Chesapeake Bay Watershed Non-Point Source Pollution Update:

A Pilot Program Which Should Drive the Nation

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The work product contained in this paper is entirely that of the student author.

I. Introduction

In the 1620's Captain John Smith first explored the Chesapeake Bay in its natural state, finding it so full of life that he described it as so bountiful that you could catch fish with a frying pan.[1] Today, hundreds of millions of pounds of nitrogen and tens of millions of pounds of phosphorous later, the bay no longer teems with the same abundance.[2] By 1984, underwater grasses in the Chesapeake Bay covered only ten percent of their potential habitat in the bay.[3] Scientists believed that these grasses once covered nearly every underwater surface where grasses could receive sunlight. However, algae, thriving on the dramatic increases in nitrogen and phosphorous, blooms in great volumes of the water, these algae blooms then die and decompose, and, in the process, leave behind hypoxic conditions in the surrounding waters.[4] When these conditions occur in shallow waters, hypoxic or anoxic conditions leave behind dead zones where fish, blue crabs and oysters cannot survive.[5] Further, although the low oxygen conditions would only directly impact animal life, underwater grasses are impacted dramatically

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1 Chesapeake Bay Foundation, *Manure's Impact on Rivers, Streams and the Chesapeake Bay* 1 (2004).

2 *Id.*

3 *Id.* at 12.

4 *Id.* at 10.

5 *Id*. (Hypoxia and Anoxia refer to the ambient levels of dissolved oxygen in a given area. Hypoxic conditions specifically occur where the oxygen level is insufficient to sustain life while anoxic conditions occur where the given oxygen level is virtually non-existent).

by the algae blooms as well because the events block sunlight necessary for photosynthesis.[6] Without the grasses, even less sunlight penetration can occur in the Bay; underwater grasses are vital to holding sediment in place at the bay floor.

In the Summer of 2003, the Chesapeake Bay experienced one of the worst dead zones in more than twenty years.[7] The zone covered approximately forty percent of the Bay's central region and affected many animal species in the region. Blue Crabs and Oysters, a vital part of the Chesapeake Bay's seafood economy are fairly resilient in low oxygen areas, surviving in regions with 3 and 1 mg/l of oxygen concentrations respectively.[8] Nevertheless the dead zone for crabs and oysters was broad in 2003, extending North, amidst the broad portions of the bay, from the mouth of the York River to the Pennsylvania border.[9]

Further, the problems caused by nitrogen and phosphorous pollution in the water system can also be a more local and personal issue. Algae blooms occur, not only in large bodies of water, like the Chesapeake Bay, but also in small waterways causing many of the habitat concerns found in the open bay.[10] Pollution of upstream waterways contribute to the problems felt in the main Chesapeake. According to the United States Geological Survey as much of half of the water in the Chesapeake Bay Watershed originates in upstream groundwater. Water surveys have also shown that this water often exceeds the 10 mg/l maximum concentration of

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6 *Id*. at 11.

7 Chesapeake Bay Foundation, *supra* at 11.

8 *Id*. (*See* diagram at 11 for additional details. Many vertebrate fish require substantially higher concentrations of oxygen for survival. For example, Striped Bass and White Perch cannot survive in oxygen concentrations below 5 mg/l).

9 *See id*. (The dead zone map provided by the Chesapeake Foundation indicates that areas marked in red, pink, orange and yellow fall at 2.5 mg/l or below which is deadly to Blue Crabs and many of these portions appear to fall below 1 mg/l which is fatal to Oyster populations as well).

10 *Id* at 12.

nitrate for drinking water.[11] To make matters worse, these same sources of groundwater often feed wells used for human and agricultural animal consumption which can lead to "blue baby" syndrome[12] in humans, and spontaneous abortions in cattle, as well as the potential for other unproven health effects.[13]

In the Chesapeake watershed there are a number of sources which can lead to phosphorous and nitrogen pollution including automobiles, industry and human sewage. However, the greatest contributor to this pollution is agricultural runoff.[14] According to the Environmental Protection Agency's (EPA) Chesapeake Bay Program assessments forty-two percent of nitrogen emissions and forty-nine percent of phosphorous emissions reaching the Chesapeake Bay originate from agricultural sources.[15] Emission control and deposit of manure, chemical fertilizers and other nutrient rich agricultural products is key to reducing the concentrations nutrient pollution in the Chesapeake Bay watershed and the health and economic dangers which accompany it.

This paper seeks to look at the challenges posed by nutrient position from a legal policy prospective. The next section will survey academic literature highlighting the present policy options available to state and federal governments, and highlight the unique challenges posed by the pursuit of each. Thereafter, this paper will examine as a case study a pilot program where

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11 *Id*.

12 Blue Baby Syndrome, or Infant Methemoglobinemia is a condition where infants develop a blue-gray skin color and become irritable or lethargic after ingesting high concentrations of nitrates, sometimes contracted when baby formula is reconstituted with tainted well-water. *See generally* Lynda Knobeloch et. al., *Blue-Babies and Nitrate-Contaminated Well Water*, Environmental Health Perspectives (2000). *Abstract and full text available at* http://www.ehponline.org/docs/2000/108p675-678knobeloch/abstract.html.

13 Chesapeake Bay Foundation, *supra* at 12.

14 *Id.* at 1.

15 *Id.* at 10.

auctions were employed to establish least-cost based incentives for pollution reduction for farmers in the Conestoga river watershed, which ultimately feeds into the Chesapeake Bay. The ultimate conclusions of this paper will be made upon the basis of whether the Conestoga pilot program serves as a legitimate, cost effective and workable policy and should therefore be duplicated as a policy option in general.

II. Policy Options

Nutrient pollution can be a complicated issue. Unlike many industrial water pollutants which may be emitted from point-sources like pipes into waterways, nutrient pollution commonly occurs as runoff from fields. This runoff can cross surface lands and enter bodies of water like streams and rivers, or it can be absorbed into the groundwater system. From a scientific perspective, this causes non-point source pollution to be difficult to monitor, difficult to mitigate and from a legal perspective, difficult to regulate. These challenges appear when pollution control is attempted through actions in tort for nuisance or trespass, through federal water pollution control legislation and through state and federal agricultural regulation.

A. Nuisance Actions in Tort

The first legal line of defense against pollution is derived from the defense of private property. Economist Ronald Coase theorized that where polluters have the right to pollute, affected parties will pay the polluter for his abatement, and where the public has the right to be free from pollution, the polluter will pay for the opportunity to pollute.[16] However, as Coase and others have recognized, where markets fail to establish efficient pollution levels, the legal system may be available to protect the public's, or the private landowners' rights to enjoyment of the

16 *See generally* Ronald H. Coase, *The Problem of Social Cost*, J.L. & Econ. 1-44 (1960).

land affected by polluters.[17] In an action for nuisance the public or private landowners can bring a case against a farmer for physical damages to a plaintiff's property.[18] It is therefore possible for a neighbor who's well water is affected by nitrates to bring a case for private nuisance against a nearby farmer for nitrogen runoff which has seeped into the groundwater feeding the plaintiff's well.

The obstacles, however, to a private action in nuisance, or even a public action, for nitrogen runoff are substantial, despite the potential health consequences that such a condition may pose. First of all, the physical invasion into nearby properties is only actionable if it is unreasonable. In nuisance law, this requires the gravity of harm to exceed the utility of the farmers' activities which lead to the pollution.[19] This is an assessment that courts are not always willing to make, due to the utility provided by farms to the public by providing an irreplaceable portion of the food supply, especially when calculating the gravity of harm can require a complicated factual inquiry.[20] Therefore it is unsurprising that nuisance actions are very difficult to litigate; victim parties are left with the difficult burden of proof to identify the farmer as the source of the pollution, prove the unreasonableness of the pollution, and prove the gravity of the harm. Even after meeting this burden, in some jurisdictions, the primary remedy is injunctive relief which leaves judges with the complicated decision between whether the equitable decision

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17 Tory H. Lewis, *Managing Manure: Using Good Neighbor Agreements to Regulate Pollution from Agricultural Production*, 61 Vand. L. Rev. 1555, 1561 (2008).

18 *Id*. at 1562.

19 *Id.* (*citing* Restatement (Second) of Torts § 826(a)(1979)).

20 *Id.* at 1562-3 (identifying five factors to determine gravity of harm: "1) extent of the harm, 2) character of the harm, 3) social value of the use invaded, 4) suitability of that use to the character of the locality, and 5) burden on the person harmed of avoiding the harm") *citing* Jesse J. Richardson, Jr. & Theodore A. Feitshans, *Nuisance Revisited After Buchanan and Bormann*, 5 Drake J. Agric. L. 121, 122 (2000)).

is to protect the food producer or the neighboring lands.[21]

Even in the clearest case for nuisance, adversely affected landowners face additional obstacles in seeking tortious relief for agricultural pollution. Every state has passed "right-to-farm" laws which protect farmers from nuisance actions.[22] These statutory protections prevent local governments from passing ordinances identifying agricultural activities as nuisance, establish strict statute of limitation requirements limiting the time periods for which nuisance actions can be brought against specific agricultural activities or codifications of "coming to the nuisance doctrines".[23]

Finally, even where nuisance actions might not be prevented by state laws, nuisance remains an inadequate cause of action to manage agricultural pollution. Aforementioned nuisance actions mainly focus on the neighboring landowners to farms and public actions brought on behalf of local communities. However, where agricultural pollution leads to harm in major waterways like the Chesapeake Bay, nuisance actions become nearly impossible. Chesapeake manure pollution alone is generated by one hundred and eighty five million agricultural animals in the Susquehanna Valley, DelMarVa Peninsula, and Shenandoah Valley as well as other agricultural areas in the Chesapeake watershed.[24] Any action in public or private

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21 *See id.* at 1562 (Discussing that the traditional remedy available for actions in nuisance are injunctions due to the 'irreplaceable' qualities in land. However, the author does identify the conditions under which some courts are utilizing other remedies).

22 Lewis, *supra* at 1573.

23 *Id.* (Coming to the nuisance doctrines were common law defenses to nuisance actions where a landowner knowingly moves into a neighborhood where agricultural activity was already occurring, thereby forcing neighbors who move into agricultural areas to give up their right to raise nuisance objections to agricultural activities).

24 Chesapeake Bay Foundation, *supra* at 3&7 (2004) (Lancaster County, PA (Susquehanna Valley), DelMarVa peninsula and Rockinham County, VA (Shenandoah Valley) producing 54% of all nitrogen runoff in the Chesapeake Bay Watershed).

nuisance for the damages sustained in the Chesapeake would require staggering numbers of plaintiffs from whom amounts of blame would be assigned for extremely diverse quantities of runoff. Amidst these challenges, it is clear that tort law actions in nuisance provide insufficient legal remedies to resolve the problem of non-point source agricultural pollution, specifically nutrient pollutants.

B. Clean Water Act

Like many Federal environmental legislative enactments, the Federal Water Pollution Control Amendments of 1972, better known as the Clean Water Act (CWA) was passed during the Nixon administration as the nation's first serious attempt to utilize federal resources to reduce water pollution. The act's original goal was to eliminate discharges of pollutants into the nation's navigable waters by 1985 and to ensure that programs would be developed to reduce water pollution from point and non-point sources.[25]

The CWA establishes a multi-faceted response to the problems of water pollution. The first facet addresses specific polluters and emissions which are traceable to a particular point source under the National Point Source Distribution Elimination System (NPDES) permits.[26] These permits allow only those polluters who receive permission from the state environmental protection departments or the EPA to emit any pollutant into the nations water system.[27] Point source emissions are then managed by the EPA by the imposition of particular technology forcing requirements by mandating the use of best economically achievable technology standards

25 Federal Water Pollution Control Amendments of 1972, 33 U.S.C. § 1251(a)(1)&(7) (2006).

26 § 1342.

27 § 1342.

for each particular industry involved in polluting into the nation's water supply.[28] These point source regulations, allow the EPA to be directly involved in polluters who are directly feeding pollutants into bodies of water, however this program is not particularly useful in managing agricultural pollution occurring as a result of runoff. Under the definition of point-source in the Clean Water Act, after identifying a number of examples of point sources, the statute identifies specifically that: "This term does not include agricultural storm water discharges and return flows from irrigated agriculture".[29]

However, the alternative regulatory scheme included in the CWA does, at least, indirectly seek to reduce non-point source pollution, including agricultural runoff. The act requires states to work with the EPA to establish ambient water quality standards for regulated bodies of water[30] which exist in that state.[31] When a state's assessment concludes that certain bodies of water cannot achieve necessary quality benchmarks through point source technological requirements alone, the state must identify sources of non-point source pollution which contribute to the non-attainment of these quality standards.[32] The EPA then requires states to pursue best management practices to control emissions which are intended to bring these bodies of water into compliance

28 *See* §§ 1316 & 1317 (CWA guidelines for standards of performance, requirements vary according to industry of source, new versus existing sources, and severity of emissions. Various standards (Best Available Technology/Best Practicable Technology) force technological adoption according to varying degrees of economic feasibility, however, this does not constitute a direct cost-benefit approach).

29 § 1362(14) (However, the statutory definition of a point source does include any "discernible, confined and discrete conveyance, including. . . concentrated animal feeding operation[s]").

30 *See* § 1362 (Waters regulated under the Clean Water Act are limited by federalism to "navigable waters" which Congress intended to be interpreted "as broadly as possible" (U.S. v. Zanger, 767 F. Supp. 1030 (N.D. Cal. 1991)) to include "relatively permanent, standing or flowing bodies of water" (Rapanos v. U.S., 547 U.S. 715 (2006)(Justice Scalia, concurring)).

31 § 1313(c).

32 James M. McElfish, Jr. et. al., *Inventing Nonpoint Controls: Methods, Metrics and Results*, 17 Vill. Envtl. L.J. 87, 90 (2006).

with ambient water quality standards.[33] Eventually, the EPA may place even more restrictions on non-complying waterways by using the Total Maximum Daily Load (TMDL) program. TMDLs allow the EPA to establish maximum emissions from point sources and non-point sources alike.

In the Chesapeake Bay watershed, the EPA has attempted to curtail non-point source emissions by utilizing the TMDL program. In 2006, for example, the EPA placed three river watersheds in Delaware under TMDL restrictions for excess nutrient emissions and low concentrations of dissolved oxygen.[34] According to the EPA, the waters in question were identified by the Delaware Department of Natural Resources and Environmental Control (DNREC) in 1996, and subsequent actions in Delaware have been insufficient to reduce the concentrations of pollutants in the subsequent decade.[35] In this particular case, no point source emissions are adding to the pollution of these watersheds, and all nutrient pollution is occurring via run-off and other non-point source sources.[36] The TMDL process is a useful mechanism for local watersheds to receive the attention of Federal research resources. In this Delaware watershed TMDL, the United States Geological Survey (USGS) provided twenty-eight water quality monitoring stations to evaluate the nutrient concentrations across the watersheds.[37] This information, combined with the Enhanced Stream Water Quality Model (QUAL2E) allowed the EPA to conclude that certain portions of the watershed were in compliance for certain nutrients while other locations required reductions of up to forty percent in order to attain the necessary

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33 Lewis, s*upra* at 1567 (citing Federal Water Pollution Control Amendments of 1972, 33 U.S.C. § 1329(b) (2006).

34 Env. Prot. Agency, *Decision Rationale for the Total Maximum Daily Load for the Chesapeake Bay Drainage Watersheds Kent, Newcastle, and Sussex Counties, Delaware* 1-2 (2006).

35 *Id.* at 2.

36 *Id.* at 5.

37 *Id.* at 4.

water quality standards.[38] Ultimately, however, the EPA has exercised little power to address the problems posed by non-point source pollution. Under the Clean Water Act, the EPA has the authority to co-fund state implemented non-point source reductions.[39] Beyond that, even under the command to reduce emissions by the TMDL program, the EPA rarely takes enforcement actions against non-point source polluters.[40] Consequently, the efforts of the Clean Water Act create a "'de facto exemption for non-point return flows from irrigated agriculture and voiding the CWA's regulation of agroenvironmental threats'".[41]

Nevertheless, the failure of the CWA to address non-point source pollution from agricultural sources, does not invalidate every effort of the Clean Water Act to regulate agricultural nutrient pollution. As previously noted, concentrated animal feeding operations (CAFOs) are regulated as point sources under the Clean Water Act.[42] CAFOs are regulated by the Clean Water Act by requiring the EPA to regulate the emission of wastewater and the use of manure on lands which are part of CAFOs.[43] However, the NPDES permits do not prevent CAFOs from using manure as fertilizer, because the impact of manure on watersheds is fairly small so long as the use occurs at "agronomic" rates.[44] Specifically, the Clean Water Act

38 *Id*. at 3-4 (Models like the QUAL2E allow simulation of emissions to predict levels of dissolved oxygen according to varying stream depths and seasonal variations based upon nutrient loads and consequential eutrophication through algae growth and death).

39 33 U.S.C. § 1329(h).

40 Lewis, *Supra* at 1567.

41 Tory H. Lewis, *Managing Manure: Using Good Neighbor Agreements to Regulate Pollution from Agricultural Production*, 61 Vand. L. Rev. 1555, 1567 (2008)(citing David E. Adelman & John H. Barton, *Environmental Regulation for Agriculture: Towards a Framework to Promote Sustainable Intensive Agriculture*, 21 Stan. Envtl. L.J. 3, 8 (2002)).

42 *See Supra* note 29.

43 40 C.F.R § 122.23 (2008).

44 Terence J. Centner, *Courts and the EPA Interpret NPDES General Permit Requirements for CAFOs*, 38 Envtl. L.

regulations "CAFO" rule articulates that NPDES permits issued to CAFOs must contain nutrient management plans such that facilities must employ best management practices which are suitable to ensure that the application of manure on the land "ensures agricultural utilization of the nutrients . . .".[45] The guidance documents released with the CAFO rule suggest that regulated animal feeding operations should plan the construction of such nutrient management plans to prevent the application of nutrients (particularly nitrogen and phosphorous) at a rate faster than the nutrients can be absorbed by the soil and the crops in question.[46] Further, CAFO regulations require that additional care be taken at regulated cites to ensure that manure and wastewater that is not being utilized as fertilizer is not entering the watershed.[47] These regulations include diverting clean water away from the "production area"[48], preventing animals from direct contact with regulated "Waters of the United States",[49] implementation of runoff buffers,[50] and compliance assurance by forcing the testing of wastewater, manure and soil.[51]

One challenge which has faced the regulation of nutrient pollution at CAFO facilities is

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1215, 1220 (2008)(citing U.S. Dep't of Agric. and U.S. Envtl. Prot. Agency, *Unified National Strategy for Animal Feeding Operations* 14 (1999)(Concluding that NPDES permits should be issued so that CAFOs are not prevented from manure use, but recognizing that such use has potential health consequences if utilized improperly)).

45 40 C.F.R. 122.42(e) (2008).

46 U.S. Dep't of Agric. and U.S. Envtl. Prot. Agency, *Unified National Strategy for Animal Feeding Operations* 19 (1999).

47 40 C.F.R. 122.42(e).

48 40 C.F.R. 122.42(e)(1)(iii).

49 40 C.F.R. 122.42(e)(1)(iv) (*See Supra* note 30 for the breadth of waters regulated by the Clean Water Act).

50 40 C.F.R. 122.42(e)(1)(vi).

51 40 C.F.R. 122.42(e)(1)(vii).

that the EPA has been traditionally content to allow for self-regulation.[52] However, after recent circuit court decisions, the EPA has been forced to adopt a more proactive rule for the regulation of CAFOs under the CWA. These decisions required the EPA to move away from a general scheme of issuing non-site specific emission permits to CAFOs and instead requiring CAFOs to develop nutrient management plans which are tailored to the particular facility and complying to the regulations set out above.[53] The EPA must now take a direct role in insuring the success of the CAFO regulation to meet the statutory burden to reduce pollution to the "maximum extent practicable".[54] Consequently, regulated animal feeding facilities are actually impacted by the Clean Water Act where other agricultural polluters continue to enjoy a regulatory gap. Simply, pollution reductions from non-CAFO settings require action beyond the Clean Water Act.

C. Safe Drinking Water Act

An additional statute implemented by the EPA to reduce water pollution is the Safe Drinking Water Act (SDWA). In general, the purpose of the SDWA seeks to limit the maximum levels of contaminants found in drinking water, regulating specifically the "public water system".[55] However, like point sources under the Clean Water Act, the SDWA allows state administrators to exempt water systems which primarily exist to provide water for agricultural

52 Centner, *supra* at 1233-1234.

53 *Waterkeeper Alliance, Inc v. U.S. Env. Prot. Agency*, 399 F.3d 486, 498 (2nd Cir. 2005)(Holding that the EPA's self-regulatory regime is an arbitrary and capricious exercise of the EPA's duty under the Clean Water Act); *Environmental Defense Center, Inc. v. U.S. Env. Prot. Agency*, 344 F.3d 832, 855-56 (9th Cir. 2003)(Holding that allowing a regulated entity to decide what reductions, if any would constitute the "maximum extent practicable" is arbitrary and capricious).

54 Centner, *supra* at 1234 (citing Federal Water Pollution Control Act, 33 U.S.C. §1342(p)(3)(B)(iii) (2000)) (asserting that the only way to ensure the maximum effectiveness of a nutrient management plan is to examine the particular circumstances of the site and to employ computer modeling to discover optimal nutrient absorption).

55 Safe Drinking Water Act, 42 U.S.C. § 300f(4)(A) (2006)(defining the public water system as the water for human consumption through pipes and conveyances serving more than twenty-five individuals).

purposes, provided that those waters are treated, at minimum by the end user before being used for incidental human consumption.[56] Nevertheless, waters distributed in public water systems that do not meet agricultural exemptions would regulate groundwater which may be polluted by agricultural runoff. The SDWA regulates pollution by establishing feasible technologies for regulated pollutants to attempt to attain the EPA's regulated maximum levels of contamination.[57] Currently, nitrate/nitrite (nitrogen) are the only nutrient pollutants regulated under the SDWA.[58] Although the EPA maintains the ability under the SDWA to regulate phosphorous as well[59], this act is not a suitable control mechanism for managing runoff pollution from agricultural sources. The SDWA is not a pollution control statute because its regulation focuses on removing pollutants from drinking water before arriving in consumer's glasses. Although reducing agricultural nutrient runoff would certainly remove regulatory burdens from the EPA's administration of the SDWA, the act itself does nothing to prevent the emissions from actually occurring.

D. State Government Policies

Regulation of agricultural pollution has an inexorable local interest. Very often farms are small family businesses, connected to communities for generations. Federal law, despite its significant power, lays out broad commands which do not necessarily cater well to the needs of

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56 § 300f(4)(B)(ii).

57 § 300g-1(4)(E).

58 *See* Maximum Containment Levels for Inorganic Contaminants, 40 C.F.R. § 141.62(7)&(8) (2008)(Nitrate and Nitrite are required to attain water contaminant levels below 10 and 1 mg/l respectively. SWDA regulations employ three Best Available Technologies for Nitrogen removal: Ion Exchange, Reverse Osmosis and Electrodialysis).

59 Safe Drinking Water Act, 42 U.S.C. § 300g-1(1)(A)&(B) (2006)(Not only is the EPA empowered to regulate Phosphorus, under the act, the administrator's decision to regulate a pollutant is subject to judicial review if the EPA has identified it as harmful).

these particular communities. Instead, smaller state and local governments may be able to carry out environmental in a more carefully tailored manor that serves the public interest and the specific needs of the community. In many cases, state environmental laws are enabling legislation that allows administrative agencies to participate in federal environmental statutes. In other cases, states carry out their own environmental statutes or administrative rules to tackle specific environmental challenges. A number of these programs, discussed in the following sections allow states to work towards nutrient emission reductions in the Chesapeake Bay Watershed.

i. Pennsylvania

In December, 2006 the Pennsylvania Department of Environmental Protection (DEP) published a nutrient trading policy that would allow water polluters in the Chesapeake Bay Watershed to use market availability to reduce water pollution.[60] This policy accepts the DEP's authority under the Pennsylvania Clean Streams Law and the Clean Water Act, among other authorities, to efficiently reduce water pollution among point and non-point sources in Pennsylvania.[61] The primary pollutants under this policy are phosphorous and nitrogen nutrient pollutants as well as sediment.[62] The trading program adopted by the department allows buyers and sellers to negotiate a price for specific reductions in the rate of pollution at facilities such that entities required to reduce emissions – via NPDES permits, for example – compensate facilities whose reductions would be voluntary so that reductions are achieved, regardless of

60 Dept. of Env. Prot., *Final Trading of Nutrient and Sediment Reduction Credits – Policy and Guidelines* (2006) (*available at* http://www.dep.state.pa.us/river/Nutrient%20Trading%20Documents/Additions%2012-29-2006/Final%20Policy%2012-28.pdf).

61 *Id*. at 3.

62 *Id*. at 5.

whether they occur precisely at the regulated entity. In the opinion of the Department, these reductions can then be achieved at lower cost[63]. However, the policy places some substantial restrictions on trading to ensure the policy can actually achieve the desired effect. The first restriction is geographical; because nutrient pollution directly affects the watershed where it occurs, the Department restricts emission trades to facilities within the same watershed.[64] Secondly, even though this policy regulates both nitrogen and phosphorous pollution, particular trades must be between the same pollutant.[65] Finally, the trades proposed must go through an approval process with the DEP.

The DEP is concerned with establishing the accurate comparability in reductions at one facility taking the place of reductions at a separate facility. The proposal review process is an expert-intensive review that decides whether the proposal meets the legal and technological requirements of the program.[66] Because of these requirements the department can evaluate the implementation of a best management practice to determine whether the reduction achieved will be pound for pound equivalent between two locations, and when a best management practice is expected to yield multiple years of reductions, the department can return to the trading arrangement to assess whether the prior year's arrangement continues to be appropriate.[67]

This particular policy places a significant administrative burden upon the DEP by requiring the Department to work so closely with each individual facility. Nevertheless, the

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63 *Id*.

64 *Id*. at 5 - 6.

65 *Id*. at 5.

66 *Id.* at 10.

67 *Id.* at 7-8 (Describing the Department's calculation of credits, credit multi-year use and potential credit reduction due to “delivery ratio”).

policy may remain a reasonable option for reducing nutrient pollution within the Chesapeake Watershed. So far implementation of this policy has been inconclusive; the Department describes a number of projects which have begun, particularly in South Central Pennsylvania, which implement nearly forty thousand pounds of nitrogen pollution reductions and nearly two thousand pounds of phosphorous pollution reductions.[68] Although these reductions are important gains against nutrient pollution, DEP has identified more than 5.7 million pounds of nitrogen pollution alone which is eligible for trading in this market.[69] Consequently, the ultimate success of this program remains unknown.

ii. Virginia

The Virginia Legislature has also taken steps to reduce non-point source pollutant emissions into state controlled bodies of water. In 1997, Virginia enacted the Water Quality Improvement Act for the ". . . restoration, protection and improvement of the quality of state waters . . .".[70] In order to achieve these goals, the Act, *inter alia*, establishes a cooperative non-point source pollution program that targets Virginia's fourteen river basins to reduce emissions.[71] The main strategy of this law is to acquire private and federal funds to make grants for specific emission reduction programs.[72] In the case of Agricultural projects, the grants allow the fund to incentivize the adoption of Virginia Agricultural Best Management Practices by sharing costs of

68 Dept. of Env. Prot., *Proposal Registry and Tradable Load Tracking* (2009)(*Available at* http://www.dep.state.pa.us/river/Nutrient%20Trading_files/Proposal%20Registry%20and%20Tradable%20Load%20Tracking%203-16-09.xls, last accessed 4/14/2009, last updated 3/16/2009).

69 *Id*.

70 Water Quality Improvement Act, Va. Code § 10.1-2118 (1997).

71 § 10.1-2124.

72 § 10.1-2124(C).

initiation with individual farmers.[73]

In 2007, the Virginia Department of Conservation and Recreation (DCR) funded a number of programs in the Chesapeake watershed to reduce non-point source nutrient pollution including one project to build a model best management practices horse farm to develop and demonstrate multiple BMPs which should be utilized across Virginia. These practices included stream crossing, riparian buffers, watering systems, nutrient management systems and pasture renovation programs.[74] Another grant was made to establish a manure composting system at a large horse stable facility.[75] However, to fully consider the value of this policy, regulators should expect to fund projects to achieve the greatest gain at the lowest cost. For example, at the manure composting facility the DCR made a $25,000 grant which lead to a 410 pound reduction in nitrogen and 250 pound reduction in phosphorous pollution each year.[76] At this cost, the grant achieves reductions in nitrogen at a cost of $6.10/lb and phosphorous at $10/lb; this paper will return to a comparison of least-cost pollution attainment in a later section.[77]

The previously discussed state policies are merely examples of a number of actions taken by Chesapeake Bay states in recent years. The unique challenges posed by Chesapeake Bay nutrient pollution have spurred many diverse programs since the 1967 establishment of the

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73 Va. Dept. of Conservation & Recreation, *Water Quality Improvement Act.* http://www.dcr.virginia.gov/soil_&_water/wqia.shtml (last accessed April 15, 2009).

74 Va. Dept. of Conservation and Recreation, *Notice of Intent to Award Grants 2007 Virginia Water Quality Improvement Fund* 5 (2007)(*Available at* http://www.dcr.virginia.gov/soil_&_water/documents/wq07noiagbaydes.pdf).

75 *Id*.

76 *Id*.

77 Author's calculations: cost per pound over ten years could be calculated: $25,000/410lbs nitrogen = $60.97/10yrs = $6.10/lb nitrogen and $25,000/250 = $100/10yrs = $10/lb phosphorous.

Chesapeake Bay Foundation.[78] Other programs have included riparian buffer initiatives, agricultural education initiatives, watershed development restrictions and bans on phosphorous based detergents.[79] Each policy attempt may bring some gains in the struggle to reduce non-point source pollution, but no program is panacea. In recent years, many initiatives advocate for so called "green payments" to incentivize the reduction of emissions much like the Virginia program. The next section will return to federal law to analyze one such green payment program.

E. Green Payments and Farm Bill Incentives

When the collapse of the roaring twenties economy thrust the United States into a period of unparalleled economic troubles, the federal government began intervening in agriculture to secure the American food supply.[80] In the decades since, federal interest in agriculture has grown to large incentive programs to increase or decrease production, protect prices and set-aside programs for conservation programs.[81] However, the subsequent eighty years place the American economy in a drastically different global system. Today, trade and environmental concerns challenge the traditional role that farm payments do or should play in American agricultural policy. First, by participating in the World Trade Organization (WTO), the United States has agreed to reduce farm subsidies which distort trade and agricultural production.[82] Secondly, while federal environmental regulation has lead to cleaner industries in general, as this

78 Chesapeake Bay Program, *Bay History* http://www.chesapeakebay.net/history.htm (last accessed April 15, 2009).

79 *Id*.

80 William Even, *Green Payments: The Next Generation of U.S. Farm Programs?* 10 Drake J. Agric. L 173, 184 (2005).

81 *See id.* at 184 – 185.

82 *Id.* at 175.

paper has already examined and others have noted, agricultural pollution runs rampant, and environmental gains have been largely voluntary.[83] To overcome these challenges, it may be possible to use incentive programs to encourage the adoption of better pollution control systems, while simultaneously meeting the signatory burdens posed by WTO membership.

One such opportunity has been in place for twenty five years through the United States Department of Agriculture (USDA) conservation programs as established by recent iterations of the Farm Bill[84]. In 1985, Congress began the Conservation Reserve Program (CRP) to encourage landowners to take erosion vulnerable lands, contract with the USDA, and trade ten or fifteen years of land retirement from agriculture and ground cover vegetation for federal funds.[85] Over the next decade, the CRP program evolved to prioritize funds for projects ranked against the Environmental Benefits Index (EBI) to ensure that limited funds chased the highest potential.[86] This initial program focused on soil erosion reductions, however, the installation of riparian buffers would have potential advantages in reducing nutrient pollution as well.

A modified version of the Conservation Reserve Program, the Conservation Reserve Enhancement Program (CREP), was established by the 1996 Farm Bill, which allowed for greater state participation in the federal funding program, so that states could tailor conservation funds to meet additional environmental goals.[87] These state programs work with the Farm

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83 *See id.* at 180-181.

84 The "Farm Bill" is an omnibus federal funding and policy instrument passed by Congress. Recent iterations have been the 1985 "Food Security Act" (P.L. 99-198), "Food, Agriculture, Conservation, and Trade Act of 1990" (P.L. 101-624), "Federal Agriculture Improvement and Reform Act of 1996" (P.L. 104-127), "Farm Security and Rural Investment Act of 2002" (P.L. 107-171), and most recently "Food, Conservation, and Energy Act of 2008" (P.L. 110-234).

85 McElfish, *supra* at 91.

86 *Id*. at 92.

87 *Id.*

Security Agency to approve measurable goals in order to be eligible for federal funding under the CREP. Further, farmers can receive greater benefits under this program, because states can extend CREP payments for longer periods of time and the USDA will pay up to half the cost of implementation of the environmental best practice.[88]

Another green payment program introduced by the 1996 Farm Bill is the Environmental Quality Incentive Program (EQIP). This program provides financial assistance to farms to implement certain BMPs which carry specific conservation or environmental goals.[89] This program is distinguished from CRP and CREP because unlike the previous programs, the farmland is not taken out of production.[90] EQIP's funding specifically incentivizes the adoption of BMPs which reduce pollution and other positive environmental outcomes from land being utilized for agriculture. In the years following EQIP's introduction the USDA and Congress have expanded the program to attain higher eligibility and participation.[91] The environmental success of the EQIP program has been substantial; as of 2004, the USDA had entered into 117,625 contracts for funding projects which covered 51.5 million acres of land.[92] Further, the National Resource Conservation Service (NRCS), acting under the USDA distributes available funding by prioritizing certain projects including those that reduce non-point source nutrient pollution into

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88 *Id.*

89 *Id.* at 93.

90 *Id*.

91 *Id.* (In the 1996 Farm Bill, EQIP funds were primarily provided to agricultural activities taking place in Conservation Priority Areas (CPAs) which had significant soil, water or other resource concerns, the 2002 Farm Bill removed requirements that 65% of these projects had to be located in CPAs and further, it raised the maximum eligible funding that individuals could receive toward implementing BMPs up to 90% of the total cost of implementation for each project).

92 Nat'l Resource Conservation Service, *Environmental Quality Incentives Program Fact Sheet* 1 (2004).

impaired watersheds.[93]

As this section has shown, green payments – particularly as they have been administered by the USDA – can be widely employed to give agricultural operations the incentive to adopt more environmentally responsible practices and ultimately lead to a decrease in emissions. In fact, this paper's policy review in general has shown that where agricultural environmental commands are imposed on non-point source emitters, they are ultimately ineffective policy instruments while most active policies are payment schemes which compensate farms for the adoption of pollution reducing best management practices; regardless of whether that compensation originates from the EPA's funds supporting the TMDL program,[94] State government or private sources,[95] or even where point-source emitters meet their obligations by compensating farmers for non-point source reductions.[96] The final policy question is how can limited resources be utilized to carry the greatest effect. The following pilot project sought to incorporate market forces to lead to the adoption of pollution reduction at the lowest cost. To the extent that it was successful, such market incentives should be adopted widely to ensure efficient use of limited resources.

III. Conestoga River Pilot Program

At the beginning of this decade Pennsylvania faced increasing pressure to adopt aggressive measures to reduce nutrient emissions into the Chesapeake Watershed. The EPA was

93 *See id.* at 2-3 (The EQIP program defines national priorities including reduction of non-point source pollution, compliance with TMDLs, reductions of air pollution to meet National Ambient Air Quality Standards (NAAQSs), reductions in soil erosion, and habitat conservation. The NRCS works with state officials and interested parties to distribute EQIP as effectively as possible).

94 *Supra* 9, note 39.

95 *Supra* 15, note 72.

96 *Supra* 13-14, note 63.

increasingly interested in developing TMDLs for Pennsylvania waterways, the Pennsylvania legislature was examining market-based water pollution reduction policies, and Chesapeake bay watersheds were updating tributary strategies.[97] Within Pennsylvania's Chesapeake watershed, the Conestoga River watershed runs through the highly agricultural community of Lancaster County[98] which, as this paper has already discussed, is one of the three agricultural pollution hot spots within the Chesapeake Bay Watershed.[99] A private-public partnership came together to develop a pilot project to reduce non-point source nutrient emissions into the Conestoga River. This partnership acquired nearly $500,000 from the USDA's Conservation Innovation Grants (CIG) program intended to fund innovative conservation strategies.[100] Originally, the project was sponsored by governmental agencies including the DEP and EPA region III and private conservation organizations including the Chesapeake Bay Foundation, The Conservation Fund, Environmental Defense, Pennsylvania Environmental Council (PEC), and CH2M HILL.[101] As the project moved forward, the PEC moved into a dominant role and brought in additional partners including the Lancaster County Conservation District and the World Resources Institute (WRI) to assist in the administration the pilot.[102]

The basic strategy of this program was to set up an auction to efficiently distribute green

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97 Pa. Dept. of Env. Prot., *Nutrient Trading Pilot Project* 5 (2003).

98 Mindy Selman et al, *Paying for Environmental Performance: Potential Cost Savings Using a Reverse Auction in Program Sign-Up*, WRI Policy Note No. 5 (World Resources Institute, Washington, DC) (June 2008).

99 *Supra* 6, note 24.

100 Scott Van de Mark and Suzie Greenhalgh, Pennsylvania Economic Council and World Resources Institute, *Conestoga River Reverse Auction* 2 (2006)(The CIG program is another conservation funding program established by the 2002 Farm Bill).

101 Pa. Dept. of Env. Prot., *Nutrient Trading Pilot Project* 6 (2003).

102 Van de Mark, *supra.*

payments for the administration of BMPs which lead to reductions in nutrient pollutants. Unlike a traditional auction where potential buyers bid up the price of a good until the highest bidder wins, the Conestoga auction worked in reverse; potential recipients of funds bid on the lowest price they would accept for the administration of a project.[103] To administer the auction, the World Resources Institute provided an online auction tool, NutrientNet, which assisted eligible[104] farmers through the application and bidding process.[105] The NutrientNet tool helped calculate the phosphorous reductions that would be achieved by implementing a proposed BMP on the particular property in question, and then ranked the project proposals according to the greatest reductions in phosphorous at the lowest bidded cost.[106]

A. Phase I

The first phase of the Conestoga Pilot Project reverse auction took place during June of 2005.[107] This initial auction did not ask participants to name the price that they would be willing to accept, but rather the NutrientNet tool estimated the reductions in emissions that the proposed BMP would achieve and then proposed a payment according to the USDA's EQIP standard BMP costs.[108] This initial auction budgeted $90,000 to fund project proposals, and did not receive

103 Suzie Greenhalgh et al, *Paying for Environmental Performance: Using Reverse Auctions to Allocate Funding for Conservation*, WRI Policy Note No. 3, 1 (World Resources Institute, Washington, DC) (January 2007).

104 Van de Mark, *supra* at 10.

105 Greenhalgh, *supra* at 5 (NutrientNet tool was available at http://conestoga.nutrientnet.org but has closed after the conclusion of the project).

106 Selman, *supra* at 3 (Although the remaining literature will focus on Phosphorous reductions, simply because the pilot project targeted phosphorous reductions as the driving force of its auction market, many of the BMP implemented by the projects have nitrogen reducing effects as well *See generally* Pa. Dept. of Env. Prot. *Chesapeake Bay Program Best Management Practices* (2006) *available at* http://www.dep.state.pa.us/river/Nutrient%20Trading%20Documents/Additions %206_27_06/BMP_Descriptions.pdf).

107 Greenhalgh, *supra* at 5.

108 *Id*.

enough bids to exhaust the budget.[109] Nevertheless $39,000 in projects proposed by six farmers were funded by the initial auction at a price ranging from around ten dollars but extending to over a hundred dollars per pound.[110] However average reductions were funded at a price of $10.32 per pound.[111]

Despite the small size and limited participation in the initial auction, the PEC was happy with the initial results. In a September, 2005 press release, President Andrew McElwaine of the Pennsylvania Environmental Council touted the initial auction as a cost effective pollution reduction mechanism, "It may cost up to $90 per pound to remove nutrients from a wastewater treatment plant, but only $10 to $20 per pound to install a conservation practice on a farm. . . [s]ince a stream doesn't care where pollution reduction comes from, getting the most reduction for each dollar spent makes sense".[112] McElwaine continued on to note that even the initial project showed that more than four thousand pounds in reductions could be achieved at a cost under thirteen dollars a pound.[113]

B. Phase II

At the conclusion of the initial auction, organizers made some streamlining and administrative modifications to the project and then reopened the auction from October 2005 to February 2006.[114] The second auction phase was organized in a more price competitive fashion.

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109 Van de Mark*, supra* at 22.

110 *Id*.

111 *Id*.

112 Press Release, Pennsylvania Environmental Council, *Reverse Auction Results in Removing tons of Pollution from Conestoga River* (September 21, 2005).

113 *Id.*

114 Selman, *supra* at 3.

This time, project proposals were accompanied by proposed minimum prices which the farm would accept to implement the BMPs, instead of relying upon the EQIP pricing suggestions.[115] During the second auction, participation was much higher and the entire budget, in excess of $400,000, was exhausted. This time, bids offered for the implementation of BMPs ranged from $2.36 to $65.40 per pound of reductions of phosphorous, with an average accepted bid achieving a pound of reductions at a price of $5.06.[116] This "true auction" phase solicited twenty-three proposed bids, which allowed the pilot program to fund the most cost-effective thirteen, leading to an estimated 88,327 pounds in phosphorous reductions across the funded lives of the projects.[117]

The Best Management Practices employed by participating farms in the Conestoga pilot program were diverse. Eight of the funded projects focused on livestock management and the remaining focused on field management projects. Within livestock best management practices, successfully funded projects focused on the storage and use of animal wastes. The most utilized BMP was a stacking pad,[118] which allows farms to store and compost animal manures for temporary purposes in all weather conditions and is designed to divert surface waters from flowing through the stored manure (and leading to agricultural runoff).[119] The next most

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115 Greenhalgh, *supra* at 5 (Comment: no author, including that of this paper, makes a case that the change in pricing between phases leads to the greater participation in the second phase. Phase I may have had low participation due to its brevity, particular administration, or simply that the Lancaster County Conservation District accomplished greater outreach during the second phase).

116 Van de Mark, *supra* at 24-25.

117 *Id.* at 24 *and* Selman, *supra* at 3.

118 Selman, *supra* at 4.

119 *See* John Tyson et. al., *Agricultural Waste Stacking and Handling Pad,* Pennsylvania State University and United States Department of Agriculture *available at* http://www.age.psu.edu/extension/factsheets/g/G73.pdf (last accessed April 20, 2009).

commonly implemented BMP for livestock management was a Nutrient Management Plan, which is the development of a plan to utilize nutrients in an optimum manner to reduce nutrient loss without suffering a loss in yield.[120] Nutrient Management Plans achieve this by controlling the ". . . type, rate, timing and placement of nutrients for each crop".[121] The two most popular field management BMPs were grassed waterways and the use of terraces. Grassed waterways are an agricultural land use conservation strategy where ground cover vegetation is utilized in naturally occurring or synthetic trenches which carry water runoff to slow water flow, reduce sediment runoff, and reduce nutrient loss.[122] Terrace farming levels contoured pieces of farmland so that runoff is not exacerbated by downhill water flow, thus reducing the amount of nutrients and sediment carried away.[123]

C. Examining Cost-Effectiveness

The next question is, whether it is possible to examine the level of success achieved by the Conestoga pilot project. Because there will always be limited available funds for green payment programs, policy makers must pursue the most cost effective solutions available. From the outset, the DEP and others eagerly sought the use of market forces for pollution abatement, believing that market forces would lead to efficient pricing. Accordingly, the World Resources Institute, a partner in this project, engaged in a cost comparison study to be used as a metric for success within the pilot project.[124]

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120 Pa. Dept. of Env. Prot. *Chesapeake Bay Program Best Management Practices* 4 (2006).

121 *Id*.

122 *Id.* at 3 (2006) *and see* Ontario Ministry of Agriculture Food & Rural Affairs, *Grassed Waterways Factsheet* (1997) http://www.omafra.gov.on.ca/english/engineer/facts/94-039.htm (last accessed on Apr. 21, 2009).

123 United States Department of Agriculture, *Terracing* ftp://ftp-fc.sc.egov.usda.gov/WSI/UrbanBMPs/water/erosion/terracing.pdf (last accessed on Apr. 21, 2009).

124 *See generally* Selman, *supra.*

During the 2005 enrollment period, the USDA Environmental Quality Incentive Program (EQIP) accepted thirteen bids in the Conestoga River Watershed, granting a total of $275,000 in project funding to farmers in the area.[125] Because the EQIP program and the Conestoga reverse auction pilot was available to fund many of the same types of BMPs for the reduction of phosphorous and other nutrients, data comparison between the two programs will be particularly instructive to evaluate the success of the Conestoga pilot. The WRI compared the thirteen EQIP projects with the first seven projects funded by the pilot.[126] Among these projects, most phosphorous reductions were accomplished through livestock management BMPs, however the EQIP program funded nearly a third of its projects as field management BMPs while the pilot program devoted less than 1% of the first $293,000 of its budget to field management programs.[127] On average, the EQIP projects reduced phosphorous emissions at a cost of $26.19 per pound while the Conestoga reverse auction program reduced phosphorous emissions at an average cost of $3.62 per pound.[128] When comparing the entire projects with one another, the EQIP program spent $275,552 to reduce a total of 10,520 pounds of phosphorous while the Conestoga pilot spent less than twice as much money, $446,990, to achieve more than eight times as great of a reduction, 88,327 pounds of phosphorous.[129] The main reason for this is that

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125 Selman, *supra* at 3.

126 *Id.* (It is appropriate to compare the EQIP projects with the first seven Conestoga reverse auction projects because they involve approximately the same amount of funding and the effectiveness can be compared in the context of the same available funds, Table 1, p4 evaluates both projects according to their entire funding).

127 *Id.* at 5 (Table two, this is significant, because the order which the seven projects were selected indicates the most efficient projects were funded first, this evidence suggests – at least in abstract – that livestock management BMPs are more cost efficient than the field management BMPs. However, this paper does not set out demonstrative evidence for that purpose and that issue is one that should be examined in the future).

128 *Id.* at 6.

129 *Id.* at 4.

the EQIP program is designed to fund projects based on providing between 50% and 75% of funding to most farmers for most projects[130], rather than awarding funds according to the market offered prices through an auction.

This cost study is obviously inconclusive due to the limits of scale, however it does provide significant insights in abstract. First of all, it demonstrates that certain pollution control methodologies are attractive to farmers at levels below the maximum funding provided by the EQIP program. Further, it proves that an auction style distribution system is a plausible policy option. With additional study, continued similar performance would suitably persuade policymakers that market based green payment allocations efficiently effect pollution reductions, where EQIP and other cost-driven methodologies provide little incentive to farmers and others to adopt pollution control practices at least cost.

D. Conestoga Project Challenges

Despite the substantial cost savings achieved by the Conestoga reverse auction pilot project, it was not without specific challenges. Organizers of the auction believed that implementing the project was difficult because the program was competing for farmer attention against other green payment programs including EQIP, state funding, and Chesapeake bay funding.[131] However, to whatever extent that farmers were uninterested in another source for funding for conservation and emission control projects, this also ensured that the success achieved by the pilot project was authentic success within a market of options. Nevertheless, organizers also cited that this program required time commitments to provide technical assistance to participating farmers who must submit project proposals and bids through the

130 *Id.* at 2.

131 Van de Mark, *supra* 26.

NutrientNet system.[132] To implement this project in a larger scale these education and training concerns would need to be addressed to insure significant participation.

There are also technical concerns with the pilot project, particularly with the NutrientNet program. This pilot program relies on the continued accuracy of the NutrientNet calculations, the suitability of particular BMPs to carry out the phosphorous pollution reductions which are claimed, and the ability of the NutrientNet system to lead a user to input the correct information to lead to the correct calculations.[133] To institute any more significant reverse auction policy, these concerns would require administrative oversight and regulation so that the auction can lead to the contemplated results.

IV. Conclusions

The Conestoga reverse auction pilot program was a successful proof of concept implementation of an efficient distribution of green payments to incentivize the implementation of best management practices to reduce emissions of nutrient pollutants as non-point source pollution into bodies of water. The analysis of cost effectiveness included in this paper provides significant grounds for optimism for future study. Further, the success shown by this project is not unique, the USDA tried an easement acquirement auction in 2006 – 2007 to implement the department's Wetland Reserve Program.[134] This program also proved to provide a cost savings versus previous methodology, specifically leading to a 14% reduction in acquisition costs.[135]

Accordingly, this program should be widely adopted to address the problems of non-point

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132 *Id*.

133 *See id.* at 27.

134 Selman, *supra* at 8.

135 *Id.*

source pollution in the Chesapeake Bay Watershed. Cost effective payment programs will allow limited state, federal or even private funds to bring great changes to the significantly diminished water quality in the Bay and its surrounding water systems. Although some of the other policies examined by this paper have lead to real reductions in nutrient emissions, this program stands only with the Pennsylvania nutrient trading pollution reduction system by using a market to lead to efficient pricing of reductions. However, a reverse auction doesn't require coordination between emission sources on a particular body of water to offset pollution between a point source and non-point source polluter.[136] Further, such a policy would not be incompatible. If both a point source trading program and reverse auction program were located on the same waterway, the point sources could acquire non-point source pollution reductions by buying projects at the auction price, using the auction to connect buyers and sellers.

Ultimately, the Chesapeake Bay Watersheds, and countless other watersheds in the United States face dim futures absent sincere policy pursuits. In non-point source pollution situations, where actual damages are difficult to trace, command based policies for reduction will remain difficult. Environmental protection agencies would face insurmountable challenges by imposing command based reductions requiring incredible enforcement compliance investigation. Further, considering the difficulty in continuing to provide farmers with subsidies as the Congress has for decades due to international trade restrictions, farms could face additional financial pressures via such mandate based regulation. Accordingly, this nation should be willing to invest in its environment, expect the greatest economic efficiency, and achieve its food supply in an environmentally sustainable fashion while protecting its vital natural resources. Amidst growing support for market based carbon control policies, politicians are becoming increasingly aware

136 *Supra* 15.

that markets provide real and actionable opportunities to improve environmental challenges. Accordingly, American policymakers should adopt reverse auctions to control non-point source nutrient pollution in agriculture.