Market Infrastructure

Purpose

The first two chapters of this Handbook addressed the viability of trading based on pollutant suitability, watershed and discharger characteristics, and the financial attractiveness of likely trades. This chapter considers the infrastructure required to enable trading. This chapter will help answer the following questions:

- What functions must a water quality trading market perform?
- Why is each function important to the success of water quality trading?
- What mechanisms have been used to perform these functions in demonstration trading projects?
- What are the considerations in selecting appropriate mechanisms and integrating them into a market?

After reading this chapter, considering the examples provided, and reflecting on what you have learned in the previous chapters, you will better understand the watershed's unique market infrastructure needs, market mechanisms best suited for the watershed, and the commitment that may be needed to create a market. This Handbook does not provide a specific blueprint for creating a market, but does highlight challenges you will face and identify ways to benefit from lessons learned in other watersheds. With this information you will be better able to decide whether trading is viable and tailor a market to your watershed's unique needs.

Approach

All viable markets, whether trading water pollutant reductions or widgets, must efficiently create benefits for its participants. "Markets" are social constructs facilitating interactions among parties interested in exchanging goods or services. Research indicates that successful markets evolve to reduce costs associated with:

- identifying others willing to purchase or supply goods or services;
- comparing the goods or services offered by other parties;
- negotiating the terms of an exchange of goods and services; and
- enforcing the terms of the exchange.

A market is more likely to be successful if it has rules, procedures, and norms allowing parties to participate at a cost acceptable to everyone involved. Viable water quality trading (WQT) markets are no different from conventional markets in this regard. However, WQT markets are unconventional in the sense that they exchange goods (pollutant loading reductions) that are created primarily by (i.e., have value because of) regulations and administrative procedures. As such, WQT markets may require different and/or additional infrastructure to ensure environmental equivalence and practical enforceability, while providing the opportunity for cost savings.

This chapter of the Handbook will introduce you to the primary functions of a viable WQT market. These functions are to ensure that, along with satisfying the efficiency criteria for conventional markets, WQT markets provide for environmental equivalence and practical enforceability.

Market development and transaction costs, as well as risks associated with various uncertainties, play an ongoing role in encouraging or suppressing market activity. These considerations, which collectively represent the degree of "friction" individual transactions face in the marketplace, should remain central to all infrastructure design decisions. Failure to manage market friction effectively will substantially constrain and may entirely stifle otherwise environmentally equivalent and financially attractive trades.

As discussed in the previous chapter, potential WQT market participants may be challenged by a variety of ***market development costs***, including those associated with analyzing the viability of trading in the watershed, developing and selecting options for market infrastructure, convening interested parties to discuss trading perspectives and options, and creating the infrastructure. ***Market development uncertainty*** – the risk that a market may not emerge – compounds these challenges.

In addition to market development costs, ***transaction costs*** include information gathering, trade execution, and compliance monitoring efforts undertaken while trading is underway. These transaction costs will be driven largely by the procedures, trade execution methods, and tracking infrastructure established by the market for the watershed. ***Transaction uncertainty*** due, for example, to an unclear basis or time-frame for regulatory approvals will compound these costs. A market that needs trade-by-trade regulatory approval, for example, will be relatively costly and uncertain. There will be a constant risk that any particular trade will not materialize or will not receive regulatory approval in time to satisfy a source's capital budgeting and/or compliance deadline constraints.

High market development costs/uncertainty combined with high transaction costs/uncertainty produce substantial overall market friction. High market friction will limit activity to only very, very financially attractive trades. The market's infrastructure will contribute to or reduce this friction. Therefore, the infrastructure designer's goal is to create the smoothest transaction path consistent with regulatory requirements and water quality improvement goals.

WQT markets are intended to provide for improved water quality at a lower societal cost. In most situations, market drivers are primarily concerned with attaining environmental goals and allow trading only as one option to further that effort. Federal, state, and local laws and the need for stakeholder involvement may require complex infrastructure mechanisms (monitoring regimens, auditing practices, public participation opportunities, etc.) that increase costs and may restrict and/or complicate market infrastructure design. For purposes of this analysis, you may think of these considerations as "regulatory friction". When designing a WQT market you need to look for ways to minimize both market friction and regulatory friction.

This chapter of the Handbook suggests ways to manage market and regulatory imperatives to encourage efficiency and increase the likelihood that trading will occur. To this end, three WQT models will be discussed based on how each model performs particular functions. Building on the information and analysis you were asked to develop in the previous chapters, this additional information will help you design an appropriate market infrastructure to perform the essential functions in your watershed. No particular approach is prescribed, but this chapter offers options and criteria to evaluate them.

Considerations: Market Sizing

This section is intended to help you find ways to substantially reduce market and regulatory friction by appropriately sizing your market infrastructure to your watershed's unique trading characteristics. The first two chapters of this Handbook, Pollutant Suitability and Financial Attractiveness, help you develop a solid understanding of where your watershed might be positioned along the water quality trading spectrum. At one end of the spectrum is a watershed with a single viable trade between two point sources who will experience modest financial benefits and are expected to sustain the trading relationship for the foreseeable future. At the other end of the spectrum is a watershed with an unknown number of viable trades among both point and non-point sources. These trades would be for limited durations and require frequent negotiations and approval, while potentially saving millions of dollars. For the watershed with only one viable trade, a market infrastructure consisting of a web-based trading platform linked to state agency databases would be unnecessary and so expensive that, if it were required, it would likely make the trade unattractive. On the other hand, if participants in the large, dynamic market were required to continually revise their NPDES permits to reflect every new trading arrangement, the costs and uncertainty in the market would diminish or eliminate the value of trading to many if not all of them. The following information and examples illustrate ways to tailor your "overhead" costs to the potential size of the market in your watershed.

What Is Driving the Market?

All markets evolve to help fulfill the demands of consumers. Consumers provide producers an opportunity to earn a profit for altering their behavior and attending to the market's constantly changing demands for goods and services. Until a consumer decides they "need" a soda, and is willing to pay someone to produce it, there is no market for sodas.

Total Maximum Daily Loads (TMDLs) are the leading market drivers for WQT markets today because they typically create the "need" to alter behavior by reducing pollutant loadings discharged to waterways. TMDLs and similar frameworks are sometimes described as "budgets" for the introduction of pollutants into watersheds. Scientific studies estimate the volume of discharge a specific watershed, or segment of the watershed, can assimilate without exceeding the water quality standards enacted to protect the watershed's designated beneficial use(s). This "pollutant budget" is then allocated across point sources and non-point sources located in the watershed, as well as a federal mandated "margin of safety." The allocation of discharge limits forces sources in the watershed to analyze current practices to see if they need to alter their discharging behavior and the associated options and costs to do so.

Although the EPA Water Quality Trading Policy indicates, "[A]ll water quality trading should occur within a watershed or a defined area for which a TMDL has been approved," the EPA's 1996 Draft Framework for Watershed-Based Trading also acknowledges trading may be possible in equivalent analytical and management frameworks like the Lakewide Area Management Plans (LaMPs) and Remedial Action Plans (RAPs) found in the Great Lakes. The Water Quality Trading Policy also supports "pre-TMDL trading in impaired waters to achieve progress towards or the attainment of

water quality standards," as well as "pre-TMDL trading that achieves a direct environmental benefit relevant to the conditions or causes of impairment to achieve progress towards restoring designated uses where reducing pollutant loads alone is not sufficient or as cost-effective." This chapter assumes that your watershed has a TMDL, or similar framework, driving your interest in creating a WQT market.

What Are the Essential Functions of a Water Quality Trading Market?

Based on a review of the academic literature and the water quality trading projects conducted to date, a WQT market has at least eight essential functions. Various mechanisms can perform these functions. Market mechanisms are limited only by participants' creativity, the regulatory environment, and the characteristics of the watershed. In some cases, specific mechanisms may perform more than one function, potentially increasing market efficiency.

The eight essential functions are:

1. Defining marketable reductions;
2. Communicating among buyers and sellers;
3. Ensuring environmental equivalence of trades;
4. Defining and executing the trading process;
5. Tracking trades;
6. Assuring compliance with relevant federal Clean Water Act and state and local requirements;
7. Managing risk among parties to trades; and
8. Providing information to the public and other stakeholders.

The following discussions review briefly why these functions may be necessary for conventional markets and why they are essential for WQT. How well a mechanism may perform its function is discussed in light of market and regulatory friction.

1. Defining Marketable Reductions

Conventional Market Function—In conventional markets, a "marketable" product or service is anything that one individual is willing to compensate another individual to produce. The marketability of a product or service may be influenced by personal need, taste, and economic conditions. For example, a person may need shelter, may prefer to live in a townhouse, and may find it financially advantageous to pay someone to build the house rather than foregoing salaried employment to build it alone. A product may be marketable to one person but not another. For example, some people need shelter, prefer to live in treehouses, and have the skills and time to build it themselves. Such a person might not be open to purchasing a townhouse.

Marketable Products in WQT Markets—TMDLs are intended to set a budget for local pollutant discharges that ensures water quality standards, including designated uses, are attained in a watershed. Discharge "overcontrol" is the marketable product and is produced when the reduction of pollutant loadings goes beyond a discharger's regulatory obligation. A WQT market must do two things to create a marketable product. First, the market must identify the relevant pollutant control obligations. Overcontrol cannot exist

until a regulatory framework sets the baseline obligations. Second, the market must transform overcontrol into a marketable product by allowing that behavior to acquire value. Value is acquired when a regulatory framework allows one source to offset its discharge reduction obligations with overcontrol by other sources. As described in the Financial Attractiveness chapter of this Handbook, the value of overcontrol is highly dependent upon differences in incremental control costs. Minor differences will create little, if any, value even if the regulatory framework allows offsets.

2. COMMUNICATING AMONG BUYERS AND SELLERS

Conventional Market Function—All conventional markets are first and foremost communication systems. They provide participants with information on product availability, variety, quality, quantity, and price. This information is used to:

- Identify parties willing to produce or consume goods;
- Compare the merits of similar offers; and
- Negotiate mutually beneficial terms of exchange.

Without a means to acquire the needed information, potential market participants would be unable to benefit from each other's ability and willingness to produce goods and services.

Communication's Unique Role in WQT Markets—A WQT market gives dischargers who face pollutant control costs a forum for communicating with other sources to identify environmentally equivalent discharge reductions potentially executable at a lower cost. Because pollutant suitability and financial attractiveness are specific to the pollutant's chemical properties, the watershed's physical characteristics, and the relevant economic conditions, WQT markets must facilitate sharing information regarding a relatively complex product—a certain type/form of pollution reduction, at a specific time and place, for a predetermined duration, in a particular quantity, for a certain cost.

A good WQT market allows parties to learn what quantity of discharge reductions are being offered and demanded, when they can/will be delivered, their duration, their likely impact on water quality at the point of purchase/sale and all relevant compliance points, and how much they will potentially cost to acquire. A WQT market is more likely to succeed if it allows participants to efficiently survey the details of all potential offers to buy or sell overcontrol and identify those most beneficial to their unique needs. It is less likely to succeed if it fails to disseminate the pertinent information and/or requires participants to expend an inordinate amount of time, energy, and money to do so.

3. ENSURING ENVIRONMENTAL EQUIVALENCE

Conventional Market Function – Some market mechanisms allow consumers to compare the characteristics and quality of products targeting similar needs. For example, over the counter drug packaging must inform consumers of the drug's chemical contents—including the relative volume of active ingredients. This allows consumers to compare the likely effectiveness of various painkillers and cold remedies so they can select the product that best meets their needs.

Equivalence in WQT Markets—As mentioned earlier, trading requires that the impact of the purchased pollutant reduction is (at least) environmentally equivalent to the required

reduction. Market participants and other stakeholders must be able to evaluate the environmental equivalence of reducing pollutants at the points of purchase and sale. For example, hydrologic conditions in the stream between the two trading points must be evaluated because they can have a profound impact on environmental equivalence.

Demonstration WQT projects have used various mechanisms to perform the essential market function of facilitating environmental equivalence assessments. One important consideration is the higher cost of developing an accurate model versus setting ratios based on a rule of thumb (i.e., 3 to 1). Although establishing ratios based on accurate modeling and a wealth of ambient data may be the most scientifically precise approach, your WQT program may not be viable unless less costly approaches can be found. The potential participants may be willing to make a tradeoff in such a case. For example, a rule of thumb ratio that is less expensive to develop can be set artificially high to ensure equivalence with a margin of safety, even though this might drive up the cost per unit of needed reductions. A good equivalence mechanism will keep the total cost of a specific trade (i.e., costs to develop the ratio and the cost of needed equivalent reductions) to a minimum. A poor mechanism will fail to control total costs.

4. DEFINING AND EXECUTING THE TRADING PROCESS

Conventional Market Function— Each conventional market has its own unique trading process. The types of trading processes depend on the types of products and participants involved. For example, in a simple retail exchange at the local convenience store, a customer chooses a loaf of bread based on personal taste and posted prices, pays the proprietor at the cash register, and leaves the store free to eat the bread or feed it to the pigeons. A more complex trading process occurs when a party seeks to purchase goods and services for construction of a new skyscraper. This process may involve a request for proposals, bidding by several interested firms, financing the project, selecting a general contractor, purchasing materials, subcontracting special elements of the work, overseeing and inspecting physical construction, and agreeing on the level of completion. Friction in conventional markets can be minimized if participants have a solid understanding of the steps involved in a transaction, the order in which they need to be completed, and each step's likely cost.

The Trade Process in WQT Markets—EPA's Water Quality Trading Policy supports trading under different conditions (i.e., both within the context of a TMDL and prior to its approval.) The policy does not prescribe specific processes that each market must employ to complete a trade. Each WQT market may develop its own trading process.

The "Trading Process" includes the steps all parties must take to complete a proposed trading transaction that ensures full CWA practical enforceability and fully supports TMDL requirements. These steps could include, but are not limited to:

- Negotiating a transaction;
- Accounting for environmental equivalence;
- Completing and conveying appropriate paperwork;
- Reviewing and approving trades;
- Installing control technologies or adopting pollutant management methods;
- Monitoring and verifying reductions;
- Reporting to appropriate regulatory agencies and other stakeholders;

- Auditing reported information against regulatory obligations; and
- Taking enforcement actions, if necessary.

A good trading process covers these steps in the appropriate order while minimizing uncertainty and costs associated with the trading transaction. A poor mechanism is incomplete and adds to uncertainty and costs associated with the transaction so that trading is potentially suppressed. This can happen if the steps don't generate enough momentum towards trade completion. For example, if the process requires control technology installation and monitoring to confirm reductions prior to allowing sale of such reductions, dischargers may be reluctant to commit scarce resources to overcontrol. In addition, redundancies in the process (i.e., steps that are revisited without adding sufficient value) add to transaction costs and will erode the value of trading.

Some states considering trading and those with demonstration projects underway, have developed "State Trading Documents" to describe the process the state will use to formally recognize water quality trades. These documents usually do not prescribe exacting protocols for individual trades, but provide general guidelines while maintaining the state's ability to control water quality administration. Great care should be taken to review your state's document (if it has one) and design the market within its guidelines.

5. TRACKING TRADES

Conventional Market Function—Most conventional markets track transactions. How much information is gathered, who stores it, and its future use depend on the types of transactions and the purposes for tracking. For example, when an individual purchases a loaf of bread at the local convenience store, the store may track the amount paid, when the transaction was completed, and what was purchased. This information may be saved by the register or transmitted to a large database for all transactions completed in the region. The information may be used to justify keeping that store open until 2 a.m., to document sales tax collection, or to manage inventory. The customer receives a receipt that can help reconcile their budget, obtain reimbursement from housemates, or enable a return of damaged goods.

Why Trades Need to be Tracked in WQT Markets—Tracking trades in a WQT market is necessary to ensure that trades are not double counted (i.e., one source does not sell the same reductions to more than one buyer) and to provide an easy audit trail for compliance assurance purposes. The two crucial pieces of information a water quality trade tracking mechanism must include are volume of reduction and chain of custody. In this context, chain of custody refers to the possession of the right to use the pollutant reduction for regulatory compliance purposes. Keeping track of this information helps ensure that the goal of the TMDL, improved water quality, is being advanced and that practical enforceability is maintained. In addition, this information makes the creation and ownership of individual reductions clear and traceable in the context of determining if sources are complying with NPDES or other relevant permits.

A good trade tracking mechanism minimizes market and regulatory friction by keeping transaction costs for chain of custody low, while providing regulators with easy and prompt access to appropriate levels of transaction detail. Transaction costs can be kept low by setting clear and consistent expectations for what information is required and limiting the administrative burden on trading partners. Sizing the tracking system to the market will help limit transaction costs. When regulators can access trade information efficiently, they are less likely to intervene on particular trades or in the market system. A

poor trade tracking mechanism will drive up the cost of administering individual trades to the point where it erodes the value of trading. It may require trading partners or regulatory agencies to perform non- value-added administrative tasks (i.e., completing unnecessary paperwork, reconstructing market activity from inconsistent transaction statements).

6. Assuring Compliance with Clean Water Act and State/ Local Requirements

Conventional Market Function—In some conventional markets, buyers and sellers have regulatory obligations to entities outside the transaction. These obligations derive from a variety of public policy goals including protecting the parties directly involved in the trade and/or those with an indirect interest in the transaction's outcome. For example, the Securities and Exchange Commission requires publicly traded companies to conduct third-party audits of financial statements and report specific information annually to the public. This reduces the opportunity to commit fraud and lowers investors' market risk.

Regulatory Obligations in WQT Markets—WQT processes must involve various watershed participants, including important non-discharging stakeholders like regulatory agencies. According to the EPA Water Quality Trading Policy, trading programs must be developed in the context of regulatory and enforcement mechanisms, which predominantly rely on discharge permits. Thus, the market, federal, state and local regulations, and the agencies responsible for their enforcement are closely connected. EPA's Water Quality Trading Policy, says that "mechanisms for determining and ensuring compliance are essential for all trades and trading programs . . . States and tribes should establish clear, enforceable mechanisms consistent with NPDES regulations that ensure legal accountability for the generation of (reductions) that are traded." EPA's 1996 Draft Framework for Watershed-Based Trading suggests a market must meet conditions, standards, and procedures for ensuring that agencies maintain their ability to enforce the intent of a specific regulation. The appropriate regulatory agency(s) therefore will need a process to authorize, evaluate, permit, verify, and audit trading programs or even individual trades. Demonstration projects have performed this function in a variety of ways.

A good regulatory compliance assurance mechanism minimizes the regulatory friction, transaction costs, and transaction uncertainty associated with any potential trade by achieving consistent approval decisions—in both outcome and timing—based on the data needed to ensure environmental equivalence, prevent degradation, and preclude localized impacts. A poor mechanism increases regulatory friction, transaction costs, and transaction uncertainty by sending incorrect signals to the market regarding what is expected of participants and then inconsistently processing the provided information.

7. Managing Transaction Risk Among Parties to a Trade

Conventional Market Function—During the exchange of goods or services, a chance always exists that the specific terms or the intent of a negotiated deal will not be fulfilled. Conventional markets allow parties to identify this transaction risk, assign the burden of the risk to the appropriate party, and provide the opportunity for recourse if it is needed. Escrow deposits and performance bonds are examples of such risk mitigation mechanisms.

Managing Transaction Risk in WQT Markets—WQT markets involve three facets of transaction risk:

- The risk that regulators will find that the discharge reductions negotiated under the agreement do not conform to market rules;
- The risk that the specific discharge reductions negotiated under the agreement (for a certain type/form, at a specific time, for a predetermined duration, in a particular quantity) will not be produced; and
- The risk that reductions will fail to have the required impact on water quality.

The chapter on Financial Attractiveness explained the detrimental effects transaction risk can have on trading. Insufficiently managed risk will induce participants to steeply discount the price they are willing to pay for discharge overcontrol. This erodes the financial benefits associated with trading and can potentially suppress market activity. Risk management transaction costs (identifying and assigning risk) increase when remedies for nonperformance of discharge reduction obligations are less certain and the number of parties involved in enforcement issues (regulators, lawyers) increase and/or they become adversarial.

A good transaction risk management mechanism identifies and assigns the three risks associated with WQT to specific parties, and sets reasonable expectations about how failure to fulfill terms of the agreement will be handled, including the size of the remedy. As always, good mechanisms minimize transaction costs. A poor mechanism will create high transaction costs and fail to account for all three transaction risks, assign the risk to an inappropriate party, and/or create ambiguity over how a transaction "gone bad" will be handled.

8. *Providing Information to the Public and Other Stakeholders*

Conventional Market Function—Some conventional markets recognize that commercial activity can directly or indirectly affect parties other than the traders. For example, the Securities and Exchange Commission requires corporate managers to notify the public when they decide to purchase or sell stock in the companies they manage. Public dissemination of this information provides investors and securities regulators with information relevant to investment decisions and public policy.

Public Information in WQT Markets—The CWA and other federal, state, and local water quality regulations require provision of opportunities for public participation, including public notice and opportunity for comment. WQT markets, given this regulatory framework, must therefore perform this essential function. WQT viability often depends on the public participation process to generate understanding and trust among watershed participants. Failure to do so could influence stakeholders to challenge the market system or specific trades, potentially introducing uncertainty and eroding the value of trading.

Although EPA's Water Quality Trading Policy supports, "public participation at the earliest stages and throughout the development of water quality trading programs to strengthen program effectiveness and credibility," informing the public about on-going operations and trades may be even more important. Easy and timely public access to transaction information may increase market efficiency. Improving water quality takes sustained

effort. An uninformed public may lose interest in a trading program, threatening its long-term viability. Informed watershed participants are more likely to discover and/or support new forms of trading. Some trading markets have produced trading opportunities that do not conform to the market design's original vision of trading, but do provide real water quality and economic benefits. Such opportunities evolve as watershed participants learn more about each other's needs, and the needs of the watershed's ecosystem.

A good public information mechanism is transparent, easy to engage, and available to all interested parties while controlling transaction costs. The EPA Water Quality Trading Policy encourages electronic publication of information on:

- Boundaries of the watershed and trading areas;
- Discharge sources involved;
- Volume(s) of reductions generated and sold; and
- Price(s) paid for reductions.

Additional information may be important to participants in your watershed. The value of satisfying all interests should be weighed against the cost of collecting, managing, and distributing data. A poor public information mechanism will be resource intensive for both the information distributors and its consumers. This leads to higher transaction costs and can have serious regulatory friction consequences. As watershed participants work harder to get information, their level of trust may diminish, thereby threatening the market's stability.

Current Market Models

The remaining market infrastructure discussion focuses on three market models that are in various stages of implementation in the United States. Each of these market models responds to the unique needs of its watershed and market participants while handling the essential WQT market functions discussed above. Each market model is discussed in terms of the basic premise underlying the market, important mechanisms used to support the system, and how the model performs certain WQT market functions. These models illustrate significantly different approaches. After reviewing them, you will have a better understanding of approaches potentially suitable for your watershed.

A Private, Non-profit Co-operative Facilitating Pre-Approved, Dynamic Trading

In 1998, the Lower Boise River Water Quality Trading Pilot Project undertook design of a WQT system for approximately 64 miles of river from Lucky Peak Dam to the mouth of the Boise River. Market participants agreed they could make trading more robust, flexible, and cost-effective by focusing on minimizing regulatory friction. Participants identified seven design principles they felt were crucial to a viable market in their watershed, including the following:

- Avoid trade-by-trade changes to the TMDL;
- Avoid trade-by-trade changes to NPDES permits; and
- Minimize trade-by-trade agency review and approval.

To support these three design principles, watershed participants and regulatory stakeholders worked together to design clear guidelines and requirements for trades that would preclude the need for trade-by-trade review of most transactions. Public notice, review, comment, and agency approval of these trading guidelines and requirements were pivotal to this approach and created a model for dynamic trading. The key element of the Lower Boise market that allows market participants to trade in this fashion is the pre-approval of trade transactions through the issuance of a single new or modified NPDES permit enabling trading.[7]

The Idaho Clean Water Cooperative, a private, nonprofit association of various watershed participants, is charged with the day-to-day management of trading in the Lower Boise River. The Co-op will rely on language in the TMDL, language in NPDES permits, and a State Trading Document establishing the ground rules for creating and verifying trade transactions to facilitate trading. The Co-op will be responsible for helping connect buyers and sellers, developing and maintaining a trade tracking database, and preparing monthly watershed-wide trade summaries. The Cooperative will provide an important link among trading parties, the environmental agencies ensuring Clean Water Act compliance, and the public. By maintaining the trade tracking database and regularly disseminating transaction details, the association will also ensure that timely information about trades is available to the public and the environmental agencies. As a non-governmental organization, the Cooperative will be dedicated to supporting the trading system as requested and agreed to by its members.

Water Quality Market Functions in the Lower Boise River

Defining marketable reductions—The Lower Boise market uses a common definition of overcontrol (control below a source's TMDL defined allocation) to classify the reductions that sources may sell. To enable non-point source market participation, market stakeholders (including state and federal regulators as well as agricultural and technical assistance agencies) created a list of Best Management Practices and construction management, monitoring, and verification protocols that pre-qualify resulting reductions for sale. The BMP List provides the basis for the straight-forward verification of the non-point source generated reductions. This was done to eliminate the need for an intermediary in any transaction and create the opportunity for direct participation of non-point sources in dynamic trading. Non-point sources that can demonstrate they follow the appropriate protocols have reductions automatically recognized as valid and fungible.

Communicating among buyers and sellers—Although the Co-op is charged with connecting buyers and sellers, the mechanisms used to fulfill that role are currently undefined. As the market manager, to which all sources must report certain information if they choose to trade, the Co-op is uniquely situated to act as a "broker". This may entail providing an electronic or physical bulletin board of bids and offers for reductions or may evolve into a more formal matchmaking role where the Co-op introduces sources with reduction needs to dischargers capable of addressing them. Both methods can help

[7] As of the publication of this document, trading in the Lower Boise market has not been initiated. Several steps and mechanisms have been created to enable trading, including the creation of the Idaho Clean Water Co-operative, reporting forms, model NPDES permit language, model TMDL language, and the State Trading Document.

participants identify trades that may meet their needs. The costs of communication in the Lower Boise will be borne by both the Co-op and market participants.

Ensuring environmental equivalence—One significant barrier to dynamic, pre-approved trading is the potential for adverse environment impact resulting from individual trades. To lower the total cost of developing a ratio and the needed equivalent reductions, the Lower Boise market will rely on the water quality model developed for formulating the TMDL. This model provided each major discharger with an individual index, allowing a source to relate their discharge's effect on water quality to discharges by other sources. Use of an existing model keeps development costs to a minimum. In addition, this model ensures that trading ratios used are consistent with the TMDL. Relative to ratios based on a rule of thumb set artificially high to ensure equivalence, this minimizes the number of reductions a source must purchase.

Assuring compliance with the Clean Water Act—The Lower Boise market supports consistent approval decisions—in both timing (immediate) and outcome (if protocols are followed). This limits friction in the market through use of specific mechanisms to marry the pre-approval process to compliance assurance.

In this market, the pertinent TMDLs will contain base phosphorus waste load allocations (WLAs) for point sources and a provision for trade-dependent WLA variability. Sources will then receive a new or modified permit incorporating their WLA as a limit and, if desired, a provision enabling a trade-dependent variable limit. As explained below, the enabling provision will allow monthly changes to either the sources' discharge limits (the amount of discharge both sources are allowed to put into the river) or the recognized discharge volume (the amount of discharge counted against the limit) based on trading arrangements.

In all point-source to point-source trades, the enabling provision automatically adjusts the buyer's NPDES discharge limit up and the seller's NPDES discharge limit down, based on the volume of reductions traded and their environmental equivalence ratio. If a source exceeds its adjusted discharge limit during a reporting period, it is in violation of the CWA and potentially subject to regulatory enforcement.

In non-point source to point source trades, the enabling provision gives the point source a "credit" that can be applied against the point source's NPDES permit limit during that reporting period. The credit is based on the volume of environmentally equivalent reductions that have been traded from the non-point source(s) to the point source. A point source violates the CWA if its actual discharge, adjusted for all reduction credits acquired through trading during that period, exceeds its discharge limit. In this market, EPA or the Idaho Department of Environmental Quality (DEQ) may invalidate credits established by the non-point source reductions if they fail to meet BMP protocols and retain full authority to enforce the corresponding point source's effluent limit without crediting its discharge volume.

Point sources involved in a trade will use modified *Discharge Monitoring Reports (DMRs)* to report to the EPA. Along with the modified DMR, each source will submit an individual *Monthly Trade Report* created by the Co-op. DMRs and Trade Reports include actual discharge, point source trades lowering or increasing their discharge limit, and non-point source credits reducing their recognized discharge volume. The EPA uses this information to assure CWA compliance.

Defining and executing the trading process—The Lower Boise stakeholders developed a trading framework clearly defining the roles and responsibilities of all parties

involved in a transaction (the buyer, the seller, the Co-op, and the regulatory agencies) and the steps needed to "complete" a transaction. Two steps common to water quality trades are handled automatically by certain mechanisms: 1) accounting for environmental equivalence; and 2) reviewing and approving trades.

The framework allows market participants to negotiate trades on their own and provides clear guidelines for paperwork submission, control technology or process installation, and reporting protocols. Reduction monitoring and/or verification is generally assigned to point sources, while the Co-op, Idaho DEQ, and EPA work together to audit trades and assure regulatory compliance. EPA is responsible for regulatory enforcement actions.

Without trade-by-trade regulatory review, transactions could fail to maintain or improve water quality. To prevent the need for trade-by-trade review without increasing transaction costs or transaction uncertainty, the Lower Boise market uses three market mechanisms to eliminate the potential adverse environmental effects of individual trades. The use of known, published ratios lowers transaction costs because this eliminates the need for potentially time and resource intensive discussion with regulators over individual trades. The pre-qualified BMP list provides participants a clear understanding of what reductions will be recognized, minimizing transaction uncertainty. To preclude localized impacts, modified NPDES permits will include caps limiting the downstream trading capacity of individual sources. This will ensure that individual trades do not produce discharges in excess of the local assimilative capacity of the river segment between trading sources.

How the Idaho Clean Water Co-operative tracks trades—In the Lower Boise, the tracking system was designed to establish chain of custody, maintain accountability, and provide the public with a means of readily tracking all reductions bought and sold. Key elements of the trade tracking system are 1) a record keeping and reporting protocol, and 2) a trade tracking database. The system strives to minimize transaction costs by setting clear and reasonable expectations for reporting. Regulatory friction is managed by providing reasonably direct communication channels between participants, the Co-op, and the regulatory agencies.

Trading parties are required to gather documentation and retain specific information pertaining to trades and then report selected information to the Co-op using standardized forms. For each point-source to point-source trade, a *Trade Notification Form* is required to officially register the trade, transfer reductions from seller to buyer, and trigger the enabling NPDES permit provision(s) to adjust allowable discharge limits. For trades involving non-point sources, both a *Trade Notification Form* and a *Reduction Credit Certificate* must be submitted by the point source to certify the non-point source reduction and generate a credit against the point source's discharge volume. The Co-op will maintain a trade tracking database as well as individual trade and account information and produce a *Monthly Trade Report* for each source.

Managing risk among Lower Boise market participants—The Lower Boise market manages the three risks associated with WQT through its trading framework and private contracts. The market mitigates the risk that specific transactions will not be recognized by regulatory authorities by including in the market driver (applicable TMDLs and implementation plans), as well as the regulatory mechanism (NPDES permits), and the state trading document, the explicit requirements for defining marketable reductions and their proper conveyance to other sources. This information is publicly available, so buyers and sellers of reductions jointly assume the risk that the paperwork documenting their transaction is proper and filed with the required entities.

A defining feature of the Lower Boise market is how it manages the risk that an agreed upon reduction will not be achieved. Water quality regulatory agencies in the Lower Boise have limited or no authority over non-point sources' discharge behavior. Although non-point sources are issued "load allocations" by the TMDL, they are not issued NPDES (or state equivalent) permits that create CWA regulatory liability. Non-point sources involved in creating the market wanted to maintain their independence from CWA regulatory liability and still be allowed to participate in the market. Faced with supporting point source trading while maintaining regulatory independence for non-point sources, market designers decided that CWA liability would reside with NPDES permit holders, while the liability for failing to produce purchased credits would be handled, particularly in the case of non-point source trades, through private contracts.

In the Lower Boise WQT market, trading parties agree on the specific terms of a trade by entering into a private contract that identifies the trading parties, reduction measures to be undertaken, reduction amounts to be achieved, effective date, responsibilities of each party, price and payment provisions, and remedies for failure to deliver reductions. Although private contracts cannot shift regulatory liability from one source to another, they can assign the financial liability of regulatory non-compliance to the seller of pollution reductions. Subject to applicable contract law, the parties to the trade can decide between them who will pay for damages in the event reductions are not delivered and the purchasing source is consequently found to be violating its NPDES permit.

As in all markets, the water quality science is still imperfect and there is some risk that the TMDL analysis was mistaken. The TMDL's waste load allocations, along with associated trading may not be strict enough to achieve water quality standards, including protection of the watershed's desired beneficial use. The TMDL allocations may ultimately be ratcheted down by regulators if water quality improvement is insufficient. Sources committing to discharge reduction strategies—whether through trading, control, or a combination of the two—could find themselves looking for additional reductions after making capital expenditures and/or purchasing/selling reductions. Private contracts help manage this risk in two ways. First, the duration of individual trades is up to the parties. This allows participants to manage uncertainty about future load allocations by choosing the length of time they are willing to commit to a certain strategy. Private contracts can also provide for a party to cancel its contractual obligations in the event that the trade does not ensure compliance with future, more stringent TMDL allocations.

Private contracts in the Lower Boise allow parties to the trade to decide how great they believe the risks are and who will bear them. Writing the contract may require legal assistance, which may be relatively expensive for some non-point sources. It is important to remember that the contract terms used to manage risk will be based on the buyer's and seller's ***perceived*** risk. High perceived risk may result in large price discounts and erode the financial attractiveness of trading.

Providing information to the public and facilitating their participation—The public participation mechanism in the Lower Boise relies on transparency in the Co-op's activities and in the issuance of relevant NPDES permits. This is extremely important because pre-approved, dynamic trading in the Lower Boise requires market designers to generate and maintain trust from non-discharging stakeholders and also satisfy CWA public notice and comment procedures.

A point source wanting to trade remains subject to the standard NPDES permitting process. The usual CWA public notice and comment procedures will give stakeholders the opportunity to learn about and participate in the consideration of issues surrounding market participation by a specific source. Where appropriate, the new or revised NPDES

permits will then include language supporting trading. As already noted, trade enabling permit provisions will include: the authorization to trade; the adjustment of the discharge limit or discharge volume; trading caps to prevent localized impacts; and trading procedural requirements. Once a trade enabling permit has been issued, the source's discharge limits and/or discharge volume may be adjusted without further administrative process for each qualifying trade, thereby minimizing transaction costs and uncertainty. The permit will be renewed according to the standard permit cycle schedule (e.g., once every five years).

The Co-op will be responsible for making transaction information accessible to the public. The marginal cost of providing the information—whether on demand or published at regular intervals—will be minimal, as the trade tracking database already manages the information likely to be requested. In the Lower Boise, non-discharging stakeholders have an open forum to question and influence the permitted discharge limits and then easy access to information keeping them informed of actual discharge behavior.

A Public Authority Banking and Managing Phosphorus Credits

In 1985 Cherry Creek Basin Water Quality Master Plan was created to manage development's environmental impact on the Cherry Creek Reservoir in Colorado. In the basin, point source and non-point source nutrient discharges cause eutrophication problems that preclude attainment of the reservoir's designated uses. Rapid economic development in the area was forecasted to strain the ability of local Publicly Owned Treatment Works' (POTWs) to serve the burgeoning population without further degrading water quality in Cherry Creek Reservoir. As dischargers of predominantly soluble phosphorus, which is readily available biologically and promotes rapid algal growth, seven utility districts operating POTWs were challenged to limit their phosphorus contribution to the Cherry Creek reservoir. A Total Maximum Annual Load (TMAL) for phosphorus discharged into the reservoir was set at 14,270 pounds. The wastewater facilities received a total allocation of 2,310 pounds per year.

Two counties, four cities, and the seven utility districts reached an intergovernmental agreement chartering a state empowered government entity, the Cherry Creek Basin Water Quality Authority (the Authority), to develop and administer a water quality trading program facilitating continued economic growth while minimizing adverse impact on water quality in the basin. Although a pilot trading program has been in place for several years, few trades have been completed. Recently, an effort has been made to elicit more market activity. The Authority has been charged with designing a market in which POTWs and other point source dischargers would be able to purchase "credits" included in the POTWs' 2,310 pound phosphorus allocation while funding new phosphorus reduction projects. These credits may increase an individual point source's TMAL allocation and allow it to expand its services to new developments, which would otherwise cause the POTW to exceed its Waste Load Allocation. The trading market requires POTWs to fund phosphorus removal projects in exchange for an allocation of additional phosphorus discharge.

In the Cherry Creek market, the Authority functions as a "Water Quality Bank" by owning and allocating purchasable phosphorus credits associated with four non-point source phosphorus control projects built by the Authority in the 1990's with taxes levied by the Authority on watershed residents. These projects have reduced the net amount of phosphorus discharged, creating additional loading capacity in the reservoir. The credits from these projects have been placed in the "Phosphorus Bank" from which POTWs may

draw credits to meet their regulatory obligations. A total of 216 annual pounds of phosphorus credits were allocated to the Phosphorus Bank by the TMAL.

The control technologies used in the non-point source projects include retention/detention ponds, constructed wetlands, and shoreline stabilization above and beyond required BMPs, leading to phosphorus discharge overcontrol. The Authority has total control over these "Sale Credits" and decides who may purchase them. Funds raised from the sale of Sale Credits will be used by the Authority to fund additional projects that will further improve water quality.

The Authority also manages an additional 216 pounds of *phosphorus credit allowances* that give POTWs the right to purchase reductions from non-Authority phosphorus reduction projects and receive an increased WLA. The TMAL allocated the allowances to a "Reserve Pool." POTWs wanting to increase their phosphorus allocation may construct projects and/or compensate third-party landowners, local governments, or other POTWs to do so for them.[8] "Transfer Credits" tied to these reductions enable the Authority to transfer a portion of the Reserve Pool phosphorus allocation to POTWs. A phosphorus reduction project will be evaluated by the Authority before a specific agreement is reached to use Transfer Credits. An approved project's reductions are registered with the Authority and create "Transfer Credits." A POTW may seek additional phosphorus discharge capacity by compensating the owner of the Transfer Credits for their use. The total number of credit allowances third-party projects may generate for redistribution to the POTWs is currently capped at 216 pounds annually.

Important Market Functions in the Cherry Creek Basin

Defining marketable reductions—Marketable reductions in the Cherry Creek market are defined as reductions accruing from the implementation of control technologies in excess of those expected from the Mandatory Best Management Practices identified in the Cherry Creek Reservoir Control Regulations. Mandatory BMPs include temporary measures implemented to mitigate construction runoff (i.e., filter fences, re-vegetation, and hay bales) and/or permanent water quality improvements required by drainage criteria and land use regulations for all new development (i.e., detention ponds, swales, and constructed wetlands).[9]

The Reserve Pool marketable reductions, as defined in the draft guidelines, evolve from one of six different types of projects.

- **Additions to Existing Development**—Phosphorus removals from BMPs not completed during land development prior to January 1, 2000 are eligible for trading.
- **Expanded or Retrofitted BMP Removals**—Phosphorus removals from BMPs that are added to land development undertaken prior to January 1, 2000 that result in additional reductions are eligible for trading.
- **Projects Beyond Required BMPs**—Phosphorus removals from BMPs that result in reductions in excess of the removals from required BMPs are eligible for trading.
- **Cooperative Authority Projects**—Phosphorus removals from Authority and third party co-development projects are eligible for trading. Credits placed in the Reserve Pool will be limited to the proportion constructed or funded by the third party.

[8] A more detailed description of these projects is provided below.
[9] *Phosphorus Credit Trading in the Cherry Creek Basin: An Innovative Approach to Achieving Water Quality Benefits.* Water Environment Research Foundation. Project 97-IRM-5A. 2000.

- **Engineered Authority Projects**—Phosphorus removals from any non-point source project for which the Authority completes preliminary engineering and design and which the Authority agrees to third party construction of that project are eligible for trading.
- **Water Supply Operations**—Phosphorus removals beyond the incidental reductions from regular, normal operations are eligible for trading.

Not every pound of phosphorus overcontrol from a project may be associated with credit allowances in the Reserve Pool. A project specific "Trade Ratio" is applied to calculate the volume of phosphorus reduction that results in credit allowances recognized by the Authority and the regulatory agencies.

Defining and executing the trading process— Similar to other trading programs, the Cherry Creek Authority and various stakeholders have developed a trading framework clearly defining the roles and responsibilities of all parties (the buyer, the seller, and the Authority) in reviewing reduction projects and trades and administering the allocations of credits. Program evaluations have identified four steps that support these efforts in the Cherry Creek basin.[10] The fifth step described below provides for regulatory review and transforms the trade into a regulatory obligation.

- **Project Evaluation and Approval**—Authority constructed phosphorus reduction projects have already been evaluated and their credits placed in the Phosphorus Bank. Interested parties may nominate other projects for consideration by the Authority. The technical specifications of the project, the estimated reductions, reliability of the project operations, comments from Colorado's Water Quality Control Division (WQCD), consistency with the Master Plan, trading guidelines, and control regulations, and the effect on water quality are all considered by the Authority. Other stakeholders may contribute input at a public meeting. The Authority's Board of Directors votes to recognize the validity of the reductions.
- **Credit Calculation**—After voting to include reductions in the Reserve Pool, the Authority's Board of Directors determines the volume of credit allowances that will be associated with the project based on projected reductions and a project specific trading ratio.
- **Credit Allocation**—Point sources looking to exceed their permitted discharge limits may apply to acquire phosphorus credits from the Phosphorus Bank or credit allowances from the Reserve Pool. Trades are reviewed based on the buyer's history of regulatory compliance and operating abilities, as well as the trade's conformance to the Master Plan and control regulations. Potential Sale Credit applicants are also reviewed based on their "need" as defined by the Authority. A Technical Advisory Team (TAC) reviews all trades and makes recommendations to the Authority Board of Directors. The Board then approves or disapproves each specific trade.
- **Trade Review**—After a transaction is completed, the Authority retains the right and obligation to review reduction performance and periodically adjust the number of credits or credit allowances awarded to point sources based on actual reduction performance.
- **NPDES Permitting**—Prior to discharging phosphorus in excess of its existing NPDES permit, the credit or credit allowance purchaser must be issued a new or modified permit.

[10] Ibid.

The trading guidelines used in the Cherry Creek market provide all participants with a clear understanding of what's expected of market participants. Transaction costs are likely to be relatively known prior to initiating a trade, as the information needed and the process used to evaluate a trade are well defined. Market participants are also likely to understand the transaction costs associated with the permitting process.

Ensuring environmental equivalence—The focus of water quality trading in this market is to maintain the designated uses of the Cherry Creek Reservoir, not to improve water quality within specific stretches of rivers or tributaries. Environmental equivalence is therefore confined to the effect each sources' individual discharge has on the concentration of phosphorus in the reservoir.

Each Reserve Pool transaction receives a trade ratio, which translates phosphorus reductions into credit allowances, set between a minimum of 2-to-1 and a maximum of 3-to-1. The trade ratio varies based on the relative load of soluble and non-soluble phosphorus between the two parties and/or the attenuation of discharged phosphorus as it moves through the watershed. For example, the ratio may be increased when the credit allowance buyer is closer to the reservoir than the credit producer. This adjustment is based on site-specific monitoring data, empirical modeling, and/or best available scientific evidence to account for environmental equivalence. Institutional and scientific uncertainty factors help ensure the ratios reflect actual benefits to the reservoir.

Communicating between buyers and sellers—Use of this market model influences the transaction costs associated with trading partner identification, product comparison, and deal negotiation and their effect on market efficiency. All available credits or credit allowances are held or managed by the Authority. Buyers do not have to contact several potential trading partners to find a mutually beneficial deal. This market model can inherently limit interactions between certain buyers and sellers. The Authority explicitly identifies and then selects trading partners allowed into part of the market by placing reductions from specific projects into the Phosphorus Bank and allowing certain buyers, based on Authority defined "need," to apply for the right to buy the Sale Credits. For the Reserve Pool, the Authority only approves or disapproves the transfer of credit allowances for individual transactions. The Authority has limited justifications for stopping a transaction. As such, market participation in this segment of the market is not limited.

The Authority manages product comparison for Phosphorus Bank reductions by quantifying their volume, applying a project specific trade ratio, and establishing the price of credits. For these reductions, the authority sets the terms of the trade based on authority funded costs of building, operating, and monitoring current and future phosphorus reduction projects, as well as the costs of establishing and administering the trading market. The Authority also manages product comparison for Reserve Pool trades by quantifying available credit allowances based on the trade ratio. However, the Authority does not price these allowances; price is negotiated by the parties to the trade.

Tracking Trades—The Authority is in a unique position to track trading activity because it plays an active role in all transactions. In addition, trades are considered to last in perpetuity, limiting the number of actual transactions that will take place during any given period. The trading activity to date has imposed minimal tracking burdens on the Authority. It is anticipated that the Authority will develop a trade tracking system as trading activity increases. Most likely, a spreadsheet managed by the Authority will be used to ensure that reductions and their associated credits or credit allowances are traded to other sources only once. Trades approved by the Authority are documented in Appendix A of the Cherry Creek Water Quality Authority Trading Program Guidelines.

Compliance assurance with regulations in the Cherry Creek Basin—Although the Authority administers the transfer of credits and credit allowances in the Cherry Creek water quality market, transactions do not *automatically* alter a source's obligations to federal, state, or local water quality regulations. In this watershed, Colorado's Water Quality Control Division (WQCD) is responsible for administering NPDES permits. The WQCD does not acknowledge Sale or Transferred Credits as immediately off-setting the sampled, actual phosphorus discharge counting against the source's NPDES permit limit.

As stated in the Trading Guidelines, "It shall be the sole responsibility of the (credit buyer) to obtain any approvals or modifications to their discharge permits necessary to allow increased or modified phosphorus discharges." Therefore, a source wishing to use 10 pounds of Sale or Transfer Credits must go through the normal permit modification process to increase their discharge by 10 pounds. Sources purchasing credits must work with the WQCD to amend their NPDES permit limits, prior to discharging excess phosphorus. Monitoring and reporting protocols for the POTWs are set out in their individual NPDES permits and follow the standard reporting mechanisms used for NPDES permitting.

Managing risk among parties trading in the Cherry Creek Market—As is common with most water quality banks, Phosphorus Bank credits are made up of credits from various projects co-mingled together. A quantity of credits sold out of the Phosphorus Bank likely includes reductions from several projects that have different risks associated with them. The Cherry Creek market model both actively and passively manages the risk that reductions do not conform to market rules, the risk that specific reductions fail to materialize, and the risk that reductions fail to have the required impact on the designated uses of the watershed for these transactions. The risk management mechanisms are largely a result of the banking model and the trading guidelines developed by stakeholders specifically for Cherry Creek.

In this market, the Authority is delegated the responsibility of evaluating and allocating credits and credit allowances by the regulatory and administrative agencies responsible for watershed oversight. The Cherry Creek Authority, a water quality bank operated as a quasi-government entity, plays an active role in defining marketable reductions. For both Phosphorus Bank and Reserve Pool transactions, the Authority, per its charter, is only allowed to allocate credits or credit allowances if reductions conform to market rules. Therefore, the Cherry Creek Authority manages the buyer's risk of purchasing non-marketable reductions by acting as a credit and credit allowance certifier.

The Authority's certification role also helps manage the risk that the credits or credit allowances purchased by the buyer are not connected to actual overcontrol. The rigorous reduction certification during project approval coupled with the trade ratio creates leeway between the desired environmental benefit and the reductions outlined in the transaction agreement. In addition, if phosphorus reduction projects begin to perform poorly, the Authority may revoke or adjust the number of credit or credit allowances downward. For Phosphorus Bank credits, if re-evaluation results in lowering the reductions achieved (and therefore the credits), the Authority relies on surplus credits in the trading pool that have not been allocated and sold to other sources to make up the difference. If there are insufficient surplus credits in the Phosphorus Bank, the Authority notifies all Phosphorus Bank credit holders that their credits have been reduced on a pro-rata basis for three years. If additional credits become available from the Phosphorus Bank during those three years, credits will be restored. After three years, the credit reductions are permanent.

Transaction risk management for Reserve Pool transactions, where the credit allowances are merely "warehoused" by the Authority until a private deal is struck, is not as actively managed by the Authority. The Authority also certifies these credit allowances. However, Reserve Pool credit allowance purchasers, who have negotiated with a specific reductions producer for specific reductions, cannot be awarded surplus Reserve Pool credit allowances if reductions fail to materialize. They must negotiate another trade and pay for additional allowances.

Finally, the market manages the risk that new development and use of reductions fail to protect the designated uses of the waterbody. The TMAL driving the Cherry Creek market has a periodic review schedule, during which the TMAL allocations may be modified, up or down. Allocations may be adjusted to reflect the volume of phosphorus being discharged into the reservoir or existing water quality. Therefore, the TMAL allocation process manages the risk that reductions will fail to maintain designated uses by ratcheting up and down the volume of phosphorus permitted into Cherry Creek Reservoir by changing the allocation among POTWs and by adjusting the volume of credits and credit allowances available for use.

Providing information to the public and other stakeholders—The on-going public participation mechanism in Cherry Creek relies on standard public notice and comment procedures commonly used for NPDES permits. In the Cherry Creek market, non-discharging stakeholders have several opportunities to play an active role in trading activity, including open forums to question and influence project evaluation, credit and credit allowance allocation, and permit modification. For project evaluation and allocation, the Authority is required to issue a public notice of its intent to review specific proposals and listen to stakeholders attending that hearing. A similar procedure is used during permit modification. These steps are necessary to create transparency and engender trust in the trading system.

The Authority is responsible for making transaction information accessible to the public. The marginal cost of providing the information—whether on demand or published at regular intervals—will likely be minimal as the Authority already possesses or generates all the pertinent information. Trades approved by the Authority are documented in Appendix A of the Cherry Creek Water Quality Authority Trading Program Guidelines.

A Nitrogen Credit Exchange

In 1990, Connecticut, the State of New York, and the federal EPA adopted a Comprehensive Conservation and Management Plan (CCMP) for the Long Island Sound National Estuary Program, known as the Long Island Sound Study (LISS). The CCMP calls for the reduction of nitrogen to increase dissolved oxygen in Long Island Sound and mitigate hypoxia damaging the Sound's ecosystem. The CCMP was designed to reduce the total enriched nitrogen load coming from point and non-point sources by 58.5 percent between 2000 and 2015. A TMDL, approved in April 2001, includes Waste Load Allocations for point sources and Load Allocations for non-point sources in the watershed. Connecticut chose to develop a trading program for the sources within its borders to lower the cost of implementing the CCMP and the TMDL.

The main mechanism facilitating trading in Connecticut is a "General Watershed Permit." Connecticut's program uses both its general state authority and its EPA delegated NPDES permitting authority to issue a single General Permit for the nitrogen dischargers it regulates in the watershed. The General Permit covers the nitrogen discharges of all point sources willing to trade on a voluntary basis through a single permit. POTWs can

have opt out of the General Permit and receive a traditional permit and implementation schedule. However, all POTWs have chosen to take advantage of trading under the General Permit. The General Permit sets a ceiling for annual, permitted, nitrogen discharges at 2000 levels, and reduces the total nitrogen discharges allowed in each year between 2000 and 2015 on a percentage basis. Individual point sources under the permit (called sub-dischargers) are required to lower their proportional share of the annual percentage reduction based on their normalized discharge in 2000.

Market designers faced two challenges. The Connecticut market area is predominantly urban, with very few opportunities for low-cost nonpoint source controls. To achieve the 58.5 percent nitrogen reduction from all identifiable sources, Connecticut's 79 POTWs located within the watershed were tasked with lowering their nitrogen discharge by 64percent from 2000 baseline levels. The second challenge involved several factors, including the proximity of certain dischargers in western Connecticut compared to their eastern counterparts, Connecticut's previous efforts to fund nutrient removal projects near Long Island Sound, and the economic disparity between communities in western and eastern Connecticut. The communities in western Connecticut are generally more affluent and able to absorb the cost of implementing new control technology. They also had been the focus of pre-trading nitrogen removal grants. Eastern Connecticut communities are relatively less affluent. Market designers felt that the water quality trading market models used in other pilot projects might lead to inequities across the regulated communities, as affluent western communities would likely be able to generate environmentally equivalent reductions by relying on previous control technology investments and their larger tax bases. Under some market models, the generally poorer eastern communities would then have to pay for available western reductions.

The trading program that evolved from this effort is best described as a "Nitrogen Credit Exchange." Sources discharging less than their annual limit receive "credits" for overcontrol. CTDEP is obligated by state law to purchase all nitrogen credits from these sources. Facilities that exceed their limit are considered out of compliance. These sources are allowed to purchase nitrogen credits from DEP to meet compliance obligations. DEP is obligated by state law to sell the credits it purchases from overcontollers to facilities that fail to comply.

Important Market Functions of the Connecticut Nitrogen Credit Exchange

Defining marketable reductions—Marketable reductions in Connecticut's Nitrogen Credit Exchange are defined as reductions in excess of a point source's Waste Load Allocation. As described in the February 2003 *General Permit for Nitrogen Discharges and Nitrogen Credit Exchange Program* publication, by March 31 of each year, the Nitrogen Credit Exchange Program (NCEP) and the Connecticut Department of Environmental Protection (CTDEP) compile the calendar year monitoring data for each individual source. The average nitrogen discharge for each month is calculated and the end-of-pipe surplus or deficit is reported as a yearly average. Marketable reductions emerge if the actual, sampled yearly average is less than the WLA for that year. A "Nitrogen Equivalency Factor," based on a source's contribution of nitrogen to Long Island Sound, is then applied to calculate the number of credits that the Nitrogen Credit Exchange (NCE) buys from that source. Appendix 1 of the General Permit provides a schedule of each sub-discharger's individual Annual Discharge Limit for Total Nitrogen as well as a Nitrogen Equivalency Factor.

Defining and executing the trading process—Unlike the other two models discussed in this section, Connecticut's trading process is stipulated in state law. Public Act No. 01-

180 describes the processes used to transfer marketable reductions from POTWs achieving overcontrol to POTWs out of compliance with their NPDES permit.

Trading in this market is executed through a multi-step process completed on an annual basis. The first step is the setting of the annual discharge limits in the General Permit. These limits, set by the Nitrogen Credit Exchange Board, are based on a 2000 baseline for each POTW, reduction goals ensuring compliance with the TMDL by 2015, and the projected nitrogen reductions to be achieved by control projects likely to be operating during the year. The annual limits require each POTW to attain an equal percentage reduction from its 2000 baseline.

POTWs unable to meet their new limits may elect to build nitrogen control projects. Funding for projects is available on a competitive basis through the Connecticut Clean Water Fund. Funding consists of a 30 percent grant with the balance loaned at 2 percent interest. Alternatively, POTWs may choose to find alternative revenue sources. Regardless of their approach to meet their annual regulatory obligations, POTWs monitor and report their discharge throughout the ensuing year pursuant to language in the General Permit.

At the end of the year, the Nitrogen Credit Exchange Board (NCEB), in conjunction with the CTDEP, analyzes the discharge for individual dischargers for compliance with the annual WLA. This analysis includes the calculation of credits produced by dischargers able to overcontrol and the number of credits needed by POTWs failing to meet their WLA. Credits are generated if the actual, sampled yearly average nitrogen discharge of a particular POTW is less than its WLA for that year. The Equivalency Factor translates the overcontrol into credits automatically purchased by the NCEP. Conversely, if the actual, sampled yearly average is more than the WLA for that year, the POTW needs to purchase credits. The Equivalency Factor translates the difference between actual, sampled discharge and the WLA into the number of credits that the POTW must buy from the NCE.

The NCEB then calculates the price of credits for both buyers and sellers. The dollar value of credits is determined annually, based on the average capital and operating costs of all nitrogen removal projects operating during that year and the total reductions achieved by those projects during that year. This is the uniform price (per pound) buyers are charged to reach permit compliance or sellers credited for their overcontrol. Those POTWs exceeding compliance with their annual WLA receive a check for their credits. Those POTWs out of compliance receive a bill for the total cost of all credits that would bring them into compliance with the General Permit.

Ensuring environmental equivalence—The focus of water quality trading in this market is to attain the designated uses of the Long Island Sound, not to improve water quality within specific watersheds or basins that drain into the Sound. Environmental equivalence is therefore confined to the effect each sources' individual discharge has on the concentration of nitrogen in the Sound itself.

As part of the LISS, a peer-reviewed water quality model was developed to delineate the impact nitrogen discharges in the large area covered by the TMDL has on oxygen concentrations in Long Island Sound. This broke the area affected by the TMDL into six different zones closely aligned with the major watersheds or basins and relates their nitrogen to oxygen impacts. Some zones were further broken down into tiers. Further modeling was done to relate nitrogen discharges within each of the identified zones or tiers. The final step used to calculate environmental equivalence involved multiplying the

two factors together to create an Equivalency Factor that relates the impact of all individual discharges across the market to one another.

Communicating between buyers and sellers—The Connecticut water quality trading model does not promote contact between individual dischargers. The NCEP manages the transaction costs that would otherwise be associated with trading partner identification, product comparison, and deal negotiation because redistribution of the cost of nitrogen control is handled exclusively by the NCEP as it carries out its statutory responsibilities. As previously discussed, the NCEP gathers information from regulated dischargers, rewards POTWs for overcontrolling, and charges others for failing to comply with their permit. This results in redistributing the cost of overcontrolling nitrogen between the two groups.

NCEP administrators of the program need three sets of information to facilitate trading in this market—discharge volumes, nitrogen reductions achieved by control projects, and the cost of those control projects. Actual, sampled discharge volumes are collected by CTDEP as part of its General Permit administration responsibilities.

The NCEP relies on funds from the purchase and sales of nitrogen credits for administration of the NCEP. Currently, the NCEP is staffed by 2.5 FTEs assigned to several programs throughout the CTDEP.

Tracking Trades—In the Connecticut market, trade tracking consists of analyzing discharge, overcontrol, and cost redistribution. In this program, trading is an annual process. By March 31 of each year, the NCEP notifies each individual facility regarding their credit balance. After the credit checks and bills are paid or redeemed, the books are "closed" for that year and the process begins again. The additional burden of trade tracking (on top of the year-end analysis) borne by the NCEP entails collecting payments from dischargers buying credits to reach compliance.

Assuring compliance with regulations in the Connecticut Market—Trading in the Connecticut market takes place within the framework of the General Permit, which regulates the annual discharge of nitrogen into Long Island Sound. The aggregated General Permit discharge is set each year to ensure steady progress towards full implementation of the TMDL in 2015, as well as providing a buffer in case total reductions achieved fall below those anticipated in the annual allocation. Each individual discharger is issued a WLA incorporating the annual reduction of the aggregated General Permit and their baseline discharge in 2000.

Trading in this market is performed based on actual, sampled discharge performance. Monitoring and reporting protocols for point source discharge are set out in the General Permit and follow the standard reporting mechanisms used for NPDES permitting. Sampling frequency and procedures are based on the volume treated by the POTW on a daily basis. The collected chemical analysis samples are entered into a Nitrogen Analysis Report (NAR) and Monthly Operating Report (MOR) and submitted to the CTDEP. In addition, each POTW calculates a monthly mass loading of total nitrogen and submits it to the CTDEP in a Discharge Monitoring Report (DMR). Each POTW is also responsible for retaining a copy of all reports submitted to CTDEP as well as the data used to generate those reports for at least five years.

POTWs failing to reach compliance must purchase credits from the NCEP by July 31st of each year for their previous year's discharge. Failure to purchase credits by this date results in non-compliance and opens the POTW to enforcement actions by the CTDEP.

Managing risk among parties participating in the Nitrogen Credit Exchange Program—In the Connecticut market, credits are based on the level of nitrogen discharged during the year and the WLA. Implicitly, they can only be generated by the sources subject to the General Permit, which are all POTWs. The authorizing legislation (Public Act No. 01-180), the General Permit, and CTDEP publications, clearly describe the process used to create the annual permitted limit, calculate discharge, and the analysis used to compute the surplus or deficit of credits for compliance purposes. Nitrogen credits are only available from the NCEP, making the program the de-facto certifier of the credits and eliminating the risk of purchasing non-marketable reductions.

The Connecticut Nitrogen Exchange Program executes trading at the end of the year, when actual discharge volumes and overcontrol are known. The NCEP is obligated by state law to sell all the credits needed by all sources to meet their regulatory obligation under the General Permit. This statutory requirement eliminates the risk to individual dischargers that specific credits will fail to materialize, regardless of the actual supply that year.

There are two risks created by this market model because of its reliance on cash management and load allocations lower than TMDL implementation requirements to maintain active participation from the POTWs . First is the risk that during the year the POTWs, in aggregate, will create more credits than are needed to offset the POTWs that fail to meet their regulatory obligations. As the NCEP is obligated by law to purchase all credits and unable to sell them to other sources, the NCEP annually runs the risk of subsidizing the surplus overcontrol. For example in 2002, the NCEP purchased $2,757,323 worth of credits from 39 dischargers. The program sold $1,317,233 worth of credits. The $1,440,110 deficit was paid for by NCEP funds.

The second risk is that during the year the POTWs, in aggregate, may fail to create enough credits for other POTWs to maintain compliance. In years when the demand for credits is larger than the supply, the NCEP receives a net infusion of cash because all sources must purchase credits to meet compliance and the NCEP must sell them, regardless of their actual availability. This infusion of cash is designed to pay off any deficits from previous years when there is a credit surplus. Purchasing credits from the NCEP relieves the POTW from regulatory consequences under the General Permit. The annual allocations are low enough to maintain compliance with the TMDL implementation. In addition, allocations may be adjusted in light of the previous year's deficit or surplus and the projected control to be completed during the year. This helps manage the annual deficits and surpluses, both control and dollars, while encouraging additional nitrogen projects.

Finally, the market manages the risk that reductions generated and traded in the market do not achieve the designated uses of the waterbody by providing for periodic review of both TMDL allocations and the General Permit allocations. These are adjusted to reflect actual progress towards the designated use. The TMDL driving the Connecticut market includes a periodic review schedule, during which the TMDL allocations may be modified, up or down. A change in the TMDL allocation could force a modification of the annual allocations of the General Permit. Therefore, the TMDL and General Permit allocation process manages the risk that reductions will fail to achieve designated uses by ratcheting up and down the volume of nitrogen allowed to enter Long Island Sound.

Providing information to the public and other stakeholders—The on-going public participation mechanism in Connecticut relies on traditional public notice and comment procedures commonly used for NPDES permits. The NCEP is operated within the framework of the General Permit, providing the opportunity for public comment for the

permit when it was issued and when it is renewed. Public comment is only allowed on the aggregated General Permit and not allowed for the WLAs for individual sub-dischargers regulated.

In addition, the NCEP annually produces a publication listing the price of nitrogen credits as calculated by the NCEB. Included with the report is a *LIS Total Nitrogen Credit Exchange Final Balance* detailing the dollar value of the credits bought by the NCEP from POTWs discharging less than their WLA as well as the dollar value of credits to be purchased by facilities exceeding their WLA.