William & Mary Environmental Law and Policy Review

Volume *34 (2009-2010)*
Issue 3

Article 3

April 2010

Priceline for Pollution: Auctions to Allocate Public Pollution Control Dollars

Robert W. Adler

PRICELINE FOR POLLUTION: AUCTIONS TO ALLOCATE PUBLIC POLLUTION CONTROL DOLLARS

ROBERT W. ADLER*

INTRODUCTION

What do eBay and Priceline have to do with pollution control? Despite many decades of effort and tremendous investments in prevention and remediation programs, some forms of pollution remain poorly controlled. This article explores the utility of competitive bidding (or auctions) for public pollution control dollars as a way to address some of the most intractable sources of pollution, using nonpoint source water pollution as an example.[1]

Although generalizations in this complex area of law and policy are difficult, legislative and regulatory programs typically have been more successful when the sources of pollution contributing to a particular problem are fewer in number, are easily identified, and are therefore subject to targeted strategies such as permits with clear associated control mandates and enforcement mechanisms. For example, discharges of pollutants from municipal sewage treatment plants are subject to the National Pollutant Discharge Elimination System ("NPDES") and minimum secondary treatment requirements of the Federal Water Pollution Control Act ("FWPCA"), more commonly known as the Clean Water Act ("CWA").[2] Those controls have resulted in significant reductions in pollution.[3] By comparison, water

---

* James I. Farr Chair and Professor of Law, University of Utah, S.J. Quinney College of Law. J.D. 1980, Georgetown University Law Center; B.A. (ecology) 1977, Johns Hopkins University. I would like to thank Professor Manuel Utset for introducing me to some of the literature on auction theory, and Heather Tanana (J.D. expected May 2010, University of Utah, S.J. Quinney College of Law), for valuable research assistance.

1 Auctions of public dollars may also have important applications for the control of greenhouse gases ("GHG") emissions. I will reserve that issue, however, for a later analysis.

2 Federal Water Pollution Control Act of 1972, Pub. L. 92-500, 86 Stat. 816 (1972) (codified as amended at 33 U.S.C. §§ 1251–1387 (2006)). The NPDES requirements are included in § 402 of the CWA, 33 U.S.C. § 1342 (2006). The secondary treatment requirement is contained in § 301(b)(1)(B). *Id.* § 1311(b)(1)(B). (Future references to the Act will be to section numbers of the statute in the text, and to the U.S.C. sections in footnotes, except as otherwise noted.).

3 *See* ROBERT W. ADLER, JESSICA C. LANDMAN & DIANE M. CAMERON, THE CLEAN WATER ACT: TWENTY YEARS LATER 14 (1993).

pollution from so-called "nonpoint sources," a broad, poorly-defined[4] category of a very large number of highly dispersed activities that result in polluted runoff and other impairments to surface waters, has been controlled relatively poorly.[5]

Similarly, when public spending has been used as a strategy for pollution control, it has been more successful when applied to smaller numbers of discrete sources, with specific attached requirements, than it has for more dispersed pollution sources with comparatively vague performance objectives. Thus, in direct parallel with the above comparison of regulatory strategies, the federal construction grant program under Title II of the 1972 FWPCA Amendments[6] played a significant role in reducing municipal sewage pollution by providing the necessary funds to build and upgrade sewage treatment plants and related conveyance infrastructure.[7] Yet the federal government has spent similar magnitudes of money on a much larger number of discrete sources of agricultural nonpoint source pollution through the Clean Water Act, Farm Bill, and other programs,[8] with far less success in reducing pollution and improving water quality.[9]

Auctions are used in private markets to increase competition, maximizing revenues for goods such as real estate, automobiles, art, and antiques.[10] With the advent of eBay,[11] Priceline,[12] and other internet-based auction sites, the public at large is increasingly involved directly with the

---

[4] Indeed, nonpoint source pollution is defined in the CWA only by negative implication as any source of water pollution that derives from something other than a "point source." 33 U.S.C. § 1362(14) (2006).

[5] *See* William L. Andreen, *Water Quality Today—Has the Clean Water Act Been a Success?*, 55 ALA. L. REV. 537, 543–45 (2004); David Zaring, *Agriculture, Nonpoint Source Pollution, and Regulatory Control: The Clean Water Act's Bleak Present and Future*, 20 HARV. ENVTL. L. REV. 515, 528 (1996); Timothy D. Searchinger, *Cleaning Up the Chesapeake Bay: How to Make an Incentive Approach Work for Agriculture*, 16 SE ENVTL. L.J. 171, 178–80 (2007) (comparing control of nitrogen from sewage treatment plants in the Chesapeake Bay watershed with efforts to control nonpoint source pollution).

[6] 33 U.S.C. §§ 1281–1287 (2006).

[7] *See* ADLER ET AL., *supra* note 3, at 14.

[8] *See* James M. McElfish, Jr., Linda Breggin, John A. Pendergass, III & Susan Bass, *Inventing Nonpoint Controls: Methods, Metrics and Results*, 16 VILL. ENVTL. L.J. 87, 89–99 (2006).

[9] *See infra* Part II(b).

[10] *See generally* Paul Klemperer, *Auction Theory: A Guide to the Literature*, 13 J. ECON. SURVEYS 227 (1999) [hereinafter *Auction Theory*] (reprinted in PAUL KLEMPERER, AUCTIONS: THEORY AND PRACTICE 11–65 (2004)).

[11] eBay, http://www.ebay.com (last visited Mar. 1, 2010).

[12] Priceline, http://www.priceline.com (last visited Mar. 1, 2010).

benefits (and potentially, pitfalls) of auction procedures.[13] Auctions are even being used to select lead counsel in class action securities litigation.[14]

Auctions are also used to improve the efficiency and cost-effectiveness of government programs. Auctions may provide the government with better, market-based information with which to allocate resources, compared to regulatory processes in which agencies make allocation decisions based on other factors and sources of information—what one commenter referred to as "beauty contests."[15] In addition, auctions may cost agencies less than competing regulatory procedures for resource allocation.[16] Governments routinely use competitive bidding or other auction procedures to sell various kinds of public resources, such as mineral resources, financial paper (such as treasury bills), or public assets (such as surplus land) at higher prices.[17] More recently, auctions have been used or proposed to allocate other kinds of public resources, such as radio spectrums or broadcast licenses,[18] internet domain names,[19] and prospect patents.[20] Similarly, governments increasingly use auctions as a procurement tool to obtain

---

[13] *See, e.g.*, Posting of Kimberly Palmer to U.S. News Alpha Consumer, http://www.usnews.com/money/blogs/alpha-consumer/2008/1/30/good-or-bad-news-for-ebay-sellers.html (Jan. 30, 2008) (discussing eBay's plans to charge higher commissions for items sold on its site).

[14] *See* Charles H. Gray, Comment, *An Economic Analysis of the Private Securities Litigation Reform Act: Auctions as an Efficient Alternative to Judicial Intervention*, 44 WM. & MARY L. REV. 829, 829 (2002).

[15] *See* D. Daniel Sokol, *The European Mobile 3G UMTS Process: Lessons From the Spectrum Auctions and Beauty Contests*, 6 VA. J. L. & TECH. 17 (2001), http://www.vjolt.net/vol6/issue3/v6i3-a17-Sokol.html (discussing telecommunications spectrum allocation decisions).

[16] *See id.* (noting that the Federal Communications Commission estimated that administrative hearings cost six times more than auctions in allocating broadcast spectrum licenses).

[17] *See Auction Theory*, *supra* note 10, at 227.

[18] *See* Sokol, *supra* note 15; David Seth Zlotlow, *Broadcast License Auctions and the Demise of Public Interest Regulation*, 92 CAL. L. REV. 885 (2004). This was discussed at some length by Ronald Coase. R. H. Coase, *The Federal Communications Commission*, 2 J. L. & ECON. 1, 15 (1959), and later authorized by Congress in the Omnibus Budget Reconciliation Act of 1993, Pub. L. No. 103-66, 107 Stat. 312 (1993) (relevant sections codified at 47 U.S.C. § 309 (2006)) and adopted in numerous other countries. *See* Stuart Buck, *Replacing Spectrum Auctions with a Spectrum Commons*, 2002 STAN. TECH. L. REV. 2 (2002) (arguing that allocation of the broadcast spectrum via auctions should be replaced by a commons).

[19] *See* Gideon Parchomovsky, *On Trademarks, Domain Names, and Internal Auctions*, 2001 U. ILL. L. REV. 211 (2001).

[20] *See* Michael Abramowicz, *The Uneasy Case for Patent Races over Auctions*, 60 STAN. L. REV. 803 (2007). To some degree, Abramowicz and others argue that the current patent system is already akin to an auction in which "the winner is the first . . . to meet the requirements of patentability." *Id.* at 823.

goods and services at a lower price and in a shorter amount of time.[21] Still, some have suggested that government agencies have been much slower than the private sector to adopt this more efficient procurement tool because of "guaranteed operating funds" and an "entrenched bureaucratic mentality and its penchant for doing things 'the way we have always done them. . . .'"[22]

The federal government and some state governments have also used variations on auction processes in an effort to reduce pollution more efficiently; i.e., to obtain more pollution reduction at the same cost as would be incurred to comply with regulatory mandates, or to reduce the same amount of pollution at a lower cost.[23] For example, the Clean Air Act's "cap and trade" program employs auction processes to reduce sulfur dioxide and nitrogen oxide emissions that cause acid rain.[24] Various legislative proposals would also rely on auction procedures to regulate GHGs through cap and trade or other mechanisms; some processes are already in place to do so internationally and regionally within the United States, with varying assessments of their relative levels of success.[25] Some of

---

[21] *See Auction Theory*, *supra* note 10, at 227; Maj. Susan L. Turley, *Wielding the Virtual Gavel—DOD Moves Forward with Reverse Auctions*, 173 MIL. L. REV. 1, 2 (2002) ("[T]he public sector has turned to auctioning to buy millions of dollars of computers, natural gas, airplane parts, dishwashers, pharmaceuticals, and even goats."). The federal government has reported significant savings in procurement costs through reverse auctions. *See* Daniel B. Volk, Note, *A Principles-Oriented Approach to Regulating Reverse Auctions*, 37 PUB. CONT. L.J. 127, 129 (2007). As a result, the use of government procurement auctions has skyrocketed: "Since 2002 FedBid has facilitated over 17,000 online auctions for federal agencies. The Department of State alone has run at least 4,700 auctions for procurements worth $169 million." *Id.* at 130. In 2000, the General Services Administration ("GSA") initiated Buyers.Gov to conduct online reverse auctions for government agencies. Turley, *supra*, at 8. Some authors suggest, but ultimately reject, legal problems with government reverse auctions and online auctions. *See id.* at 15–22; Volk, *supra*, at 129–30. Because such auctions continue routinely, and because that issue of government contracting law is beyond the scope of this analysis, I assume here that government use of reverse auctions is legally permissible so long as other applicable procurement statutes and regulations are followed properly.

[22] Turley, *supra* note 21, at 24–25.

[23] *See generally* Bruce A. Ackerman & Richard B. Stewart, Comment, *Reforming Environmental Law*, 37 STAN. L. REV. 1333 (1985) (calling for auctions and other economic trading procedures for pollution allowances and permits).

[24] 42 U.S.C. §§ 7651–7651o (2006); *see* Byron Swift, *Command Without Control: Why Cap-and-Trade Should Replace Rate Standards for Regional Pollutants*, 31 ENVTL. L. REP. 10330 (2001).

[25] *See generally* Cinnamon Carlarne, *Climate Change Policies an Ocean Apart: United States and European Union Climate Change Policies Compared*, 14 PENN ST. ENVTL. L. REV. 435 (2006); David M. Driesen, *Sustainable Development and Market Liberalism's*

those programs explicitly use auction procedures to sell carbon dioxide emissions allowances.[26] Pollutant trading programs have been proposed, but used far less broadly, to control nonpoint source water pollution.[27]

The purpose of this article is not to debate whether direct government spending or other forms of economic incentives are preferable to regulation or other options as a means of pollution control.[28] However, the federal government has spent significant amounts of money on pollution control and environmental restoration in the past and is likely to do so in the future.[29] Such direct federal spending on large capital projects often proceeds under a "public works" model in which projects are selected based on political or other factors rather than a competitive, performance-based process.[30] This is often criticized as inefficient and potentially ineffective.[31]

There is at least one example, however, in which the government has used auctions (competitive bidding) to improve the efficiency and

---

Shotgun Wedding: Emissions Trading Under the Kyoto Protocol, 83 IND. L.J. 21 (2008); David M. Driesen, *Free Lunch or a Cheap Fix?: The Emissions Trading Idea and the Climate Change Convention*, 26 B. C. ENVTL. AFF. L. REV. 1 (1998).

[26] *See* J. Jared Snyder, *Auction Design for Selling CO_2 Emission Allowances under the Regional Greenhouse Gas Initiative*, ALI-ABA Continuing Legal Education Course of Study, Apr. 3–4, 2008, Global Warming: Climate Change and the Law.

[27] *See generally* Ann Powers, *Reducing Nitrogen Pollution on Long Island Sound: Is There a Place for Pollutant Trading?*, 23 COLUM. J. ENVTL. L. 137 (1998) (discussing the costs and benefits of pollutant trading programs).

[28] Public investment in pollution control, especially where the pollution is generated by private, for-profit activities, arguably violates the "polluter pays" concept of environmental law. *See* U.N. Conference on Environment and Development, *Rio Declaration on Environment and Development*, U.N. Doc. A/CONF.151/5/Rev.1 (June 14, 1992), Principle 16. Indeed, elsewhere I have argued that nonpoint source water pollution should be the subject of some form of mandatory controls analogous to those that apply to point source pollution. *See* Robert W. Adler, *Water Quality and Agriculture: Assessing Alternative Futures*, 25 ENVIRONS ENVTL. L. & POL'Y J. 77 (2002). On the other hand, where pollution derives from either public sources or multiple, diverse sources that are difficult to control individually, public spending may be the most practical way to address the problem. *See* McElfish et al., *supra* note 8, at 89–99 (discussing various federal grant programs).

[29] *See* McElfish et al., *supra* note 8, at 89–99. One reason why pollution control spending is popular is the number of jobs that result from such projects. *See* Press Release, Envtl. Prot. Agency, EPA Administrator Cites Benefits of Pollution Control Programs (Nov. 22, 1974), *available at* http://www.epa.gov/history/topics/costs/01.htm.

[30] *See, e.g.*, *Klobuchar Secures Funding for Energy Projects*, JOURNAL, July 16, 2008, *available at* http://www.ifallsdailyjournal.com/news/state-news/klobuchar-secures-funding-energy-projects-9934 (lauding a U.S. senator for securing federal funding for an energy project in a local county).

[31] *See* Sokol, *supra* note 15 (criticizing "beauty contest" methods of allocating public funds). *See generally* TERRY R. ANDERSON & DONALD R. LEAL, FREE MARKET ENVIRONMENTALISM (2001).

effectiveness of direct spending for pollution control. In the cooperative federal multi-state effort to control salinity pollution in the Colorado River, the most recent round of which is being funded through the American Recovery and Reinvestment Act of 2009 (commonly known as the "stimulus package"),[32] federal reclamation program dollars are bid out to projects that can demonstrate the most cost-effective salinity reductions on the basis of dollars spent per ton of salt removed, combined with various ways to consider risk of project failure and other factors.[33] Although constrained thus far to a relatively limited set of circumstances, this program could serve as a model for other governmental spending programs for pollution control. For example, competitive bidding could be used to improve the effectiveness of nutrient reduction components of large aquatic ecosystem restoration programs, such as the Chesapeake Bay Program or the Everglades restoration program. More generally, competitive bidding could significantly improve the cost-effectiveness of federal agricultural program spending targeted at pollution control.

Part I of this article will discuss the theoretical underpinnings of auction theory as applied to government spending programs, and why those methods could be used to improve the effectiveness and efficiency of public spending for pollution control. Part II will describe the history, operation, and effectiveness of the Colorado River salinity control program, and evaluate both the strengths and the potential limitations of that program through the lens of auction theory. Part III will evaluate the potential utility of competitive bidding to reduce nutrients or other forms of water pollution in other watershed programs, using the Chesapeake Bay Program as an example. The Conclusion will suggest that auction theory and practice has the potential to improve the cost-effectiveness of public spending on such pollution control efforts.

I. AUCTION THEORY AND POTENTIAL IMPLICATIONS FOR PUBLIC POLLUTION CONTROL SPENDING

As explained by a leading expert on auction theory, the basic auction model assumes "a fixed set of symmetric, risk-neutral bidders with independent information who bid independently for a single object."[34] In

---

[32] American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5, 123 Stat. 115 (2009).
[33] U.S. DEPT. OF THE INTERIOR, COLORADO RIVER BASIN SALINITY CONTROL PROGRAM: AMERICAN RECOVERY AND REINVESTMENT ACT 37 (2009) [hereinafter 2009 RFP] (discussing the evaluation criteria for federal funding). For more information on federal spending, see *infra* Part II.
[34] *Auction Theory*, *supra* note 10, at 227–28.

this model, price (or another valuation measure) is determined by the forces of competition.[35] As compared to other forms of pricing—such as posted prices, as one finds in retail stores, or bi-party negotiations between buyers and sellers[36]—increasing the number of participants in an auction should maximize the revenue received by the seller, or in procurement auctions (sometimes referred to as "reverse auctions" and as exemplified in the consumer market by Priceline.com),[37] increasing the number of participants should minimize the cost or increase the value of goods or services to the purchaser.[38] Even large private businesses such as General Motors and Raytheon have found in recent years that they can reduce procurement costs significantly through procurement auctions.[39] Auctions are particularly valuable in thin markets, i.e., where there are typically no natural markets,[40] as is probably the case for the allocation of government-funded pollution control projects.

A. Types of Auctions

Four types of auctions are used and studied most frequently.[41] The form of auction known most commonly to lay people—whether via traditional in-person, call-out auctions or via eBay or similar online services—is the ascending bid auction in which the price increases through successive bids until no higher bids are submitted or until a predetermined time for

---

[35] Gray, *supra* note 14, at 840–41.

[36] *Auction Theory*, *supra* note 10, at 228.

[37] *See* Volk, *supra* note 21, at 132 (discussing reverse auctions); Turley, *supra* note 21, at 3 (citing Priceline.com as an example of a consumer application of reverse auctions because the site seeks the lowest bid for a particular travel request).

[38] There is no theoretical distinction between auctions in which the auctioneer is the seller seeking maximum revenue or in which the auctioneer is the buyer seeking lower prices or higher value. *See Auction Theory*, *supra* note 10, at 234–35.

[39] *See* Volk, *supra* note 21, at 128.

[40] Parchomovsky, *supra* note 19, at 230.

[41] This analysis categorizes auctions procedurally, i.e., according to how they are conducted. Auctions can also be categorized in terms of how the subject of the auction is valued: (1) private value auctions, in which each bidder's value does not depend on other bidders; (2) common value auctions in which values change based on signals received from other bidders; and (3) correlated value auctions, in which private valuations may change based on signals from other bidders. Parchomovsky, *supra* note 19, at 230. These distinctions are probably not relevant to bidding for government-funded pollution control projects, in which bids must reflect context-specific differences. Hence, pollution control auctions will usually, if not always, be in the private value category if bidding reflects actual pollution control costs rather than an irrational desire to win the auction even at a net loss.

the auction has expired.[42] This process is highly transparent because all bidders have the opportunity to know immediately when a higher bid is submitted and the level of that bid.[43] In fact, one of the market-facilitating aspects of ascending bid auctions is that participants can adjust their bids based on price signals received from other bidders.[44] Price is typically the only factor in deciding who wins the auction, which is sufficient if a known asset with fixed attributes is being bought or sold, and ascending bid auctions typically produce higher prices than other forms of auctions.[45] Where a purchaser is using an auction to obtain goods or services with varying levels of risk or quality, however, the single piece of information (price) generated by ascending bid auctions may not be sufficient to fully inform the auctioneer's decision, and reverse government auctions as a procurement tool have been criticized on those grounds.[46] Moreover, government auctions may seek to fulfill legal or policy goals other than maximizing sales revenues or minimizing procurement outlays,[47] and ascending bid auctions based on a single variable (price) will not fulfill all of those goals.

Thus, when the government seeks to spend money on pollution control projects where success (measured by actual pollution reductions after project completion or implementation) is as or more important than price, simple ascending bid auctions may not be the most appropriate process. Of course, if the government accepts bids in the form of units of cost per unit of pollution reduced (e.g., X dollars per pound of reduced pollution), it could pay based on proof of actual pollution reductions—to the extent those reductions can be measured accurately—rather than paying project costs up-front. However, that would shift the risk of project failure to successful bidders, and potentially result in increased bids to account for that risk. It would also freeze out of the bidding process smaller participants or others who lack sufficient capital to pay for project costs up-front. In the case of nonpoint sources of water pollution, such as farmers, this could

---

[42] *See Auction Theory*, *supra* note 10, at 230–31.
[43] *See id.* at 229.
[44] *See id.* at 230.
[45] *Id.* at 242, 256.
[46] *See* Volk, *supra* note 21, at 129. An example is the use of auctions to procure IT or other technical services, where the winner is simply the bidder with the lowest hourly rates, with no accompanying quality control. *Id.* Of course, quality or other factors can be imposed as conditions of the sale *ex ante*, which might increase the risk that a sale will be terminated after the auction. Alternatively, an auction could be structured so that the successful bidder wins only the right to negotiate additional terms with the auctioneer, which again introduces additional risk into the transaction for both parties.
[47] *See infra* Part I.B.

eliminate many of the very participants targeted by the program.[48] Moreover, since the societal goal is to reduce pollution rather than simply to avoid paying for unsuccessful pollution control projects, it is preferable to employ methods most likely to result in success.

Descending bid auctions are similar to ascending bid auctions, except that the auctioneer begins with a high price and lowers the offering price sequentially until a participant submits a single, winning bid.[49] An obvious initial decision for the auctioneer is how to determine the opening price, which might be based on previous transactions or other factors.[50] Descending bid auctions are somewhat transparent in that all parties know the instantaneous offering price and have an opportunity to submit the winning bid at any time.[51] However, the solitary, winning bidder obviously has less information about the value of the subject of the auction to other participants at the time of the bid, and therefore entails more risk in the process.[52] As with ascending bid auctions, this process omits information that may be essential to government procurement goals, absent some form of ex *ante* or *ex post* process to add non-price-based conditions to the transaction.

The remaining two forms of commonly used auctions are sealed bid auctions. In one variation, the "first-price sealed-bid auction," the winner is the participant who submits the highest bid, and the price is equal to that bid.[53] In a "second-price sealed-bid auction," the winner is still the highest bidder, but the price actually paid is equal to the bid submitted by the second highest bidder.[54] Sealed bid auctions are usually opaque

---

[48] U.S. Environmental Protection Agency, Polluted Runoff (Nonpoint Source Pollution): Agriculture, http://www.epa.gov/nps/agriculture.html (last visited Mar. 3, 2010) ("In the 2000 National Water Quality Inventory, states reported that agriculture nonpoint source (NPS) pollution was the leading source of water quality impacts on surveyed rivers and lakes, the second largest source of impairments to wetlands, and a major contributor to contamination of surveyed estuaries and ground water.").

[49] *See Auction Theory*, *supra* note 10, at 230–31. For reverse auctions the opposite would be true. The auctioneer would begin with a very low procurement price, and increase the price gradually until a bid is submitted.

[50] Turley, *supra* note 21, at 5.

[51] *See Auction Theory*, *supra* note 10, at 230.

[52] For example, if the winning participant bids $100, she has no way to know whether a competitor would have bid at $99, or only at $90. If the latter is true, the "winning" bidder paid $9 more for the item because of this lack of information. This is one example of the "winner's curse," in which a successful bidder ends up paying an inflated price. *See id.*

[53] *Id.* at 229.

[54] This is sometimes referred to as a "Vickrey auction," after economist William Vickrey, who won the Nobel Prize in economics for his seminal work on auction theory. *See id.* Although intuitively less obvious, presumably this attribute of the auction encourages

rather than transparent, at least until the results are announced.[55] Participants must bid based solely on their own private information about how much they value the object to be sold, or in the case of procurement, about how much they are willing to accept for their goods or services.[56]

Sealed bid auctions have several apparent advantages over ascending bid or descending bid auctions for purposes of public procurement or other auctions that require the use of multiple selection criteria rather than price alone.[57] First, as will be discussed *infra* in the context of the salinity control program, a sealed bid process allows the auctioneer to require more information than just price.[58] This is known as a "multidimensional auction" in which the auctioneer evaluates the bids based on a set of scoring criteria rather than a single dimension of price alone.[59] In fact, some forms of auctions might be designed to emphasize non-price criteria over price, in order to maximize overall public benefits.[60] Of course, it is arguable that the more the agency relies on subjective, policy-based criteria and the less it acts based on more specific and quantifiable (even if non-price-based) criteria on which competing bids can be compared objectively, the more the process begins to resemble the regulatory "beauty contests" for which auctions theoretically provide a preferred substitute. For example, if risk-averse government bureaucrats are biased in favor of tried

---

higher bids overall because the winner faces less risk of paying a price much higher than others are willing to pay. *See* Parchomovsky, *supra* note 19, at 231. In theory, this encourages more truthful rather than strategic bidding. *Id.*

[55] *See Auction Theory*, *supra* note 10, at 229.

[56] In an interesting variant on second-price sealed bid auctions, Professor Parchomovsky proposes that disputes between cybersquatters (those who appropriate internet domain names that match trademarks owned by large companies) and the trademark holders be resolved through sealed bid auctions in which, if the trademark owner submits the higher bid, she pays the price bid by the domain name owner, but if the domain name owner submits the higher bid, she pays the trademark owner the price of that bid. *See* Parchomovsky, *supra* note 19, at 216. This, then, would be a mixed first-price and second-price closed bid auction.

[57] Sealed bid auctions are predominant in public sector procurement processes. Patrick Bajari & Garrett Summers, *Detecting Collusion in Procurement Auctions*, 70 ANTITRUST L.J. 143, 147 (2002).

[58] *See infra* Part II.

[59] *See, e.g.*, Gray, *supra* note 14, at 849 (discussing the use of multiple criteria by judges in using sealed bid auctions to select lead counsel in class action securities litigation).

[60] *See* Abramowicz, *supra* note 20, at 808–09 (suggesting that patent auctions might award the rights "to the inventor who commits the most resources to research and development, who accepts the shortest patent term, or who agrees to sell or license the invention for the lowest amount of money," rather than the inventor who agrees to pay the highest fee to the government licensing agency).

and true methods of pollution control, and select those projects on the basis of lower risk despite higher costs, the process loses some of the intended benefits of an auction process, including not only lower costs but also incentives for innovation.

Second, sealed bidding might help to reduce performance risk—the risk that the winning bidder will default on its obligations—by preventing underbidding (inappropriately low estimates of project costs by the bidder) in an effort to win the bid.[61] Some auctions' designs require bidders to post bonds to guarantee ability to pay a successful bid,[62] but an analogous variation in a reverse auction is a requirement for a winning bidder to post a performance bond to increase the probability that the project is completed successfully. Of course, as with the earlier suggestion that the government might withhold payment until actual pollution reduction is proven, this might freeze small or resource-poor participants out of the market, and the program might lose intended beneficiaries. Moreover, if a bidder proposes to reduce pollution from a particular source, by a particular amount, and for a particular price, the auctioneer (here, the sponsoring government agency) can assess not only the cost per unit of pollution removed relative to other bids, but the nature, location, and apparent efficacy of the proposed controls. In other words, the auctioneer can judge the level of risk inherent in each bid, that is, the risk that the project will not produce the promised degree of pollution control, and determine the appropriate balance between price and risk in selecting winning projects.

Third, for procurement of pollution controls, for some purposes it might be desirable for bidders *not* to know what other participants are bidding, and for what kinds of controls.[63] As discussed below, one benefit of an auction approach to dissemination of public pollution control dollars is to encourage innovation.[64] A sealed bidding process (until projects are selected) provides bidders with adequate assurance that their designs and concepts will be confidential from other participants.[65] Of course, one of the

---

[61] *See* Volk, *supra* note 21, at 137–38 (noting that electronic reverse auctions can induce participants to submit unrealistically low bids).

[62] *See, e.g.*, Parchomovsky, *supra* note 19, at 233.

[63] Of course, in multi-year programs such as the salinity control program, all bidders have information about the successful bids and projects from the prior year, which they can use to inform their bidding and project design strategies. *See infra* Part II.

[64] Auctions for prospect patents, i.e., patents for emerging but not yet invented areas, are also designed to promote innovation, although that feature is inherent in the patent system itself. Abramowicz, *supra* note 20, at 844–45. In fact, given the policy goals of patent law, encouraging research and development might be a preferable goal for patent auctions than increasing government revenue or other objectives.

[65] *See Auction Theory*, *supra* note 10, at 229.

values of auctions is that it forces parties to reveal private information about the value they place on a resource,[66] but that occurs when the bids are opened (at least with respect to winning bids).

Fourth, a sealed bid process leaves the auctioneer with a series of bids that can be rank-ordered in priority. If an otherwise desirable bid turns out to fail on one or more grounds, the agency or other auctioneer can proceed down to the next best bid.[67] Moreover, if the process is being used to allocate funding to multiple projects, as is likely to be true for a well-funded pollution control program, sealed bids provide the agency with the information necessary to choose as many projects as are fundable and as resources allow, in priority order.[68]

B. Auction Design and Practice: Considerations for Allocation of Public Resources

There is no single best auction process or design, because different auctions seek different goals and operate in different contexts.[69] In some cases, auction design must reflect specific legal obligations by the auctioneer. For example, in considering takeover bids, corporate boards of directors have a legal duty to maximize shareholder value,[70] which suggests use of an ascending bid or other auction process designed to maximize revenue.

Government auctions might have similar, purely monetary goals, for example, in the case of procurement auctions where the goal is to purchase goods or services of a particular, easily-specified quality at the lowest price, or where the goal is to auction off government resources (such as surplus property) to the highest bidder. However, government agencies may also be subject to other legal obligations or may seek to achieve other policy goals that compete with or supplant the goal maximizing revenues or minimizing procurement expenditures. This tension is recognized in some existing federal procurement regulations and policies.[71] For example,

---

[66] *See* Parchomovsky, *supra* note 19, at 215.
[67] *See Sealed Bid Auctions*, http://sealedbids.com/ (last visited Mar. 9, 2010) (explaining the ability of the auctioneer to pick the best bid(s) out of the list of bidders).
[68] *See id.*
[69] *See Auction Theory*, *supra* note 10, at 244–45; Abramowicz, *supra* note 20, at 809–10 (noting that the design of patent auctions and selection criteria depends on competing policy goals).
[70] *See* J. Russell Denton, Note, *Stacked Deck: Go-Shops and Auction Theory*, 60 STAN. L. REV. 1529, 1532–33 (2008) (discussing corporate legal duties under *Revlon, Inc. v. MacAndrews & Forbes Holdings, Inc.*, 506 A.2d 173 (Del. 1986)).
[71] *See* Volk, *supra* note 21, at 133–34.

government procurement procedures might favor small businesses at the expense of obtaining the lowest possible cost, expressed as a percentage bid preference for qualifying firms.[72] The magnitude of the preference, however, is likely to be nothing more than a crude estimate of the added societal value of giving the contract to a small business.

The intuitive advantage of auctions for government-funded pollution control projects is the higher theoretical return on the government's investment if numerous parties bid for the same pool of funding.[73] Although increasing cost-effectiveness may be one goal of pollution control programs, maximizing environmental benefits is the ultimate objective.[74] Thus, the government might prefer to fund a less cost-effective pollution control project (expressed purely in terms of dollars spent per unit of pollution reduced) in a more environmentally sensitive or a relatively more degraded area, which might also be expressed as a percentage preference for projects that, for example, improve environmental quality in critical habitats of threatened or endangered species.[75] That, of course, is simply a more complicated way of measuring project value to the government and is more difficult to measure precisely than dollars per pound of pollutant removed. Like the preference for small businesses, the bonus for qualifying bids is likely to be an imperfect estimate of the added project value.

Several issues and problems in auction theory and practice may be relevant to the utility of auction processes as a means of allocating public resources, including the dissemination of pollution control funding, and to the optimal design of those processes.[76] Some government-designed auctions have worked very poorly,[77] meaning that particular attention should be paid to auction design issues.

---

[72] *See id.* at 137.
[73] *See* Howard L. Speight, *Current Procedures for Performing Meaningful Discussions in Federal Negotiated Procurements Are Uneconomical, Inefficient, and Ineffective—A Proposal for Improvement*, 21 ST. MARY'S L.J. 985, 1002 (1990).
[74] *See, e.g.*, 42 U.S.C. § 7401 (2006); 42 U.S.C. § 4321 (2006).
[75] *See* 16 U.S.C. § 1533(a)(3) (2006) (requiring the Secretary of the Interior to designate critical habitats in conjunction with the listing of threatened and endangered species).
[76] The economic literature on auction theory and practice is vast and complex. *See Auction Theory*, *supra* note 10, app. E at 261. An exploration of all aspects of auction design and theory for every application is well beyond the scope of this article. Rather, this section addresses only those aspects of auction theory and design that appear most relevant to the use of auctions to disseminate public pollution control dollars.
[77] *See* Paul Klemperer, *What Really Matters in Auction Design*, 16 J. ECON. PERSPECTIVES 169 (2002) (reprinted in PAUL KLEMPERER, AUCTIONS: THEORY AND PRACTICE 103–22 (2004)) [hereinafter *Auction Design*]; Sokol, *supra* note 15.

1. Defining Rights and Selection Criteria

Where there are multiple, competing legal requirements and policy goals, the government agency will first need to consider the nature of the property right being auctioned (or, in the case of reverse auctions, purchased), the appropriate combination of criteria deemed important in choosing winning bidders, and how the criteria will be weighed in designing an auction.[78] For some kinds of auctions, the problem of defining the property right is relatively trivial. For example, if the government wants to sell five acres of surplus land in downtown St. Louis or the right to harvest timber on 10,000 acres of U.S. forest land, the nature of the property right to be auctioned is quite clear. For reverse auctions, the government might be purchasing something as clearly defined as 1,000 toilet seats. As Professor Ambramowicz notes in the context of his proposed auctions for prospect patents, however, the government sometimes must make more difficult judgments about how to define rights or interests.[79] For pollution control, the government might establish a specific auction goal of reducing nitrogen loadings to a particular lake by a million pounds a year. However, purchasing environmental restoration services where the goal is to restore a sufficient percentage of an endangered species' habitat to a functional state to stabilize the population may be much more difficult to define.

Similarly, where bidders must be chosen according to factors other than price or another single, readily measured and compared bidding variable, the challenge is to delineate the selection criteria adequately both to inform the bidding process and to ensure sound and consistent selection decisions.[80] If the government is contracting for technical services, for example, such as ongoing computer maintenance, and the decision is to ensure that price is balanced against experience, the design might be as simple as a percentage bonus applied to each bid based on the average years of relevant experience of the proposed technicians. However, if the relevant factors in selecting pollution control projects include multiple factors such as price, experience of the project proponent, geographic

[78] *See* Speight, *supra* note 73, at 989–90; Abramowicz, *supra* note 20, at 835.
[79] *See* Abramowicz, *supra* note 20, at 835–37. In the case of prospect patents, the government might have to decide whether to define the right broadly, for example, all rights to nanotechnology, or narrowly, such as the right to invent a specific nanotechnology application. *Id.* at 823. The manner in which those rights are defined will affect incentives for innovation, market efficiency, and other factors. *See id.*
[80] *See id.* at 809; Turley, *supra* note 21, at 40–41. The transparency implications of those choices are discussed *infra*.

location, probability and duration of project success, etc., the selection formula might be more complex.

2. Increasing Auction Participation

The success of any auction depends in large part on the number of participants.[81] The expected value to the seller or procurer is expected to increase with the number of bidders in the auction because the winning bidder must be more aggressive in order to win the auction.[82] Therefore, auction designers need to ensure that potential bidders are willing to incur the transaction costs (in time, money, etc.) to participate, and it is particularly advantageous for auctioneers to devote time and effort to expanding the potential market.[83] This depends on the costs of participating, the likelihood of submitting a winning bid, and the likelihood that winning a transaction (whether a purchase or a sale of goods or services) will generate sufficient returns to the bidder to justify the effort relative to other endeavors and investments.

Participation in some kinds of auctions—such as bidding on a used bass guitar on eBay—does not generate particularly high transaction costs.[84] Those too young to have experienced anything but eBay may not realize that participants sometimes incur at least time costs to travel to and participate in a live auction. However, auctions designed to procure government service contracts typically require more of participants than simply a price bid. Bidders must plan and cost out their proposed projects, calculate the benefits to the sponsoring agency, and sometimes prepare elaborate bidding packages.[85] Therefore, participants generally must incur significant planning, design, and related costs simply to assemble a potentially qualifying bid with no guarantee of success (so-called "deadweight loss" for losing bidders, because they incur costs but no offsetting revenues whatsoever).[86] Of course, all businesses incur risk of some sort, and expect to win only some reasonable share of the available business in their target market.

[81] The value of the winning bid is expected to rise with the number of participants. Speight, *supra* note 73, at 1002.
[82] *See* Denton, *supra* note 70, at 1533–34.
[83] *See Auction Theory*, *supra* note 10, at 246.
[84] That is, unless one needs to check the website daily to ascertain whether the desired product is available. As I write this article, I have been in search for a particular, somewhat rare model of used bass for my daughter.
[85] *See* Gray, *supra* note 14, at 841–44.
[86] *Id.* at 843–44.

One partial solution to the problem of deadweight loss is to share information among bidders or to allow them to share information among themselves without fear of collusion charges.[87] Although this practice does not eliminate losing bidders, it does reduce the common costs of bid preparation.[88] For example, the government may want to share information with all bidders about a new pollution control method in an effort to ascertain which parties can use that method most cost-effectively. The tradeoff, of course, is the loss of at least some of the inherent competition sought in the auction process.

Unlike many kinds of auctions in which there is often only one winner (or a small number), the number of likely winners compared to the number of bidders may be much larger when agencies are allocating large sums of government pollution control dollars.[89] If the number of winners is too large, of course, the value of the auction process in identifying the most cost-effective pollution control projects may be lost. Thus, to encourage sufficient participation, the program must be funded at levels that allow a sufficient number of winners both to encourage participation and to achieve significant program results, without resulting in the selection of inefficient or ineffective projects. Alternatively, program participation can be enhanced where participants receive secondary or tangential benefits from successful bids, which do not necessarily cost the government anything extra. As discussed below, this has been one positive feature of the salinity control competitive bidding program.[90]

Participants are also likely to be deterred from bidding if they believe that the net benefits to them are not high enough to justify the risk of expending significant resources on an uncertain chance of winning.[91] Thus, although the goal of auctions generally is to maximize the auctioneer's value, if the winning bidder turns out to lose because of an unrealistically low or otherwise unfavorable bid, competition may reduce in the

---

[87] *See id.* at 842–43.
[88] *See id.* at 843 (suggesting this practice in the context of auctions for legal counsel in complex class action securities litigation).
[89] The economic literature of so-called "multi-unit auctions" is far more limited than for more common single unit auctions. *See Auction Theory*, *supra* note 10, at 240. The available research suggests that it is more difficult to generate efficient results for multi-unit than for single unit auctions. *See id.* at 243. However, if the goal of using auction procedures is simply to render public expenditures more efficient than through a less competitive process, rather than to seek optimal efficiency, that problem should be viewed as less significant.
[90] *See infra* Part II.
[91] *See* Gray, *supra* note 14, at 843.

long run, resulting in less robust auctions in the future.[92] Indeed, government procurement officials are under a duty to guard against bids that are unfair to the seller as well as the buyer, based on market conditions.[93] However, there appears to be a lack of any empirical evidence that such results have actually occurred in government auctions or that performance with government contracts has suffered due to inappropriately low bids.[94] If such negative results do occur, they might be cured through the use of second-bid procedures ("Vickrey auctions"),[95] although some might reject that solution as unduly paternalistic.[96]

In pollution control programs, the whole purpose of government funding is often to induce voluntary controls where regulations are not feasible for political or other reasons.[97] Thus, landowners simply may not participate in an auction for pollution control funding if they perceive that the benefits do not exceed the costs of participation, especially including the costs and risks of submitting unsuccessful bids. Thus, especially where the responsible agency is implementing an ongoing rather than a one-time program in which the experience of prior participants is likely to influence the behavior of potential future participants, the agency has a strong interest in promoting win-win results, i.e., in funding projects that are highly cost-effective from the government's perspective, but that also generate sufficient participant benefits that program participation continues in future rounds of funding.

3. Preventing Collusion

Auction designers also need to take steps to prevent collusion, in which bidders engage in various forms of strategic behavior to limit competition and thereby to suppress prices artificially or to increase government procurement costs and therefore the profits of successful bidders for procurement situations.[98] Because collusion typically is not overt, it is

---

[92] *See* Volk, *supra* note 21, at 138–39; Turley, *supra* note 21, at 27–31.
[93] Turley, *supra* note 21, at 30–31.
[94] *See id.* at 30.
[95] *See supra* note 54 and accompanying text.
[96] *See* Turley, *supra* note 21, at 29 ("If a bidder so lacks self-control that he cannot stop himself from cutting his own throat online, should Uncle Sam really be so paternalistic as to prevent him from doing so?").
[97] *See* Nicole Darnall & Stephen Sides, *Assessing the Performance of Voluntary Environmental Programs: Does Certification Matter?*, 36 POL'Y STUD. J. 95, 97 (2008).
[98] *See* Bajari & Summers, *supra* note 57, at 143; *Auction Design*, *supra* note 77, at 171–72. Some industry critics cite potential collusion as one reason for opposing government procurement auctions. Turley, *supra* note 21, at 25–26.

often difficult to detect.[99] However, collusion and related problems typically are not problems when there are large numbers of bidders,[100] or when the number and identity of other bidders are not disclosed.[101] Therefore, success in generating a robust market will likely reduce or eliminate those concerns. Because the whole focus of auction processes for diffuse pollution control problems is on a large number of sources that are not easily controlled through regulation, it should be easier to attract a larger number of participants to this kind of auction. Moreover, sealed bid auctions are inherently less vulnerable to collusion than are open auctions because bidders must submit their single best bid absent information about rival bids.[102] As noted above, sealed bid procedures are probably most appropriate anyway for auctions designed to allocate public pollution control dollars.[103] Of course, groups of bidders might collude in advance, but that behavior is only likely to succeed if sufficient numbers of bidders do so relative to the total number of participants.[104] This is less likely to occur as the number of auction participants increases.[105] It also may be less likely in the pollution control setting than in other areas because the purpose of the funding program is to encourage participation by landowners who otherwise might not install pollution controls.[106] The stakes and the profits to be gained per participant are not nearly as high—and as enticing—as might be true, for example, in awarding massive defense contracts.[107]

4. Transparency

Transparency may be an important but evasive goal in government auctions in particular.[108] As noted above, ascending bid or descending bid auctions are inherently transparent, whereas sealed bid auctions often are opaque.[109] But ascending and descending bid auctions based on the solitary criterion of price are not capable of addressing multi-dimensional criteria such as quality control, performance risk, policy goals or preferences, or

---

[99] *See generally* Bajari & Summers, *supra* note 57.
[100] *See Auction Design*, *supra* note 77, at 180.
[101] Gray, *supra* note 14, at 842.
[102] *See Auction Design*, *supra* note 77, at 181; Sokol, *supra* note 15.
[103] *See supra* note 65 and accompanying text.
[104] *See* CHARLES HOLT ET AL., AUCTION DESIGN FOR SELLING CO2 EMISSION ALLOWANCES UNDER THE REGIONAL GREENHOUSE GAS INITIATIVE 9 (2007).
[105] *See id.*
[106] *See id.* at 45.
[107] *See id.*
[108] *See* Volk, *supra* note 21, at 134–37.
[109] *See supra* notes 42–56 and accompanying text.

other factors. When a government auction is based on price moderated by a series of subjectively stated additional criteria, the lowest bidder will not always win the auction, but the basis for that decision may be vague or even unstated, which is what one commenter described as "the antithesis of transparency."[110] In the case of government procurement, such subjectivity can also convey—whether true or not—the appearance of bias in favor of some bidders.[111] Secondary factors that are applied after the bidding closes can also interfere with the whole intended market dynamic of an auction, in which participants base their bids in part on signals from other participants.[112] Thus, if women-owned businesses receive a ten percent preference after bidding closes, but other participants do not know which other bidders are women-owned, their bidding strategy may be compromised as a result.[113] That may be less of a problem where preferences are designed to enhance environmental benefits.

Transparency is particularly problematic in federal government auctions because of regulations prohibiting the release of an offerer's price to others absent advance approval,[114] and a federal statute (the Procurement Integrity Act ("PIA")) prohibiting pre-award disclosure of a bid or proposal.[115] This problem can be addressed if the auctioneer articulates the relevant selection criteria in more objective (if not mathematically formulaic) terms in advance, rendering the process more transparent and somewhat more predictable from the perspective of the bidders.[116] Alternatively, an auctioneer might review proposals independent of price first, and then

---

[110] Volk, *supra* note 21, at 135.
[111] *See id.*
[112] *See* Turley, *supra* note 21, at 50–51.
[113] *See id.* In other words, the bidder might have been willing to lower their bid further to obtain the contract, but perceived no need to do so if he or she already submitted the lowest price bid absent the preference. The fact of the preference is transparent, but its actual application is opaque. To guard against that risk, a participant would have to bid sufficiently below what he or she otherwise might to offset the operation of the after-the-fact preference. If it turns out that the next lowest bidder was not subject to the preference, the "winning" bidder submitted a lower bid than necessary—another variant on the "winner's curse."
[114] *See id.* at 15 (citing GENERAL SERVS. ADMIN. ET AL., FEDERAL ACQUISITION REG. [hereinafter FAR] § 15.306(e)(3) (codified at 48 C.F.R. § 15.306(e)(3) (2008)).
[115] *See id.* at 15–16 (citing 41 U.S.C. § 423(a) (2006)).
[116] For example, the auctioneer might announce in advance that x years of experience or a prescribed minimum history of past successful work is worth a ten percent "bonus" in the bidding process. Under federal procurement regulations, agencies may assign specific non-price factors a particular weight relative to price. *See id.* at 6 n.24 (citing FAR § 15.101-1(b)(2) (2006)).

solicit bidding only by those whose proposals meet non-price criteria.[117] Designers of auctions for pollution control funding could employ either strategy, or both. If selection criteria are designed to generate certain kinds of pollution control projects, it is certainly desirable to make those incentives clear to potential bidders. It also might be possible to screen project proposals for technical merit first, and to solicit cost bids only from those projects that pass the initial screening.

II. COMPETITIVE BIDDING IN THE COLORADO RIVER BASIN SALINITY PROGRAM

A. *Introduction*

The Colorado River Basin Salinity Control Program ("CRBSCP") is "one of the oldest continually operating watershed protection programs in the country."[118] The program reflects participation by, and collaboration between, at least six federal agencies[119] as well as the seven Colorado River basin states,[120] operating through the Colorado River Basin Salinity Control Forum (the "Forum").[121] Unlike more comprehensive large watershed restoration programs, however—such as the Chesapeake Bay Program[122] or

---

[117] *See* Turley, *supra* note 21, at 40.

[118] ROBERT W. ADLER & MICHELE STRAUBE, LESSONS FROM LARGE WATERSHED PROGRAMS: A COMPARISON OF THE COLORADO RIVER BASIN SALINITY CONTROL PROGRAM WITH THE SAN FRANCISCO BAY—DELTA PROGRAM, CENTRAL AND SOUTH FLORIDA, AND THE CHESAPEAKE BAY PROGRAM Exec. Summary (2000) [hereinafter LESSONS FROM LARGE WATERSHED PROGRAMS].

[119] *Id.* at 10. These include the BOR, EPA, the Natural Resources Conservation Service ("NRCS"), the Bureau of Land Management ("BLM"), the U.S. Geological Survey ("USGS") and the U.S. Fish and Wildlife Service ("FWS").

[120] *Id.* The basin states include Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming.

[121] *Id.* The Forum was formed in 1973 to coordinate state salinity control efforts in the basin, and was responsible for development and adoption of the interstate water quality standards for salinity and for ensuring attainment of those standards. *Id.*; *see also* COLORADO RIVER BASIN SALINITY CONTROL FORUM, 2008 REVIEW, WATER QUALITY STANDARDS FOR SALINITY, COLORADO RIVER SYSTEM 2–3 (2008) [hereinafter 2008 REVIEW], *available at* http://www.coloradoriversalinity.org/docs/2008%20Review.pdf. In section 204 of the Colorado River Basin Salinity Control Act of 1974, Congress created the related Colorado River Basin Salinity Control Advisory Council to help coordinate salinity control efforts between the federal and state governments. Pub. L. No. 93-320, 88 Stat. 272 (1974) (codified at 43 U.S.C. § 1594 (2006); COLORADO RIVER BASIN SALINITY CONTROL ADVISORY COUNCIL, ANNUAL REPORT ON THE COLORADO RIVER BASIN SALINITY CONTROL PROGRAM 1 (2008).

[122] *See* 33 U.S.C. § 1267 (2006).

the Great Lakes Program[123]—the CRBSCP focuses narrowly on one of many specific sources of impairment of the Colorado River.[124] "Under this program, federal and state agencies have spent over $700 million to implement programs to reduce inputs of dissolved solids (salts) into the Colorado River and its tributaries in the upper and lower Colorado River basins."[125] Program officials estimate that federal controls remove more than a million tons per year of salt from the system.[126] Given the tremendous complexity and variability of the hydrological and chemical system involved, it is difficult to document definitively the relationship between these programs and investments and ambient water quality in the river. According to the models used to guide the program, however, supported by extensive ambient monitoring data conducted largely by the U.S. Geological Survey, there is reason to believe that the program has been successful in achieving reductions in inputs of salts to the Colorado River system.[127]

Moreover, several interesting and important lessons can be drawn from study of the salinity control program because of its longevity, the availability of a relatively extensive, consistent and long-term database, and due to the introduction of a market-based, competitive bidding approach to the allocation of the program's pollution control funding. For example, it appears that the competitive bidding approach has the potential to improve significantly the cost-effectiveness of nonpoint source pollution

---

[123] *See* 33 U.S.C. § 1268 (2006).
[124] Other efforts are underway to redress other sources of impairment to the river and its ecosystems. *See generally* ROBERT W. ADLER, RESTORING COLORADO RIVER ECOSYSTEMS, A TROUBLED SENSE OF IMMENSITY (2007) [hereinafter RESTORING COLORADO RIVER ECOSYSTEMS].
[125] Robert Adler & Michele Straube, *Lessons from Large Watershed Programs: A Comparison of the Colorado River Basin Salinity Control Program with the San Francisco Bay—Delta (CALFED) Program, Central and South Florida (Everglades) Project, and the Chesapeake Bay Program*, *in* LEARNING FROM INNOVATIONS IN ENVIRONMENTAL PROTECTION: EXECUTIVE SUMMARIES FROM RESEARCH PAPERS 46 (Nat'l Acad. of Pub. Admin. ed., 2000). The Colorado River Compact artificially "divides" the Colorado River watershed within the United States into an "upper basin" and "lower basin," although that division does not really reflect typical physiographic watershed boundaries. The upper basin consists of all portions of the watershed that drain the river above Lee Ferry, which is just below the confluence of the Paria River, several miles below the site of Glen Canyon Dam. Colorado River Compact, art. II(e)–(g) (1922), UTAH CODE ANN. §73-12a-2 (West 1953).
[126] 2008 REVIEW, *supra* note 121, at 13.
[127] *See generally* DAVID KANZER & DAVID MERRITT, THE SALINITY CONTROL STORY OF THE UPPER COLORADO RIVER BASIN ILLUSTRATED BY CASE STUDIES; KENNETH J. LEIB & NANCY BAUCH, SALINITY TRENDS IN THE UPPER COLORADO BASIN UPSTREAM FROM THE GRAND VALLEY SALINITY CONTROL UNIT, COLORADO, 1986–2003 (2008).

control expenditures, and to stimulate more innovative ways to achieve environmental results. The proper use of incentives can also be important to improve participation in voluntary, cost-share programs designed to reduce nonpoint source pollution.[128] In particular, landowner participation in such programs is likely to increase where incidental benefits to landowners are high and well known by potential program participants.[129] The specific manner in which the salinity program's competitive bidding process is designed also may provide lessons for similar efforts in other areas.

At the same time, study of the salinity program underscores the importance of establishing appropriate standards for environmental improvement, and consistently monitoring attainment of those standards. Long-term program accountability requires improved methods to monitor, assess, and evaluate both the efficacy of individual program components and the success of the overall program in improving ambient water quality. Likewise, it highlights the importance of maintaining a strong, consistent financial and institutional commitment to long-range watershed programs. It is difficult to maintain program momentum and credibility absent a stable funding base.

B. History of the Colorado River Basin Salinity Control Program

1. Sources and Effects of Salinity

The Colorado River is naturally more saline than most other U.S. rivers, because it traverses areas of marine shale with high levels of saline minerals formed during periods when much of what is now the basin was covered by inland saline seas.[130] Due to natural erosion of these soils into the river, as well as salt leaching via subsurface flows and discharges from natural saline seeps and springs, prior to significant human alteration of the river and its hydrology the main stem of the river carried loads ranging from below 200 to significantly above 1,000 milligrams per liter ("mg/L") (or parts per million ("ppm") of total dissolved solids ("TDS")), depending on flow conditions and other factors.[131] A unique assemblage

---

[128] *See* LEIB & BAUCH, *supra* note 127, at 17.
[129] *See id.*
[130] *See* TAYLOR O. MILLER, GARY D. WEATHERFORD & JOHN E. THORSON, THE SALTY COLORADO 2–3 (1986) [hereinafter THE SALTY COLORADO]; RESTORING COLORADO RIVER ECOSYSTEMS, *supra* note 124, at 215.
[131] U.S. DEP'T OF THE INTERIOR, BUREAU OF RECLAMATION, QUALITY OF WATER: COLORADO RIVER BASIN PROGRESS REPORT NO. 22, 9 (2005) [hereinafter PROGRESS REPORT NO. 22]. The EPA estimated in 1971 that salinity at the site of the Hoover Dam would average about

of fish species in the relatively isolated Colorado River basin[132] evolved to withstand those high salinity levels as well as other extreme conditions, such as highly variable flows, high temperatures and high turbidity.[133]

Human development, however, has exacerbated this naturally high salinity significantly.[134] The U.S. Environmental Protection Agency ("EPA") estimated in 1971 that anthropogenic changes to the river and its watershed had more than doubled the average annual mass discharges of salts into the river.[135] This added salinity comes from several sources.[136] Because not all irrigation water is consumed by crops, excess water that is not lost to evaporation or transpiration seeps through underlying saline soils and delivers salt to the Colorado River and its tributaries.[137] Grazing, road construction, development, and other land use changes can cause erosion of saline soils during intensive rains.[138] Water withdrawals and trans-basin diversions significantly reduce the volume of water to dilute these salt loads, resulting in higher in-stream concentrations.[139] Reservoir storage

---

330 mg/L if the river remained in its natural state and with the hydrological conditions that occurred from 1942–61. U.S. ENVTL. PROT. AGENCY, THE MINERAL QUALITY PROBLEM IN THE COLORADO RIVER BASIN: SUMMARY REPORT 5 (1971) [hereinafter MINERAL QUALITY PROBLEM].

[132] Because of its isolation from other fish populations, approximately seventy percent of the native fish in the basin were endemic, i.e., found nowhere else on earth. *See* R. DANA ONO ET AL., VANISHING FISHES OF NORTH AMERICA 87–88 (1983). Those species include the Humpback chub, Bonytail chub, Colorado River pikeminnow, Razorback sucker, and woundfin. *Id.* at 92–105; RESTORING COLORADO RIVER ECOSYSTEMS, *supra* note 124, at 4; GORDON A. MUELLER & PAUL C. MARSH, U.S. DEP'T OF THE INTERIOR, LOST, A DESERT RIVER AND ITS NATIVE FISHES: A HISTORICAL PERSPECTIVE OF THE LOWER COLORADO RIVER (2002). The first four of these are now listed as endangered under the Federal Endangered Species Act. 16 U.S.C. §§ 1531–1544 (2006). *See* 56 Fed. Reg. 54,957 (Oct. 23, 1991) (razorback sucker); 45 Fed. Reg. 27,710 (Apr. 23, 1980) (bonytail chub); 32 Fed. Reg. 4001 (Mar. 11, 1967) (humpback chub and Colorado squawfish). Ichthyologists later changed the name of Colorado squawfish to Colorado pikeminnow, as the former name was an offensive slur to Native Americans. *See* Eli Sanders, *Renaming 'Squaw' Sites Proves Touchy in Oregon*, N.Y. TIMES, Dec. 11, 2004, http://query.nytimes.com/gst/fullpage.html?res=9405EED61131F932A25751C1A9629C8B63&sec=&spon=&pagewanted=all.

[133] THE SALTY COLORADO, *supra* note 130, at 9.

[134] *See* PROGRESS REPORT NO. 22, *supra* note 131, at 16–17.

[135] *See* MINERAL QUALITY PROBLEM, *supra* note 131, at 5. The study estimated that approximately forty-seven percent of the salinity at Hoover Dam derives from natural sources, while fifty-three percent is due to artificial changes. *Id.* at 17. EPA estimated that natural salinity at the site of the Imperial Dam was 334 mg/L. *Id.* Salinity at the same point in the river was 706 mg/L in 2004. PROGRESS REPORT NO. 22, *supra* note 131, at 7.

[136] *See* MINERAL QUALITY PROBLEM, *supra* note 131, at 17.

[137] *See* PROGRESS REPORT NO. 22, *supra* note 131, at 16–17.

[138] *See id.* at 42–43.

[139] *See id.* at 17–19.

contributes to salinity inputs through leaching of salts at the reservoir site and through additional evaporative water losses, but also smooths out salinity levels downstream due to mixing of low and high-concentration inflows at different times.[140] Smaller, but cumulatively significant, sources of salinity also include municipal and industrial point sources of pollution, oil and gas wells, and mining operations.[141]

In its 1971 report, the EPA estimated that thirty-nine percent of the river's salt load comes from natural diffuse sources, twenty-six percent from irrigation salt leaching, twelve percent from evaporation and plant transpiration, eleven percent from irrigation consumptive water use, eight percent from natural point sources, three percent from trans-basin water exports, and one percent from municipal and industrial point sources.[142] However, the agencies involved in the program have recognized for many years that increased consumptive water use will become an increasingly important factor in the river's salinity.[143] As in any pollution control program, identifying the magnitude of contributions from various sources is generally critical to target the most effective solutions, especially if program officials choose the projects to be funded in traditional ways. Arguably, however, if a competitive bidding process succeeds in using market forces to direct funding to those pollution sources that can be controlled in the most cost-effective way, it might be relatively less important to devote significant resources to detailed source identification and characterization.

High salinity in the Colorado River causes economic harm within the United States and downstream in Mexico, and in the latter case, has generated serious international disputes. A 1988 study conducted for the U.S. Bureau of Reclamation ("BOR") estimated annual economic damages of $311 to $831 million due to excess salinity in Colorado River water, and that damages could exceed $1.5 billion a year if salinity is not properly controlled (in 1986 dollars).[144] Based on 2004 salinity levels, the BOR modeled economic damages of between $306 and $312 million per year, and projected damages of $471 million per year absent additional control measures.[145]

---

[140] *Id.* at 10–14.
[141] *Id.* at 43–44.
[142] MINERAL QUALITY PROBLEM, *supra* note 131, at 15, tbl.1.
[143] *See id.* at 14, 21 (estimating that over eighty percent of future salinity increases at Hoover Dam would be caused by additional flow depletions); PROGRESS REPORT NO. 22, *supra* note 131, at 7, 17.
[144] LORETTA C. LOHMAN ET AL., U.S. DEP'T OF THE INTERIOR, BUREAU OF RECLAMATION, ESTIMATING ECONOMIC IMPACTS OF SALINITY OF THE COLORADO RIVER 69–72 (1988).
[145] PROGRESS REPORT NO. 22, *supra* note 131, at 8.

Approximately half of those damages were incurred by farmers, and another quarter by homeowners.[146]

Agricultural damages result from reduced crop yields due to saline irrigation water, reduced crop acreage due to salt accumulation in soils, increased agricultural costs to deal with excess salinity (such as installation of tile drains, field leveling and more efficient irrigation systems), and shifts to lower value but more salt-tolerant crops.[147] Damage to municipal and industrial water uses also occurs due to salt-induced corrosion in household appliances, car radiators, and water and wastewater pipes and facilities; deterioration of clothing and other textiles washed in saline water; and treatment costs for industrial process water.[148] At least to date, no adverse human health or in-stream environmental effects have been documented due to elevated levels of salinity in the Colorado River and its tributaries.[149]

To address these domestic impacts, in 1975 the seven U.S. basin states adopted, and in 1976 the EPA approved,[150] numeric water quality criteria for salinity in the river pursuant to section 303(c) of the federal Clean Water Act.[151] Rather than applying throughout the designated water body, however, as do most ambient water quality standards, the basin state standards establish numeric targets at three monitoring points in the main stem of the river, at increasing levels as the river proceeds downstream.[152]

---

[146] *See id* at 8, fig.2.
[147] *See* LOHMAN ET AL., *supra* note 144, at 23–28.
[148] *See id.* at 31–63.
[149] PROGRESS REPORT NO. 22, *supra* note 131, at 7. However, current salinity levels do cause violations of the EPA's secondary drinking water regulations of 500 mg/L. *Id.* Nonetheless, they are non-enforceable guidelines regulating contaminants that may cause cosmetic, aesthetic or other effects on public welfare. 40 C.F.R. §§ 143.1–143.3 (2009). Some drinking water suppliers in the lower basin mix Colorado River water with water from other sources in order to supply public water with sufficiently low levels of TDS. *See* MINERAL QUALITY PROBLEM, *supra* note 131, at 6.
[150] Envt'l Def. Fund, Inc. v. Costle, 657 F.2d 275, 281–82 (D.C. Cir. 1981).
[151] 33 U.S.C. § 1313(c) (2006).
[152] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 40. The Basin States initially proposed a simple "no further degradation" standard, but the EPA promulgated a requirement insisting on numeric standards. 39 Fed. Reg. 43721-23 (Dec. 18, 1974). The standards are 723 mg/L below Hoover Dam; 747 mg/L below Parker Dam; and 879 mg/L at Imperial Dam, all as a flow-weighted average annual level. LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 40; Colo. Dep't of Public Health and Env't, Water Quality Control Comm'n, Regulation No. 39: Colorado River Salinity Standards. Those points correspond to three of the most significant diversions of water for human use in the lower Colorado River Basin. 2008 REVIEW, *supra* note 121, at 8. The EPA initially sought standards promulgated by the individual basin states and enforceable at the state

Moreover, whereas most numeric water quality standards are expressed as maximum (and in some cases, minimum) concentration levels in the water body regardless of stream flow or volume,[153] compliance with the Colorado River salinity standards is determined by reference to flow-weighted annual averages, meaning that peak levels of salinity can be much higher so long as the annual average targets are met.[154] Finally, water quality standards are supposed to be set at levels necessary to protect designated water uses from various kinds of harm.[155] By contrast, the salinity standards are set at levels designed only to prevent *further* degradation beyond levels occurring in 1972, a time when salinity levels reached an all-time high.[156] They were not specifically established at levels deemed necessary to protect particular designated uses. Those differences may be significant when evaluating the success of the Colorado River salinity control effort in meeting environmental as compared to similar watershed-based pollution reduction programs elsewhere, but not necessarily in evaluating the success of efforts to reduce mass loadings of salt into the system.

The international dispute arises out of the U.S. obligation under the 1944 U.S.-Mexico Water Treaty to deliver approximately 1.5 million acre feet ("maf")[157] of Colorado River water a year at the international boundary.[158] The United States met that obligation without controversy until 1961, when it began to release extremely saline (roughly 6,000

---

boundaries, but later retracted that requirement in the face of opposition by the Basin States. THE SALTY COLORADO, *supra* note 130, at 26. The Environmental Defense Fund also sued unsuccessfully to force the EPA to promulgate federal water quality standards for salinity at individual state lines. *Costle*, 657 F.2d at 277–78, 288–90.

[153] *See* 40 C.F.R. § 131.11(b) (2009).

[154] The flow-weighted average annual salt load is the sum of daily salinity concentrations multiplied by daily flow for a calendar year. 2008 REVIEW, *supra* note 121, at 3. The flow-weighted average annual salinity concentration is calculated by dividing this number by the total annual water volume passing the same measuring point. *Id.* Thus, compliance with the standards is determined not by instantaneous or even daily concentrations, but by averaged annual concentrations. *See id.* Stated differently, salinity concentrations can vary above and below the numeric standards so long as the annual average does not exceed the prescribed levels. The EPA's 1971 report proposed standards based on *monthly* rather than annual averages. MINERAL QUALITY PROBLEM, *supra* note 131, at 8.

[155] *See* 33 U.S.C. § 1313(c) (2006); 40 C.F.R. § 131.11(a) (2009).

[156] THE SALTY COLORADO, *supra* note 130, at 26.

[157] An acre-foot is the volume of water required to cover an acre of land to a depth of one foot, or approximately 326,000 gallons. THOMAS V. CECH, PRINCIPLES OF WATER RESOURCES: HISTORY, DEVELOPMENT, MANAGEMENT, AND POLICY 76 (2003).

[158] Treaty on Utilization of the Colorado River art. 10., Feb. 3, 1944, U.S.-Mex., 59 Stat. 1219 [hereinafter U.S.-Mexico Water Treaty].

mg/L) agricultural return flows from the Wellton-Mohawk Irrigation and Drainage District ("WMIDD") in southern Arizona into the Colorado River downstream of Yuma, Arizona.[159] That caused U.S. water deliveries to Mexico to skyrocket to between 1,340 mg/L and 2,500 mg/L, far higher than in any water used for irrigation in the United States.[160] The 1944 treaty specified only the minimum *quantity* of water to be delivered, and said nothing expressly about water *quality*.[161] Mexico argued that both parties understood the fundamental purposes for which the water was to be used (irrigation and municipal water supply), and therefore that there was an implied obligation to deliver water suitable for those uses.[162] Ultimately, the United States agreed to deliver at least 1.36 maf of water with an average annual salinity not significantly higher than Colorado River water provided to U.S. farmers in California's Imperial Valley.[163]

---

[159] Joseph F. Friedkin, *The International Problem with Mexico over the Salinity of the Lower Colorado River*, *in* WATER AND THE AMERICAN WEST: ESSAYS IN HONOR OF RAPHAEL J. MOSES 31–32 (David H. Getches ed., 1988).

[160] Friedkin, *supra* note 159, at 31; Gerardo Garcia Saille et al., *Lining the All American Canal: Its Impact on Aquifer Water Quality and Crop Yield in Mexicali Valley*, *in* LINING THE ALL-AMERICAN CANAL: COMPETITION OR COOPERATION FOR WATER IN THE U.S.-MEXICAN BORDER? 77, 78 (Vicente Sanchez Munguia ed., SCERP, The U.S.-Mexican Border Env't Monograph Series No. 13, 2006); *see also* David H. Getches, *From Askhabad, to Wellton-Mohawk, to Los Angeles: The Drought Water Policy*, 64 COLO. L. REV. 523 (1993); EVAN R. WARD, BORDER OASIS: WATER AND THE POLITICAL ECOLOGY OF THE COLORADO RIVER DELTA, 1945–1975, 44 (2003).

[161] *See* U.S.-Mexico Water Treaty, *supra* note 158. The issue of quality had been raised during the negotiations, but the parties essentially agreed not to address the issue for fear that opposition from California might prevent treaty ratification. Friedkin, *supra* note 159, at 32–33. The treaty does provide that the United States can meet its quantity obligations "from any and all sources," U.S.-Mexico Water Treaty, *supra* note 158, at art. 10. Further, "waters shall be made up of the waters of the said river, whatever their origin." *Id.* at art. 11. Thus, Mexico understood that some of its water might be irrigation return flows. However, according to interviews with treaty negotiators, neither party anticipated the magnitude of salinity encountered from WMIDD return flows. *See* Friedkin, *supra* note 159, at 31, 45–49. For a Mexican perspective, see generally Jose Trava, *Sharing Water with the Colossus of the North*, *in* HIGH COUNTY NEWS, WESTERN WATER MADE SIMPLE 171 (1987).

[162] *See* RESTORING COLORADO RIVER ECOSYSTEMS, *supra* note 124, at 216–17.

[163] *See id.* at 217; Minute No. 242 of International Boundary and Water Commission Concerning Colorado River Salinity, Aug. 30, 1973, U.S.-Mex., 24 U.S.T. 1971–77. In particular, Minute 242 requires delivery of approximately 1.36 maf of water upstream of Morelos Dam with an annual average salinity no greater than 115 ppm, ±30 ppm, higher than the annual average salinity in Colorado River waters at Imperial Dam. Minute 242, Resolution, ¶ 1(a). For a history of the negotiations by the U.S. Commissioner to the International Boundary Commission at the time see Friedkin, *supra* note 159, at 32–50.

Salinity control efforts for the Colorado River, therefore, are designed to achieve three objectives. First, they reduce the significant economic costs within the United States caused by saline water used for agricultural, municipal, and industrial purposes.[164] Second, they are designed to meet the specific numeric water quality criteria for salinity adopted by the Basin States.[165] Third, they are designed to meet U.S. treaty obligations to Mexico.[166] The Basin States, through the interstate Colorado River Basin Salinity Control Forum, are responsible for implementation of salinity control efforts upstream of Imperial Dam—the reach within which the multi-state water quality standards for salinity apply—while the federal government is responsible for salinity control downstream of Imperial Dam, and for compliance with the international treaty requirements.[167] Although more complete histories and descriptions of federal and state salinity control efforts can be found elsewhere,[168] the next section describes and compares those aspects of the program's history relevant to evaluating the potential benefits of a competitive bidding approach to pollution control.

2. Three Distinct Federal Spending Models within the Federal Salinity Control Program

Congress adopted the Colorado River Basin Salinity Control Act of 1974[169] with the dual purposes of compliance with the U.S. treaty obligation to Mexico and to establish a comprehensive salinity control program for the Colorado River within the United States.[170] Title I of that law is designed most directly to meet treaty requirements in the lower reaches of the River along the U.S.-Mexico border.[171] Title II is aimed more broadly at salinity control in the upper basin, both to assist the Basin States in meeting the water quality standards, and necessarily to contribute to compliance with the treaty obligations.[172] Separate provisions of the Salinity Control Act or other federal legislation authorize and direct efforts by the

---

[164] 2008 REVIEW, *supra* note 121, at 2, 7–8.
[165] *Id.* at v.
[166] *Id.* at 1.
[167] *Id.*
[168] *See, e.g.*, PROGRESS REPORT NO. 22, *supra* note 131; LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118.
[169] The Act is codified as amended at 43 U.S.C. §§ 1571–1599 (2006).
[170] *Id.* § 1571(a).
[171] *Id.* §§ 1571–1580.
[172] *Id.* §§ 1591–1599.

U.S. Department of Agriculture to reduce salinity inputs from farms in the Basin,[173] and by the Bureau of Land Management—by far the largest land manager in the Basin—to reduce salinity from lands within its control and management.[174] The Basin States have also implemented controls on some nonpoint sources of salinity through plans developed pursuant to the nonpoint source control provisions of the Clean Water Act,[175] and controls on point sources through the NPDES program.[176] Control strategies within this multi-faceted program reflect three general control strategies or approaches:[177] (1) a public works model in which federal bureaucrats within the BOR identified, and Congress authorized on a project-specific basis, targeted federally-funded or cost-shared salinity control projects;[178] (2) an assistance-based approach in which federal officials within the BOR and the USDA provided technical assistance to willing farmers, and federal funding to share the costs of implementing the necessary controls;[179] and (3) the most recent approach, a collaborative effort by the BOR and the Basin States (through the Forum) to use a competitive bidding (auction) program to reduce salinity in a more cost-effective manner.[180]

a. The Public Works Model

When Congress first adopted the Salinity Control Act in 1974, it mainly adopted the public works approach traditionally used for large water projects built and managed by the BOR and other public agencies.[181]

---

[173] *See* Pub. L. No. 98-569, 98 Stat. 2933 (1984) (authorizing USDA salinity control efforts); Pub. L. No. 104-127 (1996) (transferring USDA salinity control program to the nationwide Environmental Quality Incentives Program ("EQIP"), and authorizing a cost-sharing program).

[174] *See* 43 U.S.C. § 1593 (2006) (authorizing a comprehensive program of salinity control on BLM lands); *see also* U.S. DEP'T OF THE INTERIOR, BUREAU OF LAND MANAGEMENT, SALINITY CONTROL ON BLM-ADMINISTERED PUBLIC LANDS IN THE COLORADO RIVER BASIN: A REPORT TO CONGRESS (1987).

[175] 33 U.S.C. §§ 1288, 1319 (2006); *see* 2008 REVIEW, *supra* note 121, at 15–23 (discussing various state water quality management programs).

[176] 33 U.S.C. §1342 (2006).

[177] This construct is imperfect because not all salinity control efforts in such a large, lengthy, complex, and evolving program fit neatly within each of these categories. Most of the program does fit within these three general approaches, however, and evaluating the effectiveness of each approach is useful for this analysis.

[178] *See infra* Part II.B.2.a.

[179] *See infra* Part II.B.2.b.

[180] *See infra* Part II.B.2.c.

[181] *See* Robert W. Adler, *Addressing Barriers to Watershed Protection*, 25 ENVTL. L. 974, 1017–18 (1995) [hereinafter Adler, *Barriers*]. *See also id.* at 1019–37 (discussing similar project-specific approvals for federal power, flood control, and navigation projects).

In this model, federal bureaucrats identify potential projects designed to meet certain objectives (water storage, flood control, hydroelectric power generation, etc.), and Congress approves and authorizes funding for them on a project-by-project basis.[182] Although the federal agencies typically were required to prepare a cost-benefit analysis to demonstrate that the economic benefits of each project exceeded project costs,[183] this only ensures that the project is likely to generate some net benefits. It does not ensure that federal dollars are spent in the most cost-effective way possible, i.e., that Congress authorizes those projects with the optimum ratio of benefits to costs.

The early federal salinity control effort proceeded through distinct sets of control projects in the lower and upper basins, each of which primarily employed the large public works project model. Title I of the 1974 Salinity Control Act authorized a series of large projects designed to mitigate the highly saline discharges of water to Mexico that resulted in the treaty-based salinity control obligations.[184] These included (1) a massive, federally-constructed and operated desalination plant at Yuma, Arizona designed to treat brackish WMIDD drainage water before being returned to the river for delivery to Mexico;[185] (2) lining of the Coachella Canal to reduce seepage losses, with the saved water used to replace WMIDD drainage water for delivery to Mexico;[186] (3) a so-called "protective and regulatory pumping" program designed to intercept U.S. groundwater before it crossed the border into Mexico due to similar pumping in Mexico, and use of that water as well to meet U.S. treaty obligations;[187] and (4) a bypass canal to divert WMIDD drainage water to the Cienega de Santa Clara wetlands complex in Mexico rather than discharging it to the river.[188]

Because the United States has been able to meet both the quantity and quality requirements of its international obligations in other ways, the desalination plant at Yuma, built at a cost of $260 million, sits in "ready reserve" but has never operated for its intended purposes.[189] Thus,

---

[182] *See, e.g.*, 43 U.S.C. §§ 414, 591–616 (2006) (authorizations requirement of Reclamation Act and examples of project-specific congressional authorizations).
[183] *See, e.g.*, 33 U.S.C. § 701a (2006) (providing that flood control projects were approvable "if the benefits to whomsoever they may accrue are in excess of the estimated costs").
[184] 43 U.S.C. § 1571 (2006).
[185] *See id.*; PROGRESS REPORT NO. 22, *supra* note 131, at 33–36.
[186] 43 U.S.C. § 1572 (2006).
[187] *Id.* §§ 1571, 1578.
[188] *Id.* § 1571; News Release, U.S. Dep't of the Interior, Bureau of Reclamation, Reclamation to Conduct Yuma Desalting Plant Pilot Run (Nov. 9, 2009), *available at* http://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=30721.
[189] See RESTORING COLORADO RIVER ECOSYSTEMS, *supra* note 124, at 214. The cost even

these large, capital-intensive portions of the Title I program helped the United States to meet its water quality obligations to Mexico, but did nothing to actually remove salt from Colorado River water.[190] Moreover, cost and cost-effectiveness were not key factors because the main goal was to meet the "national obligations" to Mexico, whatever the cost.[191] Title I of the Salinity Control Act, however, also employed acreage reduction and on-farm irrigation system improvements to reduce salinity in WMIDD drainage water,[192] as discussed in the following subsection regarding the federal assistance model.

In its early stages, Title II of the Salinity Control Act also relied primarily on government-selected public works-type projects, although many of them were not the kinds of water projects traditionally built and operated by the BOR.[193] Beginning in 1968, as part of a cooperative study of salinity in the Colorado River, federal water quality officials and the BOR began to identify specific sources of salinity that could be controlled with federally-constructed and operated projects.[194] The studies proposed projects to reroute tributaries from saline formations, plug abandoned oil and gas or other wells or natural saline springs and seeps, build desalination facilities, and line irrigation canals and laterals, the seepage from which picks up and conveys salt to the river.[195] The EPA's 1971 report estimated a wide range of cost-effectiveness of these projects, ranging from $3.89 to $32 per ton of salt removed (in 1970 dollars).[196] The 1974 Salinity Control Act authorized construction of four of these specific projects and planning for twelve more.[197] In the 1984 amendments to the Act, Congress approved construction of two more units.[198] As with the Title I program, cost-effectiveness was not a key criterion in project selection and approval.[199] As a colleague and this author wrote in an earlier analysis:

> [T]he Title II salinity program as initially written in 1974 resembled the traditional type of capital-intensive, inflexible

---

to maintain this reserve status is about $1.5 million per year. *Id.*

[190] LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 38.

[191] *See id.*

[192] *See* PROGRESS REPORT NO. 22, *supra* note 131, at 36–40.

[193] *Id.* at 41–48.

[194] MINERAL QUALITY PROBLEM, *supra* note 131, at 35.

[195] *See id.* at 35–45. *See also* PROGRESS REPORT NO. 22, *supra* note 131, at 44–45.

[196] MINERAL QUALITY PROBLEM, *supra* note 131, at 44, tbl.8.

[197] Pub. L. 93-320, 88 Stat 266 (1974) (codified as amended at 43 U.S.C. §§ 1592–93 (2006)); THE SALTY COLORADO, *supra* note 130, at 25.

[198] Pub. L. 98-569, 98 Stat. 2933 (1984); PROGRESS REPORT NO. 22, *supra* note 131, at 45.

[199] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 43.

> public works program as had been implemented by BOR (and for that matter, the U.S. Army Corps of Engineers and the Federal Power Administration) for decades. The main difference was that rather than building dams, power plants and conveyance facilities, BOR was in the business of lining irrigation canals and otherwise improving the regional irrigation-conveyance systems to improve irrigation efficiency, reduce seepage, and therefore reduce salinity inputs to the river and its tributaries. Although the planning reports for each unit evaluated cost-effectiveness, the 1974 statute did not impose any economic criteria for project adoption and implementation. Regardless of other salinity control opportunities, only those projects specifically approved by Congress in the law could be built. . . . [M]ore cost-effective opportunities for salinity control might have been overlooked as a result.[200]

Less than a decade after adoption of the 1974 Salinity Control Act, critics challenged the program in federal court on multiple grounds.[201] They argued that state-specific water quality standards were necessary to ensure accountability by each of the basin states;[202] that total maximum daily loads ("TMDLs") for salinity were required pursuant to section 303(d) of the CWA;[203] and most important for purposes of this analysis, that the program focused to an inappropriate degree on the large, capital-intensive off-farm construction programs described above instead of changes in basic, on-farm water use and management practices that the plaintiffs believed would be more effective in reducing salinity inputs from existing, inefficient irrigation and other farming methods.[204] Ultimately, each of these challenges was rejected judicially.[205] However, there was some precedent for on-farm improvements in the 1974 Act, and Congress adopted some of the reforms advocated in the litigation in the 1984 and 1995

---

[200] *Id; see also* THE SALTY COLORADO, *supra* note 130, at 59 ("The program represents the latest manifestation of what federal water development agencies have always done: build projects with insufficient consideration of their true costs and benefits. Thus, what drives the salinity program is not a reasoned strategy for pollution control but the unvarying historic processes of bureaucracies.").
[201] Envt'l Def. Fund, Inc. v. Costle, 657 F.2d 275 (D.C. Cir. 1981).
[202] *Id.* at 287.
[203] *Id.* at 294; *see also* 33 U.S.C. § 1313(d) (2006).
[204] *Costle*, 657 F.2d at 296–97; *see also* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 43.
[205] *Costle*, 657 F.2d at 298.

amendments to the Act.[206] Some of those changes reflect the public assistance model for federal spending discussed in subsection b, and others resulted in the market-oriented, competitive bidding model discussed in subsection c.[207]

b. The Federal Assistance Model

The federal assistance approach in the salinity control program is based on a combination of educational, technical assistance, and federal cost-sharing for improvements in on-farm infrastructure and practices (including retirement of acreage that generates particularly high amounts of soil erosion or other sources of pollution), and has its origins in the tradition of federal agricultural programs rather than in the capital project-oriented tradition of the BOR and other federal water development programs. These kinds of programs were initiated by the Soil Conservation Service ("SCS") within the U.S. Department of Agriculture[208] during the dust bowl era, and have persisted through the current Farm Bill and both federal and state nonpoint source pollution control efforts for farmers under the CWA.

In Title I of the 1974 Salinity Control Act, in addition to the capital projects discussed above, Congress authorized cooperative efforts by the BOR, the SCS, the WMIDD, and individual farmers (participating on a voluntary basis) to improve on-farm irrigation efficiency and other practices in order to reduce salt contributions from irrigated agriculture.[209] Irrigation on saline soils increases salinity loads to adjacent waters where excess irrigation water seeps through underlying saline soils.[210] Those inputs can be reduced by taking highly saline soils out of production altogether, similar to the federal Farm Bill programs in which federal subsidies are used to encourage farmers not to farm lands that contain valuable wetlands (the "swampbuster" program) or that contain highly erodible soils (the "sodbuster" program).[211] In the lower basin salinity control program,

---

[206] Pub. L. 98-569, 98 Stat. 2933 (1984); Pub. L. 104-20, 109 Stat. 255 (1995).
[207] *See id.*
[208] The current successor to SCS, with both a different name and a broader mission, is the Natural Resources Conservation Service ("NRCS"). Douglas Helms, Douglas Lawrence, Patricia Lawrence & Peter Smith, *Water Quality in the Natural Resources Conservation Service: An Historical Overview*, 76 AGRIC. HIST. 289, 289 (2002).
[209] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 39–40; PROGRESS REPORT NO. 22, *supra* note 131, at 37–39.
[210] *See* G.E. Cardon et al., *Managing Saline Soils*, May, 2007, *available at* http://www.ext.colostate.edu/PUBS/CROPS/00503.html#top.
[211] *See* McElfish et al., *supra* note 8, at 91–92; Stephen J. Brady, U.S. Dep't of Agric., *Highly Erodible Land and Swampbuster Provisions, in* A COMPREHENSIVE REVIEW OF FARM BILL

the BOR purchased acreage either to reduce existing salt loads or to prevent increases from new farm acreage, and withdrew previously eligible federal lands from irrigable status.[212]

Alternatively, irrigation-induced salinity can be reduced by improving the efficiency of irrigation methods, for example, by replacing flood irrigation with more efficient sprinkler systems or drip irrigation, by leveling fields, by lining irrigation canals and laterals both off-farm and on, and by installing water measurement and control equipment and improved irrigation scheduling procedures.[213] The higher the ratio of water actually consumed by the growing crops to the amount of water applied, the less water is available to seep into the soils below.[214] Farmers also benefit from those improvements because they use less water per given crop yields, and because more efficient irrigation methods can result in higher yields and healthier crops.[215] In the lower basin salinity control program, the BOR and the SCS (and later the NRCS) provided technical assistance and education, and Congress supplied funding for a seventy-five percent federal cost share (with the remaining twenty-five percent supplied by the farmers).[216] This program increased irrigation efficiency in the WMIDD from fifty-six percent before the program began to a peak of seventy-seven percent in 1985, and an average of seventy-two percent while the program was active.[217] The on-farm efficiency program was later discontinued, however, although the permanent improvements remain in place, and irrigation efficiencies in the district have varied between roughly sixty and seventy percent since then.[218]

Despite its discontinuation, to some degree the lower basin on-farm improvement program became a model for similar efforts in the upper basin later on. By the early 1980s, critics had already noted that on-farm efficiency improvement projects typically were more cost-effective than the BOR's large structural projects, that some BOR projects had already been cancelled due to cost-effectiveness problems, and that there were some

---

CONTRIBUTIONS TO WILDLIFE CONSERVATION, 1985–2000 5, 5–9 (2008), *available at* ftp://ftp-fc.sc.egov.usda.gov/WHMI/WEB/CompRev/Brady5-18.pdf.

[212] *See* PROGRESS REPORT NO. 22, *supra* note 131, at 37. Additional acreage reductions were accomplished in subsequent years pursuant to supplemental legislation and other efforts. *See id.*

[213] *Id.*

[214] *See id.* at 37–39.

[215] *Id.* at 38–39.

[216] 43 U.S.C. § 1571(f), (h) (2006); *see also* THE SALTY COLORADO, *supra* note 130, at 44.

[217] PROGRESS REPORT NO. 22, *supra* note 131, at 38.

[218] *See id.* at 38, 39 tbl.9.

projects whose costs exceeded their benefits.[219] In the 1984 amendments to the Salinity Control Act, Congress authorized the USDA to establish a voluntary, cooperative salinity control program with private landowners to improve water management and reduce watershed erosion on private lands within the basin, with a related seventy percent federal cost share for on-farm efficiency improvements.[220] It also directed both the BOR and the USDA to consider cost-effectiveness in implementing the program by giving preference to projects with the "least cost per unit of salinity reductions,"[221] and directed the Bureau of Land Management to undertake a comprehensive, basin-wide salinity control program for the massive federal land holdings in the basin.[222]

In the 1984 amendments, therefore, Congress at least *sought* to improve the cost-effectiveness with which limited federal program dollars were spent in three ways. By expanding the scope of the program from discrete, government-selected projects to all public and private lands in the basin, it opened up a wider range of salinity control strategies in a much wider range of locations. Potentially more cost-effective investments no longer were excluded from consideration simply because they were not included in project-specific authorization requests. By requiring a minimum thirty percent private cost share for the USDA improvements on private farmlands, in theory Congress ensured some market-based check on the worth of the improvements.[223] That theory, however, assumes somewhat tenuously that farmers judge the value of efficiency improvements in the same way as the federal agencies. The agencies were charged with ensuring that investments would reduce salinity inputs into the Colorado River and its tributaries in a cost-effective manner; while even for the same projects, farmers likely judged the cost-effectiveness of their investments in terms of whether their productivity and profitability increased

---

[219] *See* THE SALTY COLORADO, *supra* note 130, at 42-44.

[220] Pub. L. 98-569, 98 Stat. 2933 (1984); s*ee also* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 44. In 1996, as part of broader changes to federal farm assistance programs in the Federal Agricultural Improvement and Reform Act ("FAIRA"), Congress merged this separate USDA salinity control program into the nationwide Environmental Incentives Quality Program ("EQIP"). *See* McElfish et al., *supra* note 8, at 93–94. Requiring salinity control projects to compete with other USDA agricultural pollution control efforts nationwide could potentially enhance the cost-effectiveness of the projects selected.

[221] 43 U.S.C. § 1591(b) (2006).

[222] *Id.* § 1593.

[223] *See* U.S. GENERAL ACCOUNTING OFFICE, GAO/RCED-95-98, WATER QUALITY INFORMATION ON SALINITY CONTROL PROJECTS IN THE COLORADO RIVER BASIN 9 (1995) [hereinafter GAO SALINITY REPORT].

sufficiently.[224] Moreover, with a seventy percent federal subsidy, even modest improvements in farm productivity might provide a sufficient return to provide individual farmers sufficient incentive to invest thirty percent of project costs.[225] Finally, Congress directed the federal agencies to select the most cost-effective projects as judged by dollars spent per ton of salt removed, but that instruction was largely hortatory and certainly not enforceable.

c. The Market-Based, Competitive Bidding (Auction) Model

By the end of 1994 federal fiscal year, the federal government had spent $362 million on salinity control in the Colorado River basin, with plans to spend an additional $430 million.[226] By some measures, the money was well spent. Significant reductions in salt loadings had been achieved, and the numeric salinity standards had been achieved consistently.[227] However, while on-farm efficiency improvements continued to be relatively more cost-effective than large, capital-intensive structural projects, cost-effectiveness in both programs was highly variable,[228] and there was little to ensure that the program as a whole was as cost-effective as possible.[229] Moreover, a large percentage of the program spending continued to go to individual BOR projects approved by Congress on a case-by-case basis.[230]

Independent studies conducted by the BOR, the Department of Interior's Office of the Inspector General ("IG"), the General Accounting Office, and others all agreed that the existing program missed opportunities for more cost-effective salinity control. One of the IG reports found that

---

[224] *See id* at 2.
[225] *See id.* at 10.
[226] *Id.* at 2. Of the money spent to that date, the BOR had spent $266 million, the USDA had spent $89 million, and the BLM had spent $7 million. *Id.*
[227] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 46. At the time, BOR and USDA controls had reduced salinity loads by an estimated 341,000 tons of salt per year ("tpy") and 191,000 tpy, respectively. *Id.* As noted earlier, the sufficiency of the water quality standards remains in question, but that does not negate the reductions in mass loadings of salts delivered to the river. *See supra* notes 156–60 and accompanying text.
[228] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 46. The cost-effectiveness of BOR projects ranged from a low of $5 tpy for well-plugging projects to $138 tpy for large irrigation conveyance system improvement projects, while the cost of USDA projects ranged from $29 to $70 tpy for on-farm improvements, depending on the location. *See id.*
[229] *See id.*
[230] *See id.* at 47.

the traditional requirement for project-specific authorizing legislation impeded the flexible adoption of the most cost-effective salinity controls, and recommended more flexible legislative authority.[231] Another IG report found that the federal government was paying an excessive share of project costs because local irrigation districts had no incentive to control the federal share of project costs, and due to inadequate accounting of the appropriate base costs to be incurred by the farmers.[232] The subsequent GAO Report found that the cost-effectiveness of the BOR salinity control projects was highly variable, ranging from $5 to $138 per ton of salt removed.[233] The cost-effectiveness of the USDA controls was generally less variable, and generally lower.[234] Following these reports, the BOR conducted its own program review that reached similar conclusions, i.e., that it should consider alternatives to purely federally-planned projects and allow non-federal project construction; that it should consider proposals in the entire basin rather than solely in pre-selected project areas; and that it should consider any salinity control projects proposed by any combination of public and private entities, to be evaluated competitively based on a combination of cost-effectiveness and an assessment of project risk factors.[235]

In 1995, Congress again amended the Salinity Control Act to address these concerns.[236] The statute now authorized the BOR to develop a fully basin-wide program in which it could invite any public, private, or mixed party to bid for salinity control funding (in addition to the existing, specifically-authorized salinity control projects).[237] The BOR implemented this new authority in cooperation with the Salinity Control Forum through an open, competitive bidding process, under which a committee comprised of federal and Forum officials select salinity control projects based on

---

[231] U.S. DEP'T OF THE INTERIOR, AUDIT REPORT 93-I-810, IMPLEMENTATION OF THE COLORADO RIVER BASIN SALINITY CONTROL PROGRAM, BUREAU OF RECLAMATION (Mar. 1993).

[232] U.S. DEP'T OF THE INTERIOR, AUDIT REPORT 93-I-258, OPERATION AND MAINTENANCE CONTRACTS, COLORADO RIVER BASIN SALINITY CONTROL PROGRAM, BUREAU OF RECLAMATION (Dec. 1992). Under the provisions of the statute, the federal government was supposed to pay only those costs that would not be incurred by irrigation districts or companies absent salinity controls, but insufficient accounting mechanisms were in place to verify those baseline costs. *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 47.

[233] *See* GAO SALINITY REPORT, *supra* note 223, at 12.

[234] *Id.* at 13.

[235] U.S. BUREAU OF RECLAMATION, COLORADO RIVER BASIN SALINITY CONTROL ACT, P.L. 93-320 (AS AMENDED), REPORT ON PUBLIC AND AGENCY REVIEW OF THE PROGRAM AND SUGGESTED REVISIONS TO THE PROGRAM 6–7 (1994).

[236] Pub. L. No. 104-20, 109 Stat. 255 (1995).

[237] 43 U.S.C. § 1592(a)(6) (2006).

cost-effectiveness and project risk, i.e., the degree of certainty that the cost estimates are realistic and that the project will realize its salinity reduction goals over time.[238]

The new competitive bidding program quickly improved the cost-effectiveness of salinity controls in the Colorado River Basin. The BOR initially expected the average cost-effectiveness of controls under the new program to average $50 per ton.[239] After the initial four years of the program, however, selected projects averaged just over half of that estimate ($26 per ton), with a range of $11 to $36 per ton, and slightly over a third of the average cost-effectiveness of controls under the previous program ($70 per ton).[240] Moreover, although one might have expected costs to increase after the most cost-effective proposals were funded in the first year or two of the program, cost-effectiveness actually improved over the first four years of the program.[241] In part, program flexibility facilitated this improved cost-effectiveness by allowing cooperative efforts between public and private entities in ways that generated enhanced project benefits[242] and enhanced efficiencies by facilitating cooperative projects between the USDA and the BOR.[243] The most recent request for proposals was issued in April 2009 with the help of additional funding from the economic stimulus package.[244]

C. *Analysis of Auction Design and Other Components of the Salinity Control Program*

1. Project Performance Risk and Uncertainty

As discussed in Part I, auction design can be critical to success in meeting a program's goals, but those goals may vary based on the auctioneer's applicable legal obligations, policy objectives, and other factors. The 1984 amendments to the Salinity Control Act directed the BOR and the

---

[238] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 31.
[239] U.S. BUREAU OF RECLAMATION, COLORADO RIVER BASIN SALINITY CONTROL PROGRAM, REPORT TO CONGRESS ON THE BUREAU OF RECLAMATION BASINWIDE PROGRAM 14 (1996).
[240] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 48–49.
[241] *Id.* at 65.
[242] *Id.* at 49.
[243] *See* PROGRESS REPORT NO. 22, *supra* note 131, at 46–47.
[244] U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION, FUNDING OPPORTUNITY ANNOUNCEMENT NO. 09-SF-40-2896, COLORADO RIVER BASINWIDE SALINITY CONTROL PROGRAM: AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009 4–5 (Apr. 2009), *available at* http://www.usbr.gov/uc/progact/salinity.

USDA to give preference to salinity control projects with the "least cost per unit of salinity reduction."[245] The 1995 amendments provided the BOR with more flexibility to do so through the new competitive bidding program.[246] However, the BOR believes that the estimated cost-effectiveness of projects in advance also must be balanced against performance risk.[247] As explained in an early review of this new program:

> All proposals (including those studied by Reclamation) will be first ranked on their cost per ton of salinity control. This ranking will then be adjusted for risk factors which might affect the project's performance. The performance risk evaluation will consider both financial and effectiveness risks. . . .
>
> Ultimately there is a tradeoff between risk and cost. In the end, eliminating risk may cost more than accepting some risk. A ranking committee will be assembled to evaluate the tradeoffs between cost effectiveness and performance risks. The ranking committee will be made up of representatives from the two cost-sharing partners, the Basin States and Reclamation. After the committee ranks the proposals, Reclamation will attempt to negotiate the final terms of an agreement with the most highly ranked proponents.[248]

This is obviously a difficult balance to attain. If program managers pay no attention to performance risk, any improvements in cost-effectiveness as determined *ex ante* (projected units of pollution reduced per dollar) may be offset by projects that fail to meet their anticipated target, or that fail to reduce pollution at all.[249] On the other hand, if too much attention is paid to risk, all or part of the benefit of a competitive bidding approach might be lost because managers will select only those methods of pollution control that are already known to work rather than provide incentives for newer, potentially more cost-effective solutions that have never been tried, and therefore have a higher perceived risk.[250]

---

[245] 43 U.S.C. § 1591(b) (2006).
[246] *See supra* notes 235–43 and accompanying text.
[247] D.P. Trueman, U.S. Bureau of Reclamation, U.S. Dep't of the Interior, *Colorado River Basin Salinity Control Program: 1998 Review*, *in* USCID CONFERENCE ON SHARED RIVERS 115 (1998).
[248] *Id.*
[249] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 48.
[250] *See id.*

In the salinity control program, several different factors might contribute to project risk. Some kinds of projects, such as plugging discharges from abandoned oil and gas wells or from natural saline springs, have a high degree of predictability and efficacy.[251] Because their volume of discharge and salinity concentration is known in advance, eliminating the discharge entirely (assuming the structural integrity of the plugging is sound) will result in known reductions in salt loads.[252] Other kinds of projects are less certain. For example, while it is reasonable to predict that increased irrigation efficiency will reduce seepage of saline groundwater to some degree, estimating the exact degree of salt reduction over time is necessarily imprecise, especially given a lag time of years to decades between implementation and results due to groundwater flow rates and other factors.[253]

If two irrigation control proposals are being compared, the absolute accuracy of the predictive methodology may be less important than assuring that both projects are compared using the same or equivalent methods and assumptions, because the key factor for the auctioneer is which project will reduce more tons of salt per dollar spent, and not whether the actual predicted salt reduction is accurate.[254] However, when comparing a project with relative certainty of salt reductions (such as a well plugging project) against one with less certainty, the auctioneer should develop some method to take that uncertainty into account in project selection. Similarly, if one project results in pollution reductions in the river as soon as the project is implemented while another will not produce benefits for many years, that lag time should be accounted for in the project selection process through application of an appropriate discount rate or some other factor. Finally, this uncertainty suggests that predictive models used to select salinity control projects may be a valid means of choosing among competing projects in an auction process, but that real-world monitoring is necessary to ascertain or verify overall program effectiveness and determine whether sufficient reductions are achieved over time to meet water quality standards or other environmental goals.[255]

---

[251] *See id.* at 46, 48.
[252] *Id.* at 75.
[253] *See id.* Because of these complications, some studies have had difficulty proving statistically significant salinity reductions from particular salinity control projects. *See* DAVID L. BUTLER, U.S. GEOLOGICAL SURVEY, WATER-RESOURCES INVESTIGATIONS REPORT 95-4274, TREND ANALYSIS OF SELECTED WATER-QUALITY DATA ASSOCIATED WITH SALINITY-CONTROL PROJECTS IN THE GRAND VALLEY, IN THE LOWER GUNNISON RIVER BASIN, AND AT MEEKER DOME, WESTERN COLORADO 1 (1995).
[254] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 75.
[255] *See id.* at 70.

Furthermore, some kinds of pollution control projects rely not only on initial project design, construction, and implementation, but on project operation and maintenance over time.[256] The auctioning agency can include appropriate contract conditions requiring successful bidders to maintain the projects over time, but monitoring and enforcement of those requirements may be challenging, especially for large programs over long periods of time. Some studies suggest improper O&M of at least some salinity control projects over time, and others recommend that increased monitoring of project implementation and maintenance is needed.[257]

2. Other Key Salinity Program Assumptions and Attributes

Several other assumptions and attributes of the salinity control program are important both in designing the auction process and in considering whether a similar approach might work for other pollution control applications.

First, the fundamental assumption in the salinity control program is that a ton of salt (or a reduction of a ton of salt) has approximately the same effect regardless of location in the watershed.[258] Although some officials have questioned this assumption that salinity in the system is conservative, i.e., is independent of the nature of salt ions and their chemistry in different parts of the system,[259] the fundamental program assumption is that every unit of salt in the system is fungible for programmatic purposes.[260] Thus, project proposals can be compared without regard to location, and control opportunities may be developed and proposed anywhere in the vast upper Colorado River watershed. So long as total reductions in salinity are high enough to meet the Basin States' water quality standards for salinity, it does not matter where those reductions occur. This makes sense to the extent that program compliance is measured by flow-averaged salinity concentrations at just three points in the watershed[261] and because of the extensive mixing that occurs in the Basin's large reservoirs[262] before high salinity levels might impair any actual uses in the lower basin. The same assumption might not be valid for pollutants that operate at

---

[256] *See id.* at 75–76.
[257] *See id.*
[258] *See id.* at 70.
[259] *Id.* at 74.
[260] LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 110.
[261] PROGRESS REPORT NO. 22, *supra* note 131, at 24.
[262] *See id.* at 13.

more local scales, such as toxic pollutants that might cause localized harm (hotspots) if not reduced sufficiently.[263] However, a basin-wide competitive bidding approach might work for other kinds of pollutants where harm occurs mainly or entirely downstream and only after aggregation of large amounts of the pollutant from multiple, diverse sources, such as nutrient loadings from the entire Mississippi River watershed into the Gulf of Mexico, or from the Chesapeake Bay watershed into the Chesapeake Bay ("Bay").[264]

Second, the salinity program depends on the assumption that enough people or institutions will have a sufficient incentive to bid for program control dollars to generate both a vigorous market (adequate competition) and enough overall pollution control. Assuming that polluters will not bid for control projects based on altruism alone, program participants must perceive an adequate profit or other incentives to justify participation, especially given the considerable cost of designing a project and preparing a bid, coupled with the risk of losing in the bidding process.[265] Salinity control *per se* mainly reduces downstream externalities rather than benefitting the farmers directly.[266] Controlling other forms of pollution, however, such as pesticide contamination of groundwater, may benefit the bidders themselves if they use the otherwise contaminated water for personal or other uses.[267] Absent such direct benefits, however, polluters still may participate in the program if the pollution control projects confer incidental benefits on the participants, such as enhanced productivity.[268] In the salinity program, for example, farmers who propose to reduce salinity through irrigation efficiency improvements may reduce their water costs, be able to use that water for additional crops, or see higher crop yields due to healthier plants.[269]

Alternatively, entrepreneurs who are positioned to design and implement pollution controls at a sufficiently low cost relative to other bidders might reap profits to the extent that they can bid above their actual project costs but still low enough to win a project award.[270] To some extent,

---

[263] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 71.
[264] *See id.* at 71, 110.
[265] *Id.* at 71.
[266] *See id.* at 61.
[267] *See id.* at 71.
[268] *Id.*
[269] Indeed, those benefits explain why some farmers install such efficiency improvements independent of the salinity control program. *See* NATIONAL RESEARCH COUNCIL, A NEW ERA FOR IRRIGATION 51–52, 62, 66, 85, 135 (1996).
[270] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 70–71.

this has occurred in the salinity program where firms can achieve better efficiencies due to large economies of scale.[271] It also might occur where entrepreneurs develop innovative new control methods—one of the intended benefits of this kind of program—or where profits can be made by pollutant trading with point sources or others who face higher marginal pollution control costs.[272]

Third, care must be taken to ensure that funded salinity control projects are not somehow counterproductive, i.e., that the controls themselves do not result in other adverse environmental impacts or offsetting pollution elsewhere. For example, salinity reductions could be attained by fallowing lands with highly saline soils.[273] Under the prior appropriation doctrine of western water law,[274] however, if water saved by doing so is simply used to irrigate crops on other lands, some or all of the pollution control obtained by the project might return elsewhere in the watershed.[275] This project risk factor is considered by the ranking committee in the program.[276]

Fourth, the magnitude of salinity controls is tied to salt load reductions deemed necessary to meet the basin-wide water quality standards for salinity.[277] As discussed above, the validity of those standards is somewhat questionable because they were tied only to a "no further degradation" concept rather than an assessment of the salinity levels needed to protect various designated uses.[278] In addition, water quality standards measured only as long-term, flow-weighted averages have fewer complications than standards that must be met throughout a watershed, and at all times.[279] Moreover, the relationship between overall load reduction targets and attainment of the standards is determined through the use of predictive models that attempt to account for significant variability in the system

---

[271] *See id.*
[272] *See id.* at 71–72. In the salinity control program, one small firm created a market niche by evaluating, designing and preparing bid packages for irrigation districts, and implemented successful bids, thus obtaining sufficient efficiencies and cost reductions to make the venture profitable. *Id.* at 72.
[273] *See id.* at 73.
[274] *See generally* JOSEPH L. SAX, BARTON H. THOMPSON, JR., JOHN D. LESHY & ROBERT H. ABRAMS, LEGAL CONTROL OF WATER RESOURCES: CASES AND MATERIALS 98–279 (3d ed. 2000); 2 WATERS AND WATER RIGHTS, §11.01 (Robert E. Beck & Amy K. Kelley eds., 1991 ed. 2008 Replacement Volume).
[275] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 73.
[276] *See id.*
[277] *See id.* at 64.
[278] *See id.* at 78–79.
[279] *See id.* at 68.

that is beyond the control of program officials,[280] such as "annual and seasonal hydrology; location, duration and intensity of precipitation events; variations in soil and water chemistry; and the composition of salt ions in a given year as opposed to total salinity."[281] As with all predictive models, error ranges and other uncertainties can render the load targets suspect.[282]

If the main point of the predictive models is assessing the cost-effectiveness of pollution controls obtained through competitive bidding relative to traditional means of allocating public dollars, those factors are probably not relevant. The only real issue is how many units of pollution are removed per dollar spent. However, if one important aspect of the program is deciding how many resources (dollars) should be devoted to reductions of particular kinds of pollution in order to meet appropriate water quality standards or other real-world targets, both the validity of the targets and the ability to determine the magnitude of load reductions needed to meet those standards are also important.[283] For pollutants that change in chemical composition, or that accumulate or degrade during downstream transport, those complications may be important, especially as the distance between control efforts and the region to be protected increases.[284]

Ascertaining the relationship between required load reductions and attainment of water quality standards, of course, is the key challenge for the TMDL program under the CWA.[285] No formal TMDL has been prepared for the salinity control program, but the basic approach is similar.[286] The program targets are driven by the need to meet the basin-wide water quality standards; computer models predict load reductions necessary to meet those standards over time,[287] which is reflected in specific program budgets for salt reduction; overall project selections are tied to those reduction budgets and success is verified through independent monitoring by the U.S. Geological Survey.[288]

Finally, as compared to regulatory programs or others in which the polluter pays principle applies, the salinity control program assumes a reliable funding base so that adequate numbers of control projects can be

---

[280] *See id.* at 78.
[281] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 74.
[282] *See id.* at 74–75.
[283] *See id.* at 64, 70.
[284] *See id.* at 74.
[285] *See* 33 U.S.C. § 1313(d) (2006).
[286] LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 74.
[287] *Id.* at 109.
[288] *See id.* at 22–23, 29.

funded over time to meet the pollution reduction budgets.[289] Because some program funding comes from hydro power revenues from large dams in the basin,[290] some level of stable funding is assured so long as those hydroelectric facilities remain in operation. As with most federal funding efforts, however, program appropriations from Congress can be inconsistent.[291]

3. Salinity Program Auction Design Methods and Selection Criteria

Auction design in the salinity control program attempts to meet several competing program goals in a number of ways reflected in project Requests for Proposals ("RfPs").[292] First, the auction seeks to maximize cost-effectiveness of salinity controls and to promote innovation in project design and implementation by being very open-ended.[293] Rather than focusing on particular, pre-determined sources of salinity or on sources in particular locations, bidding is open to any salinity source anywhere in the basin, including saline springs, leaking wells, irrigation sources, municipal and industrial sources, erosion on public or private land, or other sources.[294] Likewise, projects can be performed through a wide range of institutional and contractual arrangements, including direct government agency action, grants, contracts, memoranda of agreement, or cooperative agreements, by any entity or combination of entities.[295] The BOR seeks to maximize participation (hence competition) by advertising the process as widely as possible,[296] and as discussed further below, by trying to make the bidding process as transparent as possible,[297] so potential bidders can evaluate their chances of winning before expending significant resources on bid

---

[289] *See id.* at 42–43.
[290] *Id.*
[291] *See id.* at 79, 111.
[292] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 59.
[293] *Id.*
[294] U.S. BUREAU OF RECLAMATION, REQUESTS FOR PROPOSALS: COLORADO RIVER BASIN SALINITY CONTROL PROGRAM 1 (Oct. 2003) [hereinafter 2003 RFP] *available at* http://www.usbr.gov/uc/progact/salinity/pdfs/rfp2003.pdf. There are, however, presumptive lower limits on project size. The program generally seeks only proposals that would control over 1,000 tons per year of salt loadings, presumably to ensure that transaction costs do not overwhelm project benefits. *See id.*
[295] *See id.*
[296] Initially the BOR published notices in sources such as the Commerce Business Daily, and later in FedBizOpps, other sources, and the Internet. *See id.* at 2; LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 59.
[297] *See infra* note 303 and accompanying text.

preparation.[298] Moreover, consistent with the statutory mandate, the RfPs identify cost-effectiveness as the "primary criterion" in project selection.[299]

However, the process is also designed to address several sources of project risk and uncertainty discussed above, as well as other factors such as regulatory compliance[300] and replacement of any habitat lost or destroyed by the project.[301] Bids are thus evaluated based on multi-dimensional criteria rather than the simple price of controls.[302] Proposals must identify the specific control methods to be used; the project management plan and schedule; the projected salinity reductions over time, along with the specific methodology used to calculate those reductions and the calculation itself, based either on approved BOR methods or other documented methods; project costs and payment methods; anticipated project life; incidental project environmental impacts (both positive and negative); and a project risk analysis that follows a prescribed formula.[303] Moreover, the RfP specifically asserts that the selection committee retains flexibility in deciding the winning bidders within the overall program scope, that it will negotiate projects that maximize benefits to the government, that it may accept bids other than those with the lowest costs, and that it might reject all bids.[304]

This multidimensional, highly flexible auction design reflects the classic tension between the complete transparency and singular focus on efficiency provided by a one-dimensional auction based on price (or cost-effectiveness) alone, and the frequent obligation of governmental entities to consider other factors as well. The salinity program competitive bidding process is transparent to the extent that the RfPs clearly and openly identify all of the information required in a bid and all of the factors that *might* be considered, or that will be considered to some degree, in choosing among competing bids.[305] However, the process reflects the classic lack of transparency characteristic of a multi-dimensional auction process in which a series of factors with differing degrees of subjectivity are considered in a less than completely determinate way.[306] To some degree, this

---

[298] *See* 2003 RFP, *supra* note 294, at 2.
[299] *See id.* at 11.
[300] Bids must assure compliance with NEPA, 42 U.S.C. § 4321-4370 (2006) and other applicable requirements. 2003 RFP, *supra* note 294, at 2.
[301] 2003 RFP, *supra* note 294, at 8.
[302] *See id.* at 11–14.
[303] *See id.*
[304] *See id.* at 2, 14.
[305] *See id.*
[306] *See id.* at 1–2.

inherent lack of full transparency is addressed by the fact that selections are made by a ranking committee comprised of the Basin States as well as the BOR, rather than a single entity, which reduces to some degree fears of bias or favoritism in the selection process.[307]

Moreover, the RfPs do disclose the evaluation criteria in more detailed ways that better inform potential bidders about the selection process, and that seek to ensure that program benefits, as distinct from overall societal benefits, are maximized.[308] Construction and implementation costs are amortized over the expected project life,[309] not including cost-sharing from other sources (such as other government subsidies).[310] Thus, cost-sharing can be used to enhance the cost-effectiveness of a proposal, because the process considers only cost-effectiveness to the program, as opposed to the actual cost-effectiveness of the project including all of its costs.[311] If one is concerned about overall societal costs and benefits, this subsidy factor makes little sense. If the program simply seeks to maximize the effectiveness of its funding in addressing the salinity (or other) issue, however, this practice encourages bidders to leverage their bids with other resources. Likewise, although the basic cost-effectiveness formula is a simple division of tons of salt reduced per year by the amortized project costs per year to generate a uniform metric of dollars per ton per year,[312] the calculation may not include salinity reduction from measures already implemented under other programs, unless the full costs of those

---

[307] *See* 2003 RFP, *supra* note 294. The actual negotiations and final project approval, however, is handled by a federal contracting official. *See* U.S. BUREAU OF RECLAMATION, REQUESTS FOR PROPOSALS, COLORADO RIVER BASIN SALINITY CONTROL PROGRAM 2 (Apr. 2001) [hereinafter 2001 RFP] *available at* http://www.usbr.gov/uc/progact/salinity/pdfs/rfp2001.pdf.

[308] *See* 2003 RFP, *supra* note 294, at 11–14.

[309] The interest rate used to amortize project costs has declined over time, targeted to the federal planning interest rate to reflect changing economic conditions. *See* 2001 RFP, *supra* note 307, at 8 (6.375 percent); 2003 RFP, *supra* note 294, at 11 (5.875 percent); 2009 RFP, *supra* note 33, at 22 (4.625 percent). The BOR explains that a fixed federal interest rate is used for amortization purposes so that non-federally financed alternatives (which may borrow funds on the open market) can be compared consistently with federally financed projects. *See* 2001 RFP, *supra* note 307, at 8.

[310] *See* 2001 RFP, *supra* note 307, at 8.

[311] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 48; 2003 RFP, *supra* note 294, at 11.

[312] 2001 RFP, *supra* note 307, at 8. The RfPs provided simple examples of these calculations. For example: "The proposal will request $2 million to fund 8,000 tons per year of control for 20 years at an [sic] 6.637 percent interest rate. The $2 million cost amortizes to $169,000 per year over the 20 year life of the project. The cost effectiveness is $169,000 per year /8,000 tons per year or $21 per ton." *Id.* at 9.

measures are included in project cost calculations.[313] Again, the auction rules are designed to maximize the *incremental* removal of salt per program dollar spent.[314]

The RfPs also provide some guidance regarding the manner in which project performance risk will be taken into account in project ranking and selection. First, the program acknowledges that performance risk typically cannot be estimated precisely, but advises that accepting some risk may reduce overall program costs because the most cost-effective proposals may entail more risk.[315] Second, the RfPs advise potential bidders of the kinds of risk factors that will be considered.[316] Those include the requirement for up-front payments as opposed to later payments when benefits actually accrue, the use of performance bonds or other instruments to guarantee performance, cost-escalation factors and how volatile they are, the reliability of methods to predict salinity reductions, the degree to which the project is susceptible to poor operation and management practices or to which those problems are proposed to be avoided through automation, and the degree to which salinity reductions can be verified independently.[317] Third, the program identified up front the typical ranking of project types from lowest to highest risk.[318] An indication that a particular kind of project might entail more risk does not necessarily indicate that it would not be selected, but does send a signal to potential bidders that the cost-effectiveness of those projects would need to be sufficiently higher to overcome the risk factor.

The auction methods and selection criteria employed by the salinity program have remained relatively constant over time,[319] which tends to

---

[313] *See id.* at 10.
[314] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 48.
[315] *See* 2001 RFP, *supra* note 307, at 9–10.
[316] *See* 2003 RFP, *supra* note 294, at 12–14.
[317] *See* 2001 RFP, *supra* note 307, at 10–11.
[318] *See id.* at 12. In particular, projects that physically intercept brine sources and treat or eliminate them were ranked with the lowest risk, followed by physical system improvements such as canal lining with low management requirements, more efficient sprinkling systems, and irrigation management programs that could more easily be abandoned. *Id.*
[319] *Compare* U.S. BUREAU OF RECLAMATION, REQUESTS FOR PROPOSALS, COLORADO RIVER BASIN SALINITY CONTROL PROGRAM 1 (Feb. 1999) [hereinafter 1999 RFP] (listing cost effectiveness and performance risk as primary selection factors), *and* 2001 RFP, *supra* note 307, at 8 (listing cost effectiveness and performance risk as primary selection factors), and 2003 RFP, *supra* note 294, at 11 (listing technical merit, cost effectiveness, and performance risk as primary selection factors), *and* 2009 RFP, *supra* note 33, at 37 (listing cost effectiveness, uncertainty associated with salt load reduction estimates, and risk associated with construction and operation as primary selection factors).

lend some desirable consistency and stability to the program, especially for bidders who participate repeatedly. Consistency allows repeat bidders to improve their chances of winning with experience, and to potentially develop projects that are more cost-effective or otherwise more advantageous to the government over time. In addition to variable details such as changing amortization rates, however, there have been three potentially significant changes in program methods over time.[320]

First, in the early RfPs, the BOR identified both cost-effectiveness and performance risk as the selection factors, but aside from indicating that cost-effectiveness was the primary criterion and would be balanced against risk, indicated no numeric weighing between the two.[321] As discussed earlier, that method advises bidders what factors will be considered generally,[322] but renders it impossible for them to quantify their bidding strategy very precisely. The 2003 RfP sought to address this issue by specifying that cost-effectiveness would be weighted at seventy percent and performance risk at thirty percent of the overall score.[323] However, these numeric weighting factors were subsequently dropped from the analysis.[324]

Second, the early RfPs suggested that the project selection process *implicitly* considered technical feasibility as part of the project performance risk analysis.[325] Presumably, extremely cost-effective projects could be rejected on grounds of questionable feasibility (or high risk). As discussed above, however, where auctions impose threshold criteria for project consideration prior to actual project ranking on more objective grounds, it is desirable to develop a two-step process. The 2003 RfP included such a process, in which only those projects that passed scrutiny based on technical merit would be evaluated under the seventy/thirty weighting formula.[326] The most recent RfP, however, does not include such an

---

[320] The 2009 RfP also adds a number of significant requirements attached to the American Recovery and Reinvestment Act ("ARRA"), which provided the funding for that round of projects. They include, for example, requirements to use American materials and to pay prevailing wages under the Davis-Bacon Act. *See* 2009 RFP, *supra* note 33, at 4–5. Those conditions also required several more direct changes in the salinity control auction process. For example, it eliminated the possibility of jointly-funded projects because stimulus projects may only be funded through that program, and only projects that could be initiated and completed within narrow time frames. *See id.* at 9.
[321] *See* 1999 RfP, *supra* note 319, at 9; 2001 RfP, *supra* note 307, at 8.
[322] *See supra* text accompanying notes 315–319.
[323] 2003 RfP, *supra* note 294, at 11.
[324] *See* 2009 RFP, *supra* note 33, at 37.
[325] *See* 1999 RFP, *supra* note 319, at 10–12; 2001 RFP, *supra* note 307, at 9–10.
[326] *See* 2003 RFP, *supra* note 294, at 11 (imposing the threshold criteria where cost-effectiveness is given seventy percent weight and performance risk is given thirty percent).

explicit two-stage process. Rather, it simply makes clear that projects should "[n]ot use unproven technology," and should "[n]ot be of a nature that creates undue financial risk" for the BOR.[327]

Third, the first RfPs required bidders to perform their own salt reduction estimates, subject to BOR review.[328] Bidders could use either accepted BOR methodology, which was presumably presumptively acceptable, or other documented methods.[329] Obviously, given significant uncertainties in salinity reduction estimates and the incentive for bidders to estimate project reductions as high as possible in order to enhance the cost-effectiveness of their bids, the agency has a strong interest in ensuring that those estimates are appropriately conservative, and can be compared fairly according to the same methods. The agency later revised the process to require bidders to submit their projects to BOR technical officers to prepare salinity reduction estimates according to a uniform methodology, and with respect to projects based on improved irrigation efficiency, only for those regions for which adequate studies have been performed to justify reduction estimates given the hydrology and soil salinity in that region.[330] In this sense, the new RfPs maintain a different form of two-step process, in which bidders first obtain salinity reduction estimates directly from the BOR, and then develop and submit their full project proposals with calculations of cost-effectiveness and the other required factors.[331]

III. POTENTIAL APPLICATION OF COMPETITIVE BIDDING TO THE CHESAPEAKE BAY PROGRAM (OR TO OTHER LARGE WATERSHED NONPOINT SOURCE POLLUTION CONTROL PROGRAMS)

A. *Introduction*

A number of other publicly-funded pollution control efforts could potentially benefit from an auction process to enhance the cost-effectiveness of program funding.[332] Although this could apply to a range of pollution

[327] 2009 RFP, *supra* note 33, at 37.
[328] *See* 1999 RFP, *supra* note 319, at 4.
[329] *See id.*
[330] *See* 2009 RFP, *supra* note 33, at 11–12.
[331] *See id.* at 11.
[332] As mentioned earlier, this does not suggest that public funding is preferable to polluter pay approaches that require those who contribute to significant nonpoint source pollution to bear the costs of their own externalities. *See supra* note 28. However, so long as Congress and other decision makers choose to subsidize pollution control efforts, it is better for those programs to be as cost-effective as possible. *See generally supra* Part II.B.2 (discussing various measures taken by Congress to control salinity pollution).

control and environmental restoration programs, including public funding to control greenhouse gas emissions and habitat restoration efforts, this analysis focuses on efforts more closely analogous to the CRBSCP—other watershed-based programs to reduce nonpoint source water pollution. Others have noted that approaches that rely on incentives might increase the cost-effectiveness of public pollution control spending for watershed programs,[333] and that increased accountability for on-the-ground results is desirable in nonpoint source pollution control programs.[334]

Competitive bidding could potentially apply to any nonpoint source pollution control program, including national programs such as those funded by Congress under nationwide Farm Bill programs.[335] However, more targeted efforts under individual watershed-based programs are arguably the most immediately suitable for this kind of program because, as in the salinity program, the auction methods and selection criteria can be tailored specifically to the sources of pollution– the control of which will be best suited to addressing the particular problems to be solved.[336]

The Chesapeake Bay Program ("CBP") serves as an excellent example of how the auction process might be applied to other watershed efforts. This section will first briefly describe[337] the nature of the nonpoint

---

[333] *See* Searchinger, *supra* note 5, at 173.

[334] *See generally* McElfish et al., *supra* note 8 (proposing that increased accountability among states for nonpoint pollution is necessary because the National Pollutant Discharge Elimination System does not currently regulate it).

[335] *See* RENA STEINZOR & SHANA CAMPBELL JONES, CTR. FOR PROGRESSIVE REFORM, REAUTHORIZING THE CHESAPEAKE BAY PROGRAM: EXCHANGING PROMISES FOR RESULTS 13–14, 17 (2009) (explaining that in "May 2008, Congress reauthorized the federal Farm Bill, which included $188 million to fund the Chesapeake Bay Watershed Initiative" and suggesting that such "a competitive-bidding program would work well for the Bay").

[336] *See id.* at 12.

[337] Other sources have described and reviewed these programs in greater depth, but that is not the goal here. *See, e.g.*, Robert W. Adler & Michele Straube, *Watersheds and the Integration of U.S. Water Law and Policy: Bridging the Great Divides*, 25 WM. & MARY ENVTL. L. & POL'Y REV. 1 (2000) (comparing the pollution control programs of the Colorado River Basin Salinity Control Program with that of the Chesapeake Bay, Everglades, and San Francisco Bay Delta); Jon Cannon, *Choices and Institutions in Watershed Management*, 25 WM. & MARY ENVTL. L. & POL'Y REV. 379 (2000) (exploring how institutions created by the watershed approach will aid cooperation between opposite minded partners and lead to effective policies); McElfish et al., *supra* note 8, at 166–68 (discussing various state and federal methods of addressing nonpoint sources of water pollution); Searchinger, *supra* note 5 (proposing ways of making the incentive approach effective in cleaning up the Bay); Annecoos Wiersema, *A Train Without Tracks: Rethinking the Place of Law and Goals in Environmental and Natural Resources Law*, 38 ENVTL. L. 1239 (2008) (arguing that current models of adaptable environmental institutions fail to focus on goals and substantive law, rather relying on process and procedural law to benefit the environment); LESSONS FROM

source pollution problem to be addressed in the Chesapeake Bay, and the nature, status, and relative degree of success of past and current control efforts.[338] Then, it will evaluate the potential utility of auctions to allocate public pollution control dollars more cost-effectively.[339]

B. *The Chesapeake Bay Program*

1. Program Description and History

The Chesapeake Bay is the largest estuary in North America,[340] with a watershed covering over 64,000 square miles in parts of six states plus the District of Columbia.[341] It is "home to more than 3,700 species of plants and animals,"[342] and was one of the most biologically productive ecosystems on earth before significant human disturbance.[343] The Bay supported economically important resources such as herring, rockfish, shad, crabs, and oysters, as well as massive populations of waterfowl and other species.[344] The ecological health of the Bay, however, declined significantly under an onslaught of pollution from point and nonpoint sources,[345] destruction and impairment of wetlands and other coastal and estuarine habitats,[346] over-harvesting of fish and shellfish,[347] population growth and accompanying urbanization,[348] and other factors.[349]

Beginning in the early 1980s, the Chesapeake Bay states and the federal government began to work together to reverse this decline in the Bay's health, and the economic and other losses facing the region as a result. In 1980, the legislatures of Maryland and Virginia established the

---

LARGE WATERSHED PROGRAMS, *supra* note 118, at 83–90 (drawing comparisons between the Chesapeake Bay Program and other large watershed programs).
[338] *See* discussion *infra* Part III.B.
[339] *See* discussion *infra* Part III.C.
[340] Chesapeake Bay Foundation, Bay Area Facts, http://www.cbf.org/Page.aspx?pid=433 (last visited Mar. 5, 2010).
[341] *Id.*; TOM HORTON, TURNING THE TIDE, SAVING THE CHESAPEAKE BAY 3 (1991).
[342] U.S. Envtl. Prot. Agency, Chesapeake Bay Compliance and Enforcement Strategy, http://www.epa.gov/oecaerth/civil/initiatives/chesapeakebay.html (last visited Mar. 5, 2010).
[343] *See generally* HORTON, *supra* note 341.
[344] *See id.* at 23, 35, 40.
[345] *See id.* at 43–47, 105–10.
[346] *See id.* at 41.
[347] *See id.* at 151–55.
[348] *See id.* at 1, 75–83.
[349] *See generally* HORTON, *supra* note 341 (presenting a comprehensive view of efforts to clean up the Bay and describing which means have been successful and which have not).

Chesapeake Bay Commission to study the Bay's declining health and to help the states to manage the Bay cooperatively.[350] In 1983, following a series of EPA reports documenting the serious decline of Bay water quality and ecosystem health,[351] the governors of those states, along with the Mayor of the District of Columbia and the Administrator of the EPA, signed the 1983 Chesapeake Bay Agreement.[352]

The 1983 Agreement was a terse, one-page statement that a cooperative federal-state approach to Bay cleanup was needed, and an agreement to form a Chesapeake Bay Executive Council and various other implementing apparatuses to accomplish that goal, but with no substantive commitments or more specific goals.[353] A 1987 follow-up agreement, however, endorsed by the same jurisdictions plus the Chesapeake Bay Commission, added a series of "goals and priority commitments" to address "[l]iving [r]esources; [w]ater [q]uality; [p]opulation [g]rowth and [d]evelopment; [p]ublic [i]nformation, [e]ducation and [p]articipation; [p]ublic [a]ccess; and [g]overnance."[354] At the same time, as part of its 1987 reauthorization of the Clean Water Act, Congress formally established a Chesapeake Bay Program within the EPA and authorized federal funding in section 117 of the Act.[355] The signatories amended the Agreement in 1992 to reaffirm water quality control commitments and to specify additional implementation measures,[356] and again in 2000 to further specify both program goals and implementation strategies in light of the program's failure to meet its original deadlines.[357]

---

[350] Chesapeake Bay Commission, History of the Commission, http://www.chesbay.state.va.us/history.html (last visited Mar. 5, 2010). Pennsylvania joined the Commission in 1985. *Id.*; *see also* CHESAPEAKE BAY PROGRAM, A "WHO'S WHO" IN THE CHESAPEAKE BAY PROGRAM (2003), *available at* http://archive.chesapeakebay.net/pubs/whowho_2003.pdf [hereinafter WHO'S WHO].
[351] Searchinger, *supra* note 5, at 175.
[352] *Id.*; Chesapeake Bay Program, 1983 Chesapeake Bay Agreement (1983), *available at* http://www.chesapeakebay.net/content/publications/cbp_12512.pdf [hereinafter 1983 Chesapeake Bay Agreement].
[353] *See* 1983 Chesapeake Bay Agreement, *supra* note 352.
[354] *See* Chesapeake Bay Program, 1987 Chesapeake Bay Agreement 1 (1987), *available at* http://archive.chesapeakebay.net/pubs/199.pdf [hereinafter 1987 Chesapeake Bay Agreement].
[355] 33 U.S.C. § 1267 (1994).
[356] Chesapeake Bay Program, Chesapeake Bay Agreement: 1992 Amendments, *available at* http://www.chesapeakebay.net/publications/cbp_12507.pdf (last visited Mar. 5, 2010).
[357] Chesapeake Bay Program, Chesapeake 2000, *available at* http://www.chesapeakebay.net/content/publications/cbp_12081.pdf (last visited Mar. 5, 2010) [hereinafter Chesapeake 2000].

At bottom, the Chesapeake Bay Program is a voluntary effort in the sense that the Agreement itself is not enforceable against any of the signatories, and the program itself even lacks implementing or regulatory authority.[358] Likewise, the Chesapeake Bay provision of the CWA adds no regulatory or other requirements beyond those available under other provisions of the law.[359] Instead, on-the-ground implementation is left to the individual jurisdictions, using whatever regulatory, voluntary, or incentive-based programs they deem appropriate.[360] Any impetus for each jurisdiction to do more or to perform better comes from public shaming rather than enforceability.[361]

Despite this largely voluntary nature of the program and its underlying agreements, the signatories have devoted significant time, money, and other resources to Bay cleanup and restoration.[362] The program now consists of the Chesapeake Executive Council, comprised of the governors of the participating states,[363] the mayor of the District of Columbia, the administrator of the EPA, and the Chair of the Chesapeake Bay Commission,[364] plus a staff committee,[365] an implementation committee,[366] the EPA's Chesapeake Bay Program Office,[367] and a somewhat mind-boggling array of other interlocking committees, subcommittees, advisory and technical committees, and other affiliated bodies.[368] This effort has produced voluminous scientific information about Bay health and cleanup options[369] and has lead to a significant number of cleanup,

---

358 *See* Chesapeake Bay Program, How We Work, http://www.chesapeakebay.net/howwework.aspx?menuitem=14905 (last visited Mar. 5, 2010).
359 33 U.S.C. § 1267 (2006).
360 Adler & Straube, *supra* note 337, at 29.
361 *See* Cannon, *supra* note 337, at 400.
362 *See* Karl Blankenship, *Bay Leaders Say They'll Not Meet 2010 Cleanup Goal*, CHESAPEAKE BAY J., Jan. 2008, http://www.bayjournal.com/article.cfm?article=3232 (discussing Virginia's efforts to meet sewage discharge goals by 2010).
363 WHO'S WHO, *supra* note 350, at 1. In 2002, Delaware, New York and West Virginia joined the water quality restoration effort in their land areas within the Bay's watershed, but are not formal signatories to the program agreements. *See* MIKE BURKE, CHESAPEAKE BAY PROGRAM, RESTORING AND PROTECTING CHESAPEAKE BAY AND ITS RIVERS 16 (2005); U.S. Envtl. Prot. Agency Great Waters Program, Chesapeake Bay, http://www.epa.gov/air/oaqps/gr8water/xbrochure/chesapea.html (last visited Mar. 5, 2010).
364 WHO'S WHO, *supra* note 350, at 1.
365 *Id.* at 6.
366 *Id.* at 7–8.
367 *Id.* at 67–68.
368 *See generally* WHO'S WHO, *supra* note 350 (listing members, committees, and subcommittees involved with the Chesapeake Bay Program).
369 According to one analyst's count, the Chesapeake Bay Program website alone includes over 800 publications. *See* Searchinger, *supra* note 5, at 172 n.6.

restoration, monitoring, public education, and other efforts.[370] Most significantly for the purposes of this analysis, the participants have spent at least $4 billion on restoration programs since 1995,[371] and probably significantly more.[372] That, of course does not include expenditures by nongovernmental parties either to comply with regulations or other requirements designed to achieve program goals, or to engage in voluntary or incentive-driven efforts.

The Chesapeake Bay Program has been praised by various sources, including this author, for *institutional* success in collaboration, scientific analysis, integration of issues that are often dissected, and other programmatic measures;[373] and criticized by various sources, including this author, for failure to reach key *substantive* goals and to be driven by appropriate substantive requirements.[374] It is acknowledged widely that the ecological health of the Chesapeake Bay remains poor despite these decades of effort, with key populations such as blue crab continuing to decline rather than to recover.[375] From the perspective of this analysis, massive amounts of public dollars have been spent on Bay cleanup, and the key issues are whether those funds have been spent in the most cost-effective manner possible, and the extent to which those expenditures have achieved the desired results.

2. Past and Ongoing Nutrient Control Efforts

Although many factors contribute to the deterioration of the Bay's health and resources, from the outset of the program officials have identified excess inputs of nitrogen, phosphorus, and sediment from both point

---

[370] *See supra* note 341 and accompanying text (describing the program's efforts).

[371] STEINZOR & JONES, *supra* note 335, at 1.

[372] A 2005 review by the U.S. Government Accountability Office ("GAO") reported $3.7 billion in direct spending as reported by 11 "federal agencies; the states of Maryland, Pennsylvania and Virginia; and the District of Columbia from fiscal years 1995 through 2004." U.S. GOV'T ACCOUNTABILITY OFFICE, CHESAPEAKE BAY PROGRAM: IMPROVED STRATEGIES ARE NEEDED TO BETTER ASSESS, REPORT, AND MANAGE RESTORATION PROGRESS 5 (2005), *available at* http://www.gao.gov/new.items/d0696.pdf [hereinafter 2005 GAO REPORT]. However, GAO estimated an additional $1.9 billion in funding spent on—but not expressly dedicated to—Chesapeake Bay restoration and cleanup. *Id.* at 6.

[373] *See* Adler, *Barriers*, *supra* note 181, at 1071–72; Adler & Straube, *supra* note 337, at 31–37; Cannon, *supra* note 337 *passim*.

[374] *See* Adler, *Barriers*, *supra* note 181, at 1072; Adler & Straube, *supra* note 337, at 35–37; Wiersema, *supra* note 337 *passim*.

[375] *See generally* CHESAPEAKE BAY PROGRAM, BAY BAROMETER: A HEALTH AND RESTORATION ASSESSMENT OF THE CHESAPEAKE BAY AND WATERSHED IN 2008 [hereinafter 2008 ASSESSMENT]; 2005 GAO REPORT, *supra* note 372, at 19.

and nonpoint sources as a critical problem.[376] High nutrient inputs feed excess algae growth, conversion to different species of algae that do not support the Bay's indigenous food chain, low concentrations of oxygen, aesthetic problems, and reduced light penetration to submerged aquatic plants that support other components of the Bay's food chain.[377] As a result, reductions in those pollutants were the subject of the program's earliest and most frequently noted numeric goals. The 1987 Chesapeake Bay Agreement established a use-based qualitative goal to "reduce and control point and nonpoint sources of pollution to attain the water quality condition necessary to support the living resources of the Bay."[378] With respect to nutrients, the Agreement quantified this goal by establishing a numeric target of forty percent reduction in nitrogen and phosphorus reaching the main stem of the Bay, from a baseline of 1985 point source loads and nonpoint source loads "in an average rainfall year."[379]

As is true for the CRBSCP, there is a distinction between the scientific basis for the numeric targets or standards established as a measure of program success, and the cost-effectiveness of programs to achieve those targets. Although the primary focus of this analysis is the latter, the former is also important because targets that are set too low might result in significant expenditures that do not solve the real world goal of supporting the Bay's living resources, while targets that are set too high might result in higher expenditures than necessary to meet that goal. The forty percent reduction goal derived from a water quality computer model developed between 1985–87, which predicted that a forty percent reduction in nutrients from point sources and controllable nonpoint sources[380] would result in "a significant improvement in the Bay's water quality."[381]

The Program acknowledged, however, that this numeric goal was subject to various scientific uncertainties, including the limitations of a

---

[376] *See* CHESAPEAKE EXECUTIVE COUNCIL, BAYWIDE NUTRIENT REDUCTION STRATEGY 1-1 (1988) [hereinafter BAYWIDE NUTRIENT REDUCTION STRATEGY] (noting that studies dating before 1970 indicated that high nutrient levels were a "major cause" of deterioration of Bay ecosystem); *see also* Searchinger, *supra* note 5, at 175 (excess nutrient and sediment levels identified in 1970's).

[377] *See* BAYWIDE NUTRIENT REDUCTION STRATEGY, *supra* note 376, at 1-1.

[378] 1987 CHESAPEAKE BAY AGREEMENT, *supra* note 354, at 3.

[379] *Id.*

[380] It is interesting that the 1987 Agreement itself is phrased in terms of overall nutrient reductions, *see id.*, while the scientific underpinning appears to be based on a different baseline: a forty percent reduction from "controllable nonpoint sources." *See* BAYWIDE NUTRIENT REDUCTION STRATEGY, *supra* note 376, at 1–4.

[381] BAYWIDE NUTRIENT REDUCTION STRATEGY, *supra* note 376, at 1–3.

first-generation Bay water quality model.[382] Therefore, in the 1987 Agreement, the signatories pledged to re-evaluate the forty percent reduction goal by 1991, based on additional research and modeling.[383] The 1992 Amendments to the Agreement specifically reaffirmed the forty percent commitment, however, and further committed to develop targeted, tributary-specific strategies to attain that goal.[384]

Some progress has clearly been made in reducing inputs of nitrogen and phosphorus through various point and nonpoint source control strategies, although it is easier to measure progress in some areas than in others. The most recent programmatic assessment of the Bay's health reports that in 2008, nitrogen loadings to the Bay were 54 million pounds less than the 345 million pound average load from 1990–2008, and phosphorous loads were 7.5 million pounds less than the 21.3 million pound average load from 1990–2008.[385] However, the accompanying graphics show wide fluctuations in nutrient loadings from year to year, and further depict a very close correlation between fluctuations in flow and fluctuations in nutrient loadings.[386] This makes it difficult from these data alone to ascertain how much of those reductions reflect pollution controls and how much simply tracks variations in basin-wide hydrology.[387] Three sets of improvements, however, clearly have resulted in some significant pollution reductions.

First, nitrogen loadings from municipal and industrial point sources have dropped by about 34 million pounds per year (from just under 90 million pounds per year in the late 1980s) due to investments in advanced sewage treatment and other wastewater treatment methods.[388] Similarly, phosphorus loads from municipal and industrial sources dropped by 5.9 million pounds per year, from roughly 9 million pounds per year in 1985.[389]

---

[382] *See id.* at 1–4. The original estimates were based on a two-dimensional, steady state model, while program engineers planned to develop a three-dimensional, time variable model for the Bay. *See id.* In addition, scientific disagreement remained about the relative roles of nitrogen and phosphorus in different parts of the ecosystem. *See id.*

[383] 1987 Chesapeake Bay Agreement, *supra* note 354, at 3.

[384] 1992 Amendments, *supra* note 356.

[385] 2008 ASSESSMENT, *supra* note 375, at 5.

[386] *See id.*

[387] *See also* Searchinger, *supra* note 5, at 177 (noting that variability makes it difficult to discern water quality trends).

[388] *See* Chesapeake Bay Program, Nitrogen Loads Delivered to the Bay from Municipal and Industrial Wastewater, http://www.chesapeakebay.net/status_nitrogenmunicipal.aspx?menuitem=19799 (last visited Mar. 6, 2010).

[389] *See* Chesapeake Bay Program, Phosphorus Loads Delivered to the Bay from Municipal and Industrial Wastewater, http://www.chesapeakebay.net/status_phosphorusmunicipal.aspx?menuitem=19803 (last visited Mar. 6, 2010).

This is consistent with the opening assertion that pollution from a relatively discrete (even if numerous) set of point sources of pollution are comparatively easier to control than pollution from nonpoint sources.[390] Efforts to control point sources of nutrients into the Bay's watershed have been relatively successful, although the program acknowledges that more work is needed even in this area, in part to keep up with continuing population growth in the region.[391] Regulatory measures through stricter NPDES permit limits are responsible for reductions from industrial point sources, with those sources bearing the control costs.[392] Similar reductions from municipal sources may have the same regulatory origin, but public funds are obviously tapped to achieve those results, with some improvements funded through a flush tax which is a supplemental fee added to residential water and sewer bills.[393] This at least raises the question of whether those are the most cost-effective public expenditures for nutrient control in the Bay watershed. It should be relatively straightforward, however, to calculate the cost-effectiveness of point source controls because the capital and operating costs of incremental controls are known, and reductions in nutrient loadings can be monitored at the outfall.

Second, one of the first control measures adopted by the Bay states was to pass state laws banning the use of phosphates in detergents.[394] One lesson from that strategy is that even the most dispersed sources of pollution (every household in the watershed) can be controlled effectively by going back to the source and banning or restricting the pollutant as an input where effective substitutes are possible, just as eliminating lead from gasoline reduced water pollution as well as air pollution.[395] Moreover, banning sources of pollutants categorically also eliminates issues of end-of-pipe or ambient monitoring and uncertainty regarding the efficacy of the controls (assuming, of course, the absence of cheating or sufficient efforts to detect cheating).[396] It is somewhat more difficult to evaluate the

[390] *See supra* text accompanying notes 2–8.
[391] 2008 ASSESSMENT, *supra* note 375, at 11.
[392] EPA Administered Permit Programs: The National Pollutant Discharge Elimination System, 40 C.F.R. § 122.41 (2009).
[393] *See* Searchinger, *supra* note 5, at 181, 183 (citing MD. CODE ANN. ENVIR. § 9-1605.2 (LexisNexis 2010).
[394] *See id.* at 174–76; Cannon, *supra* note 337, at 405.
[395] *See* Richard B. Alexander & Richard A. Smith, *Trends in Lead Concentrations in Major U.S. Rivers and Their Relation to Historical Changes in Gasoline-Lead Consumption*, 24 WATER RESOURCES BULL. 568 (1988).
[396] *See EPA Plans to Extend Lead Monitoring Network*, ENV'T NEWS SERV., Dec. 30, 2008, *available at* http://www.ens-newswire.com/ens/dec2009/2009-12-30-092.html.

cost-effectiveness of those controls,[397] but that exercise is important only if the goal is to assess the cost-effectiveness of overall societal resources, as opposed to direct expenditures of public funds on pollution controls.

Third, the Chesapeake Bay states have used a combination of some regulatory controls and some public spending (education, cost-sharing and incentives) to reduce nonpoint sources of nutrients.[398] As with point source regulatory controls, however, the costs of complying with those measures falls on private landowners.

Public spending approaches, however, have relied on the traditional models used by the U.S. Department of Agriculture under the Farm Bill and other programs, in which public funds are doled out to any qualified applicant without detailed analysis of where those dollars will be spent most effectively.[399] That is not to say that those expenditures have been wasted entirely. For example, pollution reductions have been achieved through strategies such as improved manure management, fertilizer management, planting cover crops, drainage improvements, and buffer strips and wetlands.[400] On the other hand, research suggests that at least some previous best management practices—such as no-till farming—may actually have been counter-productive and increased nutrient runoff into the Bay ecosystem.[401] That problem, however, cannot necessarily be blamed on the manner in which public funds have been allocated, as opposed to mistakes in the evolution in the applicable science of nonpoint source pollution control. As with the original salinity control program, however, presumptive decisions about public resource allocation are dictated in advance by agency officials who determine which kinds of projects are eligible for funding, with little effective monitoring or follow-up to determine how effective those expenditures are in achieving significant reductions in pollutants reaching the Bay.[402] The cost-effectiveness of those expenditures in terms of dollars spent per unit of pollution control is understood poorly, if at all, and the absence of a competitive process to allocate those resources reduces incentives to produce better results.[403] Controlling that pollution more effectively is critical to the success of the overall Bay cleanup, because

---

[397] *See EPA Offers Cost-Benefit Study on Banning Lead in Gasoline*, LAWRENCE JOURNAL-WORLD, Mar. 28, 1984, at 40.
[398] *See* McElfish et al., *supra* note 8, at 87–88; Searchinger, *supra* note 5, at 185–203.
[399] *See* Searchinger, *supra* note 5, at 190, 195 (describing the "first come, first served" nature of fund distribution for agricultural pollution control).
[400] *See id.* at 191–203.
[401] *See id.* at 187–89.
[402] *See* 2005 GAO REPORT, *supra* note 372, at 18–19, 60.
[403] *See* McElfish et al., *supra* note 8, at 206–09.

agriculture still covers about a quarter of the entire watershed, and the program acknowledges that "[a]griculture is the number one source of pollution to the Bay."[404]

Whatever the cost-effectiveness of previous nonpoint source pollution control efforts in the Bay watershed, it has been equally clear throughout the program's history that the pollutant load reductions that have occurred have not sufficed to meet the Program's forty percent reduction goal, certainly not by the original year 2000 target.[405] Moreover, reductions in nutrient inputs that have occurred have not resulted in the predicted improvements in dissolved oxygen and other indicia of aquatic ecosystem health in the Bay itself. The 2008 assessment reported that the Program had achieved only twenty-one percent of its water quality improvement goals, characterizing water quality in the Bay as "extremely poor."[406]

The Chesapeake Bay 2000 Agreement acknowledged this failure first in somewhat oblique terms: "We have made measurable reductions in pollution loading despite continuing growth and development. Still, we must do more."[407] Next, the Agreement maintains the commitment to continue to work toward the forty percent goal, but notably omits a new target date tied directly to that goal.[408] It does establish a new target date of 2010, but rather than linking that new deadline to the original forty percent reduction goal, it instead ties that date to compliance with the TMDL requirements of the CWA.[409] In particular, the Chesapeake 2000 Agreement established 2010 as the deadline to "correct the nutrient- and sediment-related problems in the Chesapeake Bay and its tidal tributaries sufficiently to remove the Bay and the tidal portions of its tributaries from the list of impaired waters under the Clean Water Act."[410] Subsidiary commitments are to *define* water quality conditions necessary to protect the

---

[404] 2008 ASSESSMENT, *supra* note 375, at 10.
[405] *See* Chesapeake 2000, *supra* note 357, at 5.
[406] *See id.* at 16.
[407] *Id.* at 5.
[408] *See id.* at 6 ("Continue efforts to achieve and maintain the 40 percent nutrient reduction goal agreed to in 1987 . . . .").
[409] *See* 33 U.S.C. § 1313(d) (2006). This provision requires states to list impaired water bodies, that is, waters or segments of waters that do not meet applicable ambient water quality standards. *Id.* The "total maximum daily load" (whether calculated on a daily or some other temporal basis) reflects the maximum amount of a pollutant from all sources that can be allowed in order to meet the standards. *See id.* The TMDL then must allocate sufficient pollution control obligations among various point and nonpoint sources throughout the watershed such that the standards are met. *See* Pronsolino v. Nastri, 291 F.3d 1123, 1128–29 (9th Cir. 2002).
[410] Chesapeake 2000, *supra* note 357, at 6.

aquatic resources of the Bay, as envisioned in the 1987 Bay Agreement,[411] to establish target load reductions tied to those levels, and to revise the applicable ambient water quality standards accordingly.[412]

That new charge does not necessarily indicate whether the scientific reassessment will result in weaker or more aggressive targets for reductions in nutrients and sediment. And while it is obviously critical to the Bay's health to establish those targets correctly, based on sound science, the focus of this analysis is how to use available public resources in the most cost-effective manner. What is crystal clear, however, is that past control efforts—particularly controls on nonpoint sources—have not been sufficient to restore water quality and the health of the Chesapeake Bay ecosystem.[413] Given that public resources to address this problem are finite, more progress might be made if greater attention is paid to the cost-effectiveness with which those dollars are spent. An auction process modeled after the CRBSCP might help to achieve that goal.

3. Current Proposed Reforms

On October 20, 2009, U.S. Senator Benjamin L. Cardin of Maryland introduced the Chesapeake Clean Water and Ecosystem Restoration Act of 2009[414]—one in a long series of proposed bills designed to reform and improve efforts to restore the health of the Chesapeake Bay.[415] The bill would amend the current Chesapeake Bay provision of the CWA[416] by continuing the existing program and funding, including funds to assist agricultural and forestry sources to reduce their nonpoint source pollution,[417] but also by introducing a number of stricter measures designed to improve the accountability and effectiveness of the program.[418] As a result, the Cardin bill has already met stiff opposition from agricultural interests and others, in part because many observers view these proposals as a "trial balloon" for similar improvements to the CWA as a whole at a later time.[419]

---

[411] *See* 1987 Chesapeake Bay Agreement, *supra* note 354, at 3.
[412] Chesapeake 2000, *supra* note 357, at 6.
[413] *See* Adler, *Barriers*, *supra* note 181, at 995–96.
[414] S. 1816, 111th Cong. (2009).
[415] According to the Library of Congress tracking system, members of Congress have introduced sixteen bills addressing some aspect of Chesapeake Bay programs during the 111th Congress alone. *See* The Library of Congress, THOMAS, http://thomas.loc.gov/, search "Chesapeake Bay" in Legislation in Current Congress) (last visited Mar. 6, 2010).
[416] *See supra* note 355–57 and accompanying text.
[417] S. 1816, 111th Cong. § 3 (2009) (proposed §§ 117(b), (e)).
[418] *See* Tom Horton, *A Tougher Shade of Green*, BAY J. NEWS SERV., Dec. 22, 2009, http://www.bayjournalnewsservice.com/ShadesOfGreen.html.
[419] *Id.*

In addition to traditional voluntary programs for nonpoint source pollution control, the Cardin bill would also add considerably more stringent and enforceable requirements to control nonpoint source loadings of nitrogen, phosphorus, and sediments.[420] In particular, the bill would require the EPA to adopt a Baywide TMDL for those pollutants with "enforceable or otherwise binding load allocations for all nonpoint sources" not subject to NPDES or other enforceable permit obligations, and specific requirements for new and revised NPDES permits to implement waste load allocations for those pollutants from point sources.[421] It would also require the Chesapeake Bay states to prepare and to implement watershed implementation plans—with specific pollution reduction targets, actions and schedules to meet those targets—for each of ninety-two tidal water segments in the Bay as a whole.[422] States would be required to submit their plans to the EPA for review and approval according to criteria adopted by the EPA; for delinquent states, the EPA would have the authority to withhold program grants and to adopt and implement federal watershed implementation plans.[423] The latter authority would reflect a distinct escalation in the EPA's ability to enforce state nonpoint source control obligations compared to its existing authority under the CWA, analogous to its authority to promulgate federal implementation plans for delinquent states under the Clean Air Act.[424]

In addition, the bill would require the EPA, in cooperation with the Bay states, to develop and implement a nutrient trading program under which nitrogen and phosphorus credits could be bought and sold on an open market.[425] That provision is potentially relevant to the auction process described below, because the bill would require the EPA to develop technical methods to identify, standardize, and verify nutrient reductions credits and associated water quality benefits that would qualify under the nutrient trading program.[426] Those same metrics could be used for, or at least form the basis for, a similar system of quantifying pollution reduction units for purchase via a public auction process. Because the bill would also

[420] S. 1816, 111th Cong. § 3 (2009) (proposed §117(i)(1)).
[421] *Id.* (proposed § 117(i)).
[422] *Id.* (proposed § 117(j)).
[423] *See id.* (proposed § 117(k)).
[424] *Compare* 33 U.S.C. § 1329(h) (2006) (authorizing EPA to withhold program grants from states with inadequate nonpoint source pollution control plans) *with* 42 U.S.C. § 7410(c) (2006) (authorizing federal implementation plans for states with inadequate state implementation plans under the CAA).
[425] *See* S. 1816, 111th Cong. § 3 (2009) (proposed § 117(k)(6)).
[426] *Id.* (proposed § 117(k)(6)).

provide considerable continued public funding for nonpoint source pollution control absent any effective accountability mechanism,[427] the same metrics used to support a nutrient trading program between private parties could be used to enhance the accountability with which public dollars are used to support the same goals.

C. A Potential Auction Process for the Chesapeake Bay

In its basic outline, an auction process through which the CBP (or individual states or other entities within the program) might purchase nutrient or sediment controls sufficient to meet the program's pollution reduction goals, or ambient water quality standards deemed sufficient to protect the living resources of the Bay, should be similar to that used by the CRBSCP.[428] However, because there are significant differences between nutrient and sediment controls in the Chesapeake Bay watershed and salinity controls in the Colorado River Basin, and because the former is admittedly more complex than the latter, the program would have to be designed carefully to address those differences appropriately.[429] The key potential design components of such a program are discussed below, but could differ in various respects so long as the basic principles of sound auction design are followed.

1. Basic Program Design and Methodology

Similar to the salinity program, in the CBP, the auctioneer(s) would solicit sealed bid proposals to fund projects designed to reduce nitrogen, phosphorus, or sediment from any source within the watershed, or from within specific sub-basins in the watershed. The breadth of that opportunity is highlighted by the fact that air deposition remains a significant source of nitrogen loadings to the Bay,[430] meaning that even projects to control sources of air pollution beyond what is required by existing regulation could be proposed in the bidding process.[431] Projects would be selected based on the amount of pollution they are projected to reduce annually per

---

[427] *See id.* (proposed § 117(q)).
[428] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 88–89.
[429] *See* Adler & Straube, *supra* note 337, at 34–35.
[430] *See* 2008 ASSESSMENT, *supra* note 375, at 25 (indicating that air emissions cause about one-third of nitrogen inputs into the Bay).
[431] The Cardin bill, however, expressly includes air deposition sources as subject to the enforceable provisions of the proposed Baywide TMDL process. *See* S. 1816, 111th Cong. § 3 (2009) (proposed § 117(i)(1)(B)(ii)).

dollar spent, tempered in some way by an assessment of project risk, with the number of projects chosen based on annual program funding and the number of acceptable bids. As discussed below, we can expect some problems with all aspects of the selection analysis, especially at the outset. In deciding whether to use these methods, however, the key question is not whether the methodology is perfect (none are), but whether the program as a whole can be expected to produce more cost-effective results than the status quo or other available options.

The pollution reduction factor depends heavily on the reliability of methods used to calculate expected load reductions from various kinds of projects.[432] This process is not entirely precise in the salinity program due to uncertainty about factors such as the relationship between the amount of reduced infiltration due to higher irrigation efficiency and reduced leaching of salts into the Colorado River system as a result.[433] However, program officials believe that the methodology is sufficiently reliable to choose among competing projects in allocating program dollars.[434] For purposes of choosing among projects, it is less important that the calculation methodology be 100 percent precise in an absolute sense than it is that the methods reflect actual pollution reductions and are applied with reasonable consistency among proposed projects in a relative sense.[435]

Thus, it is crucial that there be a sound conceptual basis for any similar cause and effect relationship used in a CBP auction process, i.e., for assuming that a particular management practice will result in pollution reductions that can be estimated within reasonable error bounds.[436] Likewise, it is important that the methods be able to distinguish reasonably between differences in pollution control effectiveness among projects due to variables such as soil type, crops grown, hydrology, location in the watershed, and other factors.[437] For all of those reasons, it would be preferable (and more transparent to bidders) for the program to prescribe fixed methodologies to estimate load reductions for various kinds of projects, to increase both accuracy and consistency of those estimates among competing projects. The Chesapeake Bay Watershed Model, which has been used for many years to estimate load reductions from nonpoint sources,[438] may present at least a good starting point for such predictive methods. Moreover,

---

[432] *See* Adler, *Barriers*, *supra* note 181, at 1105.
[433] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 69–70.
[434] *See id.* at 48, 70.
[435] *Id.* at 70.
[436] *Id.* at 89–90.
[437] *See* Searchinger, *supra* note 5, at 187.
[438] *See* McElfish et al., *supra* note 8, at 167–68.

the nutrient trading credits developed under the proposed Cardin bill,[439] or a variation on those credits, could be used as the fundamental unit of sale under an auction process.

As in the salinity program, however, even the best methods to estimate the raw cost-effectiveness of proposed projects does not account for project risk.[440] Some control methods are inherently more certain than others, but every method has some level of risk in terms of whether the predicted pollution load reductions will actually be achieved both initially and throughout the proposed project life.[441] For example, advanced wastewater treatment methods are probably more certain to achieve highly predictable results than agricultural best management practices, but obviously rely on proper operation and maintenance of the facilities.[442] Planted buffer strips that require little ongoing maintenance may have a lower degree of project risk than nutrient management planning for row crops, which must be implemented annually.[443] One of the benefits of an auction method is to stimulate innovation in pollution controls, but methods that lack a track record and scientific support at pilot levels may be riskier than management practices with a long history of effectiveness and monitoring support. Thus, the auction process should include a method to adjust raw cost-effectiveness to account for relative project risk.

2. Addressing Complexity and Variability

Each of the methodological issues discussed in the previous subsection is probably more complex in the CBP than the CRBSCP.[444] First, although considerably smaller in size,[445] the portions of the Chesapeake Bay watershed in which pollution controls are needed are more variable than the area within the Upper Colorado River Basin in which the

---

[439] *See* S. 1816, 111th Cong. § 3 (2009) (proposed § 117(k)(6)).
[440] *See* Searchinger, *supra* note 5, at 186–87; *see also* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 48.
[441] This has led to problems in the past, where program models have overestimated load reductions actually achieved by various management practices. *See* Searchinger, *supra* note 5, at 186.
[442] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 48–49, 90.
[443] *See* Searchinger, *supra* note 5, at 202; Natural Res. Conservation Serv., *Components of a Nutrient Management Plan in Minnesota*, at 3, *available at* ansci.umn.edu/poultry/resources/2003-compnmps.pdf (last visited Mar. 8, 2010).
[444] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 86.
[445] The Chesapeake Bay watershed is approximately 64,000 square miles compared to almost 250,000 for the Colorado River Basin. Adler & Straube, *supra* note 337, at 13–14, 28.

competitive bidding salinity control program operates,[446] in terms of land use, crops grown, soils, topography, and other factors relevant to actual reductions of nutrients in the Bay itself (including the location of each project in the watershed, and how that affects pollution reductions in the Bay itself).[447] Methods used to estimate the levels of pollution reduction used with particular control strategies should account for those variables to the extent possible.

Second, the wide range of activities potentially competing for control dollars also may prove challenging. The CRBSCP focuses on a relatively small number of tools to reduce salinity, such as well plugging and improved irrigation efficiency.[448] In the Chesapeake Bay, a much wider range of practices might be submitted for program funding, such as advanced wastewater treatment and other point source controls, planting buffer strips, construction of more permeable suburban parking lots, advanced fertilization methods that better match nutrient application to soil conditions and crop needs, and revised livestock feeding and manure management methods. Comparing "apples and oranges" fairly, therefore, is likely to be more challenging in the CBP than in the CRBSCP. So long as the methods used for each kind of control are reasonable, however, and are established with similar degrees of conservatism,[449] comparisons among project types should be reasonably fair.

Third, the CRBSCP focuses on one combined "pollutant" (salinity, which is actually comprised of a number of salts with different chemical compositions), while the CBP addresses nitrogen, phosphorus and sediment separately.[450] That problem would be relatively simple to address if each control project addressed only one of those three pollutants. Competitive bidding programs in the CBP could hold separate auctions for each pollutant, and select the most cost-effective projects to control each pollutant independently. However, some pollution control methods might reduce loadings of two or more pollutants at the same time. For example, a vegetative buffer strip at the edge of a field might reduce sediment by

---

[446] The whole Colorado River Basin, of course, is extremely variable in many respects. *See* RESTORING COLORADO RIVER ECOSYSTEMS, *supra* note 124, at 2–4. The CRBSCP, however, focuses most heavily on areas of irrigated agriculture in the Upper Basin, in soils dominated by saline shale formations. *See* Adler & Straube, *supra* note 337, at 25.

[447] *See* Adler & Straube, *supra* note 337, at 58–59.

[448] *See id.* at 24.

[449] For example, it would not be reasonable to assume the highest level of potential pollution reductions from one kind of strategy while employing more conservative approaches for others.

[450] *See* Adler & Straube, *supra* note 337, at 18, 30.

controlling soil erosion, and also reduce inputs of nutrients that might be bound to those soil particles, or that are absorbed by plants in the buffer strip from the underlying groundwater. Obviously, projects that can reduce multiple pollutants cost-effectively should be encouraged, but not entirely at the expense of very cost-effective proposals to control single pollutants.

There are several possible ways to address this problem, but each poses some administrative and accounting challenges. The program could hold a single set of auctions for all pollutants. Bidders would receive credit for all pollutants removed according to a set percentage formula, such that projects that are particularly cost-effective at removing one pollutant could compete with projects that remove two or three pollutants, but somewhat less cost-effectively per individual pollutant. That approach, however, would make it more difficult to target the correct amount of funding to each pollutant to achieve program goals, unless the formula automatically discounted controls on a particular pollutant once a certain target had been reached. Likewise, the program could hold one set of auctions for individual pollutants and separate auctions for multiple-pollutant projects, so that each project would only compete within its own category. Or, a bidder could be required to choose which auction to enter (probably based on which pollutant the bidder believes it will control most cost-effectively relative to the expected competition, in a classic example of auction bidders being forced to make educated predictions about competing bids). As has been done in the salinity program, however, the bidder could receive some credit in the selection process for other incidental environmental benefits, including control of other target pollutants in the program.[451] To increase transparency and to reduce any appearance of bias, it would be preferable for those factors to be spelled out quantitatively in advance (e.g., a rule that a bidder will get a specific percentage bid preference for controlling other pollutants by a specified amount). Both of those approaches would reduce but not eliminate the pollutant budget issue discussed above. None of these solutions is perfect, but neither is the problem of multiple pollutants insurmountable.

Fourth, the CRBSCP assumes that salinity inputs anywhere in the basin are fungible, and therefore treats them the same for purposes of comparing project merit.[452] Thus, any source of salinity, anywhere in the Colorado River Basin upstream from Hoover Dam, can compete in the

---

[451] In the salinity program, some projects have received additional credit for accompanying reductions in certain other pollutants, such as selenium. *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 49.
[452] *Id.* at 110.

bidding process on a level playing field with all other sources, and win an award if it can reduce salinity in a sufficiently cost-effective way.[453] In part, this is because salts are soluble (measured as total *dissolved* solids) and are stable in the system.[454] For the most part, they do not leave the water column through precipitation, volatilization, or other transport mechanism.[455] Moreover, salt is mixed thoroughly in the system's large reservoirs—especially Lake Powell and Lake Mead[456]—upstream from the point at which the salinity standards are monitored. Therefore, for purposes of the auction process, a molecule of salt reaching the river in the upper Green River can be treated the same as a molecule discharged into Las Vegas Wash.[457] Moreover, legally and politically, the seven Colorado River basin states agreed long ago to band together in the Colorado River Basin Salinity Control Forum,[458] with a unified implementation program and a basin-wide set of water quality standards ("WQS)" for salinity.[459] They accomplish their collective goals through a basin-wide salt budget and a basin-wide salinity control program implemented, in part, through the basin-wide competitive bidding program.[460]

An auction process in the Chesapeake Bay watershed would need to consider whether similar assumptions hold in suggesting a similar basin-wide auction process. Alternatively, different environmental and political factors in the Chesapeake Bay watershed might suggest that the location of sources be addressed explicitly in the bidding process, or that auctions for program funding be conducted by individual states, or within individual tributary basins. For purposes of cleaning up the Chesapeake Bay itself (as opposed to separate concerns about water quality within individual tributary water bodies), what matters is the total loading of nitrogen, phosphorus, and sediment reaching the tidal waters of the Bay. For that purpose, it is certainly possible to make the same simplistic assumption that a molecule of phosphorus discharged into the upper Susquehanna River

---

[453] *See id.* at 18.
[454] *Id.* at 34–35.
[455] *See, e.g.*, Kenneth K. Tanji et al., *Salt Deposits in Evaporation Ponds: an Environmental Hazard?*, CAL. AGRIC., Nov.–Dec. 1992, at 18, 18 (stating that salt evaporation ponds are one of the only ways to dispose of salt in the California soil).
[456] LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 108; *see, e.g.*, Jack Barnett, *Limiting Salt Loading to the Colorado River*, SOUTHWEST HYDROLOGY, Mar./Apr. 2008, at 22–23, *available at* http://www.swhydro.arizona.edu/archive/V7_N2/feature4.pdf.
[457] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 88.
[458] *Id.* at 10.
[459] *See* Adler & Straube, *supra* note 337, at 18–22.
[460] *See id.*

is equivalent to a molecule of phosphorus discharged in a small estuarine tributary on the Eastern Shore of Maryland,[461] and to propose a similar basin-wide approach to auctioning available CBP pollution control dollars. That would suggest a "Baywide TMDL" process capping overall loadings of nitrogen and phosphorus into the entire Bay.[462]

There are a number of possible reasons, however, why that assumption is less reasonable for the CBP than for the CRBSCP. For example, nutrients discharged into tributaries might be consumed by aquatic plants before they reach the Bay.[463] Phosphorus bound to sediment particles might precipitate out into river sediments, whereas dissolved phosphorus is more likely to remain in the water column.[464] Nitrogen and phosphorus each can be released in different chemical forms, with different fate and transport mechanisms.[465] Even sediment transport can vary depending on particle size, river flow and velocity, and other factors.[466] A bidding process may have to take some of those factors into account in distinguishing between different projects as more or less cost-effective in addressing water quality problems in the Bay itself. A crude approach might be to choose among projects with roughly equivalent cost-effectiveness based on the location and form of the pollutant. A more sophisticated approach would be to account for those factors in the methods used to calculate cost-effectiveness, that is, by estimating the load of pollutants a proposed project will reduce as the receiving waters enter the Bay, rather than at the point of release (or control).

Politically, the CBP has always played a solely coordinating function, unlike the CRBSCP, with actual implementation coming from the individual jurisdictions acting independently and voluntarily.[467] That arrangement avoided the need to create an entirely separate regulatory and enforcement institution at the Baywide, rather than state or local

---

[461] *See* LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 88.

[462] *See* STEINZOR & JONES, *supra* note 335, at 18–19 (describing a Baywide TMDL process).

[463] See Chesapeake 2000, *supra* note 357, at 3.

[464] *See* M.D. SMOLEN, OKLA. ST. U., PHOSPHORUS AND WATER QUALITY 1 (2004), *available at* http://osufacts.okstate.edu/docushare/dsweb/Get/Document-4676/BAE-1521web.pdf.

[465] For a discussion of the different forms of concern, see JAMES L. BAKER, MARK B. DAVID & DEAN W. LEMKE, UNDERSTANDING NUTRIENT FATE AND TRANSPORT, INCLUDING THE IMPORTANCE OF HYDROLOGY IN DETERMINING LOSSES, AND POTENTIAL IMPLICATIONS ON MANAGEMENT SYSTEMS TO REDUCE THOSE LOSSES (2006), *available at* http://www.epa.gov/msbasin/pdf/symposia_ia_session1.pdf.

[466] *See generally* P.Y. Julien & D.B. Simons, *Sediment Transport Capacity of Overland Flow*, 28 AM. SOC'Y OF ENGINEERS 755 (1985), *available at* www.engr.colostate.edu/~pierre/ce_old/resume/Paperspdf/Julien-Simons-ASAE85.pdf.

[467] *See* Adler & Straube, *supra* note 337, at 33; Cannon, *supra* note 337, at 400.

levels. It also ensures at least a rough fairness among Bay jurisdictions, with each, for example, committing to meet its own *pro rata* share of the forty percent reduction targets.[468] Continuation of that philosophy would suggest that program funding continue to be divided among the jurisdictions, and that each jurisdiction should hold separate auctions. Moreover, in part due to inadequate progress in meeting the numeric targets first identified in the 1987 Bay Agreement, more recently the participants committed to the development of individual tributary plans according to a TMDL-type process of identifying the load reductions needed in each tributary, the sources of pollution in each, and implementing mechanisms to reduce that pollution by the requisite amount.[469] Within each tributary, some of the pollution controls will continue to be attained through regulatory means, as opposed to the incentive-based distribution of public funds. This all suggests that auctions for available funding be conducted tributary by tributary, with the amount of funding allocated to each tributary based on a combination of load reduction targets and the percentage of those reductions assigned to non-regulatory controls.

The correct decision on this set of issues should be driven more by science than by politics. If pollution discharges to the Bay as a whole should be treated as comparatively fungible in terms of Bay health—that is, if discharges at the mouth of one tributary have roughly the same effect on Bay health as discharges at other tributary junctions—it would seem wiser to develop and implement a Baywide bidding process.[470] Otherwise, the program as a whole might select less cost-effective projects simply because they are in one tributary over another. On the other hand, if pollution discharges at the mouths of different tributaries cause localized or otherwise different environmental effects within different parts of the Bay, it might be more appropriate to conduct separate processes to ensure that some parts of the Bay are not cleaned up at the expense of others.

3. Program Funding: Magnitude and Sources

As discussed above, absolute accuracy in predicting load reductions is not necessary so long as the resulting allocation of public resources is

---

[468] *See* BAYWIDE NUTRIENT REDUCTION STRATEGY, *supra* note 376, at 1-4 to 1-5 (noting differences in the ways in which the different jurisdictions calculated baseline loads and other factors).

[469] *See* Chesapeake 2000, *supra* note 357, at 6; Searchinger, *supra* note 5, at 184; McElfish et al., *supra* note 8, at 167–68.

[470] The location of sources *within* each tributary could still be included as one factor in calculating cost-effectiveness, meaning, for example, that sources 500 miles upstream of the Bay may still receive lower scores than discharges just above the tributary mouths.

better than what would be achieved through "first come, first served," or other methods that focus less on comparing cost-effectiveness among projects.[471] However, it is necessary to achieve a reasonable degree of accuracy in predicting *total* load reductions expected from the program per dollar spent (or, if auctions are held within individual tributary basins, total load reductions within each basin).[472] That, combined with existing or improved information about the total load reductions necessary to achieve the program's ultimate objective of water quality sufficient to restore and maintain the health of the living resources of the Bay, provides a basis for estimating how much money is needed to accomplish the program's goals in the most cost-effective way possible.

In the CRBSCP, the Salinity Control Forum has established a budget calculating the total cost of the salt reductions needed to meet the flow-adjusted water quality standards at the prescribed monitoring points in the Colorado River.[473] Based on that budget, along with information on existing salinity levels, projected future water withdrawals, and existing controls, program officials can plan the size of investment necessary to meet the standards over time. Initially, that process was made somewhat easier by the fact that the program had maintained a history of cost-effectiveness data collected under the previous public works programs,[474] although actual cost-effectiveness during the competitive bidding program has exceeded even the initial expectations of program officials.[475]

For the CBP, an iterative process would likely be necessary to establish auction program budgets that are sufficiently accurate for program planning purposes, building on the existing Chesapeake Bay Watershed Model, Baywide TMDL estimates, and tributary plans and reduction targets. The program currently does not report expenditures in terms of cost-effectiveness (e.g., cost per pound of nitrogen removed by existing publicly-supported or subsidized projects).[476] However, there is a long

---

[471] *See supra* notes 399–422 and accompanying text.
[472] *See supra* notes 460–63 and accompanying text.
[473] *See* COLORADO RIVER BASIN SALINITY CONTROL FORUM, 2005 REVIEW: WATER QUALITY STANDARDS FOR SALINITY COLORADO RIVER SYSTEM 4-2 (2005), *available at* http://www.coloradoriversalinity.org/docs/2005 Review October.pdf; *see also* Colorado River Basin Salinity Control Brochure 4, *available at* http://www.nrcs.usda.gov/PROGRAMS/salinity/CRBSCP Brochure.pdf.
[474] *See, e.g.*, U.S. DEPT. OF THE INTERIOR, PROGRESS REPORT NO. 21, QUALITY OF WATER COLORADO RIVER BASIN 23–30 (Jan. 2003).
[475] Barnett, *supra* note 456; COLORADO RIVER BASIN SALINITY CONTROL FORUM, *supra* note 473, at 3–7.
[476] *See supra* note 183 and accompanying text.

history of public spending on pollution control in the region,[477] and a tremendous amount of scientific research identifying the degree of pollution control actually achieved by various control methods.[478] Of course, it is more difficult to derive precise measures of effectiveness for some control methods than for others, and in some cases monitoring results have led to surprising conclusions about the effectiveness—or lack thereof—of certain methods. However, sufficient information should be available to develop at least preliminary estimates of the average cost-effectiveness of pollution controls possible for the three categories of pollution,[479] in different parts of the basin, and for different pollution sources. That information can be used, as it has been in the CRBSCP, to estimate how much overall funding will be necessary, and over what period of time, to achieve the overall pollution controls necessary to achieve the load reduction targets needed from non-regulated sources.[480]

The source of funds devoted to an auction process will be the next challenge, but largely a political one given that Congress and the individual Chesapeake Bay jurisdictions are obviously free to alter current allocations and rules for public spending.[481] Because the goal of an auction process is to maximize the cost-effectiveness with which all public funds devoted to the effort are used,[482] the optimal solution would be to pool all existing sources of public funding used to subsidize nutrient and sediment control within the basin into one source of funds, and to allocate those funds to a coordinated auction process.[483] That would mean, for example, that Congress would agree to dedicate all (or at least part) of current Farm Bill water quality funding within the Chesapeake Bay watershed to this program instead of existing allocation methods, and that the individual states likewise would redirect current funding to support Chesapeake Bay pollution control efforts to this effort. This reallocation of funding will likely be opposed by interest groups that currently receive the funding,[484] but that is precisely the point. Public dollars will be spent more

[477] *See* 2005 GAO REPORT, *supra* note 372, at 22–25.
[478] *See, e.g.*, Michael Owens & Jeffrey C. Cornwell, *Sedimentary Evidence for Decreased Heavy-Metal Inputs to the Chesapeake Bay*, AMBIO, Feb. 1995, at 24, 24.
[479] LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 109.
[480] That would include reductions from regulated sources beyond that required by regulation.
[481] LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 109.
[482] *See supra* notes 128–33 and accompanying text.
[483] That unification of funding sources would not preclude allocation of those collected dollars among the three pollutants, or among different tributaries within the basis according to their pollution reduction needs.
[484] *See, e.g.*, Craig Cox, *Congress Poised to Act to Cut Conservation Funds That Aided*

cost-effectively if all proposed projects are required to compete for projects on the basis of cost-effectiveness, and on a level playing field rather than one tilted by political clout or existing program bias. Based on past history, the *total* amount of funding available to support additional pollution control efforts in the watershed is huge.[485]

A further consideration is whether the source of funding itself can be used to achieve greater program effectiveness, thus generating greater equity under the polluter pays principle of environmental law,[486] as well as incentives for pollution control in the funding mechanism as well as the use of those funds. For example, Chesapeake Bay states currently fund advanced wastewater treatment at public sewage treatment plants through a flush tax on users of those systems.[487] That requires those responsible for that part of the pollution problem, i.e., everyone who uses the public sewer system, to bear an increased share of the necessary control costs.[488] Unless the amount of the tax is tied in some way to the amount of pollution caused by each user, however,[489] the flush tax does not generate any additional incentive for pollution reduction.

One way in which program funds can be generated in ways that both satisfy the polluter pays concept and that provide additional pollution reduction incentives would be a dedicated tax on agricultural and household fertilizers and any other agricultural, commercial, or industrial products that cause nitrogen and phosphorus to reach the Bay. The funding mechanism itself thus would create incentives to use those products more conservatively, and the funds received could be allocated for additional cost-effective pollution controls through the auction process.

Farm Bill's Passage, ENVTL. WORKING GROUP, Sept. 2008, http://www.ewg.org/reports/conservationcuts.

[485] *See* 2005 GAO REPORT, *supra* note 372, at 5–6 (noting that approximately $3.7 billion in direct funding was allocated for Chesapeake Bay restoration efforts between 1995 and 2004).

[486] *See supra* note 28 and accompanying text.

[487] *See* Jessica Glasser, *Flush Tax Seen As Development Spur*, WUSA9.COM, 2006, http://www.wusa9.com/news/news_article.aspx?storyid=52015 (discussing how the tax works in Maryland).

[488] *See supra* note 393 and accompanying text.

[489] For example, a simple per household surcharge generates additional funds for the program, without distinguishing between heavy and light polluters. *See supra* note 393 and accompanying text. A per capita surcharge would do more to simulate how much sewage is generated by each household, as might a surcharge based on the amount of water used, although that would distinguish between indoor water flushed into public sewers and outdoor water use. Outdoor irrigation and other water uses, however, contribute to Bay pollution in other ways. Chesapeake Bay Program, *Toxics Pollution*, http://archive.chesapeakebay.net/toxics1.htm (last visited Mar. 8, 2010).

The use of appropriate product taxes has the added benefit of providing an ongoing, dedicated funding source for the auction program, as is true for CRBSCP funding derived from a percentage of revenues from the hydroelectric power generated by dams in the Colorado River basin. Additional funding can certainly continue from federal and state legislative and other sources. A dedicated funding stream, however, both ensures that those who are responsible for a problem bear at least a major share of the control costs, and that program funding is not completely dependent on political factors and the condition of the federal and state budgets in any given year. Once the program calculates the necessary load reduction budgets and a long-term schedule to fund projects designed to meet those targets, it is highly desirable to have a dedicated source of funding to ensure program consistency.[490] That consistency also provides potential bidders the appropriate incentive to invest in project proposals with the certainty that bidding opportunities will continue over time.

CONCLUSION

For several decades, the federal government and the Chesapeake Bay jurisdictions have spent a tremendous amount of money and other resources on Chesapeake Bay cleanup and will continue to do so for the foreseeable future.[491] Although progress has been made, that improvement has lagged behind what is needed to meet the Bay's numeric (forty percent reduction) goals.[492] That failure translates to an inability to meet the ultimate program objective of restoring and maintaining water quality sufficient to protect healthy living resources in the Bay's ecosystem.[493] Similar problems have plagued other large watershed restoration and protection programs, in the Everglades, the Great Lakes, and elsewhere.[494]

All of those programs have received large amounts of public funds from Congress and other sources, and have typically allocated those funds to subsidize pollution control efforts by private parties in ways that do not necessarily generate the most cost-effective results.[495] Auction theory suggests that the cost-effectiveness with which those public dollars are spent can be improved significantly through a competitive bidding process,[496]

---

[490] LESSONS FROM LARGE WATERSHED PROGRAMS, *supra* note 118, at 109.
[491] *See supra* Part III.
[492] *See supra* Part III.
[493] *See supra* Part III.
[494] *See supra* note 118 and accompanying text.
[495] *See supra* Parts II–III.
[496] *See supra* Part I.

much as military and other public procurement efforts have increased the value of public spending. In essence, the use of public funds for pollution control should be viewed largely as a process by which the government is purchasing pollution control services, and not as a public benefits program in which we distribute public funds without regard to the value received.[497]

None of this suggests that public subsidies are the exclusive or the best way to reduce pollution in the Chesapeake Bay or in other areas, as opposed to regulatory or other approaches. More enforceable mechanisms for nonpoint source pollution control, as proposed in the Cardin bill,[498] for example, would fill critical gaps in existing water pollution control efforts. However, so long as public dollars continue to be used to fulfill those same goals,[499] the public should get the most benefit from its money.

---

[497] See *supra* notes 61–63 and accompanying text.

[498] S. 1816, 111th Cong. (2009); *see also supra* notes 414–48 and accompanying text.

[499] Regulatory and funding approaches, of course, are not mutually exclusive, and the Cardin bill proposes to continue public funding as well as to adopt stricter regulatory or other enforceable mechanisms for Chesapeake Bay nonpoint source pollution control. S. 1816, 111th Cong. (2009); *see also supra* notes 414–48 and accompanying text.