. It was also pointed out that the limited funds that Pennsylvania has to treat acid mine drainage has to be prioritized throughout the state. Having a well-developed and community-supported watershed plan for treating mine discharges and recovering a stream is one way of gaining higher priority. PADEP personnel felt that a watershed plan for Moshanon Creek, plus Rushton funds, would help justify additional, but scarce, Pennsylvania funds for the Moshanon. A third important observation was made by a PADEP scientist. Even if Roup Run were treated, the streambed between Roup and Oceola Mills would be covered with the red precipitated iron. It was unclear how this would affect the speed of a recovery in the fishery, or whether dredging would have to be performed.

Conclusions

The discussion about this simulation was very energetic. Everyone was sympathetic to the fact that highly treated water is being discharged to a dead stream and that the prospects for correcting nearby discharges is a decade or two away. The environmental and legal position, however, was to not backslide or allow discharges below technology-based levels. A representative from the environmental community did, however, point out that permits for treatment of mine discharges under Pennsylvania's abandoned mines program are not governed by effluent limitation guidelines but based on best efforts.

During discussion, the PADEP personnel thought of another mine discharge situation that might be more straightforward as a trade than the Rushton situation. In a similar situation, a trade involving the Lady Jane Colliery on Bennett's Creek would only require one set of upstream coal mine discharges that would have to be treated instead of the many sources on the Moshanon.

Except for the limitation posed by the technology-based NPDES permit, the sense of the discussion was that something positive could happen from a trade if; 1) a watershed plan for all mine drainage sites on the Moshanon was developed, 2) the freed-up Rushton funds might be used to great leverage with other state funds, and 3) a high degree of local support was present. Table 6 presents information on the the trade variables considered.

Table 6. Consensus or Range of Opinions on Moshanon Creek Simulation Variables

Variable	Workgroup Opinions
Selection of Pollutants	Iron, aluminum, manganese, acidity, alkalinity, and pH.
Structure of Trade	Mixed Opinions: Privately conducted trade with minimal agency involvement versus PADEP helping to develop a watershed plan that included the trade and that was acceptable to the community.
Units and Minimum Quantities	Mixed Opinions: Loadings versus miles of stream improved for additional uses versus cost savings for miles of stream improved
Eligible Traders and Participants	Not discussed
Directionality	Could be upstream or downstream. Objective is to improve number of miles of fishable waters in the watershed, which can be accomplished either upstream or downstream.
Size of Trading Area	On same stream and decided on case-by-case basis
Trading Ratio	Trade discussed in terms, not of a ratio, but of enhanced miles of stream
Enforcement and Monitoring requirements	If trade is upstream and based on loadings, monitoring to be required at Rushton discharge to evaluate net change before and after trade. Fish and biological studies were suggested to monitor the success of the trade in terms of the enhanced usage intended. A performance bond was mentioned but not discussed.

Variable	Workgroup Opinions
Banking	Not discussed
Inter-pollutant trades	Trade would have to prevent multiple acid mine pollutants from being discharged to Roup Run
Permit, design, or actual loads	A function of whether loadings drives the trade. If loadings, then actual new discharges in exchange for permit and design capacity.
Assuring surplus and real trades	The success of the trade in improving miles of fishable waters would be the test.
Approvals and legal changes	All handled through Rushton's NPDES permit and/or through watershed plan. The legal issue of exceeding technology-based treatment standards would have to be addressed.
Enforcement and responsibility	This response is contingent upon adoption of the above-listed monitoring requirements for stream monitoring. Threshold points would have to be set to pass or fail the results. If a failure, a contingency plan might be required to either upgrade treatment on Roup or to include another mine discharge or to re-continue treatment at Rushton.
Registration system for credits	Not applicable
Verification of reductions	Not discussed
Anyway Credits?	Only when near-term plans would schedule the partner mines for reclamation
Public Disclosure	Necessary to get local input and approval. Public will need to know cost savings at Rushton especially if cost savings drives the number of stream miles improved.
Interstate trading	Not applicable

SWATARA CREEK SIMULATION

Background

Swatara Creek is located northeast of Harrisburg and flows into the Susquehanna River. The Swatara is on the TMDL list for, among other things, excessive nutrients. One of the larger point sources on the Swatara is a POTW for Derry Township. This POTW receives the wastewater from the Town of Hershey and the surrounding areas. Land use in the watershed is characterized by agricultural land and golf courses.

The Simulation

The expectation is that the POTW will have to reduce nutrients either because of the TMDL or a new Chesapeake Bay initiative to reduce nutrients into the basin. The assumption was made for the simulation that the present permit level of 2.0 mg/l phosphorous would have to be reduced to 1.0 mg/l. Actual discharges are approximately 1.7 mg/l. The cost for the POTW to meet a phosphorous standard of 1.0 mg/l is $9,000 for a reduction of 30 lbs. per day or 10,950 lbs. per year. The resulting cost-effectiveness is $0.82 per lb..

The two land uses of agriculture and golf were investigated for possible trades. Table 7 presents information on nutrient loads that was developed for a typical 100 acre golf course.

Table 7. 100-Acre Course in Sandy Loam Soils

Pollutant and Load/yr. As lbs./yr.	Percent Leached (L) and Runoff (R)*	Stream Load (R)	Groundwater Load (L)	Total Load as lbs./yr.
Phosphorous 7,535	L=4.0 % R=0.5%	37.68 lbs.	301.4 lbs.	339 lbs.
Nitrogen 57,182	L=34.0% R=1.0%	572 lbs.	19,442 lbs.	20,014 lbs.

* *Quantification of NPS Pollution Loads within Pennsylvania Watersheds*, Environmental Resources Research Institute, The Pennsylvania State University, University Park, PA. April 1997.

For phosphorous only the POTW has a need for a loading reduction upstream of a minimum of 10,950 lbs.. Without considering trading ratios and the fact that the POTW is already meeting 30% of their requirement, there would have to be 10,950/339 or 32 golf courses to obtain equivalent reductions in phosphorous as the POTW is required. Were the golf course to receive credit for nitrogen reductions on the golf course, in addition to phosphorous, only one golf course would be needed.

The above analysis must be looked at with some caution. A workgroup participant who works for a conservation district thought both the nitrogen and phosphorous loads were very high for a golf course. In a real trade, the workgroup felt that the actual loadings of fertilizers and their nutrient contents would have to be obtained from a baseline set of years for the specific golf course. With respect to the leaching and runoff percentages for loads, a reference document like the Penn State one listed for Table 6. would have to be used, according to the group, because the development of site-specific loads and runoff factors would entail a very large cost.

Table 8 shows the range of pounds of nitrogen and phosphorous that would have to be purchased under various trading ratios and BMP effectiveness. Both nutrients are contained in the table because it is clear that a trade involving only phosphorous would be out of the question in this simulation. (The economics only approach favorability if nitrogen can substitute, i.e., receive credit for, the POTW's required reductions.) Note that the number of golf courses required varies from 0.3 to 1.3.

Table 8. Number of Golf Courses Required for Trading Under Various Conditions

Condition: Nitrogen and Phosphorous	Lbs. Credit Needed	# Golf Courses Required
Credit Given for Treatment Below Permit Limits, i.e., from 2.0 mg/l P to 1.7 mg/l P	7,665	0.4
80 % effective BMP; 1.5:1 trading ratio	14,371	0.7
80 % effective BMP; 2.0:1 trading ratio	19,163	0.9
Credits not given for Treatment Below the Present Permit Limit of 2.0 mg/l P	10,950	0.5
80 % effective BMP; 2.0:1 trading ratio	27,375	1.3

Next, a trade involving the POTW and agricultural lands was investigated. For phosphorous, the load to surface and groundwater, according to the Penn State data, was 10.01 lbs./acre/yr. This figure was based on fertilizer sales in the area and typical leaching and runoff rates for phosphorous. The figure excludes nutrient contributions from manure spreading which is common. On a straight trade this would require that phosphorous from 1094 acres occur at 100 percent BMP effectiveness and a 1:1 trading ratio. Table 9 shows the differences in loads to water for nitrogen and phosphorous as a function of applying fertilizer and also applying manure to acreage. It is based on the following assumptions: manure loads are one-third of fertilizers; P leaches at 60% and runoffs at 33%; and N leaches at 30% and runoffs at 67%.

Table 9. Nutrient Loadings to Water from Fertilizer and Manure Applications to Farmland

Pollutant	To Surface Water Lbs./yr.	To Ground-water lbs./yr.	Total lbs. to Water
Phosphorous - Fertilizer	8.91	1.10	10.01
Phosphorous – Manure	1.78	0.12	1.90
Nitrogen – Fertilizer	44.3	5.79	50.09
Nitrogen – Manure	8.77	2.59	11.36
Total	63.76	9.60	73.36

Table 10 shows how many acres of agricultural land would have to have BMP installed under various conditions of trading ratios, pollutants for which credit can be obtained, and the control effectiveness of the BMPs. Note how the range for a phosphorous only credit condition varies from 966 to 2,298. If nitrogen is allowed credit, the acreage range reduces to 157 to 373.

Table 10. Amount of Farmland Required for Trade with POTW Under Various Circumstances

Condition	Number of Acres Required			
	Trading Ratio1.5:1		Trading Ratio 2.0:1	
Actuals Less Limit (7,665lbs.)	**100% BMP**	**80% BMP**	**100% BMP**	**80% BMP**
Phosphorous only	966	1,207	1,287	1,609
Nitrogen & phosphorous	157	196	209	261
Permit less New Limit (10,950 lbs.)				
Phosphorous only	1379	1724	1,839	2,298
Nitrogen & phosphorous	224	280	299	373

Economics of Trade

The cost to install BMPs on various types of agricultural land for the control of phosphorous is never less than about $23/lb and $2/lb if both phosphorous and nitrogen receive credit. Thus there is no economic viability of a trade between the POTW and agricultural land or golf course owners. This condition could change dramatically if the POTW had to install more expensive nitrogen removal equipment. Given the costs in the phosphorous simulation it would be logical for the state to pay the POTW to control phosphorous than to pay for BMPs at the NPS along the stream.

Table 11 presents work group's views on the trade variables considered.

Table 11. Consensus and Range of Opinions on Swatara Creek Trade Variables

Variable	Workgroup Opinions
Selection of Pollutants	Nitrogen and phosphorous
Structure of Trade	Private transaction between parties with either a pre-approval from the state or a reporting mechanism to disclose the trade to PADEP and the public.
Units and minimum quantities	Lbs. Minimum not discussed
Eligible Traders and participants	All NPS of Phosphorous. Agricultural lands and golf courses were specifically examined in this simulation.
Directionality	Upstream, unless objective is to remove nutrient loads from Chesapeake Bay basin
Size of Trading Area	Within TMDL stretch or Chesapeake basin if a need for total loadings reduction
Trading Ratio	1.5:1 to 2.0:1. Greater uncertainty for leaching to groundwater and assumption that it discharges into the watershed.
Monitoring requirements	In-stream monitors and inspections for BMP installation
Banking	Not discussed
Inter-pollutant trades	Economics would favor getting credit for both nutrients controlled where scientifically valid and if the POTW was required to reduce both phosphorous and nitrogen.
Permit, design, or actual loads	Actuals less new permit limit
Assuring surplus and real trades	Through loadings decision to use actuals and to assure that BMPs would not have to be installed anyway on NPS
Approvals and legal changes	Through NPDES
Enforcement and responsibility	Through NPDES mechanisms and input from conservation district personnel for the BMPs
Registration system for credits	Not discussed
Verification of reductions	Not discussed
Anyway Credits?	If land owners would undertake nutrient management plans on their own, or if, eventually, farmlands and golf course owners would have to install BMPs as part of the TMDL
Need to know cost?	No
Interstate trading	If it does not matter where reduced loads to Chesapeake come from

SPRING CREEK SIMULATION

Background

Spring Creek is located in central Pennsylvania, northeast of Harrisburg. Spring Creek discharges to Swatara Creek, which discharges to the Susquehanna River and eventually the Chesapeake Bay. A map of Spring Creek and its tributaries is contained in Figure 1. Land ownership and size in the watershed is characterized by two large landowners that are Hershey Foods and the Hershey School. Small farms makeup the majority of land usage except for the Town of Hershey just upstream from where Spring Creek enters the Swatara.

Spring Creek is on the Section 303(d) list as being impaired by siltation, flow variability, low dissolved oxygen, organic enrichment and urban runoff. These five causes are not present throughout the watershed. Most tributaries of Spring Creek are impaired for one or more of the reasons. Although there are four point sources in Spring Creek, none are thought to be the reasons for the impairment. Although Hershey Foods has a processing plant in the watershed, the permitted discharges are primarily cooling water. Thus, the search in Spring Creek was for a nonpoint source to nonpoint source trade. What follows is a description of the attempts at simulation, including how trading possibilities were reduced extensively by various reasons. An assessment for TMDL purposes has not yet been performed for this watershed. The discussions of impairment below are based on biological evaluations that have been performed over the years by Conservation District staff and academicians.

The Simulation

The low dissolved oxygen and organic enrichment occur on a headwaters tributary that is only about one mile long. The headwater springs in this area are already high in nitrogen. Because of the small land parcels, the short distance of the upstream, and the uncertainty of which properties were (in the absence of a TMDL) the sources of nitrogen, the chances of a trade occurring in this area were deemed low. Low dissolved oxygen and organic enrichment are not considered causes for impairment downstream of this tributary. Thus, nutrient trading in this watershed was ruled out.

The major, and perhaps only, source of urban runoff is the Town of Hershey. There are no upstream sources of urban runoff for a trade.

Flow variability from natural sources was listed by PADEP as the cause of impairment for one headwaters tributary. Even though this tributary contains a small municipal authority stream flow ceases during dry periods. Sink holes are present in the stream.

Siltation is the reason why large parts of this watershed are impaired. The siltation consists of runoff from agricultural sources and eroded streambanks. Some siltation also comes from urban sources. Trading possibilities were explored for siltation. The only candidate that arose concerned a potential plan by the Hershey School to control its riparian lands and restore streambanks. Potential participants in a trade with Hershey

School could either be located on the one mile distance to the next downstream confluence with another tributary, or for 1.5 to 2.0 miles downstream of that confluence to the Swatara Creek. Even though many siltation problems exist in a larger part of the watershed, most of those problems are either upstream or on other tributaries.

Credits for such a project, however, could only be generated for reductions beyond either BMP or whatever load reduction requirements would be called for by the TMDL implementation plan. Without a TMDL assessment the cost and amounts could not be quantified. Also lacking is data on the control costs that would be incurred for various siltation methods in the entire watershed. Were this data available the least-cost siltation control methods could be identified as preferred trading candidates. It was pointed out in discussion that trade prospects would be enhanced for siltation if the source could also obtain credits for the nutrient contents of the soil not eroded.

Conclusions

An actual simulation for siltation could not be constructed without additional time and data on siltation loads and control costs. Even if a potential simulation could have been developed it would have been limited by the lack of a TMDL implementation plan. The workgroup's knowledge also did not extend into the number of miles downstream that could be considered eligible for a trade, based on sediment movements and stream flows.

Part of the discussion during this simulation centered around weaknesses in the use of reference data to determine application rates for nitrogen and phosphorous nutrients on farmland and golf courses. Knowledgeable participants in the workgroup disputed the available reference on load rates for nutrients to farmland and the leached and runoff percentages. It was pointed out that even if one used the leached and runoff percentages of loadings to determine loads to surface and groundwater, the approval of a trade would require knowing the specific amounts of nutrients applied in the form of fertilizers or manure to the lands involved in a trade. Specific amounts need to be defined not just by total weight, but by the percentage of nutrients in the fertilizer and manure.

Uncertainty was also discussed about the assumption that all leached nutrients in the land of the watershed would end-up in the groundwater flow to the stream. It was thought that this could change as a function of the underlying geology, especially in limestone areas like Spring Creek.

APPENDIX A
Chronology of Activities

Kickoff Meeting	February 2
First Meeting with PADEP	February 8
DEP approval obtained	February 23
Recruit workgroup	February 23 - March 19
Research and information gathering	February 3 - March 29

- Katherine Tunis, EPA
- Environomics
- Great Lakes Network
- Claire Schary, EPA Region X
- Maryland, Virginia
- Allison Weideman, Chesapeake Bay Program
- Project XL EPA
- NIER

First Meeting	March 30
Add workgroup members	March 31 - April 16
Distribute Notes and Framework	April 26
Develop nominations	April 13 - May 7
Second Meeting	May 11
Develop data	May 12 –September 9
Third Meeting	July 7
Fourth Meeting	August 12
Chesapeake Bay Program Meeting	June 30
Draft Report	August 20
Final Report	September 30

APPENDIX B
Workgroup Participants

July 7, 1999

Point-Nonpoint Source Trading Simulation Projects

Bill Adams
Director of Natural Resources
PA Farm Bureau
510 So. 31st St.
Camp Hill, PA 17011
Fax: 717-631-3506
Phone: 717-761-2740
Email: waadams@pfb.com

Eva Ammentorp
NPS and 319 Coordinator
EPA Region III
1750 Arch Street
Philadelphia, PA
Fax: 215-814-2301
Phone: 215-814-5265
Email: Ammentorp.Eva@epamail.epa.gov

Pam Bishop
Office of Chief Counsel
Department of Environmental Protection
RCSOB
400 E. Market Street
Harrisburg, PA 14108
Phone: 717-787-7060
Email: bishop.pamela@dep.state.pa.us

Tom Brand
Delaware River Basin Commission
25 State Police Drive
West Trenton, NJ 08628
Phone: 609-883-9500 X221
Email: Tbrand@DRBC.state.nj.us

Bob Edwards
Susquehanna River Basin Commission
1721 No. Front Street
Harrisburg, PA 17102-2391
Phone: 717-238-0423
Email: redwards@SRBC.net

Harry Campbell
Susquehanna River Basin Commission
1721 No. Front Street
Harrisburg, PA 17102-2391
Phone: 717-238-0423
Email: Hcampbell@SRBC.net

John Childe
Chief Council
Pennsylvania Environmental Defense
Foundation
606 Pine Road
Palmyra, PA 17078
Fax: 717-520-1351
Phone: 717-520-1510
Email: Jechilde@aol.com

Jolene Chinchilli
Executive Director
Chesapeake Bay Foundation
614 No. Front St.
Suite G
Harrisburg, PA 17101
Phone: 717-234-5550
Email: jchinchilli@savethebay.CBF.ORG

Lloyd Davis
Rohm & Haas
5000 Richmond St.
Philadelphia, PA 19137
Fax: 215-537-4185
Phone: 215-537-4079
Email: Mahlrd@rohmhaas.com

Mary Frey
Lancaster County Planning Commission
50 No. Duke Street
P.O. Box 83480
Lancaster, PA 17608-3480
Fax: 717-295-3659
Phone: 717-299-8333
Email: Frey@co.lancaster.pa.us

Stuart Gansell
Director, Bureau of Watershed Conservation
PA Dept. of Environmental Protection
Rachel Carson State Office Building
4th and Market Street
Harrisburg, PA 17105
Phone: 717-787-5267
Email: Gansell.stuart@A1.dep.state.pa.us

Bill Gerlach, Esquire
Office of Chief Counsel
Department of Environmental Protection
RCSOB
400 E. Market Street
Harrisburg, PA 14108
Fax: 717-787-9378
Phone: 717-787-7060
Email: Gerlach.william@dep.state.pa.us

Mark Gutshall
Land Studies, Inc.
6 So. Broad St.
Lititz, PA 17543
Phone: 717-627-4440 x. 11
Email: mark@landstudies.com

Robert Hughes
Eastern PA Coalition for Abandoned Mine Reclamation
Schuylkill County Conservation District
1206 Ag Center Drive
Pottsville, PA 19901
Fax: 570-622-3742
Phone: 570-628-3377
Email: epcamr@ptdprolog.com

Lisa Kulujian
Project Manager
SAIC
700 Elkins Ave.
Ste. F-3
Elkins Park, PA 19027
Fax: 215-635-9060 Fax
Phone: 215-635-9040
Email: Lisa.k.kulujian@cpmx.saic.com

Michael Leifman
Economist
Environomics
4405 East-West Highway
Suite 307
Bethesda, MD 20814
Phone: 301-657-7762, X14
Email: Leifman@environomics.com

Maricruz Magowan
US Environmental Protection Agency
401 M Streets, SW
Washington, DC 20460
Fax: 703-603-0175
Phone: 703-603-7175
Email: Magowan.maricruz@epa.gov

Robin Mann
Sierra Club
266 Beechwood Drive
Rosemont, PA 19010
Fax: 610-527-7775 Fax
Phone: 610-527-4598
Email: Robin.Mann@sierraclub.org

Chuck Marshall
Project Manager
Philip Services Corp. – JACA Division
550 Pinetown Road
Fort Washington, PA 19034
Fax: 215-643-2772
Phone: 215-643-5466
Email: Cmarshall@philipinc.com

Glenn Maurer
Director, Bureau of Water Quality Protection
PA Department of Environmental Protection
Rachel Carson State Office Bldg.
4th and Market Streets
Harrisburg, PA 17105
Phone: 717-783-2946
Email: Maurer.glenn@A1.dep.state.pa.us

Lee McDonnell
PA Department of Environmental Protection
10th Floor, Rachel Carson State Office Bldg.
4th and Market Streets
Harrisburg, PA 17105
Phone: 717-783-2938
Email: McDonnell.lee@A1.dep.state.pa.us

Charlie McGarrell
Dauphin County Conservation District
1451 Peters Mountain Road
Dauphin, PA 17018
Phone: 717-921-8100
Email: Pacd.conservation@A1.dep.state.pa.us

Roger Musselman
PA Department of Environmental Protection
Southcentral Region
909 Elmerton Avenue
Harrisburg, PA 17110-8200
Fax:
Phone:
Email: Musselman.Roger@A1.dep.state.pa.us

Bill Potter
Philip Services Corp. – JACA Division
550 Pinetown Road
Fort Washington, PA 19034
Fax: 215-643-2772
Phone: 215-643-5466
Email: wpotter@philipinc.com

Don Robinson
Lancaster County Conservation District
1383 Arcadia Road
Lancaster, PA 17601
Phone: 717-299-5361
Email: Lccd@redrose.net

Paul Scally
Delaware River Basin Commission
25 State Police Drive
West Trenton, NJ 08628
Fax: 609-883-9522
Phone: 609-883-9500 X251
Email: Pscally@DRBC.state.nj.us

Evan Schuster
Chief Permits Division, Bureau of Mining and Reclamation
PA Dept. of Environmental Protection
P.O. Box 8461
Harrisburg, PA 17105
Phone: 717-787-5103
Email: Schuster.evan@A1.dep.state.pa.us

Wayne Schutz
Deery Township Municipal Authority
PA Municipal Authorities Association
670 Clearwater Road
Hershey, PA 17033
Fax: 717-566-7934
Phone: 717-566-3237 x. 312
Email: Wschutz@dtma.com

Sam Sherk
PennAg Industries Assn.
P.O. Box 329
Ephrata, PA 17522-0239
Phone: 717-733-2238
Email: pennag@pennag.com

Allison Wiedeman
U.S. EPA, Chesapeake Bay Program
410 Severn Ave., Suite 109
Annapolis, MD 21403
Fax: 410-267-5777
Phone: 410-267-5733
Email: Wiedeman.allison@epamail.epa.gov

Hank Zygmunt
US Environmental Protection Agency
1750 Arch Street
Philadelphia, PA
Phone: 215-814-5750
Email: Zygmunt.Hank@epamail.epa.gov

APPENDIX C

Notes for TMDL/Trading Work Group Meeting
PADEP – Harrisburg, PA
May 11, 1999

Attendees: Tom Brand, Paul Scally, Mary Frey, John Childe, Jolene Chinchilli, Harry Campbell, Lee McDonnell, Bill Gerlach, Robin Mann, Charlie McGarrell, Bill Potter, Sam Sherk, Allison Wiedeman, and Chuck Marshall

Mr. Marshall announced new participants to the group:

- Mr. Lloyd Davis from Rohm & Haas.
- Mr. Robert Hughes, Eastern PA Coalition for Abandoned Mine Reclamation.
- Sam Sherk, PennAg Industries Assn.
- Mary Frey, Lancaster County Planning Commission

Mr. Marshall then reviewed the expanded list of eight circumstances for water trades in PA. The list included suggestions from the previous meeting and new information compiled by Mr. Marshall. The list, found on page 2 of the handout, is summarized below:

1. After TMDL Implementation Plan is established for 303(d) stream segment.
2. As an alternative to upgrades at drinking water treatment plants.
3. In special protection waters and for antidegradation.
4. Reduction requirements for pollutants being managed outside the TMDL process.
5. Optimizing animal feeds to reduce pollutants.
6. Point source meets requirements by controlling upstream PS or NSP.
7. As a bubble for reactivated mines where existing drainage occurs.
8. As a trade by an active coal mine discharging treated water to a marginal stream with an acid mine drainage site on the same stream.

Mr. Brand of DRBC suggested a ninth circumstance for trading – he suggested credit for cogeneration plants which burn culm and tailings from inactive mine stockpiles. The plants discharge water that is generally high in total dissolved solids, but they remove materials which would generate acid drainage by runoff.

Mr. Bill Gerlach, Esquire – PADEP gave a presentation outlining legal issues with effluent trading under EPA's "Draft Framework for Watershed Based Trading." Mr. Gerlach opened his discussion by outlining three issues requiring resolution for trading programs to be legally viable:

- *Differences From Air Program (Emissions Credits)*
  - There is more flexibility in the Clean Air Act than in NPDES regulations. The Clean Air Act provides more flexibility in defining source types.
- *Permitting/Regulatory Issues*
  - Point sources are required to have NPDES permits while nonpoint sources are not. One way of reading the EPA Framework suggests that one of the trading partners would have to be a point source in order to make the trade implementable and enforceable. However, the Framework document describes NPS-NPS trades and how they could be implemented and enforced. The issue is further confused by the fact that some sources like CAFOs will become permitted.

- Antidegradation programs protect exceptional value and high quality waters. New sources may not degrade waters with those designations (with some exceptions). This can create disparity between regulation of new and existing sources. Perhaps new sources in some waters could be required to offset their loadings.
- Nonpoint sources are not currently regulated and therefore are not motivated to participate in a program. The only exception for this is areas subject to the Coastal Zone Reclamation Act.
- Trading opportunities with mine drainage sources are limited as most operations are remaining (subject to Subpart F – Anthracite or Subpart G – Bituminous) and may discharge as long as the receiving waters are not further degraded.

♦ *Enforcement Issues*
  - It is difficult to regulate and monitor nonpoint sources.
  - PADEP can't enforce contracts between private trading parties.

Mr. Gerlach then reviewed eight basic principles that must be incorporated into development and implementation of a viable trading plan:

1. Achievement of tech-based limits for all trades.
2. Achievement of WQS throughout watershed with consideration of Federal, state and local laws including anti-backsliding regs.
3. Trades developed in context of TMDL or other appropriate framework.
4. Trades must occur in context of current regulatory and enforcement mechanisms. (NPS to NPS trading will be difficult to enforce/regulate).
5. Trading boundaries must generally coincide with watershed boundaries.
6. Trading will add to monitoring (negative incentive for most traders).
7. Types of pollutants traded must be carefully considered.
8. Stakeholder involvement and public participation.

Mr. Gerlach summarized his presentation by noting that NPS's will be difficult to monitor, and won't want to go beyond BMP. In conclusion, Mr. Gerlach noted two major factors that must be addressed and properly balanced for a trading program to be accepted and successful:

1. Statutory and regulatory changes are needed to give tangible incentives for TMDL trading.
2. Environmental groups will want more regulatory details and may not like a program with more flexibility such as the Emission Credits Program. They need to understand that a net benefit in water quality is the main goal.

General discussion on enforcement and regulated issues following. The following topics were discussed:

♦ Reduction goals are developed by using a reference approach when there are no regulatory limits for nutrients. For example, one stream segment may be impaired while a second segment is not. The unimpaired segment is used as a reference guide for the impaired segment.

♦ EPA is committed by the Clean Water Act to develop regulations for nutrients from NPS by the year 2000. States will have three years to adopt programs.

♦ Ms. Weideman noted that trading benefits watershed by controlling nutrient load in addition to contaminant concentrations.

♦ Mr. Scally of the DRBC suggested that laws governing NPS's be instituted to relieve the burden on PS discharges.

- TMDL programs in antidegradation regulated areas must be allowed to decrease NPS loads in order to discharge.
- In the Chesapeake Bay Watershed, most or all wastewater treatment plants will have to institute biological nutrient removal programs. This could create the opportunity for trading with NPS's.
- Mr. McGarrell noted that varying degrees of stream degradation may be occurring as a result of stream channel erosion/sedimentation resulting from modified hydrology (development, paving, etc.).

Mr. Marshall then presented a list of potential trading candidate streams, and asked for new nominees. A revised list will be provided at the next meeting.

APPENDIX D

Notes for TMDL/Trading Work Group Meeting
PADEP – Harrisburg, PA
May 11, 1999

Attendees: Tom Brand, Paul Scally, Mary Frey, John Childe, Jolene Chinchilli, Harry Campbell, Lee McDonnell, Bill Gerlach, Robin Mann, Charlie McGarrell, Bill Potter, Sam Sherk, Allison Wiedeman, and Chuck Marshall

Mr. Marshall announced new participants to the group:

- ♦ Mr. Lloyd Davis from Rohm & Haas.
- ♦ Mr. Robert Hughes, Eastern PA Coalition for Abandoned Mine Reclamation.
- ♦ Sam Sherk, PennAg Industries Assn.
- ♦ Mary Frey, Lancaster County Planning Commission

Mr. Marshall then reviewed the expanded list of eight circumstances for water trades in PA. The list included suggestions from the previous meeting and new information compiled by Mr. Marshall. The list, found on page 2 of the handout, is summarized below:

1. After TMDL Implementation Plan is established for 303(d) stream segment.
2. As an alternative to upgrades at drinking water treatment plants.
3. In special protection waters and for antidegradation.
4. Reduction requirements for pollutants being managed outside the TMDL process.
5. Optimizing animal feeds to reduce pollutants.
6. Point source meets requirements by controlling upstream PS or NSP.
7. As a bubble for reactivated mines where existing drainage occurs.
8. As a trade by an active coal mine discharging treated water to a marginal stream with an acid mine drainage site on the same stream.

Mr. Brand of DRBC suggested a ninth circumstance for trading – he suggested credit for cogeneration plants which burn culm and tailings from inactive mine stockpiles. The plants discharge water that is generally high in total dissolved solids, but they remove materials which would generate acid drainage by runoff.

Mr. Bill Gerlach, Esquire – PADEP gave a presentation outlining legal issues with effluent trading under EPA's "Draft Framework for Watershed Based Trading." Mr. Gerlach opened his discussion by outlining three issues requiring resolution for trading programs to be legally viable:

- ♦ *Differences From Air Program (Emissions Credits)*
  - There is more flexibility in the Clean Air Act than in NPDES regulations. The Clean Air Act provides more flexibility in defining source types.
- ♦ *Permitting/Regulatory Issues*
  - Point sources are required to have NPDES permits while nonpoint sources are not. One of the trading partners would have to be a point source in order to make the trade implementable and enforceable. However, the Framework document describes NPS-NPS trades and how they could be implemented and enforced. The issue is further confused by the fact that some sources like CAFOs will become permitted.

- Antidegradation programs protect exceptional value and high quality waters. New sources may not degrade waters with those designations (with some exceptions). This can create disparity between regulation of new and existing sources. Perhaps new sources in some waters could be required to offset their loadings.
- There is no regulatory hook for NPS nonpoint sources and therefore they may not be motivated to participate in a program. The only exception might be under the Coastal Zone Reclamation Act.
- Trading opportunities with active mining sources are limited as most operations are remaining (subject to Subpart G – Bituminous or Subpart F – Anthracite) and may discharge as long as the receiving waters are not further degraded.

♦ *Enforcement Issues*

- It is difficult to regulate and monitor nonpoint sources.
- PADEP can't enforce contracts between private trading parties.

Mr. Gerlach then reviewed eight basic principles that must be incorporated into development and implementation of a viable trading plan:

1. Achievement of tech-based limits for all trades.
2. Achievement of WQS throughout watershed with consideration of Federal, state and local laws including anti-backsliding regs.
3. Trades developed in context of TMDL or other appropriate framework.
4. Trades must occur in context of current regulatory and enforcement mechanisms. (NPS to NPS trading will be difficult to enforce/regulate).
5. Trading boundaries must generally coincide with watershed boundaries.
6. Trading will add to monitoring (negative incentive for most traders).
7. Types of pollutants traded must be carefully considered.
8. Stakeholder involvement and public participation.

Mr. Gerlach summarized his presentation by noting that NPS's will be difficult to monitor, and won't want to go beyond BMP. In conclusion, Mr. Gerlach noted two major factors that must be addressed and properly balanced for a trading program to be accepted and successful:

1. Statutory and regulatory changes are needed to give tangible incentives for trading.
2. Environmental groups will want more regulatory details and may not like a program with more flexibility such as the Emission Credits Program.

General discussion on enforcement and regulated issues following. The following topics were discussed:

- ♦ Reduction goals are developed by using a reference approach when there are no regulatory limits for nutrients. For example, one stream segment may be impaired while a second segment is not. The unimpaired segment is used as a reference guide for the impaired segment.
- ♦ EPA is committed by the Clean Water Act to develop regulations for nutrients from NPS by the year 2000. States will have three years to adopt programs.
- ♦ Ms. Weideman noted that trading benefits watershed by controlling nutrient load in addition to contaminant concentrations.
- ♦ Mr. Scally of the DRBC suggested that laws governing NPS's be instituted to relieve the burden on PS discharges.
- ♦ TMDL programs in antidegradation regulated areas must be allowed to decrease NPS loads in order to discharge.

- In the Chesapeake Bay Watershed, most or all wastewater treatment plants will have to institute biological nutrient removal programs. This could create the opportunity for trading with NPS's.
- Mr. McGarrell noted that varying degrees of stream degradation may be occurring as a result of stream channel erosion/sedimentation resulting from modified hydrology (development, paving, etc.).

Mr. Marshall then presented a list of potential trading candidate streams, and asked for new nominees. A revised list will be provided at the next meeting.

APPENDIX E

Notes for TMDL/Trading Work Group Meeting
PADEP – Harrisburg, PA

July 7, 1999

The meeting commenced with an update on streams and related regulations/committees which are under consideration for simulated trading:

- Wissahickon Creek – Has both point and nonpoint sources which must be controlled for a TMDL, and is funded outside the 319 Grant Program. The Wissahickon technical committee meets later in July. Chuck intends to provide a simulation with the help of the committee.
- Coal Mine Drainage Sites – These are considered nonpoint sources and are majoritively unregulated. A search is underway for permitted mine discharges. The permitted discharges are costly, and therefore may be viable participants in a trading program. A meeting is scheduled for July 22 at the PA Hawk Run District Mining Office.
- Conodoguinet, Conestoga and Spring Creeks – The EPA contractor responsible for monitoring and characterization of these streams has not met reporting deadlines. This has slowed the process of watershed evaluation, which in turn hampers the design of a simulation for a trading program. Chuck will meet with Charlie McGarrell prior to the next workgroup meeting to explore the Spring Creek simulation.
- Delaware River Basin Commission – DRBC representatives noted that DRBC is currently developing a pilot program for streambank maintenance regulations which will impose erosion and sedimentation controls on property owners. The program is intended to preserve stream geomorphology. Landowners would be required to restore and/or maintain streambanks through Best Management Practices. The financial burden to landowners, particularly farmers, may be an impediment to instituting the proposed controls.

Due to the difficulties in obtaining needed information on the watersheds proposed for trading simulation programs, only a simulation on a Delaware River situation could be presented to the group for discussion.

The proposed simulation involves two point sources (POTW's) discharging to the Delaware River. Westfalls Twp. wants to expand its plant from 90,000 GPD capacity to 800,000 GPD. The plant currently discharges to the Delaware River in DRBC defined "Special Protection Waters". The expansion will coincide with shutdowns of existing POTW's with a total capacity of 295,000 GPD and sewer connections will be made to residences with failing septic systems.

The proposed candidate for trading is the Port Jervis, NY sewage treatment plant. This plant discharges approximately 1.3 MGD and has a capacity of 5 MGD. The plant currently discharges CBOD and TSS at concentrations well below its permit limits, making it a potential generator of credits for offsets and trading.

The objectives of the simulation are to: 1) develop offset credit calculation equations, 2) explore options for expanded POTW to achieve offset reductions and 3) to examine the pros and cons of all conditions of permit modifications and identify those which would help or hinder implementation.

DRBC's regulations specify that in Special Protection Waters, both direct and indirect incremental loadings attributable to a new source, must be offset by loading reductions elsewhere in these waters. One scenario for offset equations for calculating direct and indirect pollutant loadings was presented and discussed. Also presented were potential options for offset achievement, and potential variables and conditions which must be considered. Equations, calculations, options and variables are detailed in the meeting handout.

Almost every aspect of the proposed simulation generated discussion and comments, which are summarized below.

- There seemed to be general agreement that the expanded plant would need offsets for the direct loads from the expansion less: 1) the loads from closed STPs, 2) the load associated with no measurable change, and 3) the load for the failed septic systems. Credit would only be given for actual reductions from baselines and not from design capacity of the retired STPs.
- Future changes in regulation of the entire River Basin must be considered when developing baseline pollutant loading limits. In other words, if a shutdown STP was going to have its pollutant limits reduced below its present actual loads, then credit would be only for the newly permitted loads. The River Basin encompasses parts of four states and is also under the oversight of the Chesapeake Bay Foundation. Discharges may meet local regulatory limits, but not those of downstream regulatory entities.
- It was suggested that different modelers might get different results for the "No Measurable Change" load. It was also noted that "Assimilative Capacity" may be confused with "No Measurable Change". Also would there be a quantity of runoff pollutants that would not trigger a measurable change?
- It may be difficult to regulate offsets by attributing development pollution directly to a new POTW. Also, municipalities will not likely regulate such activities as fertilizer application to private lawns and gardens. Also it was noted that in attempting to attribute development pollution to a new POTW, it is difficult to determine whether a POTW was built/enlarged to attract development or was built/enlarged in response to increased development.
- The handout included dissolved oxygen and fecal coliforms as regulated discharge pollutants. It was noted that both parameters are monitored by instantaneous measurements, and that loads cannot be calculated for dissolved oxygen. Therefore, these parameters probably cannot be included in a trading program.
- Changes in land use must also be considered in assigning offset trade values. For example, changing land use from agriculture to development will likely cause a decrease in pollutant loading, while converting forested land into developed land may cause an increase in loading. Furthermore, nutrients are often released when farmland is developed due to exposure of the subsurface to the elements. Therefore, nutrient levels may initially spike before lowering. Development may also alter stream bank hydrology by increasing sediment loading. Regulatory trading requirements must likely include required stream bank stabilization or buffer zone restoration, and give credits for same. Finally, it may complicate matters by including indirect loadings in trading. One solution may be to give less credit or lower credit ratio for use of Best Management Practices.
- It was noted that EPA is considering (unofficially) implementation of an offset of 1.5:1 to control pollutant loading (both point and nonpoint sources) from new major facilities in impaired waterways.
- The possibility exists that a POTW such as Port Jervis, who is currently discharging pollutant loads well below permit requirements, may allow or cause pollutant levels in discharges to rise to circumvent the benefits of a trade credit. In doing so, the generator of credits would save money by getting paid for reductions they can already achieve. A suggestion was made that the Port Jervis facility would have to establish a baseline from which credits are generated.
- It was noted that establishment of allowable pollutant loads for POTW's will be difficult to establish, particularly new plants for which there is no analytical history to base levels on. Someone else noted that a baseline for a new plant could be the design capacity loading.
- Another difficulty in establishing trading ratios is implementation of a sliding scale. Generally, a single maximum parameter level is easier to explain/justify, enact and enforce than guidance which covers a range.
- Trading ratio range favored by the group ranged from 1.1:1 up to 1.3:1. This smaller ratio than EPA's default ratio reflected higher certainty in trading between two point sources under NPDES permits.

- ♦ The trading ratio may also need to take into account that its incremental loadings would be occurring over a build-out period of 20 years or more.

The discussion was closed with the suggestion that EPA should be very prescriptive in adopted regulations to prevent wide ranging disparity between regulations of several states sharing a single watershed. It was agreed that there are numerous nuances and variables which must be clearly defined and explained for the proposed trading program to succeed.

APPENDIX F

Notes for TMDL/Trading Work Group Meeting
PADEP – Harrisburg, PA
August 12, 1999

Status of Other Simulations

- *Wissahickon Creek* – The technical committee did not meet as scheduled in July, and will not meet until September, 1999.
- *Conodoguinet and Conestoga Creeks* – The EPA contractor has still not supplied enough data to simulate trading.

Based on the aforementioned facts, time constraints and budget/resource restrictions, trading simulations will not be possible for these streams.

Variables for Structuring/Evaluating Trading Simulations

Discussion was commenced with a brief review of the numerous variables which must be considered when developing a trading program. Many of the more significant variables are enumerated on page 2 of the meeting handout. Of particular importance is the possible need for new regulations to define and enforce trading programs, and whether states have the authority in place to regulate such a program.

Coal Mine Drainage – Rushton

Moshanon Creek – impaired due (majoritively) to mine drainage. Currently, a permitted mine pool discharge occurs at Rushton. The discharge is treated for elevated levels of manganese and iron. The permit allows for discharge of 5,000 gpm (recent annual discharge of 3,800 gpm), and the annual cost to pump and treat is approximately $500,000. The treated water is discharged to an impaired stream with many unpermitted/unregulated discharges. These conditions provide the opportunity for trading.

Dr. Hellier of PADEP illustrated and explained the layout of the impaired stream and its tributaries. Dr. Hellier pointed out that there are approximately 150 discharges of varying size and quality, including deep mine discharges, active mine discharges, abandoned mine discharges and uncapped mine tailing piles.

One option for trading would be to allow discontinuation of the Rushton discharge and use the available funds/credits to control some of the more contaminated dipstream discharges. This might enable recovery of approximately eight miles of stream. Since Rushton discharges treated water into a heavily impaired portion of the stream, not treating the Rushton discharge may not cause adverse effects to an already "dead" stream. Revitalization of an eight mile portion upstream may offset the negative impact of the Rushton discharge at that point. This scenario prompted several comments, questions and concerns:

- Allowing this scenario may violate the EPA's proposed anti-backsliding regulations.
- Is it fair [to citizens or downstream watersheds] to allow potentially worse degradation in one area to remediate another portion of a stream?

- No entity involved in trading will want to accept responsibility for remediating an upstream discharge. Failure of a discharge treatment in a trading scenario may involve liability issues which potential traders will want to avoid.
- Rushton could be allowed to scale back treatment or treat to a higher standard to facilitate treatment of upstream discharges.
- Is the goal of trading to reduce overall loadings to a stream or to create more unimpaired miles of stream?
- Rushton could be allowed to suspend treatment for a period of time (i.e., 5 years), and use some of Rushton's savings to be used to install passive treatment facilities/controls at upstream sites. After the prescribed period of time, Rushton would be required to continue treating its own discharge as before.

Swatara Creek

The Swatara Creek is impaired by nutrient loading, and has a POTW which discharges and must reduce its phosphorous discharge. Upstream trading candidates include a golf course and agricultural lands.

It was determined through discussion that the golf course may not be a viable trading candidate. The raw load totals [in the handout] used for golf courses may have been too high by an order of magnitude. Therefore nutrient loading by a golf course may no be significant enough to effect a trade.

Discussion then moved to the viability of trading with agricultural entities. Because phosphorous is often over-applied in agricultural situations, a basis for trading may exist. The following issues were discussed in addition to the factors outlined in the handout.

- Farms are generally required to have nutrient management plans if they are utilizing biosolid application or if they are very large. Smaller farms may not be willing to enter a trading program if they are not currently bound by a regulatory program.
- Land application rules prohibit the use of biosolid application within certain distances of streams. This often results in application of fertilizers in the areas closest to streams.
- It was noted that Conventional Tillage Nutrient Management, noted as one of the most cost effective methods of reducing phosphates from non-point sources, may actually cause an increase in phosphate loading.

Spring Creek

- Whereas sedimentation may be an issue in agricultural areas, it will be difficult to develop a sediment trading program. Increases and decreases in sediment load will be very difficult to quantify with non-point sources.

The meeting was closed with a discussion on the immense complexity of developing, instituting and regulating a trading program. Trading programs would impact a wide variety of potential traders (i.e., mining, POTW's, industrial treatment works, farmers, developers, etc.), each one with different motives for trading or not trading. Those varying interests coupled with regulatory goals and public concerns will make development of a viable trading program difficult. Furthermore, variability of conditions in each watershed will further complicate development of a consistent enforceable trading program. Accurate stream and load data will be essential in developing any trading program.