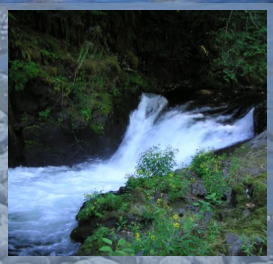
In It Together:

A How-To Reference for Building Point-Nonpoint Water Quality Trading Programs

Overview (Part 1 of 3)

July 2012



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About Us

Willamette Partnership is a 501c3 nonprofit working with a diverse coalition of leaders to shift the way people value, manage and regulate the environment. We continue to seek innovative ways to expand beyond the Willamette Valley in collaboration with other regional organizations with similar missions to direct investments in restoration to the places that matter most and at a scale that makes a difference.

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In it Together was produced by the Willamette Partnership, Pinchot Institute for Conservation, and World Resources Institute. The World Resources Institute developed the North Carolina case studies and updated information on the 24 point-nonpoint water quality trading programs, and the Pinchot Institute developed the Chesapeake and Willamette case studies.

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i. Preface

Watersheds across the United States have used different forms of water quality trading over the last decades as a flexible tool for meeting water quality goals. The successes, failures, and valuable lessons learned gathered by pioneering groups can be instrumental in helping new trading programs lay the groundwork for success. These lessons, paired with existing resources from U. S. Department of Agriculture (USDA), the U.S. Environmental Protection Agency (U.S.EPA), and others[1], have been incorporated into this how-to reference (Trading Reference) as part of USDA's ongoing efforts to advance market-based solutions as important tools for landowners implementing conservation practices[1].

Emerging water quality trading programs need not start from scratch—most programs require the same supporting infrastructure (standardized processes and technology tools), which is now available from model programs across the country. A framework has evolved that identifies what steps can be taken in order to build a water quality trading program for a local watershed. These steps include: 1) evaluating the feasibility of a program, 2) convening the right group of stakeholders, 3) designing the program itself, 4) securing some form of program approval from regulatory agencies, 5) implementing the program, and 6) setting up an adaptive management approach that will allow for improvements and fine tuning along the way.

The Trading Reference is divided into several parts so readers can quickly access the information they need.

Part 1 of this Trading Reference presents an overview and current status of point-nonpoint water quality trading programs around the country. This part is a useful primer for those interested in water quality trading in general or as an important background summarizing existing water quality trading programs and the lessons they provide for new programs. Lessons from trading programs across the U.S. provide illustrations about what works in building and implementing point-nonpoint trading programs.

Part 2 is a design reference for building and operating water quality trading programs. It is essentially a manual for new or emerging programs that outlines how to move through each of the phases of trading program development and provides milestones within each phase that will help trading program designers identify and plan for the work required to walk through the process.

Part 3 presents case study write-ups for water quality trading programs in North Carolina, the Pacific Northwest, and the Chesapeake Bay. These case studies are meant to add to existing write-ups of other programs (e.g. Midwestern programs).

Each Part is designed to stand on its own. Taken together, this Trading Reference should be helpful for local groups as they build programs to reduce program start-up time, increase efficiency, and build the base of trust necessary to sustain water quality improvements over time.

Throughout the Trading Reference text boxes highlight important terms and concepts. Green boxes are used to define technical terms relevant to water quality trading while blue boxes present examples and illustrations that help explain how water quality trading works.

Audience for this Reference

The audience for this Trading Reference includes the watershed stakeholders building programs for water quality trades between permitted entities known as point sources (e.g. wastewater or urban stormwater) acting as typical *buyers*, with unregulated, nonpoint sources (e.g. agriculture) acting as typical *sellers*. Trades occur when nonpoint sources can reduce their pollution beyond their Clean Water Act, state, or local obligations more cheaply than a point source can with technology improvements on its own (Selman *et al*, 2009).

[1]This Trading Reference specifically builds from NRCS guidelines on markets, U.S.EPA policy on water quality trading, World Resources Institute's overview of water quality trading, and Willamette Partnership lessons learned on building ecosystem market programs. They also incorporate the lessons learned from programs and research funded by the NRCS Conservation Innovations Grants, USDA Agricultural Research Service, National Institute for Food and Agriculture, and the USDA Economic Research Service.

I. Introduction and Objectives

1.1 Introduction

Water is a resource that connects us all. It is essential in supporting all life, growing food, keeping families healthy, and plays a central role in sustaining communities both socially and economically. In poll after poll, people regularly place high values on clean water (Kaiser/Pew Research Center, 2007; Nature Conservancy, 2010). Yet, when water either becomes scarce or its quality is impaired, it can pull communities apart. Conflicts arise over who has access to clean water, and the policy solution to one problem sometimes has unintended consequences for managing other areas of water resources now and into the future.

The nature of water quality problems in particular has changed substantially in the U.S. from the 1970s to today. Amendments made in 1972 and 1977 to the federal Water Pollution Control Act, known as the Clean Water Act, were passed by Congress in response to specific and visible problems, such as the Cuyahoga River fires or the Santa Barbara oil spill. At this time, the government wrote policies to give state and federal agencies authority to control the behavior of these *point sources* of pollution, which were framed as threats to the environment (Mazmanian and Kraft, 1999). Since its enactment, regulations under the Clean Water Act have helped to upgrade a large portion of the country's private and public wastewater facilities (U.S.EPA, 2000b). These actions have led to significant improvements in water quality (U.S.EPA, 2000a; Andreen, 2004), though the Act's original goal of fishable, swimmable waters across the country has yet to be achieved (U.S.EPA, 2000a).

Making that next jump in water quality improvements will be difficult as today's problems are more dispersed. Challenges surrounding urban stormwater and polluted land runoff are rooted in how we build towns, grow food, and produce other economic activity. Unfortunately, nutrient runoff that leads to eutrophication of water bodies is also one of the most significant drivers of ecological change (Millennium Ecosystem Assessment, 2003). With these challenges, neither the problem nor the solution rests with small numbers of easily identifiable sources of pollution. Almost 84% of phosphorus and 82% of nitrogen in U.S. waters come from *nonpoint sources* , including stormwater, agricultural, forestry operations, new development, and other sources (Carpenter *et. al.*, 1998; MART, 2006). Collective problems require collective solutions. Addressing these problems will require new tools and new forms of implementation.

U.S.EPA Defines Water Quality Trading

as "…an approach that offers greater efficiency in achieving water quality goals on a watershed basis. It allows one source to meet its regulatory obligations by using pollutant reductions created by another source that has lower pollution control costs." (U.S.EPA, 2003, p1).

Tip: Throughout this Trading Reference, *italicized terms* mark first occurrences of words available for lookup in the glossary.

Across all types of water quality trading, only 100 point source facilities have participated in trading, with 80% of those facilities trading in point-point trades in the Long Island Sound (U.S.EPA, 2008). Throughout the country, there are 24 active point-nonpoint trading

The Cuyahoga River helped focus water quality regulations on point sources

programs that have brought together state agencies, industrial and municipal wastewater facilities, farmers, environmental groups, and other stakeholders. "Active" programs have completed trading program designs and/or completed transactions between a permitted buyer and a seller (See Table 2.1). These programs represent decades of useful experience in building water quality programs. This Trading Reference distills that experience with the goal of helping new trading programs lay the groundwork for success.

1.2 Objectives

The examples, experience, and recommendations that follow are intended as a foundation, increasing the capacity of stakeholders across the country to successfully design and operate water quality trading programs. Designed well, trading programs can help achieve water quality goals in a way that is good for farmers, good for communities, and good for the environment. The Trading Reference is intended to build upon existing information provided by U.S.EPA, USDA, and others, such as:

- U.S.EPA Water Quality Trading Policy (2003) and Toolkit for Permit Writers (2007)[2]
- USDA Office of Environmental Markets[3]
- World Resources Institute publications[4]

This Trading Reference, produced for USDA's Office of Environmental Markets, addresses Section 2709 of the 2008 Farm Bill and responds to the need for USDA to provide support in helping market-based approaches engage more *landowners* in conservation.

2008 Farm Bill Calls for Technical Guidelines

'(a) Technical Guidelines Required —The Secretary shall establish technical guidelines that outline science-based methods to measure the environmental services benefits from conservation and land management activities in order to facilitate the participation of farmers, ranchers, and forest landowners in emerging environmental services markets."—Section 2709 of The Food, Conservation, and Energy Act of 2008 H.R. 2419

1.3 What is Water Quality Trading?

Water quality trading is an innovative, market-based, cost-effective mechanism to help achieve local water quality improvements (U.S.EPA, 2003). In water quality trading, sources with high costs of reducing pollution (also called abatement) can purchase equal or greater pollution reductions from sources with lower costs. This cost difference provides an incentive for trading to occur. Entities with lower abatement costs are able to economically lower their pollution discharges beyond permitted levels, enabling them to sell their excess reductions (Selman *et. al.,* 2009). Entities with higher abatement costs benefit by meeting their abatement goals at a reduced price. Permits under the Clean Water Act drive a lot of the current activity in water quality trading, but it is also possible to have trading driven by local water quality needs.

1.3.1 History of Water Quality Trading

Water quality trading as an idea is not new. It was first mentioned by economists identifying efficient ways to deliver water quality improvements prior to the passage of the Clean Water Act (Dales, 1968; de Lucia, 1974). Though the first pilot trading program started in Wisconsin's Fox River in the 1980s, interest in trading programs surged in the early 2000s as state water quality agencies began issuing *Total Maximum Daily Loads (TMDLs)* – the maximum amount of a pollutant a waterbody can receive and still meet applicable water

Legal Framework for Trading

Trading is not formally included in the Clean Water Act like air quality trading is in Title IV of the 1990 Clean Air Act Amendments. The legal authority for trading sits in CWA, 33 U.S.C. section 1251 and its implementing regulations (U.S.EPA, 2007, p6). Policy from U.S.EPA in 2003 added further detail about how U.S.EPA believes water quality trading is consistent with the Clean Water Act, but a lot of work on trading occurs during implementation of existing rules and regulation. Nine states have added statewide regulatory authority for trading via statute, regulation, policy, or guidance.

[2] http://water.epa.gov/type/watersheds/trading.cfm
[3] http://www.usda.gov/oce/environmental_markets/index.htm
[4] http://www.wri.org/project/water-quality-trading

Figure 1.3.1 How Point-Nonpoint Trading Works (image courtesy of Electric Power Research Institute)

Nutrient Reduction at Lower Cost

quality standards. In 2003, the U.S.EPA issued water quality trading policy (Selman *et. al.,* 2009). Early grants from the Water Environment Research Foundation, U.S.EPA, and USDA helped support early trading programs (Selman *et. al.*, 2009). See Figure 1.3.1. on how point-nonpoint trading works.

Under the Clean Water Act, the U.S.EPA and/or state or tribal environmental agencies determine the beneficial uses of waterways and the water quality standards needed to achieve those uses. Most states (except the District of Columbia, Idaho, Massachusetts, New Hampshire, New Mexico, and most tribes) are authorized to administer the *National Pollutant Discharge Elimination System (NPDES)* permit program that regulates discharges of pollutants from point sources to waters of the United States with review from U.S.EPA regional offices[5]. Nonpoint sources such as agriculture, forestry, or other dispersed sources of pollutants are not usually regulated individually under the Clean Water Act. Large confined animal feeding operations are considered point sources and covered by NPDES permits. Individual states or locales may have additional rules for nonpoint sources.

Trading rules for programs can vary greatly by state and by program (Selman *et. al.*, 2009). The differences can come from geography—shaping whether reductions need to occur up or down stream, by risk tolerances of stakeholders— driving higher or lower trading ratios, or a number of other factors unique to a local watershed.

Water Quality Trading is Just One Tool of Many

It is important to remember that water quality trading alone will not improve water quality, it is just one tool that can help decrease the cost of water quality improvement. Clean Water Act regulations, Farm Bill programs like the Environmental Quality Incentives Program, technical assistance from conservation districts, drinking water protection programs, and eco-label programs like Salmon Safe (Ecolabel Index, 2012), are all important tools. This Trading Reference's goal is to achieve more consistent, high quality trading programs that help meet Clean Water Act permits.

Discussions around trading might also lead to innovative opportunities that link economic development with conservation improvements, and new relationships between farmers, ranchers, and forest landowners who produce clean water and community and business users who rely on it.

Not all trades occur under permits and TMDLs.

State nutrient criteria, trading to offset growth, or other options that shape permits may create demand in the absence of a TMDL.

[5]http://www.epa.gov/aboutepa/where.html

1.3.2 Water Quality Trading and Total Maximum Daily Loads (TMDLs)

Section 303(d) of the Clean Water Act mandates that states assess their waters every two years, creating a list of waters that are impaired (i.e. do not meet applicable water quality standards). TMDLs are then written for those impaired water bodies, allocating allowable pollutant loads from the various sources in the impaired watershed. TMDLs were included in Section 303 of the 1972 Clean Water Act. Although U.S.EPA has issued TMDL guidance as early as 1991 (U.S.EPA, 1991), the pace of states' TMDL development has increased dramatically over the past 15 years. Since 1995, 46,740 TMDLs have been issued (with a peak of over 9,200 released in 2008) (U.S.EPA, 2012). A major driver of this activity has been 40 legal actions filed by citizen groups in 38 states to speed up issuance of TMDLs for impaired water bodies (Selman *et. al.*, 2009). Addressing sources without NPDES permits falls to state and local laws and other incentives.

A TMDL limits the total amount of pollutants a water body can receive from all sources and still maintain the designated beneficial uses and meet applicable water quality standards. A pollutant source defined as a point source under the Clean Water Act (e.g. municipal wastewater treatment plants, industrial dischargers, and some regulated municipal stormwater systems) is assigned a *wasteload allocation* in the TMDL, either individually or as an aggregate wasteload allocation with other point sources. Clean Water Act regulations require that a regulated facility's NPDES permit be consistent with the assumptions and requirements of any available wasteload allocation. It is also possible to have NPDES permit limits driven by local water quality needs in the absence of a TMDL. A pollutant source that is <u>not</u> defined as a "point source" under the Clean Water Act is considered a "nonpoint source" and is assigned a *load allocation* in the TMDL, either individually or as an aggregate load allocation with other nonpoint sources. Nonpoint sources are not regulated under the Clean Water Act.

Credit Defined

A *credit* is a measured unit of pollution reduction per unit of time [lb/year] at a location designated and standardized by the jurisdiction that can be generated, sold or traded as part of an offset (U.S.EPA, 2010).

Before generating credits, nonpoint sources must show they have met baseline pollutant load reductions defined by the trading program. The load reduction achieved beyond this baseline can be referred to as "additional". Typically, the reductions come from *best management practices* (BMPs) specified by states.

The quantity of available credit within a trading program is often calculated via equations and protocols that turn pollutant reductions from implemented BMPs into tradable credits.

Best Management Practices Defined

Nonpoint source *best management practices (BMPs)* are defined in 40 CFR 130.2 as methods, measures, or practices selected by an agency to meet its nonpoint source control needs. BMPs include, but are not limited to, structural and nonstructural controls as well as operation and maintenance procedures. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters (U.S.EPA, 2009).

Riparian buffers can create water quality credits
(Photo courtesy of Jared Kinnear)

1.4 Water Quality Trading Basics

At trading's core, a *buyer* (e.g. a pollution source such as a municipal wastewater facility) purchases water quality improvements, or credits, from a *seller* (e.g. a farmer installing a buffer along a stream to capture sediment runoff) that reduces its pollutants beyond what it is required to do. In order for trades to occur, the seller needs to reduce pollution more cost effectively than the buyer. Both buyers and sellers will need to control their own pollution to some minimum level, or *baseline*, before generating credits (U.S.EPA, 2007, p29). For nonpoint sources, baseline requirements might be a percent decrease in runoff, or implementation of a set of best management practices (BMPs). For point sources, baseline might be installation of secondary wastewater treatment. Setting baselines in a TMDL or permit can be one of the more challenging aspects of any water quality strategy, let alone trading program design. Setting baselines invokes large equity discussions that need to begin as early as possible. More detail on establishing appropriate baselines is covered in Part 2, Section 4.3.1.

A Simple Water Quality Trade

Blue City's wastewater facility needs to reduce its nutrient load into Flat Creek. It has two choices. It can install biological nutrient removal and filtration for $10 million or work with local farmers who move to no-till agriculture, install manure management systems, or plant buffer strips. Farmers can do this for $5 million, generating water quality credits that Blue City can buy.

Design elements make this trade possible in a way that reduces nutrients in Flat Creek more cost effectively, making it healthier for fish and people (Selman *et. al.*, 2009).

The Wilson River provides clean water to downstream communities (photo courtesy of Joni Elteto)

1.4.1 Categories of Water Quality Trading

Categories of water quality trading can be divided into trades between just point sources (point-point), just nonpoint sources, or between point and nonpoint sources (point-nonpoint). Nationally, the greatest percentage of trading activity by dollar volume has been between just point sources (Stanton *et. al.*, 2009).

Within point-to-nonpoint trading programs, there are several program designs ranging from an "exchange" for multiple point and nonpoint sources to "one-off" deals between one point source and one or more nonpoint sources (see box on facing page). This leaves a lot of room for program designers to innovate and customize their programs to their watershed's unique needs.

The structure of a trading program determines how trading takes place and what level of transaction costs are incurred (Woodward and Kaiser, 2002). While the market structure used by a program should be as simple as possible, program designers need to consider the anticipated future growth of a program to ensure activities are scalable. Market structures that allow for multiple buyers and sellers can be easier to expand than those with just one or two buyers.

Typical Market Structures
(adapted from Selman *et. al.*, 2009, p17)

Bilateral negotiations: Trades characterized by one-to-one negotiations where price and many other factors are typically arrived at through a process of bargaining rather than simply observing an existing price on the market. This market structure generally has high transaction costs.

Sole-source offsets*:* Structure where both point and nonpoint sources are allowed to increase pollutant loads at one point if they reduce or "offset" pollution elsewhere (either on-site or off-site). Transaction costs tend to be low.

Brokered trades: Structure where the link between sellers of credits and buyers of credits is brokered by an intermediary (sometimes called an aggregator, sometimes a clearinghouse). Intermediaries convert a product with a variable price and quality into a uniform product. For example, an aggregator might pay several farmers to install BMPs and then offer pollutant reduction credits to buyers at a fixed price. Transaction costs tend to be incurred by the intermediary and are higher than for buyers and sellers.

Auction platforms*:* This structure relies on brokered trades, but provides an independent platform for buyers and sellers to bid on and/or offer credits. The auction platform is a means of setting prices, and can be designed in several ways.

Exchange market: Structure that matches buyers and sellers anonymously. Often exchanges use auction pricing, but participants may provide bids and offers online, and the exchange system matches the trade. An exchange is characterized by its open information structure and fluid transactions between buyers and sellers. Transaction costs are typically low.

1.4.2 Who Plays What Roles in a Trading Program?

One of the most challenging and exciting aspects of water quality trading is the number of stakeholders that get involved during program design and operations. Some of the key actors and their roles include:

Buyers/Permittees: Generally, buyers are the point sources (e.g. municipal and industrial wastewater facilities) who hold the NPDES permit and have chosen to purchase credits to meet their permit requirements. The units of measurement for credits need to match the units that buyers are looking for. In a limited number of cases, there may be two sets of buyers—someone who buys the credits initially and then later resells the credits to a point source as the second buyer.

Sellers: Sellers are individuals or entities that have the ability to produce credits by implementing improvements on current land or facilities. Sellers might be the landowners directly, but landowners may also provide access to their land for others (e.g. soil and water conservation districts, nonprofits, or private business) to generate credits as aggregators.

Aggregators: Aggregators are a type of seller that create opportunities to produce credits by working with multiple landowners to pool credits.

Permitting authorities/Regulators: Under the Clean Water Act, states and tribal water quality agencies primarily set water quality standards, generate TMDLs, and issue NPDES permits. Permitting authorities that are involved early and throughout program design and operation can ensure the trading program meets their requirements and can approve its use. As trading programs begin operating, the permitting authority writes the NPDES permit language, and oversees compliance with those permit terms. They maintain the legal and policy framework for trading, but in some programs may be more active in managing transactions, verifying and certifying credits, etc.

Third Parties: A whole range of other actors play roles in trading programs. These include environmental organizations, which can help guide program goals and design, verification, and monitoring. A third party such as a soil and water conservation district may also manage the day-to-day activity of managing trades, including verifying the quality of credits, advising landowners on how to access trading programs, and participating in ongoing adaptive management of the trading program.

A lot of people help install forested buffers in agricultural land. (Photo courtesy of Ron Nichols)

Buyers, like this municipal wastewater treatment plant, buy those credits

1.5 Common Questions and Concerns about Water Quality Trading

The development of local trading programs often raises a common set of questions and concerns about water quality trading. These questions come up regardless of geography, and could be raised by any set of stakeholder groups. Some of the arguments are based on assumptions or perceptions, but they are common across market-based programs (Hienzerling, 1995; Chinn, 1999), and should be addressed by local groups building trading programs (see box below).

Real and perceived issues of integrity are barriers to any market, water quality trading being no exception. Digging into concerns and benefits is an important pathway to a successful water quality trading.

Trading project on Sylvan Creek provides benefits and challenges

Potential Challenges with Water Quality Trading:

- Creates uncertainty about actual pollution reduction achieved (tools for quantifying nonpoint source pollution are limited)
- Introduces uncertainty about whether verification organizations can track reductions over time
- Builds concern that trading might be a precursor to regulation
- Creates localized pollution hotpots (e.g. areas of elevated nutrients)
- Can create the perception that landowners are helping a point source "get off the hook" for polluting
- Creates concerns over the balance between privacy and transparency for landowners participating in trading
- Takes some active farmland out of crop production as it is converted into passive conservation
- With more stakeholders, is difficult to monitor and enforce Clean Water Act goals

Potential Benefits of Water Quality Trading:

- Reduces cost and increases speed of complying with Clean Water Act
- Provides options and flexibility in meeting Clean Water Act requirements
- Creates new revenue streams for farmers
- Creates additional funds for green infrastructure with benefits beyond water quality (e.g. habitat, recreation, climate)
- Increases accountability and provides new tools for tracking water quality improvements from nonpoint sources
- Builds new relationships between rural and urban communities

II. Current Status of Water Quality Trading Programs

2.1 Summary of Existing Programs

Two recent reports have done a good job summarizing the current status of water quality trading programs in the United States: World Resources Institute's Water Quality Trading Programs: An International Overview (Selman *et. al.*, 2009) and Forest Trends' State of Watershed Payments (Stanton *et. al.*, 2010). Some of the key facts from those reports are updated and described below.

As of 2011, there were 24 active point-nonpoint trading programs in 16 states across the country shown in Figure 2.1 and listed in Table 2.1. Active means a program design has been completed and received the necessary regulatory approvals needed to conduct trades though not all active programs have completed a water quality trade.

Between 2000 and 2008, over $52 million was transacted in nutrient trading programs in the U.S., $10.8 million of that coming in 2008 (Stanton *et. al.*, 2010). These numbers include both point-point and point-nonpoint trading programs. Most of that transaction volume occurred in a small number of trading programs (e.g. Long Island Sound's point-point trading program). The majority of trading programs to date focus on phosphorus (79% of programs) and nitrogen, with growing trading activity for temperature, and some trades for sediment (e.g. total suspended solids) and ammonia. Generally, U.S.EPA does not support trades of persistent bioaccumulative toxics, like mercury (U.S.EPA, 2007, p.10), but some states are exploring how trading might help reduce both legacy and new sources of these pollutants.

In general, the 24 active trading programs occur under specific NPDES permit language or state water quality trading guidance. Nine states have statewide trading guidance or statute to guide their trading programs, and five states have issued guidance or statute for particular watersheds (Figure 2.1). Of the 24 point-nonpoint source active programs, just over 87% allow nonpoint and third parties as trading participants. About 37% of programs allow other landowners (e.g. properties other than crop farms) to be eligible (Branosky and Selman, 2012).

In order to trade, programs need a way to quantify the water quality improvements made by farmers and other landowners in terms that connect to the NPDES permits held by industrial and municipal wastewater facilities. Many programs use a combination of approaches to calculate credits. Of the active programs, four use a set of standard BMP efficiency rates to estimate pollutant removal. Ten programs use site-specific indicators and models to estimate pollutant removal. Twelve programs use custom calculations, which make assumptions for all agricultural operations in the land area under a program.

Table 2.1 shows active programs currently using four types of market structure – 67% use bilateral trades, 46% use sole source offsets, 21% use an auction platform, and 17% use an exchange.

2.2 What Have Programs Taught Us about What Works and What Does Not?

Elements of successful environmental markets, including those for water quality trading programs include factors relating to water quality improvement, economic efficiency, and legitimacy (Freeman and Kolstad, 2006; Stavins, 2006; Tripp and Dudek, 1989). The keys to success are transparency, real pollutant reductions, accountable tracking, sound science, and clear lines of responsibility (U.S.EPA, 2007, p.ix). In addition, for both regulatory and voluntary markets, safeguarding both property rights and privacy are important. To achieve these measures of success, a program needs to have both supply and demand, a way for buyers to connect to sellers without too much cost, and a robust system to verify that conservation practices are performing as promised. Without these, a program can fall victim to some of the common hurdles found in trading. Table 2.2.1 lists and describes some of the most common hurdles and success factors for trading programs.

Figure 2.1. Map of Active Point-Nonpoint Water Quality Trading Programs and State Policies (based on data updated for this Trading Reference)

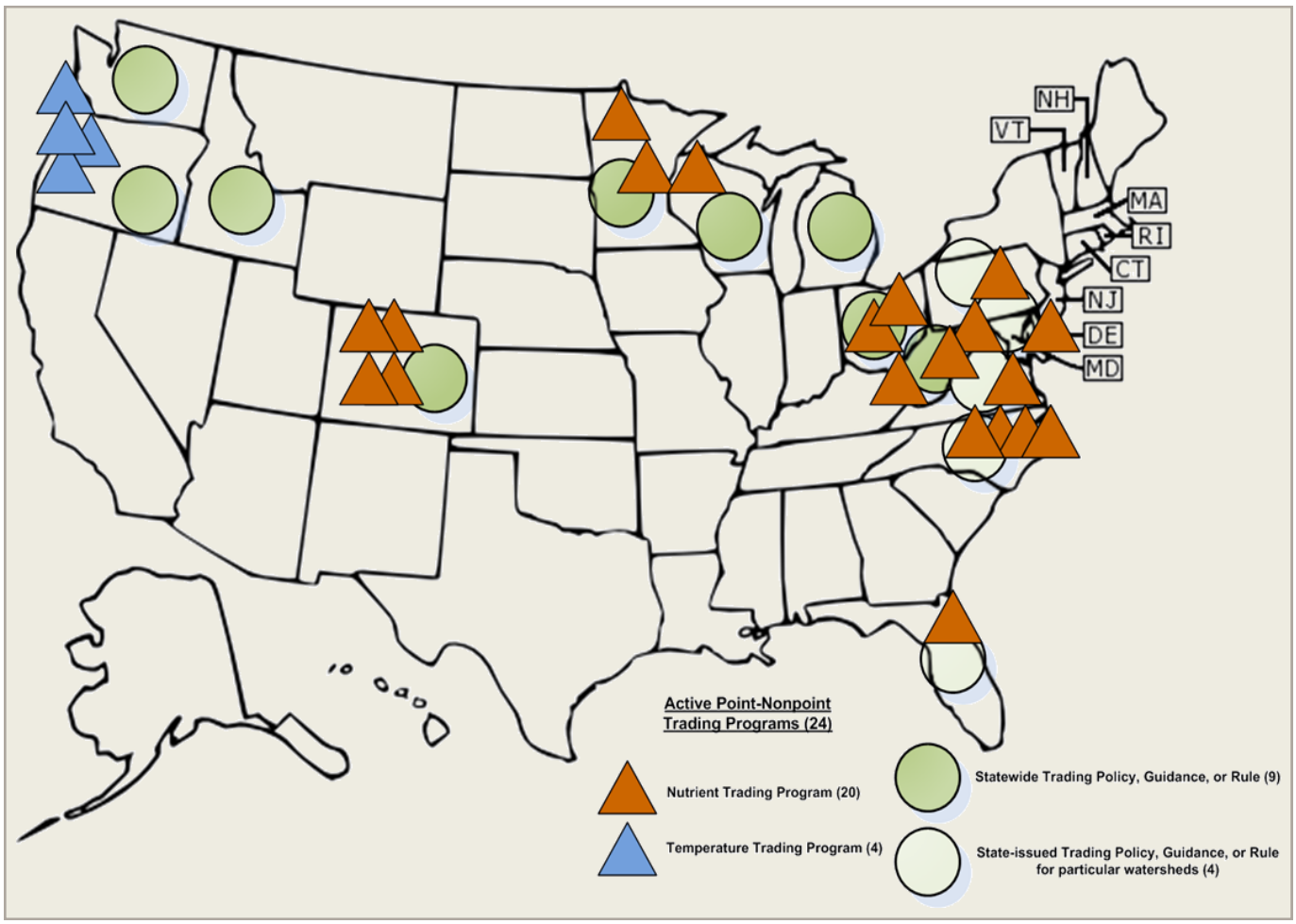

Table 2.1 Active trading Programs in the United States in 2011

Program	State	Market structure
Bear Creek	CO	Bilateral & Brokered trades
Chatfield Reservoir	CO	Bilateral
Cherry Creek Basin	CO	Sole-source offsets
Lake Dillon	CO	Bilateral
Delaware Inland Bays	DE	Bilateral
Lower St. Johns River	FL	Bilateral
MD Chesapeake Bay	MD	Auction & Bilateral
Rahr Malting	MN	Brokered trades
Southern Minnesota Beet Sugar Coop	MN	Bilateral & Sole-source offsets
Falls Lake	NC	Bilateral from private banks & in-lieu fees to the NC Ecosystem Enhancement Program
Neuse River	NC	Bilateral from private banks & in-lieu fees to the NC Ecosystem Enhancement Program
Jordan Lake	NC	Bilateral from private banks & in-lieu fees to the NC Ecosystem Enhancement Program
Tar-Pamlico Estuary	NC	Bilateral from private banks & in-lieu fees to the NC Ecosystem Enhancement Program
Great Miami River	OH	Sole-source offsets
Sugar Creek (Alpine Cheese)	OH	Bilateral & Brokered trades & Exchange
Ohio River Basin Trading Project	OH	Auction
Tualatin River (Clean Water Services)	OR	Sole-source offsets
Rogue River (Willamette Partnership)	OR	Sole-source offsets
Willamette River (Willamette Partnership)	OR	Sole-source offsets
Lower Columbia (Willamette Partnership)	OR	Sole-source offsets
PA Chesapeake Bay	PA	Auction & Bilateral & Brokered trades
VA Chesapeake Bay	VA	Bilateral through the VA Water Quality Improvement Fund or Brokered trades for compliance credits exchanged through the VA Nutrient Credit Exchange Association
Red Cedar River	WI	Bilateral
WV Potomac/Chesapeake Bay	WV	Auction & Bilateral

Table 2.2.1 Common Hurdles and Success Factors for Trading Programs

Theme	Hurdle	Success factor
Demand	Lack of demand is the biggest barrier to trading success. Many programs assume, "If we build it, they will come," and start up without having carefully identified who might need to purchase water quality credits, and without engaging those potential buyers as to how their needs can be met. Demand can also be constrained by TMDLs, NPDES permits, or other market drivers that do not push hard enough for water quality improvements, or that get mired in conflict over pollutant load allocations and reduction responsibilities that delay implementation of the TMDL.	Programs should be designed to address the needs of potential customers. If someone has a specific amount of time to make a specific improvement in water quality, and agencies are clear that trading is an option, then demand is much easier to generate. There needs to be enough demand from one or more buyers to sustain trading program operations over time.
Uncertainty	Many elements of water quality trading are inherently uncertain, creating risk for different stakeholders. Point-source buyers tend to be risk-averse and need to be certain that they can meet their permit obligations through trading. On the science side, it can be very difficult to specify the cause and effect relationship between nonpoint source conservation practices and real improvements in water quality.	Establishing clear rules of a trading program that includes an agreement with a regulatory entity to accept credits in a way that follows an agreed-to format can go a long way to reducing uncertainty. Buyers are more likely to engage if there are no current or threatened lawsuits against a permit or TMDL, if the costs of the trading alternative are clearly articulated in terms that can be compared to other options, and if there are staff or other third parties in place that can ensure the performance reliability of nonpoint source conservation practices.
Start-up & Transaction Costs	With 24 potential sample program designs around the country, no water quality program should be starting from scratch, but many do.	The biggest transaction cost in most trading programs is uncertainty created by unclear rules, missing capacities, etc. These transaction costs can be reduced with clear protocols, providing technical assistance to buyers and sellers, shared infrastructure for transactions, and consistent messaging from regulatory agencies on their support of trading from directors to permit writers. The roles for different stakeholders and the rules of their interaction must also be clear.

Table 2.2.1 (*Continued)* Common Hurdles and Success Factors for Trading Programs

Theme	Hurdle	Success factor
Stakeholder Support	Misconceptions, mistrust, lack of understanding of the water quality trading process, and lack of transparency are poison for a trading program. All stakeholders need to be knowledgeable about the basic concepts of trading, and the program design process needs to breed trust—both among internal stakeholders, and to others watching from outside the program design process.	Most successful programs have a trading "champion" that is invested in a program's long-term success and can gain support from others for the program's goals. Program support starts with basic education on what trading is and is not, what it is good for, and what it is bad for. This opens doors to educate point sources, agriculture, environmental groups, state agencies, and other stakeholders on the basics of trading. The sooner stakeholders clearly understand their role in the process, the easier discussions moving forward will be.
Goals	Several programs have failed because their goal was to create a "market" rather than asking what their watershed really needed in terms of pollutant reduction and other restoration efforts. A clear goal, one that looks holistically at the watershed rather than a single pollutant, provides an anchor to the group designing the trading program. TMDLs and NPDES permits can be written in ways that make trading difficult (e.g. mismatched timelines between point source needs and nonpoint source ability to provide credits; unrealistic load allocations). Programs should spend the appropriate amount of time and resources studying what their watershed needs and how trading might fit into that need. U.S.EPA's Trading Assessment Handbook is a helpful resource (U.S.EPA, 2004).	The water quality improvements tied to credits can take time to materialize after practices are installed. In the interim, programs with clear rules on verification, methodologies for tracking program effectiveness, and mechanisms for adaptive management can increase trust in the program's ability to achieve those water quality improvements. There is a need for agreement that the practices implemented are the right ones for the watershed overall, not just for generating credits.
Liability/ Enforceability	As point sources purchase credits, they retain the regulatory liability for the performance of those credits. This can reduce the price they are willing to pay for credits and can increase the need for transparency and safeguards to ensure credits perform as promised.	Insurance, reserve credits, trading ratios, and other protections bring confidence to the trading program by ensuring the buyer will be covered should credits not perform as promised.

2.2.2 Common Tradeoffs in Designing a Trading Program

Water quality trading programs need to balance multiple factors in their design and operation. There is no single model that existing programs have followed. Instead, they have evolved to match their local geography—physical, social, economic—and each program balances a series of tradeoffs based on its geography and its program's goals. Those trade-offs include:

Simplicity vs. complexity of the program design: Interviews with stakeholders in North Carolina's Ecosystem Enhancement Program for this Reference often cited its simplicity as one of the main sources of success. That simplicity comes from basic trading rules and a *quantification method* - methods, equations, rules, and tools that translate water quality indicators into "credits" or "debits." This simplicity makes it easy for buyers and sellers to estimate their credit quantities and the cost of providing or purchasing those credits. In other programs, more complex models are being used to quantify nutrient reductions, which can help highlight differences among projects. However, they may be labeled as "black boxes," potentially reducing trust in a program.

Larger vs. smaller trading areas: The larger the geographic region for trading, the greater the number of buyers and sellers, and the greater the opportunities to conduct trades. Yet, as trading areas get bigger, it may become more complex and can be difficult to articulate water quality improvements from point A to point B. For example, a nutrient reduction in the Colorado River does not help hypoxia in the Gulf of Mexico. There needs to be a science-based link between buyers and sellers, which creates a need to geographically constrain trading.

More vs. less formal authorization for trading: Trading programs are young and still in the process of developing. Incorporating program designs into a statute or rule can limit a program's flexibility to adapt. Yet, a program with an informal stakeholder agreement or agency guidance may not provide the regulatory certainty buyers or environmental groups would like to see.

High tolerance for risk vs. low tolerance: Different sets of stakeholders will have different capacities and interest in accepting risk and responsibility. Some watersheds may have third party aggregators willing to take on the risk of conservation projects failing. Others may have stakeholders with a history of litigation. Some farmers may like the idea of variable pricing and competing to offer the cheapest credits. Others may like the equity of a set price for everyone. Some agencies may be comfortable with annual, informal contracts for maintaining conservation practices. Others may want permanent easements. All of these preferences center on people's perception and tolerances for risk. There is no "right" level, but uncovering the real sources of risk and people's preferences for those risks will help program design be more balanced.

Ohio River trading engages diverse communities and forces discussions about tradeoffs

2.3 A Framework to Guide a Trading Program Design

Whether designing a complex trading program for multiple buyers or sellers, or putting together a deal between one buyer and one seller, the same basic steps continue to be repeated across programs and across the country. Each of the following steps needs some level of attention depending on the specific needs of a watershed:

Feasibility: Does the watershed have the right geographic, economic, social, and other elements in place to make a trading program viable? Are water quality goals clear enough for stakeholders in the watershed to know whether trading is an appropriate tool to achieve those goals? Conducting a feasibility assessment answers these and other questions to determine if trading is a viable tool.

Convening: Some of the most important work in building a trading program comes in convening and preparing the right group of stakeholders to create and operate a trading program.

Design: The design phase turns a feasible program opportunity into a reality. It includes building the science to link water quality improvements to point source discharges, and the policy to shape who can trade and how.

Agreement: Each program design needs some level of stakeholder agreement to move from design into supporting the operations of trades. That agreement can be either more or less formal, but it should include or reference some regulatory authority to place the program on solid legal and policy footing.

Operations: Often, most energy is put into designing a program, but operating a successful program over time requires flexibility, careful planning, a variety of skill sets, and potentially different groups of stakeholders. Operations require rolling out a pilot version of the program's quantification methods and protocols, identifying a Program Administrator to see projects through the credit issuance process, as well as maintaining and improving the program over time.

Adaptation: No program is perfect, and every program will need adjustments, particularly in the first few years of operation. There is a need for structured ways to gather lessons learned, catalogue needed improvements, and make adjustments on a predictable schedule.

Can buffers in West Virginia's Young River provide credits? (photo courtesy of Brian Kittler)

III. Conclusions and Next steps

Building a successful water quality trading program is a juggling act—a balance of environmental, economic, and social variables that come together in sometimes unpredictable ways in different watersheds across the United States. Yet, the last decades of experience with trading have revealed some commonalities and lessons that can help new programs get off the ground.

There is conceptual support for water quality trading in many parts of the country, and the challenge is in the details, but 24 point-nonpoint trading programs have found a way to design programs and get needed approvals from agencies and other stakeholders.

The remaining parts of this Trading Reference dive into the details of building a program (Part 2) and provide three examples of trading programs that add to existing case study write-ups (Part 3).

The Ohio River's trading program has bridged many of the challenges in setting up trades

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V. Glossary

Bold black text indicates terms found throughout this Trading Reference, while **Bold blue text** indicates additional, commonly used terms in water quality trading but not included in the Trading Reference.

Additional: In an environmental market, the environmental benefit secured through the payment is deemed —additional if it would not have been generated absent the payment provided by the market system.

Anti-backsliding: A provision in the Clean Water Act and NPDES that requires a reissued permit to be as stringent as the previous permit with some exceptions. (1)

Antidegradation: Policies that ensure protection of existing uses and of water quality for a particular waterbody where the water quality exceeds levels necessary to protect fish and wildlife propagation and recreation on and in the water. (1)

Attenuation: The degradation or diminishing of a pollutant through natural processes. (3)

Baseline: A minimum level of conservation that must be in place before additional practices may be eligible for trading. (3)

Best Available Technology Economically Achievable (BAT): Technology-based standard established by the Clean Water Act as the most appropriate means available on a national basis for controlling the direct discharge of toxic and nonconventional pollutants to navigable waters. (1)

Best Conventional Pollutant Control Technology (BCT): Technology-based standard for the discharge from existing industrial point sources of conventional pollutants including biochemical oxygen demand, total suspended solids, fecal coliform, pH, oil and grease. (1)

Best Management Practice (BMP): For point sources, BMPs are defined as schedules of activities, prohibitions of practices, maintenance procedures, and other treatment controls and pollutant removal devices (structural and nonstructural) to prevent or reduce the discharge of pollutants to waters of the United States. For nonpoint sources, BMPs are defined as methods, measures or practices selected by an agency to meet its nonpoint source control needs, many of which can be found in the NRCS Handbook of Conservation Practices. BMPs include, but are not limited to, structural and nonstructural controls and operation and maintenance procedures. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters. (1)

BMP Efficiency Rates: Generally the percentage removal of a pollutant from water treated by a best management practice (e.g. a filter strip removes 60% of the nutrients from runoff leaving a farm field).

BMP verification: Procedures for ensuring that BMPs reduce nutrients and/or sediments in compliance with the trading program's rules. (2)

Best Practicable Control Technology Currently Available (BPT): The first level of technology-based standards established by the Clean Water Act to control pollutants discharged to waters of the United States. BPT effluent limitations guidelines are generally based on the average of the best existing performance by plants within an industrial category or subcategory. (1)

Bilateral negotiations: Trades characterized by one-to-one negotiations where a price is typically arrived at through a process of bargaining not simply observing an existing price on the market. (5)

Buyer: An entity that purchases listed ecosystem benefits or funds projects for a range of reasons including general conservation purposes or offsetting an environmental impact. (4)

Certification: The application and approval process for a project intended to generate credits. (2)

Clearinghouse: Structure where the link between a generator of credits and user of credits is brokered by an intermediary. (5)

Compliance Schedule: A schedule of remedial measures included in a permit or an enforcement order, including a sequence of interim requirements (e.g., actions, operations, or milestone events) that lead to compliance with the Clean Water Act and regulations.

Contract: Written agreement between the trading parties, separate from any applicable NPDES permit, in which the parties may address a variety of financial or legal considerations and contingencies, including what happens in the case of default by any party. (1)

Credit, or Pollutant Reduction Credit: A measured or estimated unit of pollutant reduction per unit of time at the discharge location of the buyer or user of the credit. A seller generates excess load reductions by controlling its discharge beyond what is needed to meet its baseline. A buyer compensates a seller for creating the excess load reductions that are then converted into credits by using trade ratios. Where appropriate, the buyer can use the credits to meet a regulatory obligation. (1)

Credit Exchange: A centralized reserve of pollutant reduction credits administered by a third party who buys credits from point or nonpoint sources to sell to point sources in need of credits to comply with calculated WQBELs. (1)

Crediting Protocol: A core document combining the chosen quantification methods with risk management approaches in a complete protocol for creating, buying, selling, and tracking credits.

Credit registration: The process of assigning a registration number to a verified and certified credit. (2)

Cross-Pollutant Trading: Trading across two different pollutant parameters when equivalent mass loads of the different parameters can be calculated and the water quality effects of those equivalent mass loads are similar (e.g., meeting an effluent limitation for biochemical oxygen demand by purchasing credits generated for reduction of a phosphorus load). (1)

Delivery Ratio: Factor applied to pollutant reduction credits when sources are directly discharging to a waterbody of concern that accounts for the distance and unique watershed features (e.g., hydrologic conditions) that will affect pollutant fate and transport between trading partners. (1)

Design flow: The average flow that a wastewater treatment plant is designed to treat in order to comply with effluent limitations. (2)

Designated Uses: Those uses specified in water quality standards for each waterbody or segment whether or not they are being attained. Examples of designated uses include cold and warm water fisheries, public water supply, and irrigation. (1)

Edge-of-segment ratio: A trading ratio accounting for the amount of each pound of pollutant that is naturally removed as it travels from the geographic point where it is discharged to the boundary of a Chesapeake Bay Watershed Model segment. The states' definitions vary. (2)

Effluent Limitation: Any restriction imposed on quantities, discharge rates, and concentrations of pollutants that are discharged from point sources into waters of the United States, the waters of the contiguous zone, or the ocean. (1)

Effluent Limitation Guidelines and Standards (ELGs): A U.S.EPA regulation under section 304(b) of the Clean Water Act that establishes national technology-based effluent requirements for a specific industrial category. (1)

Eligible Actions: Eligible actions are the set of activities identified to improve ecosystem condition and/or counteract environmental damage from other projects. (4)

Enhanced nutrient removal (ENR): The technologies for wastewater treatment plants that can reduce average effluent concentrations to 3 mg/L TN and 0.3 mg/L TP. (2)

Exchange market: Structure that allows buyers and sellers to meet in a public forum (e.g., online) where prices are observed and all products are equivalent. (5)

General permit: A NPDES permit covering a category of dischargers rather an individual facility. (2)

Guidance: see Policy

Landowners: Properties other than crop farms that can generate nonpoint source credits. (2)

Load Allocation (LA): The portion of a receiving water's loading capacity that is allocated under a TMDL to existing or future nonpoint sources of pollution or to natural background sources. (1)

Location Ratio: Factor applied to pollutant reduction credits when sources are upstream of a waterbody of concern that accounts for the distance and unique watershed features between a pollutant source and the downstream waterbody (e.g., bay, estuary, lake, reservoir) or area of interest (e.g., a hypoxic zone in a waterbody). (1)

Maximum Extent Practicable (MEP): The standard for MS4 compliance with NPDES permits. The states' definitions vary. (2)

Measure (*verb)*: To quantify something, usually on a continuous scale, using precise equipment. Contrast with estimate, which typically implies visually estimating without use of equipment. *noun*: something that is measured or estimated, such as the condition of an indicator. (4)

Metrics: The methods, equations, rules, and tools that translate indicators of ecosystem health (e.g. vegetation cover and composition, soils, hydrology) measured at a site and/or landscape scale into "credits" or "debits." (4)

Minimum Control Level: The pollutant load that a point source buyer must first meet before buying credits to meet the facility's baseline. This pollutant load is either the TBEL specified in a permit or the current discharge level, depending on which is more stringent. (1)

Mitigation: Generally, a reduction in impacts. While used generically to refer to actions taken to reduce impacts, a more precise term is offset, if the objective is no net loss as in regulatory programs that call for mitigation or offset of impacts. (4)

Municipal separate storm sewer system (MS4): A defined stormwater area regulated under a NPDES permit. MS4s may be phase I (an urban area of 100,000 or more people) or phase II (a US Census–designated "urbanized area" with fewer than 100,000 people) (2)

National Pollutant Discharge Elimination System (NPDES): The national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Clean Water Act. NPDES permits regulate discharges of pollutants from point sources to waters of the United States. Such discharges are illegal unless authorized by a NPDES permit. (1)

Nonpoint Sources (NPS): Diffuse pollution sources (i.e., without a single point of origin or not introduced into a receiving stream from a specific outlet). The pollutants are generally carried off the land by stormwater. Common nonpoint sources include runoff from agriculture, forestry, urban environments, land disposal, and saltwater intrusion. (1)

Nonsignificant point source: The approximately 4,700 wastewater treatment plants that collectively emit substantially less pollution than do significant wastewater treatment plants. Some nonsignificant plants thus do not face nutrient load limits. (2)

Offset (verb): The act of fully compensating for environmental impacts.

Offset (noun): A credit generated by a party to compensate for environmental harm happening elsewhere. The party typically sells its offsets to polluters or resource users causing the environmental harm.

Overlay Permit: A NPDES permit issued to a group of point source dischargers that supplements individual permits by establishing permit limits and other requirements for one

or more pollutant of concern that are not addressed in the existing individual permits. (1)

Permitting Authority: U.S.EPA (an EPA Regional Administrator) or an authorized state, territory, or tribe. Under the Clean Water Act, most states are authorized to implement the NPDES permit program. (1)

Point Source: Any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural stormwater runoff. (1)

Policy (or Guidance): Policy represents official interpretation or view of specific issues. Guidance documents are published to further clarify regulations and to assist in implementation of regulations (Retrieved from http://www.epa.gov/lawsregs/policy/index.html, 2012).

Publicly Owned Treatment Works (POTW): A treatment works as defined by section 212 of the Clean Water Act (CWA), which is owned by a state or municipality (as defined by section 502(4) of the CWA). (1)

Regulations: Regulations explain the technical, operational, and legal details necessary to implement laws. Regulations are mandatory requirements that can apply to individuals, businesses, state or local governments, non-profit institutions, or others. (Retrieved from http:// www.epa.gov/lawsregs/regulations/index.html, 2012).

Reserve ratio: A trading ratio that allocates a portion of each credit into a reserve pool as insurance against credit failure. The states' definitions vary. (2)

Retirement ratio: A trading ratio that discounts each credit to ensure that a trade results in a net improvement of water quality. The states' definitions vary. (2)

Seller: Sources that reduce pollution above and beyond their baseline requirements, generating credits that can be sold to buyers. Sellers can be point or nonpoint sources.

Sole-source offsets: Structure where sources are allowed to increase pollution at one point if they reduce pollution elsewhere (either on-site or off-site). (5)

Statute: A written law passed by a legislative body (Retrieved from http:// merriamwebster.com, 2012).

Technology-Based Effluent Limitation (TBEL): A minimum level of treatment required in an NPDES permit based on available treatment technologies. For industrial (and other non-municipal) facilities, technology-based effluent limits are derived by: A) using national effluent limitations guidelines and standards established by EPA, and/or B) using best professional judgment (BPJ) on a case-by-case basis in the absence of national guidelines and standards. For municipal facilities, technology-based effluent limits are derived from national secondary treatment standards. (6)

Third parties: Those entities other than government agencies and market participants—such as aggregators, consulting firms, soil and water districts, and environmental organizations—that help administer trading programs. (2)

Total Maximum Daily Load (TMDL): A calculation of the maximum amount of a pollutant a waterbody can receive and still meet applicable water quality standards (accounting for seasonal variations and a margin of safety), including an allocation of pollutant loadings to point sources (wasteload allocations) and nonpoint sources (load allocations). (1)

Trade Agreement: Document that specifies the overall trading policies that trading parties must follow to participate in trading. The NPDES permitting authority would approve the trade agreement and could either reference the terms of the trade agreement in the NPDES permit or include the trade agreement as part of the permit for each point source participating in a trade. (1)

Trading Limit: Level of control on the pollutant discharge the point source seller chooses to achieve, through technology or BMPs, beyond that facility's baseline. (1)

Transaction costs: Costs associated with finding other buyers and/or sellers and undertaking an exchange. (3)

True-up period: The designated time period when point sources may purchase credits to meet the previous year's obligations. (2)

Uncertainty ratios: Trading ratios that account for the variability in nutrient removal efficiencies for agricultural BMPs that may be based on scientific uncertainty or random weather fluctuations. The states' definitions vary. (2)

Validation: The process through which a project developer receives confirmation that their project is eligible to track benefits and potentially sell benefits. (4)

Validator: A validator is an individual or agency approved by the administrator to conduct validations. (4)

Verification: The act of reviewing, inspecting, testing, checking, auditing, or otherwise establishing and documenting whether items, processes, services, or documents conform to specified requirements often undertaken by a third party (an independent institution or individual). (4)

Verifier: A verifier is the person or institution that confirms actions taken on the landscape produce the desired water quality benefits necessary for benefit creation. (4)

Water Quality Criteria (WQC): Elements of state water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of

water that supports a particular use. When criteria are met, water quality will generally protect the designated use. (1)

Water Quality Based-Effluent Limitation (WQBEL): An effluent limitation determined by selecting the most stringent of the effluent limits calculated using all applicable water quality criteria (e.g., aquatic life, human health, wildlife, translation of narrative criteria) for a specific point source to a specific receiving water for a given pollutant or based on the facility's wasteload allocation from a TMDL. (1)

Water Quality Standard (WQS): Provisions of state or federal law that consist of a designated use or uses for the waters of the United States, water quality criteria for such waters based on such uses, and an antidegradation policy. (1)

Waste Load Allocation (WLA): The portion of a receiving water's loading capacity (TMDL) that is allocated to one of its existing or future point sources of pollution. (1)

Glossary Resources: Source is marked by a ( ) at the end of each definition that matches the numbers below:

1. U.S Environmental Protection Agency. (2007). Water Quality Trading Toolkit for Permit Writers, EPA-833-R-07-004. U.S. Environmental Protection Agency.

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