Banking On The Future:

Investing in Smart Water Strategies for Pennsylvania and the Nation

Taxpayers for Common Sense
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Executive Summary

The United States maintains the most advanced water system in the world, but faces major funding challenges over the next twenty years to keep it operating properly. With the nation's water infrastructure nearing the end of its life, federal, state and local governments will face hundreds of billions of dollars in replacement and upgrade costs over the next two decades.

Though experts and policymakers do not question the value of securing safe drinking water well into the twenty-first century, there is a growing concern about how states, communities and the federal government will pay for these extensive upgrades.

Banking on the Future focuses on the coming funding gap crisis for water infrastructure and suggests how to make smarter water infrastructure investments that have more "bang for the buck." Though the report focuses on southeastern Pennsylvania, it explores an issue that communities are facing all across the nation: how to manage the fiscal crunch when the bill comes for essential water infrastructure improvements.

The costs are certainly steep. The Congressional Budget Office (CBO) projects that nationally it will cost between $24.6 billion and $41.0 billion annually over the next twenty years to replace the country's aging drinking and wastewater infrastructure; in Pennsylvania, water infrastructure replacement costs are estimated to be roughly $47 per person annually through 2025. Decisions we make in the short term could drive these long-term costs even higher.

Introducing Smart Water

To keep future costs under control, our current investment strategy in water infrastructure has to change drastically. Continuing to invest in old, centralized water systems with higher maintenance costs and relatively short lifespans only increase their already hefty price tag. Recognizing this challenge, a growing number of experts are looking at smarter, less expensive water infrastructure investments.

Banking on the Future calls this new approach "smart water strategy," and promotes a new era of water investment that works with the natural water system rather than investing exclusively in costly, centralized infrastructure. Smart water emphasizes integrated management and coordination between communities that share the same water source, and it encourages better long-term watershed planning.

The Challenges

Banking on the Future also finds that America needs to fix more than its water pipes. Its water policies and water infrastructure investment financing processes also need a serious overhaul. Many federal and state laws stifle innovative, cost-effective smart water solutions by inadvertently pushing local planners and municipalities into older ways of dealing with these water issues. Federal and state funding sources, meanwhile, reinforce conventional approaches by providing few incentives for smart water investments and significant incentives to continue the outdated, costly methods that have led the nation into this water funding crisis.

Directions for Moving Forward

Drawing from four case studies of southeastern Pennsylvania's watershed-based organizations, *Banking on the Future* provides several key recommendations to help states and the federal government make better water infrastructure investments. These include better integration of water infrastructure regulations and financial incentives, greater reliance on watershed groups, and stronger emphasis on long-term water planning that keeps future operating and maintenance

costs in mind. None of these reforms can happen, however, unless we hold our legislators and water planners more accountable for the health of our watersheds, the quality of our water services, and the proper expenditure of our hard-earned tax dollars.

Southeastern Pennsylvania: A Prism for the Nation

Banking on the Future is national in scope –Taxpayers for Common Sense offers recommendations that are applicable to Philadelphia as well as Phoenix, to historic, urban communities of the wet Northeast and the fast-growing suburbs of the arid Southwest. Southeastern Pennsylvania is the focus of the report because this relatively small region has a wide variety of communities facing a myriad of water-related concerns that mirror the challenges faced by the rest of the nation. Southeastern Pennsylvania is therefore an appropriate prism through which to view the nation's water problems: from inner-city Philadelphia, which is struggling to manage a decaying water infrastructure with a declining ratepayer base, to the growing communities of Bucks County, which are demanding massive amounts of new water services that will inevitably strain its water supply, this region faces problems similar to most states in the Union.

Southeastern Pennsylvania has also been a trendsetter in water infrastructure reform. The region features a number of watershed organizations that are redefining how the commonwealth manages its water services. These include both well-established groups like the Delaware River Basin Commission and the Chester County Water Resources Authority, as well as upstart partnerships created with the support of the Philadelphia Water Department. Southeastern Pennsylvania's experiences thus can serve as a model for the rest of the nation as it begins to address the water-related challenges of the new millennium.

Where Do We Go From Here

The future is here: *Banking on the Future* details a wealth of new, innovative methods of meeting our nation's water needs can save money for U.S. taxpayers while ensuring a stronger, more flexible water infrastructure for decades to come. To fully realize these advances, however, we must replace our outdated and balkanized water systems that are exacerbating, rather than alleviating, the water infrastructure crisis in southeastern Pennsylvania and the nation.

Chapter One: Smart Water Strategy

Smart Water Strategy
A new, fiscally responsible approach to investing in water infrastructure that emphasizes non-structural, least-cost, coordinated management at the watershed level. Smart water strategy eschews one-size-fits-all planning in favor of more flexible solutions tailored to meet the needs of individual communities.

A Smart Water Strategy

Communities across the country are experiencing the negative impacts of aging and inadequate water systems. Highly centralized treatment and distribution systems of conventional water infrastructure can exacerbate current problems and provide no affordable, long-term solutions to growing water needs. Whether forced by circumstance or motivated by common sense, states, municipalities and the federal government are beginning to move beyond traditional water solutions in favor of smaller scale, more flexible proposals that rely on a region's natural hydrological system rather than just a sprawling network of pipes and concrete.

In southeastern Pennsylvania, demographic shifts are causing the region's aging water system to face many of the same problems as the rest of the country. Decades of urban flight have left Philadelphia and surrounding suburbs with a reduced ratepayer base to pay to replace their decaying water service infrastructure. On the other hand, rural areas are facing increased development pressures and related challenges for managing and protecting valuable water resources. Land use decisions, such as zoning and planning for development, can drive water management decisions. The availability of new water services can become a powerful lure for new development.

While urban, suburban and rural communities have different water resource needs, from managing older infrastructure to obtaining new services, all look first to traditional solutions to meet their drinking water, wastewater and stormwater needs. But too often, these types of plans or proposals manage water in a fragmented, expensive way.

This report discusses today's growing water infrastructure crisis, and offers a new direction and specific proposals for addressing water services in America. We will explore the water infrastructure funding crisis and the challenges of water resource management, and we will examine the laws and financial resources currently available for water systems. We will also provide four case studies of management structures that deal with southeastern Pennsylvania and recommend steps to help resolve the water services crisis in a fiscally and environmentally sound manner.

The report advocates for a better way to deal with the water infrastructure crisis. We propose a new idea, which we have termed "smart water strategy" – a set of principles designed to make water

Aging water and sewer lines plague communities in Pennsylvania, costing taxpayers millions of dollars each year.

management more affordable and more responsive to the individual needs of communities. Smart water strategy takes a comprehensive approach, relying on innovative methods that manage the three main residential water services – wastewater treatment, drinking water decontamination, and stormwater control – as interrelated services, and part of the natural hydrological cycle. This is more cost-effective because it minimizes the construction of cumbersome infrastructure that is expensive to maintain and likely to wear out in a few decades. The other main component of smart water strategy is a commitment to better management at the watershed level. By placing a strong emphasis on inter-agency cooperation and coordination, smart water strategy reduces the cost of water management by avoiding the internal conflicts and "turf wars" that too often plague the government. This report has two key goals in mind. The first is to educate city officials, regional planners and water service providers of the benefits of smart water strategy. Taxpayers for Common Sense hopes that this report will encourage greater awareness of smart water approaches that have the clear potential to save communities billions of dollars.

The second is to inform policymakers about the importance of an integrated approach to water management. This report urges policymakers to reform current laws to accommodate taxpayer-friendly practices and provide disincentives for the expensive, one-size-fits-all water solutions that municipalities too often rely on. As the Pena Blanca example highlights, old technologies often leave states and localities facing enormous costs, at a time when federal funding for expensive wastewater treatment facilities has become increasingly limited.[6] There are also a number of legal and financial obstacles that discourage communities from adopting cheaper methods (more on this in Chapters Four and Five).[7] This report encourages state and federal lawmakers to modernize water laws so that water purveyors nationwide can move beyond the traditional, outdated infrastructure and more fully embrace these more cost-effective, environmentally sound solutions.

Smart Water Strategy in Practice: Pena Blanca, NM

In the early 1980's, septic tank and sewage overflows plagued the small community of Pena Blanca, New Mexico. With raw sewage surfacing across the town, the community faced an imminent public health crisis. A study by the U.S. Environmental Protection Agency (EPA) found that more than 85 percent of the homes in the community were in need of significant wastewater improvements.[1] The area's wastewater disposal systems were overloaded and had inadequate leachfields. In response to the crisis, the community hired an environmental engineering firm to develop a plan of action. After an initial analysis, the firm recommended a $3.1 million centralized sewer system that would pipe wastewater from each residence to a common treatment facility.[2]

But Pena Blanca lacked the money to build such a facility, and the State of New Mexico refused to sign off on such a costly proposal. Without the state's approval, it was impossible for Pena Blanca to get the necessary financial assistance from the EPA. It became clear that the only option was for Pena Blanca to develop a more cost-effective solution. The engineering firm was asked to revise the wastewater proposal, and it returned with a facility plan that relied on a decentralized system with onsite treatment including septic tank leachfields, cluster systems and sand mound disposal systems.[3]

The new proposal would cost Pena Blanca just over a million dollars, roughly a third of the original cost. Additionally, by subscribing to the most cost-effective option, Pena Blanca was able to pay for virtually all of the construction costs through federal funding. The plan was a success for the community and individual users.[4] Under the authority of the Pena Blanca Water and Sanitation District, the system continues to operate successfully today.[5]

A Road Less Traveled

As more and more water experts are pointing out, many new approaches to water management and maintenance are largely ignored because water planners are locked into the old model of meeting water demands, regardless of cost or environmental impact, rather than focusing on satisfying consumers need for "water services" at the lowest fiscal and ecological impact.

This business-as-usual approach is leading us to a water infrastructure crisis that promises to leave a multibillion dollar hole in the federal budget. Estimates from the Congressional Budget Office

(CBO), the EPA and the private sector[9] predict that there will be a significant fiscal gap, on the order of tens of billions of dollars, between current annual spending on water services and the predicted need. But as the nation faces record deficits and states are paring back services to keep their budgets balanced, additional public sector financial resources to close this gap will be limited.

As Peter Gleick, a leading water resources expert and president of the Pacific Institute, has said:

> Water-supply systems have brought great benefits to water users by improving the reliability of supply, reducing water related diseases associated with poor water quality, and buffering the impacts of extreme hydrologic events such as floods and droughts. They have also brought great costs, which include ecological and environmental degradation, social disruption associated with infrastructure construction, and economic problems.[9]

This report outlines infrastructural solutions that maintain the reliability of today's water system while saving the American public billions in repairs and maintenance costs, and reducing ecological impact.

While traditional water strategies are fixated mainly on building and expanding infrastructure, a smart water strategy puts the focus on a municipality's water demands. An effective water strategy simply gauges a community's need, then develops an economical and ecologically friendly implementation plan to meet it. This allows planners to focus on specific needs; it takes advantage of conservation opportunities and encourages adoption of cost-effective measures. Most importantly, these techniques generally sidestep expensive water infrastructure systems that then need to be replaced only decades down the line.

Many of the problems communities face with their water services could be resolved if the focus were shifted from increasing the water supply to conserving and efficiently using what sources we currently have. This demand-side approach is very similar to the shift that has been evolving over the past quarter-century

Local officials and regional planners must consider the economic impacts of new development on local drinking water and wastewater systems.

with energy. The old school, conventional wisdom of electricity delivery simply involved expanding supply. This was challenged when energy analysts showed that improving the efficiency of energy-consuming devices was much less costly than expanding supply to inefficient energy users, whether buildings, factories, vehicles or appliances. And indeed, total energy use per capita in the U.S. in 2000 was almost identical to what it was in 1973, while economic output (GDP) per capita increased by 74 percent.[10] Improving the way we provide water services could offer similar cost savings and economic opportunities.

As the Pena Blanca, NM, case study suggests, the smart water approach is not new – many municipalities, when faced with tough challenges for providing water services, have looked to new, better ways to solve the problem. In fact, for many communities, smart water strategy is the *most* cost-effective way to provide and maintain water services. Municipal planners need to consider a smart water strategy when making crucial decisions about infrastructure, land use and other issues that impact the quality and quantity of water resources.

An integrated approach to water services can reduce the need for new water supplies, thus saving taxpayer money. While this strategy does not preclude the use of centralized infrastructure, it limits its expansion in favor of the smaller-scale, more efficient methods that have become abundantly available in recent decades.

The bottled water industry has applied smart water solutions as a cost-saving business strategy.

These plans are based on the saying that "an ounce of prevention is worth a pound of cure." While old, centralized systems invest most of their resources on treatment and filtration, smart water solutions emphasize cleanliness at the water's source, where the elimination of contaminants is more cost-effective.[11] These techniques benefit the taxpayer because they eliminate the need for costly purification infrastructure down the road.

And, because smart water works with the natural water system, rather than independent of or against it, the approach is more ecologically friendly than the conventional network of channels, pipes and treatment facilities. Using the natural ecology to cut taxpayer costs has the added benefit of preserving the natural ecosystem.

Smart water uses a menu of options meant to be implemented interchangeably to fit local conditions and needs. This is a vital part of what makes smart water so cost-efficient: unlike the traditional one-size-fits-all infrastructure expansion, smart water takes a customized, more flexible approach. The list below indicates the wide range of options that smart water strategy allows watershed planners; the variety of techniques available is what makes smart water adaptable to communities from arid, rural Pena Blanca to wet, urban Philadelphia.

As demonstrated in Pena Blanca and in other communities across the country, smart water strategies such as decentralized sewer systems offer states and localities more affordable and flexible solutions for wastewater services.

Some Examples of Smart Water Solutions

Conservation: Programs that encourage conservation; less water-intensive toilets and showerheads; innovative pricing schemes; programs like the Delaware River Basin Commission Groundwater Protected Area, which regulates groundwater withdrawals from a sensitive area.

Land Use: Riparian buffers, smart growth or low impact development, roof gardens, innovative landscaping, porous concrete, restrictions on impervious surfaces, restoring wetlands, wetland sewage treatment, stream protection, grassed swales, water quality inlets in parking lots, preserved floodplains.

Source Water Protection: Pollution prevention programs, pesticide reduction, hazardous household waste collection, onsite spill and pollution quick response, wellhead prevention and protection, contamination containment, erosion control, organic farming initiatives.

"Soft" Infrastructure: Distributed and onsite septic systems, clustered wastewater treatment, graywater facilities, stormwater capturing facilities, leachfields, sand mounds, onsite stormwater BMP, oil/water separators.

Smart Water for the Big City

Smart water strategy emphasizes prevention and proactive measures to avoid even larger clean-up and restorative costs, and less piped infrastructure to transport water. Below are some expamples of smart water strategies in action. See Chapter 3 for more details on new, innovative solutions.

One of the most touted examples of a large-scale cost-effective approach to addressing filtration of drinking water is in New York State. In the early 1990's, New York City faced a cost of $6-8 billion to build a new drinking water treatment plant, plus $300 million a year in operating costs. The New York State Department of Environmental Conservation completed a comprehensive analysis of alternatives to

the plant and determined that the city could implement a source water protection plan at a far lower cost than the original multibillion dollar proposal for constructing and operating new filtration facilities. [12]

The source water protection plan was a partnership of the city, the state, EPA, watershed counties, towns and villages and a few environmental and public interest groups.

The smart water plan resulted in New York City pledging to spend $1.5 billion to protect the upstate reservoir system. The city also implemented extensive watershed management measures, including water quality monitoring and disease surveillance, land acquisition and comprehensive planning, and upgrading wastewater treatment plants.[13] The Watershed Agricultural Council (WAC), a local organization, was formed to support the improvement of land-use practices as well as economic development of local communities.[14]

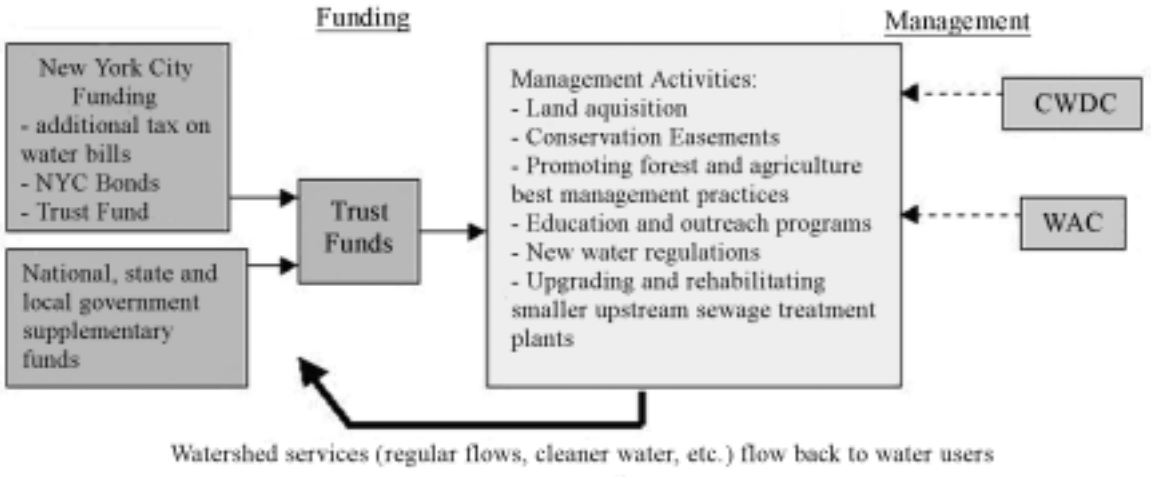
Through a series of investment in sourcewater protection, New York city has been able to keep the pristine drinking water that it is famous for while saving money for city residents.

Smart Water for Business

Perrier Vittel, arguably the best-known name in bottled water, faced serious challenges regarding its water supply after benzene was found in Perrier bottles in 1990. But after considering a costly filtration plant, the company determined that conserving farmland around their aquifers in order to control for contaminants was far better for their bottom line. The company purchased 600 acres of sensitive habitat and signed long-term conservation contracts with local farmers to protect their investment.[15]

Watershed Management: Building

The water-based finance system of New York City



Source: Sustainable Alternatives Network, http://guide.conservationfinance.org/chapter/index.cfm?Page=3

Integrated Structures

Water planners are recognizing that the fragmented way that government agencies operate is inadequate for managing water services in the 21st century. Watersheds, unlike government agencies, do not stick to political boundaries; rather, they flow between many jurisdictions and often multiple states, providing benefits to communities that may be hundreds of miles apart. While municipalities that lie along the nation's rivers and streams may be subject to different state and local laws, they are drinking the same water. For the nation's freshwater supply to be managed effectively, upstream and downstream communities must work together to keep their water sources clean and healthy.

Government-funded entities that operate across state and county lines and oversee water services on a watershed-wide level provide an appealing solution. These groups can save taxpayers millions of dollars that are now wasted on infighting and duplicative efforts; in addition, such organizations are more likely to promote cost-saving reforms, because they are better able to engage in long-term planning. In many ways, Pennsylvania has led the nation when it comes to watershed planning. The commonwealth has a number of longstanding government entities, like the Delaware River Basin Commission and the Chester County Water Resources Authority, that have been overseeing vast stretches of watershed for over thirty years. This report offers insight on how to make those pre-existing watershed organizations even more effective.

Endnotes

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[3] *Ibid*. 2.
[4] *Ibid.*
[5] Matlock, Staci. "Officials Seek Wastewater Solutions," *Santa Fe New Mexican*, October 4, 2000. P-1.
[6] DLC Model Initiatives. "Soft Path Water Quality." www.ndol.org/ndol_ci.cfm?kaid=139&subid=274&contentid=252617. Site last visited May 26, 2005.
[7] See, for example, Nelson, Valerie I. and Christopher Serjak. "Distributed and Nonstructural Water and Wastewater Systems: Charting 'Soft Paths' to Integrated Water Resource Management: Recommendations for Federal Policies and Funding," Coalition for Alternative Wastewater Treatment, 2003; and, Nelson, Valerie I. "Soft Path Integrated Water Resource Management: Update on Training, Research, and Development Activities of NDWRCDP and Opportunities for New Projects and Collaboration." Coalition for Alternative Wastewater Treatment, 2003.
[8] One major representative of private sector interests (and some public sector) is the Water Infrastructure Network, a coalition of local elected officials, drinking water and wastewater service providers, unions, construction industries, state environmental and health administrators, engineers and environmentalists.
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[13] Mertz, Tawna. "New York City Depends on Natural Water Filtration." Rand Corporation.
[14] The Catskill Watershed Development Corporation (CWDC), a non-profit organization, administers the program locally, in the upper watershed areas (See chart above from http://guide.conservationfinance.org/chapter/index.cfm?IndexID=18)
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Chapter Two: Facts About The Water Crisis

- The nationwide disparity between operation and maintenance costs and the funding available will create a financing gap that is projected to run between $12-31 billion/year over the next 20 years.
- Pennsylvania's infrastructure replacement costs are estimated to be roughly $47 per person annually through 2025.

When this country's first piped drinking water system was built in Philadelphia in 1802, it was a major advance for engineering and public health. The next step forward was installing a second set of pipes to carry away the wastewater. But this created a problem still faced today: the wastewater pipes led right back into the same rivers, streams and lakes that supplied the drinking water. To halt the rise in disease associated with water contamination, centralized wastewater treatment plants were added to the nation's water systems in the 1950's.[1]

This last major overhaul in our water system took place over a half-century ago, and the elaborate piping systems are often much older. In most cases, the current infrastructure has outlived its useful life and is in dire need of repair or replacement. Though most communities continue to throw significant resources at an aging, outdated system, many are starting to feel that it is time to take the important next step in improving our water system by subscribing to a new, smarter approach. The premise is that we must move beyond sole reliance on conventional centralized systems to replace our aging waterworks.

The Conventional Water System

Old systems place strong emphasis on infrastructure and treatment. They are characterized by their reliance on a labyrinth of pipes that travel long distances to collect, distribute and dispose of water.

The average drinking water system collects source water from underground aquifers or surface streams. It then carries the water to a centralized facility where it is filtered and treated, then distributed to residential, commercial and industrial users through a network of pipes. Regardless of its eventual use, all water is treated to be potable; thus, water that is destined to be used to flush toilets is filtered with the same rigor as drinking and bathing water.

"Post-use" water is then drained into a system of sewers that carries it to a centralized wastewater treatment plant. The plant treats the water once again, then discharges it into the local waterways.[2]

Traditional stormwater systems collect rainfall runoff through a series of separate or combined sewers, then route that runoff into local waterways. While natural areas typically dispose of much of the runoff by absorbing it through the ground, the rapid expansion of impervious surfaces (like highways and parking lots) has reduced the amount of stormwater that

The increase of land area devoted to parking lots like this one in Chester County, PA, limit an area's ability to capture stormwater through ground absorption. Instead, stormwater flows from the man-made surfaces into local rivers and streams, where they impair water quality and make communities more susceptible to flooding. *Photo courtesy of Chester County Water Resources Authority*

is processed by natural means. New development nationwide is placing a greater burden on conventional stormwater systems to manage runoff. Many water systems have been overwhelmed, causing polluted stormwater to spill across towns or drain into drinking water supplies.

For the purposes of this report, water services include drinking water, stormwater and wastewater treatment. Irrigation and other water needs are also important components of an integrated structure, but are not addressed in this report.

The State of the U.S.'s Water System

Much of the U.S.'s water infrastructure was constructed shortly after World War II; it will be reaching the end of its useful life in the next 20 to 40 years.[3] Today, the average American sewage pipe is 33 years old, and some communities rely on pipes that date back more than a century. Remarkably, some water systems still use wooden pipes. America's treatment facilities are in no better shape; many will require overhaul or replacement within the next few decades.[4] Urban centers, whose water systems are typically older than average, tend to have the greatest need for repairs.

Households' Average Bills for Typical Levels of Water Consumption in OECD Countries in the Late-1990's (Percentage per capita GDP)

Korea	0.64
Italy	0.72
United States	1.0
Japan	1.04
Turkey	1.32
Belgium	1.44
Sweden	1.48
Spain	1.52
Denmark	1.60
Australia	1.72
Finland	2.16
France	2.20
England and Wales	2.28
Netherlands	2.52
Czech Republic	3.84
Hungary	6.20

Source: Congressional Budget Office

The upkeep of these systems is expensive and requires constant expenditures. Over the past 20 years, communities have spent more than $1 trillion on drinking and wastewater treatment and disposal.[5] This figure is even higher when the construction and operation of dams, which alter the flow of two-thirds of the nation's rivers, are factored in.[6] Yet despite the already massive cost, America's conventional water systems are facing significant cost increases over the long term. Our infrastructure is still aging, and it will not adequately meet the future needs of our growing nation.

Getting the Price Right

Undervalued resources will always be wasted. This is certainly the case with potable water in America. In the U.S., the household water bill often reflects only the costs of operations and maintenance, but not the long-term costs of repairing the water infrastructure. In the 1990's, the U.S. had the third lowest average household water bill out of 16 industrialized nations of the Organization for Economic Cooperation and Development polled by the Congressional Budget Office (CBO). And some industrialized countries, like the United Kingdom, pay more than twice as much for their household water as do Americans.[7] While the inexpensive price of water has been a boon to American families, it has left America's water providers in a tight spot. This has caused a significant gap between the amount currently available to prop up the aging system, and the actual amount needed.

The federal government currently foots the bill for 23 percent of the nation's wastewater funding and 3 percent of its drinking water funding.[8] From 1973 to 2002, the federal government distributed more than $73 billion for centralized sewage treatment plants,[9] and in the years since funding for drinking water was initiated in 1996, the federal government has provided well over $5 billion.[10]

The Gap

But even with the significant federal investment, the nation's water infrastructure is underfunded, and

it is predicted that the funding gap will continue to grow. At present, the government spends $10 to $13 billion annually on its drinking water and wastewater infrastructure. The CBO estimates that it will cost, on average, between $24.6 billion and $41.0 billion annually to replace aging infrastructure and to meet the requirements of the Clean Water Act and the Safe Drinking Water Act over the next two decades.[11] This amounts to roughly $100 per capita per year. In a separate analysis, the EPA found that there will be a $535 billion gap between current levels of spending and projected needs for drinking water and wastewater infrastructure over the next 20 years.[12]

The Funding Gap

The Amount We Spend.....$10-13 billion/year
The Amount We Will Need.....$25-41 billion/year

The Shortfall.....**$12-31 billion/year**

Despite tens of billions in investment, America's water infrastructure is still in a precarious state. According to the American Society of Civil Engineers (ASCE), the nation's 16,000 wastewater systems still face enormous needs,[13] and the nation's 54,000 drinking water systems continue to degrade. At the same time, the costs of transporting and treating water have risen steadily. It is clear the federal government will be unable to address these growing problems with conventional approaches to water infrastructure. In recent years, tight budgets and shifting priorities have led to reduced levels of federal funding, adjusted for inflation.[14]

One of the greatest funding challenges is that many urban areas where infrastructure replacement needs are often greatest are losing their ratepayer base due to decades of urban flight. As a recent report attests, older urban communities tend to have a "static or declining tax base or rate base" in comparison to newer suburban or exurban developments.[15] It is these same urban communities whose water systems currently account for 65 percent of the nation's repair needs.[16] But current U.S. policy does little to address the needs of aging inner-city water systems: state and federal loans are often directed towards providing sewer and water services in new developments, rather than the maintenance of water services in established communities.

Bridging the Gap

While many suggest more construction, renovation and spending to fill the gap, the financial advantages of pursuing smart water strategy are impressive. Smart water strategy is better suited to deliver and dispose of water at lower cost, and its emphasis on conservation helps to alleviate some of the strain on existing systems. Additionally, states can help bridge the gap by coordinating and promoting regional approaches, more closely monitoring withdrawals and discharges, utilizing and encouraging demand management, promoting full-cost accounting of the price of infrastructure decisions,[17] and financing additional research and development.[18]

Urban areas or other areas with deteriorating or overwhelmed existing infrastructure will benefit from pursuing a smart water approach. Augmenting existing systems with smarter systems will enable more water to be "treated" without the centralized infrastructure.

The CBO points out that water systems are beginning to realize the benefits in efficiency savings from smart water strategies such as demand management and system consolidation.[19] This is similar to the significant savings found in another resource area, namely energy and utility power plant planning. Over-construction of power plants in the 1970's burdened ratepayers and taxpayers with more than $100 billion in extra costs.[20] State regulatory changes that rewarded delivering energy services more effectively and cost-effectively (i.e., through promotion of high efficiency building construction, appliances, office equipment, industrial motors, and combined heat and power systems) – the electricity sector's equivalent of a smart water strategy – greatly reduced planning uncertainty and led to less needless power plant construction.

Pennsylvania Department of Environmental Protection's Projected Water Infrastructure Costs to 2025:

Needed Improvement	Average Cost Per Year	Annual Cost Per Capita
Drinking Water Systems	$263 million / year	$21.25
Sewage Infrastructure	$315 million / year	$25.47
Total	**$578 million / year**	**$46.73 / person / year**

Source: DEP, U.S. Bureau of the Census (July 2003 figures)

Pennsylvania

Pennsylvania's current drinking water systems and sewage treatment plants are outdated and unable to meet the state's growing and changing needs. According to a January 2001 poll conducted among state civil engineers by the ASCE, water infrastructure is one of Pennsylvania's top three infrastructure concerns. Pennsylvania's deteriorating water systems negatively impact the commonwealth's environment, public health, and economic development. In particular, urban areas like Philadelphia and Delaware County face enormous challenges because of aging infrastructure and declining ratepayer bases.

According to the Pennsylvania Department of Environmental Protection (DEP), the state will need to invest $5.26 billion over the next 20 years for its drinking water infrastructure, and $6.3 billion more over those years to upgrade its existing sewage treatment plants and lines, including $4 billion to address combined sewer overflows.[21] This amounts to an annual per capita cost of nearly $47 until 2025. Recognizing this challenge, Pennsylvanians voted overwhelmingly in May 2004 to approve a $250 million bond to finance grants and loans for its wastewater, sewer and drinking water treatment systems. This initiative, which allocated $50 million to the Pennsylvania Infrastructure Investment Authority (PENNVEST) for repairs (see Chapter Five),[22] demonstrates that the public is becoming aware of funding shortfalls; but it is not nearly the amount that is needed each year to keep Pennsylvania's water infrastructure in working condition. And if not carefully invested, this funding could exacerbate current problems if it is used only on building new infrastructure that does not have long-term cost savings.

This future funding crunch highlights the need for long-term planning and cost-effective reforms. As the EPA itself has said, simply mending the present water infrastructure is not enough; it will take both increased spending and innovative management practices to address the nation's growing water needs.[23] On the state level, Pennsylvania will be pressed to create incentives to fix the commonwealth's major infrastructure problems and disincentives for sprawling development patterns that require new and expanded infrastructure subsidies.[24]

On the local level, the current path will remain an expensive road to follow, in both the short and long terms. As we shall see in the next chapter, smart water solutions can reduce taxpayer and ratepayer costs, address long-term needs of communities and protect watersheds as well.

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Chapter Three: Directions for the Road Less Traveled

- There are effective cost-saving measures currently available to water providers and municipal planners.
- The three major categories of water services – drinking water, wastewater and stormwater – are most effectively and inexpensively managed using an integrated approach.
- Smart water strategy emphasizes conservation, sustainable land use and decentralized infrastructure.

Water is essential to life – health and well being, economies and aesthetics. Ascribing a monetary value to water is virtually impossible. According to a recent study, the value of water to humans (for both market and non-market purposes) is estimated to be $16 to $54 trillion per year.[1] America's freshwater has been estimated to be worth hundreds of billions of dollars per year to the U.S. economy. Its value reaches far beyond sustenance and public health, as it is critical to recreation, tourism, fishing, agriculture and industry.

But whether in the western desert or eastern wetlands, it is clear that current infrastructure has undervalued our water resources, jeopardizing the long-term stability of the precious freshwater available to our society. As described in Chapter Two, current centralized infrastructure has served its purpose but funding constraints are challenging the wisdom of continuing down this path.

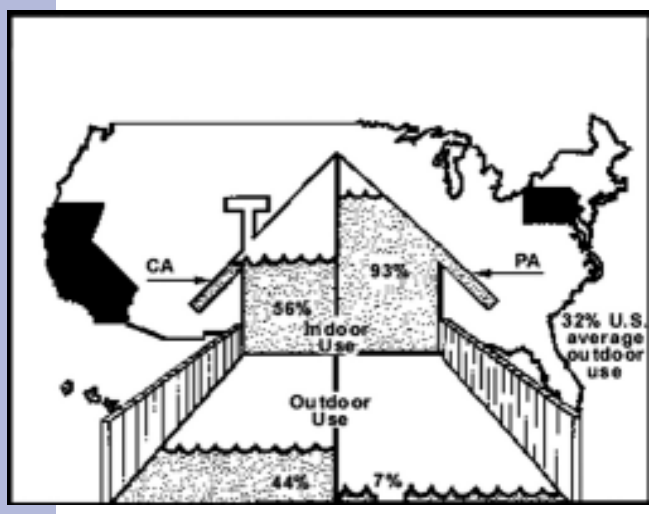
In the last twenty years, we have learned a great deal about how to deliver water services at less expense by taking advantage of a large and expanding pool of water efficient design and technology options. Now that we are in the process of renovating and replacing our water infrastructure, we need to utilize some of these new practices. When selectively applied, these relatively inexpensive technologies drastically cut the costs of operating and maintaining water systems, while practically eliminating the long-term renovation costs associated with the traditional infrastructure.

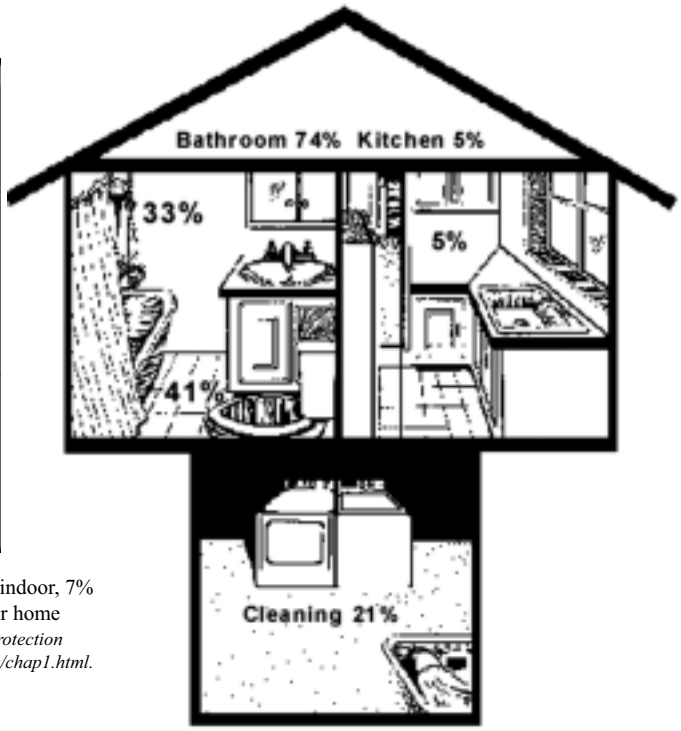
Traditional water infrastructure management divides water services into three main categories: drinking water, stormwater and wastewater.[2] The chapter reviews many of the challenges associated with the three residential water services, and demonstrates that most, if not all, of these challenges can be addressed using an integrated smart water strategy.

Drinking Water

Drinking water is collected from source water, which can be either surface water, such as streams, rivers and lakes, or groundwater from underground aquifers. This water is treated and used to supply private wells and public drinking water systems. Our current water supply systems treat all water piped to our homes, businesses and industry the same – we water lawns, wash cars and flush toilets with the same high quality water that we use to bathe, cook and drink. Additionally, the failure to set rates that capture the full cost of water (a shortcoming which is ultimately subsidized by taxpayers) contributes to the overuse of water and the construction of unnecessary infrastructure. This lack of differentiation between low- and high-quality water uses leads to a disproportionate fixation on infrastructure projects supplying high-quality drinking water for all uses.

However, much of the water we use does not need to be of drinking quality. According to the EPA, anywhere from 7 percent (Pennsylvania) to 44 percent (California) of residential water is used for outdoor purposes, such as lawn watering and car washing. Of the indoor uses, toilet flushing uses the greatest portion at 41 percent.[3] The graphics on the following page indicate the differences between typical Pennsylvania water use and California water use, as well as the national breakdown of indoor use.





Above: Typical U.S. indoor and outdoor home water use, Pennsylvania [93% indoor, 7% outdoor] vs. California [56% indoor, 44% outdoor]. Right: Typical U.S. indoor home water use [74% bathroom, 21% cleaning, 5% kitchen]. *Source: Environmental Protection Agency. "How we Use Water in These United States." http://www.epa.gov/watrhome/you/chap1.html. Site last visited March 15, 2005.*

The current water supply system's inability to differentiate between potable and non-potable water places additional strain on our already troubled drinking water system. This demand, coupled with the added burden of treating water for a variety of contaminant sources, reduces the life of the infrastructure due to wear and tear and increases the need for the construction of additional treatment facilities.

One of the most basic and expensive tasks of our drinking water system is the removal of contamination, particularly at the freshwater source.[4] Groundwater aquifers are far more vulnerable to contamination than surface waters. This is because while contaminants entering surface waters are constantly being diluted or flushed out to the sea every few weeks, groundwater remains in an aquifer for an average of 1,400 years. (Some aquifers contain rainwater up to 30,000 years old.) Aquifers are thus more likely to hold and accumulate contaminants, which makes their filtration more difficult and expensive.[7]

Water Loss: A Philadelphia Story

Leakage is a serious problem facing current water systems. In a recent audit, the Philadelphia Water Department (PWD) found that a staggering 69.2 million gallons per day of the city's potable water was lost to leakage.[5] This amount, representing 24.9 percent of Philadelphia's total water use, is due to the city's aging and leaky infrastructure.[6] Many old urban centers in the U.S. suffer a similar level of water loss.

Stormwater

Stormwater is an integral part of any natural water system.[8] It recharges underground aquifers, replenishes forests and vegetation, and ultimately provides us with the drinking water we need. However, with the onset of widespread development, stormwater has become a major challenge for our wastewater and drinking water systems. Impervious surfaces like sidewalks, parking lots, and rooftops have severely inhibited precipitation from being absorbed, creating large volumes of stormwater runoff to enter our waterways and causing sewer overflows.

Compounding the problem, as the stormwater flows over impervious surfaces, it gathers an array of debris, chemicals, dirt and other pollutants before flowing into the storm sewer system or nearest waterway. The 1996 National Water Quality Inventory determined runoff to be the leading cause of water contamination.[9]

Stormwater runoff also degrades stream banks and increases water flow.

While there are several factors that contribute to increased runoff, such as slope and soil type, the increase in impervious surfaces has caused the recent spike in runoff.[10] When 10 to 15 percent of total land is impervious, runoff significantly increases;[11] at 20 percent impervious cover, dramatic impacts to local waterways occur.[12]

Streams can become rapidly channelized, increasing flooding and damaging stream corridor property.[13] This is due in part to the large reliance on dams, levees and the funneling of water downstream that have proven ineffective against large floods and have actually promoted development in floodplain areas. In fact, the nation's overall average annual flood damages have risen in real terms from $2.6 billion per year in the early 20th century to more than $6 billion annually in the last ten years.[14]

In Pennsylvania, pollution from stormwater is a major cause of water impairment. According to the Brookings Institution, "Runoff from pavement, urban sewer discharges, and other development-related impacts contribute to the impairment of a third to a half of the state's 5,273 miles of officially 'impaired' streams."[15] Increased low-density, unregulated development of agricultural and open space continues to aggravate this serious problem.[16]

In southeastern Pennsylvania's Schuylkill watershed, stormwater has impaired 273 stream miles, mainly in the watershed's two most developed counties, Montgomery and Philadelphia.[17] As the region's population continues to spread out from older cities and boroughs to low-density townships, the rise of impervious surfaces makes the region's water quality problems even worse, because of the increased burden on near-capacity sewage collection and treatment systems.[18]

When there is a lack of groundwater recharge, dry weather streamflows dramatically decrease, because 40 percent of a stream's water comes from groundwater.[19] The rapid expansion of impervious cover in Pennsylvania's urban and suburban areas has made it especially difficult for rainwater to recharge the groundwater.[20]

Traditional management largely addresses stormwater through separate storm sewers that collect and discharge untreated water into local waterways or through combined sewers, which combine sewage and stormwater in the same system. Both can be extremely harmful to public health. Storm sewers release contaminated stormwater directly into the same water we often use for drinking, fishing and swimming, requiring expensive treatment or putting public health at risk.[21] Combined sewers can overflow during periods of intensive rainfall, causing the dangerous release

Massive water facilities like this one treat water by removing sludge and scum, aerating the water to eliminate foul odors and tastes caused by decaying organic matter, and killing bacteria through contact with chlorine (which is then neutralized by adding other chemicals). The newly cleaned water is then discharged into a local river or stream. *Photograph courtesy of EPA.*

Wetlands cleanse water through the natural filtrating power of bacteria and other organisms that live in the diverse ecosystem. *Photograph courtesy of EPA*

of sewage and stormwater into local waterways with costly impacts on public health.

Wastewater

Wastewater management is dominated by large-scale, centralized projects. All discharged water travels through sewer pipes to a centralized treatment facility. Because all discharged water is carried through a common system, the result is underground rivers of wastewater, contaminated with bacteria and other toxins. After treatment at the sewer plant, the processed wastewater is discharged into streams, rivers, bays and oceans.

The U.S. has approximately one million miles of private and municipal sewer pipes, most of which are 30 to 100 years old, with some urban pipes approaching 200 years.[22, 23] Much of this existing infrastructure will be reaching the end of its useful life in the next several decades. Deteriorating sewer pipes, damaged from years of root invasion, foundation washout, sewage back up, seismic activity and other events, may leak, putting underground aquifers at risk. This contaminated water, typically untreated raw sewage, carries human and industrial waste into underground aquifers used for drinking water.[24] Because groundwater contamination is a slow process, it can take years to detect, making the problem very difficult and expensive to clean up.

While a million miles of pipes offers a myriad of places for things to go wrong, perhaps the greatest contamination threat is from sewer overflows. The EPA estimates that, although illegal, there were approximately 40,000 sanitary sewer overflows (SSOs), along with 400,000 basement backups in 2001.[25] SSOs occur when the system becomes overloaded due to the infiltration of rainfall or snowmelt into leaky sewer pipes, sewers and pumps too small to carry wastewater from newly developed areas, blocked or misaligned pipes, or improperly maintained systems.

The second type of sewer overflow, combined sewer overflows (CSOs), occurs in systems with combined wastewater and stormwater collection systems. The combined sewer system, found predominantly in the Northeast and Great Lakes regions, is constructed similarly to the traditional sanitary sewer system, except storm drains send stormwater into the same sewer pipes that carry raw sewage for treatment. During periods of heavy rain, the combined storm and sewer

Buffers, like this riparian corridor being planted in Chester County, PA, can serve multiple purposes: reducing runoff and providing recreational space. *Photo courtesy of Chester County Water Resources Authority*

water overwhelm the system and bypass the treatment facility. The EPA estimates that 1.3 trillion gallons of raw sewage is pumped this way, often contaminating our source water, as a result of CSOs each year.[26] The agency estimates that $50.6 billion is needed to control CSOs nationally.

President Teddy Roosevelt said nearly a century ago, "[C]ivilized people should be able to dispose of sewage in a better way than putting it in the drinking water."[27] Yet the cycle of contamination due to leaks and overflows continues. Raw sewage contains harmful bacteria, viruses, protozoa, helminths (intestinal worms), and bioaerosols (inhalable molds and fungi), as well as industrial waste such as mercury, lead, sulfuric acid, phthalates and more. Contamination affects drinking water, public health, wildlife and recreational opportunities. The EPA estimates that up to 3.5 million illnesses each year are the result of people swimming in waters contaminated by sewer overflows.[28]

Aside from the pitfalls of an outdated and aging treatment system, even if everything is working properly, many communities run the risk of a net loss of water. By taking source drinking water from local underground aquifers or even streams and rivers, then discharging wastewater downstream or into bodies of saltwater, the water is removed from its natural hydrologic system, and aquifers and other source water are not adequately recharged.

The Smart Water Approach

The smart water approach pursues an integrated strategy for satisfying water services in the most flexible and efficient manner. Key components of this approach include: differentiating the demand for water use, much of which can be satisfied through other means than increasing the use of costly high-quality freshwater sources; strongly encouraging pollution prevention efforts that reduce point and non-point sources of pollutants that would otherwise contaminate surface and groundwater resources and increase treatment cost;[29] promoting economically attractive water efficiency and conservation opportunities available throughout the industrial, commercial, institutional and residential sectors; and decentralizing wastewater treatment systems.[30]

Differentiating Water Demand

One way to reduce high quality water consumption is to separate the demand for potable and non-potable water. Since about half of residential water is used for activities that do not require water as clean as drinking water, it makes little sense to pay for all water to be treated to a level at which it can be consumed. Smarter and more financially conscious approaches use such methods as capturing stormwater runoff (thereby reducing surface water pollution) or by encouraging the reuse of "graywater," which is the discharged household water from reusable sources (sinks, showers, tubs and washing machines). Graywater can be used for toilet flushing, watering plants, car washing, etc. In general, the efficient use of our water resource has the potential to significantly cut the need for treated water.

Stormwater that runs through the paved streets of urban and suburban neighbors is collected by dirty, sediment-lined storm drains like this, and is inevitably discharged into local water sources. *Photograph courtesy of EPA*

Pollution Prevention and Land Use Planning

Further savings can be made by reducing the burden on the treatment facilities. Preventing contamination at its source or using the filtration of the natural hydrological system makes additional filtration and

chemical treatment less necessary at existing facilities, and therefore reduces the need for costly repairs, expensive maintenance and/or new spending on additional treatment facilities.

The most straightforward approach to achieving this goal is by preventing source water contamination in the first place. Smart water solutions such as New York City's conservation measures protect source water by reducing contaminants that occur in and around developed areas, resulting in net savings.[31] Source water protection can also be achieved through a well-designed mix of legislation, regulation, education and incentives to reduce preventable contaminants.

The second line of defense is to prevent existing pollution, such as silt, roadway contamination, agricultural runoff and industrial chemicals, from reaching the source water. Riparian buffers – grasses, trees and shrubs planted along rivers and streams – are a proven low-cost, high return technique in this arena. Effective buffers should be at least 50 feet across, but a buffer's effectiveness roughly increases with its size, so many are several hundred feet wide. Trees and shrubs work better at removing pollutants in urban and suburban areas, while grasses and shrubs are preferred in agricultural areas.[32]

Parking lots like the one in the upper left hand corner of this picture convert rainfall into runoff. The runoff is sometimes impounded in a nearby pond, like this one, where the (often contaminated) water is left to evaporate. Impervious surfaces and their resultant runoff ponds deprive watersheds of the groundwater recharge needed to keep rivers flowing strong. *Photograph courtesy of EPA*

The Connecticut River Joint Commission of Vermont and New Hampshire considers riparian buffers "the single most effective protection of our water resources." Depending on width and species planted, riparian buffers filter up to 100 percent of sediment and 85 percent of agricultural fertilizers and animal waste; reduce runoff and stabilize banks to prevent erosion; and provide for wildlife habitat and recreational uses and aesthetics.[33] To deal with these potential contaminants through treatment would be considerably more costly.

Stormwater management is also key to preventing water pollution by reducing contaminated runoff. Roof gardens, porous concrete, rain barrels, stream buffers, infiltration swales and restored and constructed wetlands are common low-cost smart water approaches to stormwater problems. These solutions also help increase rainwater infiltration and therefore increase groundwater recharge. Once the water is collected it can also be used for graywater tasks, decreasing overall water consumption and lessening demands and costs for our drinking water system.[34] On the community level, these low-tech, low-cost techniques can be even more effective. Residential developments, office complexes and commercial sites can work together to reduce impervious cover and implement larger scale onsite collection.

Another smart water tool is to incorporate non-structural elements into flood damage reduction plans. Traditional flood control projects – dams, levees and channelization of streams – rely on keeping water out and moving it downstream quickly. These projects allow for more development closer to streams and rivers. By moving structures back from the waterway and designing a flood damage reduction plan that allows the natural floodplain to serve its purpose, a community gains a green space that also captures stormwater and serves as a riparian buffer.

Land use plans that do not contribute to sprawling development are an important smart water strategy. This reduces the need to expand expensive infrastructure while also preserving more open space to serve as natural buffers against pollution.

Roof Gardens: A New Smart Water Strategy

Often, smart water projects are ignored not because of a lack of resources, but because of a lack of awareness. This is almost certainly true in the case of vegetated roof cover, a smart water technique that is inexpensive, easy to install, and likely to reap benefits for home and building owners. This cost-efficient practice should gain popularity in the U.S. as more become aware of its benefits.

Vegetated roof cover on the Fencing Academy of Philadelphia. *Photograph courtesy of EPA*

Vegetated roof covers, also known as roof gardens, are small gardens on top of one's house or business. Because they absorb and filter rainfall, roof gardens are an innovative way of controlling stormwater runoff; this is particularly important in cities like Philadelphia, which have a high percentage of impervious surfaces, and are prone to short, high-intensity storms that can overwhelm sewage systems. But while roof gardens benefit the community, they can benefit the homeowner even more: an appropriate roof garden can conserve energy by insulating a house or business from heat or cold, and it can extend a roof's life by as much as 20 years.

Water Conservation and Efficiency

Indiscriminate expansion of water supply is costly to ratepayers and taxpayers, so the most cost-effective way to eliminate water waste and inefficiencies is through promotion of water conservation techniques and technologies. The average American single-family household uses up to 70 gallons per person per day. Studies estimate that this volume could drop to 40 gallons through the adoption of water-saving technologies, such as low-flow toilets, high-efficiency faucets, showerheads, dishwashers and washing machines, and personal use changes, such as limiting showers and avoiding the permanent press laundry cycle, which uses much more water than other cycles.[35]

Although water consumption in industrial, institutional and commercial sectors varies by type of activity, scale of operations, and other factors, there are substantial opportunities for significant increases in water efficiency in those sectors as well.[36]

There is also a substantial body of knowledge on how to set water rates and design incentive programs that ensure that water-conserving options are effectively implemented, in order to eliminate or defer constructing more costly water infrastructure (see Chapter Five).[37] In addition, incentives for water conservation, such as replacing high-input, water-intensive landscaping with water-conserving designs and installing low-water-consuming end-use technologies,

What Is Unwise Development?

Water quality is severely impacted by sprawl developments. Every year new developments eliminate more than 100,000 acres of wetland, which naturally remove up to 90 percent of water contaminants.[38]

Sprawl is typically characterized by...

- Excessive land consumption
- Low population density in comparison with older centers
- Lack of choice in ways to travel
- Fragmented open space, wide gaps between development and a scattered appearance
- Separation of uses into distinct areas
- Repetitive one story development
- Commercial buildings surrounded by acres of parking
- Lack of public spaces and community centers

Source: http://www.sprawlwatch.org


Centralized wastewater treatment facilities like this are the cornerstone of a typical wastewater system.

can help to ensure that significant savings are actually achieved while sustaining or enhancing the benefits expected from water use.[39]

Eliminating water-intensive landscaping is an excellent way to conserve water and save money. When water used for parks, gardens and other landscaping is added to outdoor use at homes, the total demand for outdoor water can account for 40 to 80 percent of a water utility's peak demand. Modest improvements, such as replacing existing lawns with native, water-efficient grasses, can reduce outdoor water use by up to 50 percent.[40] Native grasses and other drought-tolerant plants, which are naturally resistant to local pest problems, also reduce the need for pesticides and chemical fertilizers, which commonly contaminate source water. Of the 36 most common lawn pesticides, 14 have been detected in aquifers across the U.S.[41]

Decentralization of Wastewater Treatment Systems

Decentralized wastewater treatment systems are an important part of the smart water approach because they use the environment's natural ability to process and treat wastewater near its source. This can be accomplished through onsite (one treatment system per home, business, shopping mall, school, etc.) or clustered (one treatment system per group of buildings located close together) wastewater treatment systems. Decentralized wastewater treatment decreases the amount of sewer lines needed, saves money by reducing the need for costly infrastructure, lessens the chance of sewer overflows and allows for groundwater replenishment.

Decentralized and onsite systems were once only thought of as a stepping stone to a centralized system when finances and population permitted. But, today evidence is mounting that decentralized systems are cheaper, easier to implement and more adept at providing long-term benefits for public health and the

Balanced Water Budgets

A key component of smart water strategy is gathering information about the state of a community's water resources. Accurate and detailed information allows planners and policymakers to develop integrated, farsighted water resources plans for their states.

A water budget is in many ways similar to a household budget – it tallies up how much water is deposited through rainfall (income), how much is withdrawn for use (expenses) and how much remains (balance).[42] To draw up a comprehensive water budget, planners need to catalog and monitor water resources at the watershed and statewide level.

Rapidly growing Lancaster County is currently completing a water budget with a $121,000 grant from Pennsylvania's Growing Greener Program. After obtaining public input, the Susquehanna River Basin Commission (SRBC) will gather data on ground and surface water levels, use and recharge. Using a computer model developed by the Delaware River Basin Commission and the U.S. Geological Survey, SRBC will devise management recommendations and present its findings to the public.[43] This project serves as a model for other watersheds and states looking to make smarter water resource management decisions.

environment for many different types of communities as long as they are properly implemented.[44]

Beyond leakage, overflows and source water depletion, constructing the infrastructure of a centralized treatment system is often more expensive than decentralized smart water alternatives, such as the system completed in 1990 in Pena Blanca, NM. Hundreds of communities and cities across the country have pioneered the use of decentralized wastewater technologies for their treatment needs and found that it adds up to significant savings for taxpayers and ratepayers.[45]

The EPA stated in a 1997 report to Congress on wastewater that "adequately managed decentralized wastewater systems are a cost-effective and long-term option for meeting public health and water quality goals." The EPA identified lack of knowledge and misperception, legislative and regulatory restraints, lack of management programs, fear of liability, low engineering fees and financial constraints as the leading impediments to decentralized systems.[46]

To counter the lack of knowledge and misperceptions, demonstration projects on decentralized systems have popped up around the country. In Kutztown, Pennsylvania, the Rodale Institute is constructing a wetlands sewage treatment and drip irrigation system, along with onsite stormwater practices, on an experimental farm. The experimental farm serves to demonstrate how to implement effective onsite wastewater and stormwater treatment systems.[47]

Sewer overflows plague traditional wastewater systems and cost communities millions of dollars.

In Austin, Texas, a spike in population is forcing the city to grapple with the impacts of growth while inflicting the least harm to the environment, and imposing the least cost to residents. So in the early 1990's the city began exploring decentralized solutions. One major benefit of a decentralized system is less effluent moving through any single pipe, which reduces total potential risk. In this way, Austin can better protect its main source of drinking water, which in the past has been contaminated with raw sewage.[48]

The benefits of decentralized systems are numerous. They can cost as little as one-third of centralized systems and are simpler to construct. They support the local tax base and cost no more to maintain than tradi-

Potential Community Benefits of Adopting Distributed or Decentralized Wastewater Management

- **Community involvement and control**
- **Use of advanced treatment technology in a controlled setting**
- **Groundwater recharge with onsite systems**
- **Requires a fact-based assessment of existing conditions and alternatives, and may reveal unexpected results that lead to better solutions**
- **Tools to support land use.** For example, advanced treatment units and cluster systems can support high-density, small-lot development in an area where sewers would support the density, but might be expensive or create unwanted growth pressures elsewhere.

Source: 2001 American Planning Association. Adapted from "Decentralized Wastewater Management: Linking Land Use, Planning & Environmental Protection," 2001 National Planning Conference. http://www.asu.edu/caed/proceedings01/HOOVER/hoover.htm

tional sewer systems.[49] Onsite systems also recharge streams and aquifers.

There are no federal laws dedicated to regulating onsite wastewater. In the absence of regulatory authority, the EPA has released several manuals and voluntary guidelines for onsite treatment systems. The most widely known manual is known as the Purple Book, first published in 1980. It was updated and re-released in 2002 and titled Onsite Wastewater Treatment Systems Manual. EPA also provides technical assistance for onsite systems through the National Small Flows Clearinghouse, the National Environmental Training Center for Small Communities and the National Decentralized Water Resources Capacity Development Project.[50]

The key to a successful decentralized system is smart centralized managment. This assists in educating the public about water issues, ensures regular maintenance occurs, and keeps water systems running optimally. By allowing for centralized managment with onsite systems, local planners can enforce low-impact development practices. Today municipalities can hire consultants to develop decentralized plans for towns and cities that are cost effective, as well as long-term solutions that coincide with municipal smart growth planning strategies.[51]

Integrating our Water Services

While we often think of our water services in distinct categories – drinking water treatment and supply, stormwater removal and wastewater treatment and disposal – our water services are best thought of as one interconnected cycle. Solving a problem in one service area may affect water services across the board. For example, reducing drinking water demand through low-flow devices not only reduces the burden on the drinking water treatment system but also reduces the burden on the wastewater treatment facilities as well.

Integrating systems allows managers to solve problems in one service area through management of another. For instance, managing stormwater runoff increases groundwater recharge, which can improve drinking water source quality by limiting contamination and ultimately increase drinking water quantity.

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Chapter Four: The ABCs of Water Services Regulation

- Water laws, both in Pennsylvania and the nation, are often fragmented and incomplete.
- An analysis of water legislation indicates that laws that provide incentives and require strong disclosure requirements are more effective than laws with enforcement mandates and few oversight measures.

In order to properly understand the landscape of Pennsylvania and the nation's water service issues, one must have a working comprehension of the federal, state and local laws and regulations governing every aspect of the water cycle.

The system of water laws in Pennsylvania and the nation are intended to regulate the conventional systems that have been standard for half a century. Because most laws were written at a time when the problems with the conventional systems were less apparent, the laws and their associated funding mechanisms have few provisions that encourage smart water solutions.

The Pennsylvania Capitol Building in Harrisburg, PA.

Today's regulatory system inadvertently pushes local planners and municipalities into old methods of tackling water management. Thus, although there are many opportunities for introducing smart water strategies in southeastern Pennsylvania and across the nation, the current legal system is biased against new solutions. This places a significant burden on taxpayers. Conventional water systems may appear more convenient for municipalities in the short term, but smart water strategies are more cost-effective in the long term.

It is vital that lawmakers reform the present system of water laws to ease the way for low-cost, low-maintenance smart water practices. There is a need across the country for laws that encourage innovative ideas, and for laws that discourage the construction of sprawling water infrastructure that will require costly maintenance decades down the line.

There are two major roadblocks to making the legal system more amenable to smart water strategies. First, the system of laws is very fragmented. As is the case with most legislation, many of Pennsylvania's water laws were passed in response to a specific crisis of the time. Because of this, most water laws address only one pressing issue – be it drinking water decontamination, stormwater management or wastewater disposal. As a result, water regulations on both the state and federal levels have become a patchwork of laws passed at different times for different purposes. This has created a system of laws that is fragmented, sometimes redundant and poorly coordinated between the local, state and federal levels. This discourages planners from thinking of water services as integrated and interrelated and makes it difficult for municipal

planners to manage a community's water services in terms of the natural water cycle.

Second, current laws provide limited incentives for cost savings. Encouraging innovation is beneficial for everyone involved; while it may require a small investment initially, it is likely to save taxpayer dollars over the long term. Pennsylvania's recently established Wellhead Protection Program seems cognizant of this fact; the plan is intended to keep water clean at its source in order to avoid more expensive treatment costs down the line.

It is important to note that regardless of what laws are put in place, it can be a difficult transition to an integrated system if the state or federal regulators in charge are resistant to change. Many of the water laws and regulations described in this chapter are dependent upon swift implementation and rigorous oversight. When water agencies fail to carry out their responsibilities, due either to bureaucratic malaise or a lack of resources, smart water laws often fail to achieve their intent. Smart water supporters must therefore be mindful of implementation, and actively seek stronger government enforcement as well as incentives to support their efforts.

The most relevant federal, state and municipal laws and regulations for Pennsylvania's water providers are listed and described below.

Federal Laws and Regulations

Clean Water Act

By the 1970's, national water pollution problems had reached a critical period. People could no longer fish or swim in two-thirds of our waterways because of water pollution and the dumping of untreated sewage.[1] In response to this public concern, Congress passed the Federal Water Pollution Control Act Amendments of 1972.[2] This legislation later became known as the Clean Water Act (CWA).[3]

The CWA has a two-pronged strategy. First, the law provides federal funding to construct municipal sewage treatment plants (through funding mechanisms such as the State Water Pollution Control Revolving Funds).[4] Second, the law sets industrial and municipal user discharge regulations.[5] The CWA initially focused on conventional pollutant discharges, while new water programs have turned to the regulation of toxic discharges.[6]

The CWA creates a framework for regulating the discharge of pollutants into navigable waters of the United States, and authorizes the EPA and states to carry out programs to control water pollution.[7] The EPA has a number of regulatory and non-regulatory methods at its disposal for improving water quality, including the establishment of industry wastewater standards.[8]

The CWA relies on the traditional pollution-control model of using water quality requirements, but also adds a new technology-based focus.[9] This focus requires that the best economically feasible technology be used to treat wastewater, and it measures effluent limitations based on best-available technology.[10] But the new regulations do not prevent stricter requirements if the best-available technology methods fail to meet established water quality standards.[11]

Under the CWA, no one may discharge a pollutant from a point source, such as a pipeline, into U.S. waters without a permit. It was only following the CWA amendments of 1987 that the law first began to address nonpoint source pollution with the establishment of the nonpoint source management program. It does not regulate nonpoint sources of pollution, but does provide funds to states, territories and Indian tribes for a variety of projects to assess and control nonpoint sources of pollution.[12]

The CWA creates a federal-state partnership with the EPA setting effluent limitations and the state taking responsibility for making daily decisions about implementation.[13] The EPA has authorized the Pennsylvania Department of Environmental Protection (DEP) to enforce the CWA, including the National Pollutant Discharge Elimination System (see below) permit process and water resource law enforcement.[14] The

EPA offices in Philadelphia monitor the Pennsylvania DEP's wastewater discharge permit program.[15] DEP's southeast region oversees Philadelphia, Chester, Delaware, Bucks, and Montgomery counties, and is based in Norristown, Pennsylvania.[16]

Enforcement of CWA wastewater regulations presents a difficult challenge. A recent nationwide study examined the number of permittees that exceeded their effluent limitations between January 2002 and June 2003.[17] It found that over 60 percent, or 3,700, of major U.S. facilities exceeded their CWA permit limits on discharges into waterways one or more times during this time period.[18] More than 30 facilities failed to comply with the effluent limitations even once over the report's span.[19] In all, the report found that major facilities across the country violated permit limits over 32,000 times during the examined period,[20] and that on average, major facilities surpassed their permit limitations by over 600 percent.[21]

National Pollutant Discharge Elimination System

CWA Section 402 established the National Pollutant Discharge Elimination System (NPDES) to regulate discharges from pollution sources. In 1987, Congress, recognizing the need to address polluted stormwater runoff in order to meet national water quality goals, amended the CWA to require EPA to create NPDES regulations for stormwater.[22] The EPA established the NPDES stormwater program in 1990 in response to these CWA amendments. The CWA categorizes the majority of stormwater discharges as point sources and therefore requires NPDES permits for these discharges.[23]

The NPDES stormwater program has been through several phases. Phase I, enacted in 1990, extended NPDES permit requirements to polluted stormwater runoff from:

(1) "medium" and "large" municipal separate storm sewer systems (MS4s) generally serving populations of 100,000 or greater
(2) construction activity affecting five acres of land or greater
(3) ten categories of industrial activity.[24]

Phase I requires large and medium MS4 operators to establish a stormwater program to control the discharge of pollutants.[25] In Pennsylvania, Phase I impacted Pittsburgh, Erie, Philadelphia and Allentown.[26]

In 1999, the EPA required the program to cover additional sources.[27] To do this, EPA issued the NPDES Phase II program, which covers most other MS4s nationwide and somewhat alters the stormwater program focus.[28] Specifically, Phase II covers (1) "Operators of small MS4s located in 'urbanized areas' as delineated by the Bureau of the Census,"[29] and (2) "Operators of small construction activities that disturb equal to or greater than 1 (one) and less than 5 (five) acres of land."[30] Small MS4s must have programs that protect water quality, meet CWA water quality requirements, and "reduce the discharge to the 'maximum extent practicable' (MEP)."[31]

In Pennsylvania, Phase II covers approximately 1,000 urbanized municipalities.[32] Phase II mandates that specified cities establish a stormwater management program with six minimum control measures including: "public education and outreach, public participation/involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention/good housekeeping."[33]

NPDES was established to regulate point source stormwater discharges. *Photograph courtesy of EPA*

The Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) is a landmark law that was enacted in 1974 and significantly amended in 1986 and 1996.[34] The SDWA is charged with protecting public water from contamination; the act mandates nationwide standards for water contaminants, and authorizes a number of programs to encourage safe drinking water around the nation.[35] Initially, the law was chiefly concerned with water treatment. However, later amendments extended the SDWA's reach into source water protection; in addition, these amendments provided better means of financing the SDWA's requirements, and tightened national standards on contaminants like cryptosporidium and lead.[36] While the SDWA has been considered successful, many criticize it for mandating costly infrastructure upgrades, and others say that the law has been poorly enforced in recent years.

The original law established national standards for drinking water.[37] These standards, known as the National Primary Drinking Water Regulations, set enforceable maximum levels for a range of contaminants, from bacteria and organic pollutants to lead and carcinogens.[38] While the SDWA set national standards, it gave each state a large degree of latitude in overseeing its own public water systems. The law established an arrangement whereby states and Indian tribes could petition for "primacy" over their water systems.[39] Currently, 49 states and four tribes have been granted primacy over their water infrastructures; the EPA still oversees SDWA compliance in Wyoming and the District of Columbia.[40] The EPA is in charge of determining which contaminants are to be regulated, and setting the rigorousness of compliance across all states.[41]

Later amendments to the SDWA gave it a broader reach over water quality. Whereas the original law limited the SDWA's scope to "at the tap" functions – mainly water monitoring and treatment – amendments included mandates to protect source water and certify operators of water systems.[42] Later versions of the law provided assistance to small water systems, since these often have the most difficulty remaining financially solvent.[43]

The 1996 amendment contained a provision forcing each state to provide detailed information about its drinking water to residents. These annual "consumer confidence reports" were designed to make water providers and state governments more accountable to citizens for the pollutants in their water systems.[44] SDWA also provides venues for public involvement in the maintenance of water systems, and encourages water providers to reach out to the communities they serve.[45]

The 1996 amendment also created the Drinking Water State Revolving Fund.[46] By the mid-1990's, many observers were criticizing the SDWA for forcing unfunded mandates on states; the standards that SDWA set led to costly infrastructure upgrades for which the federal government did not provide capital.[47] The 1996 amendment to the act addressed this by creating the revolving fund, an innovative federal-state program to finance the necessary upgrades.[48]

SDWA has also been criticized for failing to live up to its promise of providing useful and accurate public information. According to the Natural Resources Defense Council, the consumer confidence reports of many cities were "less than direct, burying, obscuring, and even omitting findings about contaminants in city water supplies, printing misleading statements, and violating a number of right-to-know requirements."[49] The EPA has itself admitted to being less than candid in its agency's assessment. In March 2004, the EPA's Office of the Inspector General stated that over the past four years, the EPA "incorrectly reported meeting its drinking water goal."[50] The Inspector General's report detailed numerous instances where the EPA had overstated the gains in water infrastructure improvement, and had knowingly covered up deteriorations in quality.[51]

While the SDWA does have some innovative provisions, it is clear that the intended mission of the law has not been realized. Experts on America's water

claim that water quality is only improving slightly.[52] At the same time, it is unclear where states will get the money to pay for the costly infrastructure improvements that SDWA mandates but does not finance.

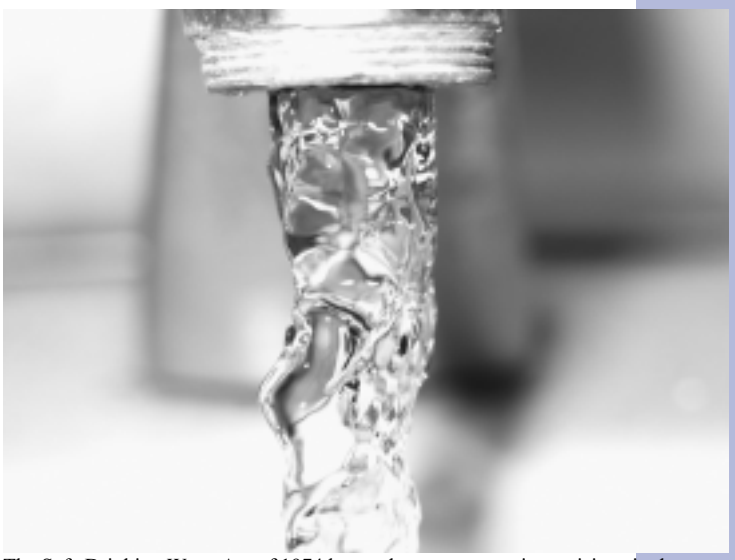
GASB-34: An Impetus for Smart Water Strategy

In June 1999, the Governmental Accounting Standards Board (GASB)[53] (often pronounced "gas-be") issued significant modifications to its Statement No. 34, a rule that details how state and local governments must report their financial statements.[54] The rule, referred to as GASB-34, was amended to make state and local governments report the total monetary value of their infrastructure, as well as the costs of operating and maintaining that infrastructure.[55] This change, which was the product of more than a decade of lobbying by Wall Street bond traders,[56] provides new opportunities for the implementation of smart water strategies.

By requiring governments to provide reports on their infrastructure's value and operating costs, GASB-34 brings greater accountability and transparency to municipal and state governments.[57] GASB-34 forces governments to publicly disclose the true costs of maintaining their water systems. It also requires governments to assess the long-term costs of keeping their water infrastructure in adequate working condition.

For communities with aging water systems, the rule will help them realize that their current infrastructure may not be worth additional investment. For rapidly growing communities, the rule will underscore how expensive a sprawling water infrastructure is to maintain over the long term. This law will also discourage communities nationwide from funneling tax dollars year after year into water systems that are beyond repair.

The new rule should lead many municipalities to reassess their expensive, out-of-control infrastructure, and to look for cheaper alternatives. With detailed, publicly available reports of their community's water infrastructure costs at their disposal, smart water advocates will now have a greater opportunity to show that their aging, bloated water system is not worth maintaining.


The Safe Drinking Water Act of 1974 has undergone two major revisions in the past three decades.

While GASB had been openly preparing to update GASB-34 since 1987, most municipalities nationwide were unprepared for the accounting changes. Initially, the new rules were to be fully implemented by 2003; but since most local governments were unable to comply, GASB delayed Statement No. 34's introduction to 2007.

By bringing increased accountability and transparency to the management of water infrastructure, GASB-34 promises to enhance smart water strategy. Smart water strategy advocates – as well as all supporters of good government – should press their lawmakers and administration officials for swift implementation of this valuable rule.

Water Resources Development Act

One of the major federal actors in water resource issues is the U.S. Army Corps of Engineers (Corps). With a broad federal mandate to work on navigation, flood control and environmental restoration issues, Corps work can be seen in every state of the Union. The main guiding legislation for the Corps is the Water Resources Development Act. This bill directs the Corps to construct new projects and provides policy

guidance and direction for Corps activities. While Corps projects are not supposed to be constructed for wastewater, drinking water or stormwater activities, these can be significant elements of multi-purpose projects.[58] There is also a Corps-run program that provides grants for wastewater and water supply projects, although this program has been highly criticized for being driven by politics rather than by merit.[59]

State Water Laws

Pennsylvania has enacted more than a dozen laws protecting its waterways and regulating drinking water quality.

The Purity of Waters Act

The Purity of Waters Act, passed in 1905, was Pennsylvania's first law regulating its natural resources. Pennsylvania passed the act at a time of great population growth within the state; this growth caused Pennsylvania's waters to become more polluted,[60] and this led to devastating typhoid outbreaks at the beginning of the twentieth century.[61] The act also created the Pennsylvania Department of Health, and gave the department the power to prevent polluters from discharging sewage into Pennsylvania waters without a permit. At first, only the Secretary of Health, Attorney General, and Governor were authorized to grant permits.[62] In 1923, however, Pennsylvania transferred control of the state's pollution permits to the Sanitary Water Board.[63]

The Purity of Waters Act was not as effective as its proponents would have liked. In 1910, Pennsylvania Commissioner of Health Samuel Dixon ordered the city of Pittsburgh to start treating its wastewater and stop dumping this waste directly into its three rivers. The city refused, and continued to dump its wastewater into the rivers until 1958.[64]

The Clean Streams Law

The next landmark piece of Pennsylvania water legislation was the Clean Streams Law, enacted in 1937. The law targeted industrial sources of pollution, specifically mine drainage.[65] It also strengthened regulations on small-scale sewage discharges, and established penalties for polluters, backed by legal enforcement.[66] The law was also notable because it created a bond system for public works to abate pollution.[67] The law has been amended seven times since its initial enactment,[68] and now contains provisions that give the Pennsylvania Department of Environmental Protection broad powers to force municipal water providers, sewage dischargers, municipalities and others to repair or improve their water infrastructure.[69]

The Pennsylvania Water Rights Act

The Pennsylvania Water Rights Act is a 1939 law that establishes state control of public water sources.[70] It is a narrow law that addresses only public uses of Pennsylvania water, and it provides no statutes for enforcement. [71]

The act is notable for its limitations. Because it has no official enforcement clauses, the only way it can be enforced is through the courts; this is costly and often ineffective.[72] In addition, the Water Rights Act is the only state law that addresses water withdrawal quantities. The lack of state laws covering private uses of water is one of the biggest gaps in Pennsylvania's water code.

The Sewage Facilities Act (Act 537)

In response to concerns about wastewater discharge, Pennsylvania enacted the Sewage Facilities Act in January 1966. Often referred to as Act 537, the law was originally passed to protect the public's health and safety and to prevent pollution of Pennsylvania's water supply. The act requires all municipalities to prepare an official sewage facilities plan for their area of jurisdiction, to be approved by the DEP.[73] If a municipality wants to develop, it has to revise its sewage plan and seek approval from the DEP.[74] Under this act, builders now must prove to the DEP that the soils and topography of their proposed site are suitable for a sewage facility before they can proceed with develop-

ment.[75] Additionally, each Pennsylvania municipality must update its sewage plan periodically (though the law does not specifically state how often).[76]

The Sewage Facilities Planning Assistance Program funds new or updated municipal sewage plans as required by the Sewage Facilities Act.[77] There is no time restriction for applicants to submit applications.[78] Applicants are reimbursed for 50 percent of "the reasonable and documented costs" of these plans.[79]

Act 537's complexity may undermine its original intent. The act's requirement that municipalities revise their sewage plan with each new expansion has caused many communities to develop in a makeshift manner. In regions where there has been considerable pressure to expand, most have done so without setting a long-term, sensible plan for growth.[80] In addition, ambiguities in the law, which have been reinforced by complicated legal decisions, have served to discourage many municipalities from actively challenging requests for new sewage facilities that are inconsistent with comprehensive plans for land use and development in the region.[81]

The flaws of the Sewage Facilities Act have become a major obstacle to sensible land use in Pennsylvania, and this, in turn, has been a hindrance to smart water initiatives in the state. Reforming Act 537 is no easy task, given the law's present complications, but efforts to revise the law in ways that gives more power to municipalities to chart their own future would be a strong step in the right direction.

The Stormwater Management Act of 1978 (Act 167)

Pennsylvania's Stormwater Management Act of 1978 requires counties to develop stormwater management plans to address surface and groundwater issues.[82] Under the act, each county must update its stormwater management plan every five years.[83] Many municipalities, however, have not complied with the act's requirements. In 2002, roughly 75 percent of the state's watersheds had not published a stormwater management plan; and even those that had were often slow to update them.[84]

Protection of pristine waters is essential to Pennsylvania's sport fishing and recreation industries.

In recent years, the DEP has worked to expand the Stormwater Management Act's reach by requiring "Act 167" plans to address water quality issues and encouraging plans to focus on smart water strategies like increasing rainfall infiltration. In 2002, the DEP released a Comprehensive Stormwater Management (CSM) Policy to strengthen the Stormwater Management Act and streamline stormwater practices within Pennsylvania.[85] CSM has since proven to be a useful tool for integrating groundwater protection, stormwater management, and land use planning. The policy addresses groundwater recharge, stream base flows, stable stream channel conditions, the carrying capacity of streams and their floodplains, and groundwater and surface water quality.[86] At present, the Chester County Water Resources Authority (see Chapter Six) has developed and is implementing a groundbreaking CSM strategy; this plan may serve as a strong model for the rest of Pennsylvania.[87]

The Safe Drinking Water Act

One of the most significant pieces of water legislation enacted in Pennsylvania was the state's Safe Drinking Water Act (PASDWA) of 1984. The PASDWA takes the place of the Purity of Waters Act, and significantly

tightens Pennsylvania's water quality standards. PASDWA established the state's Source Water Assessment and Protection Program (SWAP), and raised the number of pollutants monitored from 20 to 80.[88] In 2000, the EPA approved Pennsylvania's SWAP Program.[89] The SWAP Program lays the foundation for Pennsylvania's assessment of the potential contamination of individual public drinking water supplies.[90] The Wellhead Protection Program (WHPP), which EPA approved in March 1999, is important for achieving the goals of the SWAP Program.[91] According to the DEP:

> The Wellhead Protection Program is a proactive effort designed to apply proper management techniques and various preventive measures to protect ground-water supplies thereby ensuring public health and preventing the need for expensive treatment of wells to comply with drinking water standards. The underlying principle of the program is that it is much less expensive to protect groundwater than it is to try to restore it once it becomes contaminated.[92]

It is important to note, however, that the Wellhead Protection Program is voluntary.[93]

Water Resources Planning Act (Act 220)

Pennsylvania's most recent water law is the Water Resources Planning Act, Act 220, passed in 2002. The act was passed in response to recent water troubles within Pennsylvania – in five of the preceding seven years the state's water system had been in drought.[94] The Water Resources Planning Act legislated that the DEP must upgrade the 25-year-old State Water Plan within the next five years, and update it every five years thereafter. It also established a Statewide Water Resources Committee to facilitate long-term planning for the state's water supply.[95]

Act 220's intent is to allow for greater long-term watershed planning in Pennsylvania.[96] It calls for better reporting of the state's water use, and makes all those who use 10,000 gallons a day or more of Pennsylvania water register with the DEP and periodically report their daily usage.[97] While the act encourages voluntary water conservation efforts, it has no enforceable mandates.[98]

Municipal Water Regulations

Chapter 94

Titled Municipal Wasteload Management, this is a provision in the Pennsylvania Administrative Code (25 P.S. § 94) that clarifies the enforcement of Pennsylvania's Sewage Facilities Act and the Clean Streams Law.[99] First drafted in 1977, and amended several times since, Chapter 94 mandates that municipal sewer operators submit an annual report to the Bureau of Water Supply and Wastewater Management.[100] It also places certain responsibilities on sewage plants, including requiring those whose average flow exceeds 100,000 gallons per day to install equipment to continuously monitor their flow.[101]

The Cost of Groundwater Management

Dealing with contaminated groundwater is incredibly costly and difficult. As a result, groundwater quality can best be maintained by preventing contamination in the first place. While there are state and federal laws that regulate various activities that contaminate groundwater, no law specifically focuses on groundwater quality and quantity management. Regulating groundwater supplies, in combination with other water resource management laws, would help in creating a legal framework for tackling water resource issues in a comprehensive manner that would allow for smart water ideas to be used.

The provision stipulates that annual reports outline the sewage system's hydraulic and organic loads. The law also requires reports to describe any changes needed to the system, including load reduction and rehabilitation.[102] If the annual report indicates that the sewage system is overloaded, Chapter 94 prohibits the system from expanding any of its centralized infrastructure, and requires the system to

develop a corrective action plan.[103] These plans must bring the sewage system into compliance with the Sewage Facilities Act, Act 537.[104]

Chapter 94 gives the DEP limited but not insignificant legal enforcement powers. While the corrective action plans mandated by Plan 94 are not enforceable in court, DEP can penalize noncompliant municipalities by refusing to allow them new connections.[105] Chapter 94 also gives the DEP jurisdiction to require municipalities to undertake cleaning efforts if they are not complying with the Clean Streams Law.[106] Municipalities can appeal DEP's orders at the Environmental Hearing Board, and after that to the Commonwealth Court.[107]

Municipalities Planning Code

The Pennsylvania Municipalities Planning Code (MPC), enacted in 1968, grants municipalities the land use planning authority through the use of official maps, zoning ordinances, subdivision ordinances, and other regulations.[108] Additionally, the MPC contains water resource and water supply provisions.[109]

The MPC seeks to standardize the requirements for land use, but is more directed toward facilitating new development.[110] For instance, in Pennsylvania, land use planning and zoning is optional.[111] County comprehensive plans are only advisory, and by law, ordinances trump comprehensive plans if they conflict.[112]

Amendments to the MPC were enacted in 2000 to encourage multi-municipal planning. Multi-municipal planning efforts may receive priority consideration in state funding programs of all kinds, including Pennsylvania's Land Use Planning and Technical Assistance Program. Since the amendment's passage, there have been more than 170 multi-municipal initiatives statewide, and approximately 20 in southeastern Pennsylvania. As water does not respect political boundaries, these programs and incentives have facilitated dialogue across political boundaries and fostered larger scale planning and zoning efforts.[113]

Pennsylvania's municipal governments have little or no control over their water supply systems. Under the MPC, water suppliers have the power to extend service as they please. While suppliers must inform the municipalities, and leave time for comments, the municipality ultimately has no say over the matter.[114]

Land Use Executive Order 1999-1

Land Use Executive Order 1999-1 "identifies the Commonwealth's sound land use policies and objectives to guide state agencies when making decisions that impact the use of land in Pennsylvania. It promotes the use of best land management practices across the Commonwealth."[115] Under EO 1999-1, the Governor's Center for Local Government Services monitors and assists municipalities in land use decisions.[116] The executive order seeks to maintain infrastructure and develop improvement plans with good land use practices.[117] This is intended to encourage smart development in previously developed areas or in zones designated as growth areas.[118] Pennsylvania's land use decisions impact the environmental, economic and social health of communities.[119]

Other legislation that also may affect water resources planning include: the Storage Tank and Spill Prevention Act, the Dam Safety and Encroachment Act, the Surface Mining and Conservation and Reclamation Act, the Solid Waste Management Act, the Worker and Community Right-to-Know Act, the Pesticide Control Act, the Nutrient Management Act, and the Water Well Drillers Licensing Act.

> "There is a growing agreement among businessmen, environmentalists, municipal leaders, and homeowners that Pennsylvania's current land use law, the Municipalities Planning Code, makes it impossible for townships and boroughs to control their own destiny. By forcing every municipality to zone for every land use, current law makes sprawl inevitable."
>
> - Tom Hylton, in *Save Our Land, Save Our Towns*.[120]

Fractured Laws Impede Smart Water Efforts

The extensive web of federal, state, and municipal laws that regulate Pennsylvania's water infrastructure are well intended, but fragmented and often ineffective. The state's system of laws is vast but not comprehensive; some key areas, like water withdrawal limits, are hardly covered at all. The federal regulatory system is perhaps more complete; yet many federal laws are ineffective and poorly funded, and there is much room for improvement. Historically, "command-and-control" policies have had a poor record of enforcement. Though many water laws have mandated strict pollution controls, agencies responsible for upholding these laws – the EPA and the DEP – have at times had little success holding polluters to the legal limits, either because they were overwhelmed or because they lacked the necessary enforcement powers. Pennsylvania has gradually been moving toward incentive-based policies, like Chapter 94, which gives the DEP the power to deny new sewer connections. Incentive-based policies provide a more effective enforcement mechanism.

But even though mandates have not always been successful, laws with at least some enforceable provisions are preferable to laws that are entirely voluntary while offering few incentives. Laws like Pennsylvania's Water Resources Planning Act are not strong enough to bring about the necessary changes to the state's water infrastructure.

Public documentation is a vital way to maintain effective water regulation. Strong disclosure laws hold polluters and water users more responsible while informing the general public about their water systems. Often, as has been true with the federal Safe Drinking Water Act, poor disclosure goes hand-in-hand with poor enforcement; weak and misleading documentation makes it far easier for laws to be broken.

In most cases, regional or multi-municipal organizations are better equipped to make smart, long-term decisions regarding water resource issues than individual agencies and municipal governments. Cooperation is essential to cost-effectively achieving sensible, planned growth while keeping the character of Pennsylvania's open spaces and maintaining natural resources.[126] Watershed-based organizations, as we will see in Chapter Six, are a step in the right direction.

Building a New Framework in the Big Apple

New York City provides an excellent example of the need for better laws to allow the incorporation of smart water methods. No legal framework existed to assist New York in creating a plan to preserve its drinking water through a watershed management approach. In 1997, despite these obstacles, upstate and downstate interests negotiated a framework to protect New York City's water supply while also committing to long-term watershed management. The result was a historic agreement called the New York City Watershed Memorandum of Agreement (MOA).[121] The successful implementation of the MOA allowed the city to avoid the EPA's Surface Water Treatment Rule requirements for filtering upstate water until 2002.[122]

New York would not have met its watershed management needs by staying solely within the existing legal framework.[123] According to a National Academies report, "the Watershed Rules and Regulations of the MOA fill gaps between the CWA and the SDWA by placing specific restrictions on watershed activities."[124] Innovation of the type found in the New York City Watershed MOA cannot exist without the acceptance of smart water technologies.

The New York City Watershed MOA stands out as unique in the long history of water resource management because of its bold and ground-breaking plan. Such innovative plans are the future of watershed and water resource management. Unfortunately, there are few regulatory incentives for this type of agreements. Until local, state, and federal policy encourages the use of smart water technologies to work out difficult water resource issues, the New York City Watershed MOA will remain unique and virtually alone in using innovation to problem solve.[125] Federal laws such as the CWA and SDWA must be changed in order to promote new approaches to water resource management. Federal regulators should work closely with state and municipal decision-makers to mirror positive regulatory changes in state and local laws.

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Chapter Five: Making Sense of Water Services Funding

- Often today's water financing environment reinforces outdated practices and provides disincentives for smart water strategies.
- The pricing gap is an impediment to smart water investments that would benefit consumers and communities in the long run.
- Initiatives like the state revolving funds and Pennsylvania's Growing Greener program are a step in the right direction, but more funding directed toward innovative programs is needed.

Available funding is a driving force in all infrastructure investment decisions. The amount, type and limitations provide incentives and disincentives for particular activities, structures and approaches to meet perceived needs. Getting the funding incentives and disincentives right is critical to achieving overarching public goals.

Current federal and state financing systems provide few true incentives to pursue smart water solutions, and even fewer disincentives to pursue traditional, centralized systems. However, there are opportunities available to get the incentives and disincentives right, and there are good examples of current efforts that go in a smarter direction.

This chapter lists the federal and state sources of funding available to Pennsylvania's water service providers, followed by a discussion of how the present funding system fails to foster smart water technologies. Finally, the chapter describes a number of tactics that are being pursued to provide financial incentives for smart water approaches. Taxpayers for Common Sense does not necessarily endorse any of these funding sources; in fact, some of them have been criticized by Taxpayers for Common Sense in the past. Nevertheless, these programs exist and should be reformed to encourage smart strategies and financially sound activities.

Federal Water Infrastructure Funding

Historically, the federal government has established the majority of national water quality regulations for municipal and industrial use, but has not paid the lion's share of the costs. The greater part of the nation's public municipal water system has been constructed and financed by local communities and ratepayers.[1] But the federal government has in recent years initiated several programs to aid states and local communities in developing water projects and implementing federal laws. The attraction of this "free" or "cheap" money often directs investment decisions unwisely. Specific programs are run through the Bureau of Reclamation, the U.S. Army Corps of Engineers, Department of Agriculture (USDA), Department of Housing and Urban Development (HUD), but the largest and most familiar are EPA's State Revolving Funds (SRFs).

Through the Bureau and the Corps, the federal government has built numerous large-scale water projects, predominantly for the purpose of irrigation, flood control and navigation. These projects have contributed to municipal and industrial water needs, but traditionally as a secondary benefit. More recently, the Bureau and Corps have instituted sub-programs to address water, wastewater and environmental issues. However, these projects have been driven largely by parochial politics rather than specific need.[2] Moreover, these programs have received little funding in recent years.[3]

The programs run through the EPA, USDA, and HUD do not require congressional authorization for individual projects, and therefore represent more reliable mechanisms of funding for state and local communities. Although these programs contain some provi-

sions for smart water projects such as source water protection, they continue to emphasize large, centralized projects such as treatment plants and hard-pipe solutions. Each program possesses its own specific criteria, funding mechanisms, and designated purpose, and will be discussed in more detail below.

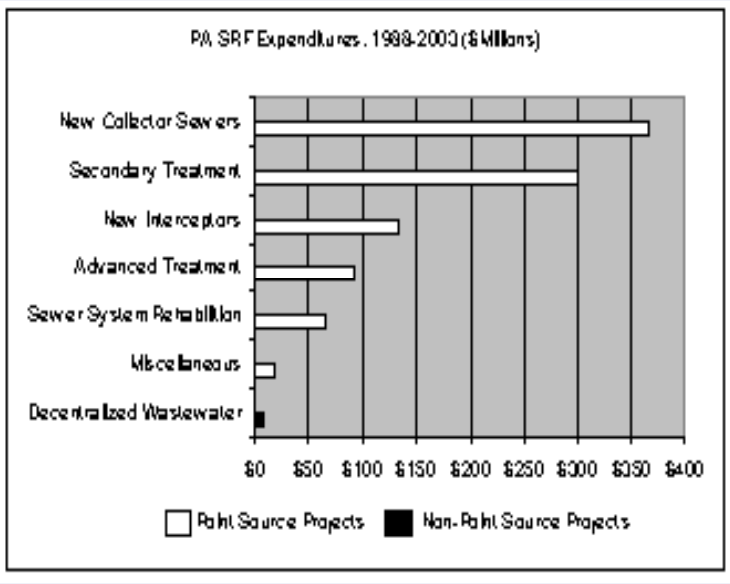
EPA Clean Water and Drinking Water State Revolving Funds

The original Clean Water Act (CWA) established criteria for municipal sewage treatment standards and provided financing to states to meet these goals. Funding through the CWA has been the largest investment by the federal government in wastewater treatment, totaling $73 billion in assistance since 1973.[4] The Construction Grants Program provided direct subsidies to share the cost of wastewater treatment plants with state and local governments. The program originally provided up to 75% of project cost, which was reduced to 55% in 1982.[5] In 1987, the CWA was amended and its mandates were expanded. To help fund efforts to comply with the increased mandates, Clean Water State Revolving Fund (CWSRF) program was established, replacing the Construction Grants Program.

CWSRF has supported over $40 billion in funded projects in all 50 states, as well as Puerto Rico, and has provided on average $3.2 billion annually for the past five years.[6] States provide a 20% match to federal capitalization grants to create each state revolving fund. States then determine both the structure of how the funds will be allocated and financed, and how recipient projects will be prioritized. The CWSRF funds are distributed as subsidized loans with a very low interest rate. As loans are repaid based on terms designated by each state, revenue is returned to the state-level CWSRF to replenish or "revolve" the pool for new loans.

To date, CWSRF programs have funded projects to address water quality issues, primarily through building or improving wastewater treatment plants, but also in some instances, runoff control, estuary improvement projects, stormwater and sewer overflows, alternative treatment strategies, and water reuse and conservation projects. Since 1990, non-point source or estuary projects have increased from 1 percent of the number of loans granted to 32 percent in 2000.[7] But in total funding, nonpoint projects still trail significantly, receiving less than three percent of CWSRF *funds* in 2003.[8]

Established in 1996, the Drinking Water State Revolving Fund (DWSRF) was set up to help close the funding gap between the costs of new Safe Drinking Water Act (SDWA) amendment compliance and the



Both the Clean Water and Drinking Water SRFs have been criticized for spending too little on nonpoint projects. Pennsylvania's SRFs are no exception – of the $983 million spent by the funds from 1988 to 2003, 99.3% was used to repair or expand point source infrastructure, while only 0.7% was directed towards nonpoint projects.

Source: Otto, Betsy. From Great Lakes Activists Water Infrastructure Workshop, Chicago, IL. American Rivers, May 11-12, 2004.

actual funding provided by the federal government and the states. The DWSRF was designed to emulate the CWSRF, and was given an original annual appropriation of $1 billion through fiscal year 2003.[9] Over its life, the program has received more than $7 billion and supported more than 5,000 projects in all 50 states.[10]

There are, however, differences between the two programs. The 1996 amendments to the SDWA place greater focus on source water protection, operator training, funding for water system improvements and public information.[11] In accordance with these new emphases, the DWSRF incorporates several set-aside options, which allow greater flexibility in supporting these difficult-to-fund projects. Each state is allowed to set aside as much as 31 percent of its annual appropriation for non-loan expenditures, ranging from program upkeep to financing of projects for disadvantaged communities.[12]

Both the CWSRF and DWSRF offer flexible loan financing options. States set the terms of the loans, with some providing zero percent interest rates and payment periods of up to 20 years. Lending approaches include pass-through loans, linked-deposit loans, and a variety of other methods such as bond issuance and purchasing or guaranteeing local debt. In particular, almost half of CWSRF programs have used leveraging techniques to enhance funding potential.[13] By using initial CWSRF funds to secure bonds, and then the proceeds from the bonds to issue new loans, leveraging has approximately doubled the funding available from the original federal grant contribution.[14] These bonds also represent a further federal contribution to the SRFs, in that they are typically tax-exempt.[15]

Rural Utility Service

Administered through the USDA's Rural Development division, the Rural Utility Service (RUS) program provides loans, grants and loan guarantees to fund water projects in rural areas and to communities of less than 10,000.[16] RUS supports drinking water, sewer, stormwater and solid waste disposal infrastructure development, and provides technical assistance and training grants.[17]

Loans through RUS's Water and Waste Disposal program may be used for a variety of water-associated costs. There are two types of loans, guaranteed and direct. Guaranteed loans are distributed through local lenders who are charged a one-time guarantee fee of 1 percent, and who then receive a loan guarantee for 90 percent of the total loan amount.[18] The local lender then determines the final interest rate for the individual borrower.[19]

To receive a direct loan, clients must be unable to acquire credit through an alternative commercial provider. Interest rates are determined based on the economic condition of the project area, and are set using three different rates: the poverty rate (currently set at 4.5 percent),[20] the market rate, and the intermediate rate (poverty rate plus half the difference between poverty rate and the market rate, but not greater than 7 percent). Loan repayment periods may be as long as 40 years.[21] For eligible candidates, grants may be allocated in conjunction with loans and may be used to cover up to 75 percent of project costs.[22]

RUS also offers two training and consulting programs. Both the Solid Waste Management (SWM) and Technical Assistance and Training (TAT) grants may be used to fully fund educational, evaluation and training projects.[23] Nonprofit organizations and public bodies may both apply for SWM grants, whereas training grants are only available to nonprofits.[24]

Emergency assistance is also available to communities facing a significant decline in water quantity or quality through RUS Emergency and Imminent Community Water Assistance Grants.[25] Grants used for repairs, partial replacement, or significant maintenance of established systems are restricted to $150,000.[26] Funding for this program has fluctuated considerably over time. Funding reached a recent peak in Fiscal Year (FY) 2001 at $20 million, up significantly from FY 2000 ($200,000), but then dropped to $2.96 million in FY 2002.[27]

Total funding for rural water and waste disposal programs between FY 1991 and FY 2000 was $12.5 billion.[28]

Water and sewer projects comprise the majority of RUS water infrastructure funding.[29] Of the 1,323 projects funded in FY 2003, 759 (57 percent) were water projects, 494 (38 percent) were wastewater, and 66 (5 percent) were combined.[30]

Community Development Block Grants

Established in 1974, the Community Development Block Grants (CDBG) program is an assistance program targeting low-income, predominately urban communities. As mandated by law, 70 percent of CDBG funds are allocated to urban areas and entitlement communities, and the remaining 30 percent to smaller communities, including rural areas.[31] Funds support a wide range of projects, including some water and wastewater infrastructure improvement. Only a small percentage of CDBG grants goes toward water resources, but considering the overall size of CDBG funding, this can be a significant total dollar amount. In FY 2002, $487.6 million was spent on drinking water and wastewater programs.[32]

Targeted Watershed Grants Program

In August 2002, the EPA announced the establishment of a new program designed specifically for watersheds across the nation. The fund, first called the Watershed Initiative Grants program, offered $15 million in competitive grants to watersheds who applied for funding with the EPA. The EPA's first competition yielded 176 applicants. From this pool, the EPA chose twenty watershed organizations to receive between $300,000 and $1 million for water restoration efforts over a two- to three-year period.[33]

The program, now called the Targeted Watershed Grants Program, was repeated in 2004 and again offered $15 million in funding.[34] While the program remains relatively small, it has been praised for allowing recipients to use its funding for a wide variety of activities, including water quality monitoring, an important but underfunded part of watershed maintenance that is not covered by many types of grants.[35]

Funding in Pennsylvania

PENNVEST

Established in 1988, the Pennsylvania Infrastructure Investment Authority (PENNVEST) operates in conjunction with the Pennsylvania Department of Environmental Protection to provide financial loans and grants for the purpose of improving clean water infrastructure throughout the state. Structured as a revolving fund, PENNVEST is currently capitalized by over $1 billion in state funds and $910 million in federal funds provided through the EPA's Clean Water and Drinking Water State Revolving funds.[36] PENNVEST receives its funds from state general appropriations, state general obligation bond sales, PENNVEST revenue bond sales, and federal funds via the EPA.[37]

Since its inception, PENNVEST has provided over $3.7 billion in low-interest loans for sewer, water, and stormwater projects,[38] as well as over $190 million in grants.[39] Interest rates usually fall between 1 and 4 percent, and loan periods range from 20 to 30 years.[40] Funding may be used for all facets of a project, from feasibility studies and initial design and engineering to improvement and construction.[41]

PENNVEST offers loans for large-scale projects, as well as to individual homeowners. Funding is available to municipalities, authorities and some private entities. Funds are only granted to applicants who provide a letter from their County Planning Agency and Agricultural Preservation Board (or County Conservation District) confirming that the proposed project abides by local land use policies. Eligible projects include drinking water and wastewater filtration and treatment plants, source development, storage facilities, distribution systems, collector and inceptor sewers, and combined sewer overflows, as well as a range of stormwater control measures.[42] Municipalities

and other government units implementing stormwater ordinances and counties with stormwater (Act 167) plans may receive stormwater funding.[43]

PENNVEST also offers programs to redevelopment authorities to address brownfield remediation.[44] As of July 2004, PENNVEST began placing increased emphasis on brownfield remediation, allocating up to 30 percent, or $48 million, of its $160 million CWSRF funds for these projects.[45] Remediating brownfields can reduce groundwater and stream contamination by simply removing potential pollutants from the system.

In 2002-2003, loans were provided to 330 individual low-income homeowners for on-lot septic tank upgrades in order to help prevent groundwater and stream contamination.[46] In order to encourage participation in this project, PENNVEST offers a 1 percent interest rate.

PENNVEST also has an incentive for projects that involve multiple municipalities. Projects that serve only one municipality are capped at $11 million, whereas those that coordinate with additional municipalities may receive up to $20 million.[47]

DEP staff works with PENNVEST and potential grantees to evaluate each proposed water project's potential benefits and feasibility. In order to be eligible, all projects must meet fiscal criteria as set by the DEP.[48] In addition, treatment facility projects must be evaluated on reasonable growth formulas based on expected population expansion.[49] In general, projects are evaluated on five criteria, namely: public health and safety, environmental impacts, economic development, compliance with state and federal regulations, and adequacy, efficiency and social impact.[50] DEP Project Managers are responsible for review of all materials except economic development. PENNVEST is responsible for financial analysis and establishes loan and grant stipulations.[51]

As part of Pennsylvania's greater Growing Greener initiative, PENNVEST will now also administer approximately $22 million in additional annual grants for clean water projects.[52] These monies will be allocated and accessible through PENNVEST's current procedures.

The Growing Greener Initiative

Pennsylvania's Environmental Stewardship and Protection Act, better known as Growing Greener, was signed into law in 1999. It was based on a recommendation of the 21st Century Environment Commission, a body appointed by the Governor in 1997. The original Growing Greener initiative provided almost $650 million in funding over five years for efforts that preserve farmland, protect open space, assist parks and local recreation areas, clean-up abandoned mine sites, restore watersheds and provide new and upgraded water and sewer systems.

Growing Greener issues grants to counties, cities, townships, water departments, conservation organizations, watershed associations, and fishing groups. In southeastern Pennsylvania, the Philadelphia Water Department and the Green Valley Association are two of dozens of groups to have received grants for watershed protection and stormwater management work.

In 2002, new legislation was passed to double funding for the Growing Greener Program through 2012. Despite these higher authorized levels of funding, the program is not fully funded. In May 2005, voters supported increased funding through the Growing Greener II program, providing $625 million over 6 years.

Rural Utility Service

In 2003, Pennsylvania's Rural Development division restructured its offices so that specialists who once worked specifically on one program area over a large geographic area now administer services on a more local scale. Administrators will now be able to guide communities through the full array of Rural Development programs and services, including water programs, in an effort to increase coordinated local efforts.[53] This bodes well for integrated water management. In FY 2003, Pennsylvania received $42.5 mil-

lion in RUS funding for water projects: $21 million in loans, and $21.5 million in grants.[54]

Innovative Financing to Encourage Smart Water

Within the parameters of the national SRF, certain states have employed innovative financing mechanisms in their SRF program to further non-structural smart water approaches. Additionally, other tactics have been pursued nationally.

Linked Deposits and Pass-through Loans

Two financing techniques that promote smart water approaches to water service needs are linked deposits and pass-through loans. These techniques require the state program to work with other state or local agencies, local banking institutions and local landowners. Both methods help make SRF loans accessible to more communities and individuals, thus promoting smart water approaches.

With linked deposits, the state SRF program purchases a CD (certificate of deposit) from a local bank or financial institution that is prepared to make a low-interest loan to a local landowner to implement important nonpoint source pollution prevention measures (evaluated by the states). The state SRF agrees to receive an interest rate several percentage points below the normal rate (on its CD). In turn, the financial institution loans the landowner the same amount for an equally below market interest rate. In this case, the SRF benefits from shifting risk and management responsibility to local financial institutions, and financial institutions reap the normal funds associated with the loans (paying lower interest on the CD and receiving an equivalent amount less in loan payments) while providing additional service for their customers. Meanwhile, the local landowners or homeowners associations are able to work with a local, and trusted, bank.[55]

In pass-through loans, essentially the SRF shifts the loan, risk and management responsibility to a state or local program that administers the loan to the local landowners. Additionally, by using all public sector sources the loan rates are generally lower than the normal subsidized rate from private financial institutions.[56]

Ohio SRF

One of the more innovative state SRF programs is Ohio's. The innovator of the linked deposit loan in 1993, the Ohio EPA launched the Water Resources Restoration Sponsor Program (WRRSP) in 2000. This program provides financial incentives to construct projects that protect or restore water resources in conjunction with SRF loans for more traditional projects.[57] To accomplish this, the program essentially makes it cheaper to complete an approved smart water project along with a sewage treatment plant upgrade, for instance, than it would be to only upgrade the sewage treatment plant.

How does this work? A community applies for a standard wastewater treatment assistance SRF loan and also for WRRSP assistance for a water resource project. If the project meets certain criteria, including need, defined benefit, and ability to accomplish, then the entire project is green lighted. The SRF then lowers the total project interest rate to 0.1% lower than the level that the total repayment cost (principal and interest) for the wastewater treatment assistance loan would have been alone.[58]

This provides crucial funding for smart water improvement projects and provides a critical linkage between wastewater treatment infrastructure and these important smart water projects. While very successful, the available funding for the program has been limited; there will be $15 million available for WRRSP in 2005.[59]

Tradable Permits

Tradable permit schemes, similar to those that regulate airborne toxins in some parts of the country,[60] could allow government entities to limit watershed pollution in the most economical way. Under a tradable permit program, either the EPA or a state agency sets a cap on total discharges of industrial waste or agricultural

runoff into a given waterway.[61] This cap would be determined by the waterway's size and its role in providing potable water to regional communities. The agency then distributes permits to point source polluters; these permits determine the maximum amount of pollutants any polluter can discharge.[62] After permits have been distributed, each polluter can then buy and sell his government-granted permits at market price.[63] Under a tradable permit scheme, those factories or farms that can least afford to abate their discharge into local waterways can buy permits from companies or landowners who can reduce their discharges more cheaply. Thus, this trading mechanism could allow watersheds to limit discharges at a minimum cost to regional polluters.

While tradable permits are appealing, they have a mixed record.[64] One of the main problems of tradable permit schemes in watersheds is the difficulty of monitoring individual pollution levels.[65] It is difficult to enforce tradable permit schemes if local authorities cannot determine how much each polluter is discharging. Additional challenges include quantifying the benefits of certain pollution abatement tactics like buffer strips; ensuring that pollution "hot spots" do not occur at critical areas, such as drinking water intakes; and establishing reliable markets for permits.[70] For these reasons, it will take some effort to adapt permit schemes to fit the needs and constraints of watersheds. Presently, tradable permits remain a promising but unproven means of regulating water pollution.

Current Funding Structure Provides Disincentives for Smart Water

While recent years have brought innovative approaches like Pennsylvania's Growing Greener and Ohio's unique revolving funds, the nation's funding scheme for water projects has been, for the most part, an obstacle to smart water. Here are the main challenges.

Lack of Research and Development (R&D) Investment

Spending on water resource research and development has atrophied over the last several decades. In

Napa County, CA

Non-structural flood control is a smart water technique that provides multiple benefits of flood damage reduction and a filtering buffer (see Chapter Three). California's Napa Valley is notoriously prone to flooding. Since 1862, the valley has experienced more than 27 major floods; the flood of 1986 caused more than $140 million in damages and the flood of 1995 cost more than $100 million.

After the 1995 event, local interest grew in new approaches to flood control. After reviewing a number of traditional flood control projects, the Napa County Flood Control and Water Conservation District pushed their state and federal partners in a different direction, toward non-structural flood control. This involved purchasing more than 300 parcels of land along a 6.9-mile segment of river. The $218 million project will include $43 million in state and federal grants and $175 million equally shared by the U.S. Army Corps of Engineers and the district. The district is using state clean water revolving fund loans, backing sales tax-supported bonds, to pick up their share.[66]

The Napa project will meet the community's flood control needs while providing a cleaner, healthier river for other uses, successfully tapping integrated water management approaches and looking at their water "needs" holistically.

Financial Benefits of Different Approaches
New York City Water Supply

The innovative approach to financing the New York City source water preservation initiative (see p. 5) relied on a variety of funding sources, urban-rural cooperation and trust. The city was facing a more than $5 billion price tag to construct a filtration plant for their water supply from the Catskill-Delaware system in the Catskill Mountains.[67] Working with farmers in the area, the city has committed to fund $70 million worth of voluntary pollution abatement measures and agricultural best management practices if farmer participation exceeded 85 percent.[68] Additionally, the city is spending $260 million for land acquisition and conservation easements and has applied for $27 million worth of SRF loans.[69]

the years between 1973 and 1997, public and private R&D on water service issues have collectively been cut in half.[71]

Reliance on Old Ways

Because they were established to serve traditional water systems exclusively, most of the existing water financing programs place an almost exclusive emphasis on the expansion and replacement of centralized infrastructure. The fact that funding is so readily available for conventional water systems and so scarce for innovative programs leads water providers to prefer the old ways, because they are, from a financing perspective, the path of least resistance.

Distorted Price Signals

Simply providing more money without appropriate incentives is not the answer. A 1984 study of the EPA's Construction Grants Program for wastewater treatment facilities found that federal money often displaced other non-federal contributions for capital improvements. The study documented that each federal dollar spent yielded only an additional 33 cents in water infrastructure spending; the remaining 67 cents was simply absorbed by state or local governments or utilities, who pocketed the money by lowering their own improvement expenses. The study also found that the uncertainties of federal funding cycle, caused by the unpredictable appropriations process in Congress, can delay or disrupt local governments' spending plans, and in some cases even increase construction costs.[72] It is important for policymakers to recognize that a poorly designed financing program may complicate the implementation of smart water strategies, or merely shift the funding burden from the states to the federal government.

The state revolving funds have dealt with this problem by requiring repayment, which demands more accountability than direct grants do. Still, there is a danger to revolving funds because large amounts of cheap money can distort price signals and encourage overbuilding. Most importantly, readily available loans can discourage preventative maintenance or pursuit of more cost-effective solutions that are not as easily supported through the program.[73] This is why it is key that revolving loan funds and other federal programs establish significant incentives for pursuing cheaper smart water solutions and integrated water management strategies through set-asides, preferences, directed local revolving loan funds or other mechanisms.

Inability to Pay for Water Service Improvements

But federal and state programs are not the only obstacles to smart water financing. Other factors such as the pricing gap between the cost of providing water and the cost to ratepayers also make implementation more difficult. As we begin to consider ways of using the government to address the nation's crumbling infrastructure, it is important to keep in mind that utilities are likely to continue undercharging their ratepayers, and may continue to do so in the future, regardless of federal or state reforms.

If any group needs financial assistance to help fix its crumbling water infrastructure, it is the urban poor. In some older cities, the per-capita replacement cost of water mains is more than three times higher than the national average due to steady population declines. The American Water Works Association points out that "because of demographic changes, rate increases

will fall disproportionately on the poor, intensifying the challenge that many utilities face keeping water affordable to their customers." [74]

> "From the standpoint of economic efficiency, it is important that any federal support for water and wastewater infrastructure be provided in a way that gives system operators and water users the appropriate incentives to keep costs and usage down."
>
> - Perry Beidler, Congressional Budget Office testimony before House Water Resources and Environment Subcommittee on March 28, 2001.

It is central to water services reform that municipalities raise their rates to account for the full costs of water use. But some Americans, including many who live in the most populous areas, like inner Philadelphia, and those who live in the least populous, like rural Pennsylvania, have trouble paying for their water as is. One possible way to address this problem would be to create a program to assist low-income households facing high water bills.

Many, including the Congressional Budget Office[75] and the Chairman of the Pennsylvania Public Utility Commission,[76] have suggested a program modeled after the Low-Income Heating Assistance Program (LIHEAP), which was established in 1981. LIHEAP is a federally-funded program that gives block grants to states to subsidize the heating and cooling costs of low-income households.[77] The idea is that by giving low-income households a fixed subsidy, rather than one tied to energy use, LIHEAP makes heating and cooling more affordable without giving poor families the incentive to consume more electricity. Because the marginal costs of heating and cooling remain the same, LIHEAP is supposed to help low-income families without distorting price signals.[78] Many have suggested a "low-income water assistance program" designed much like LIHEAP; additionally, some believe that a low-income water assistance program would work best by "piggybacking" onto LIHEAP's already-existing administrative infrastructure.[79]

While a LIHEAP-based program would help poor families while addressing the pricing gap, it is in many ways an emergency measure that will actually cause a slight increase in demand for water because of the subsidy. A more effective, lasting program would be one modeled after the Low-Income Weatherization Assistance Program (LIWAP). LIWAP, established in 1977, is another federal program designed to lower heating costs for poor families. But rather than provide direct outlays, LIWAP lowers heating and cooling costs by installing energy-efficient measures in low-income homes, free of charge. These weatherization measures, which cost an average of $2,672 per home,[80] include adding insulation, upgrading window and doors, and installing high-efficiency heating and cooling units.[81]

A program that focuses on installing water-saving measures in low-income homes, much like LIWAP, would both help poor families and encourage water conservation. It is a true smart water strategy, benefiting both households and watersheds, and it is one that could be effectively applied alongside a rate increase.

Public/Private Inter-relationships

While much of the funding available for water services is public, some of the major water resource challenges are largely private. Ensuring that private onsite and cluster systems are adequately maintained and serviced is vital to maintaining affordable water quality. Yet concerns about spending public money on private works remain, and private entities may need to give up some degree of control to enable the public to be confident that facilities are being maintained and money spent wisely.

Conclusion

Of all of the factors that will determine the proliferation of smart water approaches in the coming years, the availability of funding is the most important. The current set of financing options available to water providers strongly reinforces the conventional system

of concrete and pipe infrastructure, while giving little incentive to pursue smart water practices.

But there are many avenues through which to encourage funding for smart water strategies. The state revolving funds provide an opportunity, through innovative incentives and programs that encourage decentralized water infrastructure. There are also potential programs, similar to LIWAP, that could help address water services financing. Increased public and private investment in water service R&D will help develop a new generation of smart water techniques.

Getting the price of water services right will be enormously helpful in encouraging smart water approaches. The advent of GASB-34 will require communities to fully account water infrastructure costs. Additionally, meeting the challenge of public and private water infrastructure needs will require greater communication and involvement from both sectors as well as the use of innovative systems.

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Chapter Six: Case Studies of Water Resources Management Structures in Southeastern Pennsylvania

Today, the vast majority of water systems in the United States are demarcated by political lines – lines that separate states, counties, townships and other jurisdictions. While these lines serve important functions, they are counterproductive when it comes to managing water resources. Since our most valued water sources connect and impact multiple jurisdictions, the artificial boundaries of government have created numerous problems, including costly disputes and wasteful, shortsighted policies. For a true smart water strategy to be implemented, water management policies need to be based not on political lines, but along watershed lines.

There are a number of partnerships in southeastern Pennsylvania created expressly to manage water systems around natural watershed boundaries. The partnerships range from the Delaware River Basin Commission (P. 56), which oversees a vast watershed spanning more than 13,000 square miles in four states, to the Chester County Water Resources Authority (see below), which coordinates the policy of a single county's numerous watersheds. While none of these groups are perfect, all of them are innovative organizations that are working towards a sensible, cost-effective approach to managing their water supplies.

Chester County Water Resources Authority

The Chester County Water Resources Authority (CCWRA) monitors and promotes protection of water quality and quantity for the county's 21 watersheds. The CCWRA is the only non-regulatory countywide agency for water resources and management in Pennsylvania;[1] it oversees 1,300 miles of streams and 780 square miles of groundwater aquifers that lie within the county.[2] The organization is charged with mitigating the impact of floods and droughts,[3] protecting the watersheds from environmental degradation and overwithdrawal, and providing water quality restoration and stormwater management planning.[4] In 2002, the CCWRA released an action plan, called *Watersheds*, in which the County of Chester pledged to pursue an integrated approach to preserving water quality and maintaining adequate water supplies for a rapidly developing Chester County.[5] The plan was adopted by the Chester County Board of Commissioners as a component of the county's comprehensive land use policy plan, titled *Landscapes*.[6]

Background

The CCWRA was created in 1961 as a countywide municipal authority, operated by a board of directors and staffed by the Chester County Planning Commission.[7] It is responsible for coordinating watershed management activities with other counties and states. This is particularly important in the case of Chester County, because the county's watersheds drain into surrounding jurisdictions in Pennsylvania, Maryland, and Delaware. While the CCWRA has no regulatory authority, it does own and maintain four of the county's regional flood control facilities and their associated lakes (including a water supply reservoir).[8] The CCWRA prepares scientific assessments of the county's water resources and provides information to the public about the watersheds and their water quality.[9] To these ends, the CCWRA conducts numerous programs and routinely releases publications, often in conjunction with other organizations.

The CCWRA is funded primarily by the County of Chester. Its funding is supplemented by grants and cost-sharing agreements with a mix of state government, federal government, and nonprofit sources. Funders include the Chester County Board of Commissioners, PA DEP, U.S. EPA Nonpoint Source Pollution Management Program, Brandywine Valley Association, Pennsylvania American Water Company, U.S. Geological Survey, and the U.S. Department of Agriculture's Natural Resources Conservation Service.[10]

Members of the CCWRA Board of Directors are appointed to five-year terms by the Chester County Commissioners. The Authority's board oversees the Executive Director who supervises the work and administration of the Authority's staff and programs, as well as the Chester County-U.S. Geological Survey Cooperative Programs.[19]

One of the CCWRA's primary responsibilities in recent years has been the implementation of the *Watersheds* plan, which is part of the Chester County Planning Commission's *Landscapes,* a comprehensive land use plan for the county.[20] *Watersheds* was commissioned in 1998, and it took more than four years, and nearly $500,000, to complete.[21]

Watersheds found that, of the 1,132 miles of streams examined, 276 miles (21%) have been found to be "impaired," or of lower quality.[22] Among other problems, these impaired waters suffer from high nitrate/nitrite levels.[23] *Watersheds* cites agricultural runoff, existing development and wastewater discharges as the primary causes.[24] The report provides ten recommendations for comprehensive stormwater management to reduce runoff and flooding and improve water quality, focusing largely on reducing agricultural and stormwater discharges and minimizing impervious cover.[25]

Information gathered during the planning process of *Watersheds* was used to create a detailed Watershed Action Plan for 15 of the county's largest watersheds.[26] These plans are used to inform the municipalities, agencies, conservation organizations and others active in those watersheds of the necessary actions that should be taken to improve and sustain the respective watersheds. Each plan includes characteristics of the given watershed, management needs and priorities, management objectives and actions, and progress indicators, as well as estimated total costs to municipalities for each proposed action.[27]

Strengths and Weaknesses of the CCWRA

The *Watersheds* plan is a well-reasoned approach to water management that has been widely praised across Pennsylvania.[28] *Watersheds*' emphasis on supporting planned growth and riparian protection seems, in many observers' estimation, an intelligent and cost-effective approach to managing Chester County's water needs over the next decades.[29]

The Christina Basin Clean Water Partnership: A Success Story

One of the greatest talents of watershed organizations is their ability to facilitate coordination. The Christina Basin Clean Water Partnership, a cooperative effort that was spearheaded by the Delaware River Basin Commission and is now run with the CCWRA's extensive help, is a prime example.

The Christina Basin Clean Water Partnership was established in 1995 to address concerns over the health of the Christina Basin, a 565-mile network of rivers and watersheds located mainly in Chester County and in New Castle County, Delaware.[11] The partnership was created out of initial meetings involving a wide variety of groups at the federal, state, interstate and local levels. It was established to coordinate the funding of clean-up efforts among the groups, and to reconcile the two states' vastly different standards of water quality monitoring.

From the beginning, the partnership has operated on a shoestring budget; it has no full time employees, and functions largely on the willingness of its component organizations to take responsibility for their particular roles in keeping the basin clean.[12] But by relying on voluntary action and routine coordination, the partnership has been very successful at securing funding and implementing best management practices across the diverse communities of the basin.[13]

The Christina Basin serves the rural communities of Chester County, Pennsylvania, and the industrial cities of Wilmington and Newark in Delaware.[14] In its efforts, the Christina Basin Clean Water Partnership has pursued an impressive variety of smart water practices suited for both agricultural and urban environments. In Pennsylvania, the partnership has worked with local farms to improve land use practices: it has engaged in stream reforestation, built cattle crossings, and established barnyard runoff controls.[15] In Delaware, the partnership has focused on more urban-oriented solutions, such as improvements to the stormwater infrastructure,[16] and the establishment of the SMARTYARD program, which helps residents institute better landscaping practices.[17]

While the partnership has been very inexpensive to implement, it has had great success at attracting grant money from a wide range of sources, including the EPA, the USDA, and Pennsylvania's Growing Greener program. In 2003, the partnership won a competitive $1 million Watershed Initiative Grant from the EPA.[18]

While CCWRA has commendably sought to manage water issues with long-term planning, the organization has no regulatory authority to mandate the protection of the county's waters from present threats. Instead, it must work through partnerships and scientific efforts to encourage better management practices. But the Authority's efforts in fostering effective partnerships have been impressive. As the case of Christina Basin Clean Water Partnership demonstrates, well-devised voluntary efforts can play a major role in establishing integrated water management.

Conclusion

CCWRA's *Watersheds* plan is a tangible accomplishment that will guide the agencies and organizations involved in Chester County's watersheds for years. There is no doubt that the efforts of CCWRA and its partners over the past decades have advanced water resources management in Chester County well beyond what would otherwise have occurred.

Although it may be tempting to tout the CCWRA as a model management structure that should be duplicated, it must be noted that CCWRA was created in unique circumstances in order to capture earmarked federal money for construction of regional flood control facilities – a situation that does not exist today. In addition, CCWRA has benefited from the reputation and influence it has accumulated in over forty years of work. Replicating the CCWRA, particularly under today's economic constraints, could prove to be a difficult task for other counties.

The Darby-Cobbs Watershed Partnership

The Darby-Cobbs Watershed Partnership (DCWP) is a relatively young organization that takes an integrated approach towards managing the Darby Creek and Cobbs Creek watersheds in southeastern Pennsylvania. Founded in 1999 as a loosely-knit consortium of public and private stakeholders, the partnership seeks to improve the 75 square miles of water in the Darby-Cobbs watershed. In June 2004, the nascent group released the Cobbs Creek Integrated Watershed Management Plan (WMP), which outlines a 20-year strategy to address declining water quality, runoff and waterway concerns. This plan is likely to determine the partnership's activities for the coming years.

Background

The Darby-Cobbs Watershed Partnership was formed in 1999 under the sponsorship of the Philadelphia Water Department (PWD),[30] which has since been a major funder and among the most enthusiastic proponents of the partnership.[31] The organization seeks to improve the environmental health of the watershed so that it can be a healthier provider of drinking water, a better venue for recreation, and a more effective barrier against flooding.[32] From the outset, the partnership took an integrated approach to watershed management that focused aggressively on cooperation between its various partners. The DCWP is designed as a public participation forum where all partners are encouraged to work together to solve the watershed's problems. The DCWP's diverse membership includes both government agencies like the PWD, the U.S. Fish and Wildlife Service, and the PA DEP, and non-governmental organizations like the Cobbs Creek Community Environmental Center and the Academy of Natural Sciences.[33]

In 1999, the DCWP's public participation committee defined the ten most important projects for the partnership to undertake over the coming years. Of the ten projects defined as most important, seven were devoted specifically to education and raising awareness of the partnership.[34] The project deemed most important, however, was a comprehensive report on the watershed, with detailed recommendations for the future.[35]

The Cobbs Creek Integrated Watershed Management Plan

The PWD committed over $1 million to the development of what became the Cobbs Creek Integrated Watershed Management Plan, which was completed in June 2004.[36] The plan followed various interim reports and findings on the water quality and flow of the Darby-Cobbs watershed. The status reports

found alarmingly low levels of dissolved oxygen, and high amounts of fecal coliform in both upstream and downstream waters,[37] all of which indicate that the creeks were subject to excessive pollution from sewage and organic wastes. The reports also found that the streams had been adversely affected from high runoff, due largely to the proliferation of impermeable surfaces.[38] The July 2004 plan outlined a set of recommendations to address these water quality and flow concerns in the Darby-Cobbs watershed.

The plan split its recommendations into three targets: Dry Weather Water Quality and Aesthetics, Healthy Living Resources, and Wet Water Quality and Quantity. Dry Weather Water Quality and Aesthetics, or Target A, focuses on reducing waste and controlling sewage. Target B, Healthy Living Resources, introduces measures to protect benthic and invertebrate species by improving the creek's habitat. Target C, Wet Water Quality and Quantity, addresses flooding, and is considered by the plan's writers to be the most difficult target to meet.[39]

To address Target A's goals, the WMP suggests a mix of regulatory approaches, education programs, and municipal measures. The report suggests public education and volunteer programs, on-lot disposal management, and more costly projects to clean up sewers and detect illicit discharges.[40] For Target B, the WMP suggests just two programs: a $26.4 million Bed Stabilization and Habitat Restoration effort, and a $130,000 program to improve fish passages. Target C's projects are heavily weighted towards Source Control Measures, including a costly program to increase urban tree canopy.[41]

The Target A measures will cost an estimated $43.6 million up-front, and $2.76 million annually thereafter.[42] Of these costs, the PWD pledged to bear $18.6 million up-front and $1.55 million annually.[43] The WMP projects that Target B's habitat restoration will cost $26.5 million up-front, and $33,000 in annual maintenance costs.[44] The PWD pledged to pay half.[45] Finally, Target C's measures are projected to cost $16.1 million up-front, and $2.25 million annually. PWD pledged to pay for a little over one-third of those costs. In all, the WMP estimates that the proposed measures will cost between $93 and $122 million up-front, and $5.0 million annually.[46] The PWD pledged to cover roughly 40 percent of both costs.[47]

Other PWD Watershed Partnerships

The Darby-Cobbs Watershed Partnership is only one of a number of watershed groups that the PWD has helped to set up. The **Tookany/Tacony-Frankford Watershed Partnership** (TFWP) was founded in 2000 by the PWD and others to improve the environmental health and raise public awareness about the 29-square-mile Tookany/Tacony-Frankford Watershed that flows through Philadelphia and Montgomery Counties and discharges into the Delaware River. Like the Darby-Cobbs Watershed Partnership, the TFWP is an inclusive organization that conducts open public participation meetings and welcomes both public and private organizations into its fold. While the TFWP is still in the process of developing a Watershed Management Plan,[48] the partnership released a River Conservation Plan in May 2004, where it outlined concerns about the creeks and proposed various solutions.

The **Schuylkill River Source Water Assessment Partnership** (SWAP) is a multiparty organization charged with studying the environmental concerns of the Schuylkill River watershed and identifying potential solutions for improving the river's water quality. The assessment of the 130-mile long Schuylkill River was prompted by the 1996 federal Safe Drinking Water Act amendments, which mandated that all waterways must undergo such a study. The DEP largely financed the assessment partnership. The Philadelphia Water Department assisted the assessment partnership by providing much of the data collection; other municipalities also played a role in coordination and planning.[49]

The **Delaware River Source Water Assessment Partnership** (DWAP) was founded in late 1999 to study the environmental health and water quality of the Delaware River. Like the Schuylkill Source Water Assessment Partnership, the DWAP was assigned

to examine the sources of pollution in the Delaware River, as mandated by the 1996 federal Safe Drinking Water Act amendments. The partnership focused on the Lower Delaware River, between Allentown and Philadelphia,[50] and was funded largely by a $1.8 million grant from the U.S. EPA,[51] and from funding from the DEP.[52] The partnership lasted from 2000 to 2003, and was carried out largely by the PWD.[53]

The **Pennypack Watershed Partnership** (PWP), founded in January 2003, seeks to protect the 56-square-mile Pennypack Creek and improve the quality of its water. The PWP began in 2003 with a $100,000 grant from the Pennsylvania Department of Conservation and Natural Resources and sponsorship from the PWD;[54] it is working on a comprehensive, integrated management plan that it plans to release in 2006.[55] Any plan will likely include measures to combat agricultural runoff, which the partnership's Baseline Assessment established as a major source of the creek's impairment,[56] and water quality, which is also a concern to the PWD.[57]

PWD Partnerships Conclusion

In its efforts to integrate the management of Philadelphia's water, the PWD has used a similar template to build partnerships in the Darby-Cobbs, Tookany/Tacony-Frankford, and Pennypack Watersheds. Now that the Darby-Cobbs Watershed Partnership has finished its Integrated Water Management Plan (and most other partnerships have finished theirs or are soon to do so), the question remains whether these partnerships can pull their diverse membership together and finance the plans' multimillion-dollar proposals. Each of these partnerships has had a strong track record of bringing different groups together to participate in meetings and small-scale clean-up projects, but securing financial support for the partnerships' long-term plans will remain a challenge. Additionally, the groups at the table have different agendas and primary interests: the PWD is obviously concerned about protecting a clean, but affordable source of water for its customers, while other partners may have differing goals. Maintaining a balanced and equitable approach will be key to their success.

The Delaware River Basin Commission

The Delaware River Basin Commission (DRBC) is the agency that oversees the quality and water levels of the Delaware River Basin. Founded in 1961 as a cooperative effort between the four states that the Delaware River passes through – New York, New Jersey, Pennsylvania, and Delaware – and the federal government, the commission manages 13,539 square miles of watershed that serve nearly 15 million Ameri-

The Role of Citizen Groups

Watershed organizations, municipal councils and county-wide boards are known for accomplishing a great deal with very few resources: they often operate on a shoestring budget and rely heavily on volunteers, part-time legislators and overworked government officials to function. In addition, local water officials are often influenced by conflicting forces – not only by activists within their community, but also by homebuilders and business interests who want to tailor the region's water infrastructure to fit their needs and have the financial resources to make a compelling case.

It is for these reasons that citizen groups and watchdogs play a vital role in the community water planning process. With their emphasis on recreation, conservation and good government, as well as their understanding of a community's history and their years of accumulated experience, local citizen groups are a very important part of the local water planning process. These grassroots groups are often important counterbalances to self-serving special interests.

Local citizen water groups abound in Pennsylvania. In Chester County, the Brandywine Valley Association conducts education programs and weekend clean-ups, while the Green Valleys Association has filed lawsuits and drawn attention to new developments in the county that have threatened water quality. In many watersheds, such as Darby-Cobbs, groups like the Cobbs Creek Community Environmental Center have lent a hand in drafting water plans and even contributed financially to the watershed partnerships. Citizen groups, because of their expertise and their standing within the community, are frequently the glue that holds together a successful watershed partnership.

When government officials consider forming a watershed organization of their own, they should be mindful of the importance of local watchdogs and citizen groups, and be aggressive in soliciting their input and their support. This sort of collaboration has proven to be very fruitful.

cans. The commission also plays a role in preserving the 153 miles of the Delaware River (almost one-half of the river's total length) that are part of the National Wild and Scenic Rivers system.

Background

The creation of the DRBC was spurred on by a 1954 U.S. Supreme Court decision that established a court-ordered formula dividing the Delaware's waters between the river states and New York City.[58] This decision, and the desire to take a more unified approach to the river's management, led the four states to join with the federal government in signing the Delaware River Basin Compact at the White House in November 1961.[59] The compact established the federal government and each of the states as an equal partner in the DRBC; each has one seat on the commission, and each is expected to provide partial funding.[60] The DRBC is administered by the five-member commission, which consists of the governors of each of the basin states (with high-ranking officials from their state environmental agencies serving as alternates), and one federal representative, appointed by the President.[61]

The creation of the commission solved many of the Delaware River Basin's jurisdictional problems. At the time that the DRBC was established, the Delaware River Basin was under the jurisdiction of 43 state agencies, 14 interstate agencies, and 19 federal agencies, and there was a widespread sense that these groups' efforts were often duplicative.[62]

The DRBC is heavily involved in managing the water resources of the Delaware River Basin. The commission is charged with setting water quality standards and regulating flow rates for the basin, and it provides detailed hydrologic information about the river. The commission also resolves interstate flow disputes, manages droughts, controls pollution, plans for watersheds, protects against floods, permits discharges and withdrawals, and provides outreach and education. Aided by EPA water quality grants, the DRBC employs a staff of ecologists and field technicians to monitor conditions and bacterial levels in the watershed.[63] The DRBC's project reviews and scientific experiments are very highly regarded.[64]

The members of the commission elect a Chair, a Vice Chair, and a Second Vice Chair each year.[65] Presently, the Chair is Gov. George E. Pataki of New York, the Vice Chair is Gov. Ruth Ann Minner of Delaware, and the Second Vice Chair is Brig. Gen. Meredith (Bo) Temple, the federal representative.[66] Brig. Gen. Temple is commander of the North Atlantic Division of the U.S. Army Corps of Engineers. The commission's issues are decided by a simple majority of commissioners, except in the case of the annual budget or a declaration of drought.[67]

In 1978, Congress added 114 miles of the Delaware River to the National Wild and Scenic Rivers System.[68] The newly designated areas became known as the Upper Delaware Scenic and Recreational River and the Delaware Water Gap National Recreation Area.[69] Since then, the DRBC has actively worked to protect those waters from degradation. In 1992, after receiving a petition from the Delaware Riverkeeper Network (then known as the Watershed Association of the Delaware River), the commission amended its regulations to enforce more stringent standards on a 121-mile stretch of the Delaware River from Hancock, NY, to the Delaware River Gap, and on other tributaries that were part of the Upper Delaware Scenic and Recreational River. These became known as Special Protection Waters.[70]

The Lower Delaware Wild and Scenic Rivers Act, which was signed into law in 2000, added another 39 miles of the Delaware to the National Wild and Scenic Rivers System. In October 2004, the DRBC announced that it planned to add a 76-mile stretch of the Lower Delaware River to its Special Protection Waters.[71] The DRBC decided to bestow the designation upon these waters, which run from the Delaware Water Gap to Trenton, NJ, based on water quality data collected in response to a petition from the Delaware Riverkeeper Network.[72] The commission is seeking public comment before issuing a final decision.[73]

Successes and Challenges for the DRBC

The DRBC's status as a regional organization not tied to any one state or federal government has some clear advantages. The DRBC's exceptional structure gives the organization latitude to collaborate with a variety of partners; it also positions the DRBC as a natural broker between different government agencies. The DRBC is given the power to enforce permits throughout the entire 330-mile stretch of the Delaware River, and it has an almost unlimited authority over the river's water standards, so long as it has the support of a majority of its commissioners. Perhaps most importantly, the DRBC's integrated structure saves money for each of its member states. The DRBC saves money for the states by providing services that they would have had to do on their own – the DRBC can fulfill these tasks at cheaper costs, because it benefits from economies of scale and from lack of redundancy. Moreover, because it has jurisdiction over the entire Delaware River and its flow, the DRBC can solve interstate disputes about such divisive topics as water allotments through its own in-house committees, thus avoiding expensive legal battles between states.[74]

The DRBC's structure allows it to pursue innovative, wide-ranging programs. In 1986, the DRBC adopted an inventive water metering program for all of its agricultural, industrial, or commercial users consuming over 100,000 gallons of water per day.[75] In 1987, the commission tightened leak-detection standards for pipes carrying Delaware River Basin water.[76] The next year, the commission released uniform fixture standards for faucets, showers, and toilets.[77] In 1991, the DRBC "mandated" that all four states adopt the commission's strict standards.[78] When the Pennsylvania state legislature failed to pass these plumbing codes, the DRBC sent a letter to 505 of the state's municipalities, strongly urging them to enforce these codes locally. According to the DRBC, approximately 80 percent of the municipalities complied.[79] These successful conservation projects have had a lasting impact on the basin.

But the DRBC's unique structure also has its drawbacks. Because the DRBC is a regional agreement that is not under the direct jurisdiction of either the federal or state governments, it is often difficult to enforce the provisions signed in the original compact. Under the original compact, the DRBC is funded by the four states and the federal government, as well as by various revenues accrued from the river. As a result, there is a great degree of uncertainty over how large DRBC's budget will be from year to year, given that Congress or any of the state legislatures could pull funding at any time. The federal government, for example, has not contributed to DRBC since 1997, and came up short the two years prior, resulting in a cumulative shortfall of $5.7 million;[80] New York State has also fallen nearly $700,000 behind its obligations in recent years.[81] Increasingly, this reduction in funding has hampered the DRBC's ability to develop and maintain programs. For the fiscal year 2005, the commission has adopted a budget of $4.867 million, but will have to cut funding by as much as $869,000 if the federal government and states fail to fully contribute.[82] While Sen. Arlen Specter (R-PA), Sen. Thomas Carper (D-DE) and Sen. Jon Corzine (D-NJ) have led efforts in the Senate to restore the DRBC's funding, both through the Water Resources Development Act[83] and the Appropriations Committee, the House of Representatives has shown little interest in including funding for the DRBC.[84]

In recent years, the Delaware River has been criticized for its poor water quality, although the DRBC contends that the river is the cleanest it has been 100 years. In 1998, the U.S. Public Interest Research Group rated the Delaware River as the ninth most polluted river in the nation, due to its high levels of PCBs and other pollutants.[85] Recognizing that state-initiated programs were not sufficient to address the problem, the DRBC approved tougher regulations governing point sources in the mid-1990's.[86] But the river's pollution had only slightly improved by 2003, largely because over 70 percent of the river's pollutants came from nonpoint sources.[87] In December 2003, the U.S. EPA established total maximum daily loads for polychlorinated biphenyls in the tidal Delaware River based on several years of technical work conducted by the DRBC. The DRBC's need to placate various groups in order to promote a unified plan slows down

its response to long-term issues, like pollution, and hampers its ability to effectively rein in some of the river's greatest problems.

Conclusion

The Delaware River Basin Commission is a groundbreaking collaboration with a strong track record. As a unique multilateral organization, DRBC has succeeded in spearheading innovative programs that reach across state borders, leading to substantive, positive changes for the Delaware River. Indeed, the DRBC has been hailed as "the principle model of a federal-interstate compact," and it has served as the archetype for regional organizations across the nation.[88]

While the commission has been successful at spearheading initiatives, it has had less success brokering arrangements between states. The commission has a much harder time acting as a managing body, particularly when its initiatives call for funding or sacrifices. The DRBC's mixed successes illustrate that integrated water management has the strong potential to positively impact a river's health, but that integrated organizations, like any government agency, are likely to be hampered by competing interests and jurisdictional clashes.

Assessing Pennsylvania's Watershed Partnerships

Other organizations, like the Western Pennsylvania Watershed Program and the Susquehanna River Basin Commission, have also taken active roles in reducing point and nonpoint pollution and guarding precious water supplies. However, more partnership structures with regulatory and enforcement capabilities and financial resources are needed. These watershed-based organizations are forward-thinking and offer a tremendous potential to encourage smart water strategies. If improved and extended, they could play a key role in encouraging smart water approaches nationwide.

Because their sole responsibility is watershed management, regional water partnerships are far better equipped than local governments to make intelligent long-term decisions about land use and source water protection. Watershed organizations are more adept at balancing the needs of multiple communities, and making farsighted decisions about water infrastructure. It is not surprising, then, that most of the partnerships place a strong emphasis on smart water practices, which range from supporting water quality improvements (CCWRA) to implementing widespread conservation efforts (DRBC). Furthermore, all of these watershed groups share a common focus on collecting information and distributing it to the public; raising public awareness about water quality concerns and the costs of infrastructure maintenance is a vital way to hold water purveyors accountable and convince Americans to begin considering alternatives to outdated methods.

There is no question that each of Pennsylvania's watershed partnerships suffers from funding constraints, and is forced to balance the wills and desires of competing constituents. Yet each of these partnerships has shown uncommon vision, and all appear capable of improving water quality within their jurisdictions. In order to foster watershed groups, state and citywide agencies should follow the model set by the Philadelphia Water Department: they should team up with local governments and stakeholders and help fund regional, mutually beneficial partnerships. The EPA and its regional offices could support this process by offering matching contributions and by agreeing to give watershed partnerships an annual stipend. Lawmakers at the state and federal level can also encourage regional water groups by giving watershed partnerships greater legal powers over their source water.

The DRBC, CCWRA, and DCWP offer compelling examples of cooperative watershed organizations that promote smart water strategies and manage water services with common sense. Together, these case studies provide a strong model for communities looking to improve their water services while controlling long-term costs to taxpayers.

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Chapter Seven: A New Approach

As this report shows, the smart water approach is working – offering smart strategies to meet communities' water needs while reducing short- and long-term costs and minimizing environmental impacts. Through a series of technological and managerial improvements, a smart water approach will help solve Pennsylvania's and the nation's looming water crises:

■ **A smart, integrated approach to water resources must replace the current outdated and balkanized approaches to water management and development that are exacerbating, rather than alleviating, the nation's and Pennsylvania's current water crisis.**

■ **Municipal and state water planners must begin to regard smart water solutions as more than an "alternative" or "plan B" to traditional hard pipe infrastructure. Water planners should be required to consider these solutions before pursuing traditional approaches.**

In order to accomplish these goals we suggest several measures, including:

A. Greater Integration

To realize an effective smart water strategy, plans and actions must be coordinated and integrated on a watershed basis and across the three major water service areas – wastewater disposal and treatment, stormwater management, and drinking water treatment and supply. For this to occur, we must redesign our water laws and redraw our regulatory boundaries in a way that encourages cooperation and long-term planning.

A.1. Water resources should be managed as a coordinated regional effort along natural watershed boundaries. Nationwide, water resources are currently regulated by numerous state, regional, local, public and private agencies. But there are only a few umbrella organizations or coordinated management entities that exist at the watershed level. A few of the most prominent, groundbreaking watershed organizations reside in southeastern Pennsylvania – including the Delaware River Basin Commission and the Chester County Water Resources Authority (a countywide group whose guiding manual, *Watersheds*, emphasizes management at the watershed level).

Groups like the Delaware River Basin Commission and Chester County Water Resources Authority can dramatically cut the costs of watershed management and help to harmonize water policies among the more than 200 municipalities in southeastern Pennsylvania, and among the various states sharing the same water resources.

A.1.1. Watershed partnerships should be extended across the nation, and should be augmented by state, local and regional regulatory efforts to integrate their practices. State and urban agencies should follow the model set by the Philadelphia Water Department and actively work to develop collaborative watershed groups.

A.1.2. States and the federal government should provide funding incentives for integrated management, and help create planning entities that can look at water resource issues across municipal boundaries and integrate water resource decisions with zoning decisions.

A.2. Federal, state and local entities should be encouraged to jointly regulate or oversee water services. Water is not bounded by city, township, municipal or county lines, and the decisions that manage it should not be either. Yet today, states across the nation are hampered by fragmented laws that impede the pursuit of a smart water strategy and by agencies with overlapping responsibilities and often conflicting mandates. Both of these widespread problems hinder

long-term planning and play a major role in reinforcing inefficient approaches.

With strong and well-designed centralized structures in place, states can better encourage agencies to work together. And by offering incentives and preferential treatment, agencies can promote collaboration between municipalities. Both steps will inevitably promote farsighted decision-making.

A.2.1. One of the most promising ways for states to begin the process of improving the coordination of their water services is to initiate a comprehensive statewide water resources plan. A statewide water resources plan can allow states to assess their current water resources, and gives them an opportunity to prepare for their most pressing needs over the coming decades.

Pennsylvania's Act 220, passed in 2002, is a smart piece of legislation that, if implemented effectively, should help the state address its water concerns for the next generation. The law calls for Pennsylvania's outdated State Water Plan to be revised by March 2008, and then updated every five years thereafter. The act wisely created six regional water resources committees, delineated roughly around major watersheds, to help facilitate the planning process, and one umbrella organization, the Statewide Water Resources Committee, to oversee the plan's guidelines and procedures. The law encourages DEP to coordinate its planning activities with existing watershed groups, and requires large water users – those using 10,000 gallons or more per day – to periodically report their use to the DEP. In all, Act 220 is a forward-thinking law with high prospects.

For Act 220 to be a success, Pennsylvania's Statewide Water Resources Committee must engage a wide variety of citizens and water planners with a strong grasp of Pennsylvania's water needs. Without input from a broad range of participants, the plan is likely to be incomplete and far less effective than it can be. In addition, Pennsylvania's improved State Water Plan, like any statewide water resources plan, should include:

- Goals and directions for all of the state's major watersheds
- A database of specific measures and the funding sources available for them.
- Enforcement and implementation mechanisms that enable the plan's success
- Detailed water budgets on the watershed and statewide scales
- Incentives to develop multi-municipal planning initiatives

A.2.2. Agencies at all levels must learn to better coordinate their activities. As it stands, government agencies involved in different aspects of the water cycle are prone to poor cooperation, leading to inefficiency and redundancy. Better communication would help planners and providers treat the three categories of water services – wastewater, stormwater, and drinking water – in a big picture way. This in turn would lead to more integrated and cost-efficient water management. A statewide water resources plan could greatly help agencies achieve better communication.

A.2.3. Multi-municipal planning, which allows for watershed-wide initiatives, should be encouraged by states. Pennsylvania's changes to the Municipalities Planning Code in 2000 provided a small step in this direction by offering priority funding consideration to multi-municipal planning efforts and projects that are consistent with them. The language in the MPC is weak, however, and funding incentives have not been implemented consistently among state agencies. That said, these changes to the MPC have helped foster more than 170 multi-municipal initiatives statewide; stronger and better enforced regulations, particularly those with more defined financial incentives, would further encourage multimunicipal planning.

A.2.4. Comprehensive stormwater management (P.19) should be extended and implemented nationwide. It is a cost-effective solution to handling a community's stormwater needs, while protecting public health and preserving a clean watershed.

B. Cost-Effective Solutions

The one benefit of a smart water strategy that everyone can appreciate is that, when applied effectively, it saves money for consumers and communities alike. But for Pennsylvania and the nation to realize these cost saving reforms, it is vital that legislators put the right funding incentives in place. The current funding scheme on the federal and state level is too tilted toward traditional water infrastructure; it reinforces hard pipe methods at the expense of more cost-effective approaches. Legislators must therefore remodel water financing and pricing to provide strong incentives for smart water strategies.

B.1. Policymakers should update the system of water infrastructure financing to provide greater incentives for cost-saving reforms.

B.1.1. Pennsylvania's Growing Greener program, which provides funding for watershed protection and stormwater management (P.44) has undoubtedly been a success, with strong bipartisan support and widespread calls for its expansion. Growing Greener provides a model that other states can follow; yet Growing Greener, for all of its success, is a relatively limited pilot program. It should be expanded in Pennsylvania and transformed into a permanent program coupled with other initiatives to maximize returns.

B.1.2. Ohio's Water Resources Restoration Sponsor Program (P.45) is a great example of how government entities can use their funds to help spread smart water strategies. Such incentive-based programs are beneficial both to communities and to taxpayers, because they help establish an infrastructure that is less costly to maintain over the long term. Like Growing Greener, WRRSP is small; its use should be increased in Ohio and used as a model for similar statewide programs across the country.

B.2. Policies should be crafted to more aggressively pursue water conservation and efficiency measures and programs. In many cases, the most cost-efficient way to manage water is to consume less of it. Conservation and efficiency programs save money in many ways: by decreasing the demand for new infrastructure, by alleviating the impacts of drought, and by generally lowering the operation and maintenance costs of any water system. This report recommends a number of proven conservation measures, including:

B.2.1. Incentives at the local, state and federal level for the installation of water-saving devices in residences and commercial buildings;

B.2.2. Measures that increase the efficiency of water transport and delivery, like the DRBC's leak-detection standards program (P.58);

B.2.3. Increased public and private investment in water service-related research and development, which has historically proven to promote innovations and measures that have been beneficial to taxpayers in the long term.

B.2.4. Initiatives to promote capture and reuse of graywater.

B.3. Water managers must pursue opportunities to protect open space in the watershed and become involved in land use planning. Land use decisions, whether supporting desired growth and development or preserving critical resources, such as wetlands and streams, are an integral part of a watershed's health. Furthermore, problems that occur as the result of poor land use can be extremely expensive to fix. Water purveyors must thus become more active in protecting a watershed's natural buffers; this is an effective way to guard against the massive costs of building large filtration and stormwater infrastructure down the line.

B.3.1. Smart growth initiatives should be extended and given more legal authority. Laws like Pennsylvania's Sewage Facilities Act (P.31) should be amended to put more emphasis on consistency with long-term, sustainable land-use planning.

B.3.2. States and state agencies like PENNVEST should amend their criteria to encourage funding

for conserving or easing open space critical to watershed protection to save on filtration plant costs.

B.3.3. Watersheds and municipalities should actively seek to increase riparian buffers within their communities. Campaigns to add riparian buffers, particularly one which focuses both on the fiscal and community benefits of open spaces, have the potential to reverse the trend among corporations and local governments of selling watershed lands or natural resource rights.

B.4. Policymakers and water service providers should focus on protecting water quality at the source, where it is most cost-effective. As the risk of watershed contamination continues to grow and financial resources decline, watershed preservation is an increasingly appealing lower cost alternative to costly infrastructure solutions. Source water protection requires a relatively small initial investment, while saving millions in treatment costs. This report recommends programs such as those listed below:

B.4.1. Water protection measures, like the Delaware River Basin Commission's Special Protection Waters;

B.4.2. Pollution prevention programs, like Pennsylvania's recently instituted Wellhead Protection Program;

B.4.3. Onsite spill and pollution quick response initiatives, like those proposed by Chester County Water Resources Authority's *Watersheds*.

B.5. Management and financing criteria should be established to enable decentralized water systems to be part of a cost-effective pursuit of a smart water strategy.

B.5.1. Municipalities and county governments must establish strong guidance to dictate the appropriate use and location of decentralized systems. While a very useful tool in pursuing smart water strategies, the use of decentralized sewer systems to pursue noncontiguous (leapfrog) and low-density development ultimately increases costs and fragments coordination. Often existing water and sewer systems have the capacity to meet development goals if development is planned appropriately. Current systems need a strong ratepayer base to cover increasing costs of the system infrastructure. It is vital that all decentralized systems meet long-term sustainable development goals of a community.

B.5.2. Central management and coordination with existing governance systems is also key to the success of a decentralized system. Centralized management structures must be in place to ensure recapitalization and full cost recovery structures are put in place to ensure proper maintenance and repair of decentralized systems down the road, eliminating risks for leakage and water contamination.

B.6. A tradable permit system, similar to those that regulate airborne toxins in some parts of the country, should be considered. By allowing those factories or farms that can least afford to abate their discharge into local waterways to buy permits from those who can abate more cheaply, permit schemes can allow governments to limit watershed pollution in an economical way. Tradable permit schemes have had a mixed record in practice. More experimentation with permit schemes will help to smooth the kinks in implementation.

B.7. Water prices should be increased to reflect the true cost of water services. Unless utilities charge a price that accurately reflects the full costs of water infrastructure – a cost that consumers already bear indirectly, through government expenditures – there will be little incentive to pursue innovative, cost-efficient smart water strategies. The state and federal government should therefore encourage water utilities to raise the price of potable water; for low-income families, the increased burden should be alleviated by a subsidy program similar to the Low-income Home Energy Assistance Program or the Low-income Weatherization Assistance Program.

C. Understanding Water Resource Challenges

Accurate information is essential to the success of smart water strategy. For smart water practices to be adopted, water service providers must be better educated as to their benefits; furthermore, more information about water services and their costs must be known and citizens must be educated on the impact their decisions have on water resources.

C.1. Public awareness campaigns should be developed and improved to better highlight water resource challenges and costs. All water stakeholders, from water users to landowners and developers must be aware of the health of the local watershed, their impact on it and what they can do to help. A successful campaign should highlight:

C.1.1. Smart measures that can be implemented in the home, such as low-flow faucets and water efficient appliances;

C.1.2. Individual and community measures to protect local source water, such as proper disposal of hazardous substances and avoidance;

C.1.3. Onsite stormwater strategies that can help alleviate overflows and improve groundwater recharge;

C.1.4. Information on the benefits of connecting water and sewer development with smart growth land-use planning;

C.1.5. The potential of graywater capture. Graywater is a cost-effective smart water approach that could be implemented in homes nationwide. The first step toward improvement of graywater prospects is to inform Americans about its safety and its cost savings for households.

C.2. Laws and statutes should be reformed to hold state and local agencies more accountable for their infrastructure decisions. Strong public disclosure laws are effective ways of enforcing water laws and ensuring that polluters and water users are held responsible for their actions.

C.2.1. Regulations like GASB-34 (P.30) increase transparency and accountability, and should be expanded. Fuller disclosure of water infrastructure costs discourages planners from pursuing wasteful projects that will burden their communities over the long term.

C.2.2. Defective disclosure laws, like those contained in Act 537, should be rewritten.

C.3. Congress should establish a national water commission to provide comprehensive oversight of the nation's water infrastructure building. A national water commission would establish national standards and recommendations for a comprehensive integrated water services policy. Many experts have talked about a model for such a commission and Congress has held hearings on this issue. However the commission is formed and regardless of its makeup, it needs to address water resource challenges in a way that implements the components of a smart water strategy.

Appendix: Acronyms

ASCE: American Society of Civil Engineers
CBO: Congressional Budget Office
CCWRA: Chester County Water Resources Authority
CD: Certificate of Deposit
CDBG: Community Development Block Grants
Corps: U.S. Army Corps of Engineers
CSM: Comprehensive Stormwater Management
CSO: Combined Sewer Overflow
CWA: Clean Water Act
CWSRF: Clean Water State Revolving Fund
DCWP: Darby-Cobbs Watershed Partnership
DEP: Department of Environmental Protection
DRBC: Delaware River Basin Commission
DWAP: Delaware River Source Water Assessment Partnership
DWSRF: Drinking Water State Revolving Fund
EO: Executive Order
EPA: Environmental Protection Agency
GASB: Governmental Accounting Standards Board
GDP: Gross Domestic Product
HUD: Department of Housing and Urban Development
LIHEAP: Low-income Heating Assistance Program
LIWAP: Low-Income Weatherization Assistance Program
MEP: Maximum Extent Practicable
MPC: Municipalities Planning Code
MS4: Municipal Separate Storm Sewer System
NPDES: National Pollutant Discharge Elimination System
PASDWA: Pennsylvania Safe Drinking Water Act
PENNVEST: Pennsylvania Infrastructure Investment Authority
PWD: Philadelphia Water Department
PWP: Pennypack Watershed Partnership
R&D: Research and Development
RUS: Rural Utility Service
SDWA: Safe Drinking Water Act
SRF: State Revolving Fund
SWAP: Source Water Assessment and Protection Program
SWAP: Schuylkill River Source Water Assessment Partnership
SWM: Solid Waste Management
TAT: Technical Assistance and Training
TFWP: Tookany/Tacony-Frankford Watershed Partnership
USDA: United States Department of Agriculture
WAC: Watershed Agricultural Council
WHPP: Wellhead Protection Program
WMP: Watershed Management Plan
WRRSP: Water Resources Restoration Sponsor Program

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