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Article

***337** DESIGNING A NONPOINT SOURCE SELENIUM LOAD TRADING PROGRAM

Susan A. Austin [FNa1]

I. INTRODUCTION

Across the country, there has been a growing movement to regulate discharges from nonpoint sources. Traditionally, federal and state governments have not regulated nonpoint sources, such as farms, as heavily as point sources, such as factories. When regulation of a nonpoint source does occur, it generally takes the form of a regulatory body requiring a nonpoint source to use best management practices ("BMPs") [FN1] to reduce discharge. More recently, regulatory bodies have been exploring market-based regulatory options, such as load trading. Load trading in the nonpoint source context generally involves a point source funding implementation of BMPs at a nonpoint source, thereby reducing discharge from the nonpoint source. In return for its efforts, the point source may discharge more than otherwise allowed. A regulatory agency approves the trade and determines how much credit the point source receives.

The selenium load trading program in the Grassland Drainage Area of California's San Joaquin Valley differs significantly from this model. The selenium load trading program is a cap-and-trade program in which ***338** a regulatory agency sets the cap on the selenium that the Grassland Area Farmers are allowed to discharge. The Grassland Area Farmers, a group of irrigation and drainage districts on the west side of the San Joaquin Valley, administers an internal selenium load trading program. Pursuant to the trading program, the total allowable regional selenium load is allocated among the member irrigation and drainage districts. The districts can either meet their load allocation or buy selenium load allocation from other districts. Regulatory oversight is important to ensure that the regional load targets are met, but trades take place among member districts without regulatory oversight; the Grassland Area Farmers take it upon themselves to monitor discharge from each district.

The theoretical benefits to such a program are threefold. First, the region as a whole should meet its regional load target at less cost than without trading because reduction measures should be taken where they are cheapest to achieve. In addition, the program should spur innovation by bringing decision-making regarding selenium reduction measures to the local level. Finally, the trading program aims to distribute the costs of selenium discharge reduction equitably among the districts.

The selenium load trading program is the first trading program designed for trades among nonpoint sources. Prior to the development of this policy, the conventional wisdom was that nonpoint-nonpoint source trading would not work. [FN2] The reason for this skepticism was that many people believed it was impracticable to establish a cap and allow trading because of difficulties in measuring and controlling discharge. [FN3] In addition, many people doubted that trading would take place without point source funding because the marginal costs among agricultural nonpoint sources would not be sufficiently different to outweigh the transaction cost associated with trading. [FN4] The experience of the Grassland Area Farmers suggests that when measurement of discharge from a nonpoint source is possible, a cap-and-trade load program can be an effective tool in the regulation of discharge from irrigated

agriculture. The selenium load trading program can serve as a model for the design of nonpoint source trading programs elsewhere.

While this Article should be useful to those interested in the regulation of nonpoint sources, it should also be useful to those interested generally in market-based regulatory policies to address any number of environmental problems. Market-based regulatory policies are gaining acceptance ***339** as an alternative to traditional command-and-control policies to address a wide variety of issues, including water quality, air quality, wetlands conservation, habitat preservation, and global climate change. Although much has been written about the theory behind these policies, relatively little has been written about programs that are established and functioning. This case study aims to narrow this gap in the literature. The principles behind market-based policies are the same regardless of the context in which they are applied. Therefore, the experience of the Grassland Area Farmers also sheds some light generally on the issue of using market-based regulatory policies to improve environmental quality.

The selenium load trading program demonstrates that allowing the regulated parties to design their own trading program may be more desirable than having a regulatory agency involved in the details of the design and implementation of the program. The selenium load trading program also shows how the regulatory setting impacts the design of a trading program. Finally, the selenium load trading program in the Grassland Drainage Area demonstrates the importance of collecting adequate information, so that rational decisions can be made regarding the prices and quantities of load traded, and so that the policy can be assessed for effectiveness.

II. REGULATORY MECHANISMS FOR CONTROLLING NONPOINT SOURCES OF DISCHARGES

A. Nonpoint Source Discharges

The Federal Water Pollution Control Act, more commonly referred to as the Clean Water Act ("CWA"), distinguishes between discharges from two types of sources, point sources and nonpoint sources. [FN5] Point sources include factories, water treatment plants, and any other "discernable, confined and discrete conveyance." [FN6] Nonpoint sources include all other discharges, such as farms, timber operations, urban runoff, storm water, erosion, and natural runoff. [FN7] The CWA regulates discharges from point sources with the National Pollutant Discharge Elimination System ***340** ("NPDES") permit program. [FN8] Agricultural discharges, however, are specifically exempt from this program. [FN9] Much has been written about the ineffectiveness of the CWA in regulating nonpoint sources. [FN10]

Regulating discharge from nonpoint sources is more challenging than regulating discharge from point sources for two main reasons. First, nonpoint source discharges are generally small, even though their cumulative impact can be quite large. Identifying and regulating many small dischargers, all of whom contribute to a water quality problem, is more difficult than identifying a single large source or a relatively small number of large sources. [FN11] Second, by definition, nonpoint source discharge is diffuse, rather than from a fixed point. [FN12] This can make it more difficult to measure how much each nonpoint source is discharging. To the extent that discharge from nonpoint sources has been regulated, it has been done by the states through the implementation of BMPs. [FN13] BMPs are

> [M]ethods, 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 and operation and maintenance procedures. BMPs can be applied before, during, or after pollution producing activities to reduce or eliminate the introduction of pollutants into receiving waters. [FN14]

California regulates water quality through the Porter-Cologne Water Quality Control Act. [FN15] The Porter-Cologne Act established the State Water Resources Control Board ("State Board") and nine Regional Water Quality Control Boards ("Regional Boards"). [FN16] These boards develop statewide water quality control plans and regional basin plans. [FN17] Any potential***341** discharger must obtain waste discharge requirements from the appropriate Regional Board prior to discharging waste into a water body. [FN18] Because the State of California administers the NPDES program in California, the waste discharge requirements and the NPDES permit are the same for point sources. [FN19]

California's Porter-Cologne Act does not distinguish between point and nonpoint source discharges. [FN20] Therefore, broad authority exists under the Porter-Cologne Act to regulate nonpoint sources. However, Regional Boards have generally relied upon voluntary implementation of BMPs instead of waste discharge requirements to regulate nonpoint source discharges. [FN21] Alternatively, Regional Boards have relied upon regulatory-based

encouragement of BMPs. [FN22] In general, Regional Boards have refrained from imposing effluent limits on nonpoint dischargers that use BMPs. [FN23]

Against this statutory backdrop, it is easy to see why discharge from point sources has decreased dramatically since the early seventies while nonpoint source discharge continues to be a serious problem in California and across the nation. [FN24] Researchers estimate that about one-third of the nation's rivers, lakes, and estuaries do not meet water quality standards. [FN25] Environmental groups, seeking to decrease discharges from nonpoint sources, have seized upon a section of the CWA that for many years was largely ignored. [FN26] Section 303(d) of the CWA requires each state to identify water bodies for which technology-based effluent limitations are not stringent enough to meet water quality standards, to establish a priority ranking of those waters, and to establish a "total maximum daily ***342** load" ("TMDL") at the level necessary to meet water quality standards. [FN27] In a series of lawsuits across the country, environmental groups have focused attention on TMDLs, and the Environmental Protection Agency ("EPA") is beginning to respond. [FN28]

EPA interprets the TMDL provisions of the CWA to require load allocations for nonpoint sources. The California Farm Bureau and other agricultural and timber interests disagree. The California Farm Bureau argues that nonpoint source regulation should be left to states, while the agricultural and timber industries argue that TMDLs only apply to point sources. [FN29] In Pronsolino v. Marcus, commonly known as the Garcia River Case, the United States District Court for the Northern District of California considered this issue. The Court held that TMDLs are authorized "without regard to the sources of pollution" and that EPA may withhold grant money from states that refuse to implement TMDLs for nonpoint sources. [FN30] In light of this ruling, load allocations for many nonpoint sources may become more common. If so, load trading could become an important tool for many nonpoint sources dealing with regulatory caps on a wide variety of discharges.

B. Economic Incentive Policies

At the same time that there has been a shift in the focus of water quality regulation toward nonpoint sources, there has also been a shift in focus in the types of regulatory tools that are adopted to address all kinds of pollution. Under the traditional approach to environmental regulation--also called a command-and-control approach--regulators set uniform standards and require specific control technologies. Under the newer, market-based or economic incentive approach, regulators create financial incentives that are designed to improve environmental quality. [FN31] These incentives can take many forms, from removing subsidies for environmentally destructive activities, to imposing environmental taxes, to creating a market for buying and selling pollution. [FN32]

***343** The theoretical benefits of economic instruments in comparison to traditional command-and-control policies are well understood:

> In comparison with existing "command-and-control" regulatory policies, economic instruments could in principle contribute to the efficiency and effectiveness of environmental policy .... They could reduce the economic cost of achieving a given level of environmental protection, by allowing polluters greater flexibility in how they achieve the required reduction in pollution. Viewed another way, economic instruments can permit a greater standard of environmental protection to be achieved without increasing the economic costs incurred. They may stimulate more rapid innovation in pollution abatement technologies because they provide an incentive for polluters to seek ways to reduce pollution by more than required for compliance with current regulatory standards. [FN33]

Several important experiments in market-based approaches can be found in the air emissions context. For example, emissions markets in place in the United States include the acid deposition trading program created by the 1990 Clean Air Act Amendments [FN34] and the Regional Clean Air Incentives Market ("RECLAIM") program to control air emissions in the Los Angeles Basin. [FN35] Currently, negotiations are under way for a program of international carbon dioxide trading to address the threat of global climate change. [FN36]

In the context of water quality, market-based approaches in place thus far have been designed for trades between two point sources or between point sources and nonpoint sources. [FN37] Most of these programs do ***344** not abandon the traditional, technology-based regulatory approach entirely, but instead add flexibility to that approach by allowing point sources to fulfill their permit obligations by funding cutbacks in discharges from other sources. [FN38]

III. THE SELENIUM PROBLEM IN THE GRASSLAND DRAINAGE AREA

A. Background

1. Geography of the Grassland Drainage Area

California's Central Valley is an agricultural region that is about forty miles wide and stretches about 450 miles parallel to the Pacific Coast. [FN39] The southern three-fifths of the Central Valley is called the San Joaquin Valley. [FN40] The Grassland Drainage Area is a 97,000-acre region on the west side of the San Joaquin Valley. [FN41] The dominant industry within the Grassland Drainage Area is agriculture, [FN42] and the main crop is cotton. [FN43] Other crops in production include melons, vegetables, alfalfa hay, and grains. [FN44] Orchards and vineyards are also present. [FN45] With rainfall at less than ten inches per year, farmers irrigate almost all the crops in the Grassland Drainage Area. [FN46] Without adequate drainage facilities to carry excess irrigation water and leached salts, farmland becomes waterlogged, ***345** trapping salts and trace elements in the root zone of the crops. [FN47] In California's San Joaquin Valley, inadequate drainage and accumulating salt have been persistent problems for more than a century. [FN48]

2. The Selenium Problem

Selenium is a naturally occurring trace element in the soil. [FN49] When irrigation water passes the root zone of crops growing in soils high in selenium or when water is applied to leach salt from such soils, selenium in the soil dissolves in the water and leaches into the shallow groundwater. [FN50] Because much of the land in the Grassland Drainage Area is underlain by thin, horizontal layers of clay that are fairly close to the surface, subsurface drains must be installed in order to avoid raising the ground water level and damaging the crops. [FN51] Agricultural drainage water is collected in the drains and then pumped out. Selenium collected in these drains goes out with the agricultural drainage water. In the Grassland Drainage Area, loads from districts can be measured directly by measuring water volume and selenium concentrations when the agricultural drainage water is pumped out of the ground. [FN52]

In high concentrations, selenium can be toxic. In 1983, scientists discovered deformities in bird embryos and hatchlings at Kesterson Reservoir, and the problem was traced back to selenium in the agricultural drainage water that flowed into Kesterson. [FN53] Although drainage from the ***346** Grassland Drainage Area did not contribute to the findings at Kesterson, [FN54] the incident alerted people to the potential dangers of selenium in agricultural discharge. Like the lands that had drained into Kesterson, the Grassland Drainage Area is located on the western side of the San Joaquin Valley, [FN55] where selenium is widespread. [FN56] Since the Kesterson disaster, environmentalists, regulators, and farmers have debated how best to regulate selenium discharge from the Grassland Drainage Area.

The most important step in reducing selenium discharge is to prevent excessive deep percolation of water by making improvements in the application of irrigation water. [FN57] On-farm improvements in irrigation methods--such as shortening the length of furrows in furrow irrigation, [FN58] installing sprinkler systems, or using drip irrigation systems--can accomplish this. The installation of subsurface drainage water recirculation systems can provide greater control over the timing of selenium discharges. These systems allow district managers to recycle the drainage water, blending it with the irrigation supply water and reapplying it. [FN59] District managers also can displace drainage water that would otherwise be discharged through the sumps by using subsurface drainage water for sprinkling roadways for dust control [FN60] and by using drainage water to irrigate salt tolerant crops. [FN61]

***347** In regions that control nonpoint sources by mandating BMPs, these engineering and operational activities would probably form the basis of such BMPs. [FN62] In the Grassland Drainage Area, however, BMPs are not required. Instead, economic incentive policies encourage district managers and farmers to reduce selenium discharge by whatever means they find to be most effective.

3. Drainage of Agricultural Discharge from the Grassland Drainage Area

Historically, surface and subsurface drainage from the Grassland Drainage Area was discharged to the San Joaquin River through the channels of the Grassland Water District, a wetland area. [FN63] The Grassland Water District uses these historic discharge channels for deliveries of their fresh water. [FN64] Prior to the Kesterson disaster, the

freshwater deliveries were mixed with the drainage discharges from the Grassland Drainage Area. [FN65] Following the incident at Kesterson, the freshwater deliveries and the drainage water were kept separate by reducing the number of channels that carried drainage water and by alternating the remaining channels between fresh water and drainage water. [FN66] The region used a system whereby the Grassland Water District would use some of the channels for its deliveries and the Grassland Drainage Area would use the others for its drainage. [FN67] Then the two would "flip-flop" so that fresh water could be supplied to the entire wetland area. [FN68] This practice proved cumbersome. [FN69] With the passage of the Central Valley Project Improvement Act of 1992, the Grassland Water District received additional fresh water supply. [FN70] Without exclusive use of the channels, it became difficult to deliver this water to the wetlands at optimal times for habitat management. ***348** [FN71] Furthermore, drainage water flowing through the wetland channels meant that there was still some exposure of fish, wildlife, and humans to selenium. [FN72] The Grassland Water District and the environmental community pressured the government to eliminate drainage water from the wetland channels. [FN73] Recognizing that stringent water quality standards in the wetland channels were imminent, the Grassland Area Farmers sought to bypass the Grassland Water District by using twenty-eight miles of the San Luis Drain ("the Drain"). [FN74] They accomplished this goal by developing the Grassland Bypass Project, which began operation in the fall of 1996. [FN75] Before they were permitted to use the Drain, however, they were required to agree to certain conditions that are described in detail in the following section.

B. Regulation of Selenium Discharge from the Grassland Drainage Area

In order to understand the development of the selenium load trading program in the Grassland Drainage Area, it is helpful to explore the regulatory setting that was in place in the region when the program was developed. This section traces the history of regulation of selenium discharge from the Grassland Drainage Area. It starts with a discussion of the Agreement for Use of the San Luis Drain ("Use Agreement"), [FN76] which set a cap on the selenium load the region could discharge. The Use Agreement also resulted in a commitment on the part of the irrigation and drainage districts within the Grassland Drainage Area to form a regional drainage entity for the purpose of managing selenium discharge from the region. [FN77] The regional drainage entity is called the Grassland ***349** Area Farmers. [FN78] Specifically, the irrigation and drainage districts, which are local government bodies, entered into an agreement ("Activity Agreement") under the legal umbrella of the San Luis & Delta-Mendota Water Authority to exercise common powers for the purpose of managing agricultural drainage. [FN79] With the cap and the regional drainage entity in place, the stage was set for the development of the selenium load trading policy.

1. Limits on Selenium Load Discharge

Before districts within the region could allocate and trade load among themselves, a cap was necessary for the region as a whole. The Use Agreement authorizes the Grassland Area Farmers to use a portion of the Drain in order to divert their drainage water away from the historical drainage channels. [FN80] The Use Agreement is an agreement between the United States Bureau of Reclamation, which owns the Drain, and the San Luis & Delta-Mendota Water Authority, which is a joint powers authority that includes the irrigation and drainage districts that make up the Grassland Area Farmers. [FN81] Joining the Bureau of Reclamation at the negotiation ***350** table were EPA, the U.S. Fish & Wildlife Service, environmental interests, and local governments downstream. [FN82]

In exchange for use of the Drain, the San Luis & Delta-Mendota Water Authority, on behalf of the Grassland Area Farmers, agreed to measures that minimize negative environmental impacts. [FN83] These measures include a schedule of monthly and annual load values limiting the total amount of selenium that the region may discharge. [FN84] These load values are based on historical averages. [FN85] They begin to decrease after the first two years of the project, calling for a 15% reduction in selenium load discharged to the San Joaquin River by the end of the fifth year of the project. [FN86] The Use Agreement also includes a schedule of incentive fees that the Grassland Area Farmers must pay to the Bureau of Reclamation if their discharge exceeds the monthly or annual regional load values. [FN87] These incentive fees increase for each year of the project. [FN88] An Oversight Committee then determines how these funds can be used to assist the Grassland Area Farmers in meeting the selenium load values. [FN89] Perhaps most significantly, the Use Agreement also imposes a cap whereby the Grassland Area Farmers would be cut off from using the Drain should their discharges exceed the target by 20% of the annual load value. [FN90]

***351** 2. Regional Drainage Entity: The Grassland Area Farmers

A regional drainage entity, such as the Grassland Area Farmers, is important because of hydrologic and economic linkages among local water agencies [FN91] and because it forms an entity that is politically responsible for drainage issues. [FN92] The governing body of the Grassland Area Farmers is the Grassland Basin Drainage Steering Committee ("Steering Committee"). [FN93] The Steering Committee is made up of representatives of the districts that signed the Activity Agreement. [FN94] All actions of the Steering Committee require the unanimous vote of a quorum of Steering Committee Members that are present, [FN95] and each of the districts in the Grassland Area Farmers must ratify all rules of the Steering Committee before such rules can come into effect. [FN96] Although they cannot vote, representatives of the U.S. Bureau of Reclamation, the California Department of Fish and Game, and the Central Valley Regional Water Quality Control Board participate in the Steering Committee meetings. [FN97]

The executive officer of the Steering Committee is the Regional Drainage Coordinator. [FN98] The Regional Drainage Coordinator compiles and circulates all regional data, prepares all necessary reports, and represents the Grassland Area Farmers at meetings and hearings. [FN99]

3. Requirements for Continued Use of the Drain

The Use Agreement allowed use of the Drain for two years--water years 1997 and 1998. [FN100] The Use Agreement allowed renewal for no more than three years if certain conditions were met. [FN101] One condition for renewal was that the Central Valley Regional Water Quality Control Board adopt and implement Basin Plan amendments and measures consistent ***352** with the environmental protection recommendations included in a 1995 Consensus Letter. [FN102] In May 1996, the Regional Board adopted such amendments and is currently implementing them. [FN103]

Another condition of renewal was that the Regional Board issue waste discharge requirements to the San Luis & Delta-Mendota Water Authority for discharges from the Drain. [FN104] These waste discharge requirements were to be consistent with the recommendations in the Consensus Letter, and the San Luis & Delta-Mendota Water Authority was required to operate the Drain in accordance with these requirements. [FN105] The Regional Board issued these Waste Discharge Requirements on July 24, 1998. [FN106]

Having determined that the conditions were met, the Bureau of Reclamation extended the use of the Drain in 1999 for an additional three-year period ending September 30, 2001. [FN107] Use of the Drain beyond the three-year renewal period required completion of an environmental impact statement under the National Environmental Policy Act. [FN108] The Grassland Area Farmers and the Bureau of Reclamation have distributed a draft environmental impact statement and environmental impact report for continuation of the Grassland Bypass Project through 2009. [FN109]

IV. DESIGNING THE TRADING PROGRAM

The decentralized regulatory approach adopted to address the issue of selenium discharge from the Grassland Drainage Area made development of a cap-and-trade program possible. The trading program is the result of a collaborative effort among a number of individuals, many of whom often held opposing viewpoints on drainage issues. The initial design ideas for the trading program were explored at meetings of the Economic Incentives Advisory Committee ("Advisory Committee"), a committee convened to advise the project director, the Author, on the design and implementation of the selenium load trading program. [FN110] The Advisory ***353** Committee included four members: a farmer, [FN111] a regulator, [FN112] an environmentalist, [FN113] and an academic. [FN114] The project director then took the Advisory Committee's proposals to the Steering Committee members for their input and eventual passage. As with any rule passed by the Steering Committee, the rules establishing a trading program had to be ratified by each of the member districts before taking effect. [FN115]

With the exception of one EPA representative serving on the Advisory Committee, federal and state regulators were not involved in the design and implementation of the trading program. Local participants worked out the details of the program.

Designing the trading program took about a year and a half. The design process started in spring 1998. The first trading program was adopted by the Steering Committee in June 1998 for water year 1998. [FN116] During the next

six months, the design of the trading program was amended, and the Steering Committee adopted a tradable loads rule for water year 1999 on January 18, 1999. [FN117] The Steering Committee adopted a tradable loads rule for water year 2000 that is similar to the 1999 rule. [FN118] Unless another version of the rule is specifically mentioned, this discussion refers to the 2000 tradable loads rule, which can be found in Appendix A.

In designing the selenium load trading program, the first step was allocating load among districts. The second step was adopting a penalty structure to enforce that allocation. The last step was adopting rules for trading. Adequate monitoring was already largely in place. Once the Grassland Area Farmers had allocated load among the member irrigation and drainage districts and adopted a penalty structure and other rules for trading, it was up to the individual districts to decide whether to buy or sell load, and at what price.

***354** A. Allocation of Selenium Load Among Districts

Allocation of selenium load is a necessary first step in the implementation of a cap-and-trade program. During the first year of the Grassland Bypass Project, the Grassland Area Farmers did not allocate load among the member districts. In March 1998, the Steering Committee passed a rule to do so. [FN119] The regional allocation set forth in the Use Agreement was divided among the member districts according to a formula based on historical load, number of acres that are underlain by subsurface drains, [FN120] and number of total acres in the district. [FN121] Each factor was weighted evenly. [FN122] As part of the allocation process, the first "trade" took place. One small district permanently traded its load allocation in the fall months for some of one large district's load in the spring. Because there is little to no irrigation during the fall, selenium loads in the fall are easier to meet. The large district agreed to the trade in order to make the load allocation acceptable to the small district. [FN123]

B. Designing a Penalty Structure

1. The Foundation for the Penalty Structure: Regional Incentive Fees

The greatest challenge in designing the selenium load trading program was creating a penalty structure to enforce the allocation of selenium load among the market participants. The Grassland Area Farmers sought to develop the trading program as one of a number of policies designed to achieve the requirements set forth in the Use Agreement. Therefore, it made sense to base the penalty structure of the trading program on the Use Agreement incentive fees. However, the structure of the regional incentive fees hindered the development of a sensible penalty structure because the incentive fees decline per pound as discharge increases and because the percentage brackets can produce arbitrary fluctuations in the severity of the fees.

***355** The fee structure in the Use Agreement is based on percentage brackets. Recall that the Grassland Area Farmers must pay incentive fees for exceeding the regional load targets in any month or in any water year. [FN124] These incentive fees are stated in terms of flat fees for any exceedance within a certain percentage bracket. [FN125] For example, the annual load target for water year 1999 was 6327 pounds of selenium. Exceeding the annual load target for water year 1999 by 0.1% to 5% would result in an incentive fee of $63,000, and exceeding the annual load target by 5.1%-10% would result in an incentive fee of $92,000. When the fee per pound of selenium load discharge exceeding the load target is plotted against the total pounds of exceedance for a given month or year, the result is a declining curve with spikes. The shape of the curve and the spikes are both problematic, as discussed below. The incentive fees for each month and for each year of the project follow the same trend. Figure 1 demonstrates the curve of the annual incentive fees for water year 1999.

a. Declining Curve

The concern with a declining incentive fee curve is that it leaves open the possibility of an onerous fine for a small exceedance or an insufficient fine for a great exceedance. As can be seen in the graph, the incentive fees start at a high price per pound for a small amount of exceedance and then fall dramatically until the Grassland Area Farmers would be cut off from using the Drain. For example, the price per pound in water year 1999 varied from over $9,000 per pound if the region exceeded its load value by seven pounds, to $119 per pound just before the region would be cut off from using the drain. That is, if the region discharged 1265 pounds above its annual target and just fell under the 20% cutoff, the fine would be $119 per pound.

The concern with the declining curve is that it is contrary to what economic theory suggests would be a rational fee

structure. According to economic theory, the incentive fees should be based on some measure of the externality created by the selenium discharge of the Grassland Area ***357** Farmers. [FN126] In practice, measuring the magnitude of an externality and placing a dollar figure on it is extremely difficult. [FN127] At a minimum, however, the incentive fees should have a realistic curve. It is likely that each additional pound of selenium load discharged above the load level has a greater impact on environmental quality than the previous pound. Therefore, instead of having a declining curve, the incentive fees should start at a low price per pound and then rise, or at least remain flat.

Figure 1: Regional Incentive Fee Structure

Incentive Fee per Pound of Selenium Load Discharge Above the Regional
Allocation (Annual Incentive Fees for Water Year 1999)
TABULAR OR GRAPHIC MATERIAL SET FORTH AT THIS POINT IS NOT DISPLAYABLE
Graph courtesy of Carl Mahr.

The main concern in setting the fee structure is the fairness of the fees rather than a concern that the districts will attempt to take advantage of "bargain prices" at the right hand side of the curve. That scenario is unlikely for three reasons. First, the district managers place a high value on the public relations benefits of demonstrating good faith. Second, the threat of being cut off from the Drain is serious enough that the district managers would not want to discharge at levels anywhere near the cutoff point. Third, although the price per pound of exceedance generally falls as more selenium load is discharged, the district managers still have to pay more in absolute terms as they move into higher exceedance brackets.

b. Spikes

The spikes in the declining curve also impeded the design of a rational penalty structure. As the number of pounds of exceedance increases, the price per pound occasionally shoots up. It does so at the beginning of each percentage exceedance bracket. Then it declines gradually until the next exceedance bracket begins. Because of these spikes, the amount that the Grassland Area Farmers would have to pay per pound of exceedance varies dramatically. Again, the concern here is not that the district managers may try to take advantage of the spikes; it is unlikely that district managers could control selenium load discharge with enough precision to do so. Rather, the concern about the spikes, like the concern about the declining price per pound, is one of creating a rational and fair penalty structure for the trading program.

When the incentive fees were first created, the Grassland Area Farmers did not allocate load among the member districts; all districts ***358** shared the burden for payment of incentive fees regardless of the level of their own discharge. [FN128] When load was allocated among member districts and when the tradable loads rule introduced an enforcement scheme that required each of those districts responsible for the regional exceedance to pay their proportion of the incentive fees, the risk of an extremely large penalty for a relatively minor infraction became more serious.

Although the aim of the trading program penalty structure was to lessen the unpredictability and the risk imposed by these spikes, any penalty structure based on the incentive fees would impose some risk that a district's discharge would happen to be at the beginning of an incentive fee bracket when the incentive fees per pound were relatively high. It is conceivable that, after several years of the trading program, the penalty structure would impose unfair fines on an unlucky district. This problem could easily be remedied by altering the incentive fees imposed at the regional level. Instead of having percentage brackets, the regional incentive fees should be calculated on the basis of a per pound fee that either rises gradually or stays flat. [FN129]

Altering the incentive fees imposed at the regional level would not have been possible in the short run, so the Advisory Committee and the Steering Committee examined ways to make the best penalty structure possible for the trading program within the existing structure of the incentive fees.

2. A Beginning: The First Penalty Structure

In water year 1998--the first year that the Grassland Area Farmers allocated selenium load among member districts and instituted a trading program--the Grassland Area Farmers adopted a penalty structure in which each member

district was responsible for its proportional contribution to any regional exceedance of the regional target. [FN130] Specifically, a district's share of any incentive fee assessed was calculated by dividing the district's exceedance (in pounds) by the total of all districts' exceedances (in pounds). [FN131]

In the rule for water year 1998, districts exceeding their selenium load allocation only had to pay a penalty if the region as a whole went over its regional target. Districts that benefited the region by going under ***359** their selenium load allocation did not receive any financial benefit. Meanwhile, districts that exceeded their load allocation could receive a financial benefit (in the form of lessened or no fines) based on the region's overall performance.

District managers and Advisory Committee members concluded that it would be more fair if the rule provided that districts would face a penalty whenever they exceeded their load allocation, even if the region as a whole did not incur incentive fees. [FN132] For water year 1999, the Advisory Committee and the Steering Committee sought to create a penalty structure that would be fair for all districts, would create the right incentives, and would be easy to implement. They considered the following alternatives.

3. Alternatives Examined

Alternative 1: Penalty Based on Price Per Pound of Selenium Discharged, with Penalty Pegged to Incentive Fee Structure. Under the first alternative, a district's penalty would be whatever the regional incentive fees would have been if the district had been the only district to exceed its selenium load allocation, and if all other districts discharged the exact amount of their selenium load allocations. [FN133]

Recall that pursuant to the incentive fees, if the region exceeded its selenium load value by any amount within a certain percentage bracket, say 0.1% to 5%, the entire region would pay a flat fee. [FN134] Charging an individual district the full amount in any given bracket could result in a tremendous burden on the district. [FN135] Multiplying the number of pounds of a district's exceedance by the price per pound of exceedance as revealed by the incentive fee structure would solve this problem. [FN136]

Because of the structure of the incentive fees, however, basing the penalty on a flat fee derived from the incentive fees would be complicated and inequitable. [FN137] If a district happened to fall at the lower end of a Use Agreement percentage bracket, the price per pound could be very high; if a district happened to be at the upper end, the price per pound ***360** would be considerably lower. [FN138] This discrepancy in price per pound would make it difficult for districts to figure out the price at which to buy and sell selenium load allocation. [FN139] It could also lead to trades that would merely adjust districts within percentage exceedance brackets without equalizing marginal selenium control costs among districts. [FN140] This alternative was therefore rejected by the Advisory Committee.

Alternative 2: Penalty Based on Percentage Exceedance of Selenium Load Allocation, with Penalty Pegged to Incentive Fee Structure. Under Alternative 2, a district's penalty would be its proportional share of what the regional penalty would have been if all districts had exceeded their selenium load allocations by the same percentage as that district exceeded its selenium load allocation. [FN141] This alternative is inequitable, however, as districts may face different fines for discharging the same number of pounds above their selenium load allocation. [FN142] Alternative 1 resulted in different prices per pound of selenium as the number of pounds discharged changed, but at least all of the districts faced the same schedule. [FN143] Like Alternative 1, Alternative 2 was rejected because it would not encourage districts to trade to equalize marginal costs of selenium discharge control; rather it would encourage them to trade merely to equalize differential penalties. [FN144] In addition, it presents the problem that the fines collected could potentially exceed or fall short of the regional incentive fees.

Alternative 3: Penalty Based on a Flat Price per Pound of Selenium Discharged, with Penalty Loosely Based on Incentive Fee Structure. This alternative is a penalty structure that consists of a flat price per pound. [FN145] Unlike Alternatives 1 and 2, trades would be motivated by differential marginal costs of selenium control because every district would face the same penalty. [FN146] In addition, under this alternative it would be easier for districts to figure out the prices at which to trade. [FN147] Ease of trading would theoretically result in more trades and achievement of the least cost solution to regional selenium discharge control. [FN148]

***361** The flat price per pound could be based loosely on the incentive fee price per pound. [FN149] Therefore, the

total amount collected by the Grassland Area Farmers should approximate the amount necessary to pay the incentive fees. [FN150] If the Grassland Area Farmers collected too much in a given year, they could either put the money in a general fund to be disbursed as seen fit or redistribute the money to districts via rebates. [FN151] If the Grassland Area Farmers collected too little in a given year, they could either take the remainder from the general fund, or charge those districts that exceeded their selenium load allocation their proportional share of the additional amount due. [FN152] The benefit to taking the remainder from the general fund would be to insulate individual districts from incurring extremely high fines should the Grassland Area Farmers happen to be at the beginning of a percentage bracket where the fines per pound are higher. [FN153]

The Steering Committee did not adopt a flat fee penalty structure, in large part because it could involve collecting large sums of money from the districts and then redistributing it among them. In addition, calculating a reasonable penalty price per pound would be difficult, given the structure of the regional incentive fees.

Alternative 4: The Selected Alternative. The selected alternative retains the basic idea of the Grassland Area Farmers' penalty structure for water year 1998 whereby all districts that exceed their selenium load allocation must pay their proportional share of the incentive fees. In addition to the incentive fee penalties, there is a rebate system in order to compensate districts that conferred benefit on the region by going under their annual selenium load allocation. All penalties and rebates are calculated once, at the end of the year, after all the final discharge numbers are available.

In theory, rebates should not be necessary for the trading program to reach the least-cost solution to selenium discharge reduction. [FN154] If the market is functioning properly, then as long as some districts exceed their selenium load allocation, there will not be any districts that are under their selenium load allocation. Those that are over will buy selenium load allocation from those that are under. [FN155] If for some reason districts chose ***362** not to engage in trades that would be mutually beneficial, however, the region would not reach the least-cost solution to the selenium reduction problem. [FN156] A rebate system could bring the region somewhat closer to achieving this. [FN157] Given that the rebate system had some potential to make the penalty system fairer and at worst would be redundant, the Advisory Committee recommended a rebate system to the Steering Committee and the Steering Committee adopted one. [FN158]

Several district managers favored having the rebate system apply only to annual loads to allow greater operational flexibility than having monthly targets as well. [FN159] In addition, having fees and rebates only for annual loads would be simpler. [FN160] Ultimately, the Steering Committee adopted a penalty structure for water year 1999 that included both monthly and annual targets, [FN161] primarily because the region faces both under the Use Agreement. [FN162]

The rebate is based on a flat amount. [FN163] Although districts still face some uncertainty regarding the penalty they would face for exceeding their annual selenium load allocation, basing the rebate on a flat amount reduces that uncertainty somewhat.

The rebate amount was intended to be low enough so as not to distort the market and reduce economic efficiency. [FN164] In setting the rebate level, the Grassland Area Farmers selected the lowest price per pound of annual exceedance that would be possible under the Use Agreement. In other words, the adopted structure set the annual rebate at the level that would be assessed under the incentive fees just before the Grassland Area Farmers would be cut off from the Drain. In water year 1999, that was about $120 per pound of selenium. [FN165] The Grassland Area Farmers set the ***363** monthly rebate at about $50 per pound of monthly exceedance in water year 1999. [FN166] Because the regional incentive fees increase every year, [FN167] the rebate amounts in the rule for water year 2000 rose to $170 for the annual rebate and $70 for the monthly rebate. [FN168]

In the spirit of keeping the amount of the transfer through the rebate system low, the rebate is calculated by multiplying the rebate amount by the lesser of (1) the cumulative number of pounds of exceedance of all districts in excess of their selenium load allocation or (2) the cumulative number of pounds of underage of all districts that went under their selenium load allocation. [FN169]

The selected penalty structure offers several benefits. First, it builds on what the Grassland Area Farmers were already doing, rather than starting anew. Second, it offers some level of compensation to those districts that go under

their selenium load allocation, while sufficiently limiting the amount of the rebates. The main drawback of the selected penalty structure is that, because it is based on the Use Agreement penalty structure, it carries forth the latter's odd characteristics.

4. Exceptions to the Penalty Structure: Storm Events and Out-of-Area Flows

One of the difficulties in regulating selenium discharge from the Grassland Drainage Area is that the farmers and district managers do not have complete control over the discharge. Recall that irrigation efficiency improvements can decrease selenium discharge. [FN170] Rainfall, however, can increase selenium discharge.

The current Use Agreement does not differentiate between allowable discharges in wet or dry years. [FN171] In designing their own internal regulation, however, the Grassland Area Farmers chose to include provisions to account for the impact of storms. Noting that "[t]here are impacts on selenium loads from extraordinary storm events [such as] discharges from coast range streams and increased discharges due to excessive local rainfall," [FN172] the rule provides that member districts are not obligated to pay ***364** penalties under the tradable loads rule for exceedances caused by a storm event. [FN173]

In practice, storm events are determined on a month-by-month basis, with the Regional Drainage Coordinator declaring a particular month to be an extraordinary storm event. [FN174] Of course, the region as a whole is still obligated to pay incentive fees for any exceedance of the regional target. Under the extraordinary storm events provision, however, the incentive fees are paid from the general fund of the Grassland Area Farmers. [FN175] This is an exception to the general rule that each member district is assigned a portion of the incentive fees according to its proportional share of the exceedance. [FN176] The rationale behind the exception is that storm event discharges are regional discharges, not district discharges, so the general rule for district discharges should not apply. [FN177]

Some members of the Advisory Committee questioned the necessity of including an exception for extraordinary storm events. [FN178] If storm events impact all districts evenly, taking into account the flows from outside the region that impact the member districts unevenly, then the allocation among member districts may also be fair during storm events. [FN179] The rationale behind the rule, however, was that storm events do impact districts unevenly, particularly because storm events increase subsurface flow from outside the district, and the subsurface flow impacts member districts unevenly. Because the impacts cannot be measured, the Grassland Area Farmers decided to make the region as a whole accountable for exceedances during extraordinary storm events.

Even when storm events are not present, the Grassland Area Farmers must contend with out-of-area flows. These include subsurface and surface flows that bring selenium into the Grassland Drainage Area. Currently there is no provision in the tradable loads rule to account for out-of-area subsurface flow. Although the district managers are convinced that selenium reaches their districts through subsurface flows from outside of the district, no one has been able to measure accurately the impact of subsurface flow. Because surface flow is easier to measure, it is less of a challenge to deal with than subsurface flow.

***365** The main surface flow of selenium-laden water into the Grassland Drainage Area is Panoche/Silver Creek. The Grassland Area Farmers addressed this issue in the tradable loads rule. [FN180] The rule notes that:

> Even in periods not classified as extraordinary storm events, there are impacts on selenium loads from storm events that trigger surface flows through Panoche/Silver Creek. These exceedances shall not be solely the responsibility of those [member districts] that simply convey the surface water flows to prevent damage to other [member districts]. [FN181]

The rule requires the Regional Drainage Coordinator to determine as closely as possible the exceedances caused by flows of Panoche/Silver Creek. [FN182] Member districts are released from making payments for those exceedances under the tradable loads penalty structure. [FN183] Instead, like incentive fees attributable to exceedances caused by extraordinary storm events, incentive fees attributable to exceedances caused by Panoche/Silver Creek are paid by the Grassland Area Farmers out of the general fund. [FN184]

C. Rules for Trading

1. Permissible Buyers

Under the terms of the Use Agreement, only districts that are parties to the Use Agreement may discharge into the Drain. [FN185] Nevertheless, it is conceivable that others, such as government agencies or environmental groups, could have bought selenium load allocation in order to decrease the amount of selenium that is discharged into the river. [FN186]

At first glance, it appears that allowing sales of selenium load allocation to outsiders would not negatively impact the Grassland Area Farmers, because all trades would be voluntary between the buyer and ***366** the seller. The Advisory Committee felt that expanding the buyer pool would strengthen the market and suggested that a buyer of selenium load allocation need not be a member of the Grassland Area Farmers. [FN187] The Grassland Area Farmers, however, decided to allow only member districts to buy load. [FN188] One reason cited for the change was to reduce competition that potential buyers of selenium load allocation would face. [FN189] Another reason was to prevent a district from selling out to the Bureau of Reclamation or other groups and reducing the total amount of selenium to be discharged by the region. [FN190] The regional load targets were already difficult to meet, and the Grassland Area Farmers felt that the load that had been allocated to the region would be needed within the region.

2. Trades Causing Exceedance

Provision IV.E of the 1999 Tradable Loads Rule originally stated that "[a]ny trade of [selenium load allocation] may not cause any exceedance of the monthly or annual selenium load values ...." [FN191] Some Advisory Committee members interpreted this provision as preventing districts from attempting to use trades to increase the regional load values. [FN192] At least one member of the Advisory Committee, however, interpreted this provision to mean that parties exceeding their allocation could not trade if the region was going to exceed its selenium load value. [FN193] Because it is not always possible to know in advance whether the region would exceed the selenium load values, the Steering Committee amended the text to read: "Any trade of [selenium load allocation] may not be designed to cause any exceedance ...." [FN194]

***367** 3. Retroactive Trades

The trading rules provide that a "trade may alter a [member district's selenium load allocation] for any month and any year, whether that month or year is in the past, present, or future." [FN195] Monitoring in the Grassland Drainage Area allows the districts to have contemporaneous knowledge of their discharge to some degree, but the final numbers are not available until several months later. The Grassland Area Farmers felt that allowing retroactive trades reduced their risk by allowing them to seek trades after they knew their discharge numbers. They therefore adopted a rule allowing retroactive trades.

4. Mechanism for Trading

Several mechanisms may be used to make trading possible. One is the use of brokers. For example, in the sulfur dioxide emissions trading program, 80% of external trades are made through brokers. [FN196] A second mechanism is a clearinghouse. A clearinghouse is an "open trading system in which buyers and sellers post their asking prices and selling prices." [FN197] An example of this type of system is the Westlands water market, which uses an Internet sell board and buy board. [FN198] A third mechanism--the one used in the Grassland Drainage Area Trading program--is bilateral negotiation. [FN199] In other words, a trade takes place by agreement of two parties--a buyer and a seller. [FN200] Bilateral negotiation makes sense in the Grassland Drainage Area because the region is relatively small and the district managers interact with one another regularly, at least once a month at the regular meetings of the Steering Committee. This process is aided by the Regional Drainage Coordinator, who assists in the negotiation process by "sharing information as appropriate." [FN201]

The trading program did not place many requirements on the trading parties. District managers needed only to negotiate a trade, memorialize ***368** the trade in a contract, and submit the contract to the regional drainage coordinator. [FN202] The sample trading agreement in Appendix B served as a template.

5. Monitoring and the Role of the Regional Drainage Coordinator

Pursuant to the tradable loads rule, the Regional Drainage Coordinator maintains records of the trades and the

resulting changes to each member district's selenium load allocation. [FN203] The Regional Drainage Coordinator also monitors each member district's compliance with the monthly and annual selenium load allocation. [FN204] Finally, the Regional Drainage Coordinator reports the data to the Steering Committee. [FN205]

Because the Regional Drainage Coordinator was responsible for monitoring and reporting efforts pursuant to the requirements of the Use Agreement prior to the trading program, the structure was already in place for a well-functioning trading program within the region. [FN206] The only remaining issue regarding monitoring was whether districts wanted to spend additional money to improve the accuracy of the monitoring beyond what was already required to assure themselves that the trading program was being implemented fairly. [FN207]

At least for the time being, the Grassland Area Farmers have accepted the current level of inaccuracy. Much discussion remains among district managers regarding how to best take into account subsurface flow from outside the district. Ideally, district managers would like to be able to measure loads attributable to flow from outside the district in order to address this perceived inequity issue.

6. Whether To Set the Price of Selenium Load Allocation

The price of selenium load allocation is determined by the market. Some members of the Steering Committee had suggested that the Regional Drainage Coordinator set the price at which districts would trade selenium load allocation. [FN208] There is some precedent for setting prices in a water market. Advisory Committee members noted that "in the past the state drought water bank has set the prices for buying and selling water, ***369** and this experience may have led people to believe that the price should be set." [FN209]

Other Steering Committee members felt that getting the price would place too much of a burden on the Regional Drainage Coordinator. [FN210] Moreover, one of the benefits of a trading program is that it allows the region to meet its target at a lower overall cost than without trading. Each district has a different cost of selenium load discharge abatement. With trading, districts with higher abatement costs can purchase load from those with lower costs. The freer the market, the greater the potential cost savings for the region. Several Advisory Committee members felt that "having the state set the buying and selling prices of water resulted in a poorly functioning market." [FN211] As there appeared to be no compelling reason to interfere with the market, the group decided to insert language to state that the Regional Drainage Coordinator will facilitate trades among districts rather than set prices. [FN212]

7. Framework for Determining the Quantity and Price for Selenium Load Allocation Trades

The district managers experienced some difficulty in determining a fair price at which to trade. Therefore, the Author, as project director of the selenium load trading project, distributed a memorandum in an effort to assist them. The memorandum instructs district managers to decide levels and price of trades based on costs of abatement and how close districts are to their selenium load allocation target. This memorandum may be found in Appendix C.

Determining a reasonable price for trades was the greatest challenge in implementing the trading program. The Grassland Area Farmers had difficulty determining the costs and benefits of the various activities that reduce selenium discharge. [FN213] As the trading program matures, improvements in data collection should enable the district managers to make more informed pricing decisions.

8. Making Records Public

One source of unease among some district managers and farmers in the Grassland Drainage Area was whether and how to make trading ***370** agreements public. The Advisory Committee had recommended the following language for provision V.C: "Trading Agreements, records of changes in each Member/Participating Party's selenium load allocation, and monitoring results shall be available to the public for inspection." [FN214] The Advisory Committee felt that making records public was important because the trading program was a new development in regulatory policy and could serve as a model elsewhere. Indeed, the umbrella agency for the Grassland Area Farmers had made a strong commitment to share information so that EPA could learn from the region's experience with economic incentive programs. [FN215]

Some Steering Committee members, however, were concerned that this provision would make public the discharge data from individual sumps and non-public agencies' areas--areas that are not required to disclose discharge data. [FN216] Others were more concerned about making sure that the data released were accurate. [FN217] The group therefore adopted the following language in the 1999 Tradable Loads Rule:

The Steering Committee shall review all Trading Agreements, records of changes in each [member district's selenium load allocation], and monitoring results connected with the tradable loads program. Once the Steering Committee has reviewed this information for accuracy and clarity, the Steering Committee shall release this information to the public provided that inaccurate or unclear information will not be released until it is corrected or clarified. [FN218]

This language raised some concerns about Brown Act violations. [FN219] In California, the Brown Act and the Public Records Act govern the responsibilities of government agencies to release information to the public. [FN220] In response to concerns about Brown Act violations, the Grassland Area Farmers settled on the following language: "The Regional Drainage Coordinator shall report to the Steering Committee on the data collected ***371** through the monitoring program. Once the Steering Committee has reviewed this information for accuracy and clarity, the Steering Committee shall release this information to the public." [FN221]

D. Other Issues

Designing the selenium load trading program in the Grassland Drainage Area involved extensive discussions pertaining to the allocation of the load, the penalty structure, and the rules for trading. Several issues that could potentially be important topics of discussion in the design of trading programs elsewhere were not particularly important here. This section briefly discusses why hot spots, trading ratios, and takings issues did not generate much discussion in the Grassland Drainage Area.

1. Hot Spots

"Hot spots" are an area of concern in the context of environmental trading policies. [FN222] A hot spot occurs when, in trading to decrease the regional levels, traders concentrate the pollutant in specific areas within the region. [FN223] The hot spot issue was not a concern in the Grassland Drainage Area trading program because with or without the program, all of the selenium discharged from the region goes through the same channel to the San Joaquin River. In other words, the trading program could not shift selenium load discharge from one area to another.

2. Trading Ratios

Regulators often use trading ratios to ensure that trades lead to improvements in environmental quality. The basic idea is that for every unit of discharge that a seller sells, the buyer receives an amount less than that unit. In the water quality context, trading ratios are typically used when a point source funds discharge reductions from a nonpoint source. [FN224] For example, a 2:1 ratio means that two units of discharge reduction from a nonpoint source are needed to offset one unit of discharge increase from a point source. [FN225]

Trading ratios are used to address two major concerns. First, trading ratios may be used when the seller's discharge cannot be monitored directly***372** and therefore must be estimated. This is typical when a point source buys load from an unregulated nonpoint source. A trading ratio is used to mitigate the uncertainty about the effectiveness of nonpoint source controls. [FN226] Second, trading ratios may be used when the seller is downstream of the buyer. For example, nonpoint source controls have less water quality benefit if they are installed downstream of the point source buying the controls. [FN227] Trading ratios are designed to bring about an overall environmental benefit despite this situation.

In the Grassland Drainage Area, neither of these concerns is present. Selenium discharge from each district and from the region as a whole is monitored at the outflow and all the discharges enter the river at the same location. Therefore, trading ratios are not necessary. In addition, implementing trading ratios would not be politically feasible in the Grassland Drainage Area. The trading program is an internal program that the Grassland Area Farmers adopted as one of their tools to achieve selenium load reductions to meet their regional targets. Unlike an environmental regulatory agency, the Grassland Area Farmers did not seek to further lower their cap on discharge. Moreover, trading ratios would have increased the cost of trading and could potentially have prevented some trades from taking place that would have moved the region towards meeting its environmental goals at the least cost.

Therefore, the Grassland Area Farmers did not include trading ratios in their selenium load trading policy.

3. Takings Issues

Another issue that is sometimes raised in the context of environmental trading programs is the risk of a takings claim. [FN228] The Fifth Amendment of the United States Constitution provides that "private property [shall not] be taken for public use, without just compensation." [FN229] If a policy dictates a decrease in the level of discharge allowable under an environmental trading program or if some dischargers are unable to obtain enough permits and must shut down, a takings claim against the government is conceivable. [FN230] Although a successful takings claim would be unlikely, it is generally sensible to use caution when designing ***373** environmental trading programs. [FN231] However, because the Grassland Drainage Area trading program is an internal program among a group of districts subject to the same waste discharge requirement, a potential taking claim is not a concern. [FN232]

V. ASSESSING THE EFFECTIVENESS OF THE TRADING PROGRAM

This Part discusses the progress of the Grassland Area Farmers in achieving their environmental goals. The results suggest that the trading program has been effective. Nevertheless, definitively determining the effectiveness of the trading program is difficult because of the many other influences that impact selenium load discharge from the Grassland Drainage Area. This Part attempts to draw some conclusions despite the lack of complete data.

A. Progress in Attaining Environmental Goals

The Grassland Area Farmers have made significant progress in reducing their selenium load discharges. Since the start of the Grassland Bypass Project in water year 1997, the volume of drainage water discharged from the Grassland Drainage Area has decreased 40% and selenium load discharge has decreased 48%. [FN233] The Bureau of Reclamation and Oversight Committee for the Grassland Bypass Project commended the Grassland Area Farmers for their "excellent management of selenium loads in water year 1999" and their exemplary dedication to "the implementation of innovative drainage strategies." [FN234] Because the Grassland Area Farmers did not exceed any of their monthly or annual load targets in water year 1999, the Oversight Committee did not assess any incentive fees. [FN235] Annual discharges in water year 2000 were even lower than in water year 1999, and again the Grassland Area Farmers did not exceed any of their monthly or annual load targets. [FN236]

***374** This progress did not come easily, however. In the first year of the Grassland Bypass Project, water year 1997, the Grassland Area Farmers exceeded their selenium load targets in six months of the water year. [FN237] This resulted in incentive fees totaling $60,500. [FN238]

The following year, water year 1998, was an El Niño year that yielded the heaviest rainfall in the Grassland Drainage Area during the fifty-year period of record. [FN239] As discussed previously, increasing irrigation efficiency is one major component to lowering selenium discharge. [FN240] Excess rainfall, like excess irrigation, increases selenium load discharge. With this extreme rainfall, the Grassland Area Farmers exceeded their regional selenium load targets even though they were irrigating very little. [FN241] In water year 1998, they exceeded their monthly selenium load limits in seven months of the year, [FN242] and exceeded the 6660-pound annual load target value by 37% (2458 pounds). [FN243] Because of the unusually heavy rains, the Oversight Committee determined that load discharged from February through June 1998 resulted from an "unforeseeable and uncontrollable event" and therefore waived incentive fees for that period. [FN244] The Grassland Area Farmers were assessed incentive fees for water year 1998 of only $3,400, for discharge exceedances in July and September 1998. [FN245]

Although the Grassland Area Farmers did not meet the regional selenium load targets in water year 1998, the region did discharge 24% less selenium load than in 1995, which was another year of heavy rains. [FN246] Drainage discharge in 1999 had been reduced compared to water year 1996, a year with similar irrigation supply and rainfall. [FN247] Figure 2 shows discharge since the start of the Grassland Bypass Project.

***375** Figure 2: Selenium Load and Target, Water Years 1997-2000

SAN LUIS DRAIN OUTLET

TABULAR OR GRAPHIC MATERIAL SET FORTH AT THIS POINT IS NOT DISPLAYABLE

Graph courtesy of Joe McGahan.

***376** Figure 3: Comparison of February 1998 and 1999 Irrigation, Rainfall, and Selenium Load

TABULAR OR GRAPHIC MATERIAL SET FORTH AT THIS POINT IS NOT DISPLAYABLE

Graph courtesy of Joe McGahan.

***377** B. DIFFICULTIES IN DETERMINING EFFECTIVENESS OF THE TRADING PROGRAM

1. The Influence of Rain and Lateral Subsurface Flows

Measuring the impact of the activities of the Grassland Area Farmers on reducing selenium load discharge is difficult because precipitation has an impact on discharge levels. The impact of rainfall on selenium loads may be seen by comparing irrigation and loads in February 1998 to those in February 1999. Rainfall was 4.4 inches in February 1998 and 1 inch in February 1999. [FN248] This equates to approximately 36,000 acre-feet of rainfall over the drainage area in February 1998 and approximately 8000 acre-feet in February 1999. [FN249] The amount of irrigation in the Grassland Drainage Area was 1600 acre-feet in February 1998 and 14,000 acre-feet in February 1999. [FN250] Selenium load discharged was 1315 pounds in February 1998 [FN251] and 609 pounds in February 1999. [FN252] This example, shown in Figure 3, demonstrates that excess rainfall--like excess irrigation--increases selenium load discharge.

It is difficult to determine how much discharge is attributable to rain and how much to irrigation. The Grassland Area Farmers and the Technical and Policy Review Team of the Oversight Committee [FN253] have attempted to develop a methodology to partition the load between these two causes. [FN254] Their efforts "highlighted the complexity of the hydrologic system and helped to identify additional data collection needs with regard to partitioning and understanding the controllability of selenium loads." [FN255] The Technical and Policy Review Team concluded that additional data and analysis are needed before any partitioning methodology can be applied.

In addition to the problem of rainfall is the problem of determining the impact of subsurface lateral flows on selenium load discharge. Scientists have attempted to estimate how much selenium load from upslope areas migrates to the Grassland Drainage Area to be discharged through the sumps there. [FN256] However, much uncertainty remains.

***378** 2. The Influence of Drought

While a number of policies in the Grassland Drainage Area almost certainly had an effect on reducing selenium loads, the drought in the early 1990s--which brought about greater efficiency in the application of irrigation water--was perhaps the greatest driving force in decreasing selenium load discharge from the region. [FN257] Drought conditions persisted in California from 1987 through 1992. [FN258] Reservoirs allowed California farmers to receive relatively normal water supply during the first few years of the drought, but supply dropped considerably after 1989. [FN259] The western side of the San Joaquin Valley was among the areas hardest hit by the drought. [FN260] The reduced supply of water provided an incentive to manage water more carefully. [FN261] As discussed previously, careful water management is one of the most important factors contributing to a decrease in selenium load discharge. [FN262]

3. The Influence of Various Other Policies in Place To Reduce Selenium Load Discharge

While it is clear that the Grassland Area Farmers are making progress towards their environmental goals, it is not always clear how much selenium discharge abatement can be attributed to each of their various activities. [FN263] A number of policies in the Grassland Drainage Area have been working together to reduce selenium load discharge. A number of districts implemented tiered water pricing policies at various times before and after the formation of the regional drainage entity. [FN264] The regional drainage entity was formed in the mid-1990s, at about the same time as the Use Agreement incentive fees and cap came into effect. A trading program was implemented in the late 1990s. All the while, districts have ***379** been conducting workshops [FN265] on irrigation efficiency and providing low-interest loans for the purchase of irrigation equipment. [FN266] With all this activity in the Grassland Drainage Area, it is difficult to determine which reduction policies, strategies, and techniques have been effective in helping the region meet its environmental goals. [FN267]

Measuring the cost-effectiveness of the various policies in place in the Grassland Drainage Area also proved difficult. [FN268] The Author designed detailed interviews with district managers to gather information about the cost of each particular drainage activity in terms of per unit selenium reduction. [FN269] For each activity, the district managers were asked to describe the activity, its costs, and its benefits. [FN270] For the costs, the district managers were asked about capital costs, the cost of borrowing money for the project, and the variable costs. [FN271] For the drainage-related benefits, the district managers were asked about the resulting reduction in selenium load discharge and the resulting reduction in drainage water volume. [FN272] For the non-drainage related benefits, the district managers were asked about the value of the reduction in water use (in terms of money saved by not having to buy additional water or money earned by selling surplus water). [FN273] District managers were also asked about any other non-drainage benefits, such as an increase in yield or a decreased dust problem. [FN274] The purpose of asking about the value of non-drainage benefits was to subtract the non-drainage benefits from the cost to get a more accurate calculation of how much each drainage activity or program cost per unit of selenium reduced. In addition, district managers filled out a questionnaire following each trade to provide information about potential ***380** cost savings brought about by each trade. [FN275] In a well-functioning market, one would expect marginal abatement costs to be equalized across dischargers. [FN276]

Unfortunately, these interviews and questionnaires did not produce sufficient data to allow quantitative analysis. All of the districts had data regarding the amount of selenium discharged, and most--although not all--had data regarding the cost of various activities to reduce selenium load discharge. They did not, however, have information about the benefits of their activities, such as how much their activities contributed to a decrease in selenium load discharge or to a reduction in water use. Therefore, information about marginal abatement costs was unavailable. This made it difficult for the farmers to determine at what price to buy and sell selenium load allocation. This also made it difficult for the Author to determine how well the market was functioning.

Because the market participants have incomplete information, it is unlikely that the market is functioning with optimal efficiency. It is expected that as the market develops, the district managers will add to their knowledge base and will be able to determine with increasing accuracy the marginal abatement costs of their various options. Nevertheless, due to the challenges and expense of collecting the necessary data, the district managers will likely settle for a goal less ambitious than complete information about marginal abatement costs. Even with incomplete information, however, the trading program appears to bring about some efficiency gains, as described below.

C. Data on the Trading Program

The most significant sign that the trading program is bringing about economic efficiency gains is the presence of trading activity. [FN277] As of February 2000, nine trading agreements had been executed. Many of these trading agreements contained multiple trades. For example, a May 1999 trade involved the transfer of nineteen pounds of selenium load allocation for February 1999, forty pounds of selenium load allocation for March 1999, and fifty-nine pounds of annual selenium load allocation for water year 1999. [FN278] Counting each trade agreement component as a separate trade adds up to thirty-nine trades as of February 1, 2000. In all, 605 ***381** pounds of monthly selenium load allocation and 128 pounds of annual selenium load allocation have been traded. [FN279]

A total of $14,320 has changed hands as a result of the trades. [FN280] At the beginning, trading agreements collapsed the distinction between monthly and annual selenium load allocation, charging, for example, $40 for a pound that would count both toward the monthly target and the annual target. Later, trading parties began to distinguish between monthly and annual load. These trades generally had a price of $40 per pound for monthly load and $100 per pound for annual load. [FN281] In negotiating a price, the district managers used the rebate amounts set forth in the tradable loads rule for water year 1999 as a guide. In that rule, the monthly rebate was set at $50 per pound and the annual rebate was set at $120 per pound. [FN282]

The price of selenium load allocation rose somewhat after trading parties began to distinguish between monthly and annual load. Nevertheless, the low price at which selenium load traded was surprising, given that selenium discharge limitations were so greatly reduced from their historical levels. As load targets ratchet down and penalties ratchet up, higher prices are likely. In addition, prices are likely to depend to a great extent on the amount of actual or expected rainfall.

All of the trades described above were executed during water year 1999 or during water year 2000 for water year

1999 loads except for one. The exception is the one trade that took place in water year 1998. [FN283] The low level of trading activity during water year 1998 was probably the result of several factors. First, the trading program was not in place until the last third of water year 1998. [FN284] Second, as discussed above, water year 1998 was an El Niño year. [FN285] Throughout the year, the Grassland Area Farmers were unsure whether the Oversight Committee would declare the year's heavy rains "unforeseeable and uncontrollable." In a normal year, incentive fees can be anticipated. Because of the heavy rains, however, the incentive fees were uncertain throughout most of water year 1998. Trading was scarce because of this uncertainty and the fact that the penalty structure for the selenium load trading program depended on those fees. [FN286]

***382** Several district managers did consider trades under the tradable loads rule for water year 1998, but these trades did not occur. [FN287] A number of district managers met in mid-July to address how to discharge within targets for the months of July, August, and September of 1998. [FN288] Panoche Water District agreed to reduce its discharge to under its target allocation and to sell its remaining allocation for those months. [FN289] Panoche intended to sell load after the water year had ended and the districts knew their final monthly selenium load discharges. [FN290] The parties involved determined that they would set the price at about what the Use Agreement incentive fees would have been. [FN291] Ultimately, however, the Grassland Area Farmers declared every month in water year 1998 to be a storm event month, and the incentive fees therefore were paid from the general fund rather than proportionally from each district that exceeded its load allocation. Given this development, it is not surprising that trades did not materialize.

Transaction costs in the trading program appear to be very low. District managers who engaged in trades reported a negotiation process that ranged from five minutes to two weeks, with most trades taking an hour or less to negotiate. [FN292] Most district managers reported that the cost to the district of negotiating and executing the trade (not the cost of purchasing selenium load allocation) was negligible. [FN293] When district managers did attach a cost to the negotiation process, they estimated the cost to range from $0 to $100. [FN294] The only estimates above this range were $500 and $1,000, the amounts one of the districts paid to a lawyer to review the trading contracts. [FN295]

VI. CONCLUSIONS

A. A Successful Start

1. Creating Accountability at the Regional and District Levels

The most important developments in creating accountability for discharge from the Grassland Drainage Area were (1) the institution of load targets, incentive fees, and a cap on discharge, [FN296] and (2) the establishment ***383** of a regional drainage entity that is responsible for monitoring discharge and meeting environmental goals. [FN297] While the Use Agreement--with its load targets, incentive fees, and cap--created accountability at the regional level, the trading program--with its load allocation among districts and penalty structure--created accountability at the district level. Establishing a trading program was a logical step, particularly since the region was already divided into districts that had a long history of working with farmers on irrigation and drainage issues.

2. Providing Flexibility and Spurring Innovation

The regulatory structure in the Grassland Drainage Area is decentralized and flexible. This allows the Grassland Area Farmers to meet their environmental goals in the way they see fit, without the government dictating which irrigation technologies to use, which displacement strategies to pursue, or which policies to implement. In addition, this approach seems to spur the irrigation and drainage districts to look for creative solutions to the drainage problem. If regulators had mandated specific control technologies, [FN298] it is unlikely that there would have been so much experimentation in the Grassland Drainage Area. Today, districts are pursuing many creative solutions to improve the quality of their subsurface drainage water, from active land management [FN299] to selenium removal projects. [FN300] Although pursuing a number of options at the same time can make assessment of each policy program difficult, in the Grassland Drainage Area it appears that pursuing a number of options improved water quality. As new experiments in drainage management continue, the Grassland Area Farmers may find more efficient and cheaper ways to meet their environmental goals.

***384** 3. Minimizing Transaction Costs

With regard to the trading program, one of the factors contributing to active trading has been the low transaction costs. [FN301] Low transaction costs were possible in the Grassland Drainage Area because the trading program was not hindered by a pre-existing permit scheme, which has raised transaction costs in other experiments with environmental trading. For example, the Minnesota Pollution Control Agency allows offsets or trading between point sources and nonpoint sources or between point sources and other point sources within the same watershed. [FN302] Rahr Malting Company, a point source, financed upstream reductions in non-point source phosphorus loading in exchange for biological oxygen demand ("BOD") [FN303] discharges from its new wastewater treatment plant. [FN304] It took two years, however, to complete this trade, in large part because Rahr's permit had to be modified to allow for it. [FN305] If the districts in the Grassland Drainage Area had permits that needed to be modified with each trade, trading activity probably would have been reduced.

Designing and implementing a trading program in the Grassland Drainage Area was aided by the fact that regulation of selenium discharge was a relatively new development, and the regulatory structure was designed to make a trading program possible. [FN306] In areas where there is already a well-developed permit system in place, particularly if the permits are technology-based, implementing a trading program would be more difficult. Although replacing such an existing regulatory structure with a performance-based regulatory structure could be a difficult undertaking, doing so would probably result in greater gains from any market-based policies implemented. [FN307]

***385** B. A Work in Progress

1. Creating Accountability at the Farm Level

Although the district managers have been generally positive about the trading program, [FN308] they recognized that its impact is limited because it functions at the district level, rather than at the farm level. [FN309] As discussed previously, the most important step in reducing selenium discharge is to prevent excessive deep percolation of water by making on-farm improvements in the application of irrigation water. [FN310] On-farm irrigation efficiency improvements can take the form of better technology or better management. Because farmers are responsible for irrigation and are therefore in the best position to improve irrigation efficiency, accountability at the farm level is important. Policies in the Grassland Drainage Area that focus on the farm level include tiered water pricing policies, workshops for farmers, and low-interest loans. [FN311]

The trading program works together with farm-level incentives to allow the region to meet its discharge cap in a cost-effective way. [FN312] To get the most benefit from the market, however, the individual farm must be the unit at which load is allocated and traded. [FN313] In deciding whether to implement farm-level trading, the costs of allocating and trading load at the farm level must be weighed against the benefits derived from such a market. [FN314] The biggest impediment to farm-level trading in the Grassland Drainage Area is that several farmers may share a sump, making it difficult to know how much discharge each contributed. [FN315] Calculations are further complicated by the unresolved issue of how to measure the impact of migration of subsurface flows from upslope of the sump drainage area. [FN316]

Ideally, farmers would one day participate individually in the market for selenium load allocation. [FN317] Either the farmer could participate directly ***386** in the market or the farmer could approach the district manager with a proposal to buy or sell selenium load. [FN318] Determining each farmer's allocation within a district would be difficult and district-specific policies would need to be established for farmer trades. [FN319] But certainly it would be possible to design a trading program that created a market--and increased accountability--at the farm level.

2. Creating Accountability at the Watershed Level

Many districts, in addition to those in the Grassland Drainage Area, discharge drainage water into the San Joaquin River. It is conceivable that the Grassland Area Farmers and the other agricultural regions that drain into the San Joaquin River might form a watershed level drainage entity. Regulators are already beginning to talk about the prospect for the regulation of salinity and boron. [FN320] Given the current regulations, that is unlikely to happen. [FN321] If, however, a TMDL is implemented for the San Joaquin River that limits the discharges from the nonpoint sources in the watershed, it would not be surprising if the Grassland Area Farmers and other regions in the watershed found it in their interest to form a watershed drainage entity. [FN322] They might also find it in their

interest to develop a trading program for salinity that included the entire watershed. [FN323]

3. Setting Appropriate Penalties

One of the most difficult tasks in designing the trading program was creating a sensible penalty structure. Although the overall regulatory structure in the Grassland Drainage Area was conducive to the design of a trading program because it set environmental goals and allowed flexibility in meeting those goals, the incentive fee structure of the Use Agreement hampered the effort. [FN324] In the Grassland Drainage Area, the incentive fees were part of a five-year Use Agreement. In the short run, ***387** the incentive fee structure could not be changed, even though doing so would have made the selenium load trading penalty structure less complicated and more equitable. In the long run, however, the overall regulatory structure could be changed. Indeed, the proposed Agreement for Use of the San Luis Drain for the period October 1, 2001, through December 31, 2009, incorporates a flat fee per pound for regional exceedances of regional load values. [FN325] This should result in a better functioning selenium load trading program. The lesson here is to think carefully about the pre-existing regulatory structure, how it may impact the design of a trading policy, and how, if necessary, it could be changed.

4. Collecting Better Data

Collecting better data would improve the functioning of the tradable loads market. Once district managers know the costs and benefits of the alternatives for reducing selenium discharge, they will be better able to make informed decisions about the prices at which to buy and sell selenium load allocation. Parties' ability to assess the value of selenium load allocation is critical to an efficiently functioning market. [FN326]

In addition, collecting better data on the marginal abatement costs in the districts would allow better evaluation of the policy instruments in the Grassland Drainage Area, particularly evaluation of the trading program. It is impossible to know whether the trading program is succeeding in equalizing the marginal abatement costs across districts without knowing what the marginal costs are. [FN327]

C. Transferability to Address Environmental Problems Elsewhere

This Article focuses mainly on the design and implementation an environmental trading policy once the decision to proceed with one has already been made. [FN328] The lessons learned from the experience of the Grassland Area Farmers should be helpful to others that are designing and implementing such policies elsewhere. In assessing the transferability of such an environmental trading policy to address other nonpoint source problems, it is also important to consider the following threshold issues.

***388** 1. Acceptability of the Concept of Environmental Trading

Many environmentalists oppose environmental trading. [FN329] For instance, Robert Goodin argues against trading on moral grounds:

> The impetus to economic efficiency leads us to regard ... opportunities to exploit common property resources (by some but not all) as things to be allocated somehow to someone. The impetus to fairness leads us to regard such opportunities as things to be eschewed, rather than being allocated at all. Granting environmental indulgences, upon payment of a suitable price, is essentially an allocation device. On the fairness critique, it allocates what ought not to be allocated at all. Those are efficiency gains that, in all fairness, we ought not pursue. [FN330]

Other environmentalists oppose trading for other reasons, such as the risk of hot spots. [FN331]

In the Grassland Drainage Area, however, the impetus for the trading program came from environmentalists. [FN332] Environmental Defense has supported market incentive approaches generally, [FN333] and enthusiastically endorsed a trading approach to the selenium problem. [FN334] The trading policy in the Grassland Drainage Area was designed and implemented with the support of environmentalists, regulators, and the farmers. Consensus among stakeholders regarding whether a market-based policy is an appropriate solution to the problem at hand is crucial.

***389** 2. A Cap on Discharge

Although it is possible to have environmental trading without a cap, [FN335] an environmental trading program

like the one described in this Article requires a cap. Because of the circumstance of the Grassland Area Farmers needing to discharge through the Drain, a cap on selenium load discharge was possible. [FN336] Elsewhere, a cap may result from implementation of a TMDL [FN337] or from implementation of state law. [FN338]

3. A Regulatory Structure Conducive to the Development of an Environmental Trading Policy

In the Grassland Drainage Area, farmers are organized into irrigation districts, which in turn formed a regional drainage entity. [FN339] The discharge permit was issued to the regional drainage entity, which then devised its own trading program. Without the regional drainage entity, the burden on the regulators would have been far greater. The regulators, rather than the members of a regional drainage entity, would have had to allocate the total regional allowable load among irrigation districts. The regulators also would have had to design and implement the trading program. Finally, the regulators would have had to issue and enforce discharge permits for each irrigation district, rather than issuing a single permit for the entire region. Although a political structure such as the regional drainage entity is not necessary to the development of an environmental trading program, [FN340] it served an important role in the success of the trading program in the Grassland Drainage Area.

***390** 4. Measurement of Discharges

Environmental trading cannot work unless discharges can be measured or discharge reductions can be estimated. In the Grassland Drainage Area, drainage discharge could be measured directly at the point where the agricultural drainage water is pumped out of the ground. [FN341] In regions where discharge from irrigated agriculture is not pumped out, measuring water inputs could be used as a surrogate. [FN342] Environmental trading with a program similar to that implemented in the Grassland Drainage Area is probably not viable where agricultural drainage is a result of non-irrigated agriculture.

5. Sufficiency in the Degree of Differences in the Marginal Costs of Abatement Among Dischargers

If all the dischargers face the same marginal cost curve, then there would be no incentive to trade and therefore no efficiency gains from the implementation of a trading program. Prior to implementation of the trading program in the Grassland Drainage Area, there was much doubt about whether the marginal cost differences would be great enough to generate trades. [FN343] Conducting a study to research this issue probably would not have been conclusive, considering that the district managers do not have a clear idea of the marginal cost of abatement of their various activities. Nevertheless, once the program was in place, the marginal cost differences apparently were great enough to generate trades. This suggests that an environmental trading policy may be an appropriate tool even when marginal cost differences have not been conclusively demonstrated.

Environmental trading policies are not suitable to address all environmental problems. Moreover, even where they are an appropriate environmental tool, the design of each policy will surely be unique. This Article explored the particular issues in the Grassland Drainage Area and explained the solutions reached to address those issues. The Grassland Area Farmers have made significant progress in reducing their selenium load discharge, and it appears that the economic incentive policies, along with a number of other important policies in the Grassland Drainage ***391** Area, assisted the Grassland Area Farmers in meeting their environmental goals in a cost-effective manner. The experience of the Grassland Area Farmers suggests that trading policies show considerable potential to achieve environmental goals without excessive cost.

[FNa1]. Attorney and Environmental Policy Consultant, San Francisco; J.D., Harvard Law School, 1995; A.B., Stanford University, 1991. Funding for the design and implementation of the trading program and for the writing of this Article was provided by a grant from the U.S. Environmental Protection Agency ("EPA"). EPA provided Clean Water Act ("CWA") Part 319 funding for controlling nonpoint sources to the California State Water Resources Control Board, which in turn contracted with the San Luis & Delta-Mendota Water Authority, which in turn contracted with me. I would like to thank Sam Ziegler, the EPA grant manager for this grant, and Gail Louis of EPA. In addition I would like to thank the contract managers at the Central Valley Regional Water Quality Control Board, Sue McConnell and Valerie Connor. The main impetus behind the trading program and a number of other policies in place in the Grassland Drainage Area is Plowing New Ground: Using Economic Incentives to Control Water Pollution from Agriculture, a 1994 Environmental Defense report by Terry Young and Chelsea Congdon. Many of the ideas in this Article derive from that work and from discussions with the participants of the Economic

Incentives Advisory Committee and the Grassland Basin Drainage Steering Committee. Thanks to all the participants of those committee meetings, with special thanks to Jeff Bryant, Dave Cone, David Cory, Chris Eacock, Dennis Falaschi, Joe Karkoski, Joe McGahan, Dan Nelson, Doyle Perry, Dianne Rathman, Rudy Schnagl, Al Vargas, Marca Weinberg, and Terry Young. Thanks also to the following people for their comments on earlier drafts of this Article: Valerie Connor, David Cory, Chris Eacock, Aaron Edlin, John Hewitt, Joe Karkoski, Carl Mahr, Joe McGahan, Clay Ogg, Dianne Rathman, Rudy Schnagl, Susan Soong, Terry Young, and Sam Ziegler. Finally, thanks to Bonnie Docherty, Irene Chan, Mike Gershberg, and the rest of the staff of the Harvard Environmental Law Review for editing the Article for publication.

[FN1]. See infra text accompanying notes 13-14.

[FN2]. Memorandum from Terry Young, Senior Consulting Scientist, Environmental Defense, to the Author (Apr. 12, 2000) (on file with Harvard Environmental Law Review). This memo describes the conventional wisdom prior to publication of her report, Plowing New Ground. TERRY F. YOUNG & CHELSEA H. CONGDON, ENVTL. DEFENSE FUND, PLOWING NEW GROUND: USING ECONOMIC INCENTIVES TO CONTROL WATER POLLUTION FROM AGRICULTURE (1994) (stating the case for establishing economic incentive policies in the Grassland Drainage Area).

[FN3]. Memorandum from Terry Young, supra note 2.

[FN4]. Id.

[FN5]. Federal Water Pollution Control Act § § 101-607, 33 U.S.C. § § 1251-1387 (1994 & Supp. IV 1998).

[FN6]. Id. § 502, 33 U.S.C. § 1362 ("The term 'point source' means any discernable, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feed operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture."). The CWA does not define the term nonpoint source, but it uses the term throughout the Act. David Zaring, Agriculture, Nonpoint Source Pollution, and Regulatory Control: The Clean Water Act's Bleak Present and Future, 20 HARV. ENVTL. L. REV. 515, 516 (1996).

[FN7]. JENNIFER RUFFOLO, TMDLS: THE REVOLUTION IN WATER QUALITY REGULATION 3 (Cal. Research Bureau Pub. No. 99-005, 1999).

[FN8]. Federal Water Pollution Control Act § 301, 33 U.S.C. § § 1311 (establishing effluent limitations), 1311(a) (prohibiting discharge of any pollutant by any person except in compliance with a permit), 1362(11) (defining "effluent limitation" as discharge from point sources), 1342 (describing the NPDES permitting provisions); see also RUFFOLO, supra note 7, at 3.

[FN9]. Federal Water Pollution Control Act § 402, 33 U.S.C. § 1342(1)(1).

[FN10]. See, e.g., Zaring, supra note 6, at 516-28; Chelsea H. Congdon et al., Economic Incentives and Nonpoint Source Pollution: A Case Study of California's Grasslands Region, 2 HASTINGS W.-NW. J. ENVTL. L. & POL'Y 185, 187-89 (1995) (concluding that "while Congress has expressed the clear intent to address nonpoint source pollution, the language of the CWA fails to ensure effective nonpoint source pollution control").

[FN11]. See OLIVER A. HOUCK, THE CLEAN WATER ACT TMDL PROGRAM: LAW, POLICY, AND IMPLEMENTATION 4 (1999).

[FN12]. See id. at 5.

[FN13]. ENVTL. LAW INST., ENFORCEABLE STATE MECHANISMS FOR THE CONTROL OF NONPOINT SOURCE WATER POLLUTION 1 (1997).

[FN14]. RUFFOLO, supra note 7, at 33.

[FN15]. Cal. Water Code § § 13000-14958 (West 1992).

[FN16]. Id. § 13200 (describing the nine regions).

[FN17]. Id. § § 13140-13147 (requiring the State Board to formulate state water plan), 13240-13247 (mandating each regional board to formulate a water quality control plan for areas within the region); see also RUFFOLO, supra note 7, at 4.

[FN18]. Cal. Water Code § § 13263, 13264, see Ruffolo, supra note 7, at 4.

[FN19]. Cal. Water Code § 13160 ("The [S]tate [B]oard is designated as the state water pollution control agency for all purposes stated in the Federal Water Pollution Control Act ..."); see Ruffolo, supra note 7, at 4.

[FN20]. See RUFFOLO, supra note 7, at 4.

[FN21]. Id. at 6.

[FN22]. Id.

[FN23]. Id. at 4. The Regional Board is not required to issue waste discharge permits. See Cal. Water Code § 13269(a) (permitting a regional board to waive waste discharge permits "as to a specific discharge or a specific type of discharge where the waiver is not against public interest"); see also Envtl. Law Inst., Almanac of Enforceable State Laws to Control Nonpoint Source Water Pollution 21 (1988). The ability to regulate nonpoint sources varies from state to state. See Enforceable State Mechanisms for the Control of Nonpoint Source Water Pollution, supra note 13, at 1.

[FN24]. HOUCK, supra note 11, at 60-61 ("[N]onpoint source pollution has become the dominant water quality problem in the United States, dwarfing all other sources by volume and, in conventional contaminants, by far the leading cause of nonattainment for rivers, forests, lakes, and estuaries alike. It is no secret to any observer of the CWA that the primary reason for this mushrooming problem is the fact that while other sources have been abated through required controls and their enforcement, no comparable controls or enforcement have been applied to agriculture, silviculture, and the rest of the nonpoint world.").

[FN25]. Id. at 4.

[FN26]. Id. at 49-56.

[FN27]. Federal Water Pollution Control Act § 303(d), 33 U.S.C. § 1313(d)(1) (1994 & Supp. IV 1998).

[FN28]. See RUFFOLO, supra note 7, at 14-17

[FN29]. Id. at 22-23.

[FN30]. Pronsolino v. Marcus, 91 F. Supp. 2d 1337, 1356 (N.D. Cal. 2000).

[FN31]. PROJECT 88, HARNESSING MARKET FORCES TO PROTECT OUR ENVIRONMENT: INITIATIVES FOR THE NEW PRESIDENT 1 (1988) [hereinafter PROJECT 88] (A Public Policy Study Sponsored by Senator Timothy E. Wirth, Colorado, and Senator John Heinz, Pennsylvania).

[FN32]. Id. at 1; see also ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, EVALUATING ECONOMIC INSTRUMENTS FOR ENVIRONMENTAL POLICY 9 (1997) [[hereinafter OECD, EVALUATING ECONOMIC INSTRUMENTS]. These markets are sometimes called emissions trading schemes, see, e.g., Steve Sorrell & Jim Skea, Introduction, in POLLUTION FOR SALE 1, 1 (Steve Sorrell & Jim Skea eds., 1999), or tradable permits, see, e.g., ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, IMPLEMENTING DOMESTIC TRADABLE PERMITS FOR ENVIRONMENTAL

PROTECTION 9 (1999) [hereinafter OECD, IMPLEMENTING DOMESTIC TRADABLE PERMITS].

[FN33]. OECD, EVALUATING ECONOMIC INSTRUMENTS, supra note 32, at 9.

[FN34]. Dallas Burtraw, Cost Savings, Market Performance and Economic Benefits of the U.S. Acid Rain Program, in POLLUTION FOR SALE, supra note 32, at 43, 43.

[FN35]. David Harrison, Jr., Turning Theory into Practice for Emissions Trading in the Los Angeles Air Basin, in POLLUTION FOR SALE, supra note 32, at 63, 63. The RECLAIM program is a cap-and-trade program for NO_x and SO_2 emission from diverse sources. Id. at 69, 75.

[FN36]. See generally Peter Bohm, An Emission Quota Trade Experiment Among Four Nordic Countries, in POLLUTION FOR SALE, supra note 32, at 299, 299-321; ZhongXiang Zhang & Andres Nentjes, International Tradable Carbon Permits as a Strong Form of Joint Implementation, in POLLUTION FOR SALE, supra note 32, at 322, 322-42; Tim Denne, Implementation Issues in International CO_2 Trading, in POLLUTION FOR SALE, supra note 32, at 343, 343-53; Jim Skea, Flexibility, Emissions Trading and the Kyoto Protocol, in POLLUTION FOR SALE, supra note 32, at 354, 354-79.

[FN37]. See generally Environomics, A Summary of U.S. Effluent Trading and Offset Projects, Prepared for Dr. Mahesh Podar, EPA Office of Water (1999) [[hereinafter Environomics Report] (on file with Harvard Environmental Law Review). Regulators in Wisconsin are considering establishing a trading program that would include nonpoint to nonpoint trading. See id. at 34. EPA's Draft Framework for Watershed-Based Trading reports two nonpoint to nonpoint trades at Lake Dillon, Colorado. OFFICE OF WATER, U.S. ENVIRONMENTAL PROTECTION AGENCY, DRAFT FRAMEWORK FOR WATERSHED-BASED TRADING 8-1 (1996). According to the Environomics Report, however, the two trades that have occurred at Lake Dillon have been nonpoint to point trades. Environomics Report, supra at 8. At Lake Dillon, "point sources may obtain offsets by controlling [phosphorus] loads from nonpoint sources that existed prior to 1984." Id. The Author has spoken with two sources knowledgeable about the Lake Dillon program that confirm that there have not been any nonpoint to nonpoint trades there. Telephone Interview with Robert Ray, Water Quality Director, Northwest Colorado Council of Governments (July 21, 1999) (on file with Harvard Environmental Law Review); Telephone Interview with Bill McKee, Upper Colorado Watershed Coordinator, Colorado Department of Public Health and Environment (Apr. 27, 2001) (on file with Harvard Environmental Law Review). In response to questioning about the two nonpoint to nonpoint trades that were reported in EPA's Draft Framework, McKee said that information could be based on trades that were considered several years ago but never happened. Id.

[FN38]. See Environomics Report, supra note 37, at i.

[FN39]. Encyclopaedia Britannica, Central Valley, available at http://www.britannica.com/eb/article?eu=22436&tocid=0 (last visited May 4, 2001).

[FN40]. Id.

[FN41]. Grassland Bypass Project, Project Description and Update 1 (1999) [[hereinafter 1999 Project Update] (on file with Harvard Environmental Law Review).

[FN42]. 1 Draft Grassland Bypass Project Environmental Impact Statement and Environmental Impact Report 7-5 (2000) [hereinafter Grassland Bypass Project EIS/EIR] (on file with Harvard Environmental Law Review).

[FN43]. Id.

[FN44]. Id.

[FN45]. Id.

[FN46]. Id.

[FN47]. YOUNG & CONGDON, supra note 2, at 7.

[FN48]. U.S. DEP'T OF THE INTERIOR & CAL. RESOURCES AGENCY, A MANAGEMENT PLAN FOR AGRICULTURAL SUBSURFACE DRAINAGE AND RELATED PROBLEMS ON THE WESTSIDE SAN JOAQUIN VALLEY, FINAL REPORT OF THE SAN JOAQUIN VALLEY DRAINAGE PROGRAM 15 (1990) [hereinafter 1990 DRAINAGE MANAGEMENT PLAN]. See generally Theresa S. Presser, Geologic Origin and Pathways of Selenium from the California Coast Ranges to the West-Central San Joaquin Valley, in SELENIUM IN THE ENVIRONMENT 139, 139 (William T. Frankenberger, Jr. & Sally Benson eds., 1994); Theresa S. Presser et al., Bioaccumulation of Selenium from Natural Geologic Sources in Western States and Its Potential Consequences, 18 ENVTL. MANAGEMENT, 423, 423 (1994).

[FN49]. 1990 DRAINAGE MANAGEMENT PLAN, supra note 48, at 39-40.

[FN50]. Id. at 27; see also Letter from John Hewitt, California Regional Water Quality Control Board, Central Valley Region, to Author (May 30, 2000) (noting that not all irrigation moves selenium to the groundwater) (on file with Harvard Environmental Law Review). Shallow groundwater is defined as ground water within twenty feet of the surface of the land. 1990 DRAINAGE MANAGEMENT PLAN, supra note 48, at 182.

[FN51]. 1990 DRAINAGE MANAGEMENT PLAN, supra note 48, at 27.

[FN52]. YOUNG & CONGDON, supra note 2, at ES-11 ("[C]ompliance can be verified either by measuring district-level drainage discharges directly or by measuring farm-level discharges indirectly using water inputs as a surrogate. Both are currently monitored or will be in the future.").

[FN53]. Id. at 9. Although selenium was toxic to the wildlife living in the selenium-laden water at Kesterson, selenium is not thought to present a problem to humans that consume the crops grown with selenium-laden water. 1990 DRAINAGE MANAGEMENT PLAN, supra note 48, at 60-61. The selenium found in crops grown with such water would merely contribute to the nutritional requirement for selenium in the human diet. Id. at 61. However, because selenium can concentrate in aquatic plants and animals, consumption of these plants and animals could pose a health threat to humans. Id.

[FN54]. See Dennis Wichelns & David Cone, Tiered Pricing Motivates Californians to Conserve Water, 47 J. SOIL & WATER CONSERVATION 139, 140 (1992).

[FN55]. CAL. REGIONAL WATER QUALITY CONTROL BD., CENTRAL VALLEY REGION, AMENDMENTS TO THE WATER QUALITY CONTROL PLAN FOR THE SACRAMENTO RIVER AND SAN JOAQUIN RIVER BASINS FOR THE CONTROL OF AGRICULTURAL SUBSURFACE DRAINAGE DISCHARGES 3 (1996) [hereinafter BASIN PLAN AMENDMENTS]. The San Joaquin Valley forms the southern portion of California's Central Valley. 1990 DRAINAGE MANAGEMENT PLAN, supra note 48, at 15.

[FN56]. Id. at 27.

[FN57]. Id.; see also Pacheco Water District Resolution No. 96-16, Resolution Establishing and Implementing Pre-Irrigation Tiered Water Pricing Program (Oct. 16, 1996) (on file with Harvard Environmental Law Review).

[FN58]. C.M. BURT ET AL., AMERICAN SOCIETY OF ENGINEERS, SELECTION OF IRRIGATION METHODS FOR AGRICULTURE 39 (2000) ("Furrows are sloping channels formed in the soil."). Water is applied at the upslope end of the field and it flows down the furrows, seeping into the soil as it goes. Id. Switching from half-mile to quarter-mile furrows can reduce deep percolation by reducing the infiltration at the top end of the furrow. See id. at 40 (discussing furrow lengths). Another option is alternate-furrow application, in which water is applied in alternate furrows on either side of a crop row during each irrigation. See id.

[FN59]. See Joseph C. McGahan, Drainage Control Activities by Grassland Area Farmers, in GRASSLAND BYPASS PROJECT ANNUAL REPORT, OCTOBER 1, 1997 THROUGH SEPTEMBER 30, 1998, at 23-24 (1999) [hereinafter GRASSLAND PROJECT ANNUAL REPORT 1997-98]. Panoche, Broadview, Firebaugh, Pacheco, and Charleston have district-wide recycling systems in place or under construction. Id. at 24. On-farm

recirculation is not feasible in all districts. For example, farmers in Broadview Water District cannot recirculate drainage water on-farm because the district collects all of the surface and subsurface drainage water. Wichelns & Cone, supra note 54, at 142.

[FN60]. McGahan, supra note 59, at 24.

[FN61]. Using drainage water to irrigate salt tolerant crops is known locally as active land management. See id. at 22. Recirculating tailwater is also important because it results in less sedimentation in the drain. Telephone Interview with David Cory, Ranch Manager, R.E. & D.E. Des Jardins Ranches (Apr. 16, 2000) (on file with Harvard Environmental Law Review).

[FN62]. See supra text accompanying notes 13-14 (defining BMPs).

[FN63]. See McGahan, supra note 59, at 19.

[FN64]. See Telephone Interview with David Cory, supra note 61 (noting that the channels were used for drainage before they were used for freshwater deliveries).

[FN65]. Theresa S. Presser & David Z. Piper, Mass Balance Approach to Selenium Cycling Through the San Joaquin Valley: From Source to River to Bay, in ENVIRONMENTAL CHEMISTRY OF SELENIUM 153, 169 (William T. Frankenberger, Jr. & Richard A. Engberg eds., 1998).

[FN66]. Id. at 169-70 (noting that the practice of alternating freshwater with drainage water continued from 1985 through 1996); Telephone Interview with David Cory, supra note 61.

[FN67]. Telephone Interview with David Cory, supra note 61.

[FN68]. Id.

[FN69]. Id.

[FN70]. Central Valley Project Improvement Act, Pub. L. No. 102-575, § 3406(b)(2), 106 Stat. 4706, 4715-16 (1992) (dedicating 800,000 acre-feet of Central Valley Project water for the purpose of implementing fish, wildlife, and habitat restoration projects).

[FN71]. See David W. Cory, The Grassland Bypass Project: An Example of the Successful Regulation of a Nonpoint Source Agricultural Discharge 10-11 (Apr. 27, 2000) (unpublished manuscript, on file with Harvard Environmental Law Review); see also Bob Young, Summary, in GRASSLAND PROJECT ANNUAL REPORT 1997- 98, supra note 59, at 2 (noting that the Grassland Bypass Project allowed Grassland Water District managers to deliver fresh water to the wetlands according to optimum habitat management schedules).

[FN72]. See Young, supra note 71 (noting that the Grassland Bypass Project reduced exposures to fish, wildlife, and humans in the wetland channels).

[FN73]. See Cory, supra note 71, at 11.

[FN74]. Id. at 11-12.

[FN75]. See Young, supra note 71, at 2 (noting that the Grassland Bypass Project completed its second year of operation on September 30, 1998).

[FN76]. Central Valley Project, U.S. Dep't of the Interior, Agreement for Use of the San Luis Drain (signed November 3, 1993) [hereinafter Use Agreement] (on file with Harvard Environmental Law Review).

[FN77]. Letter from Daniel Nelson, San Luis & Delta-Mendota Water Authority; Roger Patterson, U.S. Bureau of Reclamation; Felicia Marcus, EPA; and Joel A. Medlin, U.S. Fish and Wildlife Service, to California Regional

Water Quality Control Board 1 (Nov. 3, 1995) [hereinafter Consensus Letter] (discussing a "commitment to develop a drainage entity under a Joint Powers Agreement among several of the Grassland Basin irrigation and drainage districts with authority sufficient to provide regional drainage management") (on file with Harvard Environmental Law Review). The need for a regional drainage entity was recognized early in the process of determining how to deal with drainage issues on the west side of the San Joaquin Valley. 1990 DRAINAGE MANAGEMENT PLAN, supra note 48, at 3, 133; YOUNG & CONGDON, supra note 2, at 108, 114.

[FN78]. The organization of the Grassland Area Farmers is discussed in Part III.B.2, infra.

[FN79]. Because the agreement forming the Grassland Area Farmers is called the Activity Agreement, the group called Grassland Area Farmers is sometimes referred to as the Activity. First Amended and Restated Grassland Basin Drainage Management Activity Agreement (Mar. 7, 1996) [hereinafter Activity Agreement] (on file with Harvard Environmental Law Review). The Grassland Area Farmers include Broadview Water District, Charleston Drainage District, Firebaugh Canal Water District, Pacheco Water District, Panoche Water District, and a portion of Central California Irrigation District called Camp 13. All of the irrigation and drainage districts that make up the Grassland Area Farmers are members of a joint powers authority called the San Luis & Delta-Mendota Water Authority. Id. at 1-2. Also included in the Grassland Area Farmers are "participating parties," which are not public entities and therefore not members of the San Luis & Delta-Mendota Water Authority, but have agreed to participate in the Activity Agreement by execution of a memorandum of understanding. Id. at 5 (defining "participating party"); Grassland Basin Drainage Steering Committee Rule Enforcing Selenium Load Allocation and Establishing a Tradable Loads Program for Water Year 2000, pt. II.E, at 1 [[hereinafter Tradable Loads Rule for Water Year 2000] (defining "participating party") (on file with Harvard Environmental Law Review); see also Memorandum of Understanding Regarding San Luis & Delta-Mendota Water Authority Grassland Basin Drainage Management Activity Agreement (n.d.) (example of a document that brings participating parties into the Grassland Area Farmers) (on file with Harvard Environmental Law Review). For ease of discussion, the term "members" will include both the members and the participating parties and the term "districts" will include both the districts and participating parties. Establishment of the regional drainage entity occurred prior to execution of the Use Agreement. Use Agreement, supra note 76, at 3 (noting that "the AUTHORITY has entered into an agreement with its members, referred to as the Grassland Basin Drainage Management Activity Agreement, and into memoranda of understanding with certain other parties, all of which have a need for use of the San Luis Drain").

[FN80]. See supra notes 63-64 and accompanying text for a discussion of the historical drainage channels.

[FN81]. Use Agreement, supra note 76 at 1; Young, supra note 71, at 2. The San Luis & Delta-Mendota Water Authority also includes districts that did not seek to use the Drain.

[FN82]. Terry F. Young & Joe Karkoski, Green Evolution: Are Economic Incentives the Next Step in Nonpoint Source Pollution Control?, 2 WATER POL'Y 156, 158 (2000).

[FN83]. Measures to minimize negative environmental impacts were written into a Finding of No Significant Impact and a consensus letter, which were incorporated into the Use Agreement. See Use Agreement, supra note 76, at 4; Mid-Pacific Region, U.S. Bureau of Reclamation, Finding of No Significant Impact and Supplemental Environmental Assessment, Grassland Bypass Channel Project, Interim Use of a Portion of the San Luis Drain for Conveyance of Drainage Water Through the Grassland Water District and Adjacent Grassland Areas 4 (1995) [hereinafter FONSI]; Consensus Letter, supra note 77.

[FN84]. The monthly and annual load values are in Appendix A of the Consensus Letter, supra note 77.

[FN85]. Id. The raw load data for these reports are available online at http://www.swrcb.ca.gov/~rwqcb5/agunit/load/10yrload.htm.

[FN86]. See Consensus Letter, supra note 77, at 4 (discussing 15% reduction), app. A (listing load values).

[FN87]. Use Agreement, supra note 76, at 10-13.

[FN88]. Consensus Letter, supra note 77, at app. B (Performance Incentive Fees).

[FN89]. Use Agreement, supra note 76, at 10-13. The Oversight Committee consists of senior-level representatives from the U.S. Bureau of Reclamation, the U.S. Fish and Wildlife Service, the California Department of Fish and Game, the Central Valley Regional Water Quality Control Board, and EPA. Young, supra note 71, at 9 ("The role of the [Oversight Committee] is to evaluate all operations of the [Grassland Bypass Project], including monitoring data, compliance with selenium load reduction goals, and other relevant information.").

[FN90]. Use Agreement, supra note 76, at 16 ("If the calculated annual load of selenium discharged from the Drain into Mud Slough as determined in accordance with the monitoring program established under the FONSI exceeds by 20% or more the annual Selenium Load Values, RECLAMATION shall terminate this Use Agreement unless the Oversight Committee, after consulting with the Draining Parties, any other stakeholders, and any technical committee established by the Oversight Committee, makes an affirmative finding that the AUTHORITY has shown that such exceedance was caused by unforeseeable and uncontrollable events (as discussed in the FONSI)."); Young & Karkoski, supra note 82, at 158 ("[Because the incentive fees] are arguably too low to provide a significant financial incentive, their effectiveness is more a result of potential bad press than economic concerns."), 160 n.15 (noting that the cutoff from the Drain for exceeding the cap by 20% is considered a "real risk").

[FN91]. See 1990 DRAINAGE MANAGEMENT PLAN, supra note 48, at 133.

[FN92]. See YOUNG & CONGDON, supra note 2, at 108.

[FN93]. Activity Agreement, supra note 79, at 8-9 (establishing the Steering Committee).

[FN94]. Id.

[FN95]. Id. at 10 (describing quorum and voting).

[FN96]. Id. at 10-11 (stating that the Steering Committee shall take actions "[s]ubject to the direction of the governing bodies of the Activity Agreement Members").

[FN97]. McGahan, supra note 59, at 21.

[FN98]. Currently the Regional Drainage Coordinator is Joe McGahan of Summers Engineering, Inc. Id. at 21.

[FN99]. See id. at 21-22.

[FN100]. A water year runs from October 1 through September 30. Water year 1997, for instance, runs from October 1, 1996 through September 30, 1997.

[FN101]. See FONSI, supra note 83, at 4; see also Young, supra note 71, at 5 (discussing conditions).

[FN102]. FONSI, supra note 83, at 4; Consensus Letter, supra note 77. See also supra note 83 (describing relationship of Consensus Letter to Use Agreement).

[FN103]. Young, supra note 71, at 5.

[FN104]. FONSI, supra note 83, at 4.

[FN105]. Id.

[FN106]. Young, supra note 71, at 5.

[FN107]. 1 Grassland Bypass Project EIS/EIR, supra note 42, at ES-1.

[FN108]. National Environmental Policy Act of 1969, 42 U.S.C. § § 4321-4370d (1969 & Supp. IV 1998). The FONSI that formed the basis of the Bureau of Reclamation's decision to enter into the Use Agreement provided for

use of the Drain for up to five years. FONSI, supra note 83, at 5 ("Reclamation anticipates that any long-term use of the Drain beyond the scope of this interim experimental project will require further specific planning and prior completion of an EIS under NEPA ...").

[FN109]. 1 Grassland Bypass Project EIS/EIR, supra note 42, at ES-1.

[FN110]. The role of the project director was to work with the Grassland Area Farmers, environmentalists, and regulators to design, implement, and assess the selenium load trading program. The grant supporting this project called for the project director to convene these meetings. Eleven meetings were held. The Author prepared minutes following each of these meetings and circulated the minutes for correction by the participants.

[FN111]. David Cory, Ranch Manager, R.E. & D.E. Des Jardins Ranches.

[FN112]. Joe Karkoski, at the time an Environmental Engineer with EPA, currently with the Central Valley Regional Water Quality Control Board.

[FN113]. Terry Young, Senior Scientist, Environmental Defense.

[FN114]. Marca Weinberg, Professor, Department of Environmental Science and Policy, University of California at Davis.

[FN115]. See supra note 96 and accompanying text; see also Tradable Loads Rule for Water Year 2000, supra note 79, § VIII ("To be effective, [this rule] must be adopted by each Member/Participating Party.").

[FN116]. Grassland Basin Drainage Steering Committee Rule Establishing a Tradable Loads Program for Water Year 1998 (passed June 26, 1998) [hereinafter Tradable Loads Rule for Water Year 1998] (on file with Harvard Environmental Law Review).

[FN117]. Grassland Basin Drainage Steering Committee Rule Enforcing Selenium Load Allocation and Establishing a Tradable Loads Program for Water Year 1999 (passed Jan. 18, 1999) [hereinafter Tradable Loads Rule for Water Year 1999] (on file with Harvard Environmental Law Review).

[FN118]. See Tradable Loads Rule for Water Year 2000, supra note 79.

[FN119]. Grassland Basin Drainage Steering Committee Rule Enforcing Selenium Load Targets and Tailwater Restrictions (amended Mar. 27, 1998) [hereinafter 1998 Enforcement Rule] (on file with Harvard Environmental Law Review). For a detailed discussion of the various allocation methods that were available to the Grassland Area Farmers, see YOUNG & CONGDON, supra note 2, at 37-51.

[FN120]. See supra note 51 and accompanying text.

[FN121]. Tradable Loads Rule for Water Year 2000, supra note 79, § III.B, at 2.

[FN122]. E-mail from Joe McGahan, Regional Drainage Coordinator, to the Author (May 2, 2000) (on file with Harvard Environmental Law Review).

[FN123]. See Mike Gardner, Panoche Irrigation District, Post-trade Questionnaire (July 3, 1999) ("We made this trade because we wanted to help out Charleston.") (on file with Harvard Environmental Law Review).

[FN124]. See supra text accompanying note 87.

[FN125]. Consensus Letter, supra note 77, at app. B. Note that there are gaps in the percentage brackets. For example, there is a gap between 5% and 5.1%. To have brackets without gaps, it would be necessary to have brackets such as: 0.1%-5%; >5%-10%; >10%-15%, etc., or to round to the nearest 0.1%.

[FN126]. An externality is a type of market failure that occurs when the social cost of an activity is not taken into

account in the decision-making process of the person or entity pursing the activity. See generally Economic Perspectives, in LAW AND THE ENVIRONMENT: A MULTIDISCIPLINARY READER 33, 34 (Robert V. Percival & Dorothy C. Alevizatos eds., 1997). The classic example of an externality is taken from Garret Hardin's famous article, The Tragedy of the Commons. Garrett Hardin, The Tragedy of the Commons, 162 SCI. 1243 (1968) (arguing that when herders graze their sheep on a common pasture, the commons will be overgrazed beyond the socially efficient level).

[FN127]. See, e.g., Susan A. Austin, The National Oceanic and Atmospheric Administration's Proposed Rules for Natural Resource Damage Assessment Under the Oil Pollution Act, 19 HARV. ENVTL. L. REV. 549 (1994).

[FN128]. See 1998 Enforcement Rule, supra note 119, at 1 (establishing load allocations for the first time).

[FN129]. See infra note 325 and accompanying text.

[FN130]. 1998 Enforcement Rule, supra note 119, at 2.

[FN131]. Id. Note that a district's share of any incentive fee was not calculated by dividing the district selenium load allocation exceedance (in pounds) by the region's exceedance (in pounds). If this were the rule, then it would be possible for a district to be responsible for an amount greater than 100% of the incentive fees. Minutes of the Economic Incentives Advisory Committee Meeting 3 (July 30, 1998) [hereinafter Minutes of July 30, 1998] (on file with Harvard Environmental Law Review).

[FN132]. Minutes of July 30, 1998, supra note 131 (comments of David Cory, stating that at a meeting of several district managers on July 16, 1998, one of the district managers whose district was expected to exceed its selenium load allocation mentioned that he thought it would be more fair to charge a district whenever it exceeded its selenium load allocation, regardless of whether the region as a whole exceeded its target).

[FN133]. Memorandum from the Author, to the District Managers 1 (Oct. 6, 1998) [hereinafter Penalty Memorandum] (regarding the Advisory Committee's Recommended Penalty Structure for the Rule Establishing a Tradable Loads Program for Water Year 1999) (on file with Harvard Environmental Law Review).

[FN134]. See Figure 1.

[FN135]. See Penalty Memorandum, supra note 133, at 1.

[FN136]. Id. at 2 (describing a meeting in which David Cory and the Author met to discuss alternative penalty structures).

[FN137]. Id.

[FN138]. Id.

[FN139]. Id.

[FN140]. See Penalty Memorandum, supra note 133, at 2.

[FN141]. Id.

[FN142]. Id.

[FN143]. Id.

[FN144]. See id. at 4.

[FN145]. Penalty Memorandum, supra note 133, at 4.

[FN146]. Id. at 2, 4.

[FN147]. Id. at 4-5.

[FN148]. Id. at 5.

[FN149]. Id.

[FN150]. Penalty Memorandum, supra note 133, at 5.

[FN151]. Id.; see Minutes of the Economic Incentives Advisory Committee Meeting 3 (Sept. 4, 1998) [hereinafter Minutes of Sept. 4, 1998]; see also infra notes 154-169 and accompanying text (discussing the benefits and drawbacks of a rebate system).

[FN152]. See Penalty Memorandum, supra note 133, at 5.

[FN153]. Id. See supra notes 134-136 and accompanying text for a discussion of the percentage brackets.

[FN154]. See Minutes of the Economic Incentives Advisory Committee Meeting 1 (Aug. 13, 1998) [hereinafter Minutes of Aug. 13, 1998] (on file with Harvard Environmental Law Review).

[FN155]. See id.

[FN156]. Id.

[FN157]. Id.

[FN158]. See Tradable Loads Rule for Water Year 2000, supra note 79, § VI.C, at 4-5; Tradable Loads Rule for Water Year 1999, supra note 117, § VI.C, at 4- 5.

[FN159]. See Minutes of the Economic Incentives Advisory Committee Meeting 1 (Oct. 22, 1998) [hereinafter Minutes of Oct. 22, 1998] (comments of David Cory) (on file with Harvard Environmental Law Review).

[FN160]. Id.

[FN161]. Tradable Loads Rule for Water Year 1998, supra note 116, at 3-5.

[FN162]. See Minutes of Oct. 22, 1998, supra note 159, at 1.

[FN163]. The initial proposal for Alternative 4 was that districts that exceeded their annual selenium load allocation would pay districts that went under their annual selenium load allocation the difference between what the incentive fees actually were and what the incentive fees would have been had no district gone under its annual selenium load allocation. Summary of the Meeting with District Managers Regarding the Draft Tradable Loads Rule for Water Year 1999, at 3 (Oct. 8, 1998) [hereinafter Meeting on 1999 Tradable Loads Rule] (comments of Dan Nelson) (on file with Harvard Environmental Law Review). A flat fee was suggested instead as an effort to reduce the effect of the spikes in the incentive fee curve. Id. at 4 (comments of David Cory). For a discussion of the spikes, see supra Part IV.B.1.b.

[FN164]. See Minutes of Oct. 22, 1998, supra note 159, at 1-2 (comments of Marca Weinberg).

[FN165]. See Figure 1.

[FN166]. See Tradable Loads Rule for Water Year 1999, supra note 117, § § VI.C.1.a (monthly rebate), VI.C.2.a (annual rebate), at 4-5. The $50 amount for the monthly rebate was selected because that is where the price per pound curve flattens out.

[FN167]. See supra note 88 and accompanying text.

[FN168]. See Tradable Loads Rule for Water Year 2000, supra note 79, § § VI.C.1.a (monthly rebate), VI.C.2.a (annual rebate), at 4-5.

[FN169]. Tradable Loads Rule for Water Year 1999, supra note 117, § VI.C, at 4-5.

[FN170]. See Pacheco Water District Resolution No. 96-16, supra note 57 and accompanying text.

[FN171]. But see YOUNG & CONGDON, supra note 2, at 31 (suggesting that load limits vary with the type of water year and suggesting three water year types: critical, dry/below normal, and above normal/wet).

[FN172]. Tradable Loads Rule for Water Year 2000, supra note 79, § VI.D.1, at 5.

[FN173]. Id. § VI.D.3, at 5.

[FN174]. Some Advisory Committee members suggested that perhaps the time period considered a storm event could be more accurately defined. In other words, perhaps there could be some way of allocating a particular amount of selenium load to a particular storm, taking into account that selenium load discharge increases for some period of time following a storm, without declaring the entire month a storm event. Minutes of the Economic Incentives Advisory Committee Meeting 2 (June 18, 1998) [hereinafter Minutes of June 18, 1998] (on file with Harvard Environmental Law Review).

[FN175]. Tradable Loads Rule for Water Year 2000, supra note 79, § VI.D.4, at 6.

[FN176]. Id. § VI.B, at 4; see also Part 0, supra (describing the selected penalty structure).

[FN177]. Telephone Interview with David Cory, supra note 61.

[FN178]. See Minutes of June 18, 1998, supra note 174, at 2.

[FN179]. See id.

[FN180]. See Tradable Loads Rule for Water Year 2000, supra note 79, § VI.E, at 6.

[FN181]. Id. § VI.E. 1, at 6.

[FN182]. Id. § VI.E.2, at 6.

[FN183]. Id. § VI.E.3, at 6.

[FN184]. Id. § VI.E.4, at 6.

[FN185]. See Use Agreement, supra note 76, at 4 (granting permission to the San Luis & Delta-Mendota Water Authority to use the Drain); see also Minutes of the Economic Incentives Advisory Committee Meeting 2 (May 21, 1998) [[hereinafter Minutes of May 21, 1998] (comments by Terry Young) (on file with Harvard Environmental Law Review).

[FN186]. Terry Young suggested that the incentive fees collected by the Bureau of Reclamation could be used to purchase selenium load allocation. See Minutes of the Economic Incentives Advisory Committee Meeting 4 (May 8, 1998) [[hereinafter Minutes of May 8, 1998] (comments by Terry Young arguing that those districts making progress towards meeting their environmental goals would be rewarded by receiving money from the Bureau for the sale of selenium load allocation) (on file with Harvard Environmental Law Review).

[FN187]. Minutes of June 18, 1998, supra note 174, at 1. The language it recommended to the Steering Committee was as follows: "The buyer of [selenium load allocation] may be a Member/Participating Party, an individual

farmer, a government agency, or any other organization or individual." Meeting on 1999 Tradable Loads Rule, supra note 163, at 1-2. Although there was support among some Advisory Committee members for allowing anyone to purchase selenium load allocation, it was not considered fundamental to the success of the trading program. Minutes of Oct. 22, 1998, supra note 159, at 2 (comments by Terry Young).

[FN188]. Tradable Loads Rule for Water Year 2000, supra note 79, § IV.B, at 2 ("The buyer of [selenium load allocation] must be a Member/Participating Party."); Meeting on 1999 Tradable Loads Rule, supra note 163, at 2.

[FN189]. Meeting on 1999 Tradable Loads Rule, supra note 163, at 2.

[FN190]. Id.

[FN191]. Id. (comments by David Cory).

[FN192]. Minutes of Sept. 4, 1998, supra note 151, at 2.

[FN193]. Id.; Meeting on 1999 Tradable Loads Rule, supra note 163, at 2 (David Cory reporting on Joe Karkoski's comments).

[FN194]. Meeting on 1999 Tradable Loads Rule, supra note 163, at 2.

[FN195]. Tradable Loads Rule for Water Year 2000, supra note 79, § IV.D, at 3.

[FN196]. OECD, IMPLEMENTING DOMESTIC TRADABLE PERMITS, supra note 32, at 35. See generally A. Denny Ellerman et al., Summary Evaluation of the U.S. SO_2 Emissions Trading Program as Implemented in 1995, in POLLUTION FOR SALE 27, supra note 32, at 27, 31-32 (describing the development of the market for sulfur dioxide allowances). Allowances for the sulfur dioxide market may be purchased through an annual auction conducted by the Chicago Board of Exchange, through a broker, or through environmental groups such as the Clean Air Conservancy. EPA, Buying Allowances (July 17, 2000), at http:// www.epa.gov/airmarkets/trading/buying.html (last updated Jan. 24, 2000) (on file with Harvard Environmental Law Review).

[FN197]. Minutes of May 21, 1998, supra note 185, at 3.

[FN198]. Id.

[FN199]. See generally Susan Austin, Grassland Drainage Area Tradable Loads Program List of Trades of Selenium Load Allocation Through February 1, 2000 (Feb. 1, 2001) (on file with Harvard Environmental Law Review).

[FN200]. Minutes of May 21, 1998, supra note 185, at 3.

[FN201]. Tradable Loads Rule for Water Year 2000, supra note 79, § V.D, at 3.

[FN202]. See id.

[FN203]. Id. § V.A, at 3.

[FN204]. Id. § V.B, at 3.

[FN205]. Id. § V.C, at 3.

[FN206]. Minutes of the Economic Incentives Advisory Committee Meeting 2 (July 16, 1998) [hereinafter Minutes of July 16, 1998] (comments by Terry Young) (on file with Harvard Environmental Law Review).

[FN207]. Id.

[FN208]. Meeting on 1999 Tradable Loads Rule, supra note 163, at 2.

[FN209]. Minutes of Oct. 22, 1998, supra note 159, at 2 (comments by Terry Young and Marca Weinberg).

[FN210]. Meeting on 1999 Tradable Loads Rule, supra note 163, at 2.

[FN211]. Minutes of Oct. 22, 1998, supra note 159, at 2 (comments by Terry Young and Marca Weinberg).

[FN212]. Meeting on 1999 Tradable Loads Rule, supra note 163, at 3; Tradable Loads Rule for Water Year 2000, supra note 79, § V.D, at 3.

[FN213]. See infra Part V.B.3.

[FN214]. Meeting on 1999 Tradable Loads Rule, supra note 163, at 2.

[FN215]. Id. (comments by Dan Nelson).

[FN216]. Id.

[FN217]. For example, the minutes of the meeting show that Dennis Falaschi stated that "his district's policy is to let anyone gather data about discharges from sumps, but his main concern is errors in the data." Id.

[FN218]. Tradable Loads Rule for Water Year 1999, supra note 117, § V.C, at 3.

[FN219]. Letter from Thomas J. Keene, Attorney with Linneman, Burgess, Telles, Van Atta & Vierra, to Joseph McGahan, Regional Drainage Coordinator (Feb. 10, 1999) ("The Steering Committee is subject to the Brown Act. As such any documents submitted to it, unless they meet a statutory exception, become public record when provided to the Steering Committee membership. I know of no exception which would apply to proposed Trade Agreements.") (on file with Harvard Environmental Law Review).

[FN220]. Ralph M. Brown Act, Cal. Gov't Code § § 54950-54962 (West 1997); see also California Public Records Act, Cal. Gov't Code § § 6250-6265 (West 1995).

[FN221]. Tradable Loads Rule for Water Year 2000, supra note 79, § V.C, at 3.

[FN222]. NATIONAL WILDLIFE FEDERATION, A NEW TOOL FOR WATER QUALITY: MAKING WATERSHED-BASED TRADING WORK FOR YOU 20, 32 (1999) [hereinafter NWF, A NEW TOOL].

[FN223]. See id.

[FN224]. See generally Environomics Report, supra note 37 (listing the trading ratios of a number of trading programs in the United States).

[FN225]. NWF, A NEW TOOL, supra note 222, at 19.

[FN226]. Id.

[FN227]. Id.

[FN228]. See generally Susan A. Austin, Comment, Tradable Emissions Programs: Implications Under the Takings Clause, 26 ENVTL. L. 323 (1996) (examining the risk of a successful takings claim in the context of tradable emissions programs to control air emissions).

[FN229]. U.S. Const. amend. V (applying to the states through the Due Process Clause of the Fourteenth Amendment, § 1); see also Texaco, Inc. v. Short, 454 U.S. 516, 523 (1982) (explaining that the Fifth Amendment's Takings Clause applies to state governments through the Fourteenth Amendment).

[FN230]. Austin, supra note 228, at 323.

[FN231]. Id.

[FN232]. A trading program implemented at the state level would be a greater risk. Even at the state level, however, current state law would make a successful takings claim unlikely. California law provides: "No discharge of waste into the waters of the state, whether or not the discharge is made pursuant to waste discharge requirements, shall create a vested right to continue the discharge. All discharges of waste into the waters of the state are privileges, not rights." Cal. Water Code § 13263(g) (West 1992).

[FN233]. 1999 Project Update, supra note 41, at 3. Salt load has been reduced by 32%, and boron load has been reduced by 14%. Id.

[FN234]. Letter from Lester Snow, Regional Director, Mid-Pacific Regional Office, Bureau of Reclamation, to Daniel Nelson, Executive Director, San Luis & Delta-Mendota Water Authority (Mar. 7, 2000) (on file with Harvard Environmental Law Review).

[FN235]. See id.

[FN236]. See Figure 2; San Francisco Estuary Institute, Summary of Selenium Loads at Station B, at http://www.sfei.org/grassland/reports/index.htm (last visited Apr. 27, 2001) (on file with Harvard Environmental Law Review). Monthly and quarterly data reports are on the Bureau of Reclamation Web site. Bureau of Reclamation, Reports, at http:// www.mp.usbr.gov/mp150/grassland/Resources/Reports/rhome.html (last modified Apr. 23, 2001) (on file with Harvard Environmental Law Review).

[FN237]. 1999 Project Update, supra note 41, at 3.

[FN238]. Young, supra note 71, at 8.

[FN239]. See id. at 6.

[FN240]. See supra note 57 and accompanying text.

[FN241]. See McGahan, supra note 59, at 19 fig.9 (Comparison of February 1998 and 1999 Rainfall, Irrigation, and Selenium Load).

[FN242]. See Bob Young, Summary, in GRASSLAND BYPASS PROJECT ANNUAL REPORT 1998-99, at 7 (2000).

[FN243]. See id.

[FN244]. Young, supra note 71, at 6, 8.

[FN245]. Id. at 8.

[FN246]. McGahan, supra note 59, at 15.

[FN247]. Id. at 12 ("drainage volume has been reduced 39% and selenium load has been reduced 49%").

[FN248]. Id. at 15.

[FN249]. Id.

[FN250]. Id.

[FN251]. Id.

[FN252]. Young, supra note 242, at 5.

[FN253]. For information on the Oversight Committee, see supra notes 89-90.

[FN254]. See Young, supra note 71, at 8-9. The methodology they attempted to develop would also assess more accurately the level of progress that the Grassland Area Farmers are making in reducing selenium discharge. See id. at 8.

[FN255]. Id. at 8.

[FN256]. See, e.g., JOHN L. FIO, CALCULATION OF A WATER BUDGET AND DELINEATION OF CONTRIBUTING SOURCES TO DRAINFLOWS IN THE WESTERN SAN JOAQUIN VALLEY, CALIFORNIA 94-95 (U.S. Geological Survey Open File Report, 1994).

[FN257]. Minutes of the Economic Incentives Advisory Committee Meeting 2 (Mar. 23, 1999) [hereinafter Minutes of Mar. 23, 1999] (on file with Harvard Environmental Law Review).

[FN258]. See KENNETH W. UMBACH, AGRICULTURE, WATER, AND CALIFORNIA'S DROUGHT OF 1987-92: BACKGROUND, RESPONSES, LESSONS 1 (Cal. Research Bureau Issue Summary, CRB-IS-94-003, 1994).

[FN259]. See id.

[FN260]. See id.

[FN261]. See Dennis Wichelns et al., Economic Incentives Reduce Irrigation Deliveries and Drain Water Volume, 10 IRRIGATION & DRAINAGE SYS. 131, 136 (1996).

[FN262]. See supra note 57 and accompanying text.

[FN263]. See generally McGahan, supra note 59, at 21-24.

[FN264]. Tiered water pricing means increasing the price of water that irrigation districts charge to water users as more water is applied. 1990 DRAINAGE MANAGEMENT PLAN, supra note 48, at 132. Although a district is not allowed to make a profit, it can structure the policy such that the district comes out even or it can use the additional revenue to fund water conservation measures. See id. For a discussion of tiered water pricing in the Grassland Drainage Area, see generally Wichelns & Cone, supra note 54.

[FN265]. Districts in the Grassland Drainage Area conduct workshops to educate landowners and growers about the drainage problem and the importance of irrigating efficiently. See McGahan, supra note 59, at 22.

[FN266]. In 1987, Congress added Subchapter VI to the CWA to establish grants to states for the establishment of revolving funds for water pollution control. Federal Water Pollution Control Act § § 601-07, 33 U.S.C § § 1381-1387 (1994 & Supp. IV 1998). The state revolving fund provides low-interest loans to districts in the Grassland Drainage Area. McGahan, supra note 59, at 22. These loans are used to fund irrigation system improvements such as sprinkler systems and drip irrigation. Id. As of spring 1999, the Grassland Area Farmers had used state revolving fund loans to fund $7.7 million in such improvements. Id.

[FN267]. McGahan, supra note 59, at 14; Minutes of Mar. 23, 1999, supra note 257, at 2.

[FN268]. Minutes of Mar. 23, 1999, supra note 257, at 2.

[FN269]. The Author interviewed David Cory of Camp 13 on July 22, 1999, in Dos Palos, California; Dennis Falaschi of Panoche Water District and Pacheco Water District on Sept. 8, 1999, in Firebaugh, California; Jeff Bryant of Firebaugh Canal Water District on Sept. 22, 1999, in San Francisco, California; Doyle Perry of Charleston

Drainage District on Sept. 24, 1999, in Los Banos, California; and Dave Cone of Broadview Water District on Oct. 5 & 22, 1999, in Firebaugh, California and Los Banos, California, respectively.

[FN270]. Draft Questionnaire on Economic Incentives Policies and Drainage Activities (Sept. 7, 1999) (on file with Harvard Environmental Law Review).

[FN271]. Id.

[FN272]. Id.

[FN273]. Id.

[FN274]. Id.

[FN275]. Post-Trade Questionnaires (July 1999 to Jan. 2000) (on file with Harvard Environmental Law Review).

[FN276]. OECD, EVALUATING ECONOMIC INSTRUMENTS, supra note 32, at 10.

[FN277]. Id. at 10, 91 (noting that "permit trading volumes may be an indication that economic efficiency gains are being achieved, relative to the same allocation of rights without trading," but that these data say little about "the underlying criterion of economic efficiency, which is the central theoretical justification for preferring economic instruments to conventional command-and-control regulation").

[FN278]. Austin, supra note 199.

[FN279]. See id.

[FN280]. See id.

[FN281]. See id.

[FN282]. Tradable Loads Rule for Water Year 1999, supra note 117, § § VI.C.1.a (monthly rebate), VI.C.2.a (annual rebate), at 4-5.

[FN283]. See supra note 123 and accompanying text (discussing the trade that took place at the time of the allocation of selenium load among districts).

[FN284]. See Minutes of Mar. 23, 1999, supra note 257, at 2.

[FN285]. See supra note 239 and accompanying text.

[FN286]. See Minutes of Mar. 23, 1999, supra note 257, at 2.

[FN287]. See Minutes of July 30, 1998, supra note 132, at 1 (comments by David Cory).

[FN288]. Id. (comments of David Cory, who participated in the July 16, 1998 meeting of district managers).

[FN289]. See id.

[FN290]. Id.

[FN291]. Id.

[FN292]. Post-Trade Questionnaires, supra note 275.

[FN293]. Id.

[FN294]. Id.

[FN295]. Id.

[FN296]. See supra Part III.B.1.

[FN297]. See supra Part III.A.2.

[FN298]. As discussed in the text accompanying supra note 62, an alternative regulatory structure could have been technology-based, mandating specific technologies rather than mandating specific performance standards in the form of load discharge restrictions.

[FN299]. See supra text accompanying notes 57-61.

[FN300]. For years, experiments have been underway to find a way to remove selenium from drainage water. 1990 DRAINAGE MANAGEMENT PLAN, supra note 48, at 42-49, 88 (describing various experiments and drainage water treatment projects). Several experiments are currently underway in the Grassland Drainage Area. See McGahan, supra note 59, at 21-24. For example, Panoche Water District is installing a full-scale sump treatment system that may help manage selenium, molybdenum, boron, and salt. See id. at 24. Broad-view Water District is experimenting with biological methods to treat drainage water. See Joseph McGahan et al., A Three-year Active Land Management Program to Reduce Drain Water and Improve Wildlife Habitat, Project Proposal Submitted to U.S. Bureau of Reclamation 3 (May 15, 1998) (on file with Harvard Environmental Law Review). Firebaugh Canal Water District is investigating whether selenium and salt can be removed through a membrane treatment process. McGahan, supra note 59, at 24. The consensus among district managers in the Grassland Drainage Area is that, in the long run, selenium and salt removal is necessary if the region is to continue viable agriculture while meeting environmental goals. Telephone Interview with David Cory, Ranch Manager, R.E. & D.E. Des Jardins Ranches (Apr. 27, 2001).

[FN301]. See supra notes 292-295 and accompanying text.

[FN302]. Environmental Research and Reporting Section, Minnesota Pollution Control Agency, Staff Initial Post-hearing Response to Public Comments In the Matter of Proposed Revisions of Minnesota Rules Chapter 7050, Relating to the Classification and Standards for Waters of the State (Sept. 15, 1999), available at http://www.pca.state.mn.us/news/publicnotice/pr-r7699- response.pdf.

[FN303]. One environmental problem with the Minnesota River is low dissolved oxygen. Id. BOD refers to discharges that result in lower dissolved oxygen in the river.

[FN304]. Environomics Report, supra note 37, at 22.

[FN305]. See Memorandum from James Klang, Minnesota Pollution Control, to the Great Lakes Trading Network (Mar. 30, 2000) (attachment to the GLTN Conference Call Summary from the Feb. 15, 2000, minutes) (commenting that although "it took a substantial period of time to renegotiate the permit to bring the environmental participants on board" the Rahr Malting Company "has exceed [sic] all expectations with point nonpoint pollutant trading" by creating even more offset units than are required by the permit) (on file with Harvard Environmental Law Review).

[FN306]. See generally YOUNG & CONGDON, supra note 2.

[FN307]. To reap the full benefits of market-based approaches to controlling water pollution, it may be necessary to reform the CWA itself. See Revisions to the National Pollutant Discharge Elimination System Program and Federal Antidegradation Policy in Support of Revisions to the Water Quality Planning and Management Regulation, 64 Fed. Reg. 46,058, 46,065-66 (proposed Aug. 23, 1999) (describing the proposed process for allowing trades between point sources and nonpoint sources within the context of the existing permitting system for point sources). See generally OECD, IMPLEMENTING DOMESTIC TRADABLE PERMITS, supra note 32, at 16.

[FN308]. Comments on the trading program included: "Good program--will see more trades as penalties get higher," "Program works fine for seller and buyer," and "I think it's a good program. It allows District Managers to be more flexible." Interviews with district managers, supra note 269.

[FN309]. Interview with David Cory, supra note 269.

[FN310]. See supra note 57 and accompanying text.

[FN311]. See supra notes 265-266and accompanying text.

[FN312]. See YOUNG & CONGDON, supra note 2, at 100 (comparing regulatory options and their applicability at the district level and farm level).

[FN313]. See Minutes of May 21, 1998, supra note 185, at 2 (comments by Marca Weinberg); Minutes of June 18, 1998, supra note 174, at 2.

[FN314]. See Minutes of May 21, 1998, supra note 185, at 2 (comments by Marca Weinberg).

[FN315]. Telephone Interview with David Cory, supra note 300.

[FN316]. Id.

[FN317]. Minutes of June 18, 1998, supra note 174, at 1.

[FN318]. Id.

[FN319]. Id. at 2 (comments by David Cory).

[FN320]. E-mail from Rudy Schnagl, Senior Land and Water Resources Specialist, Central Valley Regional Water Quality Control Board, to Author (Apr. 30, 2001) (on file with Harvard Environmental Law Review).

[FN321]. Interview with David Cory, in Los Banos (Mar. 24, 2000).

[FN322]. See supra notes 27-29 and accompanying text (discussing TMDLs).

[FN323]. Watershed-level trading of selenium load discharge is an unlikely development because the selenium problem is geographically limited. Salt discharge, however, is a widespread problem. Watershed-level trading of salt discharge could potentially function better than the more limited selenium trading described in this Article. Currently, there are eight players in the trading program, and one of those players is especially large. A larger area with more players would probably improve the functioning of the market by preventing trades from being affected by monopoly power. See OECD, EVALUATING ECONOMIC INSTRUMENTS, supra note 32, at 10.

[FN324]. See generally Part IV.B.

[FN325]. 2 Grassland Bypass Project EIS/EIR, supra note 42, at 42.

[FN326]. See supra Part V.B.

[FN327]. See OECD, EVALUATING ECONOMIC INSTRUMENTS, supra note 32, at 10.

[FN328]. For a detailed discussion of the decision to pursue a policy based on market incentives in the Grassland Drainage Area, see Young & Karkoski, supra note 82.

[FN329]. See, e.g., Alexandra Teitz, Assessing Point Source Discharge Permit Trading: Case Study in Controlling Selenium Discharges to the San Francisco Bay Estuary, 21 ECOLOGY L.Q. 79, 126-28 (1994) (describing environmentalists' opposition to environmental trading).

[FN330]. Robert E. Goodin, Selling Environmental Indulgences, 47 KYKLOS 573, 585 (1994) (arguing against the use of environmental trading policies by analogizing such policies to selling indulgences in medieval times). Goodin is less disapproving of economic approaches to environmental policy if they serve a more modest function of "policy enforcement" than if they serve a more ambitions function of determining "'optimal' levels of despoliation." Id. at 588-91.

[FN331]. See supra text accompanying note 222 (discussing hot spots).

[FN332]. See generally YOUNG & CONGDON, supra note 2.

[FN333]. See Teitz, supra note 329, at 92 n.57 (noting the support of Environmental Defense for the acid rain provisions of the 1990 Clean Air Act). The National Wildlife Federation also supports the general concept of environmental trading. NWF, A NEW TOOL, supra note 222, at 1 ("The challenge with trading is to allow for innovative, market-based reforms without compromising the existing safeguards in environmental protection.").

[FN334]. See Teitz, supra note 329, at 127 (noting that Environmental Defense was the only environmental group that enthusiastically endorsed a trading approach to the selenium problem).

[FN335]. Pollution trading can be divided into two main categories: (1) cap-and-trade programs, which are based on ex ante allocations, and (2) emission reduction credit programs, in which the "business as usual" performance is compared to actual performance. OECD, IMPLEMENTING DOMESTIC TRADABLE PERMITS, supra note 32, at 10. In the latter case, "[i]f an emitter/user performs better than the anticipated baseline, a 'credit' is earned. This credit can then either be used by the emitter/user himself, either at the current location or elsewhere, or sold to some other emitter whose emissions are higher than the accepted baseline (and presumably at a lower price than what it would cost the latter to abate on his own)." Id. The majority of environmental trading programs in the water quality context are of this second type. See generally Environomics Report, supra note 37 (surveying effluent trading and offset projects in the United States).

[FN336]. See supra Part III.B.1.

[FN337]. See supra note 27 and accompanying text.

[FN338]. See supra notes 15-19 and accompanying text.

[FN339]. See supra note 77 and accompanying text.

[FN340]. To be sure, an environmental trading program needs some kind of political entity to establish, implement, and maintain the program. For example, the South Coast Air Quality Management District ("SCAQMD") approved the RECLAIM program and serves the role of registering transactions and providing information. Harrison, supra note 35, at 63, 74. The role of SCAQMD in the RECLAIM program differs significantly from the role of the Grassland Area Farmers in the selenium trading program, however. SCAQMD is a regulatory body that chose a market-based permit system as its method of regulating SO_2 and NO_x in the Los Angeles basin. GERT TINGGAARD SVENDSEN, PUBLIC CHOICE AND ENVIRONMENTAL REGULATION: TRADABLE PERMIT SYSTEMS IN THE UNITED STATES AND CO2 TAXATION IN EUROPE 107 (1998). By contrast, the Grassland Area Farmers is a permitee that in turn established a trading program among its member irrigation and drainage districts. The theory behind the trading policies is the same, but the political structure involved is quite different.

[FN341]. YOUNG & CONGDON, supra note 2, at 95-96.

[FN342]. Id.

[FN343]. See supra note 4 and accompanying text.

GRASSLAND BASIN DRAINAGE STEERING COMMITTEE RULE ENFORCING SELENIUM LOAD ALLOCATION AND ESTABLISHING A TRADABLE LOADS PROGRAM FOR WATER YEAR 2000
Passed October 22, 1999

I. Purpose

To enable the Grassland Basin Drainage Management Activity to meet its selenium load target in a flexible, economically efficient manner.

II. Definitions

A. The ACTIVITY is the organization formed by the Activity Agreement.

B. The ACTIVITY AGREEMENT is the First Amended and Restated Grassland Basin Drainage Management Activity Agreement, dated March 7, 1996.

C. An EXCEEDANCE occurs when an entity discharges more selenium load than that entity's SLA.

D. MEMBERS are members of the San Luis & Delta-Mendota Water Authority and are signatories to the Activity Agreement.

E. PARTICIPATING PARTIES are not public entities and therefore not members of the San Luis & Delta-Mendota Water Authority but have agreed to participate in the Activity Agreement by execution of a memorandum of understanding.

F. The REGIONAL DRAINAGE COORDINATOR is employed by the Activity pursuant to 2.E. 1 of the Activity Agreement.

G. RICEWATER is surface drainage water from the flooding of a rice field.

H. The SAN LUIS DRAIN is an existing feature of the Central Valley Project that, under the terms of the Use Agreement, is used by the Activity to convey agricultural drainage water.

I. SELENIUM LOAD ALLOCATION ("SLA") is the number of pounds of selenium allocated to each Member/Participating Party pursuant to Exhibit A, as adjusted by any trades.

***393** J. The STEERING COMMITTEE is the governing body of the Activity.

K. TAILWATER is surface irrigation drainage water other than ricewater.

L. TILEWATER is subsurface irrigation drainage water that is discharged through a sump.

M. A TRADING AGREEMENT is a written document entered into by two or more parties to effect a trade of SLA.

N. An UNDERAGE occurs when an entity discharges less selenium load than that entity's SLA.

O. The USE AGREEMENT is the Agreement for Use of the San Luis Drain, signed November 3, 1995, together with all duly executed amendments.

P. USE AGREEMENT ANNUAL INCENTIVE FEES or ANNUAL INCENTIVE FEES are fees levied pursuant to the Use Agreement for exceedance of the regional annual selenium loads.

Q. USE AGREEMENT MONTHLY INCENTIVE FEES or MONTHLY INCENTIVE FEES are fees levied pursuant to the Use Agreement for exceedance of the regional monthly selenium loads.

R. WASTE DISCHARGE REQUIREMENTS are provisions of the Regional Water Quality Control Board's Order Number 98-171.

S. WATER YEAR 2000 runs from October 1, 1999, through September 30, 2000.

III. Initial Allocation

A. Section II.H.(3) of the Use Agreement establishes monthly and annual selenium load values for the Activity.

B. Exhibit A, hereby incorporated in this rule, establishes the monthly and annual SLA for each Member/Participating Party. The SLA for each Member/Participating Party is calculated based upon the proportion of tiled acreage, total acreage, and loads historically discharged from the area served by each Member/Participating Party.

***394** IV. Characteristics of Acceptable Trades

A. Any Member/Participating Party may trade some or all of its SLA.

B. The buyer of SLA must be a Member/Participating Party.

C. SLA may be traded for money, for SLA, for services, or for any other legal consideration.

D. A trade may alter a Member/Participating Party's SLA for any month and any year, whether that month or year is in the past, present, or future, provided that the trade is consistent with provision IV.E of this document.

E. Any trade of SLA may not be designed to cause any exceedance of the monthly or annual selenium load values

established by Section II.H.(3) of the Use Agreement. In addition, any trade of SLA must not cause any violation of Waste Discharge Requirements.

F. Trades pursuant to this rule must be documented in a written Trading Agreement. The Trading Agreement must name the parties involved and must specify the amount of SLA being traded. Because SLA is specific to a particular month and year, the Trading Agreement also must specify the month and year of the SLA being traded. The Trading Agreement must be certified by the Regional Drainage Coordinator as consistent with provision IV.E of this document. This certification must take place prior to execution of any Trading Agreement.

V. Duties of the Regional Drainage Coordinator

A. The Regional Drainage Coordinator shall maintain accurate records of the trades and of the resulting changes to each Member/Participating Party's SLA.

B. The Regional Drainage Coordinator shall establish a monitoring program sufficient to verify each Member/Participating Party's compliance with monthly and annual SLA as that allocation changes with any trades that are executed.

C. The Regional Drainage Coordinator shall report to the Steering Committee on the data collected through the monitoring program. Once the Steering Committee has reviewed this information for accuracy and clarity, the Steering Committee shall release this information to the public.

***395** D. The Regional Drainage Coordinator shall facilitate trades among Members/Participating Parties by sharing information as appropriate.

VI. Consequences of Exceeding the Monthly or Annual SLA

A. Each Member/Participating Party must not exceed its monthly and annual SLA in order to avoid any obligations under VI.B, VI.C, or VI.F, below. The Regional Drainage Coordinator shall calculate each Member's/Participating Party's obligations under VI.B and VI.C at the end of the water year.

B. Payment of Proportional Share of Use Agreement Incentive Fees

1. Use Agreement Monthly Incentive Fees. Use Agreement Monthly Incentive Fees will be paid by those Members/Participating Parties, if any, that exceeded their monthly SLAs. The share to be paid by each Member/Participating Party that has exceeded its monthly SLA will be the percentage of the Use Agreement Monthly Incentive Fee calculated by dividing such Member's/Participating Party's monthly SLA exceedance (in pounds) by the total of all Members'/Participating Parties' monthly SLA exceedances (in pounds) for such month.

2. Use Agreement Annual Incentive Fees. Use Agreement Annual Incentive Fees will be paid by those Members/Participating Parties, if any, that exceeded their annual SLAs. The share to be paid by each Member/Participating Party that has exceeded its annual SLA will be the percentage of the Use Agreement Annual Incentive Fee calculated by dividing such Member's/Participating Party's annual SLA exceedance (in pounds) by the total of all Members'/Participating Parties' annual SLA exceedances (in pounds) for such year.

C. Payment of Rebate to Districts That Went Under Their SLA

1. Monthly Rebate. Members/Participating Parties that exceed their monthly SLA shall compensate any Members/Participating Parties that go under their monthly SLA.

a) The total amount of the monthly rebate shall be $70.00 times the smaller of the following:

***396** (1) the total of all Members'/Participating Parties' monthly SLA exceedances (in pounds); or

(2) the total of all Members'/Participating Parties' monthly SLA underages (in pounds).

b) Each Member/Participating Party that exceeds its monthly SLA shall pay its share of the total monthly rebate in the same proportion as it pays its share of the Monthly Incentive Fees.

c) Each Member/Participating Party that goes under its monthly SLA shall receive a share of the total monthly rebate calculated by dividing the Member's/Participating Party's monthly SLA underage (in pounds) by the total of all Members'/ Participating Parties' monthly SLA underages (in pounds) for such month.

2. Annual Rebate. Members/Participating Parties that exceed their annual SLA shall compensate any Members/Participating Parties that go under their annual SLA.

a) The total amount of the annual rebate shall be $170.00 times the smaller of the following:

(1) the total of all Members'/Participating Parties' annual SLA exceedances (in pounds); or

(2) the total of all Members'/Participating Parties' annual SLA underages (in pounds).

b) Each Member/Participating Party that exceeds its annual SLA shall pay its share of the total annual rebate in the same proportion as it pays its share of the Annual Incentive Fees.

c) Each Member/Participating Party that goes under its annual SLA shall receive a share of the total annual rebate calculated by dividing the Member's/Participating Party's annual SLA underage (in pounds) by the total of all Members'/Participating Parties' annual SLA underages (in pounds) for such year.

D. Extraordinary Storm Events

1. There are impacts on selenium loads from extraordinary storm events. These include storm discharges from coast range streams and increased discharges due to excessive local rainfall.

***397** 2. Extraordinary storm events and the exceedances caused by them shall be determined as closely as possible by the Regional Drainage Coordinator and approved by the Steering Committee.

3. For exceedances declared by the Steering Committee to be caused by an extraordinary storm event, Members/Participating Parties shall have no obligations under VI.B and VI.C.

4. The share to be paid by each Member/Participating Party for Use Agreement Monthly or Annual Incentive Fees attributable to exceedances caused by extraordinary storm events will be the same percentage each Member/Participating Party is assigned for payment of costs in Budget Category 3A, the general fund for participation in the Activity.

E. Surface Flows from Panoche/Silver Creek in Periods Not Classified as Extraordinary Storm Events

1. Even in periods not classified as extraordinary storm events, there are impacts on selenium loads from storm events that trigger surface flows from Panoche/Silver Creek. These exceedances shall not be solely the responsibility of those Members/Participating Parties that simply convey the surface water flows to prevent damage to other Members/Participating Parties.

2. Exceedances caused by Panoche/Silver Creek flows shall be determined as closely as possible by the Regional Drainage Coordinator and approved by the Steering Committee.

3. For exceedances caused by Panoche/Silver Creek surface flows, Members/Participating Parties shall have no obligations under VI.B and VI.C.

4. The share to be paid by each Member/Participating Party for Use Agreement Monthly or Annual Incentive Fees attributable to exceedances caused by Panoche/Silver Creek surface flows will be the same percentage each Member/Participating Party is assigned for payment of costs in Budget Category 3A, the general fund for participation in the Activity.

F. Discretionary Consequences

1. If current estimates of selenium discharges indicate that a Member/Participating Party has exceeded or will exceed its ***398** monthly or annual SLA, the Regional Drainage Coordinator shall notify the Member/Participating Party of such exceedance.

2. The Steering Committee shall review any Member's/Participating Party's exceedance of any monthly or annual SLA and is authorized to determine appropriate sanctions, if any, on a case by case basis. Sanctions may include discharge restrictions or fines. In determining whether sanctions are appropriate, the Steering Committee shall consider relevant factors, including but not limited to a) whether the Member/Participating Party is taking all reasonable steps to avoid the exceedance, and b) whether the monthly or annual load value for the region, as set forth in the Use Agreement, has been or will be exceeded due to the Member's/Participating Party's discharge.

VII. Tailwater Restrictions

A. No Member/Participating Party may discharge irrigation tailwater into the San Luis Drain.

B. Each Member shall provide the Regional Drainage Coordinator with a schedule and proposed plan for removing tailwater.

C. A waiver or relaxation of the tailwater restriction may be granted by the Steering Committee provided that the combination of tailwater and tilewater discharged by a Member/Participating Party does not exceed a standard of 75 mg/l total suspended solids, or upon such alternate terms as may be fixed by the Steering Committee from time to time.

D. Ricewater is not considered tailwater and therefore may be discharged with the tilewater into the San Luis Drain, provided that the combination of ricewater and tilewater does not exceed a standard of 75 mg/l total suspended solids, or upon such alternate terms as may be fixed by the Steering Committee from time to time.

VIII. Adoption by Members/Participating Parties

To be effective, this Rule Enforcing Selenium Load Allocation and Establishing a Tradable Loads Program for Water Year 2000 must be adopted by each Member/Participating Party.

***399** APPENDIX B

SAMPLE TRADING AGREEMENT

For a Purchase of Selenium Load Allocation

For [Date]

Recitals

A. The Grassland Basin Drainage Steering Committee adopted on January 18, 1999, a "Rule Enforcing Selenium Load Allocation and Establishing a Tradable Loads Program for Water Year 1999" ("Rule"). This agreement ("Trading Agreement") is undertaken pursuant to that Rule.

B. Seller and Buyer are entering into this Trading Agreement in order to adjust their Selenium Load Allocation as that term is defined in the Rule.

C. Seller has not discharged its full monthly selenium load allocation for [[Date] and is willing to assign a portion of such selenium load allocation to Buyer.

D. Buyer requires additional selenium load allocation for [Date] and is willing to purchase selenium load allocation from Seller.

Agreement

1. Seller hereby assigns to Buyer ___ pounds of selenium load allocation for the month of [Date].

2. Buyer agrees to pay Seller $___ per pound for such assigned selenium load allocation, for a total of $___.

3. This load trade shall not affect the selenium load allocation of the parties described in Exhibit A of the Rule for any month other than [Date]. Nor shall it affect the annual selenium load allocation of the parties for Water Year 1999 or for any other water year.

4. This load trade shall not modify the monthly or annual selenium discharge allocation of the Grassland Basin Drainage Area as a region.

5. Except as modified by this and any future Trading Agreements, the selenium load allocation established by the Rule shall remain in full force and effect.

***400** Signed:

_____Date: ___

[Name]

Seller

_____Date: ___

[Name]

Buyer

The trades in this Trading Agreement are certified as consistent with the Rule Establishing a Tradable Loads Program for Water Year 1999:

_____Date: ___

Joseph C. McGahan

Regional Drainage Coordinator

***401** APPENDIX C

MEMORANDUM TO DISTRICT MANAGERS REGARDING DETERMINING THE QUANTITY AND PRICE FOR SELENIUM LOAD ALLOCATION TRADES [FNi]

Purpose of the Memorandum

This memorandum sets out a framework that may be useful to you as you are making your decisions about how much selenium load allocation to buy or sell, and at what price. Applying this framework to your own situation will

probably involve some guesswork. The better the information you collect about your costs, the better you will be able to figure out the correct quantities and prices for selenium load allocation trading.

Determining Price and Quantity for Selenium Load Allocation Trading

To determine how much selenium load allocation to purchase and at what price, you will need to know: 1) how close you are to your selenium load allocation target and 2) how much it costs you to abate selenium discharge using various options. Although figuring out the costs of abatement is the more difficult task, you probably already have some idea about these costs. For as long as you have been required to abate selenium discharge, you have been examining your various abatement options, and you have been pursuing those options with the lowest cost per pound selenium abated.

Now, with trading, you use the same kind of analysis, but you have one more option to consider. If you think that you will be going over your selenium load allocation, you would figure out the cheapest way that you could cut back on selenium discharge yourself, and then you would see whether anyone would sell you selenium load allocation for less than that. As long as purchasing a pound of selenium load allocation is cheaper than abating a pound of selenium discharge, you should purchase an additional pound of selenium load allocation. From the seller's perspective, as long as someone will buy a pound of selenium load allocation for more than it costs you to abate a pound of selenium discharge, ***402** then you should abate selenium discharge and sell selenium load allocation.

So far, this discussion has assumed that the price is given and that all you have to figure out is how many pounds of selenium load allocation to buy or sell. This would be the situation in a perfectly competitive market. That may happen one day in the selenium load allocation market, but that is not the situation today. Therefore, parties must bargain for both quantity and price for each trade. As a buyer, you should know both the amount of selenium load allocation you need and the maximum price you would pay for a pound of selenium load allocation. You would figure out your maximum price as described above: by calculating how much it would cost you to abate selenium discharge by yourself. As a seller, you should know the minimum price you will accept. If you incur costs in order to abate enough selenium load allocation to be able to sell some, you would want to cover the costs of your abatement efforts. Any price between the buyer's maximum price and the seller's minimum price is reasonable and will result in efficiency gains for both trading parties. The range of reasonable prices could be quite large. The price agreed upon within that range will depend on the bargaining strategies of the parties.

Types of Costs to Consider

In the above discussion, I wrote generally of the importance of costs in determining the quantity and price for selenium load allocation trades. In this section, I explain a little more about types of costs to consider. This section uses some concepts that firms apply in determining how much of a good to produce. Although your district is not a firm producing goods in a competitive market, it may be helpful to think about your costs in a similar way. For you, the "good" being produced is selenium abatement: you are figuring out how many pounds of selenium abatement to "produce."

When making decisions about how much to produce in the short run, a profit-maximizing firm in a competitive market keeps producing more goods until the price of the good equals the marginal cost of producing the good. The short run is the period of time during which capital investments are fixed. For example, in the short run, you have only a certain capacity to recirculate drainage water. Building additional capacity is something you could only do in the long run. Whereas firms would consider the marginal cost of production, you would consider the marginal cost of abatement. The marginal cost of abatement is the change in cost associated with the abatement of one additional pound of selenium discharge. For example, if abating 20 pounds of selenium has a variable ***403** cost of $200 and abating 21 pounds of selenium has a variable cost of $210, then the marginal cost of abatement is $10.

The marginal cost of abatement generally rises. This is probably true of selenium discharge abatement as well: the more pounds of selenium discharge that are abated, the more expensive abatement becomes per pound. This is because districts presumably would pursue the most cost-effective measures first, and as additional measures are needed, the marginal price would rise. To keep with our example above, if abating 22 pounds of selenium has a variable cost of $222, then the marginal cost of abatement rises to $12. If you estimate that you will be above your selenium load allocation target, it makes sense to abate selenium discharge for as long as your marginal cost of abatement is lower than the price at which you can purchase selenium load allocation. When your marginal price of abatement equals or rises above the price at which you can purchase selenium load allocation, you should purchase

selenium load allocation. From the seller's perspective, if your marginal cost of abatement is lower than the price at which you can sell selenium load allocation, you should abate additional selenium load and sell selenium load allocation. You should stop abating additional selenium load only when your marginal cost of doing so equals the price of selenium load allocation.

Fixed costs--like building a factory or a recycling facility--do not come into consideration in the short run, because they cannot be changed. In the long run, however, a profit-maximizing firm in a competitive market must cover its total costs (fixed costs plus variable costs). The price of the good must equal the average total cost of producing the good. The analogous cost for a district would be the average total cost of abatement. That is, the total cost of selenium discharge abatement divided by the number of pounds of selenium discharge abated. Just as in the long run a firm must cover its fixed and variable costs, so must a district.

Selenium abatement options appear to have low marginal costs and high average total costs. For example, the marginal cost of using a recycling facility to recirculate enough drainage water to abate an additional pound of selenium load is probably low relative to the fixed cost of building the recirculation facility. Selenium load allocation is likely to be undervalued if parties enter the bargaining process with only the short run marginal costs in mind.

[FNi]. Adapted from Memorandum from the Author, to District Managers (May 13, 1999) (on file with Harvard Environmental Law Review). Sources used for the memorandum were WILLIAM S. BROWN, PRINCIPLES OF MICROECONOMICS (1995) and TOM TIETENBERG, ENVIRONMENTAL AND NATURAL RESOURCE ECONOMICS (2d ed. 1988).

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