White Paper

Clean Water is Good Business in the Christina Basin

first draft December 4, 2009

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For consideration by:

Christina Basin Clean Water Partnership

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Table of Contents

List of Tables

List of Figures

List of Appendices

Note

This white paper is intended for discussion purposes only and does not yet reflect the consensus of the CBCWP.

1. Introduction

In March 2009, the Gallup Poll found the top four environmental problems among Americans were about water resources as 84% of respondents were greatly/fairly concerned about pollution of drinking water, 83% concerned about river pollution, and 80% concerned about water contamination or freshwater (Figure 1).

I'm going to read you a list of environmental problems. As I read each one, please tell me if you personally worry about this problem a great deal, a fair amount, only a little, or not at all. First, how much do you personally worry about ... ?

	Great deal	Fair amount	Only a little/Not at all
	%	%	%
Pollution of drinking water	59	25	16
Pollution of rivers, lakes, and reservoirs	52	31	17
Contamination of soil and water by toxic waste	52	28	19
Maintenance of the nation's supply of fresh water for household needs	49	31	19
Air pollution	45	31	24
The loss of tropical rain forests	42	26	32
Extinction of plant and animal species	37	28	34
The "greenhouse effect" or global warming/ Global warming	34	26	40

March 5-8, 2009

GALLUP POLL

Figure 1. Gallup Poll concerning environmental problems, March 2009

Public policy (water policy) change occurs when the three streams of problem, politics, and policy coincide to create a window of opportunity (Figure 2). In watershed management there are significant problems (poor water quality and dwindling revenues), a political stream (a new administration in Washington), and a policy stream (renewed emphasis by the EPA in enforcing the Clean Water Act). With the confluence of these three public policy streams, today there is a window of opportunity to adopt a new business model and develop new sustainable watershed funding mechanisms to implement watershed restoration projects to meet the fishable and swimmable goals of the Clean Water Act and stream water quality standards of the states.

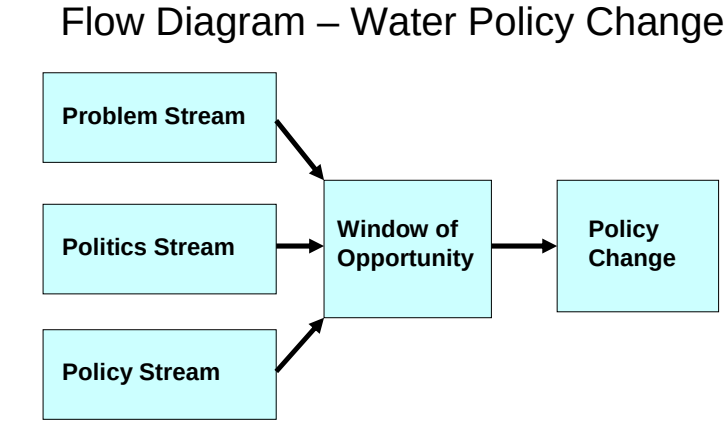

Figure 2. Flow diagram of water policy change

Like many watersheds throughout the USA, Christina Basin partners in both states have been implementing water quality restoration projects while trying to navigate the nexus between the Total Maximum Daily Load (TMDL) and NPDES Municipal Stormwater Permit (MS4) provisions of the Clean Water Act, all while State and local government funds are dwindling during the global economic drought.

At its September 18, 2009 meeting at Longwood Gardens in Kennett Square, Pennsylvania, the Christina Basin Policy Committee recommended preparing a table to outline alternative sustainable watershed funding options to finance restoration of the Christina Basin. The purpose of this white paper is to review the mission and goals of the Christina Basin Clean Water Partnership and discuss the feasibility of new funding options to restore the waters of the Christina Basin to fishable and swimmable Clean Water Act status.

Since 1994 the two States, U. S. Environmental Protection Agency, Delaware River Basin Commission, and Christina Basin Clean Water Partnership have been working together to restore the Brandywine, Red Clay, White Clay, and Christina Creeks in Delaware and Pennsylvania (Figure 3) to fishable, swimmable, and potable status as per the Federal Clean Water Act, Safe Drinking Water Act, and state surface water quality standards. The Christina Basin has unique interstate coordination challenges as it is one of only two watersheds in the Delaware Basin that cross the borders of more than one state (Figure 4).

The Christina Basin, with the Christina River as the 2nd largest tributary to the Delaware Estuary, lies in Chester County, Pennsylvania and New Castle County, Delaware. The Christina Basin Clean Water Partnership implements restoration projects integrated with action levels adopted by the Delaware Estuary Comprehensive Conservation and Management Plan or CCMP (1996). The Delaware Estuary is one of only 28 tidal embayments nationwide designated by Congress as part of the National Estuary Program.

Action Level	**Del. Estuary CCMP Recommendation**
Action L2	Support Watershed-Based Planning
Action L4	Support the Establishment of Riparian Corridor Protection Measures
Action H4	Coordinate and Enhance Wetlands Management within the Estuary
Action H5	Target Habitat Enhancement Opportunities for Present and Future Action
Action E6	Develop Educational Initiatives for the Habitat/Living Resources Action Plan
Action E12	Promote 'Hands-On" Educational Activities/Volunteer Stewardship

Recently, the Christina Basin Partnership submitted a coastal habitat restoration program proposal to NOAA under the American Recovery and Reinvestment Act of 2009 to commence work on 20 projects during 2009 to fund 125 green infrastructure jobs. The multi-disciplinary nature of the Christina Basin coastal habitat restoration projects are designed to be sustainable and provide benefits to the Delaware Estuary, a coastal resource of national significance as part of the National Estuary Program. This interstate partnership assembled the following list of bundled projects to meet coastal habitat restoration goals:

- Reforest 130 acres of riparian buffer in coastal watersheds,
- Restore 11,855 feet of stream buffer habitat,
- Restore 8 miles of White Clay Creek for American shad/diadromous fish migration
- Restore 16 acres of wetlands in coastal watersheds, and
- Deliver a public outreach program to the 600,000 residents of the Christina Basin.

The CBCWP employs a watershed approach to address the socioeconomic status of diverse populations in the Christina Basin. Low income populations in Wilmington practice subsistence fishing from tidal Christina Basin waters that have fish consumption advisories. The Christina Basin has a growing population of Latino workers in the mushroom farming and agriculture economy who utilize the waters for irrigation, recreation, and subsistence fishing. The Chester County Conservation District has designed agricultural conservation

programs to reach out to church elders to reduce pollutants to downstream waters as a growing population of Amish and Plain Sect farmers have moved to the headwaters of the Brandywine Creek.

In 2006, the USEPA and two states issued low flow/high flow TMDLs for impaired streams in the Christina Basin. In 2002, Chester County developed watershed action plans for the Brandywine, Red Clay, and White Clay watersheds. In 2007, Delaware completed a Christina Basin Pollution Control Strategy.

In February 2008 at a legislative briefing in Kennett Square, Pennsylvania the partnership announced the completion of a $1 million USEPA Targeted Watershed Grant (2008). The Christina Basin TWG was the No. 1 rated application out of 170 watersheds in the USA and successfully doubled restoration goals and leveraged federal funds with local money by over a 2 to 1 margin. The Christina Basin provides 100 mgd of drinking water to 600,000 people (including over 60% of Delaware's population) and provides ecosystem services in excess of $260 million per year for water supply, fishery, ecotourism, and ecological protection uses. The White Clay Creek National Wild and Scenic River flows through the basin as one of only two wild and scenic rivers in the USA designated by Congress on a watershed basis. In 1946, the Brandywine Valley Association was formed as the first small watershed association in the USA.

The Christina Basin restoration complies with EPA Strategic Plan Goal 2 (Clean and Safe Water), Objective 2.2 (Protect Water Quality), and Sub-objective 2.2.1 (Improve Water Quality on a Watershed Basis). Since 1994, the Christina Basin Partnership has employed a phased watershed approach:

Phase	Tasks	Milestones
I	DRBC/USEPA Mediation/Problem Assessment	1994 - 1996
II	GIS Watershed Characterization	1997 - 1998
III	Water Quality Monitoring/Implementation	1999 - 2000
IV/V	TMDL Modeling/Implementation	2001 - 2005
VI	Targeted Watershed Grant Implementation	2004 - 2007
VII	Implementation of Pollution Control Strategy	2008 – 2020

The Christina Basin Clean Water Partnership has redoubled efforts to restore the waters of the Brandywine, Red Clay, White Clay, and Christina Creeks in Delaware and Pennsylvania by 2015 -2020:

1. Implement Christina Basin Pollution Control Strategies in Delaware and Pennsylvania.
- Delaware
  - Christina Basin Pollution Control Strategy in Delaware
  - MS4 NPDES permits for New Castle Co., DELDOT, and City of Newark
  - CSO abatement plan by Wilmington
  - Brandywine Creek source water protection plan by Wilmington
- Pennsylvania
  - Chester County Watersheds Plan
  - Targeted Stormwater TMDL Strategy for MS4 permits in Chester County
  - Brandywine Valley Association Red Streams Blue program
2. Employ a full time watershed governance structure.
- Christina Basin Policy Committee
- Christina Basin local co-coordinators in PA and DE
- Christina Basin Coordinating Committee
- Christina Basin Task Force (public education/outreach)
3. Implement watershed - based permitting (TMDLs integrating with NPDES MS4 permits).
4. Conduct water quality monitoring to track TMDL progress.
5. Develop sustainable watershed funding mechanism(s).

The Unique Christina Basin

Among watersheds along the Atlantic seaboard, the Christina Basin has unique water supply, ecological, recreational, and historic attributes:

1. Awarded $1 million EPA Targeted Watershed Grant, the No. 1 application out of 170 USA watersheds.
2. One of only 2 interstate watersheds in the entire 13,000 sq mi Delaware River Basin.
3. Watershed with the upper 2/3 in Pa. and the lower 1/3 in Del. with a small sliver in Md.
4. The Christina River is the only stream in Delaware that flows through 3 states.
5. Includes 4 watersheds - the Brandywine, Red Clay, White Clay Creeks, and Christina River.
6. White Clay Creek in Delaware and Pennsylvania is a National Wild and Scenic River designated by Congress and one of only two wild and scenic rivers in USA designated on watershed basis.
7. Water quality is improving for dissolved oxygen, phosphorus and sediment; but declining for nitrogen.
8. Provides 100 million gallons per day of drinking water for over half million people in both states.
9. Largest drinking water source in Delaware and water supply for 60% of First State's population.
10. Miles of high quality, cold water trout streams in Pa. and home of only 6 trout streams in Del.
11. Protected species habitat for bald eagle, brook trout (state fish of Pa.), cerulean warbler, bog turtle.
12. Ecosystem water supply, ecological, and recreational value exceeds $260 million annually.
13. Has a growing ecotourism industry with canoe and kayak liveries along the Brandywine River.
14. Within commuting distance of Wilmington, West Chester, and Philadelphia. The real estate industry designated the rolling Piedmont valleys as one of the top 10 markets in the USA.
15. Stream valleys are inspiration for the Brandywine school of art popularized by Pyle and the Wyeths.
16. In 1638, Swedes first permanent European settlement in Delaware Valley at mouth of Christina River.
17. Largest battle in War for Independence fought along the Brandywine in Chadds Ford, Pa. (Sep 11, 1777). Delaware's s only battle of the Revolution fought along Christina River at Cooches Bridge (Sep 3, 1777).
18. Brandywine Valley Association formed as the USA's first small watershed organization in 1946.
19. Largest concentration of mushroom farms in United States at Hockessin, Del. and Kennett Square, Pa.
20. Wilmington along Christina River is largest U.S. banana port, importing 1 million tons per year.
21. At latitude 40 degrees north, climate conducive for some of most productive public gardens in the world at Longwood, Winterthur, Mt. Cuba, and Hagley.
22. In 1802 DuPonts sited gunpowder mills along the Brandywine with a total hydropower head exceeding the height of Niagara Falls.
23. International headquarters of DuPont, Gore, and Disney incorporated in Wilmington under Delaware banking laws.

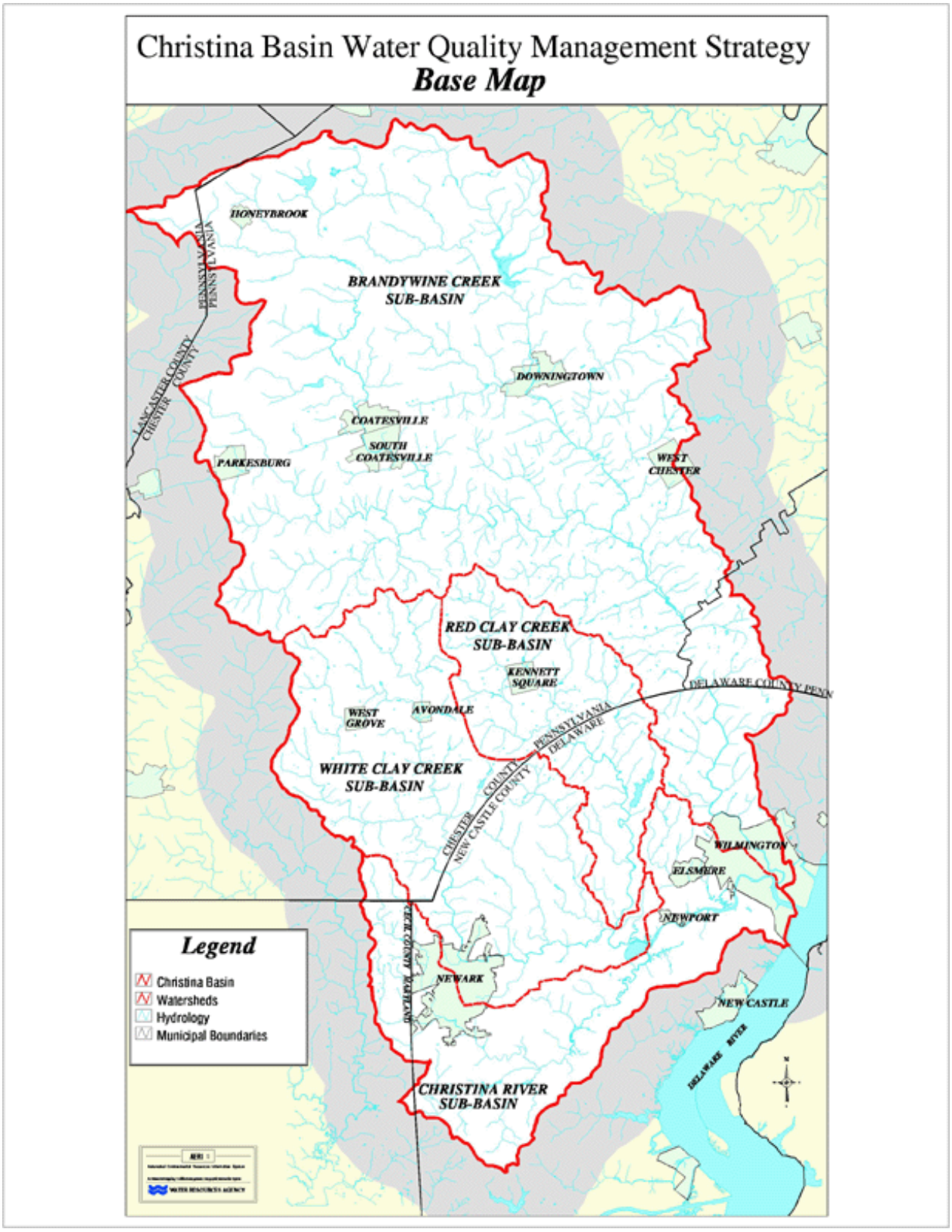

Figure 3. The interstate Christina Basin in Delaware and Pennsylvania

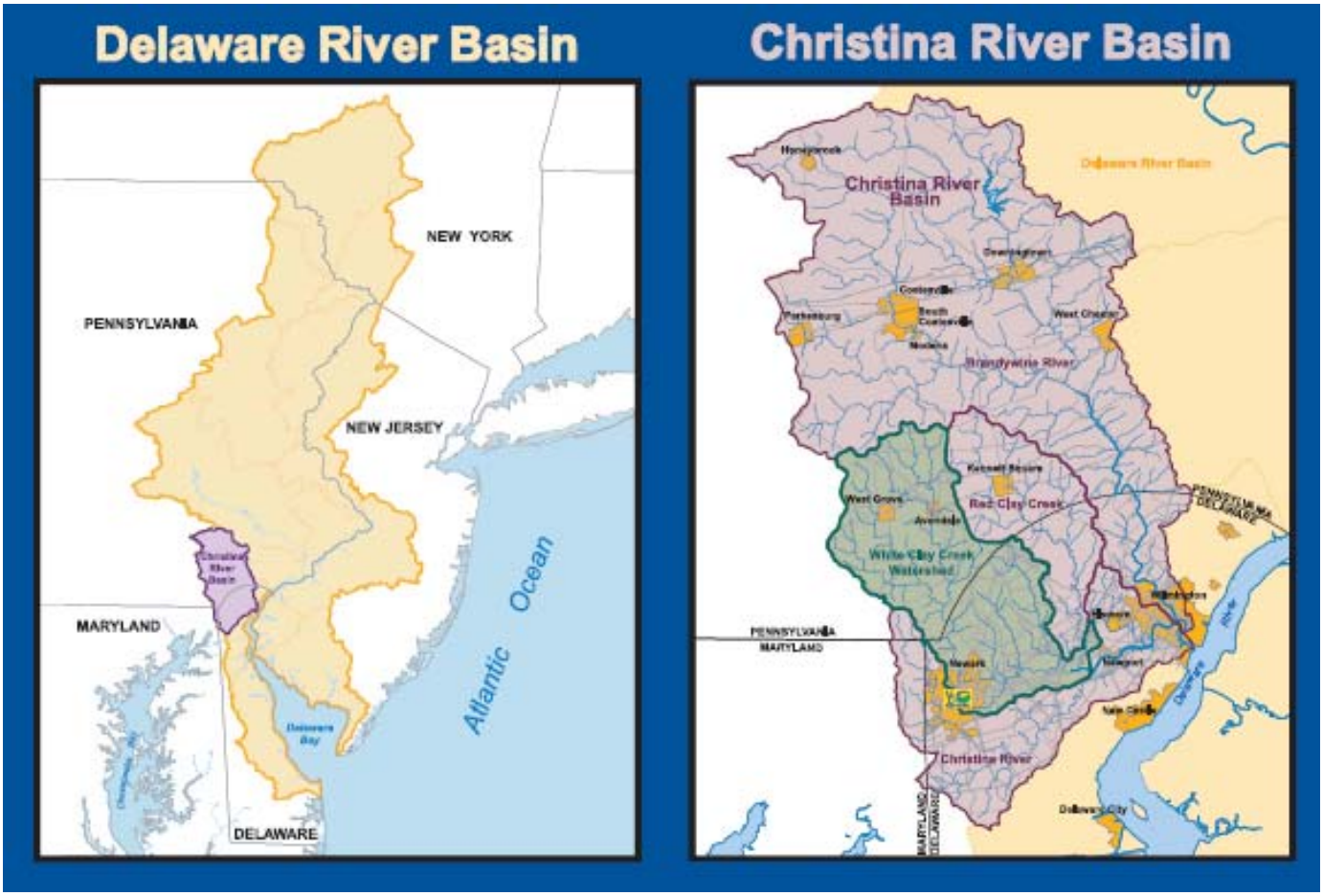

Figure 4. The Christina Basin as one of only two interstate watersheds in the Delaware Basin

2. Watershed Governance/Mission/Goals/Objectives

Watershed Governance

Local co-coordinators of the Christina Basin Clean Water Partnership chair monthly progress meetings and include the University of Delaware - Water Resources Agency and Delaware Nature Society in Delaware and Chester County Conservation District and Chester County Water Resources Authority in Pennsylvania (Figure 5). The Brandywine Valley Association chairs quarterly meetings of the Christina Basin Task Force, the public outreach arm. The Christina Basin Policy Committee meets annually to review the program and consists of the DRBC, USEPA Region 3, Delaware DNREC, and Pennsylvania DEP. Watershed governance initiatives include:

Ongoing

- CB Coordinating Committee monthly progress meetings in West Chester, Pa. and Newark, Del.
- Quarterly progress reports from stakeholders on implementation of watershed restoration projects.
- Stepped up public education and outreach program.
- Merge Del. Pollution Control Strategy and Chester Co. Watershed Action Plans as interstate plan.

Under Consideration

- Proposed interstate watershed MOU between Delaware and Pennsylvania.
- Hold Christina Basin Caucus for chief executives from over 60 local basin governments.
- Fold the CBCWP into the structure of the Partnership for the Delaware Estuary

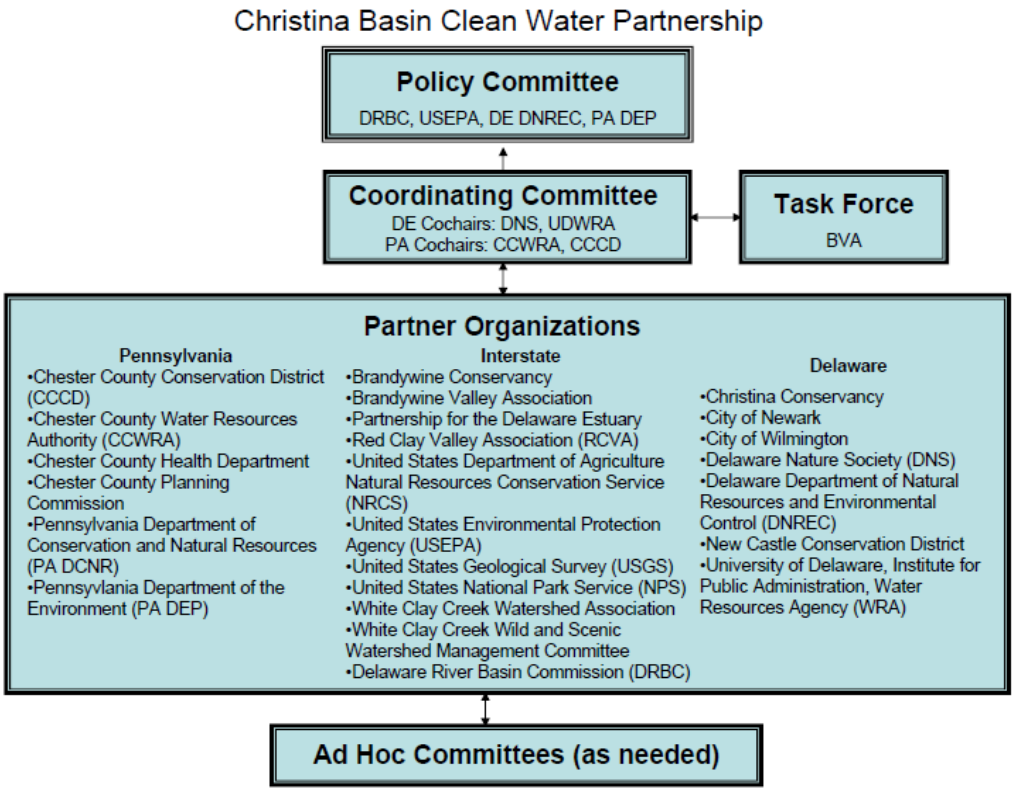

Figure 5. Organization of the Christina Basin Clean Water Partnership

The Christina Basin Partnership pursues watershed restoration through an implementation framework:

1. Stormwater

Stormwater best management practices require a coordinated effort to engage local municipality participation and expand the role of non-government collaboration through community groups.

- Design and implement stormwater BMPs in line with TMDLs
- Limit addition of new impervious cover
- Advance Low Impact Development practices
- Creat consistency within stormwater ordinances
- Implement a stormwater utility
- Retrofit stormwater BMPs
- Increase urban tree canopy

2. Open Space

Open space tasks include not only agency and non-profit actions, but private interests. Open space projects that would enhance water quality include:

- Map an inventory existing open space areas
- Prioritize high value water resource areas for protection
- Install vegetated buffers
- Implement new stream restoration plans
- Acquire open space and easements
- Conserve programs for existing open space
- Reforest watersheds and headwaters.

3. Wastewater

High cost wastewater best management practices would need to address complex regulatory, engineering and enforcement programs, along with municipal, utility and private sector coordination.

- Conduct inspections, pump-out onsite wastewater treatment systems
- Eliminate cesspools and seepage pits
- Connect onsite wastewater treatment systems to existing wastewater treatment plants.
- Eliminate combined sewer overflows
- Continue inspection, repair, and elimination of unpermitted discharges
- Remediate contaminated waste sites

4. Agriculture

Continue implementation of agricultural best management practices such as:

- Nutrient management plans
- Cover crops
- Pasture stream fencing
- Grassed filter strips and buffers
- Grassed waterways
- Riparian forested buffers

5. Education

Education and outreach efforts that can enhance the efforts of the Christina Basin Partnership include:

- Target individual behavior change through social marketing
- Encourage golf course managers to decrease nutrient application and stormwater runoff and erosion
- Educate pet owners on cleaning up pet waste
- Educate homeowners on residential stormwater BMPs

- Encourage corporate environmental stewardship programs
- Coordinate with nonprofit organizations throughout the Basin
- Support water conservation to reduce nutrients leaving a site
- Provide education programs on lawn and garden BMPs

Mission

The mission of the Christina Basin Clean Water Partnership is to protect and restore the chemical, physical and biological integrity of the Brandywine, Red Clay, White Clay Creeks, and Christina River in Delaware and Pennsylvania and restore the Christina Basin to fishable, swimmable, potable, and ecological standards by 2015 – 2020.

Goals/Objectives

Goal No. 1 – Water Quality

Reduce point and nonpoint source pollutant loads such as nutrients, sediment, bacteria, and toxics delivered to the Christina Basin to meet water quality standards and source water protection goals.

1.1. Meet the fishable and swimmable goals of the Federal Clean Water Act and state stream water quality standards (Table 1) along 50% of basin streams by 2020 and 100% of basin streams by 2030.

Table 1. Christina Basin water quality standards set by Delaware, Pennsylvania and DRBC

Status	**Parameter**	**Delaware**	**Pennsylvania**	**DRBC**
Fishable	Dissolved oxygen	4.0 mg/l freshwater	4.0 mg/l warm water	4.0 game fish
		5.0 mg/l cold water	5.0 mg/l cold water	5.0 trout
			7.0 mg/l HQ cold water	7.0 spawning
Swimmable	Bacteria	185 cfu/100 ml	200 cfu/100 ml	
(Primary recreation)		enterococcus	fecal coliform	
Potable	Total diss. solids		750 mg/l	
Ecological	Nitrate Nitrogen	10 mg/l	10 mg/l	
	Total Nitrogen	1.0 mg/l		
	Total Phosphorus	0.2 mg/l		

1.2. Remove 50% of streams from Christina Basin impaired streams list (Table 2) by 2020 and remove the remaining 50% of impaired .streams from the list by 2030.

Table 2. Impaired stream miles in the Christina Basin

Watershed	**Dissolved oxygen**		**Bacteria**		**Sediment**		**Nutrients**	
(mi)	**DE**	**PA**	**DE**	**PA**	**DE**	**PA**	**DE**	**PA**
Brandywine		3.3	13.1			49.9	13.1	35.7
Red Clay		16.2	15.4	59		17.0	15.4	1.8
White Clay		17.8	33.8	6		65.9	39.1	46.2
Christina	6.6		143.6			0	91.4	0
Impaired Streams (mi)	**6.6**	**37.3**	**205.9**	**65**		**132.8**	**159.0**	**83.7**

1.3. By 2020, achieve low flow Total Maximum Daily Load (TMDL) reductions at 8 wastewater treatment plants (Table 3) by upgrading NPDES wastewater discharge permits in 5 year cycles.

Table 3. .Required low flow, point source total maximum daily load reductions in the Christina Basin.

NPDES Permit facility	Flow	Level 1 and 2 (% Reduction)		
	(mgd)	CBOD5	NH3-N	TP
East Branch Brandywine Creek				
PA0043982 – Broad Run Sewer Co.	0.4	13%	0%	13%
PA0012815 – Sonoco Products	1.03	26%	26%	26%
PA0026531 – Downingtown Area Authority	7.5	30%	25%	0%
West Branch Brandywine Creek				
PA0026859 – PA American Water Co.	3.85	28%	0%	28%
PA0044776 – NW Chester Co. Municipal Auth.	0.6	10%	10%	10%
West Branch Red Clay Creek				
PA0024058 – Kennett Square	1.1	34%	34%	83%
PA0057720 – Sunny Dell Foods	0.072	5%	5%	5%
West Branch Christina River				
MD0022641 – Meadowview Utilities	0.7	0%	69%	0%

1.4. Achieve half of the high flow, nonpoint source Total Maximum Daily Load (TMDL) reductions by 2020 and achieve the remaining half by 2030 by implementing the Christina Basin Pollution Control Strategy in Delaware, the Pennsylvania Watershed Action Plans, and regulatory/non-regulatory measures(Table 4).

Table 4. Required high flow nonpoint source total maximum daily load reductions in the Christina Basin.

Watershed	% Reduction			
	E. Bacteria	Sediment	Total N	Total P
at PA-DE line				
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 in DE				
Brandywine Creek	63%		64%	63%
Red Clay Creek				
White Clay Creek				
Christina River	72%		72%	72%

1.5. Replace or eliminate 50% of failing septic systems in the Christina Basin by 2020 (Table 5).

Table 5. Septic systems in the Christina Basin

Jurisdiction	Septic Systems
New Castle Co., Del.	1,650
Chester County, Pa.	55,200

1.6. Install agricultural conservation plans at all of the 910 farms in the Christina Basin by 2020. According to the USDA 2007 census of agriculture, there are 10 farms in the Delaware portion of the Christina Basin and 900 farms in Chester County, Pa. Presently, 200 farms have agriculture conservation plans installed by the New Castle and Chester County conservation districts. Table 6 list the number of farm animals in the Christina Basin.

Table 6. Farm animals in the Christina Basin

Agriculture Category	Chester County, PA	New Castle County, DE
Cattle/Calves	42,000	2,700
Hogs/Pigs	1,300	100
Poultry	700,000	0
Horses/Ponies	8,600	800
Sheeps/Lambs	2,800	400

1.7. Cleanup over 270 contaminated waste sites in the Christina Basin as listed in Table 7

Table 7. Contaminated waste sites in the Christina Basin.

Watershed	Chester County, PA	New Castle County, DE
Brandywine Creek		58
Red Clay Creek		9
White Clay Creek		50
Christina River		277

Goal No. 2 – Environmental Resources

Protect and expand forest cover and forested riparian buffer areas, especially those adjacent to first and second order streams, wetlands and floodplains.

2.1. Reforest and increase forest/tree cover to 40% (226 sq mi) of the Christina Basin by 2030 from 25% (143 sq mi) presently.

Table 8. Land use and forest cover in the Christina Basin

Year	Dev. High Density	Dev. Low Density	Agriculture	Forest	Other	Total
1992 (sq mi)	271	62.3	224.6	229.8	20.8	564.6
2001 (sq mi)	29.2	89.4	266.8	143.5	35.6	564.6
Net change (sq mi)	2.1	27.1	42.2	-86.3	14.8	
% of basin (2001)	5%	16%	47%	25%	6%	

2.2. Restore 3,000 acres of forested riparian buffers along wetlands and floodplains in Christina Basin watersheds: Brandywine (1200 ac), Red Clay (600 ac), White Clay Creek (800 ac), Christina River (400 ac).

2.3. Protect and restore 10 acres of wetlands annually throughout the Christina Basin or 100 acres by 2020.

Goal No. 3 – Ecological Integrity

Protect and restore the ecological integrity of the Christina Basin to enhance aquatic and terrestrial diversity, increase recreational use and provide for a quality fishery.

3.1. Remove 50% of Christina Basin streams from the full fish consumption advisory list by 2020. (Table 9).

Table 9. Streams with fish consumption advisories in the Christina Basin

Waterbody	Species	Extent	Contaminant	Advisory (per year)
Delaware				
Tidal Brandywine	All Finfish	Mouth to Baynard Blvd.	PCBs	No Consumption
Non-tidal Brandywine	All Finfish	Baynard Blvd. to PA line	PCBs, Dioxin	two 8-ounce meals
Tidal Christina River	All Finfish	Mouth to Smalley's Dam	PCBs, Dieldrin	No Consumption
Non-tidal Christina	All Finfish	Smalley's Dam - DE/MD line.	PCBs, Chlordane	six 8-ounce meals
Tidal White Clay Cr.	All Finfish	Mouth to Route 4	PCBs	No Consumption
Nontidal White Clay	All Finfish	Route 4 to DE/PA line	PCBs	Twelve 8 ounce meals
Red Clay Creek	All Finfish	State line to Stanton	PCBs, Dioxin	two 8-ounce meals
Little Mill Creek	All Finfish	Mouth to Kirkwood Hwy.	PCBs	No Consumption
Becks Pond	All Finfish	Entire Pond	PCBs, Mercury	one 8-ounce meal
Christina Creek	Stocked Trout	Rittenhouse Pk. - DE/MD Line	PCBs, Dieldrin	six 8-ounce meals
Trout Streams	Stocked Trout	Designated Trout Stocking	PCBs	Twelve 8-ounce meals
Pennsylvania				
Brandywine Creek	American Eel	Rte.1 Chadds Fd. - PA/DE line	Chlordane	Do Not Eat
West Br. Brandywine	American eel	Rt. 20 Coatesville to Buck Run	PCB	6 meals/year
Red Clay Creek	White sucker	Entire basin and tribs.	PCB	1 meal/month
	American eel		PCB	Do Not Eat

3.2. Remove 12 dams and re open 20 stream miles to anadromous/resident fish passage by 2020 and remove the remaining 13 dams and reopen 20 stream miles by 2030 (Table 10).

Table 10. Christina Basin streams with low dams and fish passage constraints

.Stream	Stream mile	Name of Dam	Dam height (ft.)
Brandywine Creek	2.37 mi.	Baynard Boulevard (No. 1)	4
	3.04	City Dam (No. 2)	5
	3.50	No. 3	5
	3.75	No. 4	2
	4.35	No. 5	6
	4.62	No. 6	7
Red Clay Creek	9,500 ft.	Kiamensi Road (No. 1)	12
	13,500	Kirkwood Highway (No. 2)	8
	17,000	No. 3	5
	26,000	Lancaster Pike (No. 4)	2
	35,000	No. 5	7
	43,900	No. 6	6
	56,300	Sharpless Road (No. 7)	7
	58,800	(No. 8)	8
	62,200	Yorklyn Road (No. 9)	4
	67,300	State Line (No. 10)	8
White Clay Creek	22,300	Delaware Park Race Track (No. 1)	8
	40,200	Red Mill Rd. (No. 2)	3
	50,000	Old Paper Mill Rd. (No. 3)	4
	53,300	Route 72 Paper Mill Road (No. 4)	6
	58,400	Newark Intake Dam (No. 5)	10
	61,300	Creek Rd. (No. 6)	3
	67,000	Louviers (No. 7)	6
Christina River	60,500	Smalley's Pond (No. 1)	10
	101,000	I-95, Cooch Farm (No. 2)	11

3.3. Re-establish ____ acres and ____ species of native freshwater mussels to support habitat and water quality improvements

Goal No. 4 – Watershed Stewardship

Continue to promote collaborative partnerships, leverage resources and increase volunteer participation in watershed restoration activities throughout the Basin.

4.1. Expand local participation in the Christina Basin Clean Water Partnership, increase awareness, promote stewardship and influence coordinated policy and regulation in the interstate watershed.

Table 11. Summary of Christina Basin watershed restoration goals

Goals met by:	2010	2015	2020	2025	2030
1.1. Meet fishable/swimmable goals of Federal Clean Water Act and State stream water quality standards. along 50% of streams by 2020 and 100% by 2030.	10% of streams	25%of streams	50% of streams	75% of streams	100% of streams
1.2. Remove 50% of stream miles from Christina Basin impaired streams list in Del. and Pa. by 2020 and 100% of streams by 2030.	DO: 44 mi	33 mi	22 mi	11 mi	0 mi
	Bac: 271 mi	202 mi	135 mi	67 mi	0 mi
	Sed: 133 mi	99 mi	66 mi	33 mi	0 mi
	Nut: 243 mi	181 mi	121 mi	60 mi	0 mi
1.3. Achieve low flow Total Maximum Daily Load (TMDL) reductions at 8 WWTPs by upgrading State NPDES wastewater discharge permits in 5 yr. cycles.	8 WWTPs need load reductions	4 WWTPs need load reductions	0 WWTP need load reductions		
1.4. Achieve 50% of high flow, nonpoint source Total Maximum Daily Load (TMDL) reductions in Christina Basin by 2020 and remaining 50% by 2030.	Bac: 94%	71%	47%	24%	0%
	Sed: 70%	52%	35%	17%	0%
	N: 49%	37%	25%	12%	0%
	P: 54%	40%	27%	13%	0%
1.5. Replace/eliminate 50% of failing septic systems in the Christina Basin by 2020 and 100% by 2030.	57,000 septic systems	42,700	28,500	14,200	0 septic systems
1.6. Install agricultural conservation plans at all of the 910 farms in the Christina Basin by 2020.	200 farms with plans	550 farms w/ plans	910 farms w/ plans		
1.7. Cleanup half of the 270 contaminated waste sites in the Christina Basin by 2020.	0 sites cleaned	68 sites cleaned	135 sites cleaned	200 sites cleaned	270 sites cleaned
2.1. Reforest/increase forest to 40% (226 sq mi) of Christina Basin by 2030 from 25% (143 sq mi) now.	143 sq mi forest (25%)	164 sq mi forest (29%)	185 sq mi (32%)	205 sq mi (36%)	226 sq mi forest (40%)
2.2. Restore 3,000 acres of forested riparian buffers along streams, wetlands and floodplains in the Christina Basin watersheds by 2020.		1,500 ac buffer restored	3,000 ac buffer restored		
2.3. Protect and restore 10 acres of wetlands annually throughout the Christina Basin or 100 acres by 2020.	10 ac wetlands restored	50 ac wetlands restored	100 ac wetlands restored	150 ac wetlands restored	200 ac wetlands restored
3.1. Remove 50% of Christina Basin streams in Del.and Pa. from the full fish consumption advisory list by 2020 and the remaining 50% by 2030.	0% fish advisories removed	25% fish advisories removed	50% fish advisories removed	75% fish advisories removed	100% fish advisories removed
3.2 Remove 12 dams and reopen 20 stream miles to anadromous/resident fish passage by 2020 and remaining 13 dams and 20 miles by 2030.	0 dams removed 0 mi reopened	6 dams removed 10 mi reopened	12 dams removed 20 mi reopened	18 dams removed 30 mi reopened	25 dams removed 40 mi reopened
3.3. Re-establish ____ acres and ____ species of native freshwater mussels to support habitat and water quality improvements					

3. TMDL/NPDES MS4 Permit Nexus

The USEPA requires the two states, two counties, and over 50 municipalities to restore Christina Basin streams through the TMDL and NPDES Municipal Storm Water (MS4) provisions of the Federal Clean Water Act. Watershed - based TMDLs are imposed on impaired streams through Section 303 of the CWA while political boundary - based NPDES MS4 permits (Figure 6) are issued under Section 402 of the CWA.

TMDLs

The Christina Basin low flow TMDLs revised in September 2006 mandate that 8 wastewater dischargers in Pennsylvania and Maryland reduce CBOD5, Ammonia nitrogen (NH3-N), and total phosphorus (TP) by up to 34%, 69%, and 83%, respectively, during NPDES permit renewals in 5 - year cycles (Table 12). The high flow TMDL (revised Sep. 2006) mandates TN and TP reductions up to 75%, bacteria reductions of 29% to 93%, and sediment reductions over 50% (Table 13) by implementing municipal NPDES stormwater permits in Delaware and Pennsylvania and through the Christina Basin Pollution Control Strategy in Delaware.

Table 12. Low flow, point source TMDL reductions in the Christina Basin

NPDES Permit facility	**Flow**	**Level ½ % Reduction**		
East Branch Brandywine Creek	**(mgd)**	**CBOD5**	**NH3-N**	**TP**
PA0043982 – Broad Run Sewer Co.	0.4	13%	0%	13%
PA0012815 – Sonoco Products	1.03	26%	26%	26%
PA0026531 – Downingtown Area Authority	7.5	30%	25%	0%
West Branch Brandywine Creek				
PA0026859 – PA American Water Co.	3.85	28%	0%	28%
PA0044776 – NW Chester Co. Municipal Auth.	0.6	10%	10%	10%
West Branch Red Clay Creek				
PA0024058 – Kennett Square	1.1	34%	34%	83%
PA0057720 – Sunny Dell Foods	0.072	5%	5%	5%
West Branch Christina River				
MD0022641 – Meadowview Utilities	0.7	0%	69%	0%

Table 13. High flow, non point 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%

NPDES MS4 Permits - Delaware

In the Delaware portion of the Christina Basin, the DNREC is considering draft NPDES and CSO abatement permits that would be implemented by the following local governments:

- City of Newark (requested UD as co-permittee) – NPDES Permit DE0051152
  - Public Education and Outreach
  - Public Involvement and Participation
  - Illicit Discharge Detection and Elimination
  - Construction Site Storm Water Runoff Control
  - Post Construction Stormwater Management
  - Pollution Prevention/Good Housekeeping
  -
- New Castle County, Delaware DOT, Elsmere, New Castle, Wilmington - NPDES DE0000000
  - Public Education/Public Involvement
  - Illicit Discharge Detection and Elimination
  - Construction/New Development Stormwater and Sediment Control
  - Good Housekeeping Pollutant Reduction
  - Industrial Stormwater Inspection
  - Watershed Infrastructure Plans
  - TMDL Implementation
  - Stormwater Monitoring

- City of Wilmington – CSO Abatement Strategy.

Watershed - based Permitting

The National Academy of Sciences has recognized the incongruity between watershed - based TMDLs and municipal boundary - based MS4 stormwater permits and recommended that USEPA consider watershed - based permitting for more seamless implementation of watershed restoration. The Christina Basin remains a candidate for the USEPA to consider a streamlined, watershed-based TMDL/NPDES MS4 permit process.

The draft NPDES MS4 permits under consideration for the City of Newark and New Castle County have similar tasks and components. For instance, both permits have public education and illicit discharge requirements. Both governments share the same watersheds. Both governments will have to raise revenues to fund the implementation of these permits. Perhaps a single, streamlined watershed based MS4 permit could be issued to Newark and New Castle County, Delaware to eliminate redundancies and funding inefficiencies.

Figures 7 through 10 summmarize the percentage of urban/suburban plus agricultural land in the local governments of the four watersheds in the Christina Basin. These developed land uses contribute nonpoint source, stormwater pollutant loads to the receiving streams. If the USEPA were to consider an interstate, watershed based TMDL/NPDES permit, then contributions toward implementation could be proportionate to the amount of developed land in a local government.

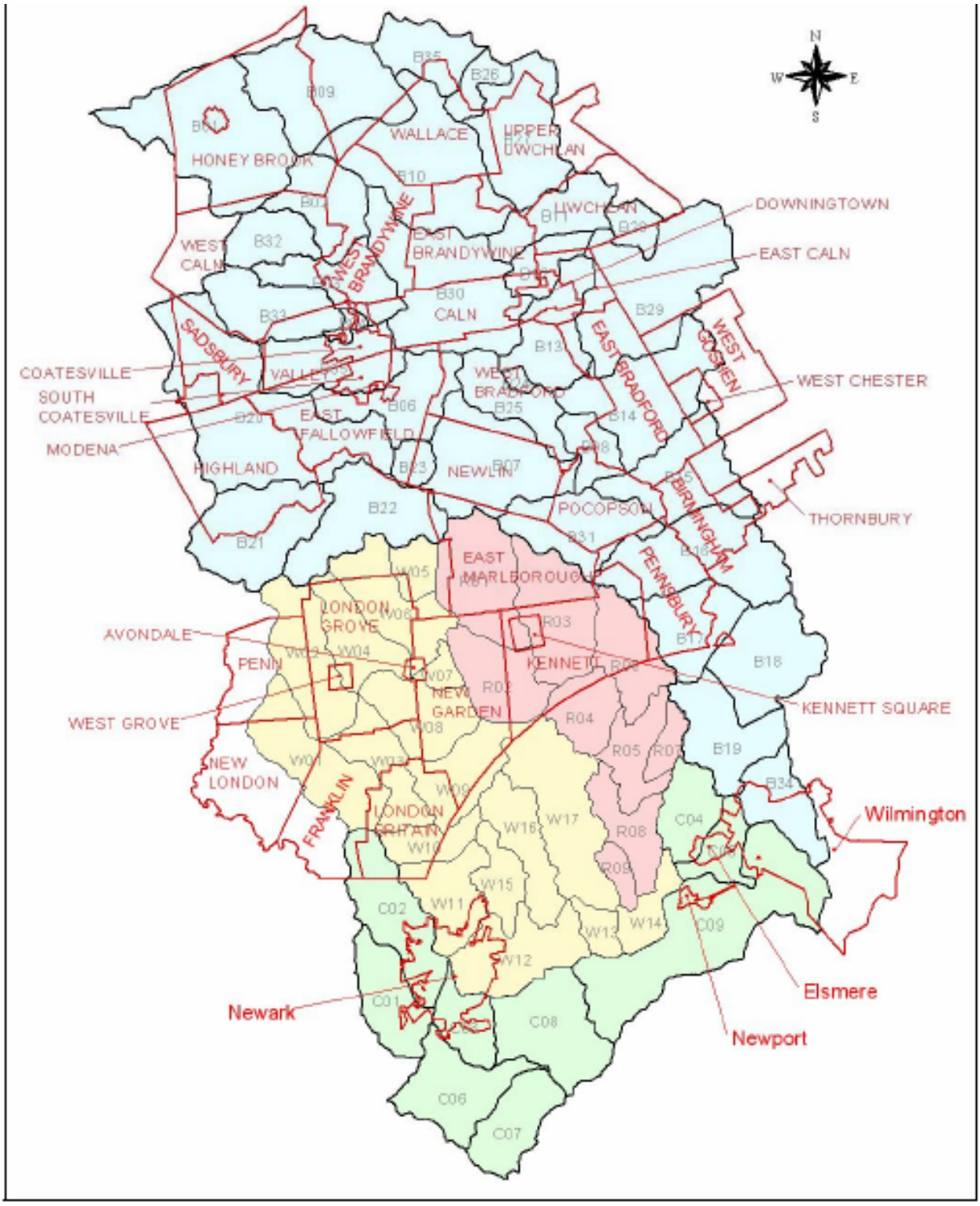

Figure 6. Municipalities under MS4 permit review in the Christina Basin

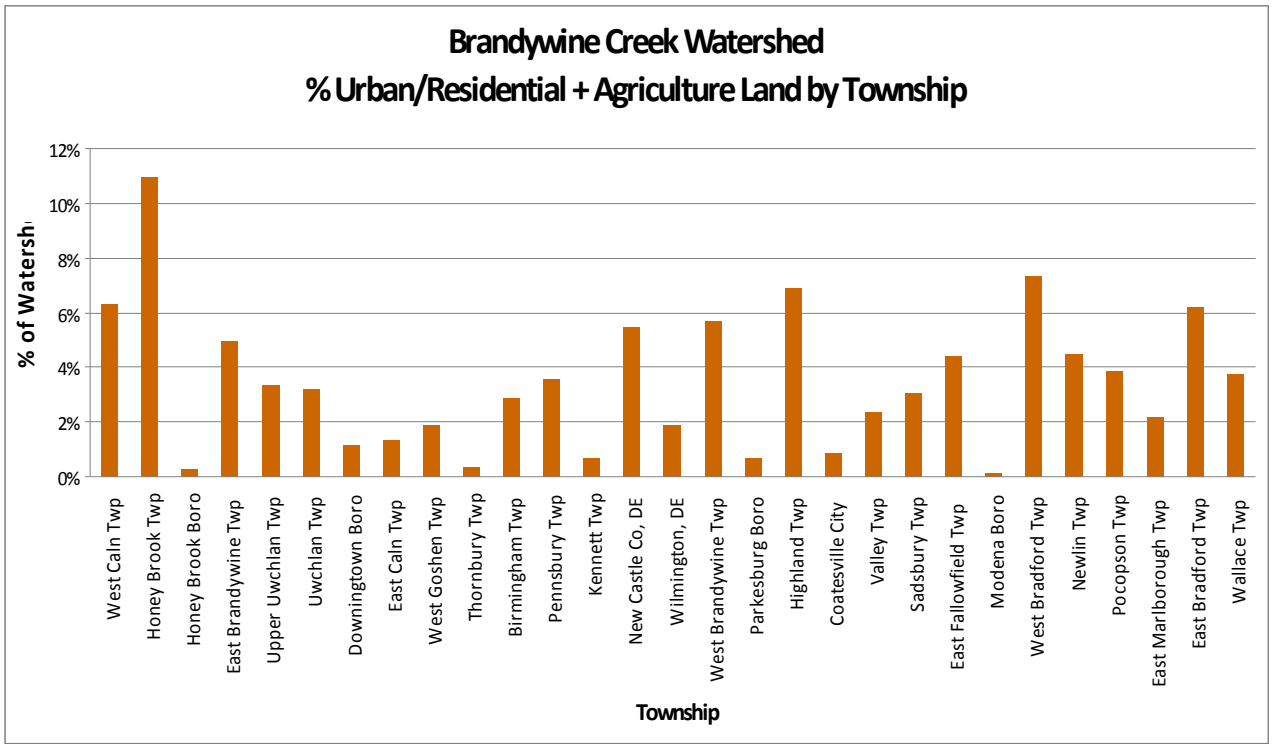

Figure 7. Percentage of urban/suburban plus agricultural land in the Brandywine Creek watershed

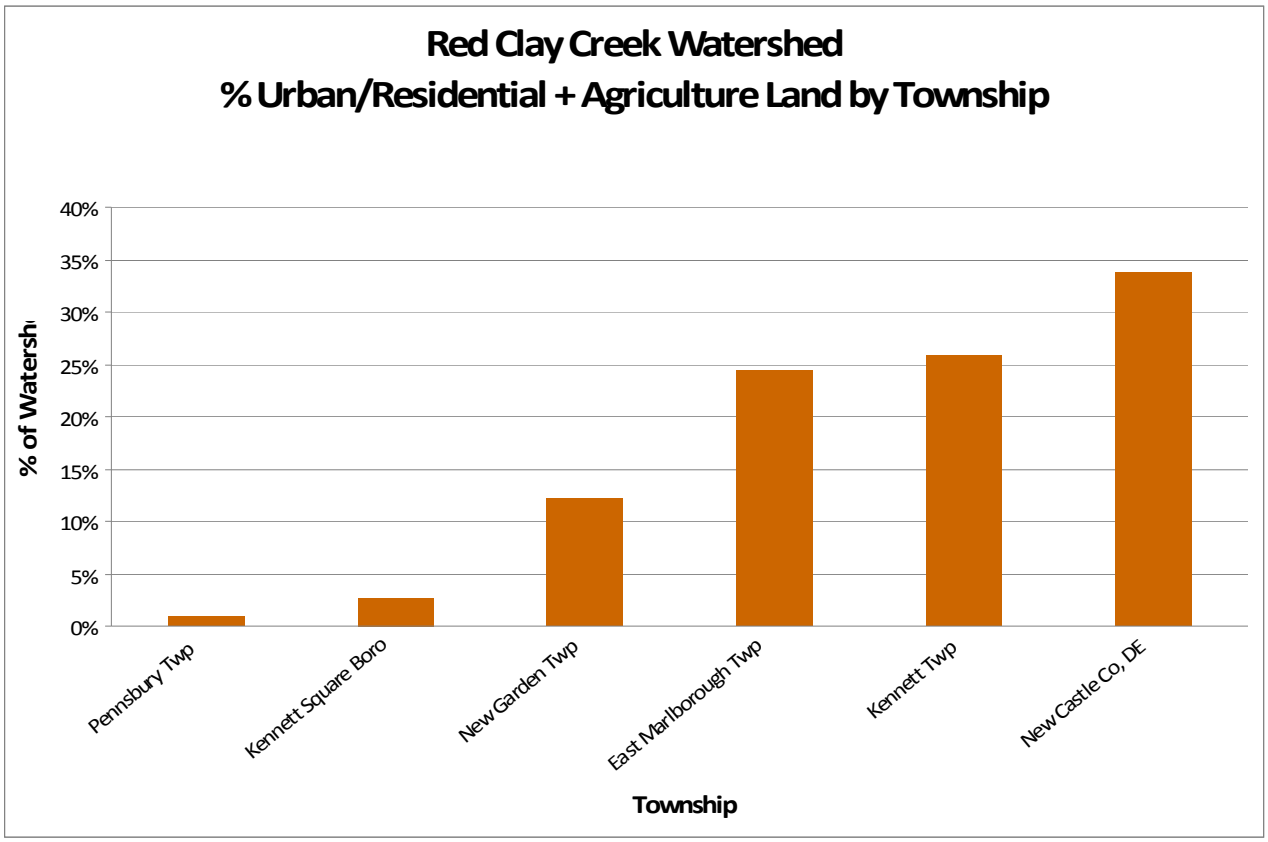

Figure 8. Percentage of urban/suburban plus agricultural land in the Red Clay Creek watershed

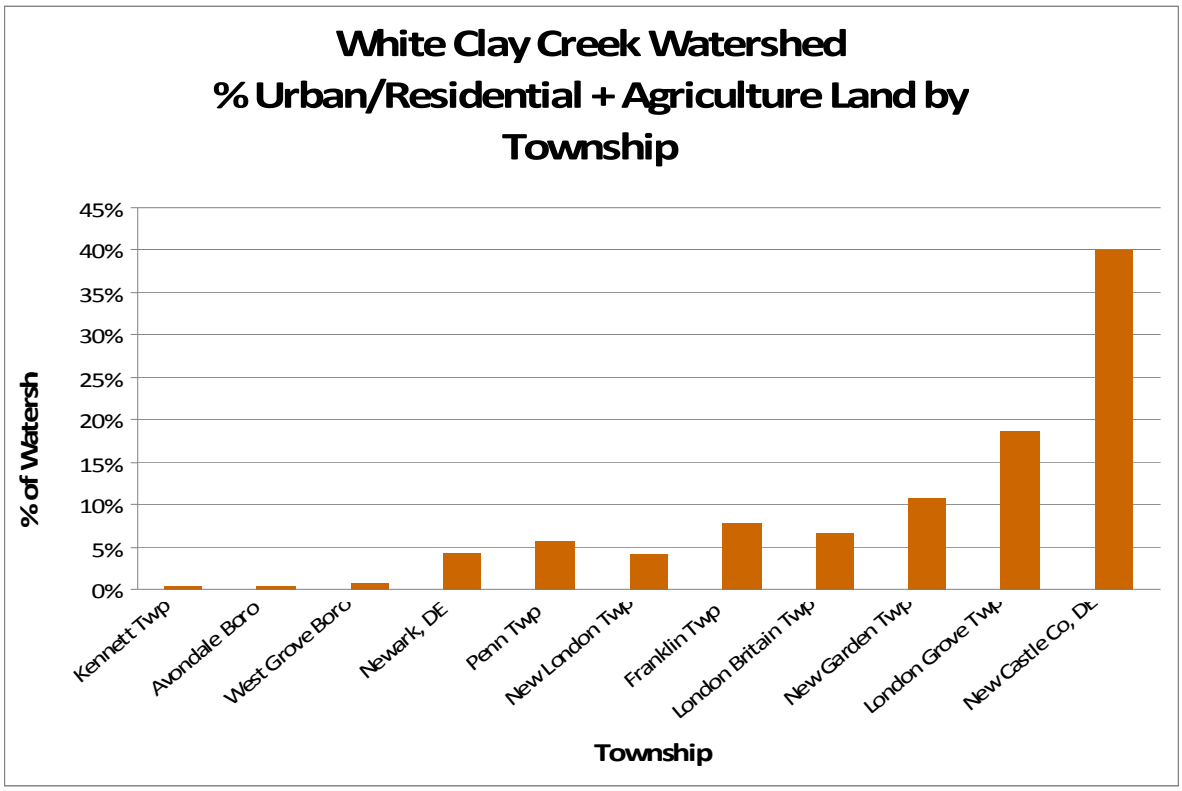

Figure 9. Percentage of urban/suburban plus agricultural land in the White Clay Creek watershed

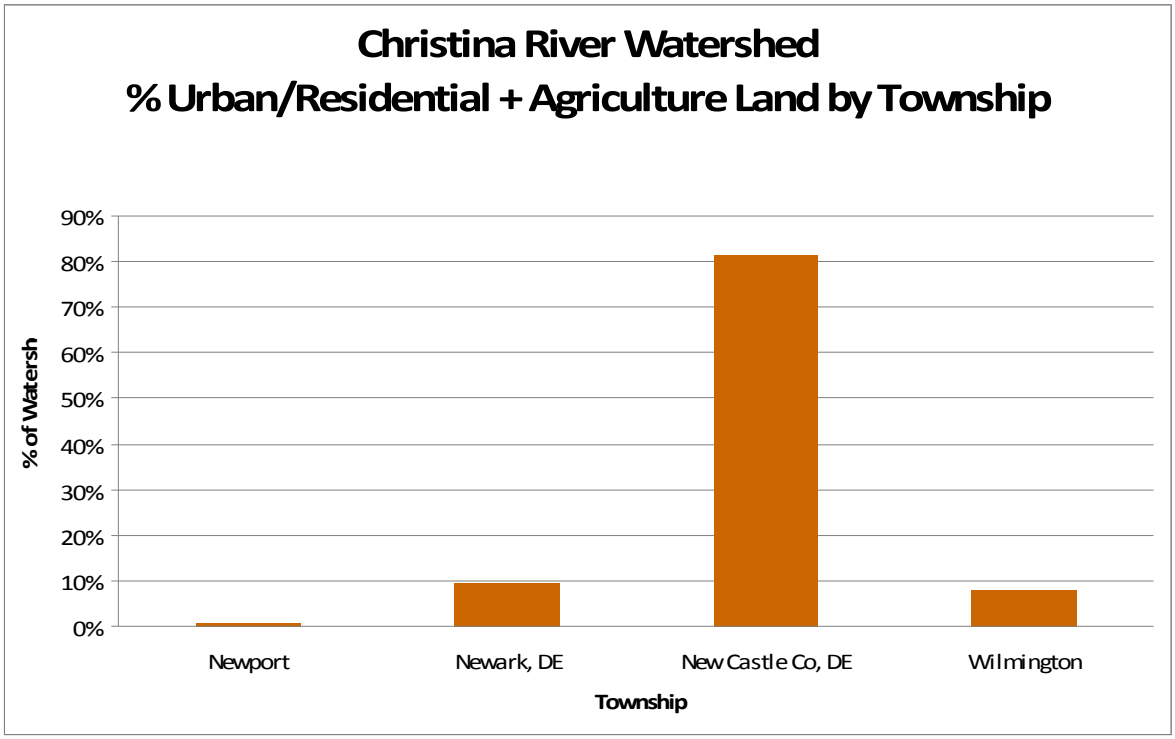

Figure 10. Percentage of urban/suburban plus agricultural land in the Christina River watershed

4. Water Quality Trends

Over the last decade and a half, stream water quality in the Christina Basin has mostly improved or rremained constant for dissolved oxygen, total phosphorus, and total suspended sediment but has degraded for nitrogen (Figures 11 through 13 and Table 14).

Dissolved oxygen levels along the four streams have improved since the 1990s and mostly meet a minimum water quality standard of 4 mg/l.

Total phosphorus levels have improved or remained constant since the 1990s although TP levels along the White Clay Creek have degraded slightly since 1995. TP continues to violate stream water quality standards.

Total Kjehldahl nitrogen levels have degraded along the Brandywine, Red Clay, and White Clay Creeks since the 1990s and improved only along the Christina River. TKN continues to violate stream water quality standards.

Total suspended sediment has improved or remained constant in all four streams since the 1900s. While Delaware and Pennsylvania do not have numeric sediment standards, over 95% of TSS samples are below a compareable 40 mg/l standard specified by the State of New Jersey

Table 14. Water quality trends along Christina Basin streams in Delaware, 1990 - 2005

Parameter	Brandywine Creek	Red Clay Creek	White Clay Creek	Christina River
DO	↑	↑	↑	↑
TP	→	↑	↓	→
TKN	↓	↓	↓	↑
TSS	→	→	→	↑

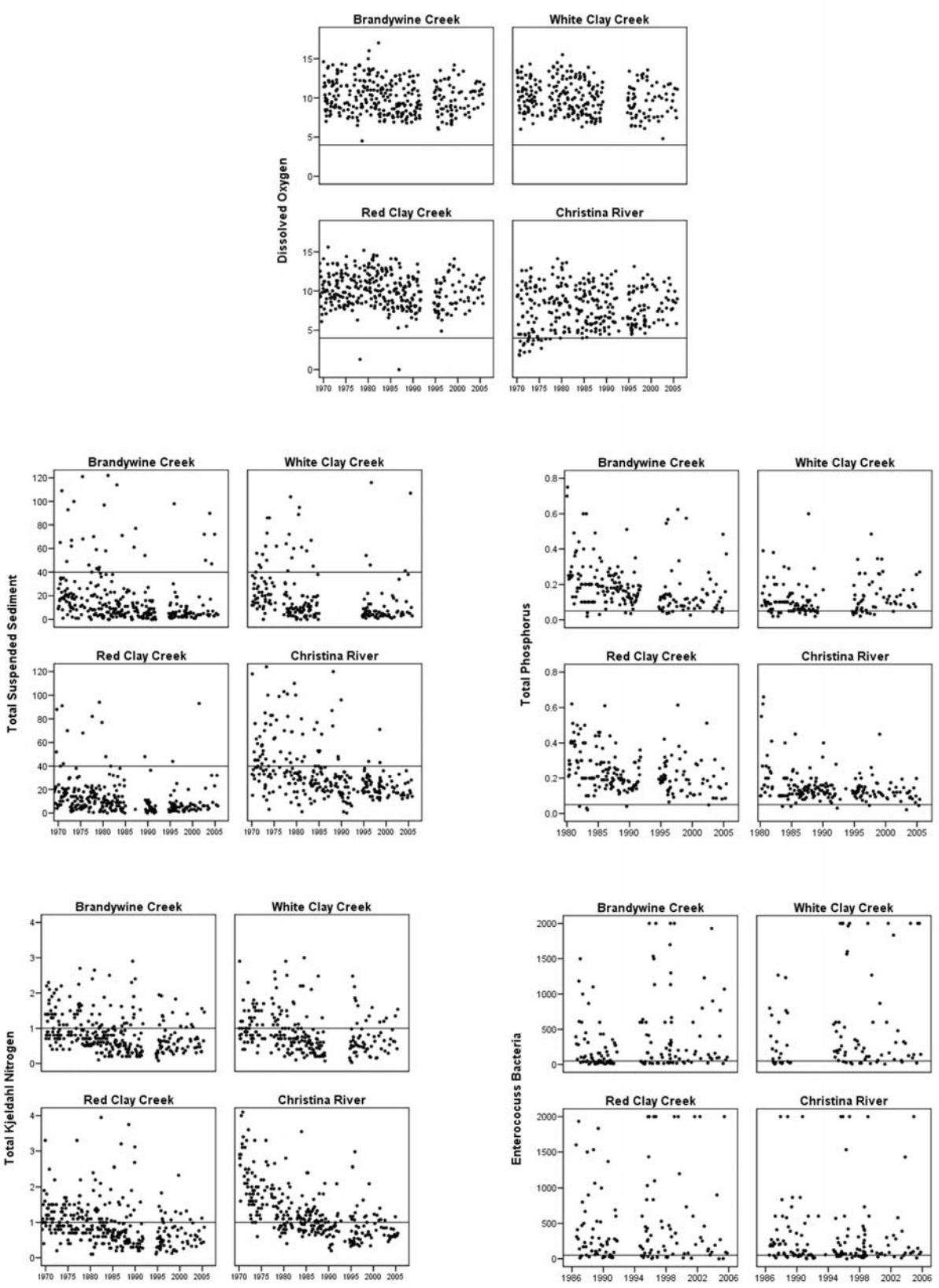

Figure 11. Water quality scatterplots along Christina Basin streams

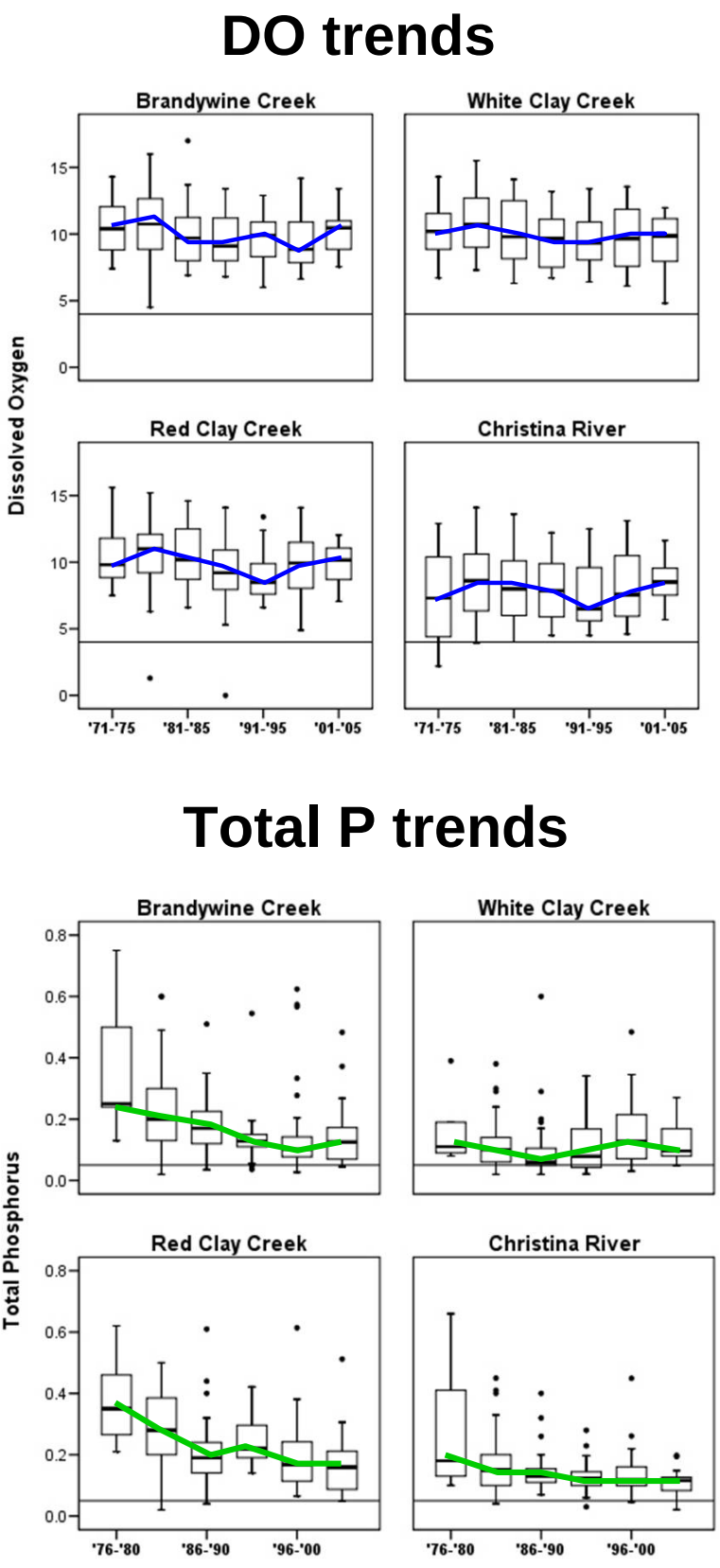

Figure 12. Water quality boxplots for dissolved oxygen and phosphorus in Christina Basin streams

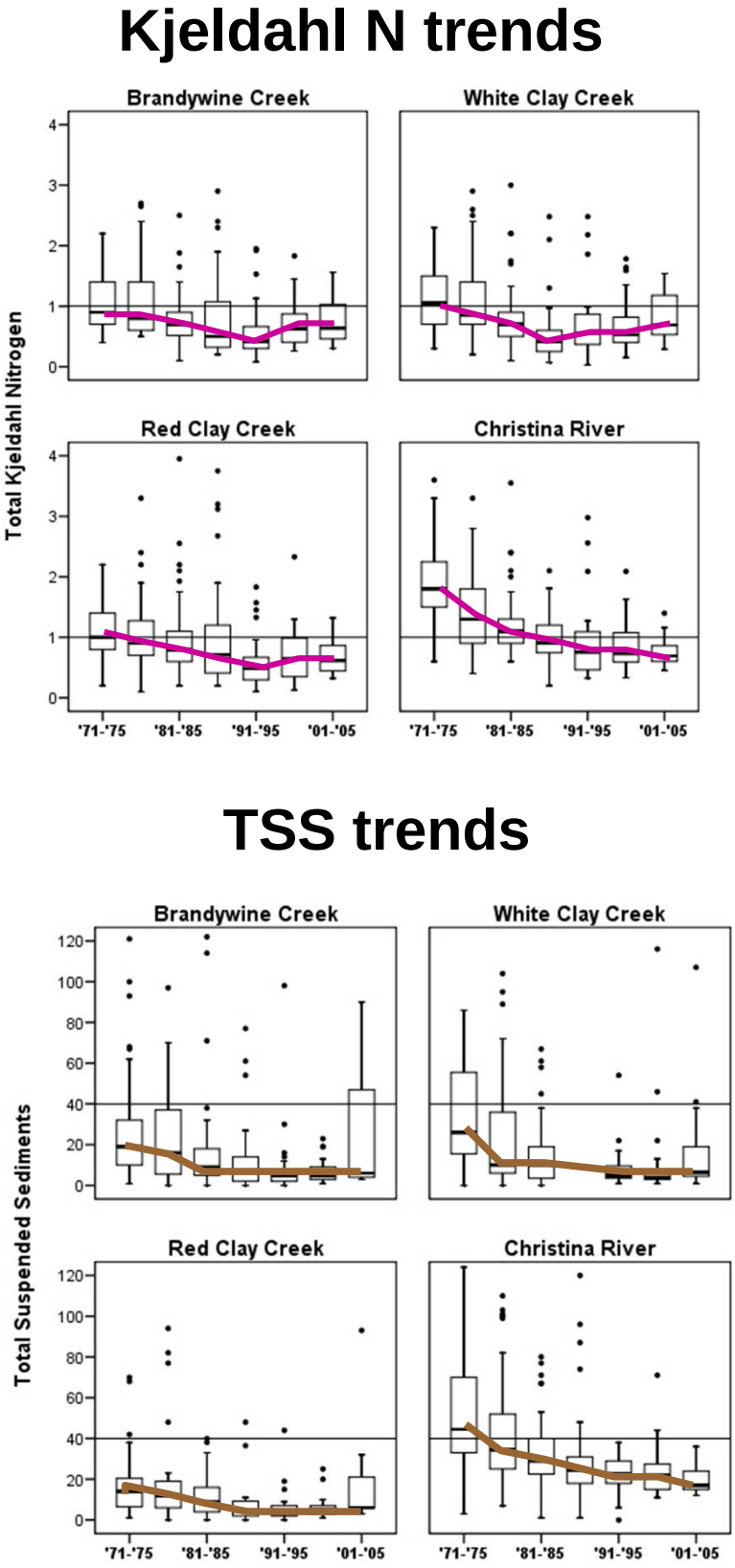

Figure 13. Water quality boxplots for total Kjehldal nitrogen and sediment in Christina Basin streams

5. EPA Targeted Watershed Grant

The Christina Basin Clean Water Partnership in Delaware and Pennsylvania has demonstrated the organizational capacity to implement large habitat restoration projects by completing the $1 million EPA Targeted Watershed Grant in 2008 (Figure 9). In 2003, the USEPA launched the first national Targeted Watershed Grant (TWG) program and the Christina Basin Partnership was selected as one of only 20 community-based watershed groups in the USA to receive federal funding. The Christina Basin was selected to receive $1 million as the No. 1 rated watershed grant out of 176 applications reviewed by USEPA.

The Christina Basin Partnership leveraged federal targeted watershed funds with local and private sources by a 2 to 1 margin. The Christina Basin restoration budget was $3,679,778 including $1,000,000 provided by the Targeted Watershed Grant, $339,000 provided by local match from Delaware and Pennsylvania stakeholders, and $2,340,778 received in leveraged funds from other sources. For every federal dollar invested, over two dollars were raised from local match and leveraged sources to implement the watershed restoration projects.

Table 15 and Figure 14 summarize on-the-ground projects completed with the Targeted Watershed Grant funds with federal monies as well as match and leverage funds. Through construction efficiencies and leveraging, the Christina Basin Partnership exceeded its original restoration goals on projects by 150% to 200%. For instance, along Delaware streams, 5,000 feet of stream reforestation/restoration were originally proposed and 8,920 feet were delivered. Through contractor efficiencies and leveraging, the Delaware DNREC was able to restore nearly 10,000 feet of stream, double the original goal!

Table 15. Christina Basin Targeted Watershed Grant implementation project deliverables

Task	Action	Original Deliverable	Final Result
3.1C	PA Soil Conservation Practices	500 acres	>725 acres
3.1D	PA Waterway Diversions	2,000 feet	2,250 feet
3.1E	PA Water Control Structures	4 structures	6 structures
3.1F	PA Stream Fencing	1,000 feet	8,025 feet
3.1G	PA Stream Reforestation	6,000 feet	9,148 feet
3.2	DE Smartyards and Rain Barrels	150 rain barrels	204 rain barrels
4.1	DE Stream Restoration/Reforestation	5,000 feet	8,920 feet

Through the EPA Targeted Watershed Grant, the Christina Basin Clean Water Partnership demonstrated the following strengths:

- A conscientious mission to meet restoration goals in the Christina Basin by 2015.
- Leadership from Congress including now Vice President Joe Biden (former Senator from Delaware who sponsored the original White Clay Creek Wild and Scenic legislation), Senator Tom Carper, Senator Ted Kaufman, Congressman Mike Castle, all from Delaware; and Senator Arlen Specter and Congressman Joe Pitts from Pennsylvania.
- A 15 year commitment from local watershed co-coordinators from Delaware and Pennsylvania, dating back to 1994.
- Through leveraging and economic efficiencies, the Partnership consistently exceeds its goals for habitat implementation.
- An interstate partnership is in place using the “middle-in” approach whereby restoration plans are developed by the Christina Basin partners in government and the nonprofit sectors and locally implemented by supportive residents and stakeholders.

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EPA Environmental News

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Report Shows Progress Exceeding Plans in Christina River Basin

(PHILADELPHIA, February 5, 2009) – The U.S. Environmental Protection Agency, announced today that the Christina River Basin Clean Water Partnership in Pennsylvania and Delaware has made significant progress in reducing pollution from storm water runoff to the Christina River basin.

A recent report by the University of Delaware and the Delaware River Basin Commission shows that, throughout the past four years, the Partnership, with the assistance of a $1 million EPA grant, has implemented numerous projects to reduce the harmful effects of stormwater runoff pollution on drinking water supplies, recreation, fisheries, and wildlife.

For every federal dollar invested in the project, the Partnership leveraged more than two dollars, allowing them to exceed the original goals, some by more than 50 percent.

Figure 14. Christina Basin completes $1 million EPA Targeted Watershed Grant

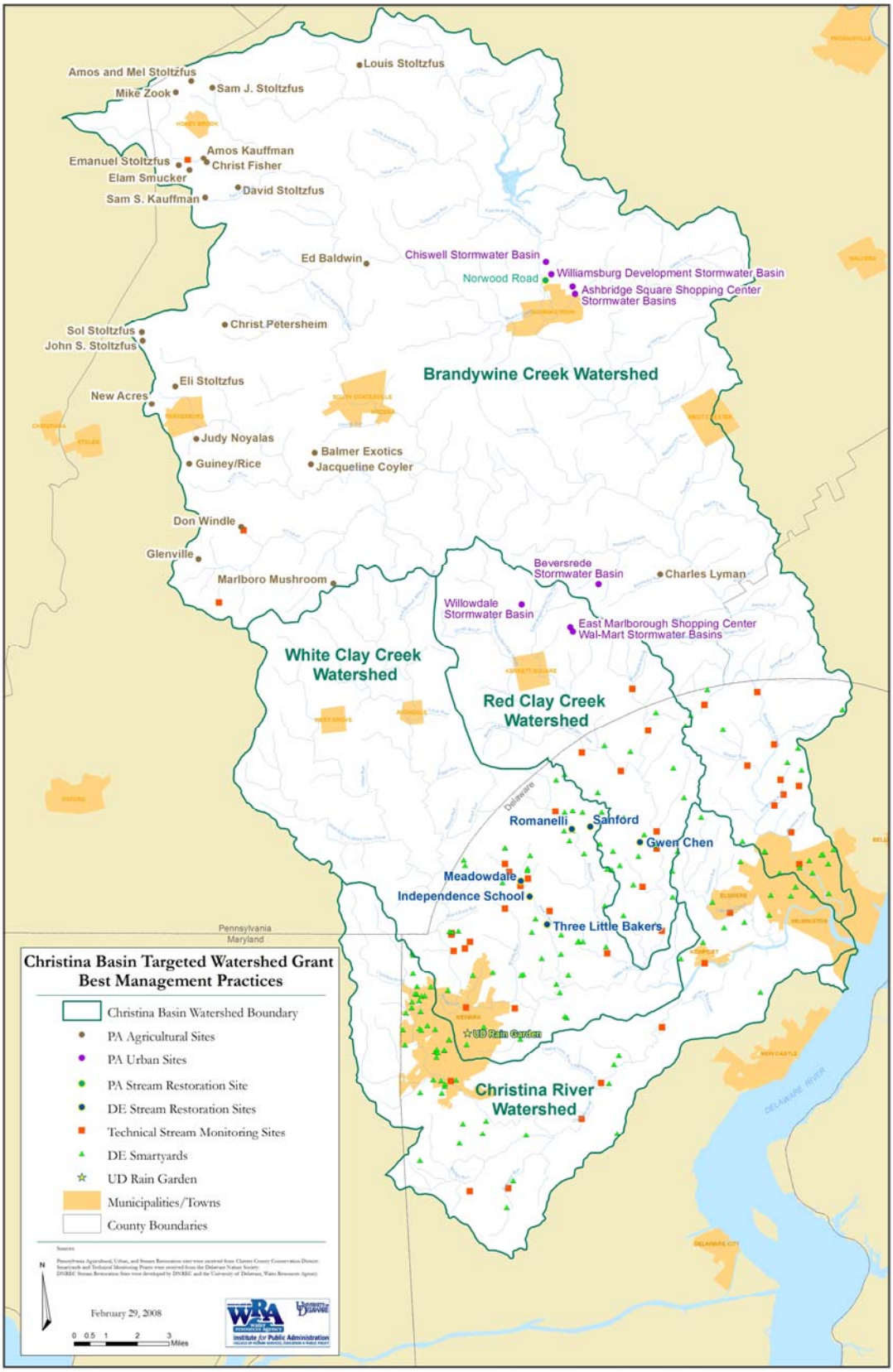


Figure 15. Christina Basin Targeted Watershed Grant best management practices

Congressman Joe Pitts (PA) presents award at Christina Basin TWG event, Feb 29, 2008

Congressman Mike Castle (DE) presents award at Christina Basin TWG event, Feb 29, 2008

Figure 16. Christina Basin Targeted Watershed Grant legislative event, February 29, 2008

Lower Fisher farm pasture pre-BMP (May 18, 2004).

Lower Fisher farm pasture post-BMP (September 19, 2007).

Figure 17. Before and after BMPs at Lower Fisher Farm, Brandywine Creek, Pennsylvania

Christina Basin Clean Water Partnership Awards Ceremony: A Celebration of Success
Red Clay Room • Kennett Square, Pennsylvania February 29, 2008

10:00 AM REGISTRATION

10:30 AM PROGRAM

MASTER OF CEREMONIES

ROBERT STRUBLE, EXECUTIVE DIRECTOR, BRANDYWINE VALLEY ASSOCIATION

WELCOME AND INTRODUCTIONS

DELAWARE RIVER BASIN COMMISSION

ROBERT TUDOR, DEPUTY EXECUTIVE DIRECTOR

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, REGION III

JON CAPACASA, DIRECTOR, WATER PROTECTION DIVISION

RESULTS OF THE TARGETED WATERSHED GRANT

CHESTER COUNTY CONSERVATION DISTRICT

CHOTTY SPRENKLE, WATERSHED COORDINATOR/SPECIALIST

DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

STEVE WILLIAMS, ECOLOGICAL RESTORATION COORDINATOR

DELAWARE NATURE SOCIETY

JOHN HARROD, BACKYARD HABITAT COORDINATOR

PRESENTATION OF AWARDS

U.S. REPRESENTATIVE MICHAEL CASTLE (DELAWARE)

U.S. REPRESENTATIVE JAMES GERLACH (PENNSYLVANIA)

U.S. REPRESENTATIVE JOSEPH PITTS (PENNSYLVANIA)

DELAWARE AWARD RECIPIENTS:

NICK AND HUGO IMMEDIATO, THREE LITTLE BAKERS GOLF COURSE

THE INDEPENDENCE SCHOOL, MARY ANN CAPRIA

PENNSYLVANIA AWARD RECIPIENTS:

JOSEPH AND DYANNE DELANEY , MATT BALMER, M. BALMER EXOTICS

THE LAFFEY FAMILY, GLENVILLE FARMS

FUTURE PLANS

PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION

CATHY CURRAN MYERS, DEPUTY SECRETARY

DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

DAVID SMALL, DEPUTY SECRETARY

ADJOURN AND ACKNOWLEDGEMENTS

DELAWARE RIVER BASIN COMMISSION

ROBERT TUDOR, DEPUTY EXECUTIVE DIRECTOR

12:00 PM LUNCH

6. Watershed Ecosystem Services

The USEPA urges watershed partnerships to value water resources and watershedsthrough an ecosystem services approach. Traditionally, the marketplace has treated water resources as free goods. With little or no value, water resources are compromised and pollution and overuse occurs. The ecosystem services approach strives to price watershed services to acquire economic value. If the resource incurs economic value, then there will be incentive in the markets to preserve and restore water resources. Under this model, downstream users (i. e. drinking water suppliers, industries, and recreational users) invest in improvements to upstream watersheds to strive for more cost effectiveness. This approach is estimated to provide at least a 2 to 1 economic savings in watersheds throughout the United States (Table 16). The ecosystem services approach has the potential to become the new business model to restore the Christina Basin.

The classic case study of ecosystem services occurred in New York City where the USEPA required the City to construct a $10 billion drinking water microfiltration system under the terms of the Safe Drinking Water Act. As an alternative, NYC passed a water rate surcharge and funded a $1.5 billion watershed protection program of reforestation, open space acquisition, wastewater treatment plants, and agriculture conservation projects at farms to protect drinking water in the Catskill reservoirs in the headwaters of the Delaware Basin. This ecosystem service model resulted in a cost effectiveness ratio of 6.5 to 1.

Regarding restoration of the Great Lakes, the Brookings Institution as reported in the Economist (June 2009) estimates that watershed restoration investments totaling $26 billion will result in benefits amounting to $80 billion, a 3 to 1 B/C ratio.

The economic value of the Chesapeake Bay is estimated at $1 trillion according to a 2004 study referenced in a 2009 EPA report to President Obama.

The Iowa Lakes Restoration and Valuation Project estimated that investments of $10 million would result in total net benefits in natural resources and recreational uses ranging from $22 to $733 million depending on the lake system of study.

The Ko'ohau Watershed project in Oahu, Hawaii concludes that investment of $43 million would result in total net benefits of $900 million in biodiversity protection, improved recharge, and improved quality of ground and surface water.

In the Biscayne Bay near Miami, Florida, restoration of ecosystems, native plant species and coastal habitat from investment of $16 million would result in benefits of $57 million with total net benefits of $41 million.

Table 16. Ecosystem services value of watersheds in the United States

Watershed	Investment	Value	Savings
New York City Catskill Reservoirs	$1.5 billion	$10 billion	6.5:1
Great Lakes	$26 billion	$80 billion	3:1
Chesapeake Bay		$1 trillion	
Iowa Lakes	$10 million	$22 million	2:1
Ko'ohau Watershed Oahu, Hawaii	$43 million	$900 million	21:1
Biscayne Bay Miami, Florida	$16 million	$57 million	3:1
Christina Basin, Del and Pa.		$260 million	

The waters of the Christina Basin in Delaware and Pennsylvania provide substantial water supply, ecological, and recreational economic benefits to society amounting to between $234 and $262 million per year (Table 17). The drinking water supply is worth at least $36.1 million annually. The warm water fishery is worth $6.2 million per year using plug-in values. Primary recreation (boatable water quality) is worth $6.6 million annually. The canoe and kayak eco-tourism businesses earn about $0.8 million annually. Trout fishing is worth $4.3 million per year. Motor boating in the tidal waters of the Christina Basin is worth $10.5 million annually. The present value of wetland habitat using the mid-range plug-in value is $10.0 million per year, and $38.1 million per year if valued for goods and services. Forests are worth $159.7 million per year. The net present value of these water related benefits in the basin is over $4.6 billion over 30 years assuming a 3% annual discount rate. The lofty economic value of the Christina Basin indicates it is worth continued public and private investment to improve the quality of these waters.

Table 17. Present value of the Christina Basin.

Benefit	**Present Value ($ million/yr)**	**Net Present Value ($ million) n = 30 yrs, r = 3%**
Drinking Water Supply	36.1	744.0
Warm Water Fishery	6.2	127.3
Recreation (Boating)	6.6	135.3
Ecotourism (kayaking)	0.8	16.5
Trout Fishing	4.3	88.9
Motor Boating	10.5	217.1
Wetlands	10.0 to 38.1	206.9 to 784.9
Forest	159.7	3,290.1
Total	**234 to 262**	**4,619 to 5,404**

The Christina Basin delivers 99 mgd of drinking water (peak) to residential, industrial, commercial and institutional customers (Table 18).

Table 18. Drinking water supply in the Christina Basin

Source	**Peak Withdrawal (mgd)**
Delaware Surface	71
Delaware Ground	13
Pennsylvania Surface	11
Pennsylvania Ground	4
Total	99

Northern Delaware water purveyors estimate that the approximate cost to withdraw and pump the water from the streams (the value of the raw water supply) is $1.00/1,000 gal or $1,000/mg. A study by the New Jersey Department of Environmental Protection places the in situ market value of untreated water supply at $0.394/1000 gal (Mates, NJDEP, 2007). Therefore, the present value of the raw water supply in the Christina Basin is:

PVws = 99 mgd ($1,000 /mg) (365 days/yr) = $36,116,385/yr = $36.1 M/yr

The streams in the Christina Basin support a warm water fishery. The economic benefit of the fishery can be estimated using plug-in environmental shadow price values (Boardman, Greenberg, Vining, Weimer, 2006). The plug-in value of rough fishing (warm water fishery) ranges from $12.70 to $51 per year per household with a mid-range value of $32/yr/household. About 560,000 people live in the the Christina Basin. The U. S. Census indicates there are about 2.9 people per household. The present value of the warm water fishery using the mid-range plug-in value is:

PVfh = $32/yr/household (560,000 p) / (2.9 p/household) = $6,179,310/yr = $6.2 M/yr

The streams in the Christina Basin have sufficient water quality to support primary recreation such as boating and canoeing. The water quality is not sufficient to support secondary recreation such as swimming due to high bacteria levels. The plug-in value for boatable water quality ranges from $8.50 to $59 per year per household with a mid-range value of $34/yr/household. (Boardman et. al., 2006). The present value of boatable water quality in the Christina Basin using the mid-range plug-in value is:

PVbt = $34/yr/household (560,000 p) / (2.9 p/household) = $6,565,517/yr = $6.6M/yr

The Brandywine Creek in the Christina Basin supports a sizable ecotourism business through canoe and kayak liveries. Two outfitters – Wilderness Canoe Travels and Northbrook Canoe – provide services to 20,000 customers per summer. The average cost of a canoe or kayak trip is $40 per person. Therefore the economic value of the ecotourism business is:

PVet = $40(20,000 p/yr) = $800,000/yr = $ 0.8 M/yr

The Christina Basin has sufficient watershed health to support six put and take trout streams that are cold enough to support a stocked cold water fishery during the winter, spring and fall of the year. The streams are too warm during the summer to support a reproducing wild trout fishery. Over 2,700 Delaware trout stamps are sold to licensed anglers and 30,000 trout are stocked annually to fish in the following trout streams:

White Clay Creek above Newark	Mill Creek
Beaver Run	Upper Christina River above Newark
Wilson Run	Pike Creek

In addition, approximately 14,100 trout stamps are sold in Chester County, PA, the predominant county of the basin. Since the Christina Basin comprises 51% of Chester County, we pro-rated the number of trout stamps at 7,190. In combination, there are 9,890 trout stamps sold in the basin.

The value of recreational fishing is estimated at $43.63 per activity day (Boardman et. al., 2006). If each licensed trout fisherman wets a line 10 days per year, the present value of trout fishing is:

PVtf = $43.63 per day (9,890 fishermen) (10 days/yr) = $4,313,749/yr = $4.3 M/yr

Delaware recreational mariners own 8,400 registered boats that ply the tidal waters of the Christina River and Brandywine Creek. In Chester County, registered boats total 7,680, which is 3,915 pro-rated for the Christina Basin. This is 12,315 boats for the entire basin. The value of recreational motor boating is estimated at $42.80 per activity day (Boardman et. al., 2006). If registered boater cruises the waters for 20 days per year, the present value of motor boating is:

PVmb = $42.80 per day (12,315 boaters) (20 days/yr) = $10,540,856/yr = $10.5 M/yr

According to 2007 land use data, there were 5 sq mi (3,228 ac) of wetlands in the Christina Basin. From Boardman (2006) the existence value of wetland habitat ranges from $8 to $97 per household per year with a mid-range value of $52/household/yr. About 560,000 people live in the Christina Basin and there are about 2.9 people per household. Therefore, the present value of the wetland habitat using the mid-range plug-in value is:

PVwe = $52/yr/household (560,000 p) / (2.9 p/household) = $10,041,379/yr = $10.0 M/yr

Alternatively, wetland values can be calculated based on the goods and services that they provide. For example, wetlands offer water filtration and protection from floods, among other benefits. Based on an NJDEP study (2007), freshwater wetlands can be valued at $11,802/acre/year. There are 3,228 acres of wetlands in the Christina Basin, therefore the present value of wetlands is:

PVwe = $11,802/ac/yr (3,228 acres) = $ 38,098,980/yr = $38.1 M/yr

This suggests a range in wetland valuation, and places the present value of freshwater wetlands in the Christina Basin between $10.0 and $38.1 M/yr.

Forests cover 93,180 acres of the Christina Basin, according to data from 2007. Using the benefits of the goods and services, the NJDEP has calculated a value of $1,714/acre/year for forested land. Thus, the present value of forests is:

PVfo = $1,714/ac/yr (93,180 acres) = $159,711,326/yr = $159.7 M/yr

The present value of the water supply, fishable, primary recreation, and ecotourism uses in the Christina Basin ranges between $224 to $262 million per year. The net present value of economic benefits in the Christina Basin can be determined over 30 years (n = 30) assuming an interest rate (r) equal to 3 % annually. The net present value of Delaware benefits in the Christina Basin is $4.6 to $5.4 billion over 30 years. The present value of benefits is discounted to year n using the discount annuity factor where:

$$P/A = \frac{PV}{(1 + r)^n}$$

7. Sustainable Watershed Funding

The Christina Basin Clean Water Partnership has assembled a $41 million backlog of over 176 watershed restoration projects (mean = $315,624) in need of funding (Appendix). In Delaware, the Christina Basin Pollution Control Strategy (2007) prepared by the University of Delaware for the DNREC and the Christina Basin Tributary Action Team has estimated a watershed restoration program to implement TMDLs will cost $9 million annually (minus CSO abatement costs in Wilmington).

Since 1994, the Christina Basin Partnership has funded restoration projects through a combination of in-kind funds from local partners, grants from Section 319 of the Clean Water Act, Safe Drinking Water Act source water funds, the $1 million EPA Targeted Watershed Grant, USDA agriculture conservation funds such as P. L. 566 and Conservation Reserve Enhancement Program through the New Castle County and Chester County Conservation Districts, Growing Greener grants from Pennsylvania, and Clean Water Revolving Loans from Delaware and Pennsylvania. Table 19 summarizes current Christina Basin restoration grant activity.

Dedicated financing is needed to supplement the grant by grant approach that has worked reasonably well over the last 15 years but will not fund enough projects to meet aggressive clean water goals over the next 10 years. Dedicated funds would be collected in a Christina Basin Clean Water Fund and distributed to parties such as the CCCD, NCCD, BVA, Brandywine Conservancy, Partnership for the Delaware Estuary, Delaware Nature Society, DNREC, PADEP and others who work to put projects in the ground. The annual funding goal would range from $1 to $3 million. These funds would be reinvested right back into the economy to pay for environmental restoration jobs for engineers, planners, biologists, consultants, and construction firms.

Sustainable funding options certainly have regulatory, political, and logistical concerns highlighted by differences in governance between the states as little Delaware has a county - based government different from the Commonwealth of Pennsylvania's network of municipal - based local governments. Additional funding complexities are interjected by different sections of the Clean Water Act because the MS4 stormwater permit program is based on political boundaries and TMDLs are based on watershed boundaries.

Grants and loans such as the $1 million EPA Targeted Watershed Grant have provided a much welcome source of Christina Basin restoration funding. Attesting to its success, the TWG was extremely competitive as only 20 watersheds were selected for funding from over 700 applications nationwide, a probability of success of only 3%.

Lately, competition among stakeholders for federal grants has exploded due to the scarcity of the global economic drought. Recently the Christina Basin Partnership was not selected as one of 50 successful applicants for a NOAA coastal restoration grant from a pool of 820 applicants for $170 million in funds. Due to dwindling economic resources, the competition to receive this Recovery Act grant was significant, a testimony to the great need to fund restoration in the USA. The probability of receiving large grants such as the NOAA award was 6%. The low probability of securing watershed grant funding makes it difficult to count on sufficient funding to meet aggressive Federal Clean Water Act restoration goals.

Therefore, dedicated and sustainable source(s) of watershed funding are essential if the Christina Basin Partnership is to have a high probability of restoring the waters of the basin over the next 10 years to the fishable, swimmable, and potable standards of the Federal Clean Water Act and the Safe Drinking Water Act and meet the Delaware and Pennsylvania surface water quality standards through the TMDL and NPDES MS4 permit process,

Watershed managers may wish to emulate a dedicated funding approach in place in the energy field in Delaware. The State of Delaware utilizes a dedicated funding source as an energy fee to replenish the Sustainable Energy Utility Trust Fund in accordance with Chapter 15 of Delaware Code. Each residential

electric customer is assessed no more than $0.58 per month to fund the SEU Fund. By May 30, the SEU Fund submits a status report to the Governor and General Assembly. By July 1, funds are distributed to the Delaware Energy Office for the SEU to be used for energy conservation and weatherization projects.

The University of Maryland Environmental Finance Center (2008) prepared a report for the USEPA on a Pennsylvania Stormwater Financing Initiative that examined the following watershed financing options.

- Local User Fees
- Regional User Fees
- County User Fees
- Watershed/River Basin District User Fee

The University of Maryland Environmental Finance Center (2006) prepared a Financing Feasibility Study for the Delaware Estuary that explored the feasibility of the following funding options.

- Ship Docking/Piloting Fees
- Motor Vehicle Tolls
- Water Extraction Fees (DRBC)
- Water Discharge Fees (Chesapeake Bay Restoration Fund)
- License Plate Program
- State Income Tax Checkoff
- EZ Pass Fees
- Boater Registration Fees
- Fishing/Hunting Licenses
- Utility Bill Roundup Programs

The watershed restoration grants process is relatively complex in public policy as there are at least 9 steps beginning when a citizen files an income tax return through the appropriations process and distribution of the funds through a request for proposal (Figure 18). The probably of receiving a grant through this process has been very low ranging from 3% to 6%.

In comparison the sustainable watershed restoration funding process is more efficient as there are only 5 steps between the citizen and actual watershed restoration (Figure 19). Once enacted, the probability of receiving watershed restoration funds through a dedicated funding stream is close to 100%.

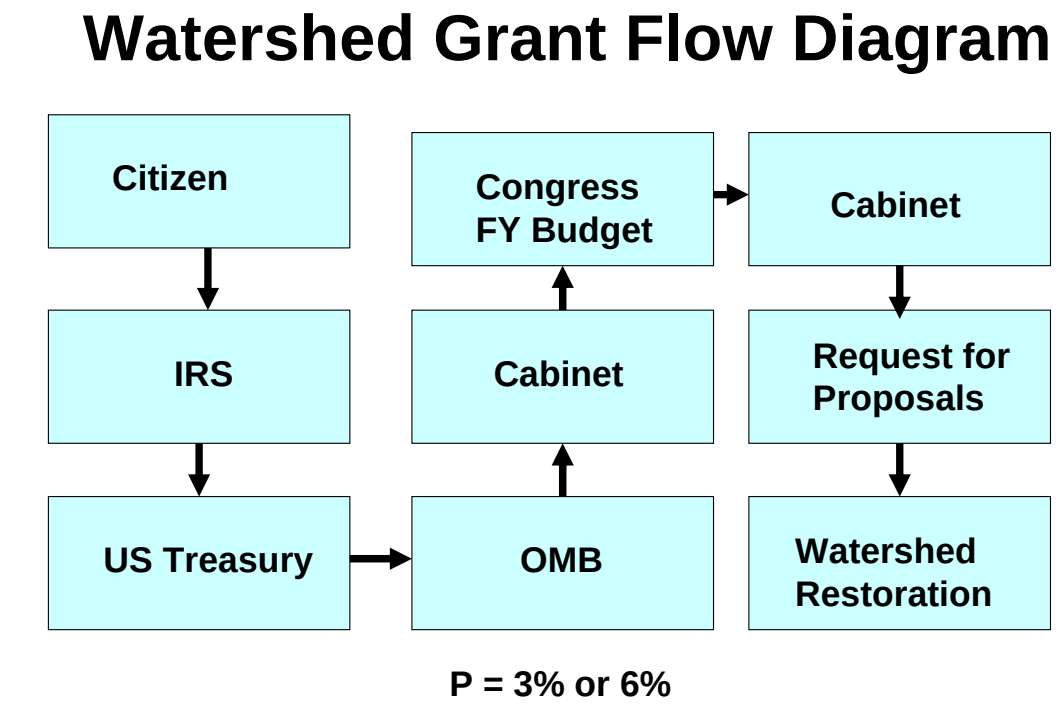


Figure 18. Watershed grant flow diagram

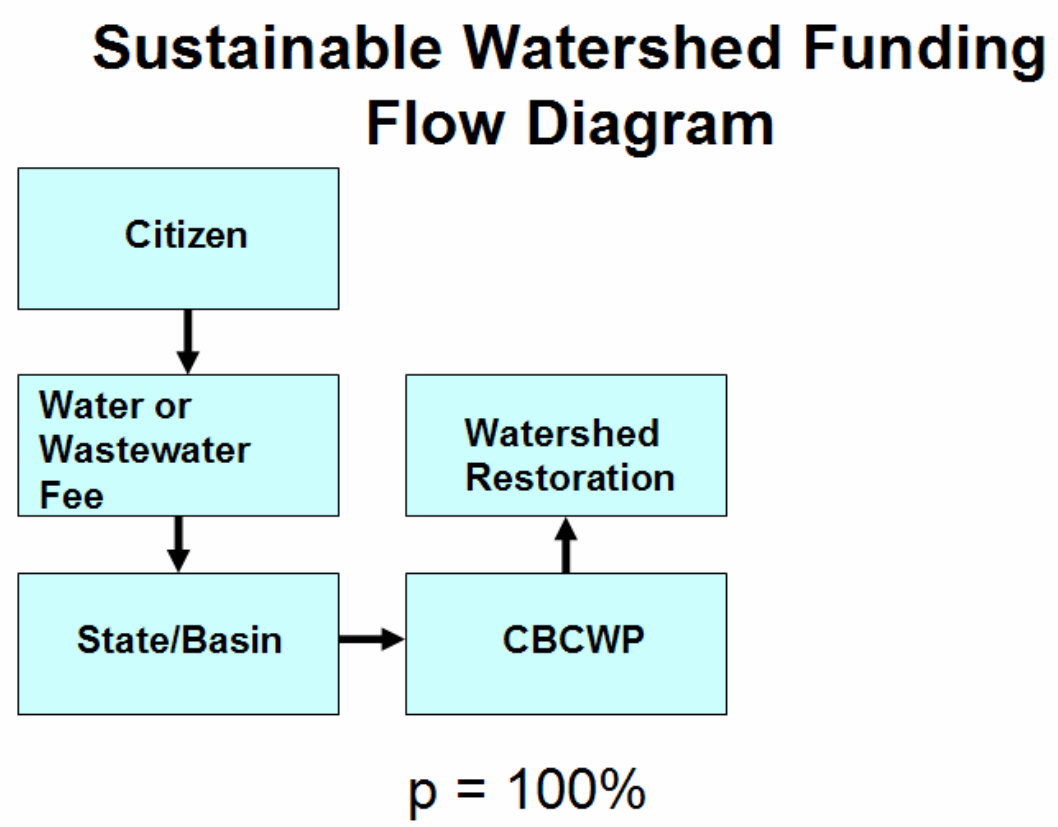


Figure 19. Sustainable watershed funding flow diagram

Table 19. Christina Basin grant funding activity (Nov 2009)

Funder	Grantee	Project	Amount	Status
DuPont Clean into the Future	UD Water Resources Agency	Shad in Schools Project	$24,000	Pending
DuPont Clean into the Future	Delaware Nature Society	Volunteer Riparian Habitat Assessment	$17,000	Pending
National Fish and Wildlife Federation	UD Water Resources Agency	White Clay Creek Shad Restoration	$39,000	Approved
NOAA Coastal Habitat Restoration	Christina Basin Partnership	Christina Basin Coastal Grant	$3,900,000	Not Approved
NOAA Coastal Habitat Restoration	Stroud Lab	Reforestation PA White Clay Creek		Not Approved
NOAA Coastal Habitat Restoration	Brandywine Conservancy	Shad Restoration Brandywine Creek		Not Approved
NOAA Coastal Habitat Restoration	DNREC Div of Fish and Wildlife	Governor Peterson Wetland Refuge		Not Approved
NOAA Coastal Habitat Restoration	Partnership for Delaware Estuary	Freshwater Mussel Restoration		Not Approved
Pennsylvania Growing Greener	Brandywine Valley Association	Brandywine Cr. Radley Run	$95,000	Approved
Pennsylvania Growing Greener		Brandywine Cr. Plum Run	$141,000	Approved
Pennsylvania Growing Greener	Stroud Lab	White Clay Creek	$208,000	Approved
Pennsylvania Growing Greener	West Chester Univ.	West Branch Brandywine Cr.	$20,000	Approved
US Army Corps of Engineers Recovery Act	Delaware River Basin Commission	Brandywine Creek Restoration	$2,000,000	Pending
USDA NRCS	Chester Co. Cons. District	Red White Clay Tech Assistance	$30,000	Approved
USDA NRCS Recovery Act Watershed Restoration	Chester Co. Cons. District	Red-White Clay Creek	$430,000	Approved
USDA NRCS Recovery Act Watershed Restoration	Chester Co. Water Resources Authority	Brandywine Cr. Hibernia Wetland	$20,000	Approved
USEPA Brownfields	Delaware DNREC	Wilmington Southbridge	$2,000,000	Approved
USEPA Clean Water Revolving Green Reserve	UD Water Resources Agency	White Clay Creek Restoration	$135,000	Preapplication Approved
USEPA Region 3 Wetlands	UD Water Resources Agency	Christina Basin Wetland Grant	$165,000	Not Approved
WREN	East Fallowfield Twp.	East Fallowfield Park Rain Garden	$5,000	Approved
WREN	White Clay Wild & Scenic Program	Reforestation London Grove,	$4,960	Approved
Kneale Dockstader Foundation	White Clay Wild & Scenic Program	reforestation outreach	$1,569	Approved
National Science Foundation	UD Plant & Soil Sciences, Stroud Lab.	Critical Zone Observatory	$4.8 million over 5 years	Approved

The following dedicated and sustainable watershed funding options are available for discussion by the Christina Basin Clean Water Partnership.

1. Local and Regional Government Pooled Fund

Local governments would contribute a proportion of funds (several thousand dollars per year) annually to the Christina Basin Clean Water Fund. Using these funds, the Christina Basin Partnership would implement restoration projects to meet local NPDES MS4 permit obligations. Local governments in Delaware and Pennsylvania would contribute to the Christina Basin Fund based on a formula of percent urban/suburban plus agricultural land or population. An annual $1 million Christina Basin Clean Water Fund budget could be established with $500,000 toward the Brandywine Creek, $300,000 to the White Clay Creek, and $100,000 each to the Red Clay Creek and Christina River watersheds.

Consider the White Clay Creek watershed with an annual funding need of $100,000. If New Castle County, Kennett, East Marlborough, New Garden, and Pennsbury Townships, and Kennett Square Borough account for 34%, 25%, 25%, 12%, 3%, and 1% of the urban/suburban plus agricultural land in the White Clay Creek watershed, then these jurisdictions would contribute $34,000,$25,000, $25,000, $12,000, $3,000, and $1,000, respectively, to the Christina Basin fund for watershed implementation to meet the terms of their NPDES MS4 permits.

The June 2009 issue of EPA Nonpoint Source News-Notes summarizes regional models where local governments pool their funds to implement NPDES municipal stormwater permits:

- Lake Superior Regional Stormwater Protection Team (RSPT) – Local governments and the South St. Louis Soil and Water Conservation District near Duluth, MN contribute dues proportioned by population.

- Northeast Wisconsin Stormwater Consortium (NEWSC) – Four committees implement a regional NPDES MS4 permit on behalf of 34 municipalities.

- Iowa Stormwater Partnership – Pooled government fund of 38 municipalities near Iowa City, IA.

- Northern Virginia Clean Water Partners - $1 million contributed by residents on behalf of 9 local governments, 2 water/sewer authorities, and one regional commission.

- Metro WaterShed Partners - 60 entities in Twin Cities of Minneapolis and St. Paul participate in a regional NPDES MS4 permit.

- Chittendon County, VT, Regional Stormwater Education Program – Pooled fund of 9 municipalities including Burlington, VT, University of Vermont, Burlington International Airport, and Vermont Agency of Transportation.

- Tahoe Regional Planning Authority, California and Nevada – TRPA established a $75,000 budget where each county in California pays $18,750 and each county in Nevada pays $12,500 with funds supplemented by the States of California and Nevada.

2. Income Tax Checkoff

The Federal government and Maryland, Virginia, and Colorado permit voluntary income tax deductions for land conservation, fish and wildlife, and water quality programs. The Healthy Rivers Fund administered by

the Colorado Water Control Board is supported by a check off option on the Colorado income tax return. Since 2003, the fund has generated $650,000. If 30% or 200,000 taxpayers in the Christina Basin voluntarily checked off $5.00 on their income tax forms, then $1,000,000 would be raised for watershed restoration.

3. Water Pollution Damages/Penalties

Under the Clean Water Act, companies and firms are liable to pay water pollution damages due to spills, hazardous waste accidents, and violation of permits. Citizens are permitted to sue and engage the Attorney General to recover damages from water pollution violations under the bounty provisions of the Clean Water Act. Approximately $100,000 in penalties occur in the Christina Basin each year that could be applied to watershed restoration.

Water pollution penalties have funded watershed projects throughout the USA. The National Fish and Wildlife Foundation (NFWF) received $600,000 to fund a Delaware Basin Restoration Plan from oil spill damages received along the Delaware River. Robert F. Kennedy Jr., an environmental lawyer, funded the Hudson Riverkeeper by successfully winning citizen suits against polluters under the bounty provisions of the Federal Clean Water Act. In 2001, Wal-Mart agreed to a $1 million penalty to resolve Clean Water Act NPDES storm water permit violations at 17 stores/construction sites in Texas, New Mexico, Oklahoma and Massachusetts.

In 2001, the USEPA announced Amtrak agreed to pay a $500,000 civil penalty and spend $900,000 on environmental projects to restore wetlands and reduce PCBs in New England for violations of the Clean Water Act. In 2001, Iowa Beef Packers agreed to pay the United States $4.1 million in penalties for violating the Clean Water Act at IBP plants in Nebraska, Iowa, Kansas and Texas.

In 2009, the Black Warrior Riverkeeper settled a $150,000 judgement against Birmingham Airport Authority, Alabama under the bounty provisions of the Clean Water Act to fund a land conservation project in Jefferson County Village Creek watershed to be managed by the Freshwater Land Trust. The Lower Susquehanna Riverkeeper won a $120 million settlement between PADEP and PPL Corp. to end violations of the state Clean Streams Law and federal Clean Water Act at the PPL Brunner Island electric plant in York County. PPL will pay fines assessed by PADEP directly to the Lancaster and York County Conservation Districts to protect streams in the lower Susquehanna watershed.

4. Aquifer Protection Area Fee

Fees would be charged for withdrawals of groundwater and discharge of wastewater within designated aquifer (wellhead or recharge) protection areas near public water supply wells. In 2004, Spokane County, Washington voters reauthorized aquifer protection area fees for water supply withdrawals and wastewater discharges within the Spokekane - Rathdrum Aquifer Protection Area. New Castle County, Delaware protects delineated wellhead and aquifer recharge areas under the water resource protection area provisions of the Unified Development Code. If an aquifer protection fee of $0.10 per 1000 gal ($6.00 per household per year) were assessed on public water wells (7 mgd) in the delineated New Castle County WRPAs in the Christina Basin, then $255,500 would be raised annually.

5. Wastewater Surcharge Fee

In 2004, Maryland passed a law authorizing the Chesapeake Bay Restoration Fund financed by a $2.50 monthly fee on users of wastewater treatment plants and a separate fee on septic systems. This “flush tax” is used to fund nutrient removal projects (nitrogen and phosphorus) by upgrading Maryland’s 66 largest wastewater treatment plants, eliminating failed septic systems, and supporting agriculture cover crop programs. Maryland DNR funds $65 million annually for wastewater treatment and $12 million for septic

system upgrades. If a $2.50 monthly fee were assessed at 200,000 households in the Christina Basin, a flush tax would raise 500,000 monthly or $6 million per year.

6. Boater Registration Fees

A $2 fee would be assessed on boater registration fees that range from $10 to $60 in Delaware for 52,000 boats to $26 to $52 in Pennsylvania for 354,000 boats. Washington State has a voluntary checkoff program on boat registrations to contribute nonprofit funds for restoration. For registered boats in both states, a $2 fee would generate $104,000 in Delaware and $708,000 in Pennsylvania.

7. Chesapeake Fund

The Chesapeake Fund was launched to jump-start the reduction of 1 million pounds of nitrogen annually in "hotspots" around the Chesapeake Bay watershed by channeling investments from nitrogen offsets into conservation and restoration practices. Work is underway to create a market for nitrogen to dramatically reduce the harmful nitrogen emissions into the Bay's watershed leading to improved water quality. The Chesapeake Fund is a new and innovative program to establish a voluntary water quality market in the watershed to reduce nitrogen. The aim is to develop an environmental marketplace built around good science and strong policies that will lead to cleaner waters and healthy, functioning ecosystems. By putting the marketplace to work for restoration, the Fund will encourage cost-effective and efficient means for implementing conservation and restoration practices.

8. Air Emissions Charges

Emissions charges put a price on the right to pollute by addressing air - borne pollution at the source. Over 30% of nitrogen and mercury water pollution originates from atmospheric emissions from motor vehicles, industries, and power plants. Under Title V of the Federal Clean Air Act, states charge permitted dischargers a fee of $25 per ton for emitted pollutants. Emissions charges create a strong incentive to innovate and create mechanisms to reduce air pollution. However, little has been done to utilize air emissions charges to reduce atmospheric deposition as a major cause of water pollution.

9. Motor Vehicle Toll Fees

Every year, over 234 million vehicles travel on toll roads through the Christina Basin in Delaware and Pennsylvania. Motor vehicles require roads and highways that have a significant impervious cover impact on watersheds. Motor vehicles deposit contaminants such as oil, grease, gasoline, worn tires and break lining metals that flow to rivers and streams. This mechanism would assess a $0.02 fee on motor vehicle tolls along toll roads that cross through the Christina Basin operated by the Delaware Transportation Corporation (I-95 and Route 1), Pennsylvania Turnpike Authority, and Delaware River and Bay Authority (Delaware Memorial Bridge). The two pennies per toll mechanism has the potential to raise $4.1 million annually (Table 20).

Table 20. Potential motor vehicle toll fees in the Christina Basin

Toll Road/Bridge	Annual Vehicles	Annual Revenue ($)
Delaware Transportation Corporation	28,000,000	560,000
Pennsylvania Turnpike Authority	162,450,000	3,249,000
Delaware River and Bay Authority	16,425,000	328,500
Total	$234,875,000	$4,137,500

10. Fishing License Fee

A $1.00 per license fee would be assessed on the 8,000 fishing licenses issued in Delaware ($8.50 resident, $15 nonresident) and 10,000 fishing licenses issued in Pennsylvania ($22 resident, $52 nonresident) for fishing in the Christina Basin. Annually, this mechanism would raise $8,000 in Delaware and $10,000 in Pennsylvania for restoration.

11. Franchise Fees

Some governments such as Denver assess a 3% franchise fee on annual gross revenues from utilities to acquire park and recreation areas.

12. Green Credit Card Fee

The Christina Basin Clean Water Partnership would work with banks such as Bank of America headquartered in Wilmington to set up a green credit card. For each credit card issued, a small percentage would be contributed to the watershed restoration fund. Environmental organizations such as the National Wildlife Federation and Nature Conservancy use the green credit card to raise revenue. If 600,000 people live in the Christina Basin and there are 200,000 households (3 people per household) who choose a green credit card that returns $2 per card, then the annual revenue would be $400,000.

13. License Plate Fee

Maryland and Virginia charge $25 for a special "Save the Bay" license plate that generates millions for the Chesapeake Bay Restoration Fund. If 100,000 Christina Basin motorists all purchased "Save the Christina" license plates at $25 each, then $2,500,000 would be raised for watershed restoration.

14. NPDES Wastewater Discharge Permit Fees

The 2004 Natural Resources and Environmental Protection Act authorizes state environmental departments to collect NPDES permit fees. Section 106 of the Clean Water Act authorizes USEPA to provide financial incentives for states to utilize discharge permit fees to implement an NPDES permit program. In California, NPDES wastewater dischargers pay an annual fee set by the State Water Board deposited in the Waste Discharge Permit Fund which generates $78.5 million annually. In the Christina Basin in Delaware and Pennsylvania, if a $100 per million gallons annual fee were authorized on 93 NPDES wastewater discharges of 25 mgd, then $912,500 in revenue could be raised annually.

15. Rhode Island Aqua Fund

The Rhode Island Department of Environmental Management administers the Aqua Fund which provides grants to fund water quality improvement projects in the Narragansett Bay. Funds are issued for projects to prevent pollution of the Bay and tributaries, such as wastewater treatment projects and urban runoff abatement. The Aqua Fund has awarded over $8.8 million in grants.

16. Septic System and Well Permit Fees

Randolph, New Jersey and Monroe County, Michigan charge fees for septic system and well permits. The State of Delaware charges fees for well permits. The permit fees help ensure septic systems and wells are properly constructed and maintained as per environmental and health regulations.

17. Ship Docking Fees

A 10% ship docking fee would be assessed on ships that dock at the Port of Wilmington at the mouth of the Christina River. If 800 ships dock annually at the port and the average ship docking charge is $10,000, then the 10% ship docking fee ($1,000) would generate $800,000 annually.

18. Special Watershed Assessment Fees

Governments assess a surcharge by fee for a specific watershed zone. Minneapolis, Minnesota; Fargo, North Dakota; and Manhattan, Kansas charge special assessments to fund water works systems, sanitary sewer systems, installation/repair of water/sewer service lines, and flood protection projects.

19. Water Withdrawal Application Fees

Most western states charge water appropriations application fees to fund water supply planning and hydrogeological studies. A water appropriation is an authorization granted by a state to make private beneficial use of the state's water resources. Water rights application fees are used to cover the costs including site investigation, environmental/hydrogeologic analyses, water availability investigation, reports with investigators findings, and recommendations regarding approval. Virginia charges public water supply withdrawal application fees for subdivisions, public water systems, stores, and other entities for the right to withdraw water in quantities ranging from 10,000 gallons to over 100,000 gallons per day. Michigan charges a $2,000 water withdrawal fee which is relatively stable due to the inelasticity of water demands. Water allocation permit fees in Delaware are currently $375 per application and have not been increased in over 15 years. Virginia and New Jersey charge fees 3 to 10 times higher than Delaware (Figure 20). Doubling the fee in Delaware would raise more than $1 million per year.

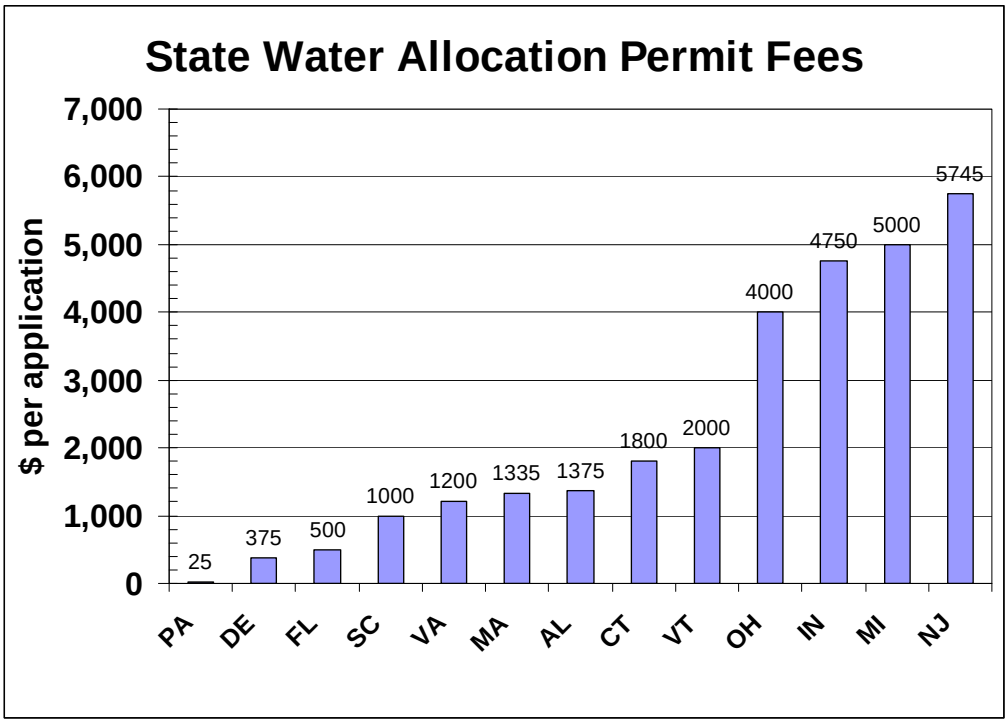


Figure 20. State water allocation permit fees

20. Stormwater Utility

Delaware law authorizes governments to form stormwater utilities under Chapter 40, Title 7 of Delaware Code: (c) *Authority is also granted to the Department, conservation districts, counties or municipalities to establish a stormwater utility as an alternative to total funding under the fee system."*

Local governments in the Delaware portion of the Christina Basin have considered stormwater utility funding mechanisms to finance restoration and source water protection projects (Figure 21):

- City of Wilmington – City Council adopted a stormwater utility in 2007.
- City of Newark – City Council held workshops in Aug/Nov 2009 to consider a stormwater utility.
- New Castle County – Hired a consultant to study feasibility of stormwater utility, ongoing.

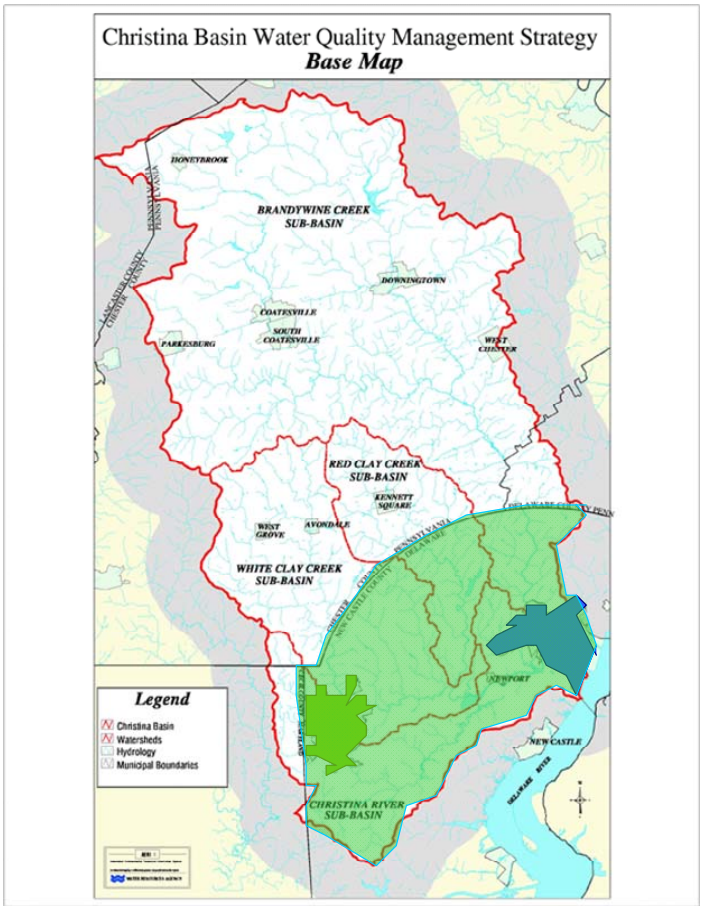
Stormwater utilities are progressive mechanisms implemented by clean water advisory groups all over the USA. Stormwater utilities accrue funds based on the amount of roof and pavement on a property, an equitable concept where homeowners with 30% impervious cover on a ¼ acre lot pay less than parking lot owners with 100% pavement. Wilmington adopted the first stormwater utility in Delaware and lowered residential water rates in the process. The City earns revenue to abate combined sewer overflows and work with upstream farms to improve water quality on the City's Brandywine water source. Governments in Philadelphia, Richmond, and Montgomery County, Md. have adopted stormwater utilities. Chesapeake, Va. has a stormwater utility that charges $2.55 per month or $31.00 annually. A Christina Basin bi-state stormwater utility fee of $9.00 per customer per year for 200,000 residential customers would raise $1.8 million annually

Close to 700 local governments in the USA have adopted stormwater utilities to finance stormwater, flood control, and watershed management programs (Figure 22 and 23). The average stormwater fee for single family residential parcels is $3.67 per month. In the USA, residential stormwater fees range from $2.00 to $40.00 per quarter. In college towns, monthly residential fees range from $1.50 (Burlington, VT), $3.43 (Orono, ME), to $14.26 (Ft. Collins, CO). In the Delaware Basin, stormwater utilities charge monthly residential fees of $2.71 in Wilmington and $10.80 in Philadelphia. Stormwater utilities have several advantages as a dedicated funding source:

- Treats stormwater as utility resource (like drinking water)
- Equitable - stormwater from roof/pavement impervious cover
- Hydrologic relationship - impervious and stormwater runoff
- Impervious cover measured on a parcel by basis by GIS
- Dedicated/sustainable funding - total life cycle cost accounting
- Accrued to tax paying and tax exempt properties
- Improves the overall equity of the municipal financing mix
- Billing system in place for water, sewer, property assessment

Newark City Council is considering a stormwater utility fee assessed at $0.01 per sf of impervious cover to raise $720,000 per year based on residential uses and a $10 per 1000 sf of impervious rate for nonresidential parcels (Tables 21 and 22). Figure 24 summarizes Newark stormwater fees.

- $5.08 per mo. (RH residential, 21,780 sf)
- $3.92 per mo. (RT residential, 15,000 sf)
- $3.42 per mo. (RS residential, 9,000 sf)
- $2.82 per mo. (RD residential, 6,250 sf)



Stormwater Utility Status Delaware

Figure 21. Status of stormwater utilities in the Christina Basin. Wilmington has an approved stormwater utility. New Castle County and City of Newark are considering stormwater utilities.

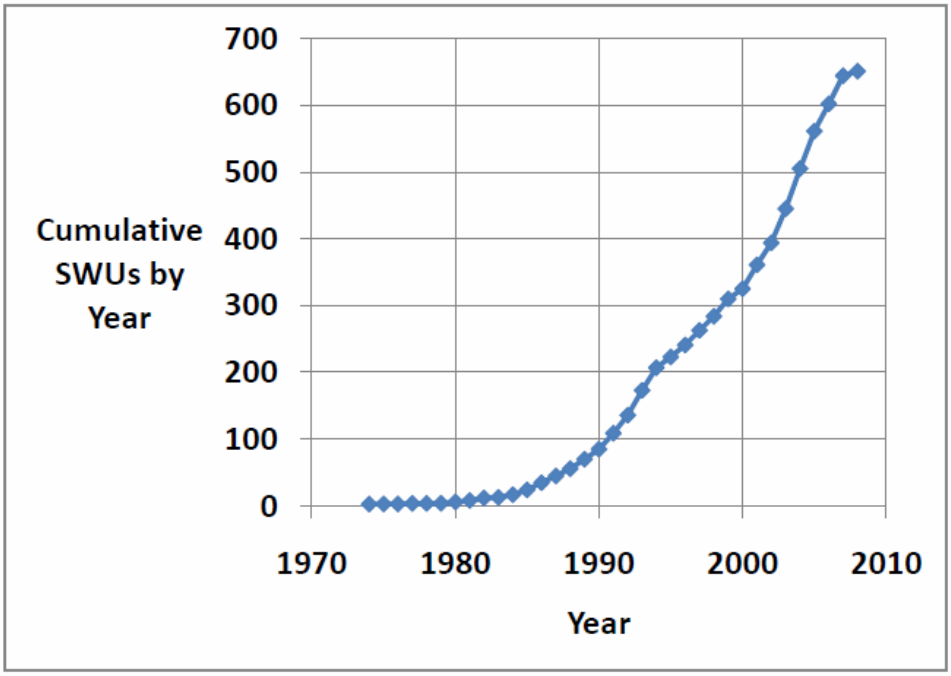


Figure 22. Growth of stormwater utilities in the United States (Western Kentucky University)

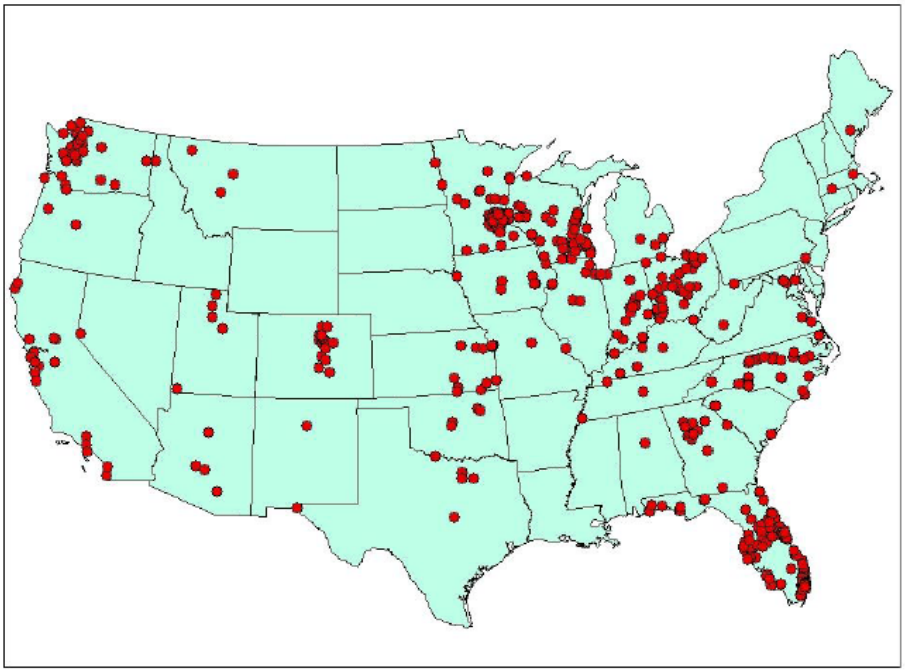


Figure 23. Stormwater utilities in the United States (WKU, 2008)

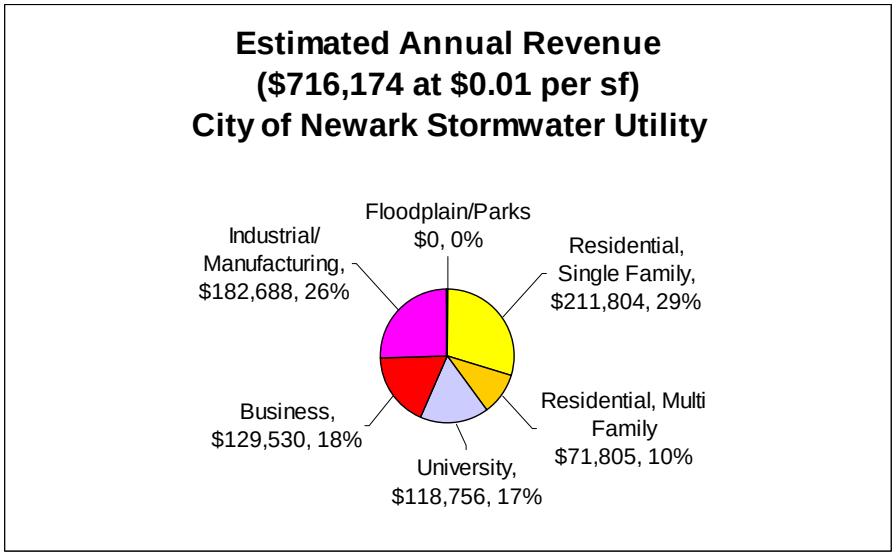


Figure 24. Estimated stormwater fee for a City of Newark stormwater utility

Table 21. Typical stormwater fees for parcels in the City of Newark

Parcel	Area (sf)	Impervious (sf)	Impervious (%)	($0.01/sf imperv.)
Drug Store	89,200	54,700	60%	$547
Shopping Ctr.	711,900	603,060	85%	$6,031
Restaurant	17,100	17,100	100%	$171
Church	53,850	23,820	44%	$238
School	519,610	170,300	33%	$1,703

Table 22. Recommended stormwater utility fee in the City of Newark

Designation	Option 1 ($0.01/sf) Stormwater Fee
Residential, One-family, detached, semidetached	$3.33 monthly
Multifamily Residential, University, Business, Manufacturing, Industrial, Office	$10.00/1000 sf monthly
Open floodway district (undeveloped)	No building permitted
Parkland, Roads/streets, Railroads. City – owned land. City – leased parking facilities	Exempt
Projected Annual Revenue	**$716,174**

21. Water Utility Bill Roundup Program

If 200,000 Christina Basin water consumers (30% of the basin population) voluntarily chose to contribute $6.00 per year ($0.10 per 1000 gallons assuming 15,000 gal per quarter residential consumption) as a water utility bill checkoff program, this program would raise $1,200,000 annually.

22. Water Rate Fee

The Rhode Island Water Resources Board has a public drinking water protection program known as the "penny per hundred" program which assesses a $0.10 per 1000 gal or $100 per million gallons fee with $18 million disbursed since 1994. New Jersey considered this approach to raise $100 million per year for green acres and open space watershed protection

In the Christina Basin, a non-irrigation water fee of $0.10 per 1000 gallons would result in a charge to each residential customer of $6.00 per year assuming average water use of $15,000 gallons per quarter. A water surcharge fee by definition is temporary and could be waived when the economy improves. The fee, as opposed to a tax, is voluntary and control lies totally with the consumer. If one wishes not to pay the surcharge, one simply conserves water. The water fee could be assessed by state law or through the provisions of the 1961 Delaware River Basin Compact.

In the Christina Basin, normal public water demand is 100 mgd with 70% withdrawn in Delaware and 30% in Pennsylvania. If a water fee were set at $0.10 per 1000 gallons and normal water use is 15,000 gallons per quarter, the annual charge per residential customer would be $6.00 per year. A Christina Basin water allocation fee has the potential to raise $3,650,000 per year based on 100 mg per day ($0.10/1000 gal) or $10,000 per day over a 365 day year (Figure 25). These funds would be deposited into a Christina Basin Clean Water Fund to finance watershed restoration projects to be implemented by the Christina Basin Clean Water Partnership. Clean water funds would be reinvested right back into the "blue" economy and pay for jobs by engineers, planners, biologists, and contractors who design and build watershed restoration projects.

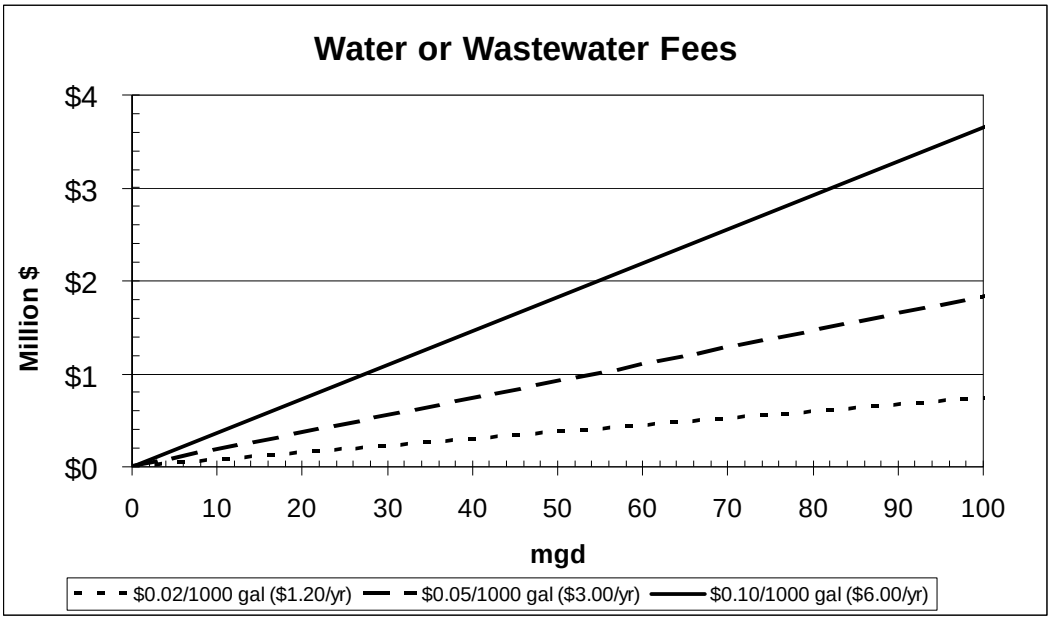


Figure 25. Water or wastewater fee schedule

23. Alcohol Beverage Tax

Alcohol is brewed from barley, hops, grapes, and other agricultural products, therefore, a surcharge on alcoholic beverage taxes could be imposed to fund agricultural runoff control programs. Breweries require a large volume of clean water and discharge wastewater from the distilling process, so revenues from an alcoholic beverage tax surcharge could be dedicated to drinking water treatment and point source water pollution control programs. The demand for alcohol is relatively unresponsive to price changes; thus a tax increase would not necessarily cause a decrease in sales sufficient to offset revenues. If 1.2 million cases of beer (24 bottles per case) were sold in the Christina Basin yearly and a tax of $0.02 per bottle were assessed for agriculture conservation projects, $576,000 would be raised.

24. Bottled Water Surcharge Tax

A nickel per bottle surcharge on bottled water would offset plastic recycling costs, reduce use of petroleum products, and create incentives for consumers to drink less costly public water supplies. Mayor Dailey in Chicago is raising millions in new revenues through this measure. If 1.2 million cases of bottled water (24 bottles per case) were sold in the Christina Basin yearly and a tax of $0.05 per bottle were assessed for watershed restoration projects, $1,440,000 would be raised.

25. Carbon Energy Tax

Carbon taxes are energy taxes levied on energy sources that emit carbon dioxide into the atmosphere Energy taxes are surcharges on bills for utilities such as electricity, heating oil, and gas. A tax on gasoline or oil and coal would be considered since carbon based fuels emit nitrogen, sulphur, and mercury that pollute waterways. In 2007, voters in Boulder, Colorado approved a Climate Action Plan Tax that funds an annual budget over $850,000 from fees that average $1.33 per month for a residential household and $3.80 per month for a business. In spring 2009, the U. S. House of Representatives passed a bill for cap and trade of carbon air emissions that is now under consideration in the Senate. Vermont is considering implementation of a carbon tax. The debate over carbon taxes is currently most active in the European Union. New Zealand considered adopting a carbon tax in 2005.

26. Environmental Tax Shifting (Fertilizer, Pesticide, Concrete)

Fertilizer and pesticide fees include dealer license fees, assessment and inspection fees, and registration fees. Massachusetts has an environmental tax shifting program on fertilizer and pesticides. Iowa charges pesticide fees authorized by the 1987 Groundwater Protection Act. A portion of the revenues raised with these pesticide fees is placed in the agriculture management account of Iowa's groundwater protection fund. Montana charges pesticide and fertilizer registration fees and uses the revenues it raises with the fees to fund groundwater quality monitoring work. Nebraska charges fertilizer inspection fees and pesticide registration fees and dedicates the revenues raised with the fees to programs for regulating fertilizers and pesticides. Long Island, NY recently banned nitrogen fertilizer use during the summer.

The 1987 Iowa Groundwater Protection Act assesses pesticide manufacturing registration fees, pesticide dealer licensing fees, and fertilizer taxes. Retailers of nitrogen-based fertilizers must pay an additional $0.75 per ton fee. Pesticide dealers pay an annual registration fee of 1/5 of 1% of gross sales with a minimum fee of $250 and a maximum fee of $3,000. Fifty dollars of each fee are deposited in the general fund of the state and the remainder placed in the agriculture management account of the groundwater protection fund. This legislation established the Leopold Center for Sustainable Agriculture at Iowa State University to study agricultural impacts on groundwater quality, the Center for Health Effects of Environmental Contamination at the University of Iowa to assess pollution's impact on human health, the Iowa Waste Reduction Center at the University of Northern Iowa to help small business properly handle and dispose of solid and hazardous materials, and programs administered by the Iowa Department of Natural Resources, Iowa Department of Agriculture and Land Stewardship and Iowa State University Extension.

California assesses a fee on all pesticide sales of $0.021 on each dollar of sales levied at the point of first sale into the state with funds distributed to the Department of Pesticide Regulation Fund and used to pay for the State's pesticide regulatory program.

27. Litter tax

Virginia levies a litter tax on manufacturers, wholesalers, distributors, and retailers of consumer products. About 95% of Virginia's litter tax revenues are used for litter prevention and recycling grants. The State of Washington imposes a litter tax on industries that sell, manufacture, or distribute consumer products and packaging. About 20% of proceeds from Washington's litter tax funds the Community Litter Cleanup Program, 30% of proceeds funds waste reduction and recycling efforts, and 50% funds other litter cleanup efforts. Oakland, California imposes a litter tax on fast food restaurants, retailers, and other businesses and uses the revenues from the tax to pay crews to pick up litter.

28. Rental Car Tax

Rental car taxes could be used to finance infrastructure improvements, such as increases to wastewater capacity and drinking water treatment plants, needed to meet the needs of seasonal tourists. In addition, revenues from rental car taxes could be used to fund air pollution control programs. Rental car tax revenues have also been used to finance public transportation programs and projects.

29. Florida Water Management Districts

In 1972 the Florida Water Resources Act created five water management districts. Each of the districts is headed by a Governing Board appointed by the Governor and confirmed by the Florida Senate. The Florida Department of Environmental Protection is involved in managing the quality and quantity of water through its relationship with the water management districts. Regulatory programs delegated to the districts include

programs to manage the consumptive use of water, aquifer recharge, well construction and surface water management. The water management districts:

- Administer flood protection programs
- Perform technical investigations into water resources
- Develop water management plans for water shortages
- Acquire and manage lands for water management purposes under the Save Our Rivers program.

In 1976 authority was given to the districts to levy ad valorem (property) taxes to fund water resource management efforts. While all of the water management districts have similar responsibilities, not all have the amount of financial resources available to address these responsibilities. Three of the five water management districts are constitutionally allowed to levy up to one mill ($1 per $1,000 of taxable property value). The Northwest Florida Water Management District is allowed to levy up to one-twentieth of a mill ($.05 per $1,000 of taxable property value), and the Suwannee River Water Management District is authorized to levy up to .75 mills. In 2008 a property tax reform amendment was passed allowing property owners to deduct an additional $25,000 homestead exemption from the assessed value of their properties.

Each district derives varying amounts of their total revenue from the ad valorem taxes. The Northwest Florida Water Management District has a millage rate of .045 or $4,701,800 in revenue. Their total revenue is $81,107,354 and most of their funding comes from cooperative projects, grants and legislatively funded programs. For the Southwest Florida Water Management District, the ad valorem tax is the primary funding source. This district has a millage rate of 0.3866 which generates $525,229,365 in revenue, or 58.4% of total funds. The other management districts are as follows:

- Suwannee River Water Management District: 0.4399 mills generating $6 million in revenue, or 8% of total revenue (this is the smallest district). The remaining 92% of revenue comes from state program and project funds, federal grants and programs, the Florida Forever program, permit and license fees, and timber sales.

- St. Johns River Water Management District: .4158 mills generating $136.62 million, or approximately 36% of revenue. The St. Johns River Water Management District calculated that at .4158 mills a property owner with a homestead property valued at $200,000 would pay an annual tax of $62.37.

- South Florida Water Management District: .624 or .481 mills depending on the area, generating $459.9 million in revenue, or 30% of total revenue

It is interesting to note that the Southwest Florida Water Management District is slightly different than the other districts in that the district is divided into eight Basin Boards. These boards provide guidance for local programs that are specific to the basins they protect. They finance their programs in part through ad valorem taxes. The one mill taxing capability of the District is divided evenly between the Basin Boards and the Governing Board.

30. Tax Ditch District

Delaware law permits tax ditch districts that assess taxes in specific watersheds for the operation and maintenance of agricultural drainage ditches.

31. Tobacco Tax Surcharge

Tobacco is an agricultural product that utilizes water for irrigation, generates nonpoint source pollutant loads to streams, and is a negative impact on human health. The 2006 U.S. federal cigarette excise tax is $0.39 per

pack. All 50 states have cigarette taxes. Some states earmark a portion of revenues from taxes on cigarettes and tobacco products for environmental purposes. The State of Washington dedicates a portion of its cigarette tax revenues to water quality protection and salmon recovery programs. Idaho uses a portion of its cigarette tax revenues for water quality protection initiatives. In California, $0.25 of the cigarette and tobacco products tax is used to fund programs for environmental conservation, protection, restoration, enhancement, and maintenance of fish, waterfowl, and wildlife habitat areas, and enhancement of state/local parks/recreation. The Conservation Trust of Puerto Rico receives funding from cigarette/alcohol taxes maintain the quality of forests and water sources.

If 80,000 adult smokers in the Christina Basin smoked 3 packs per week and the watershed restoration tobacco tax surcharge were $0.05 per pack, then $624,000 would be raised annually.

32. Water Quality Trading

The Chesapeake Bay fund establishes a nitrogen trading mechanism where credits are bought and sold. Long Island Sound has a water quality trading program for nitrogen and phosphorus. A graduate master thesis from the University of Pennsylvania recommended a water quality trading mechanism for the Christina Basin. A formal Christina Basin water quality trading bank could be established whereby stakeholders may fund upstream improvements. Wilmington is participating with upstream farms in Chester County as part of their source water program. Governments may choose to cost effectively fund improvements in other portions of the watershed instead of spending more costly funds on less effective projects within the town.

In point source/nonpoint source trading, a point source of pollution arranges for reduction of nonpoint source pollution discharges in the same watershed in lieu of making more expensive upgrades to its own treatment beyond the minimum technology-based treatment requirements. There must be a combination of point sources and nonpoint sources each contributing a significant portion of the total pollutant load in the watershed, and accurate data to establish targets and measure pollution reductions. There must be significant pollutant load reductions for which the marginal cost (cost per pound reduced) for nonpoint source controls are lower than the costs for upgrading point source controls. Under ideal conditions, a trading program will both save money for point source dischargers and improve water quality.

The Pennsylvania Voluntary Nutrient Trading Program establishes credits for more efficient ways for NPDES permits to meet effluent limits for nutrients and sediment with a focus on the Chesapeake Bay Watershed. Great Miami River, Ohio Watershed Water Quality Credit Trading Program has the potential to save communities $300 million over 20 years while improving water quality. Soil and water conservation districts work with farmers who voluntarily change farming practices to reduce phosphorus and nitrogen runoff. The projects will generate “credits” that wastewater treatment plants use to meet regulatory requirements. Funding is from wastewater treatment plants combined with a grant from the USDA Natural Resources Conversation Service – providing more than $1 million for agricultural projects during the program’s first three years.

In the Tualatin River, Oregon, Clean Water Services, a public utility, developed a watershed trading program in 2004 with help from USEPA and Oregon Dept. of Environmental Quality. Clean Water Services has a watershed-based permit that involves its wastewater treatment facilities, and allowed for them to establish a trading program to maintain water quality standards and trading of TMDLs.

The National Academy of Sciences recently released a report that recommended that the USEPA base stormwater discharge and wastewater permits on watershed boundaries instead of political boundaries. The revised watershed based permitting structure includes market based trading of credits among stormwater dischargers to achieve compliance. The NAS recommended a pilot program to allow the USEPA to work

through the watershed based permitting approach. The Christina Basin could be considered for a USEPA pilot program for watershed based stormwater permitting.

33. Grants/Loans

The Christina Basin Clean Water Partnership has successfully tapped grants and loans in the past, with the largest being the EPA Targeted Watershed Grant for $1 Million. The following Federal sources of funding are available for watershed restoration.

USDA Rural Development
- Grants for Water and Wastewater Revolving Funds
- Solid Waste Management Grant Program
- Technical Training and Assistance Grant Program

USDA Forest Service
- Cooperative Forestry Assistance Grants
- Forest Stewardship Program Grants
- Urban and Community Forestry Program

USDA Business and Cooperative Programs
- Rural Business Enterprise Grants

U.S. Dept. of Commerce
- Economic Development Administration: Public Works and Economic Development
- NOAA Coastal Services Center Grants
- NOAA Coastal Zone Management Act Administration Awards

USEPA
- Environmental Education Grant Program
- Environmental Justice Small Grants Program
- Performance Partnership Grants
- Section 319 Nonpoint Source Pollution Control Grants
- Superfund Technical Assistance Grants
- Leaking Underground Storage Tank Trust Fund Grants
- Underground Storage Tank Categorical Grants
- Wetlands Program Development Grants
- National Center for Environmental Research: Science to Achieve Results (STAR)
- Drinking Water State Revolving Fund Loan Principal Forgiveness

U.S. Department of Homeland Security (FEMA)

Superfund Amendments and Reauthorization Act, Title III Grants

US Housing and Urban Development
- Community Development Block Grant Entitlement Communities Grants

U.S. Fish and Wildlife Service
- Standard Grants Program for Wetlands Protection
- North American Wetlands Conservation Act Small Grants Program

USDOT (Transportation Equity Act for the 21st Century)

34. State of Pennsylvania: Growing Greener Program

In 1999, the Pennsylvania Growing Greener Program was signed into law, providing nearly $650 million to address the state's most pressing environmental challenges. In 2005, Growing Greener II was signed into law, investing $625 million to extend the Growing Greener Program. Funding is provided under the Program for many different types of environmental protection initiatives including cleanup and restoration of watersheds, and construction of new and upgraded water and sewer systems. Counties, local governments, authorities, conservation districts, watershed associations and nonprofit groups may apply for Growing Greener grants. The Growing Greener Program is the largest single investment to protect the environment in Pennsylvania's history, amounting to $1.2 billion dollars.

35. Dedicated Government Trust Funds

A dedicated government trust fund is an account set up to receive and disburse revenues for a specific program or activity. The most commonly used methods of raising revenue for dedicated government trust funds include earmarked portions of taxes and fees, referendum bond act dollars, environmental fines and penalties, lotteries, budget surpluses, and private donations. Deposits accrue automatically and usually are available only for the purpose named in the dedication. States and localities throughout the U.S. have dedicated environmental trust funds. Common uses for dedicated environmental trust funds include open space acquisition, habitat restoration, and the operation and maintenance of pollution control facilities. Environmental trust funds include: Nebraska Environmental Trust, South Carolina's Heritage Trust Program, and the Natural Lands Trust Fund in Ocean County, New Jersey. The Superfund Trust Fund and the Nuclear Waste Fund are examples of federal dedicated trust funds.

Prioritization of Funding Options

Using the Delphi technique, a committee of staff and students prioritized the sustainable watershed funding options into three categories – A, B, and C. Funding options on the "A" list are more preferred and recommended for further discussion by the Christina Basin Coordinating Committee (Table 23):

Category A (more preferred)
- Direct link between funding source and water quantity/quality
- Provides at least $1,000,000 per year alone or in combination with other options
- Less likely to have special interest or political opposition
- Forward for discussion and consideration by Christina Basin Coordinating Committee.

Category B (potentially feasible, but less likely)
- Moderate or indirect link between funding source and water quantity/quality
- Generates insufficient revenue
- More likely to have special interest or political opposition
- Hold in reserve for consideration by committee.

Category C (not likely)
- Weak link between funding source and water resource
- Certain opposition from special interests or lobbies
- Just not feasible

Table 23. Potential Christina Basin sustainable funding options

Rank	Watershed Funding	Case Studies	Strengths	Weaknesses	Annual Revenue
A	Local & Regional Government Pooled Fund	* Tahoe Regional Planning Agency	* Regional approach * Precedent in other USA watersheds	* Small towns may not have sufficient funds.	$1,000,000
A	Water Pollution Damages/Penalties	* Wal-Mart * IA Beef Packers, * Susquehanna	* Mitigation funding * Authorized by CWA	* Competition high for funds. * Not dedicated to Christina Basin	$100,000
A	Wastewater Surcharge Fee	* Chesapeake Bay Flush Tax	* Connection between wastewater and water quality * $2.50 per household/month		$6,000,000
A	Motor Vehicle Toll Fees		* Only 2 pennies/toll * Significant revenue generator	* Moderate link road travel and water quality * Not include local roads	$4,137,000
A	Green Credit Card Fee		* Delaware headquarters of banks	* Competition for card fees	$400,000
A	License Plate Fee	* MD and VA "Save the Bay"	* Voluntary	* $25 per license plate	$2,500,000
A	Stormwater Utility	* VD, MD, VA, Wilmington, Phila * 700 towns in USA	*Equitable based on impervious cover *Runoff as utility use	* Some perceive as tax	$1,800,000
A	Voluntary Water Bill Roundup Programs		* Voluntary * Only $6/ household		$1,200,000
A	Water Quality Trading	* OH Great Miami R. * Tualatin River, OR * PA Nutrient Trading	* Potential cost effective between upstream/downstream	* Little performance history	
A	Grants/Loans	SD State Revolving Loan Program * IL Clean Lakes	* Most popular source of funding	* Low probability (3% to 6%) of receiving)	
A	State of Penna. Growing Greener Program		* Successful source of funding for PA portion of Christina Basin		
A	Chesapeake Fund	Chesapeake Bay, MD and VA	* Innovative market approach	* Little past performance history	
A	Voluntary Income Tax Checkoff		* Voluntary * Only $5 per taxpayer per year		$1,000,000
B	Water Withdrawal Application Fees	* VA, MI, DE, NJ	* Increase in DE * Link between water use and water quality	* Water purveyor for or against?	$1,000,000
B	Water Rate Fee	* Loveland, CO * Seattle, WA * L. Michigan Water	* Spreads fee over to all consumers * Only $6/ household	* Water purveyor for/or against?	$3,650,000
B	Bottled Water Surcharge		* Link between plastic bottle and environmental impacts	* $0.05 per bottle * Bottle water lobby opposition?	$1,440,000
B	NPDES Wastewater Discharge Permit Fees	California NPDES Program	* Direct link water quality and wastewater * Only $6/ household		$912,500
B	Rhode Island Aqua Fund	* RI Narragansett Bay	* Issued $8.8 million in		

			Narragansett watershed grants.		
B	FLA Water Mgmt. Districts	* Florida	* Successful program in FL.	* Property tax surcharge * Additional layer govt.	
B	Dedicated Government Trust Funds	* NE Envir. Trust * SC Heritage Trust * NLT, Ocean Co, NJ * Superfund	* Susccessfully used for land preservation by Natural Lands Trust		
C	Aquifer Protection Area Fee	* Spokane County, WA	*Only $6 per household per year	* Applies only to aquifer areas	$255,500
C	Boater Registration Fees	* State of Washington		* Indirect link between boat use and water quality	$812,000
C	Air Emissions Charges	* Title V Federal Clean Air Act	* Federal law in effect	* Little done in water quality * Revenue goes to air quality programs.	
C	Fishing License Fee		* User (fisherman) – water quality link	* Little revenue available	$18,000
C	Water Utility Franchise Fees	* Denver, CO		* Already assessed in Delaware.	
C	Septic System and Well Permit Fees	* Randolph, NJ * Monroe Co., MI	* Direct link to water use	* Already in use in DE and PA	
C	Ship Docking Fees		* Mitigation from environmental damage from shipping	* Moderate link between shipping and water quality	$800,000
C	Special Watershed Assessment Fees	* Minneapolis, MN * Fargo, ND * Manhattan, KA		* Another form of tax	
C	Alcohol Beverage Tax	California	* Link between alcohol hops and ag water use * $0.06/ 6 pack increase	* Liquor lobby opposition	$576,000
C	Carbon Energy Tax	Boulder, CO Carbon Tax	* Link between air borne pollutants an water quality	* Little precedent although emerging	
C	Environmental Tax Shifting (Fertilizer, Pesticide, Concrete)	* IA 1987 Groundwater Act * CA Pesticide Bill	* Funds used for U of Iowa programs.	* Tax on commodities like fertilizers.	
C	Litter tax	* VA, WA * Oakland, CA	* Link between trash and water pollution		
C	Rental Car Tax			* Little link between rental cars & water quality	
C	Tax Ditch District		* In effect in Delaware although not for watershed mgmt.	* No agricultural tax ditches in Christina Basin	
C	Tobacco Tax Surcharge	California	* Tobacco ag. product with water demand. * States have tobacco taxes	* Competes with other uses of tobacco taxes.	$625,000

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Appendix A

MEMORANDUM OF AGREEMENT, AMONG

The Christina Basin Clean Water Partnership consisting of the Delaware River Basin Commission, United States Environmental Protection Agency, Partnership for the Delaware Estuary, State of Delaware Department of Natural Resources and Environmental Control, State of Pennsylvania Department of Environmental Protection, Chester County, City of Coatesville, City of Downingtown, Borough of West Chester, New Castle County, City of Newark, City of Wilmington, Delaware Nature Society, Brandywine Valley Association/Red Clay Valley Association, Brandywine Conservancy, Chester County Water Resources Authority, Chester County Conservation District, and University of Delaware Institute for Public Administration-Water Resources Agency

REGARDING: **Integrated, interstate efforts to meet total maximum daily loads for the Christina Basin and meet fishable, swimmable, and potable standards by 2020:**

WHEREAS, the Christina Basin contains 565 square miles of land in its watershed that spans three states, Delaware, Maryland, and Pennsylvania; and,

WHEREAS, the headwaters begin in Pennsylvania and flow through the Piedmont hills of northern New Castle County in Delaware to the Delaware River at Wilmington; and,

WHEREAS, the waters in the Christina Basin are the source of public surface water supply for over half million people in the Basin with over 75 percent of the population served in New Castle County and most of the water supply withdrawals in Chester County; and,

WHEREAS, the waters of the Christina Basin provide many recreational, cultural, and ecological opportunities as well as important habitat for wildlife, aquatic life, and plant life; and,

WHEREAS, since 1994 the United States Environmental Protection Agency, Delaware River Basin Commission, and two states have worked together and developed an integrated framework for coordination through the Christina Basin Clean Water Partnership to resolve water quality problems involving the waters of the Christina Basin in Delaware and Pennsylvania; and,

WHEREAS, in 2001 the Christina Basin Clean Water Partnership, received the USEPA's Targeted Watershed Grant for $1 million and demonstrated its ability to work collectively to implement over $3 million in restoration projects and education efforts throughout the Basin; and,

WHEREAS, despite the ongoing efforts, and bearing in mind there have been improvements in water quality, the waters of the Christina Basin remain on the Clean Water Act list of impaired waters thereby requiring a total maximum daily load set in April 2005; and,

NOW, THERFORE, we, the undersigned executives representing the municipal, county, state, regional, federal, private, and nonprofit entities agree that we will:

- Work toward a bi-state integrated approach to meet the total maximum daily loads in the Christina Basin to remove these waters from the Clean Water Act list of impaired waters.
- Collectively, as well as individually, seek new ideas, aim to use the most cost-effective solutions, and remain committed to the goal of achieving the nutrient, bacteria, and sediment goals set for the waters of the Christina Basin.

- Maintain an open and public-oriented process, with the intent to encourage public participation at all times.
- Carry on the past commitments and efforts of the federal, regional, state, and county agencies, the nonprofit organizations, and other groups.

BY this agreement, we formalize the ongoing collaborative, fair, and equitable multi-agency effort to improve the water quality in the Christina Basin by the Christina Basin Clean Water Partnership consisting of the Delaware River Basin Commission, United States Environmental Protection Agency, State of Delaware Department of Natural Resources and Environmental Control, State of Pennsylvania, Chester County, City of Coatesville, City of Downingtown, Borough of West Chester, New Castle County, City of Newark, City of Wilmington, Delaware Nature Society, Brandywine Valley Association/Red Clay Valley Association, Brandywine Conservancy, Chester County Water Resources Authority, Chester County Conservation District, and University of Delaware Institute for Public Administration-Water Resources Agency. We agree to remain committed to the common goal of a swimmable, fishable, and potable Christina Basin.

SIGNATORIES

Federal
U. S. Environmental Protection Agency _____

Regional
Delaware River Basin Commission _____
Partnership for the Delaware Estuary _____

Delaware
State of Delaware _____
New Castle County _____
New Castle Conservation District _____
University of Delaware Water Resources Agency _____
City of Wilmington _____
City of Newark _____

Pennsylvania
State of Pennsylvania _____
Chester County _____
Chester County Water Resources Authority _____
Chester County Conservation District _____
City of Coatesville _____
City of Downingtown _____
Borough of West Chester _____

Nonprofit Organizations
Delaware Nature Society _____
Brandywine Valley Association _____
Red Clay Valley Association _____
Christina Conservancy _____
White Clay Creek Wild & Scenic River Committee _____

Appendix B - Recommended Christina Basin BMPs
Delaware Pollution Control Strategy and Pennsylvania Watershed Action Plans

Recommended BMP	DE	PA	Recommended Implementer(s)
Stormwater			
Complete implementation of High Flow TMDLs		X	USEPA, DRBC, PA DEP, DNREC
Require urban tree canopy.	X		DNREC, NCC, municipalities, DCH
Require stormwater BMPs be designed to reduce nutrients according to the TMDLs.	X		DNREC
Limit addition of new impervious cover < 20 percent of the watershed above public water supply intakes.	X		Wilmington, Newark, NCC
Promote LID in new construction and redevelopment.	X		Developers
Implement comprehensive stormwater management ordinances.	X	X	WCC CBCWP, RCVA, BVA, Wilmington, Newark, NCC, CC, CCWRA, CCCD
Expand the role of RPTAC to create a Christina Basin group to review new development applications.	X		NCC
Implement a stormwater utility.	X		Municipalities, NCC, DNREC
Maintain BMPs.	X		Municipalities, NCC, DNREC
Reduce and manage existing impervious cover.	X		Municipalities, NCC, DNREC
Identify areas where stormwater retrofits would effectively reduce sediment and nutrients.	X		NCC, NC Conservation District
Implement pilot urban stormwater runoff projects to reduce impacts of urban runoff.		X	Kennett Square, RCVA, CCCD, PADEP, NCC, UDWRA, NCCD, DNREC
Implement suburban runoff retrofits to reduce peak rate/volume of runoff.		X	Kennett Square, RCVA, CCCD, PA DEP, NCC, UDWRA, NCCD, DNREC
Establish an expanded Watershed Watch program throughout the watershed.		X	BVA
Implement NPDES Phase II requirements in regulated PA municipalities		X	PA municipalities, conservation districts, PA DEP
Recommended BMP	**DE**	**PA**	**Recommended Implementer(s)**
Open Space			
Map, inventory, and prioritize existing wooded open space areas.	X		UDWRA
Protect existing wooded/vegetated open space areas.	X		NCC, DNREC
Require management plans for community and HOA open space areas.	X		DNREC
Require forested riparian buffers of adequate and proper widths sufficient to reduce or eliminate nonpoint source	X	X	USDA NRCS, RCVA
Implement stream restoration projects.	X		DNREC
Implement pilot geomorphology based stream restorations for several degraded stream reach to restore instream flow regime		X	Chester County, BVA, NCCD, DNREC, CCCD
Acquire/conserve additional open space and retain conservation easements.	X		DNREC, NCC, Newark
Focus open space streams and water supply reservoirs and intakes; wellhead protection zones; woodlands; and floodplains.		X	Nongovernmental land conservancies, land owners, developers, County planning agencies
Reforest watersheds and headwaters.	X		Delaware Dept. of Agriculture, DNS, NCCD
Recommended BMP	**DE**	**PA**	**Recommended Implementer(s)**
Wastewater			
Require OWTS performance standards, and conduct inspections and pump-outs.	X		DNREC
Eliminate cesspools and seepage pits.	X		DNREC, NCC (Dept. of Special Services)

Remove OWTS through connection to centralized WWTP.	X		NCC Department of Special Services
Prohibit new OWTS drainfields within 100 feet of wetlands, tidal waters, perennial streams, perennial ditches, and ponds with perennial watercourses.	X		DNREC, NCC (Dept. of Special Services)
Implement City of Wilmington CSO Remediation Plan	X	X	Delaware, Wilmington, USEPA
Continue sewer repair projects and conduct regular inspections.	X		NCC, Newark, Wilmington
Eliminate runoff from and remediate contaminated substance sites.	X	X	DNREC, USEPA, UDWRA
Recommended BMP	**DE**	**PA**	**Recommended Implementer(s)**
Agriculture			
Nutrient management plans.	X		USDA-NRCS, NCCD, Delaware Dept. of Agriculture, PA USDA-NRCS, UDWRA
Cover crops.	X		USDA-NRCS, NCCD, Delaware Dept. of Agriculture, PA USDA-NRCS, UDWRA
Pasture stream fencing and cattle crossings.	X	X	USDA-NRCS, NCCD, Delaware Dept. of Agriculture, PA USDA-NRCS, UDWRA
Grassed filter strips.	X		USDA-NRCS, NCCD, Delaware Dept. of Agriculture, PA USDA-NRCS, UDWRA
Grassed waterways.	X		USDA-NRCS, NCCD, Delaware Dept. of Agriculture, PA USDA-NRCS, UDWRA
Forested riparian buffers.	X	X	USDA-NRCS, NCCD, Delaware Dept. of Agriculture, PA USDA-NRCS, UDWRA
Pasture and hay planting.	X		USDA-NRCS, NCCD, Delaware Dept. of Agriculture, PA USDA-NRCS, UDWRA
Prepare, update, and implement soil and water conservation plans and practices on all crop farm lands.		X	USDA-NRCS, NCCD, Delaware Dept. of Agriculture, PA USDA-NRCS, UDWRA
Implement manure management plans and facilities to eliminate runoff from barnyards to streams or infiltration to groundwater.		X	USDA-NRCS, NCCD, Delaware Dept. of Agriculture, PA USDA-NRCS, UDWRA
Recommended BMP	**DE**	**PA**	**Recommended Implementer(s)**
Education			
Educate Christina Basin stakeholders on nonpoint source pollution and their role in reducing it, specifically targeting behavior change.	X		Nonprofit, private, government entities
Encourage nutrient management plans for turf fields at education facilities.	X		Nonprofit, private, government entities
Encourage golf course managers to decrease nutrient application, stormwater runoff, erosion.	X		Nonprofit, private, government entities
Educate pet owners on cleaning up pet waste.	X		Nonprofit, private, government entities
Educate homeowners and implement programs for residential stormwater BMPs, BMP maintenance, and nutrient reduction.	X	X	Nonprofit, private, NC and CC Conservation districts, BVA, UDWRA
Integrate education into state and local permitting processes.	X		Nonprofit, private, government entities
Encourage corporate environmental stewardship programs.	X		Nonprofit, private, government entities
Coordinate nonprofit organizations throughout the basin.	X		Nonprofit, private, government entities
Support and encourage water conservation and water quality measures to reduce nutrients leaving a site.	X		Nonprofit, private, government entities
Work with organizations to provide education programs on lawn and garden BMPs.	X		Nonprofit, private, government entities
Advise DNREC to research nutrient reductions related to bacteria counts and BMPs.	X		Nonprofit, private, government entities
Recommended BMP	DE	PA	Recommended Implementer(s)
Monitoring			

Establish a Long-Term Water Quality and BMP monitoring program to monitor progress and identify problems in the watershed.	X	X	PADEP, DNREC, USGS, DRBC, CCWRA, New Castle and Chester County Conservation Districts
Recommended BMP	**DE**	**PA**	**Recommended Implementer(s)**
Water Supply/Wastewater Planning and Protection			
Prepare and implement Integrated Water Resources including EB Brandywine Creek , Honey Brook, West Branch Brandywine.		X	Municipalities, county agencies, purveyors
Complete Source Water Assessment underway for surface water intake, and prepare Source Water Protection Plan		X	PA DEP, DNREC, water suppliers, county agencies, UD IPA-WRA
Complete wellhead protection plans for groundwater based public water supply systems in PA.		X	Utilities, public water supply well owner, county agencies, BVA, RCVA
Complete wellhead protection plan for Honey Brook Borough Water Authority		X	Honey Brook Borough Water Authority, Honey Brook Township, PA DEP
Develop and implement reservoir mgmt. and water quality monitoring program.		X	Reservoir owners, City of Wilmington
Provide groundwater budget information/data to municipalities for use in decision making		X	CCWRA, BVA, RCVA
Protect stream water quality through conversion of point source discharges of treated effluent to land application systems.		X	PA DEP, County agencies, BVA, RCVA

Appendix C – List of proposed Christina Basin watershed restoration projects

Community Name	Project Description	State	Watershed	Stream	Budget
Brandywine Conservancy	Dam removal/stream restoration	DE	Brandywine	Lower Brandywine	100,000
Delaware Nature Society	Smartyards/Backyard Habitat	DE	Christina	Red Clay/Brandywine	125,000
Delaware Nature Society	Green landscaping	DE	Christina	Homebuilders/Nursery	15,000
Delaware Nature Society	Habitat restoration	DE	Christina	Yorklyn	25,000
Delaware Nature Society	Conservation buffers	DE	Red Clay	Burrows Run	100,000
Delaware Nature Society	Meadow/forest restoration	DE	Christina	Middle Run	50,000
DNREC	Stream restoration	DE	Red Clay	Burrows Run/Hyde Run	
DNREC	Stream bank stabilization	DE	White Clay	Mill Creek/Knodel	
DNREC	stream/wetland stabilization	DE	White Clay	Mill Creek/Bennett	
DNREC	Stream/sewer line stabilization	DE	Christina	Little Mill Cr./Barley Mill	
DNREC	Streambank/wetland stabilization	DE	White Clay	White Clay St. Park	
New Castle County	Riparian/wetland restoration	DE	Christina	Koppers Superfund site	
New Castle County	Stream restoration	DE	Christina	Little Mill Creek	
New Castle County	Stream restoration/riparian buffer	DE	Christina	Little Mill Cr./Barley Mill	
New Castle County	Stream restoration	DE	Christina	Barley Mill Creek	
New Castle County	Septic system elimination	DE	Brandywine		
New Castle County	Septic system elimination	DE	Christina	Little Mill/Pike Cr.	2,000,000
New Castle County	Sanitary sewer improvement	DE	Christina	Little Mill Cr./Boxwood	600,000
Newark	Stream restoration	DE	Christina	Elkton Road	150,000
Newark	Stream restoration	DE	Christina	Sandy Drive	175,000
Newark	Stream restoration	DE	Christina	Macduff Court	200,000
Newark	Stormwater basin retrofit	DE	Christina	Evergreen on 896	40,000
Newark	Stormwater basin retrofit	DE	Christina	Iron Glen Park	50,000
Newark	Stormwater basin retrofit	DE	Christina	McKees, Rahway	360,000
Newark	Stormwater basin retrofit	DE	White Clay	Cool Run/ Silver Brook	180,000
Newark	Stormwater basin retrofit	DE	Christina	Silver Brook	200,000
Newark	Stormwater basin retrofit	DE	White Clay	Jenny's Run	120,000
Newark	Stormwater basin retrofit	DE	Christina	Silver Brook	20,000
Newark	Sewer eliminat./stream restoration	DE	White Clay	Wedgewood Rd	350,000
Partnership for Del. Estuary	Stormwater schoolyard habitat	DE	Christina	Christina School District	50,000
Partnership for Del. Estuary	Pet waste reduction	DE	Christina		40,000
Partnership for Del. Estuary	Priority land restoration	DE	Christina		150,000
University of Delaware	Riparian buffer reforestation	DE	White Clay		1,325,000
University of Delaware	Riparian buffer reforestation	DE	Red Clay		1,250,000
University of Delaware	Stream restoration	DE	White Clay	Laird Campus	50,000
University of Delaware	Urban reforestation	DE	Christina	Newark	50,000

University of Delaware	Urban reforestation	DE	White Clay	Newark	50,000
University of Delaware	Stormwater basin retrofit	DE	White Clay	Academy St.	100,000
University of Delaware	Porous pavement/wetland	DE	Christina	Rullo Stadium	40,000
University of Delaware	Bioretention pond	DE	White Clay	Cool Run/Health Bldg	50,000
University of Delaware	Infiltration basin	DE	White Clay	Cool Run/Academy St.	50,000
University of Delaware	Rain Garden	DE	White Clay	Cool Run/Townsend Hall	25,000
University of Delaware	Green street retrofit	DE	White Clay	Haines St, Newark	50,000
University of Delaware	Rain garden/downspout disconnect	DE	White Clay	Fairfield Crest Newark	40,000
White Clay Wild & Scenic	Dam removal/fish passage	DE	White Clay	Dams 1 through 5	200,000
White Clay Wild & Scenic	Sewer removal/stream restoration	DE	White Clay	Creek Road Newak	200,000
Wilmington	Agricultural BMP/Stream fencing	DE	Brandywine	West Br./Honeybrook	268,000
Wilmington	Agricultural BMP/Stream fencing	DE	Brandywine	Beaver Creek	30,000
Wilmington	Riparian reforestation	DE	Brandywine	Indian Creek/Perkins Run	500,000
Wilmington	Farm Nutrient Mgmt. Plans	DE	Brandywine	West Br./Honeybrook	20,000
Wilmington	Riparian reforestation	DE	Brandywine	Wilson Run	100,000
Avondale	Stream restoration	PA	White Clay	East Branch	366,289
Brandywine Conservancy	Riparian reforestation	PA	Brandywine	Honey Brook	500,000
Brandywine Conservancy	Stormwater BMP Retrofit	PA	Brandywine	To be determined.	75,000
Brandywine Conservancy	Stream classification upgrades	PA	Brandywine	Buck and Doe Runs	50,000
Brandywine Conservancy	Priority parcel preservation	PA	Brandywine		100,000
Brandywine Conservancy	Watershed reforestation	PA	Brandywine	Buck and Doe Runs	75,000
Brandywine Conservancy	Watershed reforestation	PA	Brandywine	Marsh Creek	50,000
Brandywine Conservancy	Stream restoration	PA	Brandywine	Valley Run	150,000
Brandywine Conservancy	Dam removal/stream restoration	PA	Brandywine	E. Branch Lewis Dam	107,228
Brandywine Valley Assoc.	Stream/floodplain restoration	PA	Brandywine	Doe Run trib.	250,000
Brandywine Valley Assoc.	Stream Restoration	PA	Brandywine	Radley Run	95,000
Brandywine Valley Assoc.	Streambank fencing/restoration	PA	Brandywine	Plum Run #66	20,000
Brandywine Valley Assoc.	Streambank fencing/restoration	PA	Brandywine	Little Buck # 15-17	425,000
Brandywine Valley Assoc.	Streambank fencing/restoration	PA	Brandywine	Little Buck # 39-HW	90,000
Brandywine Valley Assoc.	Streambank fencing/restoration	PA	Brandywine	Little Buck # 36-38	15,000
Brandywine Valley Assoc.	Streambank fencing/restoration	PA	Brandywine	Little Buck Trib #42-46	30,000
Brandywine Valley Assoc.	Streambank fencing/restoration	PA	Brandywine	Plum Run #8-11	160,000
Brandywine Valley Assoc.	Streambank fencing/restoration	PA	Brandywine	Plum Run # 14-15	75,000
Brandywine Valley Assoc.	Stream restoration	PA	Brandywine	Plum Run # 19-26	600,000
Brandywine Valley Assoc.	Stream restoration	PA	Brandywine	Plum Run #17	80,000
Brandywine Valley Assoc.	Stream restoration	PA	Brandywine	Plum Run # 4-6	8,500
Brandywine Valley Assoc.	Dam removal/stream restoration	PA	Brandywine	Plum Run # 7-8, 32	20,000
Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Plum Run # 36-37	25,000
Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Plum Run #46-47	20,000

Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Plum Run #19-65	350,000
Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Plum Run # 76-81	45,000
Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Radley Run # 13-14	225,000
Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Radley Run # 14-15	70,000
Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Radley Run # 46-47	40,000
Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Radley Run # 53-54	80,000
Brandywine Valley Assoc.	Dam removal/stream restoration	PA	Brandywine	Radley Run # 18	25,000
Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Radley Run # 20-21	18,000
Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Radley Run # 44-46	3,500
Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Radley Run # 51	14,000
Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Radley Run # 73-76	2,000
Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Little Buck # 9-13	300,000
Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Little Buck # 14-15	135,000
Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Little Buck Trib #48-50	15,000
Brandywine Valley Assoc.	Stream buffer restoration	PA	Brandywine	Little Buck Trib # 56	10,000
Brandywine Valley Assoc.	Urban stormwater retrofit	PA	Brandywine	Plum Run # 53-55	100,000
Brandywine Valley Assoc.	Urban stormwater retrofit	PA	Brandywine	Plum Run # 97	100,000
Brandywine Valley Assoc.	Urban stormwater retrofit	PA	Brandywine	Radley Run #66	25,000
Brandywine Valley Assoc.	Wetland restoration	PA	Brandywine	Trib Radley Run #98	90,000
Brandywine Valley Assoc.	Urban stormwater retrofit	PA	Brandywine	Little Buck # 19	100,000
Chester Co. Cons. District	Manure mgmt./barnyard controls	PA	Brandywine	Broad Run/Strasburg Rd.	40,000
Chester Co. Cons. District	Manure mgmt./barnyard controls	PA	Brandywine	Honey Brook/Stolzfus	50,000
Chester Co. Cons. District	Mushroom Runoff BMP	PA	White Clay	Keith Kimmel	40,000
Chester Co. Cons. District	Mushroom Runoff BMP	PA	Red Clay	Chandler Mushrooms	40,000
Chester Co. Cons. District	Roof run off management	PA	Red Clay	Pocopson/Wickersham	5,000
Chester Co. Cons. District	Barnyard Controls	PA	Red Clay	Honey Brook/Stoltzfus	10,000
Chester Co. Cons. District	Mushroom Runoff BMP	PA	Red Clay	DePaul Mushrooms	40,000
Chester Co. Cons. District	Mushroom Runoff BMP	PA	White Clay	Davis Mushrooms	40,000
Chester Co. Cons. District	Manure mgmt./barnyard controls	PA	Brandywine	Honey Brook/Esh Farm	70,000
Chester Co. Cons. District	Terraces, waterways	PA	Brandywine	Honey Br./Amos Stoltzfus	25,000
Chester Co. Cons. District	Manure mgmt./barnyard controls	PA	Red Clay	Phillips Mushroom	50,000
Chester Co. Cons. District	Stormwater basin retrofit	PA	Brandywine	Knobb Hill – Doven	80,000
Chester Co. Cons. District	Mushroom Runoff BMP	PA	Brandywine		66,000
Chester Co. Cons. District	Stream restoration	PA	White Clay	Avondale square	500,000
Chester Co. Cons. District	Stormwater basin retrofit	PA	Brandywine	Broad Run/Tattersal	60,000
Chester Co. Cons. District	Stream restoration	PA	Red Clay	Kennett	100,000
Chester Co. Cons. District	Stream restoration/retrofit	PA	Brandywine	Parke Run	50,000
Chester Co. Cons. District	Stormwater basin retrofit	PA	Brandywine	Doe Run/Fox Friends	20,000
Chester Co. Cons. District	Stormwater runoff BMP	PA	White Clay	Guizzetti Mushroom Farm	200,000

Chester Co. Cons. District	Stream restoration	PA	Brandywine	Plum Run	959,520
Chester Co. Cons. District	Basin retrofit – install smaller orifice	PA	Brandywine	Shamona Cr./Eagleview	2,000
Chester Co. Cons. District	Stormwater basin retrofit	PA	Brandywine	Shamona Creek	550,000
Chester Co. Cons. District	Basin Retrofit	PA	White Clay	Wheatland Farms	80,000
Chester Co. Cons. District	Basin Retrofit	PA	White Clay	Candlewyck	40,000
Chester Co. Cons. District	Stormwater basin retrofit	PA	White Clay	Lowes	20,000
Chester Co. Cons. District	Mushroom Runoff BMP	PA	Red Clay		20,000
Chester Co. Cons. District	Stream restoration/fish habitat	PA	Brandywine	Culbertson Run	200,000
Partnership for Del. Estuary	Stream buffer enhancement	PA	Red Clay	New Bolton Campus	10,000
Partnership for Del. Estuary	Freshwater mussel restoration	PA	White Clay	Middle/West/East Br.	30,000
Partnership for Del. Estuary	Freshwater mussel reintroduction	PA	White Clay	Middle/West/East Br.	60,000
Downingtown	Fish habitat restoration	PA	Brandywine	East Br./Kerr Park	90,000
Natural Lands Trust	Dam removal/stream restoration	PA	Brandywine	E.t Bradford/Stroud Dam	185,500
Red Clay Valley Assoc.	Strem fencing/riparian restoration	PA	Red Clay	Hillendale	50,000
Red Clay Valley Assoc.	Stream/buffer restoration	PA	Red Clay	Old Kennett Rd & Rte 82	200,000
Red Clay Valley Assoc.	Stream/ fish habitat restoration	PA	Red Clay	Hillendale & McFarlan	30,000
Red Clay Valley Assoc.	Stream stabilzation	PA	Red Clay	Potter Drive	135,000
Red Clay Valley Assoc.	Riparian buffer restoration	PA	Red Clay	Rosedale	5,000
Red Clay Valley Assoc.	Stream stabilzation	PA	Red Clay	Rosedale Bayard	210,000
Red Clay Valley Assoc.	Wetland/floodplain restoration	PA	Red Clay	Bayard & Sills Mill	90,000
Red Clay Valley Assoc.	Stormwater wetland retrofit	PA	Red Clay	Orchard/Bayard	200,000
Red Clay Valley Assoc.	Stormwater wetland retrofit	PA	Red Clay	McFarlan & Rte 1	100,000
Stroud Water Research Ctr.	Stormwater basin BMPs	PA	White Clay	East Branch	592,377
Stroud Water Research Ctr.	Rain gardens	PA	Red Clay	Longwood Gardens	46,000
White Clay Wild & Scenic	Waatershed reforestation	PA	White Clay		100,000

Appendix D - Proposed tasks and budget for Christina Basin NOAA Coastal Habitat Restoration Grant

Task	Partner	Coastal Watershed	Habitat Restored	Budget ($)	No. of Jobs
1.0 Restoration Grant Coordination	White Clay Watershed Assoc.	Christina Basin	11	Local match	1
	UD Water Resources Agency	Christina Basin	partners	75,000	4
	Chester Co. Water Res. Auth.	Christina Basin		25,000	1
2.1 Restore shad habitat/Remove 3 dams	UD Water Resources Agency	White Clay Creek	8 mi	300,000	13
2.2 Restore wetlands	UD Water Resources Agency	White Clay Creek	5 ac		
3.0 Restore/reforest riparian habitat	Partnership for Del. Estuary	Red Clay Creek	5 ac	45,830	8
			500 ft		
4.1 Reforest riparian habitat	Delaware Nature Society	Red Clay Creek	50 ac	308,913	10
4.2 Reforest riparian habitat	Delaware Nature Society	Burrows Run	10 ac		
4.1 Reforest riparian habitat	Delaware Nature Society	White Clay Creek	15 ac		
4.1 Reforest riparian habitat	Delaware Nature Society	Christina River	20 ac		
4.1 Reforest riparian habitat	Delaware Nature Society	Cooch-Dayett Mill	5 ac		
5.1 Restore stream buffer habitat	Delaware DNREC	Mill Creek	2,175 ft	456,238	20
5.2 Restore wetlands	Delaware DNREC	Mill Creek	2.5 ac		
6.1 Mushroom Farm Conservation	Chester County Cons. District	Brandywine Creek	4 farms	480,350	10
6.2 Amish Farm Restoration	Chester County Cons. District	Brandywine Creek	4 farms		
7.1 Restore stream habitat	Brandywine Valley Association	Brandywine Creek	3980 ft	1,485,225	10
7.2 Restore wetlands	Brandywine Valley Association	Brandywine Creek	8 ac		
7.3 Restore riparian buffer	Brandywine Valley Association	Brandywine Creek	14 ac		
8.0 Restore stream buffer habitat	City of Newark	Christina River	2000 ft	407,000	20
9.1 Reforest stream buffer	Brandywine Conservancy	Brandywine Creek	25 ac	240,116	20
9.2 Restore stream riparian buffer	Brandywine Conservancy	Brandywine Creek	5000 ft		
10.1 Public Education and Outreach	Partnership for Del. Estuary	Christina Basin	600,000	43,120	6
10.2 Public Education and Outreach	Delaware Nature Society	Christina Basin	residents	See Task 4	
10.3 Public Education and Outreach	Brandywine Valley Assoc.	Christina Basin		See Task 7	
		Total		**$3,866,792**	**125**