Appendix
Brandywine-Christina Water Fund

Background

The USEPA requires 57 local governments in both states to restore Brandywine Christina streams to fishable and swimmable standards through the Total Maximum Daily Load (TMDL) and NPDES Municipal Separate Storm Sewer (MS4) provisions of the Federal Clean Water Act. Watershed-based TMDLs are imposed through Section 303 of the CWA while political boundary-based NPDES MS4 permits are issued under Section 402 of the CWA. The 2006 Brandywine Christina high flow TMDL mandates reductions in bacteria by 29% to 93%, sediment by over 50%, and nitrogen and phosphorus reductions by up to 75% by implementing NPDES MS4 permits in Delaware and Pennsylvania (Table 1). They states are addressing TMDLs through the Christina Basin TMDL Implementation Plan (CTIP) led by the Brandywine Valley Association and Chester County WRA and the Christina Basin Pollution Control Strategy (PCS) led by the Delaware DNREC and University of Delaware.

A water fund offers the potential to provide economic incentives to comply with the TMDL and NPDES MS4 requirements of the Federal Clean Water Act. Watershed funding options have regulatory and political challenges as the Commonwealth of Pennsylvania has a local municipal-based form of government and the State of Delaware has a county-based government. The MS4 NPDES permits are municipal-based and TMDLs are watershed-based however the disconnect between these two Clean Water Act mandates may be overcome by the incentives provided by a water fund.

Table 1. High flow nonpoint source TMDL reductions in the Christina Basin

Watershed	**% Reduction**			
at PA-DE line:	**E. Bacteria**	**Sediment**	**Total N**	**Total P**
Brandywine Creek	93%	16 – 60%	46%	41%
Red Clay Creek	58%	45 – 52%	31%	40%
White Clay Creek	70%	26 – 70%	28%	73%
Christina River (at MD-DE line)	58%		73%	48%
in DE:				
Brandywine Creek	88 - 94%		16%	36%
Red Clay Creek	29 – 89%		49%	54%
White Clay Creek	66 – 89%			
Christina River	61 – 91%		6%	9%
CSO Discharges, Wilmington DE:				
Brandywine Creek	63%		64%	63%
Christina River	72%		72%	72%

An Interstate Watershed Partnership

Since 1994, an interstate partnership effort between the USEPA, Delaware River Basin Commission, Commonwealth of Pennsylvania, and State of Delaware has been working to restore the Brandywine, Red Clay, White Clay, and Christina Creeks to fishable, swimmable, and potable status (Figure 1). The Brandywine Christina subwatershed is the second largest watershed draining to the Delaware Estuary (after the Schuylkill) and is one of only two watersheds in the entire 13,000 square mile Delaware Basin that cross state boundaries, a complex interstate policy challenge. The Brandywine Christina supplies 100 million gallons per day of drinking water to over 600,000 people in both states and supplies over 60% of the drinking water to Delaware residents.

For close to 20 years, the partnership has been implementing projects such as reforestation, stream restoration, rain gardens, and agricultural conservation through a voluntary alliance of watershed organizations. The goal is to be one of the first watersheds in the Delaware Valley to be restored to Clean Water Act fishable and swimmable goals and serve as an example of what can be achieved when governments and two states cooperate with progressive policies to restore the environment. The partnership focuses on five key areas of action including: (1) Stormwater, (2) Open Space, (3) Wastewater, (4) Agriculture, and (5) Education.

Figure 1. Christina Basin Clean Water Partnership

Restoration of the Brandywine/Christina can meet environmental, economic, and social goals as the watershed in Delaware and Pennsylvania annually contributes: (1) $1.5 billion in economic activity from water quality, water supply, fish/wildlife, recreation, agriculture, forests, and public parks benefits, (2) $0.9 billion in ecosystem goods and services in $2010 with a net present value (NPV) of $29.5 billion over 100 years, and (3) directly and indirectly supports over 122,000 jobs with over $4 billion in annual wages. A benefit-cost analysis would indicate it is worth significant investment to protect and restore this invaluable resource.

The Economic Approach

Water is one of the few substances in nature without an economic substitute. Traditionally, economics has not accounted for negative externalities in the environment such as water pollution that can harm people living downstream and who do not receive compensation (Daily and Allison 2002). A water quality market administered by a river basin organization that involves market-based fees or charges would "internalize the externalities" and set up a pricing system that provides financial incentives for dischargers and water suppliers to invest upstream to reduce water pollution. Dorfman and Jacoby (1972) from Harvard singled out the river basin authority as the ideal organization that could implement an economically efficient "Pareto admissible pollution abatement plan" to balance water quality benefits with the costs for attaining it and benefit everyone without hurting the individual. Kneese and Bower (1984) from Resources for the Future offered the "economic approach" as the "science of choice" to make efficient decisions about water resources management. They cited the Delaware Basin as an example where if the river basin organization managed water use as an industry, then the tendency to pass off costs to downstream users would evaporate because negative externalities would become internal within the basin organization.

The scientific methods to restore watersheds are becoming increasingly successful, however they are hamstrung by diminishing appropriations at the Federal, state, and local level. Federal infrastructure funding in has dwindled even though 95% of the U.S. public rank clean water as the most important government service and 87% believe the government should invest in clean water. The Congressional Budget Office determined public investment in water infrastructure as a percentage of the GDP fell from 0.35% during the 1970s Clean Water Act years to 0.25% by 2006. Two popular Federal programs have been reduced recently, the Clean Water State Revolving Fund (CWSRF) and CWA Section 319 Nonpoint Source Pollution Grants (Figure 2). The EPA and Congressional Budget Office (CBO) estimated $630 billion should be raised over the next 20 years ($32 billion/yr) to keep up with water investment needs (Green For All 2011). In 2012, the Corps of Engineers Institute for Water Resources reiterated the call for a new national water policy initiative to maximize net benefits based on the old Harvard Water Program (Stakhiv 2012).

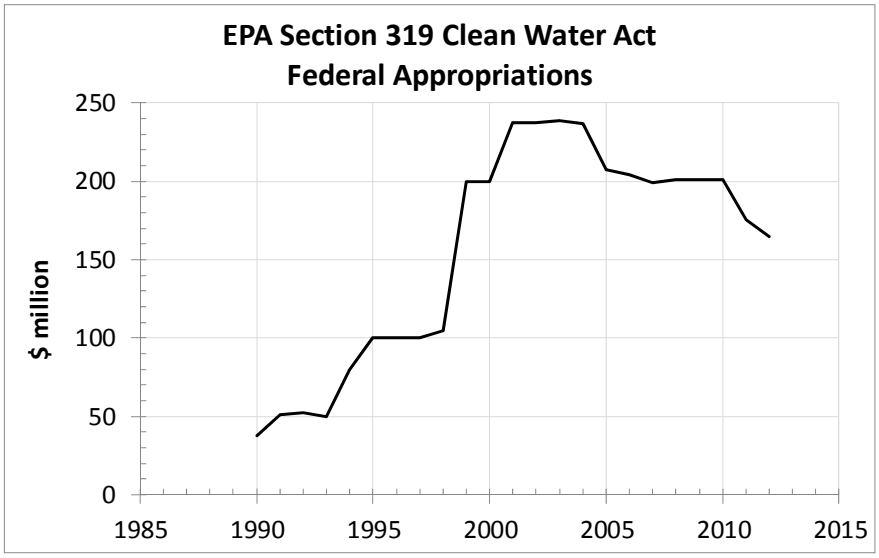

Figure 2. EPA Section 319 nonpoint source appropriations

These public water resources funding gaps have reignited interest in a movement to adopt new and progressive economic policies to fund water quality control programs. Every $1 billion invested yields 10,000 to 15,000 jobs in water supply and 5,000 to 20,000 jobs in stormwater management, and 12,000 to 22,000 jobs in urban conservation (Pacific Institute 2013). The Water Puts America to Work campaign asserts that every billion dollars invested in water and wastewater infrastructure funds 28,000 jobs and generates $3.5 billion in economic activity. At these ratios, a $1 million/yr investment to improve water quality in the Brandywine/Christina would boost GDP by $6.3 million and yield 280 direct water jobs.

With declining Federal, state, and local funding; watershed managers and policy makers have trained renewed interest on market-based funding models such as fees, charges, and water quality trading as more efficient alternatives to the traditional command and control regulatory approach that relies on subsidies and grants. New York City (Catskill Reservoirs), Boston (Quabbin Reservoir), San Francisco (Hetch Hetchy), and Seattle have tapped investment in watershed services to fund upstream watershed restoration efforts using water use surcharges. One of the most successful IWS case studies is New York City who negotiated with EPA in 1997 to invest $1.5 billion and restore forested watersheds in the Catskills instead of building a $10 billion microfiltration plant in the Bronx, a 6.5 to1 benefit cost ratio (B/C). In the Chesapeake Bay watershed, forest buffers reduce nitrogen at half the cost of wastewater treatment. Wetlands can treatment wastewater at a fraction of the cost of conventional wastewater treatment plants (Figure 3).

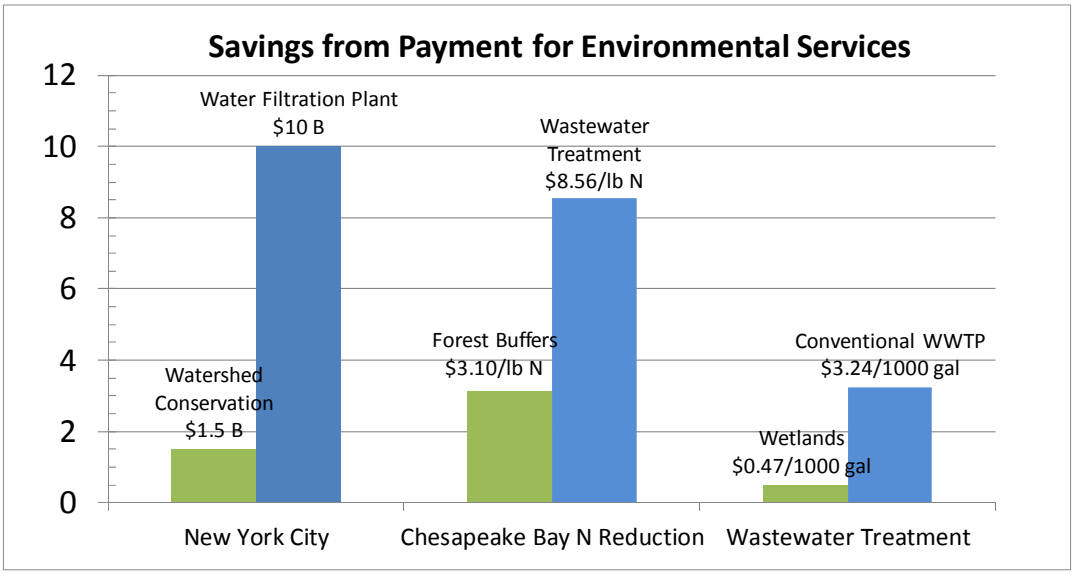

Figure 3. Investment in watershed services

As part of the William Penn Foundation clustered watershed initiative, the University of Delaware and The Nature Conservancy propose to research and develop new business models to restore the Brandywine/Christina Basin and if successful translate the findings to other watersheds in the Delaware Basin and across the U.S. Sustainable funding vehicles such as investments in watershed services (IWS), fees, charges, and pollutant trading have provided incentives to reduce water pollution control in several river basins in the U.S. and around the world. The following funding options would be considered for potential implementation in the Delaware Basin (Figure 4):

- Investment in Watershed Services (IWS)
- User Pays (Water Use Charge)
- Polluter Pays (Effluent or Emissions Fee)
- Watershed (Stormwater) Utility Fee
- Pollutant Trading

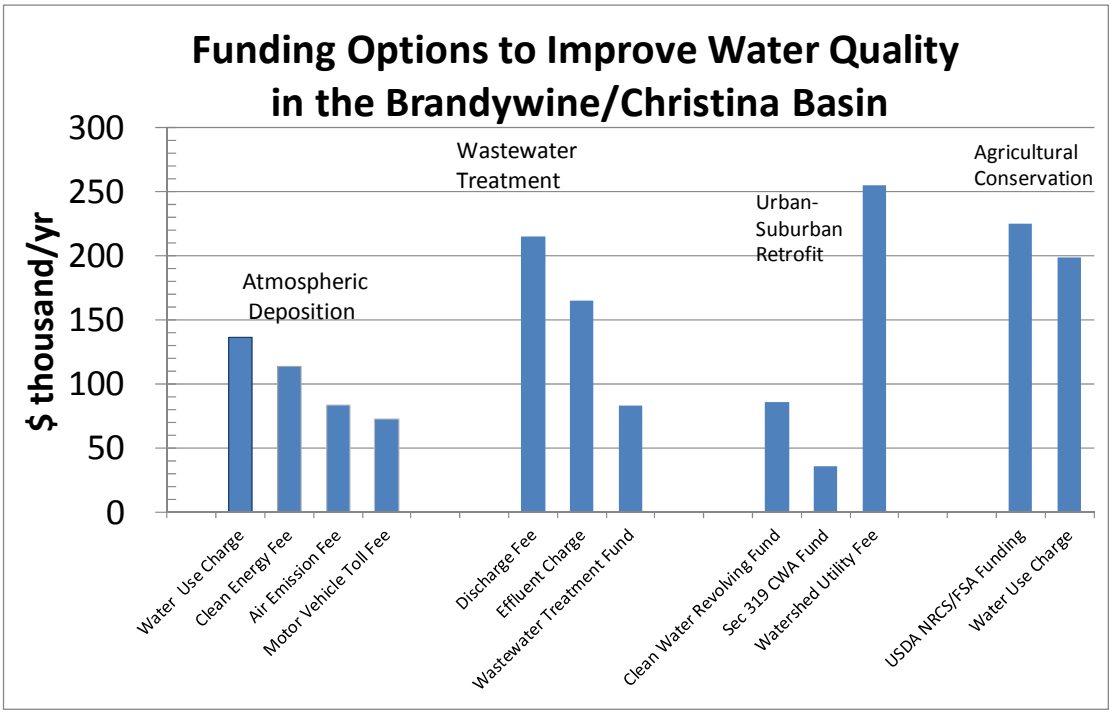

Figure 4. Typical market-based funding mechanisms in the Brandywine-Christina Subwatershed

We propose to conduct a benchmarking survey of watersheds nationwide and establish a sustainable watershed - based financing strategy to raise funds on an equitable basis and pay for watershed restoration projects. For close to 20 years, the Christina Basin Clean Water Partnership has funded restoration projects by stitching together Federal and State and local grants from year to year in a piece-meal fashion. This lack of sustainable watershed financing on a continuous basis has hampered progress in restoring the Brandywine Christina. The goal is to establish a dependable and annual funding stream that would allow for strategic budgeting of watershed restoration projects through 2025.

We plan to identify innovative funding strategies such as water rate surcharges ($/customer/year), stormwater utilities (impervious cover based), and watershed revenue districts and implement the most feasible and cost-effective funding stream in the Brandywine Christina Subwatershed. We expect that introducing a watershed based financing structure will be challenging as the Brandywine Christina Subwatershed includes governments in two States, two counties and 57 municipalities. Our literature review to date indicates that the long term success of watershed restoration depends on dependable, consistent, and annual financing. Based on our long term record of cooperation and achievement between the two states, we optimistically hope to meet this intergovernmental water policy and financing challenge.

The water quality trading component would include a nationwide survey to develop, recommend, and establish a bank whereby stakeholders can purchase and sell credits for reducing pollutants into the streams. The Christina Basin TMDL has set pollutant reduction targets for bacteria (90%), nitrogen (>50%), phosphorus (>50%, and sediment (>50%) to meet Clean Water Act goals. Under the water quality trading bank mechanism crafted after the cap and trade mechanisms from the carbon emissions field, a discharger that reduces nitrogen by 60% (10% over the goal) would be able to sell 10% as

their credit to an upstream discharger that could only meet say a 40% reduction in pollutant load. Water purveyors in Delaware are already practicing water quality trading along the White Clay Creek and Brandywine Creek by contributing funds for agricultural conservation projects at upstream farms in Chester County to reduce pollutant loads flowing to the drinking water intakes. Preliminary calculations indicate that water quality trading to reduce nitrogen loads by 50% could save over $1 million per year in this watershed (Figure 5). Wastewater and urban/suburban stormwater dischargers (who hold NPDES permits in Delaware and Pennsylvania) may find it less expensive to invest upstream in agricultural conservation projects instead of costly retrofitting. Farmers would receive revenue to conserve their farms and downstream users such as water utilities would benefit.

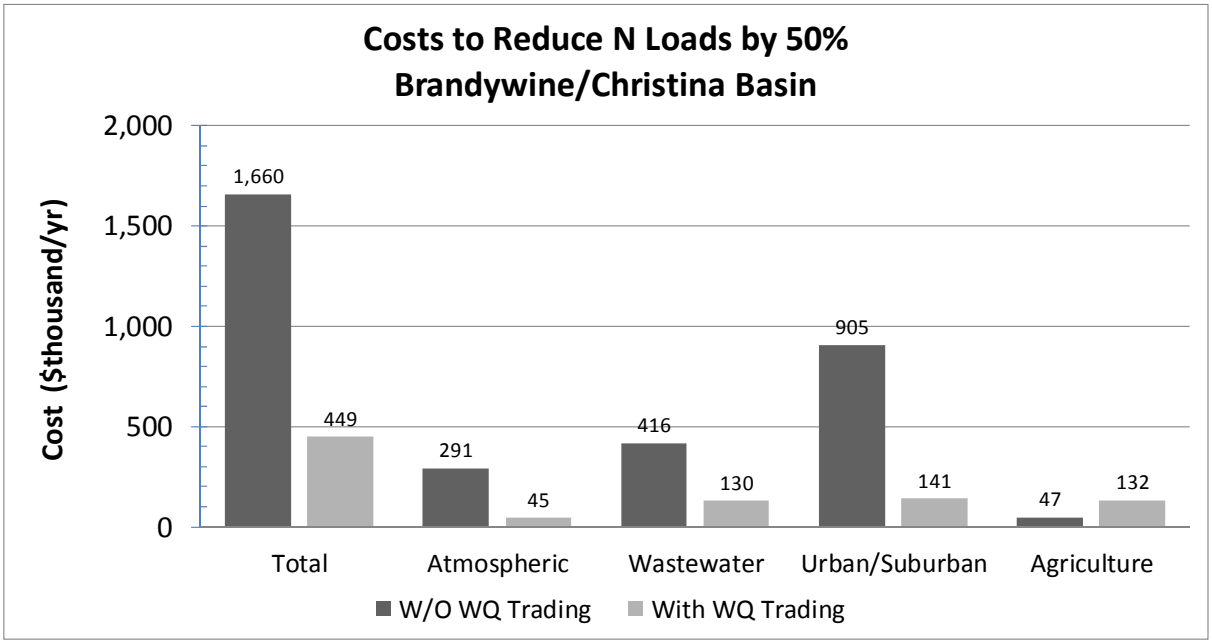

Figure 5. Annual costs to reduce N loads by 50% in the Brandywine-Christina Subwatershed