Water Protection Series

published by THE TRUST FOR PUBLIC LAND *and*
AMERICAN WATER WORKS ASSOCIATION

"The health of our waters is the principal measure of how we live on the land."

LAND CONSERVATION AND THE FUTURE OF AMERICA'S DRINKING WATER

PROTECTING THE SOURCE

THE TRUST *for* PUBLIC LAND
CONSERVING LAND FOR PEOPLE

The Trust for Public Land conserves land for people to enjoy as parks, gardens, and other natural places, ensuring livable communities for generations to come.

AWWA is the authoritative resource for knowledge, information, and advocacy to improve the quality and supply of drinking water in North America and beyond. AWWA is the largest organization of water professionals in the world. AWWA advances public health, safety, and welfare by uniting the efforts of the full spectrum of the drinking water community. Through our collective strength we become better stewards of water for the greatest good of the people and the environment.

Written by Caryn Ernst
Edited by Kim Hopper and David Summers

cover photo left © 2001 Al Fuchs
cover photo right © 1999 Bill Silliker, Jr.

Quotation on front cover by Luna Leopold, professor emeritus, Department of Landscape Architecture, University of California, Berkeley

LEFT COVER PHOTO:
Protecting watershed land has many benefits. In Ohio, just south of Lake Erie, Edison Woods offers public access to 1,300 acres of woods, wetlands, and meadows.

RIGHT COVER PHOTO:
More than half a million people receive their drinking water from Mountain Island Lake near Charlotte, North Carolina.

PROTECTING THE SOURCE

Land Conservation and the Future of America's Drinking Water

THE TRUST *for* PUBLIC LAND
CONSERVING LAND FOR PEOPLE

THIS REPORT WAS PRODUCED
WITH FUNDING FROM THE
FOLLOWING ORGANIZATIONS

Henry Phillip Kraft Family Memorial Fund
of the New York Community Trust

Aquarion Water Company

Contents

CASE STUDIES

Foreword

© PHIL SCHERMEISTER

Will Rogers

COURTESY OF AMERICAN WATER WORKS ASSOCIATION

Jack Hoffbuhr

In 1997, the Trust for Public Land (TPL) released the first edition of *Protecting the Source*. The report promoted the strong interrelationship between land and water resources and the absolute necessity of landuse planning in watershed management. Over 15,000 copies of the report were distributed to communities across the country. This new edition of *Protecting the Source* is the result of a partnership between TPL and the American Water Works Association (AWWA) to look more closely at the case for land conservation as a source water protection strategy.

The release of the 1997 report coincided with the 1996 amendments to the Safe Drinking Water Act that mandated a state source water assessment and planning process—and, we think, created a renewed interest in a multiple-barrier approach to source protection. By the mid-1990s, TPL was increasingly working with local governments and water suppliers on land conservation strategies for water quality protection. Based on public surveys testing voter support for new taxes to support land conservation, it was clear to us by the late 1990s that the public was greatly interested in using land conservation as a tool to address water quality.

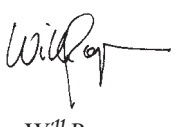
In 2002, TPL formed a partnership with AWWA to revisit the ideas in the first edition of *Protecting the Source* and to provide a stronger case and a set of best practices for using land conservation for source protection. AWWA's Source Protection Committee, composed of volunteer practitioners and scientists, has worked diligently to support TPL's efforts to ferret out research and field practice regarding the value and practice of land conservation for protecting drinking water quality.

AWWA has long promoted the idea of source protection. Reporting on the results of a major 1991 AWWA Research Foundation watershed management study, the *AWWA Journal* asserted that "the most effective way to ensure the long-term protection of water supplies is through land ownership by the water supplier and its cooperative public jurisdictions." At that time, the *Journal* noted, the median percentage of watershed lands owned by water utilities nationwide was only 2 percent. That number has not changed significantly over the past decade.

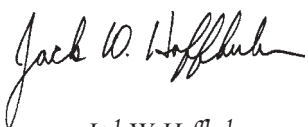
TPL and AWWA's partnership on this edition represents the first effort in a collaboration to promote suppliers' ability to turn EPA-mandated source water assessments into protection strategies. Both organizations are strongly committed to source protection. In the summer of 2003, AWWA's board reaffirmed its commitment to securing drinking water from the highest quality sources available and to "actively and aggressively" protecting those sources. Land conservation is central to TPL's mission, and over 30 years of partnering with local and state governments on land protection strategies make it well suited to partnerships with water suppliers.

The original edition of *Protecting the Source* introduced the issue of source protection to landuse planners—and revisited historical efforts. It highlighted the increasing pressure on supplies as development sprawls into drinking watersheds. This new edition builds on earlier case-making with more detailed information on cost benefits, on the increasing challenges to water treatment, and on a growing body of knowledge regarding the use of land conservation for source protection.

For 60 years, the safety of most of America's drinking water has been dependent on technology. Today, water suppliers are revisiting the idea that watershed protection—the first barrier against contamination—needs to, once again, be an integral part of their water quality protection strategy. The information and best practices in this report will ensure that suppliers will be well prepared to take on this challenge.



Will Rogers
PRESIDENT
TPL



Jack W. Hoffbuhr
EXECUTIVE DIRECTOR
AWWA

Acknowledgments

The Trust for Public Land (TPL) would like to thank the many people who helped to make this report possible. In particular, we would like to thank the members of the American Water Works Association (AWWA) Source Water Protection Committee and TPL's Source Water Protection Advisory Committee for their support throughout this project and the untold hours they committed to conference calls and reviewing drafts to help TPL "get it right." AWWA's Source Water Protection Committee Chairperson, Richard Gullick, deserves special recognition for supporting this project since its outset, not only with technical insight and editorial assistance, but also by providing a much needed water utility perspective. Special thanks also to Gary Logsdon, for his detailed, thoughtful, and technically proficient review comments, and to Grantley Pyke, for his extensive references, data sources, and guidance with our water supplier surveys. Without the wisdom of our many advisors, TPL could not have produced this report or its companion report, *Source Protection Handbook: Using Land Conservation to Protect Drinking Water Supplies*.

TPL's Source Water Protection Advisory Committee

Scott Abrahamson, New York State, Department of Environmental Conservation
Paul Barten, University of Massachusetts
Kathy Blaha, Trust for Public Land
Suzanne Chiavari, American Water
Chris Crockett, Philadelphia Water Department
Scott Emry, Hampton Roads Planning District Commission
Stephen Gasteyer, Rural Community Assistance Program
Richard Gullick, American Water
Ed Holland, Orange Water and Sewer Authority, North Carolina
Pam Kenel, Black and Veatch
Gary Logsdon, Black and Veatch
Walton Low, U.S. Geologic Survey, National Water Quality Assessment Program
Kirk Nixon, San Antonio Water System
K. C. Price, Startex, Jackson, Wellford and Duncan (SJWD) Water District
Grantley Pyke, Hazen and Sawyer
Carol Storms, New Jersey American Water Company
Brian Thompson, Aquarion Water Company of Connecticut

TPL would also like to thank the many water suppliers who participated in our survey, which surfaced critical information on the link between forest cover and treatment costs. We would like to convey our special appreciation to the many municipalities, water utilities, and state and federal agency representatives who provided extensive materials for our case studies and background data for making the case. EPA staff at the Office of Ground Water and Drinking Water, especially Debra Gutenson, supported TPL's fieldwork, where many of our best practices and case studies originated. We are grateful for their partnership and support of our work.

Special appreciation is due to Kathy Blaha, Senior Vice President of National Programs at TPL, for her support, guidance, and countless hours of reviewing and revising drafts. Thanks also to Kathryn Lanouette for her research assistance and her tenacious effort to collect water supplier surveys, and to Kyle Holland for his assistance with research and other editorial details.

TPL is especially grateful for the financial support provided by the Henry Phillip Kraft Family Memorial Fund of the New York Community Trust and by the Aquarion Water Company, without which this report would not have been possible.

EXECUTIVE SUMMARY

Water is the most critical resource issue of our lifetime and our children's lifetime. The health of our waters is the principal measure of how we live on the land.

—Luna Leopold

In 1896, shortly after constructing its first public water supply system, Seattle leaders agreed on a long-term plan to eventually own the entire Cedar River Watershed, thus permanently protecting and securing Seattle's drinking water source. With a 100,000-acre watershed, it was a bold vision.

One hundred years later, Seattle's original vision had finally been achieved. By taking advantage of opportunities, creating dedicated local funding, and patiently sticking to a long-term vision, the City of Seattle has permanently protected one of the most pristine sources of drinking water in the country. Seattle made a cost-effective investment in clean source waters that will never be threatened by pollution from roads, sewers, or urban runoff. It is an investment that will continue to pay off many times over through reduced treatment costs and a safe supply of water for generations to come.

Unfortunately, watersheds in many other fast-growing communities remain unprotected and threatened by development. New roads, homes, and commercial development can abruptly alter a landscape and generate nonpoint source pollution that contaminates drinking water supplies. According to the U.S. Environmental Protection Agency, the leading cause of water quality degradation is nonpoint source pollution (NPS)—over 60 percent of pollution in U.S. waterways comes from runoff from lawns, farms, cities, and highways, as well as leachate from rural septic systems and landfills. While point sources of pollution—which emit from pipes, canals, or municipal wastewater treatment plants and industrial facilities—have been closely monitored and regulated since the 1970s, the management of nonpoint sources of pollution has only recently become a national priority.[1]

Advances in treatment technologies allow most suppliers to meet current drinking water standards, yet the constantly expanding diversity of contaminants, coupled with greater pollutant loads and fewer natural barriers, has made treatment more difficult and expensive, and it has increased the chances that contaminants will reach our tap. Some of the treatment challenges faced by suppliers drawing from intensively used source lands include:

1. The emergence of new contaminants that suppliers may not be prepared to test or treat
2. Spikes in contaminant loads due to storms and flooding that make treatment more challenging
3. Constantly changing standards and regulations regarding new contaminants, which are present in the water long before they are identified as threats to public health
4. Increased treatment and capital costs due to higher pollutant loads and changing water quality standards

The loss of natural lands to development impacts not only the quality of our drinking water, and therefore the cost of treating it, but also the *quantity*. That's because development increases demand for drinking water while decreasing the ability of water to infiltrate the ground and recharge water supplies. Sprawling suburban-style development contributes even more to water scarcity than does compact development, as it promotes more lawn areas and larger lots planted with turf grass, requiring significantly more water than homes with smaller lots.

Watershed Management—The First Barrier in a Multiple-Barrier Approach to Source Water Protection

The considerable threats to our drinking water require an integrated and comprehensive response. Governments and water suppliers are tasked with protecting each droplet of water. Starting in the watershed or aquifer recharge areas, continuing through the treatment process, and extending to the distribution system, suppli-

The Geauga Park District acquired 574-acre Bass Lake Preserve at the headwaters of the Chagrin River, 25 miles east of Cleveland, Ohio, in 2003 to help protect regional water quality. Watershed protection funds from the Ohio Environmental Protection Agency made the transaction possible.

ers must safeguard the water from contamination, erecting multiple barriers of protection at every stage from source to tap. It is a *multiple-barrier approach*; each method of protection acts as a barrier safeguarding water from contamination.

Watershed protection is the first and most fundamental step in a multiple-barrier approach to protecting drinking water. Healthy, functioning watersheds naturally filter pollutants and moderate water quantity by slowing surface runoff and increasing the infiltration of water into the soil. The result is less flooding and soil erosion, cleaner water downstream, and greater groundwater reserves.

When communities invest in land protection as a way to protect their drinking water, they are investing in the long-term health and quality of life of their citizens—guiding growth away from sensitive water resources, providing new park and recreational opportunities, protecting farmland and natural habitats, and preserving historic landscapes. Many communities don't realize the cost-saving benefit of source protection and the potentially dramatic increase in treatment costs that can result from the loss of forests, grasslands, and wetlands, and the natural filtration these landscapes provide. A study of 27 water suppliers conducted by the Trust for Public Land and the American Water Works Association in 2002 found that more forest cover in a watershed results in lower treatment costs. According to the study, for every 10 percent increase in forest cover in the source area, treatment and chemical costs *decreased* approximately 20 percent, and approximately 50 to 55 percent of the variation in treatment costs can be explained by the percentage of forest cover in the source area.[2]

This report presents a series of best practices to guide communities' source protection efforts and to showcase those communities that are already linking land and water protection effectively. *Protecting the Source* serves as a reference and resource for those seeking best practices in developing and maintaining the highest level of water quality and, at the same time, preserving our limited natural land resources.

Best Practices—Guiding Implementation in the Field

The following five best practices provide a framework for developing and implementing a source protection plan for city planners, government officials, and water suppliers.

1. *Understand your watershed*: An effective source protection plan is built upon an understanding of your watershed and aquifer recharge areas. Scientific data and watershed analyses are essential to define an effective source protection plan and build public support for its implementation.
2. *Use maps and models to prioritize protection*: Municipal water supply managers and conservation agencies routinely face questions and problems when choosing where to invest in conservation and restoration strategies. Using maps and models to identify high-priority land for protection and restoration is critical, as funding is always limited and multiple demands are often made upon a valuable piece of land.
3. *Build strong partnerships and work watershed-wide*: The support and cooperation of a variety of public and private partners will be required to effectively implement a source protection plan, as most communities' source areas lie partially, if not entirely, outside of their jurisdiction. Effective source water protection can be achieved by influencing others to act on your behalf, utilizing existing initiatives and frameworks, and finding common goals with others.[3]
4. *Create a comprehensive source protection plan*: Creating a comprehensive source water protection plan is an opportunity to pull together everything learned from analyzing a watershed, assessing the threats to drinking water, mapping high-priority land for protection and restoration, and developing partnerships. Such a plan should incorporate:
   - •Strategies for both managing threats and protecting natural resources
   - •A combination of voluntary and regulatory strategies
   - •A long-term vision, short-term action strategies, and measurable goals
   - •A strategy to fund the plan
5. *Develop and implement a "funding quilt"*: Implementing a comprehensive source water protection plan requires a significant and steady stream of funds. Successful communities secure funds from a variety of sources—federal, state, local, and private—creating a "funding quilt." By tapping into a range of sources, communities can raise and leverage significant amounts of money and avoid reliance on a single revenue stream.

Moving Forward

The 1996 amendments to the Safe Drinking Water Act reflected a renewed national focus on source protection as a tool to prevent the contamination of drinking water supplies. Instead of focusing on water treatment, emphasis is placed on contamination prevention and on the integrated management of source areas by requiring all states to develop Source Water Assessment Plans (SWAPs), which identify threats to every public water supply in the state. These forward-thinking amendments mark a return to a set of historic best practices in watershed protection and management.

Local water suppliers support the notion that watershed planning and protection activities are key to a multiple-barrier approach. Voters support it too, with poll after poll showing support for new taxes for land conservation that protects water quality. States are also creating programs and using federal Clean Water Act dollars more creatively to support more comprehensive approaches to addressing threats from nonpoint source pollution. State and federal support, through increased and more flexible funding options, new tools and technologies, and incentives to promote the creative use of existing programs, will be key in ensuring their success.

With the completion of the Source Water Assessment Plans, local communities are poised to move forward on implementing source protection strategies. The best practices outlined here offer a guide to success for local communities.

PART ONE

MAKING THE CASE

Protecting Water Resources

As we grow, the land around us changes forever. Sometimes this happens dramatically as new roads, homes, and commercial development abruptly alter our landscape. Other times it is subtle, and we recognize that we've lost farmland, forestland, and open space over the years.

The numbers confirm the story. Urbanized land—land with houses, businesses, or industry—has quadrupled since 1954. From 1992 to 1997, the national rate of land development more than doubled to three million acres per year, and urban land area increased more than twice as fast as did population between 1950 and 1990.[4] These changes impact our communities, our quality of life, and our natural resources—the air and water we need to survive.

Increased sprawl and development brings increased pressure to develop land in drinking water source areas. Once development infringes on source areas, the controls designed to protect water quality become stressed. Although advances in treatment technologies allow most suppliers to meet current drinking water standards, the challenges of storm water runoff from agricultural and developed lands make treatment more heavy-handed, complex, and expensive. Compounding the problem is the loss of wetlands, forestlands, and grasslands, which naturally filter water and serve as buffers to water supplies.[5]

The considerable threats to our drinking water require an integrated and comprehensive response. Consider for a moment that a drop of water often traverses many miles through both natural and manmade systems before reaching household drinking taps. Governments and water suppliers are tasked with protecting this droplet during its travels—beginning in the watershed or aquifer recharge area, continuing at the treatment facility, and extending through the distribution system—ensuring the purity of each glass of drinking water poured by the consumer. The process is a *multiple-barrier approach*; each method of protection acts as a barrier safeguarding water from contamination.

Considering the water droplet's journey, the first opportunity to protect it from contaminants is at its source—the point at which water falls to earth, either seeping into the ground and into underground aquifers, or winding its way across the earth through surface waterways. The reservoir or waterway itself is the next protection point. Then, barriers are needed to remove impurities as the water is processed in treatment plants and flows into canals, pipes, wells, and holding tanks, and finally to the tap.

Historically, protecting source lands—the watersheds that supply surface water and the aquifer recharge areas that cover groundwater sources—has been an essential part of a multiple-barrier approach to clean drinking water. Cities such as Seattle, San Francisco, Boston, and New York initiated source water protection efforts in the 1800s as a primary tool for protecting public health before chlorination and other treatment technologies were available. Understanding the value of a protected source, they continue to employ source protection methods today.

Many newly developing midsize cities and suburbs have not been as proactive about protecting their source areas. "Authorities face tough choices between building houses for growing populations, chopping down forests for timber, or conserving them to help secure the water supply," say Chris Elliot, Director of World Wildlife Fund's Forest for Life Program.

Fortunately, source protection is receiving a renewed focus. With the passage of the Safe Drinking Water Act, Congress and the U.S. EPA emphasized the protection of source waters as a key component of our national efforts to safeguard America's drinking water. It is increasingly clear to many at the federal, state, and local levels that land conservation and watershed management practices are necessary to reduce pollutant loads to aquifers, rivers, and reservoirs in our complex watersheds.

This report makes a case for land conservation as an essential element of the multiple-barrier approach to water protection. It does so by presenting a series of best practices to guide communities' efforts in the field, and by highlighting those communities that already link their land and

water protection efforts. *Protecting the Source* serves as a reference and resource for those seeking best practices in protecting their precious water resources and preserving their sensitive natural lands.

The Trust for Public Land has also produced a companion report, *Source Protection Handbook: Using Land Conservation to Protect Drinking Water Supplies*, which provides detailed guidance on how to implement each of the best practices presented in *Protecting the Source.* Copies of the handbook can be ordered from TPL's Web site, *www.tpl.org*.

Despite the expenditure of hundreds of billions of dollars over the last 30 years, the 1972 Clean Water Act goals of fishable and swimmable waters have not been achieved, largely because contaminants from diffuse [nonpoint] sources have not been controlled successfully.

National Research Council, 2001[6]

Nonpoint Source Pollution—The Primary Threat

Point sources of pollution—which emit from pipes, canals, or municipal wastewater treatment plants and industrial facilities—have been closely monitored and regulated since the 1970s, but the management of nonpoint sources of pollution (NPS) has only recently become a national priority.[7] NPS pollution includes runoff from lawns, farms, forests, cities, and highways, as well as leachate from rural septic systems and landfills. As water from rainfall or snowmelt flows over the ground, it carries with it natural and human-made pollutants. Eventually, these pollutants reach our lakes, rivers, oceans, and even underground sources of drinking water, as they seep into the ground.

According to the U.S. Environmental Protection Agency, the leading cause of source water degradation is nonpoint source pollution.[8] Although agriculture is currently the greatest nonpoint source threat to drinking water quality, urban runoff is the fastest-growing threat nationwide. The development of formerly forested land can also exacerbate existing agricultural pollution, for it removes the natural buffers that once trapped and filtered those pollutants before they reached waterways. In Carroll County, Georgia, Commission Chairman Robert Barr has seen that change firsthand. "In our county there has been a rapid shift from agricultural landuse to suburban landuse," explains Barr. "Row crops are no longer a major landuse. The greatest new contributor to water quality degradation is accelerating residential and commercial development."

The impact of NPS on the quality of un-

CLEAN WATER ACT AND SAFE DRINKING WATER ACT

Congress passed mandates for drinking water protection in the 1980s that form the basis for modern water protection activities. Although these laws focus on mitigating existing pollution and constructing or upgrading wastewater and drinking water treatment plants, the Clean Water Act and Safe Drinking Water Act can potentially fund initiatives focused on protecting source waters via land conservation.

Clean Water Act: The goal of the Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the nation's waters so that they can support the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water. Under the Clean Water Act, the EPA funds three water quality programs:[9]

- *Clean Water State Revolving Fund (SRF) (Section 212):* Provides loans for water quality improvements and has traditionally been used for wastewater treatment infrastructure, but it can also be used to fund the implementation of nonpoint source management plans and the development and implementation of estuary plans. In 2003, states were awarded $1.29 billion and provided $4.7 billion in assistance for wastewater, nonpoint source, and estuary projects. Currently, only about 5 percent of the Clean Water SRFs are used for mitigating nonpoint source pollution, with 95 percent going toward wastewater treatment infrastructure.[10]
- *Nonpoint Source Program (Section 319):* Provides grants for projects that address nonpoint source pollution, such as implementation of best management practices, restoration, and public education. Approximately $237.5 million in grants was distributed for this program in 2002. The Nonpoint Source Program receives only 17 percent of clean water funding, despite the fact that NPS pollution now accounts for 60 percent of all pollution in U.S. waterways.[11]
- *National Estuary Program (Section 320):* Funds projects that protect or improve estuaries. The program distributed $17 million in 2002.

Safe Drinking Water Act: Under the Safe Drinking Water Act, the EPA awards grants to states to fund Drinking Water State Revolving Funds (DWSRFs). State Revolving Funds provide eligible public water systems with loans and other assistance to finance infrastructure projects. Up to 31 percent of these capitalization grants can be set aside to administer the SRFs and state source protection programs and to fund source water protection activities, including land acquisition. Up to 15 percent of the set-aside can be used for land conservation and voluntary, incentive-based protection measures, with no more than 10 percent used for a single type of activity, such as land protection. In 2003, states were awarded $787.4 million and were provided $1.3 billion in loans for infrastructure improvements. Since the act's inception, only $2.7 million in assistance has been used by systems to protect less than 2,000 acres of land under the set-asides.[12]

treated water depends on several factors, including the amount of pollutants carried by runoff (pollutant load) and the pathway the water takes when it flows through the source area. If water flows quickly over the surface of the land, most of the pollutants it carries will reach the main body of water. If the water flows more slowly or infiltrates the ground, more of the pollutants will be filtered out, either by adhering to plants and soil or by being absorbed through plants' root systems. Pollutants are carried between surface water and groundwater, which means that both resources must be monitored and protected.

Water resource protection requires an understanding of the interconnection between groundwater and surface water. The terms "surface water" and "groundwater" refer to the same water regardless of its source. They merely clarify the location of the water at a particular time.[13] According to a national study performed by the U.S. Geologic Survey, an average of 52 percent of stream flow nationally is provided by groundwater. The groundwater contribution can vary tremendously depending on the season and watershed characteristics, but the important point is that groundwater pollution, chemistry, and flow can directly impact surface water quality, as surface water pollution can impact groundwater quality. In areas where supply wells are located in shallow aquifers adjacent to streams or lakes, supply wells can reverse the direction of groundwater flow under pumping conditions, and they can induce aquifer infiltration through stream and lake bottoms.

The close relationship between ground and surface water makes it imperative that water suppliers understand what percentage of their supply comes from each in dry and wet seasons, and that they act to protect those resources. A closer look at just how ground and surface water sources are impacted by nonpoint source pollution follows.

Surface Water and Nonpoint Source Pollution

Surface water is precipitation that does not infiltrate the soil. Instead, the water moves as overland flow to streams and rivers. The land area from which water drains into a surface water supply—a stream, reservoir, or lake—is called a watershed. In a watershed with natural groundcover, about 50 percent of precipitation infiltrates the ground and only about 10 percent flows over the land surface as runoff. In a highly developed watershed, with its impervious surfaces and lack of vegetation, about 15 percent infiltrates and approximately 55 percent becomes surface runoff, carrying sediment and pollutants to surface water bodies.[14]

The riparian zone is the area where streams interact with the land, and it is a stream's best defense for keeping nonpoint source pollutants out of its waters. The riparian zone protects water quality by processing nutrients, filtering contaminants from surface runoff, absorbing and gradually releasing floodwaters, maintaining fish and wildlife habitats, recharging groundwater, and maintaining stream flows.[15]

Groundwater and Nonpoint Source Pollution

Water moves underground through pores in the soil and cracks in surface rocks. An *aquifer* is rock or soil that contains and transmits water and thus can be a source of underground water.[16] In a confined aquifer, layers of impermeable clay or rock, above and below the aquifer, protect the water from some contaminants and restrict the water's movement. The recharge area for a confined aquifer, where surface water infiltrates the land and resupplies the aquifer, may be miles from a well that draws water from it.

In an unconfined aquifer, water can infiltrate directly from the surface to the aquifer, carrying landuse contaminants with it. The extent to

SOURCE WATER ASSESSMENT PROGRAMS

In 1996 the Safe Drinking Water Act (SDWA) was amended, placing a new focus on source water protection. The law requires every state to examine existing and potential threats to the quality of all public water supplies and to develop a Source Water Assessment Program (SWAP). The assessments' purpose is to inform and motivate local source water protection activities, which the EPA considers the critical initial component in the SDWA multiple-barrier protective scheme. Instead of focusing on water treatment, the amendment emphasizes contamination prevention and the integrated management of multiple supplies that share one source area.

As part of the U.S. Environmental Protection Agency's requirement that states conduct source water assessments on all source areas within their jurisdiction, states have identified all of the source areas that supply public tap water, inventoried potential contaminants, and assessed susceptibility to contamination. At the completion of the SWAPs, states must inform the public of the results. Although some resources were provided to the states to conduct assessments, no resources were authorized or appropriated for implementing protection strategies, and no mandate that it occur has been given. Implementation will have to be locally driven and creatively funded. Contact your local water supplier or your state source water protection office for more information and for a copy of the SWAP for your water supply. Contact information for state source protection offices can be found at http://www.epa.gov/safewater/protect/contacts.html.

which contaminants are filtered from groundwater as it passes through the soil depends on how porous the soil is. Where the soil is sandy or porous, water flows more quickly below the surface, and fewer contaminants are removed.

Reservoirs, lakes, aquifers, and other standing bodies of water tend to act as sinks for contaminants. When these water supplies are damaged, useable water resources are lost.[17] Some communities already connect more than one potential source to their treatment facility so as to choose which source to use at a particular time, depending on shifts in source water quality and the ability to treat substances in the water. In extreme cases, drinking water sources must be abandoned because water quality has become unsafe or too costly to treat, causing communities to invest tremendous resources in developing new sources. Wetlands and forested land, if left undeveloped, can help slow and filter water before it gets to lakes, rivers, and aquifers, keeping these drinking water sources cleaner and making treatment cheaper.

DRINKING WATER TREATMENT

Drinking water treatment is one of the most critical barriers in a multiple-barrier approach, as it provides a direct barrier against disease agents and is considered essential in protecting public health. Whether drinking water comes from groundwater sources or surface water supplies, it is likely treated before it reaches the tap. Even in the most pristine watersheds, natural pollutants such as animal waste and organic matter can impair the quality of water.

Modern drinking water treatment can reduce most source water contaminants to acceptable levels before water is delivered to consumers. The types of treatment necessary depend on the quality of the source water and the pollutants encountered. Water quality standards are created by the U.S. Environmental Protection Agency based on extensive public health research. These standards guide the amount and type of treatment needed for all ground and surface water supplies.

A wide variety of treatment methods are currently in use, and new technologies are employed regularly to ensure drinking water meets current standards. Treatment costs can increase significantly when more rigorous treatment is needed to cleanse contaminated source water.[18]

Most suppliers of surface water clarify the water through a sedimentation process (letting particles settle out), then filter water through sand or high-tech membranes in order to remove particles and microorganisms. Some facilities treat water with carbon or mix it with air to remove pollutants or reduce taste and odor. The final treatment state is disinfection, often using chlorine, to kill disease-causing microorganisms. All surface water supplies must be disinfected, although a small number of highly protected supplies are not required to be filtered. Many groundwater supplies are disinfected, though some are used without any treatment. For more information on how drinking water is treated or on treatment standards, go to www.epa.gov/safewater/DWH/Treat/.html.

CASE STUDY

Suffolk County, New York

Located at the eastern end of Long Island, Suffolk County contains much of New York's premier ecosystem, the Pine Barrens, underneath which is the island's largest supply of fresh drinking water. Suffolk County Water Authority is the largest groundwater supplier in the nation, serving 1.2 million residents from this federally designated sole source aquifer. Heavy development in the aquifer recharge area in recent decades led to concern about damage to this sensitive and unique ecosystem and the threat of nonpoint source pollution seeping into the groundwater.

In response to this concern, in 1987 Suffolk County voters overwhelmingly approved (83 percent to 17 percent) the continuation of a quarter-cent of the county's sales tax to purchase critical watershed areas through a new Drinking Water Protection Program. As part of this program, the county acquired watershed lands in one of the Special Groundwater Protection Areas (SGPAs); seven SGPAs are designated within the deep aquifer recharge areas of the county. Since the inception of the program, over $220 million has been spent on land acquisitions. When the program was due to expire in 2000, voters once again voiced their support for drinking water protection by extending the program through December 2013. By leveraging funding from their sales tax, Suffolk County also received a $75 million loan in the late 1990s and another $62 million in 2003 from New York's Clean Water State Revolving Fund to acquire land in priority watershed and aquifer recharge areas.

In the early 1990s, even as voters were approving the use of sales tax revenues to protect the Pine Barrens, several hundred development projects were being proposed in the central Pine Barrens. If these projects had been successful, the ecological integrity of the Long Island Pine Barrens would have been severely compromised. A grassroots advocacy effort by the Long Island Pine Barrens Society to educate the public and elected officials about the ongoing threats to the Pine Barrens led to the passage of the Long Island Pine Barrens Protection Act in 1993.

The legislation established a Central Pine Barrens Commission to oversee the development and implementation of a Comprehensive Management Plan (CMP). The plan delineated two major regions within the 100,000-acre area—a 52,000-acre core preservation area where no new development is permitted and

a 48,000-acre compatible growth area where limited, environmentally compatible development is allowed. The CMP also recommended that 75 percent of the core preservation area be preserved through public acquisition. The plan was adopted by the Pine Barrens Commission in 1995. Various landuse and zoning tools are used to accomplish the preservation goals of the act, including transfer of development rights, cluster zoning, and conservation easements.

CONTACT: Tom Isles, Planning Director
ADDRESS: Suffolk County, 100 Veterans Highway, Havtiange, NY 11788-0099
PHONE: 631-853-5190
FAX: 631-853-4044
EMAIL: Tom.Isles@co.suffolk.ny.us

CASE STUDY

Charlotte-Mecklenburg County, North Carolina

Mountain Island Lake (MIL), a section of the Upper Catawba River that has been shaped by a series of dams, is a meandering lake that divides Charlotte-Mecklenburg County from Gaston and Lincoln Counties in the southern piedmont of North Carolina. Although it receives some of its flow from Lake Norman, to its north, it receives most of its flow and pollutants from the Mountain Island Lake Watershed, a 69-square-mile watershed of which 72 percent lies in Charlotte-Mecklenburg County. The lake supplies drinking water to about 600,000 people in Charlotte-Mecklenburg County and in Gastonia and Mount Holly, both in Gaston County.

In the past decade, rapid development in the MIL Watershed raised alarms with local leaders, who feared that what they had taken for granted for so many years—clean water from Mountain Island Lake—was threatened by increasing sediment and fecal coliform from new development. In 1997, in response to this growing concern, the Foundation for the Carolinas convened a group of partners to create and implement a plan to protect the MIL Watershed, which became known as the Mountain Island Lake Initiative. The initiative's formation coincided with the state's creation of the North Carolina Clean Water Management Trust Fund (CWMTF), the first state-funded program in the nation dedicated to funding activities to protect and improve waterways statewide. The CWMTF's first grant was $6 million for the MIL Initiative's effort to protect a large tract on the western shore of the lake.

To ensure that future investments in the protection of MIL had the greatest impact on clean water, the MIL Initiative created GIS models of the watershed to help them identify the highest priority areas for conservation. Modeling showed that although protection of the lakeshore and regulated floodplain was important, protection of the smaller streams and tributaries in the headwaters was equally important. As a result, the MIL Initiative set a goal to protect both 80 percent of the lakeshore and 80 percent of its tributaries. In 1999 Charlotte-Mecklenburg County passed a $220 million land-banking bond to preserve land countywide for future public needs, including open space, parks, greenways, and schools. Fifteen million dollars of the bonds were directed to preserve land within the MIL Watershed. Over the next few years, the City of Gastonia, the City of Charlotte, and the North Carolina CWMTF also contributed funds to support land protection in the MIL Watershed. These years of focused protection efforts have protected 74 percent of the lakeshore and 20 percent of the tributaries. Since 1999, more than $31 million has been spent in Charlotte-Mecklenburg County for land acquisition. Approximately 4,009 acres have been acquired in this county, including donations of floodplains for greenways. Over $9 million has been spent in Gaston and Lincoln Counties. Today more than 6,000 acres of watershed land is protected.

In addition to land conservation strategies, regulatory protections of landuse and point sources of pollution are also needed in a watershed where much of the land is already developed. In 1996, in response to declining water quality conditions and the need for a broader set of watershed protection tools, the Charlotte-Mecklenburg County Board of Commissioners took a stand in support of clean, useable creeks and lakes by directing staff to develop a plan to ensure that all surface waters in the county were fishable and swimmable, a daunting task considering only about 15 percent of the county's creeks then met the criteria. The Surface Water Improvement and Management (S.W.I.M.) Program was created, and it has been instrumental in the adoption of a countywide stream buffer system, implementation of streamside forestry and restoration projects, the 70 percent reduction of fecal coliform through reduction of sewer discharges, and the reduction of sediment through improved inspection and enforcement of erosion control from construction sites.

Since the MIL Initiative and the S.W.I.M. Program were created, water quality has measur-

The South Central Regional Water Authority (SCRWA) in Connecticut closed an aging treatment plant on Lake Whitney because it could no longer effectively treat the raw water, which had degraded significantly due to heavy development in the watershed. Almost a decade after the plant was shut down, the water authority is investing substantial resources in building a facility with more advanced treatment and filtration capacity that will again make Lake Whitney a safe and viable source. Because they understand the challenges and costs associated with treating degraded water, the SCRWA is now one of the most progressive suppliers in the state when it comes to protecting source water, investing in land conservation and watershed management strategies to protect water resources.

ably improved throughout the MIL Watershed and Charlotte-Mecklenburg County as a whole. Current efforts focus on raising additional funds to protect the remaining high-priority streams, through acquisition and easements and by implementing the second and third phases of the S.W.I.M. Program.

CONTACT: Nancy Brunnemer
ADDRESS: Mecklenburg County Real Estate Department, 1435 West Morehead Street, Suite 120, Charlotte, NC 28208
PHONE: 704-336-8828
EMAIL: brunnnm@co.mecklenburg.nc.us
WEB SITE: http://www.charmeck.org/Departments/LUESA/Water+and+Land+Resources/Programs/Water+Quality

Protecting Water Quantity

In the past 100 years the world population tripled, but water use for human purposes multiplied sixfold!

World Water Council, 2000[19]

The loss of source lands impacts not only the quality of our drinking water, but also the quantity. Development increases demand for drinking water while decreasing the ability of land to recharge water supplies.

When water infiltrates soil, the ground itself becomes a temporary storage tank; rather than evaporating into the atmosphere or flowing out to the ocean, water is stored underground for days, weeks, or years, slowly supplying our water sources. Rainfall needs to infiltrate the ground and recharge groundwaters in order to maintain supplies during dry seasons. Where land is developed, water infiltrates less and moves more rapidly and in much greater volume than under natural conditions. The result is a decrease in groundwater flows into streams, less recharge into aquifers, an increase in the magnitude and frequency of severe floods, and high stream velocities that cause severe erosion, damaging water quality, aquatic habitat, and infrastructure.[20] Additionally, removing groundwater at a faster rate than recharge can replace it causes permanent loss of groundwater storage capacity, increased movement of contaminated groundwater into clean groundwater, more saltwater intrusion into coastal basins, and reductions in stream flow.[21]

In addition to decreasing infiltration, sprawling suburban-style development also contributes to water scarcity because it promotes more lawn areas and larger lots planted with turf grass. According to the EPA, an average of 32 percent of residential water use is for outdoor purposes. A study in the Seattle metropolitan area found significant differences in water use among suburban-style housing. Large suburban properties consumed as much as 16 times more water than did homes on a more traditional urban grid with smaller lots. Per capita use of public water is about 50 percent higher in the western United States than in the east, due to the amount of landscape irrigation needed to maintain lawns in more arid regions.[22]

Increased imperviousness, over-appropriated rivers, and excessive groundwater pumping have become serious problems across the United States. Many eastern communities are now facing frequent water shortages similar to those of their western counterparts. For much of the mid-Atlantic region, 2002 was the driest year in over 100 years of record-keeping, as communities up and down the coast declared drought emergencies and implemented water restrictions.

A recent American Rivers report looked at the change in the amount of impervious, or paved, surfaces from 1982 to 1997 in cities around the country. American Rivers sought to estimate the amount of water "lost" to runoff and evaporation as a result of increased development and impervious surfaces. A key finding was that the potential amount of water lost annually ranged from 57 billion to 133 billion gallons in the Atlanta metropolitan area alone. Atlanta's losses in 1997 amounted to enough water to supply the average daily household needs of 1.5 million to 3.6 million people per year.[23]

"In the past, water barely even entered into our calculations," says J.T. Williams, chairman of Killearn, Inc., which has developed thousands of golf courses and clubhouse community homes in the Atlanta metro area in recent years. But now, Mr. Williams admits, "People in the development industry are a little nervous," with water wars brewing in Georgia, Alabama, and Florida.[24]

CASE STUDY
Brick Township, New Jersey

The Brick Municipal Utility Authority (MUA) provides drinking water to more than 100,000 residents in Brick Township and Point Pleasant Beach, drawing 75 percent of its raw water from the Metedeconk River and 25 percent from deep and shallow wells. Throughout the Metedeconk Watershed, seven other communities also draw their drinking water from wells.

The Metedeconk River Watershed, with its headwaters in Turkey Swamp Wildlife Management Area, has benefited from extensive wetlands that cover 30 percent of the watershed, relatively intact riparian forests, gentle topography, and sandy, well-drained soils. As a result,

CHALLENGES FOR SMALL WATER SYSTEMS

The more than 45,000 small community water systems in the country serve fewer than 3,300 people each. Over 30,000 of these systems are very small, serving fewer than 500 people each. Because of less stringent disinfection requirements and the large number of small, rural groundwater supplies, groundwater sources for small communities violate drinking water standards for microbes and chemicals almost twice as often as those serving larger communities—58 percent of outbreaks as opposed to 33 percent[25]—leaving people served by these systems even more vulnerable to outbreaks of waterborne illness.[26]

The vast majority of small water systems use groundwater supplies, which are threatened primarily by bacteria from rural septic effluent. It can be particularly challenging and costly for small water suppliers to upgrade treatment technologies to address contamination threats and to meet increasingly strict drinking water standards.[27] A $100,000 capital investment is considered minor for a system that serves over 300,000 people, yet it may be out of reach for a system serving fewer than 5,000 people. In 2000, almost 40 percent of privately owned community water systems serving fewer than 500 people suffered financial losses, as compared to only 5 percent of those serving over 100,000 people.[28]

According to the Committee on Small Water Supply Systems assembled by the National Research Council, "small water suppliers should seek the cleanest water supply available and protect that resource before investing in new treatment technologies, other than disinfection."[29]

The National Rural Water Association (NRWA) assists small suppliers around the country with planning and implementing source protection strategies in order to protect public health and avoid costly treatment upgrades. According to Jennifer Palmiotto of the Northeast Rural Water Association, a regional office of NRWA,

> small rural water systems are faced with increasingly complex challenges. In order to safeguard public health, water systems must meet the requirements of ever-growing regulations and monitoring demands while struggling to make ends meet. Many of these rural systems are managed by volunteer boards and have one operator, who is also often a volunteer with limited time and limited training. Rates tend to be very low and there is very little will to invest in system upgrades unless there is a crisis, as rural residents assume their raw water is clean. At NeRWA, we try to help small systems address these challenges with on-site technical assistance in operation, maintenance, finance, governance and source protection planning.[30]

CASE STUDY

West Groton Water Supply District, Massachusetts

The West Groton Water Supply District supplies water to approximately 520 households in West Groton, Massachusetts. The sole source of drinking water is a well field located in a shallow, sand-and-gravel-stratified drift aquifer with 47 interconnected wells. The aquifer is only 30 feet deep and is directly under the influence of surface water. It is thus highly susceptible to contamination from inappropriate landuse.

For years the West Groton Water Supply District has been proactive about purchasing and protecting land in its Zone I source protection area (a 250-foot buffer around the well field), and critical parcels in its secondary Zone II source protection area. Because it is a small district with limited resources, it needs to be strategic about when and how to acquire land and finance its long-term protection.

In 1985, the Water Supply District detected trace amounts of Trichloroethylene (TCE) solvents (a petroleum by-product) in its source water. A machine shop in the Zone II protection area was identified as the source. The TCE was no longer detected shortly after the machine shop was closed. Fifteen years later, the landowner decided to sell the 1.5-acre commercially zoned property. In order to avoid potential future contamination from commercial use of the property, the Water Supply District decided to acquire it. The Water Supply District had only $60,000 in reserves to spend, which was not nearly enough to cover the $250,000 asking price and the need for environmental assessments and potential clean-up. In order to protect the property, the Water Supply District needed a creative solution.

Aside from the machine shop, the only other building on the lot was a small house, which was not deemed a source water threat. The Water Supply District wanted to control only the commercial portion of the site but could not buy it separately from the rest of the property. If it bought the entire parcel as a public entity, the Water Supply District would not be able to resell any portion of it to recoup costs.

To solve the dilemma, the Water Supply District created the West Groton Water Supply District Realty Trust to own and manage the land. This allowed it to purchase the property, subdivide it, and resell the house. The house was subsequently placed back on the tax rolls, and most important, the Water Supply District recouped $200,000 of its $260,000 investment. The district continues to control the commercial site, using it for storage, and the creek that runs through the property and is hydrologically linked to their well fields.

During negotiations with the landowner, the Water Supply District completed an environmental assessment of the property and discovered leaking underground oil tanks. The Massachusetts Department of Environmental Protection immediately removed the tanks and began clean-up. By controlling the site, the Water Supply District was able to avoid the future contamination of their well fields and the potentially significant public health threat and clean-up costs.

CONTACT: Gordon Newell
ADDRESS: West Groton Water Supply District, P.O. Box 246, West Groton, MA 01472
PHONE: 978-448-3711
FAX: 978-425-9372

Source water protection is critical for small communities dependent on local groundwater supplies.

© 2001 CLARK JONES

New Jersey's Turkey Swamp Wildlife Management Area, which expanded in 2001 to include the Metedeconk River and Toms River headwaters, safeguards the Barnegat Bay watershed and the region's water supply.

storm water runoff is slower, infiltrates more easily, and is cleansed naturally by large wetland forests. With urban development now covering 35 percent of the watershed, rainwater flows overland and out to the ocean, instead of infiltrating into the ground and recharging the shallow aquifer. In this way it is lost as a potential freshwater source. Although Brick MUA draws most of its water from the Metedeconk River, it is almost completely dependent on the shallow aquifer for its supply, as 60 to 80 percent of the Metedeconk's baseflow comes from groundwater.

After almost four years of drought conditions, water quantity has become a critical issue for local water suppliers and residents alike. In 2002, severe restrictions had to be placed on water use to ensure that water supplies would last into the fall, when authorities could only hope for rain. The restrictions included a mandatory ban on all nonessential outdoor water use, including no watering of lawns and gardens; no washing of cars, buildings, sidewalks, and driveways; and no outdoor use of water for ornamental or aesthetic purposes, including fountains. It also banned serving water in restaurants, unless specifically requested by the patron. Eventually, low rainfall caused salt water intrusion into the Metedeconk River, forcing Brick MUA to shut down its surface water intake and rely solely on groundwater wells, which were also low.

Although the drought led to severe restrictions on water use, it brought a beneficial awareness to watershed residents of the threats to their water supply, creating greater support for watershed protection. The Brick MUA is taking advantage of this increased interest and of the incentives provided by new storm water management regulations, and is expanding its source protection activities. In 2002, Brick MUA hired a Watershed Coordinator to facilitate activities with the seven townships and two counties in the watershed and is looking at ways to build partnerships and provide incentives for watershed protection and growth management. Brick MUA plans to work with other jurisdictions to develop storm water management plans, educate the public, and implement protection and restoration activities. Additionally, in order to better understand their watershed and to guide and support protection strategies, Brick MUA has implemented a Watershed Management Model to estimate runoff and pollutant loads.

Building on Brick MUA's monitoring and modeling program, priority areas for protection and restoration have been mapped throughout the watershed. In 2001, the Trust for Public Land, working in partnership with Freehold Township in Monmouth County and Jackson Township in Ocean County, purchased over 1,794 acres adjacent to Turkey Swamp Wildlife Refuge, expanding the refuge's boundaries and protecting critical wetlands and forests in the headwaters. Brick MUA will continue to work with TPL and others to protect land critical to groundwater recharge, ensuring the quality and quantity of future supplies.

CONTACT: Rob Karl, Source Water Administrator
ADDRESS: Brick Municipal Utility Authority, 1551 Highway 88 West, Brick, NJ 08724
PHONE: 732-458-7000, ext. 271
EMAIL: LGialanella@brickmua.com
WEB SITE: http://www.brickmua.com

Drinking Water and Public Health

Throughout history, the contaminants in source waters have changed, as has our understanding of what is safe and what is not. The introduction of chlorine in the early 20th century, combined with filtration, dramatically reduced waterborne disease in the United States and has made the American water supply one of the safest in the world. But these technological advances have caused people to question the importance of protecting source lands. "The bargain made by some communities of a century ago was to trade source water protection for a future reliance on water treatment. The wisest choice is to marry the two together whenever possible,"[31] according to Dr. Jeffrey Griffiths, Director, Graduate Programs in Public Health, Tufts University School of Medicine.

Some of the treatment challenges faced by suppliers drawing from intensively used source lands include:

1. The emergence of new contaminants that suppliers may not be prepared to test for or treat
2. Spikes in contaminant loads due to storms and flooding that make treatment more challenging
3. Constantly changing standards and regulations regarding new contaminants, which are present in the water long before they are identified as threats to public health

This section takes a close look at these public health challenges. With an understanding of the threats comes an ability to provide clean and plentiful drinking water supplies into the future. Keep in mind that local governments and water suppliers have the most critical responsibility where source protection is concerned. Public and private water suppliers are responsible for providing drinking water that meets Safe Drinking Water Act standards; both can and should take action to ensure the ongoing safety and availability of their source water.

Emerging Contaminants

The threat to public health from emerging contaminants presents the most compelling reason to protect drinking water sources. Emerging contaminants are contaminants that either are new to the environment (new diseases or chemicals) or have only recently been identified as potential health threats.

In the 1980s, Cryptosporidium, a waterborne pathogen, was first identified as a potential threat to human health. By the early 1990s multiple large outbreaks of cryptosporidiosis were traced to infected drinking water sources. Although some suppliers had been required by the EPA to test for Cryptosporidium and some were testing voluntarily, it was not until 2002 that rules were passed requiring all suppliers to test for and treat Cryptosporidium.

Emerging pathogens pose one of the greatest waterborne threats to public health. According to epidemiologists, recently emerging pathogens, such as Cryptosporidium, Giardia, and Hepatitis E,[32] share similar characteristics. They tend to be:[33]

- Resistant to chlorination or disinfection
- Resistant to antibiotics or have no medical treatment
- Spread by animals as well as humans
- Highly infectious—small numbers of microbes can cause illness

That last characteristic means that isolated and chronic waterborne diseases can go undetected or unrecognized, because current methods of detection may not be suitable to detect low levels of microbe infiltration.[34] A nationwide study of waterborne disease outbreaks found that epidemic outbreaks of waterborne disease have been recognized only after thousands of acute cases were reported.[35]

In addition to pathogens, emerging contaminants include chemicals, metals, and pharmaceuticals. According to Daniel Okun, a leading environmental engineer at the University of North Carolina, new knowledge about the health impacts of chemicals has made them a primary concern among epidemiologists studying emerging threats in drinking water.[36]

Industries invent and put on the market new chemical compounds daily, such as pesticides for agriculture, pharmaceuticals, and chemicals for plastics. Because we increasingly live and work in our drinking water watersheds, these manmade chemicals eventually reach our water sources via septic systems, storm sewer overflows, and runoff from lawns and farms.

With the increasing diversity of manmade chemicals reaching our waterways, and with the need for special testing methods to identify and measure them, these emerging contaminants can go undetected.[37] A recent study by the U.S. Geological Survey included a list of potential emerging contaminants that have largely been ignored

Clean water, clean food, and sewerage have led to two-thirds of the increase in life span from 1900 to today. Drinking water degradation is a critical threat to the foundation of our societies.[38]

Dr. Jeffrey Griffiths, MD MPH & TM, Tufts University School of Medicine

"It is difficult to know what new contaminants might be in the watershed that could make it to the treatment facility, and therefore what treatment process will be most effective at safely removing them," explains Chris Crockett, Manager of Philadelphia Water Department's Source Water Protection Program. "From a public health perspective, it is prudent to manage and protect the source area to the degree possible to prevent contaminants from reaching the raw water source in the first place."[39]

by researchers to date, such as nonprescription drugs and plasticizers, and it developed new monitoring techniques to measure these contaminants' prevalence in our waterways. Through nationwide monitoring, researchers found steroids and nonprescription drugs in over 80 percent of the 139 streams tested. The highest concentrations were of detergents, steroids, and plasticizers. This monitoring effort represents significant progress in identifying and measuring emerging contaminants in our waterways, but it points to the fact that our ability to identify and measure contaminants will always be behind their emergence as a threat.[40]

Conventional treatment processes, such as clarification and filtration, remove many known and as yet unknown contaminants, yet they typically do little to remove most pesticides or pharmaceuticals. Not much is known about the toxicity of these substances at low levels and in complex mixtures, making it difficult to predict even potential health effects on humans. Also, we don't know much about how common processes, such as disinfection, alter the structure of many of these chemicals and the types and toxicity of the by-products that may be produced.[41]

CASE STUDY

Carroll County, Georgia

The Upper Little Tallapoosa River Watershed is located in Carroll County, about 50 miles west of Atlanta, Georgia. A series of small reservoirs on the Little Tallapoosa River provide drinking water for 30,000 people. The fertile lands of the Little Tallapoosa River Watershed have enabled Carroll County to become the second leading producer of beef cattle in Georgia, but development, moving west from Atlanta, is quickly encroaching on agricultural lands. No public sewer exists in much of the county, and individual on-site septic systems are proliferating.

The first known major outbreak of Cryptosporidium in the world occurred in the Upper Little Tallapoosa Watershed in the city of Carrollton and Carroll County in January 1987. Immediately following the outbreak, water trucks had to be brought in to serve the residents, and restaurants imported ice and water from Alabama. "There was a period of time when you couldn't get a drink of water from a restaurant in Carrollton," says Curtis Hollabaugh, a longtime resident and university professor at West Georgia College, where the outbreak was first discovered.

In response to the outbreak, U.S. EPA and Georgia EPA inspectors worked with City of Carrollton engineers to evaluate the cause of the outbreak and to upgrade the filtration system to address the problem. The costs to upgrade the system came to almost $280,000—a significant cost for a relatively small supplier. Though many in the city and county were left sickened by water, in the years that followed the outbreak the public maintained a heightened awareness and understanding of watershed activities and water quality.

Although the new treatment processes initiated after the outbreak successfully controlled the threat from Cryptosporidium and other pathogens, in the seventeen years since the outbreak, increasing sediment and organic loads, most likely from cattle in the streams and new development, have made treatment more difficult and expensive. The increased treatment needed to address high organic loads has contributed to an increase in unwanted disinfection by-products (DBPs). In recent years, DBPs have on occasion exceeded water quality standards. Because DBPs are a by-product of the disinfection process, one of the best ways to reduce them is to reduce organic pollutant loads in the raw water, thereby decreasing the degree of disinfection required. Basically, cleaner water requires less treatment and results in fewer treatment by-products.

In 2002, Carroll County applied for and became a demonstration site for the Trust for Public Land and U.S. EPA to study source water protection activities that could result in cleaner water. Led by County Chairman Robert Barr, the Upper Little Tallapoosa Steering Committee has embraced a series of recommendations from the study that focus on better watershed management for safe drinking water. Some of the source protection efforts under way as a result of this study include the development of watershed protection ordinances, a plan for managing wastewater and on-site septic systems, outreach to farmers on best management practices, the acquisition of lands critical to protecting source water, and the establishment of a dedicated local funding source for land protection. In November 2003, voters approved new funding via a local sales tax that will direct about $20 million toward land acquisition for source water protection and public recreation.

CONTACT: Amy Goolsby
ADDRESS: Carroll County Department of Community Development, Carroll County Administration Building, P.O. Box 338, Carrollton, GA 30117
PHONE: 770-830-5800
FAX: 770-830-5992
EMAIL: agoolsby@carrollcountyga.com
WEB SITE: http://www.carrollcountyga.com

Spikes in Pollutant Loads

Spikes in pollutant loads are caused by the accumulation of pollutants in the watershed over time and the transport of those pollutants to waterways during rainfall or snowmelt. These pollutants are eventually flushed into a receiving body of water, such as a lake, reservoir, or large river, via storm water runoff or storm sewer overflows. Because spikes usually occur during heavy rains, and because the pollutants accumulate throughout the watershed and over a period of time, it is very difficult to accurately target sources and to measure the impact of pollution on water quality and public health.

As forests in our watersheds and aquifer recharge areas are replaced by development, more water runs over the surface of the land at greater speeds, quickly carrying heavy loads of pollutants to our water treatment plants. Even though the series of barriers in a modern water supplier's infrastructure should effectively prevent these pollutants from reaching consumers, the failure of even a single stage threatens the entire system. Consequently, spikes in pollutant loads can have serious public health consequences. Various estimates suggest that between 900,000 and two million people become ill each year in the United States by ingesting protozoan, bacterial, and viral pathogens in incompletely treated and untreated drinking water from community water supplies.[42]

In Milwaukee, Wisconsin, in 1993, more than 403,000 people became ill and an estimated 54 people died as a result of an outbreak caused by Cryptosporidium that contaminated the water during a rainstorm, which carried heavy pollutant loads to the treatment plant.[43] In 1990 in Cabool, Missouri, four people died and 243 were stricken ill from drinking water contaminated with hemolytic E. coli from pasturelands. In Walkerton, Ontario, in 2000, seven people died and more than 2,300 became ill when the drinking water system became contaminated during a rainstorm with E. coli and Campylobacter jejuni, which reached the intake from a nearby field recently fertilized with animal waste.[44] In each of these cases, spikes in pollutant loads from heavy surface runoff during rainstorms, combined with improper or insufficient drinking water treatment, were the likely causes of contamination. In some cases, the failure of monitoring systems, both at the treatment plant and by the regulatory agencies, meant the outbreaks were not recognized or addressed quickly enough to protect public health.

Occasional spikes in pollutant loads can be very expensive for water suppliers, who must upgrade their treatment facilities to deal with maximum loads. The city of Decatur, Illinois, for instance, spent $8.5 million on a nitrate removal facility in 2001, which is only used to address spikes in pollutant loads during heavy rainfall or storm events. During years with low rainfall, the facility is scarcely used.

CASE STUDY

City of Lenexa, Kansas

Lenexa is a community of over 40,000 residents located in Johnson County, Kansas, in the southwestern Kansas City metropolitan area. The city's location and accessibility have fueled its growth as a business center and resulted in a significant retail base. Three of the city's five main watersheds drain to tributaries of the Kansas River, less than one mile upstream from the county's main water supply intake. Because 50 percent of Lenexa's storm water runoff drains to the county's water supply intake, there is a need for a progressive approach to storm water management and the protection of natural resources.

Because storm water runoff from the city directly impacts the quality of source water for the entire county, local communities are very interested in managing storm water runoff, flooding, and resulting spikes in pollutant loads. Working with consultants from the Black and Veatch Corporation, the city undertook an extensive community planning process to develop a storm water management plan that reduces the risk of flooding and of spikes in pollutant loads to the water supply intake, while providing ancillary community amenities, such as parks and greenways. The watershed-based approach to storm water management that was developed through this planning process incorporated strategies to minimize flooding and deal with storm water runoff by creating a system of in-stream wetland treatments and a chain of lakes and wetlands to provide flood retention and improved water quality. The system of lakes and wetlands includes wetland and riparian filters as well as the implementation of upstream best management practices, such as infiltration basins, aggressive erosion and sediment control practices, stream restoration and conservation, and regional storm water detention. This project has been part of a larger effort to inventory and protect stream corridors with high habitat quality in the developing western portion of the city of Lenexa.

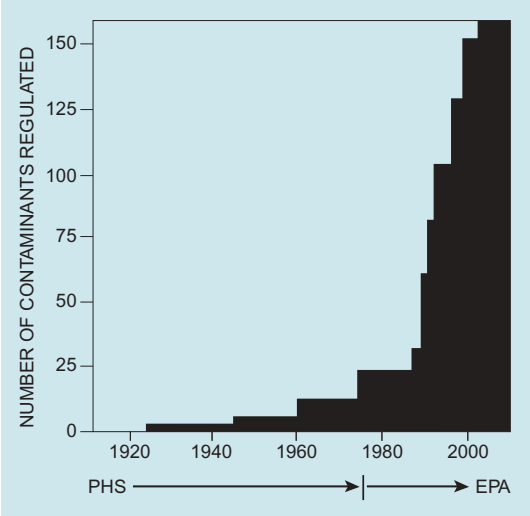
Lenexa is leveraging opportunities created

"There are a large number of chemical compounds that are used extensively in our day-to-day lives and our use of the land and, therefore, occur frequently in the aquatic environment. Because many of them are unregulated in drinking water, their occurrence and concentration in the environment raises water-quality and human-health concerns," explains Carol Storms, Manager of Water Quality, with American Water. "At American Water we understand that regulation of a contaminant is always somewhat behind its occurrence in the raw water, so we monitor extensively to identify potential contaminants of concern and to ensure that our treatment process is adequately removing them."[45]

by the storm water management plan to provide recreational amenities for residents. With the motto "Rain to Recreation," dry-bottom detention basins will be constructed to double as sports fields, and new lakes and protected riparian corridors will be connected to residential and commercial areas via a new greenway trail system.

Implementation of conservation and restoration activities began in the fall of 2000. The city is combining these activities with a mix of incentives and regulations to encourage a more conservation-oriented approach to development. With the U.S. EPA's storm water management rules in effect since the fall of 2003, the city of Lenexa has already met many of the requirements and serves as a model for other communities looking for innovative ways to meet federal storm water management requirements.

CONTACT: Jim Finlen, Lenexa, Kansas
ADDRESS: Parks and Recreation Department, 134 20 Oak Street, Lenexa, KS 66215
PHONE: 913-541-8592
FAX: 913-492-8118
EMAIL: jfinlen@ci.lenexa.ks.us
WEB SITE: http://www.ci.lenexa.ks.us



Number of drinking water contaminants regulated by the U.S. government. The large increase in regulated contaminants that begins after 1976 is due to regulations issued under the Safe Drinking Water Act and its subsequent amendments. Adapted, with permission, from Okun (1996). © 1996, the American Society of Civil Engineers.

Changing Standards

Since the passage of the Safe Drinking Water Act, the EPA has continued to identify compounds that hold the potential to cause cancer and other adverse health effects, and it has set maximum contaminant levels in drinking water for each substance. The establishment of such standards has had a dramatic impact on the quality of drinking water in this country. However, "as any analytical chemist knows, what you see depends on what you look for," says Lynn Roberts, a professor of environmental chemistry at Johns Hopkins University.[46] What you see also depends on the resources and time available to researchers. The inherent challenges of establishing and adapting contaminant standards are as follows:

- The seemingly endless number of known, and as yet unknown, contaminants that need to be identified and studied
- Limited resources available for such research
- The difficulty of drawing clear conclusions about cancer-causing agents, as the onset of cancer may require decades-long exposure and extensive and complex epidemiological research
- The difficulty of assessing health effects from simultaneous exposure to multiple contaminants

It is particularly challenging to set containment standards, as new chemical compounds are constantly reaching our water sources, and their public health risks may not be understood. Until recently, long-term exposure has been the primary concern with chemical compounds and disinfection by-products (DBPs); measuring the impact of average doses over many years has been considered adequate. Current research, however, is showing potential impacts on reproductive systems (endocrine disruptors) that can result from

exposure to chemical compounds and DBPs over periods as short as three months.[47]

Drinking water standards and treatment guidelines have been established for numerous chemicals. However, many chemical compounds do not have standards, and current standards do not yet account for exposure to complex mixtures for long periods at low concentrations, or for seasonal spikes in concentrations.[48]

The Costs of Not Protecting Source Waters

Treatment and filtration, land conservation, new development, and infrastructure—each has a price tag that impacts decisions about drinking water protection. For municipalities and water suppliers, budget constraints and the bottom line factor in throughout the process. What's important is making informed assessments about the costs, both long- and short-term, of source protection in relation to other approaches.

Landuse and protection decisions are often based on short-term (one to five years) revenue and expense projections for local governments, as elected officials decide how to balance land protection policies based on current budgets. However, the impacts of development on water quality and treatment costs are realized over the long term—five to ten years and longer—and are often ignored in landuse planning processes. The short-term costs for protection of source lands can be high, and water suppliers, who understand the long-term cost and public health impacts of watershed development, are not usually involved in landuse or land protection decisions.

It is difficult to establish the impact of landuse alone on water quality. By the time water quality degradation has become apparent and treatment methods need to be upgraded, it is often too late for municipalities and suppliers to choose source water protection as a means for addressing the problem. "For many cities, time is running out," said David Cassells, a World Bank forest specialist. "Protecting forests around water catchment areas is no longer a luxury but a necessity. When they are gone, the costs of providing clean and safe drinking water to urban areas will increase dramatically."[49]

Many communities that have experienced the increased treatment and capital costs of degraded water and the quality-of-life impacts of fast growth are now implementing regulatory and nonregulatory strategies to protect land and encourage more sustainable development patterns. These communities are learning that while land conservation is a big investment, it may also be a bargain compared to the long-term costs of treatment and contamination. This section summarizes the potential costs of not protecting a community's source lands.

Increased Treatment Costs

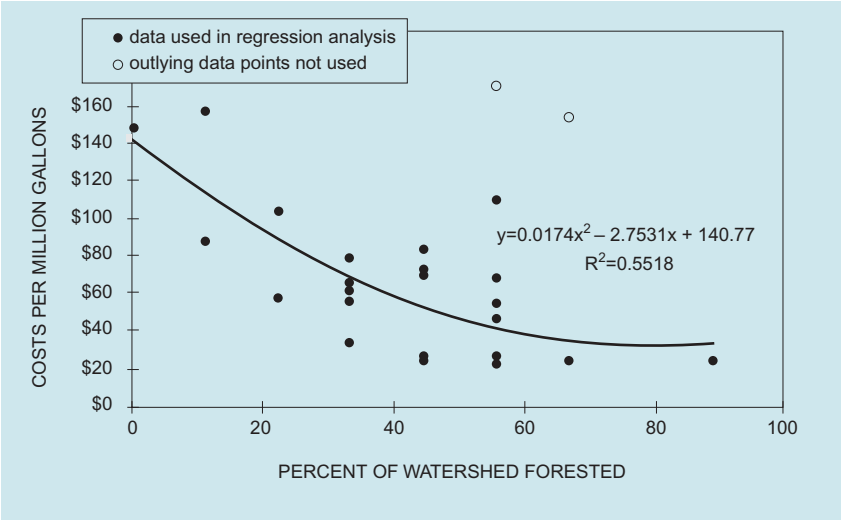
The development of watershed and aquifer recharge lands results in increased contamination of drinking water. With increased contamination come increased treatment costs. The costs can be prevented with a greater emphasis on source protection.

A study of 27 water suppliers conducted by the Trust for Public Land and the American Water Works Association in 2002 found that the more forest cover in a watershed, the lower the treatment costs. According to the study:

- Approximately 50 to 55 percent of the variation in treatment costs can be explained by the percent of forest cover in the source area.[50]
- For every 10 percent increase in forest cover in the source area, treatment and chemical costs *decreased* approximately 20 percent, up to about 60 percent forest cover.

The study did not gather enough data on suppliers with over 65 percent forest cover to draw conclusions; however, it is suspected that treatment costs level off when forest cover is between 70 and 100 percent. The 50 percent variation in

"When rapid development in Mecklenburg County began to impact the Mountain Island Lake Watershed, which provides drinking water to 600,000 county residents, it was a wake-up call to the community that we needed to act now to protect our drinking water," says Ruth Samuelson, Mecklenburg County Commissioner. "In addition to the cost of treatment for a degraded water supply, the loss of our forests and natural landscapes threatened the quality of life in our community. Today, Mecklenburg County owns over 4,000 acres, an eighth of the total of Mountain Island Lake Watershed."[51]



WATERSHED FORESTED	TREATMENT AND CHEMICAL COSTS PER MG	CHANGE IN COSTS	AVERAGE TREATMENT COSTS PER DAY	PER YEAR
10%	$115	19%	$2,530	$923,450
20%	$93	20%	$2,046	$746,790
30%	$73	21%	$1,606	$586,190
40%	$58	21%	$1,276	$465,740
50%	$46	21%	$1,012	$369,380
60%	$37	19%	$814	$297,110

treatment costs that cannot be explained by the percent forest cover in the watershed is likely explained by varying treatment practices, the size of the facility (larger facilities realize economies of scale), the location and intensity of development and row crops in the watershed, and agricultural, urban, and forestry management practices.[52]

The table above shows the change in treatment costs predicted by this analysis, and the average daily and yearly cost of treatment if a supplier treats 22 million gallons per day—the average production of the surveyed suppliers.[53] (The percentage change in costs starts at zero percent forest cover: from zero percent forest cover to 10 percent forest cover, treatment costs decrease 19 percent.)

A similar study was conducted in 1997 by the Department of Agricultural Economics at Texas A&M University.[55] From a sample of 12 geographically representative suppliers with three years of data, researchers found that:

- Suppliers in source areas with chemical contaminants paid $25 more per million gallons to treat their water than suppliers in source areas where no chemical contaminants were detected.
- For every 4 percent increase in raw water turbidity, treatment costs increase 1 percent. Increased turbidity, which indicates the presence of sediment, algae, and other microorganisms in the water, is a direct result of increased development, poor forestry practices, mining, or intensive farming in the watershed.

Some utilities understand that protected lands mean protected water quality and are working to prevent future increases in treatment costs through targeted land conservation. Kirk Nixon at San Antonio Water System is developing ways to measure the water quality, quantity, and financial benefits of their successful effort to protect approximately 15,888 acres of aquifer recharge land over the past five years, the total acreage from both the San Antonio Water System Sensitive Land Acquisition Program and the City of San Antonio Proposition 3 Initiative.

According to Nixon, "The benefits of these types of programs are quite difficult to quantify. It is a difficult task to compare actual land development and the associated storm water treatment required versus conserving land in a natural, undeveloped state. These are the very issues that we at the San Antonio Water System, in cooperation with other entities, are striving to resolve. Through a cooperative agreement with USGS, we are conducting pollutant loading studies, recharge and runoff estimation models, and hydrogeologic and vulnerability mapping projects. In the first phase of our study, we're establishing gauging and sampling stations on small, specific landuse watersheds, collecting the data, and characterizing the impacts from various landuses on the Edward's Aquifer Recharge Zone. In the second phase, we will calibrate a watershed model to predict runoff, constituent loads, and recharge on the Bexar County portion of the recharge zone."[54]

Increased Capital Investment in New Treatment Technologies

The impact of development and loss of forestland on water quality happens over time and is usually greatest during periods of heavy rainfall. At first, heavy pollutant loads are isolated events during storms. Gradually, larger and more complex pollutant loads appear with greater frequency and severity until an acute event or revised water quality regulations cause suppliers to alter treatment strategies or upgrade facilities.

Upgrading treatment systems can be extremely expensive. Between 1996 and 1998 the City of Wilmington, North Carolina, spent $36 million to add ozonation and to expand its treatment facility, in part as a result of an increase in industrial and agricultural runoff in their watershed. In 2000, Danville, Illinois, invested $5 million in a nitrate removal facility to deal with spikes in nitrogen resulting from agricultural runoff. In 2001, Decatur, Illinois, invested $8.5 million in a nitrate removal facility, also to deal with agricultural runoff.

New water quality regulations are often the final impetus for treatment upgrades. However, suppliers with protected source waters are less likely to be forced to invest in major upgrades because their pollution concentrations are more likely to remain below maximum allowed levels. In fact, EPA's proposed Long Term 2 Enhanced Surface Water Treatment Rule embodies the principle that higher quality waters require less treatment. This rule establishes additional treatment requirements for water treatment plants that draw from sources with elevated levels of Cryptosporidium.[56]

Loss of Consumer Confidence—A High Price to Pay

When water quality causes illness or even just an unusual taste, odor, or color, the public quickly loses confidence in the safety of its supply. An erosion of public trust costs both the supplier and the community, often leading to broader economic impacts in addition to treatment and capital costs. Residents begin buying bottled water and household filtration systems, and local businesses that rely on clean water install their own filtration systems. In some cases, businesses and individuals may choose not to live or work in a community because they perceive it has poor water quality.

The impacts of contamination and waterborne disease outbreaks should not just be measured economically. They should also be measured in human terms. In an inquiry into an E. coli outbreak in Walkerton, Ontario, in 2000, the investigator wrote that the most important consequences of the outbreak were in the "suffering endured by those who were infected; the anxiety of their families, friends, and neighbors; the losses experienced by those whose loved ones died; and the uncertainty and worry about why this happened and what the future would bring."[57]

CASE STUDY

New York, New York

New York City supplies the nation's largest metropolitan area with surface water from 19 reservoirs and three controlled lakes. It serves nine million users and delivers approximately 1.3 billion gallons per day from a 2,000-square-mile watershed in parts of eight upstate counties. Protecting the purity of this source water became an even higher priority for the city with the Safe Drinking Water Act (SDWA) amendments in the late 1980s that directed the EPA to develop criteria for filtration. The vast bulk of the city's drinking water (approximately 90 percent) comes from two systems known as the Catskill and Delaware water supplies. After allowing the city to operate supplies for a brief period of time without filtration, the EPA put the city on notice: develop and implement a comprehensive program to protect the Catskill and Delaware Watersheds, or filter the water. At the time, the city owned less than 8 percent of its watersheds. Faced with the prospect of spending $6 to 8 billion on a new Catskill/Delaware filtration plant and $300 million in annual operating expenses, the city chose to take on an aggressive watershed management plan with land acquisition as its centerpiece. A new filtration plant would have resulted in the likely doubling of water rates.

In January 1997, the City of New York, through its Department of Environmental Protection (NYC-DEP), entered into a groundbreaking Watershed Memorandum of Agreement with some 76 signatories, including the EPA, the State of New York, virtually all of the counties, towns, and villages in its watersheds, and a number of environmental and public interest organizations, including TPL. This agreement established a far-reaching program to protect all three of the city's watersheds—Catskill, Delaware, and Croton—including adoption of new watershed regulations, environmental and economic partnerships with watershed communities, and a watershed land acquisition program. All together, the city projects spending approximately $1.2 billion over the first 10 years on a variety of watershed improvements. The agreement, which by protecting the watershed allows New York to avoid filtration for its Catskill and Delaware plants, includes direct city investment in upstate water pollution controls. Acknowledging that upstate users are the stewards of city water, the city realized that providing financial and technical resources to enable that stewardship was in the city's best interest. For example, the city is spending approximately $270 million to bring all 114 existing wastewater treatment plants in the watershed up to tertiary treatment standards.

The city expects to purchase land in fee or to purchase conservation easements on land for watershed protection. With 355,000 acres under consideration, NYC-DEP had to establish prioritization criteria to determine which tracts are most essential for maintaining pollution-free source water. Through GIS modeling, planners identified the land with the most potential impact on water quality as acquisition priorities. Five priority areas were established for the Catskill and Delaware Watersheds and three for the Croton Watershed. In the Catskill and Delaware Watersheds, each priority area has certain natural features criteria, including minimum parcel size, that define land that is eligible for purchase. The city agreed to solicit percentages of eligible land in each Catskill/Delaware priority area, ranging from 95 percent in the highest priority to 50 percent in the lowest.

Funding for these programs is expected to come from utility user fees, bonding, and state and federal funding sources, including SDWA funding, U.S. Army Corps funding, and USDA

Auburn, Maine, saved $30 million in capital costs, and an additional $750,000 in annual operating costs, by spending $570,000 to acquire land in their watershed. By protecting 434 acres of land around Lake Auburn, the water systems are able to maintain water quality standards and avoid building a new filtration plant. Funding for the land acquisition came from a Drinking Water State Revolving Fund Loan to the Auburn Water Department.

The town of Maynard, Massachusetts, a rapidly developing community in the Boston metropolitan area, experienced a dramatic increase in the levels of iron and manganese in their groundwater as a result of increased urban runoff. The water had become discolored, leading to a surge in complaints from customers concerned about the safety of the water. Although discoloration from iron and manganese is not a threat to public health, expensive treatment is required to remove it. As a result of public concern, the town voted to approve a new $4.6 million treatment facility.[58]

© KEN SHERMAN

By protecting the watersheds supplying its nine million residents with drinking water, New York City expects to both improve water quality and save money that would have gone toward construction and operation of a new filtration plant.

funding—and is expected to be far less than the cost of construction and operation for a filtration plant. More importantly, the watershed protection activities are beginning to show success in addressing water quality challenges. The phosphorus loads from wastewater treatment plants in the watershed between 1994 and 1999 dropped by 65.7 percent. Of this reduction, about 77 percent appears to be due to treatment performance that has been aggressively addressed by Department of Environmental Protection staff. Treatment plant upgrades and storm water management plans, including watershed buffers and wetlands protection, are expected to lead to even better results in the future. As a result of these improvements, EPA agreed in November 2002 to extend filtration avoidance for another five years.

CONTACT: Mark Hoffer, General Counsel
ADDRESS: New York City Department of Environmental Protection, Bureau of Legal Affairs, 59-17 Junction Boulevard, 19th Floor, Corona, NY 11368
PHONE: 718-595-6528
FAX: 718-595-6543
EMAIL: mhoffer@dep.nyc.gov

CASE STUDY

Salem, Oregon

The City of Salem's water system currently supplies drinking water to approximately 170,000 people. The city relies almost entirely on the North Santiam River for its water supply source. Salem's watershed covers more than 490,000 acres of land stretching from the Cascade Mountain peaks of Mount Jefferson and Three-Fingered Jack to the city's water intake above Stayton. Approximately 80 percent of the land in the watershed is owned and managed by the United States Forest Service, the Bureau of Land Management, and the Oregon Department of Forestry, which harvest timber on much of the land. A few small but growing communities with a combined population of about 2,700 are located along the river.

After unusual flooding on the North Santiam River in Oregon in February 1996, the City of Salem was forced to take drastic steps to provide potable water to its customers. Salem's water treatment system relies on slow sand filtration, which is a very efficient and effective way to treat the normally clear waters of the North Santiam River. However, high turbidity causes the filter system to plug quickly. The water intake from the river is normally shut down when turbidity exceeds 8 nephelometric turbidity units (ntu). During and after the February flood, the river reached 140 ntu twice and did not fall below 8 ntu until two months after the flood. Due to the severe limitations on providing adequate water supplies in the aftermath of the flood, the city was forced to declare a water emergency. The resulting cost for the city to keep water supplied to customers was more than $200,000. Due to the impacts from the 1996 flood, the city built a permanent Chemical Pretreatment System that cost approximately $1 million. For a city that spends less than $27 per million gallons for treatment, an unexpected $1 million investment is significant.

The U.S. General Accounting Office (GAO) report *Oregon Watersheds: Many Activities Contribute to Increased Turbidity During Large Storms* (July 1998, GAO/RCED-98-220) found that, although the watershed seems well protected, timber harvesting and related road construction practices contributed to heavy soil erosion during the 1996 storm. Also contributing to flooding and significant erosion on the 20 percent of land not in public ownership were agricultural, urban, and residential development, including a highway that parallels the city's sole source of drinking water.

Since the 1996 flood, the city has worked

closely with local, state, and federal agencies to implement better watershed management practices to protect its drinking water and avoid future episodes of contamination. The city signed a Memorandum of Understanding with all federal agencies in the watershed that outlines watershed protection goals and created an online water quality monitoring program that is cost-shared with the U.S. Geological Survey (http://oregon.usgs.gov/santiam/). The city also participates in initial site assessments for all timber sales with the Bureau of Land Management (BLM), the U.S. Forest Service (USFS), and the Oregon Department of Forestry (ODF). The results of water quality monitoring to measure the impact of watershed protection efforts can be viewed in the first report by the U.S. Geological Survey on this effort at http://oregon.usgs.gov/pubs_dir/WRIR03-4098/. Although improving water quality and maintaining treatment costs are the city's long-term goals, the city considers its positive relationships with the USFS, BLM, and ODF to be an immediate benefit of cooperative actions.

CONTACT: Libby Barg, Water Quality and Treatment Supervisor, City of Salem Public Works
ADDRESS: 1410 20th Street SE, Salem, OR 97302
PHONE: 503-361-2224
FAX: 503-588-6480
EMAIL: lbarg@open.org
WEB SITE: http://cityofsalem.net/~swater

Watershed Management: The First Barrier in a Multiple-Barrier Approach

Watershed management is the first and most fundamental step in a multiple-barrier approach to protecting drinking water. Healthy, functioning watersheds naturally filter pollutants and moderate water quantity by slowing surface runoff and increasing the infiltration of water into the soil. The result is less flooding and soil erosion, cleaner water downstream, and greater groundwater reserves.

Watershed management is a multifaceted discipline that involves conservation and restoration, landuse monitoring, proactive landuse regulations, on-site field inspections, education, planning, emergency spill response, and incentives. Although all of these components are essential to improving water resources, only the protection of land prevents contamination by nonpoint source pollutants and costly clean-up of drinking water.

Land can and should be protected with both regulatory and voluntary tools. Yet in the past, many communities have relied too heavily on regulatory landuse strategies; although these are critical to any land management plan, as a singular approach they can place excessive burdens on landowners in the source area. In addition, they may be difficult or even impossible to implement for communities that do not have the authority to regulate landuses within the source area they need to protect.

Voluntary tools include land conservation, best management practices (BMPs), and public education. BMPs can be effective over time by changing the behaviors and practices of those in the watershed, but they may be insufficient on their own to protect water resources. Such voluntary compliance strategies are usually most effective when combined with other approaches, such as landuse regulation or land conservation. Voluntary land protection strategies provide permanent protection for critical natural resources. Land and development rights are acquired from willing sellers in a process that is fair to both sellers and buyers. Specific tools include the acquisition of land or conservation easements and several leasing arrangements.

Given the array of protection tools, where does land conservation work best? Protection of natural lands will benefit any ground and surface water sources, but conservation is particularly effective in defined circumstances.

- *Size.* The smaller the drainage area, the easier it is to accomplish measurable water quality objectives. Water suppliers who choose land conservation as a primary strategy usually have drainage basins or aquifer recharge areas of 300,000 acres or less.[59]
- *Existing or potential landuses.* Land conservation strategies are more politically salient in communities where tracts of unprotected forest or grasslands are still privately owned, or where water quality has declined measurably as a result of landuse, such as new development.
- *Overlapping benefits.* Communities that have other land protection goals, such as growth management or flood control, in addition to water quality, are more likely to support funding for land conservation.

New knowledge about watershed hydrology and the flow of pollutants through the watershed is allowing communities to make smarter invest-

The American Academy of Microbiology, in their 1996 study on water safety, argued that one of the best tools for reducing the transmission of waterborne diseases is the establishment of watershed protection programs.[60]

Serving Chapel Hill and Carrboro, North Carolina, Orange Water and Sewer Authority (OWASA) uses their land acquisition program to purchase the most sensitive land in their watershed to protect their drinking water source through negotiations with interested landowners. By paying landowners for the value of their property, OWASA "actually puts money back into the pockets of watershed landowners who more typically perceive themselves as 'victims' of source water zoning and development restrictions. This has been a successful response to the challenging issue of equity," notes Ed Holland, planning director. "Source water protection has traditionally enjoyed a high level of support by the environmentally conscious community we serve. Our Five-Year Capital Improvements Budget typically includes over $2 million for watershed land and easement acquisition."[61]

ments in land conservation that have the greatest benefit for drinking water resources. Land conservation can be used to protect both surface water and groundwater resources.

Surface Water Protection

Traditional land protection strategies have focused on protecting riparian areas along large rivers or reservoir shorelines, often ignoring the smaller feeder streams. We now understand that the greatest volume of runoff water, and therefore the greatest volume of pollutants, enters most watersheds from small streams.

Within any particular watershed, small streams constitute up to 85 percent of the total stream length and collect most of the surface runoff and pollutants from the land.[62] Because small headwater and tributary streams comprise most of the drainage network in watersheds, they strongly influence the quantity, timing, and quality of streamflow. However, due to their size, small streams are rarely mapped by many local governments and are often ignored during planning processes.

Recent scientific studies show that protecting small streams and their riparian zones can have a greater impact on maintaining water quality and quantity than protection of larger tributaries.[63] Watershed managers are beginning to target the protection of small streams and their riparian zones.

Groundwater Protection

In the past, most groundwater protection efforts have focused on wellhead protection—protecting the area immediately surrounding the wellhead, where contaminants can reach the treatment plant quickly and with little time for detection. Although wellhead protection is important, pathogens and soluble pollutants, such as nitrate, can travel long distances in groundwater (in some cases very rapidly) and may even reach deep aquifers.[64] Once water flows underground and settles in an aquifer, it may remain there for hundreds to thousands of years. If pollutants reach an aquifer, particularly a deep aquifer, contamination may be essentially permanent.[65] Protecting deep or confined aquifers from contamination requires protecting land in the aquifer recharge zone. Protecting the wellhead may not be sufficient to protect the aquifer from contamination.

Shallow groundwater sources and unconfined aquifers under the influence of surface water are very susceptible to contamination from nonpoint source pollutants. Since water and pollutants travel easily between surface waterways and shallow aquifers, pollutants originating in the headwaters of a watershed can make their way to wells farther downstream. Therefore, shallow groundwater sources and unconfined aquifers need to be protected in a similar manner to that of surface water sources, through the protection of forests, wetlands, small streams, and high-yield recharge areas.

CASE STUDY

Orange Water and Sewer Authority, Carrboro, North Carolina

The University Lake Watershed is an important drinking water source for residents of Carrboro, Chapel Hill, and the University of North Carolina at Chapel Hill. These communities, as well as 90 percent of the watershed, are located within Orange County, which has experienced significant growth during recent decades. By the late 1980s it was clear that, unless more carefully managed, continued growth could have a serious effect on the safety and availability of water in University Lake.

In response to this growing threat, Orange Water and Sewer Authority (OWASA) initiated a planning process with the four governmental units that had planning and zoning jurisdiction within the watershed (Orange County, Chatham County, and the Towns of Carrboro and Chapel Hill). The goal was to develop a joint source water protection agreement that incorporated a variety of voluntary and regulatory landuse tools.

A committee of elected officials from each jurisdiction negotiated a protection plan that met the interests and needs both of the residents in the watershed and the consumers of the drinking water. After two years of negotiation, water quality modeling, and extensive public outreach, the committee developed an agreement that was politically viable and technically justified in all of the affected communities. This agreement creatively used a variety of regulatory tools, including minimum lot sizes, limits on impervious surfaces, the prohibition of public sewer extensions into the watershed, and the potential for the transfer of development rights between zones in the watershed.

During the negotiation process, it became

clear that regulatory strategies alone would not be viewed as equitable by all communities in the watershed. Rural watershed residents were perceived to be bearing the brunt of the protection measures through down-zoning of their properties, without receiving any of the benefits, as they did not drink the water from the lake and, under the protection plan, could not receive sewer services.

In response, a land acquisition fund was created to redirect some of the resources from the communities that would benefit from the cleaner water—primarily Carrboro and Chapel Hill—to the rural communities in the watershed. Rural landowners could choose to sell their properties at fair market value or sell the development rights, rather than lose value to down-zoning. OWASA created a line item in their Capital Improvements Budget that authorized spending a percentage of revenue each year to purchase sensitive lands. Since its inception in 1991, the fund has spent $4 million on acquisitions and easements and leveraged that investment to attract an additional $1.7 million in grant funds from the North Carolina Clean Water Management Trust Fund.

CONTACT: Ed Holland, Planning Director
ADDRESS: Orange Water and Sewer Authority, P.O. Box 366, Carrboro, NC 27510-0366
PHONE: 919-537-4215
FAX: 919-968-4464
EMAIL: eholland@owasa.org
WEB SITE: http://www.owasa.org

CASE STUDY

San Antonio, Texas

The San Antonio Water System (SAWS) serves approximately 1.1 million customers via 92 wells that draw from Edwards Aquifer. In 1975, it was the first aquifer in the United States to receive a sole source designation by the EPA.

In a May 2000 bond measure, San Antonio voters approved a one-eighth cent sales tax increase for land acquisition to protect the Edwards Aquifer and to create greenways along sensitive creeks within the city. This measure raised approximately $65 million over the next four years. Of the four bond measures on the ballot in 2000, including measures to increase tourism and attract new businesses, the water quality measure was the only one approved by San Antonio voters.

Years of public education efforts by the San Antonio Water System had laid the groundwork for the measure by educating residents on water supply issues within their community. But the impetus and popular support necessary to pass the bond measure came from grassroots efforts to mobilize voters and educate the public about the threat to their water supply brought by rapid development within the aquifer's recharge zone.

SAWS initiated its sensitive Land Acquisition Program (LAP) in 1997 specifically to protect and preserve the quality and quantity of water in the aquifer recharge zone. The program protects lands that are predisposed to geologic sensitivity and possible contamination, such as point recharge features (caves, solution cavities, and sink holes). Criteria used to determine eligibility for acquisition include maximum thickness of Edwards limestone on the property; presence of streams or rivers; presence of faulting; presence of major features; and availability and affordability of the property.

Funding for the LAP is allocated through a portion of the Water Supply Fee. Since 2000, SAWS and its partners have preserved over 10,000 acres of land, at a cost of over $5.6 million. The cost to SAWS was just $1.8 million, as it effectively leveraged its funding with funding from the city, state, and private funding sources.

The Trust for Public Land, The Nature Conservancy, Texas Parks and Wildlife, and the Bexar Land Trust are working as a team with SAWS to protect and manage these lands. Texas Parks and Wildlife took title to one of the first major acquisitions, Government Canyon, creating Government Canyon State Natural Area. Land for this first acquisition came from more than a dozen public agencies and private groups. The Trust for Public Land, The Nature Conservancy, and the Bexar Land Trust work cooperatively with landowners to negotiate and contract for many of the fee and easement acquisitions and, in some cases, to help with ecological inventories and land management strategies.

CONTACT: Kirk Nixon, Manager
ADDRESS: San Antonio Water System, 1001 East Market Street, San Antonio, TX 78298
PHONE: 210-704-7305
EMAIL: knixon@saws.org
WEB SITE: http://www.saws.org

"Our watershed is on the central coast of New Jersey, where the soils are sandy and water can travel underground about 150 feet per day," notes Steve Specht with the Brick Municipal Utility Authority. "We draw our drinking water from both surface and groundwater sources, but with 70 percent of the river water coming from the ground, we know our surface and groundwater resources are one and the same. We're actively working with the state, counties, and surrounding communities to protect the wetlands in our headwaters. We believe this is one of the main reasons our water quality is still good, despite increased development upstream."[66]

PART TWO

BEST PRACTICES

With the national rate of land development increasing twice as fast as population, communities need to be proactive about protecting natural resources, particularly their source of drinking water. Although investments in maintaining and upgrading treatment systems will always be critical to protecting public health, these remedial approaches need to be balanced with investments in source protection. Communities that invest in land protection as a way to protect their drinking water are investing in the long-term health and quality of life of their citizens—guiding growth away from sensitive water resources, providing new park and recreational opportunities, protecting farmland and natural habitat, and preserving historic landscapes.

The emphasis on source protection has changed over time and continues to evolve. The congressional mandate for state Source Water Assessment Plans (SWAPs) in the 1996 amendments to the Safe Drinking Water Act provided a critical national focus on watershed health as a component of preserving safe drinking water. SWAPs are a comprehensive initiative designed to inform communities about the location of their drinking water resources and about threats to their water's quality and quantity in order to encourage and assist local protection activities, including land conservation. The call for SWAPs acknowledged the increasing challenges and costs facing public water systems, and the value of promoting source protection as part of a multiple-barrier approach.

Though not mandated, public water suppliers and local communities are now expected to develop management measures to protect their drinking water sources. Armed with data from their SWAP process, many communities are now focusing on watershed management issues, including landuse planning, public education and outreach, land management, and conservation. Yet the tools, best practices, funding, and partnership for implementation are currently limited. Networks for sharing information are only just developing via efforts by the Environmental Protection Agency, American Water Works Association, National Rural Water Association, Association of State Drinking Water Administrators, and others.

The series of best practices and case studies outlined here are designed to fill this gap, offering suppliers and municipalities a set of guidelines and funding strategies for using land conservation as part of a comprehensive approach to source water protection. The following five best practices provide a framework for developing and implementing a source protection plan. They can guide city planners, government officials, and water suppliers through a process that begins with developing a comprehensive understanding of landuse threats to drinking water and leads to funding actual land protection strategies.

The best practices we explain here are:

1. Understand your watershed
2. Use maps and models to prioritize protection
3. Build strong partnerships and work watershed-wide
4. Create a comprehensive source protection plan
5. Develop and implement a "funding quilt"

The Trust for Public Land has also produced a companion report, *Source Protection Handbook: Using Land Conservation to Protect Drinking Water Supplies*, which provides detailed guidance on how to implement each of the best practices presented. Copies of the handbook can be ordered from TPL's Web site, *www.tpl.org*.

Best Practice: Understand your watershed

An understanding of your watershed and aquifer recharge areas is the foundation upon which an effective source protection plan is built. Such an understanding involves the collection and analysis of scientific data about source lands, landown-

© DUDLEY WITNEY

The rapidly growing population in the vicinity of Florida's Indian River Lagoon, an estuary stretching more than 150 miles down the East Coast, is expected to reach nearly one million by 2010. Efforts to protect the area's water quality through land acquisitions have been underway since the 1970s.

ership, growth and development patterns, and the health of watershed lands. Scientific data and watershed analyses are essential to define an effective source protection plan and build public support for its implementation. That's because zoning and other public policy changes need to be both technically and legally justifiable, and they require political support from elected officials; land conservation strategies, although voluntary, require public support and usually the commitment of public funds.

In many watersheds and aquifer recharge areas, water quality data is being, or has been, collected by more than one organization, and watershed analyses have been conducted at the local, state, or federal level. Often, these varied sources of information have not been brought together into one source water assessment. The first step in understanding your watershed is to compile existing information in order to understand the current and likely future threats to your drinking water.

Comprehensive water quality monitoring is another key to understanding watershed health and tracking the impacts of changing landuse on water quality. Monitoring is a technical process that can help you understand the fundamental health of your watershed, where landuse is impacting water quality, and where conservation, restoration, or best practices are effectively mitigating those impacts.[67]

A comprehensive monitoring program should include (1) sampling on all major tributaries throughout the watershed, (2) sampling at targeted sites to test the impacts of specific landuse activities, (3) physical, chemical, and biological sampling methods, and (4) monitoring during both wet and dry weather.[68] A monitoring program should be implemented consistently across all jurisdictions in the watershed in order to establish a baseline of past and current watershed health and to document the impact on water quality from changes in landuse or management.

In most watersheds, multiple organizations have collected data at different times. This data can be consolidated and analyzed as a single resource. An analysis of existing data that is physically and conceptually accessible to the public, elected officials, and other stakeholders will help create a shared understanding of current and future threats to water resources and can lead to a shared commitment to action.

"If you don't understand the baseline and normal water quality range in your source area, you have no way to identify where landuse is impacting water quality and where restoration or best practices are effectively mitigating those impacts," says Chris Crockett with the Philadelphia Water Department. "In every other industry, the raw materials are so important they are tested repeatedly to ensure the quality of the final product. Water treatment needs to be approached similarly by creating comprehensive monitoring programs that effectively track the quality of water throughout the source area."[69]

Although there will always be a need for ad-

ditional data, improved analysis, and better data collection methods, waiting until every outstanding question is answered can stall valuable implementation strategies to address known threats. "We found that although it is important to continuously improve our understanding of the watershed and the threats to our drinking water, it is equally important to begin acting on the information we have," explains Carol Storms, Manager of Water Quality with New Jersey American Water.[70]

CASE STUDY

Philadelphia Water Department, Pennsylvania

The Philadelphia Water Department (PWD), which provides drinking water to 1.5 million people, draws its water from three drinking water intakes in the Delaware River Watershed, which drains from 13,000 square miles of land stretching from Pennsylvania and New Jersey all the way to New York state. This extremely complex watershed incorporates dozens of urban areas throughout the mid-Atlantic, such as Philadelphia and Trenton.

Despite the size and complexity of its watershed, the Philadelphia Water Department has been proactive about finding out what is in their source water, where it is coming from, and how they and their partners can mitigate pollutant loads throughout the watershed. Philadelphia is on the cutting edge of identifying, monitoring, understanding, and treating emerging contaminants. Chris Crockett, manager of Philadelphia's Source Water Protection Program, says,

> The balancing act is, how do we stay at the front edge of emerging contaminants and prepare for the future without overreacting to something or wasting resources? Our strategy is to (1) identify potential sources of contamination from monitoring data, landuse information, and literature review; (2) determine the future potential impact of those sources on treatment, public health, and aquatic life; (3) identify what existing practices can be used to address this future threat; and (4) determine what amount of resources will be needed. Our systematic approach to understanding and addressing emerging threats helps us target our resources most effectively.
>
> For example, if monitoring data and literature reviews point to antibiotic-resistant bacteria or pathogens from animals as a growing threat in particular sub-basins, we look for ways to increase our stream bank fencing and manure management techniques, which we know are effective at keeping those contaminants out of the water. It gets more complicated when we look at pollutants such as endocrine disruptors and pharmaceutical residuals from humans, because even if we could estimate loadings through monitoring and modeling, there is limited knowledge of public health impacts and no water quality standards to guide our remediation efforts. But just knowing the pollutant is there and understanding its source is critical to protecting public health.[71]

The Philadelphia Water Department works with governmental and nonprofit partners to collect monitoring data throughout the watershed to measure pollutant loads, identify potential sources, and develop strategies for addressing those sources. Their partnership with the Schuylkill Action Network is an example of this process in action. The partnership includes over 200 stakeholders, from community and watershed groups to regulatory agencies. PWD provides technical coordination and planning to the network by compiling information on water quality, stream impairment, landuse, source activities, compliance, funding and protection activities, and data analysis in order to prioritize areas for restoration and protection. Stakeholders then review the information to determine the actions necessary to address priority sites and how they can be integrated effectively with existing initiatives. By working collaboratively, they address multiple stakeholder objectives and bridge Clean Water Act and Safe Drinking Water Act goals.

CONTACT: Chris Crockett, Manager, Source Water Protection Program
ADDRESS: Philadelphia Water Department, 1101 Market Street, 4th Floor, Philadelphia, PA 19107
PHONE: 215-685-6234
FAX: 215-685-6043
EMAIL: chris.crockett@phila.gov

Best Practice: Use Maps and Models to Prioritize Protection

Municipal water supply managers and conservation agencies routinely face questions and problems when ranking conservation and restoration priorities. Which forested parcels should receive the highest priority for conservation? Which areas are in need of restoration using creekside forest

buffers? Where will storm water management practices likely yield the greatest improvements in water quality? Identifying high-priority land for protection and restoration is critical, as funding is always limited and multiple demands often are made on a valuable piece of land.

A number of characteristics make some lands more important to protect or restore than others. Parcels with steep slopes and erodable soils, in forest or other natural cover, and close to a waterway or encompassing small streams are the most critical to protect; development on these sites is more likely to degrade water quality. Geographic Information System (GIS) maps and models can be very helpful in identifying these critical parcels and showing where protection or restoration will have the greatest benefit for water quality. GIS software can be used to identify high-priority lands in a number of different ways, including:

- Identifying landuse and features (such as streams or slopes), or locating parcels of land or contaminants using existing data sources.
- Creating ranking systems and operational models that rank parcels based on a set of characteristics. These models require digitized data layers for the characteristics of greatest interest, such as slope, land cover, and distance to stream.
- Developing quantitative models that can predict potential impacts from landuse on water quality, such as pesticide concentration, nutrient loading, or total suspended solids in stream water. These models require long-term, research-grade weather, streamflow, water quality, and watershed data for development, testing, and validation.

As our understanding of the impacts of landuse on water quality improves and the GIS mapping software becomes more sophisticated and accessible, prioritizing areas in a watershed is becoming more feasible even for communities with limited resources and technical capabilities. The simplest use of GIS—mapping landuse, municipal, or parcel boundaries, or locating contaminant sources—can be very helpful in integrating information into one watershed map that can become a shared resource and guide for remediation or protection. For small communities with limited resources, this can be an excellent first step in understanding threats to drinking water and mapping out a strategy for protection. For more information on how to create such a tool, see *Using Technology to Conduct a Contaminant Source Inventory: A Primer for Small Communities*, a publication by the Groundwater Foundation (www.groundwater.org).

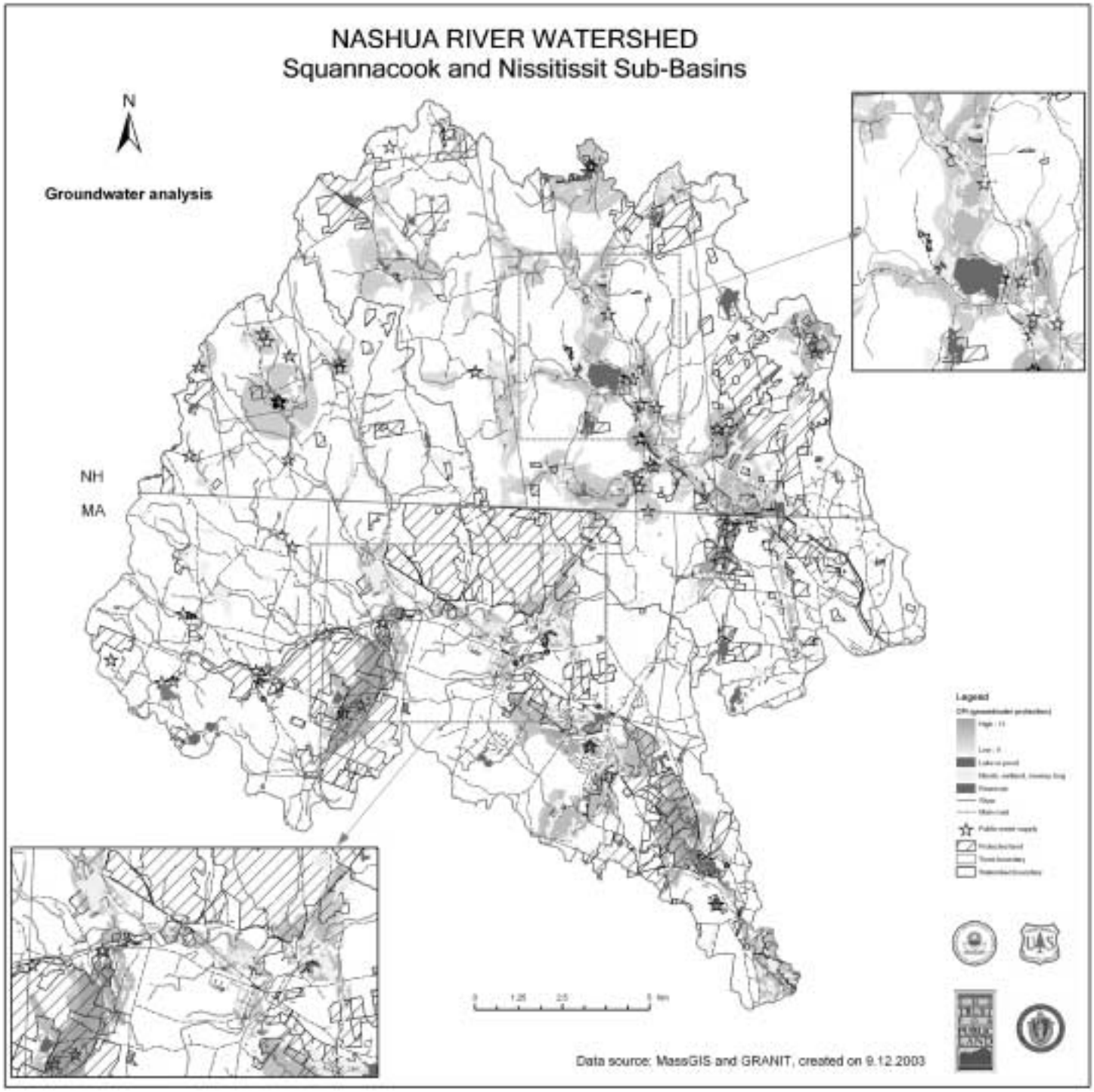
Complex GIS applications, such as quantitative models that predict impacts on water quality from landuse change, can be very useful and accurate. Yet they require more significant resources, technical expertise, and data than many communities may have. Environmental consulting companies are excellent resources in thinking through whether and what quantitative models are the most appropriate tools for reaching your goals.

Ranking systems, which are easier to implement than quantitative models, are a widely used GIS tool for identifying high-priority areas for protection and restoration. Ranking systems combine information on land characteristics such as soil type, slope, landuse, and zoning, ranking each characteristic in importance. For example, a large forested parcel that encompasses small streams with steep slopes and highly erosive soils would rank higher for protection or restoration than a level parcel with good soils that is far from a water source. Where digitized parcel data is available, each parcel can be given a numeric score indicating its value for conservation or restoration. Ranking systems can efficiently generate land protection priority lists. When combined with local knowledge and field inspections, the resulting priority lists are accurate and effective decision-making tools. For more information on creating a GIS-based ranking system for your watershed, see the *Source Protection Handbook: Using Land Conservation to Protect Drinking Water Sources.*

The EPA's Southeast Regional Office has developed a Watershed Characterization System that provides a wealth of information for organizations operating in the Southeast. This software incorporates extensive state-level data on landuse, soils, slope, and water quality, all of which can be used for targeting on-the-ground strategies.

Some communities have combined GIS-based ranking systems with other analyses, such as cost-benefit. For example, Orange County Water and Sewer Authority, working in partnership with Tetra Tech, Inc., has developed an efficient and cost-effective way to prioritize parcels for acquisition by using formulas to estimate potential phosphorous loads from future development at each site, and then weighing phosphorous loads against the cost for either acquisition or easements. This strategy allows them to identify the parcels with the greatest potential phosphorous load and the lowest cost, which are highest priority for protection.

For more information on the many ways GIS can be used, refer to *Conservation Geography: Case Studies in GIS, Computer Mapping, and Activism*.[72]



Groundwater Conservation, Restoration, and Storm Water Management Priority Indices for the Squannacook and Nissitissit River Watersheds, Massachusetts and New Hampshire. The enlarged areas are centered on (left) Townsend, Massachusetts, and (right) Brookline, New Hampshire. Conservation Priority level was based on whether forested or wetland, type of soil, transmissivity, and whether there is a public water supply. This map includes all Community Water Systems with more than 25 users, with Zone I and Zone II source protection areas in gray.

CASE STUDY

Nashua, Massachusetts

The Nashua River Watershed extends through 31 communities in northeastern Massachusetts and southern New Hampshire. The Squannacook and Nissitissit sub-basins make up the northern portion of the Nashua Watershed, where it crosses the state borders. These sub-basins comprise approximately 133 square miles and include portions of four counties, two states, and five towns in Massachusetts and six towns in New Hampshire. They are primarily rural and forested and have been recognized for their pristine water and important and unique habitat. There are approximately 12 community water systems in the Squannacook and Nissitissit sub-basins, all of which draw their water from wells.

The Nashua River Watershed Association (NRWA), which has been working since 1969 to protect and improve the ecosystem of the Nashua River Watershed, recognized that protecting drinking water sources was critical to the health of the watershed community, and that source protection strategies could effectively strengthen and support their broader clean water and habitat goals. In 2001, the NRWA applied to participate in an EPA-funded demonstration project to study the Squannacook and Nissitissit sub-basins and identify ways that land protection and management strategies could be used to protect drinking water sources.

As part of this demonstration effort, the University of Massachusetts produced maps that identified areas of the watershed that were highest priority for conservation and restoration. Because all of the communities in the Squannacook and Nissitissit sub-basins drink groundwater, maps and models were developed that combine data on groundwater wells, soils, slope, landuse, and pumping rates to identify the highest priority lands for protecting and improving groundwater. The Nashua map shows in gray areas of the watershed that are high priority for conservation, with highest priority areas in dark gray. Recharge areas for groundwater wells ranked high, along with areas with shallow groundwater under the influence of surface water. Similar maps were produced to identify high-priority areas in the watershed for the protection of surface water supplies.

By overlaying parcel lines, the NRWA is able to identify individual landowners whose property is critical to the quality and quantity of groundwater supplies. Using these maps, NRWA staff is conducting outreach to landowners to discuss options for participation in state forest stewardship programs, which offer tax breaks for implementing forest management plans, and ways that landowners can conserve their property through state and federal easement and cost share programs.

CONTACT: Al Futterman
ADDRESS: Nashua River Watershed Association, 592 Main Street, Groton, MA 01450
PHONE: 978-448-0299
EMAIL: alfutterman@nashuariverwatershed.org
WEB SITE: http://www.nashuariverwatershed.org

Best Practice: Build strong partnerships and work watershed-wide

Effectively implementing a source protection plan requires the support and cooperation of a variety of public and private partners. That's because most communities' source areas lie partially, if not entirely, outside of their jurisdiction and, in most cases, cross multiple jurisdictions and even state lines. And although few suppliers have the authority to directly control activities on land in their source area, most have the ability to plan and partner with other communities and stakeholders who can directly influence landuse and land management. Source water protection can be achievable and effective when you influence others to act on your behalf, utilize existing initiatives and frameworks, and find common goals with others to build partnerships.[73]

Potential pollution sources must ultimately be managed at the local level, where most landuse decisions are made. Partnerships can be built with local jurisdictions, nonprofits, and other stakeholders by identifying common goals and planning ways to achieve them together. Farmers benefit from clean water for cows in order to reduce disease. Recreational users benefit from improved fish habitat and safe swimming opportunities, and upstream townships might benefit by meeting obligations for existing regulatory initiatives, such as Phase II Storm Water Regulations or Total Maximum Daily Loads, or simply by improving local quality of life.[74] "We have found that sometimes simply finding a way to help a partner address a nagging local issue can make a project successful," notes Crockett.[75]

When thinking about who needs to be involved in a source protection planning process, the key is to consider who will ultimately be needed to successfully implement a plan. "Too often we count the success of a planning effort based on how

© CHRIS LANCETTE

A coalition of groups is working to protect a 180-mile greenway along the banks of Georgia's Chattahoochee River from development pressures. The river provides drinking water to half the state's population.

many people were at the table, particularly how many residents or members of the general public showed up to our meetings," says Billy Turner, director of the Columbus Water Works. "Instead, we need to think about what our ultimate goal is and who will be needed to implement that goal once the planning has ended."[76]

It may not be clear at the beginning of the process exactly who will be needed for successful implementation, but it will be clear that:

- *Local*, *state*, and *federal* funding will be needed.
- *Landowner groups* will be important, such as farmers, developers, and woodlot owners, if nonpoint source pollution is the primary threat.
- The *municipalities* that reside in the watershed or manage the local water supply will ultimately have to implement regulatory changes or fund acquisition.
- *Business and industry groups*, which may contribute to water quality problems, need to be part of finding solutions. Their early substantive involvement is critical to developing successful and broadly supported protection strategies.
- If supplies are managed privately, those *suppliers* can be involved in funding and implementing strategies to protect their source.
- *Local land trusts, watershed associations, and other nonprofits* can be key to public outreach and education and, potentially, to implementing strategies with their constituent groups.

Other jurisdictions and stakeholders will often support and contribute to source water protection efforts that meet their goals and objectives and that build on initiatives they already have under way, if the information they need to guide their actions is made available to them. Most watershed and community organizations, and even some municipalities, lack the technical knowledge or resources to direct their activities at the highest priority needs. Stakeholder relationships can be developed through the exchange of data, maps, or other technical or scientific information. If the utility or municipality does not have the capability to provide this data themselves, they can work with other municipalities, local colleges, planning commissions, or river basin commissions to help them create the needed resources.[77]

Although local municipalities and suppliers play an important role in coordinating source protection efforts, federal and state governments and nongovernmental organizations (NGOs) play critical roles in planning, financing, and implementing source protection strategies. Involving state and federal representatives in source protection planning facilitates the local communities' access to additional data, funding sources, and technical assistance, all of which contribute to successful implementation.

In some source areas, voluntary watershed associations and other NGOs are beginning to take on the role of coordinating entities. As independent third parties, they can often bring together local municipalities and counties that may not have planned cooperatively in the past and help them to plan for the protection of regional resources. Nongovernmental organizations often bring unique skills and organizational flexibility that can leverage new resources and encourage new strategies.

CASE STUDY
Columbus, Georgia

Columbus Water Works (CWW) is in its final year of a three-year program studying water quality in the Middle Chattahoochee River Watershed. The study is an effort to assess total maximum daily load (TMDL) allocations through the calibrated Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) developed in the Middle Chattahoochee study. This work will help provide communities with assistance in their regulatory and stewardship programs, including source water assessment and protection.

CWW serves approximately 200,000 customers in an estimated 74-square-mile area on the river about 120 miles southwest of

Atlanta. The river segment in this study area divides Georgia from Alabama and encompasses the growing cities of LaGrange, West Point, and Opelika. Metropolitan Columbus, located in the center of the study area, is growing within the core areas of the drinking watershed. A key feature of this study is CWW's initiative in testing the idea of interstate water resource coordination with the creation of a stakeholder team that includes seven water companies, Georgia Power, Natural Resources Conservation Service, local universities, the Chattahoochee River Keeper, and state and federal agency representatives.

While CWW has primary responsibility for the Combined Sewer Overflow (CSO) control, the comprehensive watershed study was approached as a partnership venture. The stakeholders are working together with CWW consultants, the EPA, and the Water Environment Research Foundation (WERF) on the watershed study. They are coordinating a monitoring network and an Internet-based GIS information and communications network; discussing and implementing source water protection policies; and integrating drinking water source protection with other regional goals for recreation, tourism, and economic redevelopment.

In 1993, CWW developed a vision, "to be the nation's best water resources utility by 2000," and it made significant progress toward that goal through its multi-jurisdictional partnership and aggressive public outreach efforts. In the early 1990s, the citizens of Columbus were faced with significant increases in water/wastewater rates to rehabilitate the CSO system to meet state requirements. Voters overwhelmingly supported a 1 percent special local option sales tax to underwrite the cost of the CSO program as well as a number of associated community projects.

CWW used the funding to implement the CSO plan and to foster a comprehensive public education initiative to develop and nurture a long-term commitment to protecting drinking water supplies. The Oxbow Meadows Environmental Learning Center, the crown jewel of the outreach initiative, provides environmental education to a broad spectrum of users and visitors. Two new treatment facilities were developed with dual-use community features such as the 8.2-mile Riverwalk and a two-block city park built over one of the treatment plants. These strategies provide both recreational amenities to residents and needed treatment facilities.

The total cost of the CSO control program and parallel community projects like the Riverwalk was $95 million. Between 1997 and 1998, CWW's total assets increased more than $100 million to $382 million. During the same time period, the operating budget reflected a $1 million decrease from the previous year's budget of nearly $14 million, due to numerous managerial and operational improvements. More importantly, Combined Sewer Overflow events monitored since the fall of 1998 have demonstrated consistent compliance with water quality standards for the river.

CONTACT: Billy Turner, Director
ADDRESS: Columbus Water Works, P.O. Box 1600, Columbus, GA 31902
PHONE: 706-649-3430
FAX: 706-327-3845
EMAIL: bturner@cwwga.org
WEB SITE: http://www.cwwga.org

Best Practice: Create a comprehensive source water protection plan

Creating a comprehensive source water protection plan is an opportunity to pull together everything learned from analyzing a watershed, assessing the threats to drinking water, mapping high-priority land for protection and restoration, and developing partnerships. Such a plan should be developed with other partners and jurisdictions in a source area and should incorporate the following:

- *Strategies for managing threats, such as wastewater and agricultural runoff, and for protecting natural resources, such as forests and wetlands.* In most drinking water watersheds, threats to water quality exist from septic systems, agriculture practices, lawn maintenance, underground storage tanks, and other point and nonpoint sources of pollution. Source water protection plans should identify the greatest threats and outline a plan to manage those threats in the future. Likewise, identifying and protecting highly sensitive lands that are vulnerable to development allows communities to be proactive about protection and avoid costly mitigation or restoration action in the future.
- *A combination of voluntary and regulatory strategies, such as land acquisition and landuse regulation.* A comprehensive source water protection plan should combine voluntary and regulatory strategies, along with best management practices. Landuse regulations should be balanced with voluntary acquisition and

cost-share programs in order to be politically viable and effective over the long term. "No single management option can meet all of our source water protection objectives; therefore, a combination of methods is needed," according to Ed Holland with Orange Water and Sewer Authority in North Carolina.[78]

- *A long-term vision, short-term action strategies, and measurable goals.* Plans are only as valuable as the actions that result from them. Therefore, a long-term vision (extending as far as 30, 50, or even 100 years) should be accompanied by short-term action strategies. Such action strategies should be feasible and their results measurable, with timelines, budgets, and critical partners identified, so that as funding becomes available or opportunities arise, they can be acted on.
- *A strategy to fund the plan.* Funding can come from a wide variety of sources that change regularly, depending on the political and financial climate. Potential funding sources that are identified up front can be pursued when the time comes. Look for both existing funding sources and new sources created through public finance measures, fees, or other strategies.

"Start your plan early and stick with it," advises Suzanne Flagor, director of Watershed Management with Seattle Public Utilities. "The key to Seattle's success in protecting our watershed was in having a long-term plan and taking advantage of opportunities to make progress on that plan as they arose. Funding availability and land ownership change regularly, creating unique opportunities for action. If you are not prepared to take advantage of those opportunities, they'll be lost."[79]

CASE STUDY

Seattle, Washington

In the late 1800s, residents in the small, coastal city of Seattle, Washington, were drawing their water from a series of wells, springs, and private water companies dispersed throughout the city. In 1889, the Great Seattle Fire, which destroyed the entire 64-acre business district, exposed the glaring inadequacies of the city's water supply system, which had insufficient water or water pressure to suppress the blaze as it raged through town.

Immediately after the fire, residents voted to create a city-owned and -operated water system. A bond was passed within a year to purchase two water companies. By 1895, voters again approved bonds to construct the Cedar River system, in the mountains outside of town, which continues to be Seattle's primary water source today.

Shortly after constructing the water supply system, city leaders agreed on a plan to eventually own the entire Cedar River Watershed, thus permanently protecting and securing Seattle's drinking water. With a 100,000-acre watershed, it was a bold vision, yet the plan was simple:

- Buy land, not trees.
- Invest in the future by planting seedlings.
- Manage the land for water and wildlife.

The city's first purchases were in 1898. At the time, the watershed was owned by homesteaders, timber and mining companies, and the federal government, all of whom were there to extract resources from the land. The city knew it was buying a "fixer-upper," but that was part of the plan. The city negotiated agreements with timber companies to allow them to harvest the trees and eventually sell the barren land to the city at incredibly low prices. Over the next 50 years, the city purchased almost two-thirds of the watershed through similar deals with private companies and individual landowners.

The remainder of the watershed was owned by the federal government, which is not permitted to sell land but can exchange it for land of equal or greater value. Over the course of 60 years, the City of Seattle purchased land in other parts of the state that they knew was high priority for the federal government, and they negotiated a series of land and timber exchanges that eventually led to the city's ownership of almost 100 percent of the Cedar River Watershed.

In 1996, the city's original vision, created over 100 years earlier, had finally been achieved. By strategically and creatively taking advantage of opportunities as they arose, and patiently sticking to a long-term vision, the City of Seattle has secured for its residents the permanent protection of one of the most pristine sources of drinking water in the country.

CONTACT: Suzanne Flagor, Director of Watershed Management
ADDRESS: Seattle Public Utilities, 19901 SE Cedar Falls Road, North Bend, WA 98045
PHONE: 206-233-1528
FAX: 206-233-1527
EMAIL: Suzanne.Flagor@seattle.gov
WEB SITE: http://www.cityofseattle.net/util/services/Drinkingwater

CASE STUDY

Austin, Texas

In 1998, the citizens of Austin, Texas, passed several bond measures for watershed protection and parks, officially launching the city's Smart Growth Initiative after years of grassroots advocacy. The Edwards Aquifer, on the western side of Austin, is the sole source of drinking water for over 1.5 million people, including residents of San Antonio and Austin. The Barton Springs segment of the aquifer—the segment around Austin—has been identified as the most endangered aquifer in Texas. It is highly vulnerable to pollution due to its relatively small size, its high porosity, and the region's land-development boom.

In 1995 and 1996, a Citizens Planning Committee studied landuse, transportation, and environmental concerns and developed the guiding principles for what in 1998 would become Austin's comprehensive Smart Growth Initiative. During the process, it was determined that the city's surface water needed protection beyond current regulatory restrictions. Building on that recommendation, the city council designated the most sensitive third of the Austin region—land that drains into Barton Springs and the Highland Lakes—a "Drinking Water Protection Zone." The remaining two-thirds were designated a "Desired Development Zone," which included the urban core, commercial corridors, and the central business district. This innovative landuse plan directed development away from sensitive groundwater recharge lands and toward targeted urban growth centers. This enhanced economic and neighborhood development strategies while protecting drinking water.

Even as Austin voters were trying to strengthen development regulations, they were also moving to protect the watershed through land acquisition. A 1991 poll jointly sponsored by the Trust for Public Land and Citizens for Open Space revealed that Austin residents favored open space acquisition—particularly as a means to protect water quality and secure recreation—and that they would approve increased property taxes to pay for the land. In 1992, they approved a $20 million bond act for a new Barton Creek Wilderness Park, which would protect the most critical areas around the springs.

Since 1992, Austin voters have chosen to spend over $200 million to protect their watershed. In 1997, after years of research, the city's Watershed Protection Department published *The Barton Creek Report*, which recommended further conservation through the purchase of land and development rights in order to protect drinking water quality. In 1998, voters approved several land-protection funding measures, including a $65 million revenue bond to purchase land and easements within the Drinking Water Protection Zone and a $75.9 million bond to create and improve parks and greenways, partly as incentive for attracting new development to the Desired Development Zone. Most recently, in November 2000, Austin voters once again taxed themselves, approving $13.4 million in bonding authority to protect land in the Barton Springs Watershed.

CONTACT: Butch Smith, Senior Planner
ADDRESS: Parks and Recreation Department, Municipal Building, 124 Eighth Street, No. 111, Austin, TX 78701
PHONE: 512-974-2000
FAX: 512-974-1886
EMAIL: butch.smith@ci.austin.tx.us
WEB SITE: http://www.ci.austin.tx.us

The Barton Creek Watershed protects the water quality of Edwards Aquifer, which is the sole source of drinking water for 1.5 million Texans.

Best Practice: Develop and implement a "funding quilt"

The implementation of a comprehensive source water protection plan requires a significant and steady stream of funds. Successful communities secure funds from a variety of sources—federal, state, local, and private—creating a so-called funding quilt. By tapping into a range of sources, communities can raise significant amounts of money and avoid reliance on a single, potentially unpredictable revenue stream.

On any specific project, a wide range of funding sources may combine to meet funding requirements, including a state grant matched by local funding; local funding that is supplemented by a private fundraising campaign; and a private conservation effort that leverages a federal grant. It is essential to use one funding source to leverage others.

Yet despite the importance of quilting together a combination of resources, local funding is the foundation of any long-term land conservation effort. Local funds allow for local control and demonstrate the commitment needed to leverage other resources. Explore all funding options, but always keep in mind that the largest burden rests with the local government.

This section outlines best practices for creating a source protection funding quilt. Included are guidelines specifically designed for local water suppliers and municipalities as well as broader state and federal frameworks. Only by understanding the conservation and source protection landscape at all levels is the full funding of local conservation projects possible.

CASE STUDY

Assawompsett Pond Complex, Massachusetts

Through a combination of state, local, and private funding sources, nearly 4,000 acres of the Assawompsett Pond Complex was protected in fast-growing southeastern Massachusetts. This collaborative effort included acquiring the 480-acre Betty's Neck property in Lakeville and securing conservation easements on 3,500 adjacent acres already held as municipal watershed land. The Assawompsett Pond Complex is the sole source of drinking water for the Cities of New Bedford and Taunton and provides drinking water to Lakeville. It is also home to an abundance of wildlife species and offers scenic beauty and recreational opportunities in the fastest-growing part of the state.

The majority of funding for this July 2002 project was provided by the state's Department of Environmental Protection Aquifer Land Acquisition Program, which made a $6.55 million grant and will receive a conservation easement on 3,500 acres. The state's funding came from the 1996 Environmental Bond Bill. The Town of Lakeville contributed $1.1 million and the City of New Bedford contributed $600,000 toward the Betty's Neck purchase. The City of Taunton hopes to receive $600,000 from the Statewide Revolving Fund for that purpose. The Trust for Public Land also contributed $250,000 to the project, thanks to an anonymous Boston foundation.

CONTACT: Badge Blackett
ADDRESS: TPL New England Regional Office,
33 Union Street, 4th Floor,
Boston, MA 02108
PHONE: 617-367-6200
FAX: 617-367-1616
EMAIL: Badge.Blackett@tpl.org
WEB SITE: http://www.tpl.org

Create and maintain dedicated local public funding sources

Local (preferably dedicated) funding is the foundation of any credible, long-term land conservation effort. The competition for state and federal funds is intense, and local funding is often necessary to secure these outside funds. Local funding is also the only source that is completely within the control of the local government, as federal and state sources are frequently subject to significant fluctuations that make them less reliable.

Local funding can take the form of a general fund appropriation or a legislatively approved tax increase. Often, however, the price tag, the politics, and the legal options warrant approval by voters of a conservation spending measure. Hundreds of local governments have passed ballot measures in recent years. During 2002 and 2003—two years of slumping economic fortunes—205 local governments across the United States passed ballot measures that included funding for land conservation. Seventy-five percent (in 2002) and 83 percent (in 2003) of local ballot measures placed before the voters passed around the country.[80]

The Trust for Public Land has worked with dozens of local governments to pass ballot measures, assisting with research and development,

public opinion polling, and ballot language design, and has compiled lessons learned regarding the key components to winning a land conservation measure. For more information on how to create a dedicated local funding source, see TPL's *Local Greenprinting for Growth Workbook, Volume III: How to Secure Conservation Funds*, which can be downloaded for free from TPL's Web site, *www.tpl.org*.

CASE STUDY

New York/New Jersey Northern Highlands

The Northern Highlands serve as the source of drinking water for 4.5 million people in New Jersey. The area includes a series of reservoir systems—the Wanaque/Monksville system, the Pequannock system, and the Boonton/Split Rock system. Over the past five years, within each system, a range of funding sources has come together to protect thousands of acres.

Several factors underpin the success in land conservation efforts in the Highlands. First, New York and New Jersey have significant state funding for land conservation—New York approved the $1.75 billion Clean Water, Clean Air Bond in 1996, and New Jersey's Garden State Preservation Act (1998) provides $98 million annually from the state sales tax. Second, New Jersey has provided the legal framework for counties and municipal governments to initiate local open space trusts and the incentives (via matching grants) to create them. As a result, all of New Jersey's 21 counties and more than 178 local governments have open space trust funds. Finally, there are broad networks of private foundations, land trusts, and citizen supporters of conservation in the area.

Local conservation finance measures have been approved in recent years in both Sussex and Morris Counties, home of the Pequannock and Boonton/Split Rock systems. Sussex County voters approved their first-ever property tax levy in November 2000, which raises $1.6 million annually, while Morris County voters increased their levy in November 2001 to $25 million to $30 million annually.

The Hawkwatch project in Rockaway Township, New Jersey, is an example of the local government funds helping to leverage other funding. Of the total $7 million for the project, Morris County and Rockaway Township contributed $1.5 million from their local property tax levies, and $3 million came from the state's Green Acres Program with a mix of grants and loans. An additional $1 million came from the federal Forest Legacy Program and the state grant portion of the federal Land and Water Conservation Fund, with more than $1 million from private foundations.

The most notable purchase within the Highlands was the 1998 purchase of 15,000 acres of Sterling Forest, a heavily forested area straddling the New York/New Jersey border. To reach the total cost of $55 million, Congress approved $17.5 million; the state of New York, $16 million; and New Jersey, $10 million. In addition, the Lila Acheson and DeWitt Wallace Fund for the Hudson Highlands and the Doris Duke Charitable Foundation contributed $5 million, while the Victoria Foundation contributed $1 million. Private donors provided the remaining funds.

CONTACT: Terrance Nolan
ADDRESS: Trust for Public Land, 20 Community Place, 2nd Floor, Morristown, NJ 07960
PHONE: 973-425-0360
FAX: 973-425-0366
EMAIL: terrance.nolan@tpl.org
WEB SITE: http://www.tpl.org

Create substantial state funding and the right mix of policies to support broad-based land conservation in a state

While landuse and land conservation activities are primarily the domain of local governments, the public policies established by state governments shape those decisions significantly. A good state framework for clean water and watershed management can give communities the flexibility, funding, and technical assistance they need to plan and implement successful programs.

States can promote source protection and clean water programs with incentives and funding programs that help local communities meet their watershed protection goals. States can play an enormous role in local watershed planning activities by putting forth an ambitious vision that captures complementary goals for land conservation and water quality protection. They can also provide key technical assistance with data collection and management, GIS mapping, build-out analysis, and landuse analysis.

A clear vision for source protection and clean water can lead to partnerships and leveraging of complementary federal funding, such as USDA's Natural Resources Conservation Service and Forest Legacy Programs. As public water suppliers and watershed planners create their funding quilt, states can help support these programs with clear

goals, blended funding streams, and program integration that matches the kind of integration happening locally. Some of the steps states can take to support local conservation for clean water are outlined below.

1. *Create substantial state investment.* A dedicated state funding source pays for statewide source protection projects and reinforces a long-term conservation commitment and vision. Some existing state programs rely on a single revenue stream, while others use a combination of revenue sources. The most common revenue streams used by states are general obligation bonds, sales tax, lottery income, real estate transfer tax or deed recording fees, and general fund appropriations.
2. *Enable and provide incentives for local financing.* State enabling legislation gives local governments the authority they need to raise local dollars. Incentives, often in the form of matching grants and low interest loans, encourage local governments and nonprofit conservation organizations to develop programs and generate local funds while strengthening partnerships.
3. *Leverage federal financing.* State grants and loans can be linked to federal Clean Water and Drinking Water State Revolving Funds to provide grants or low-interest loans for land conservation efforts that protect water resources.
4. *Link multiple community priorities.* State programs that link water quality benefits with other community goals, such as recreation, historic preservation, and habitat protection, will attract greater support and funding from the public and elected officials.

CASE STUDY

North Carolina

Following several high-profile water pollution incidents, in 1996 North Carolina's General Assembly created the Clean Water Management Trust Fund. The fund is the first state funding program in the country dedicated exclusively to water quality protection. It acts as a quasi-independent agency within the Department of Environment and Natural Resources, awarding grants to projects addressing water pollution problems.

Nonprofit land conservation organizations, municipalities, and state agencies have received grants supporting up to 100 percent of project costs. For example, in 1998, the fund granted rural Gaston and Lincoln Counties the full $6.15 million needed to buy 1,231 acres around Mountain Island Lake, key watershed land providing drinking water for more than a half-million Charlotte-area residents.

The Trust Fund has the option of requiring a 20 percent local match in funds. Projects must enhance or restore degraded waters, protect unpolluted waters, or contribute toward a network of buffers along riverbanks and greenways for environmental, educational, and recreational benefits. Uses for the funds include land acquisition, conservation easements, cooperative planning efforts, stream restoration, and wastewater and storm water projects.

The initial allocation for the program was 6.5 percent of the state's unspent fund balance, which came to about $45,000. Five years later, the allocation had grown to $30 million per year. And within the program's first decade, legislation requires the allocation be increased to $100 million.

CONTACT: Bill Holman, Executive Director
ADDRESS: North Carolina Clean Water Management Trust Fund, 1651 Mail Service Center, Raleigh, NC 27699-1651
PHONE: 919-733-6375
FAX: 919-733-6374
EMAIL: bill@cwmtf.net
WEB SITE: http://www.cwmtf.net

Use state-directed federal funds more creatively

Three distinct types of federal funding for land conservation exist:

1. State-directed programs, in which states receive grants from the federal government but are given broad discretion to allocate funds (Clean Water and Drinking Water State Revolving Funds)
2. Direct federal programs, in which the federal government makes direct grants in partnership with states to local recipients, usually local governments (Forest Legacy Program)
3. Direct federal acquisition (Forest Service or National Park Service acquisition)

The first category, state-directed federal programs, include the Clean Water State Revolving Fund (CWSRF), the Nonpoint Source Grant

Program (Section 319), and the Drinking Water State Revolving Fund (DWSRF). The revolving funds provide water quality improvement grants to states, which then make loans to local governments, and in some cases nonprofits, private citizens, and others. States are given a great deal of flexibility in the allocation and management of funds in order to encourage innovation and to allow them to address their most pressing water quality problems.

Traditionally, the CWSRF was used to fund new and upgraded wastewater treatment plants, and the DWSRF was used to fund new or upgraded drinking water treatment plants. Although there continues to be a need for capital improvements in many communities, the primary threat to water quality in most of our nation's waterways is no longer effluent from wastewater treatment plants but nonpoint source pollution. In fact, nonpoint source pollution now accounts for 60 percent of all pollution in U.S. waterways, yet 95 percent of CWSRFs go toward wastewater treatment upgrades.[81] Federal rules allow a great deal of flexibility in the use of the CWSRF, but the DWSRF rules only allow states to set aside up to 15 percent of their loan pool to fund land conservation or voluntary, incentive-based protection measures. This set-aside is too small to cover many land protection projects, ranked separately from other projects, and it is not integrated with other capital investments.

So how can states more effectively use their share of state-directed federal funds to address threats from nonpoint source pollution at the local level? The following best practices highlight what's working in many states.

1. *Create an integrated priority ranking system.* In order to fund a wider variety of high-priority projects, particularly nonpoint source projects, integrate Clean Water Act funding programs, including the CWSRF, the Nonpoint Source Grant Program, and the Estuary Program, and prioritize funding decisions based on primary water quality threats. In 2002, approximately 26 states took advantage of the flexibility in the Clean Water Act to create integrated priority ranking systems, including Minnesota, Oregon, and Washington. For more information on integrated priority ranking systems, refer to EPA's publication: EPA-832-R-01-002, March 2001.
2. *Allow private and public borrowing in the State Revolving Fund, Nonpoint Source Grant, and Estuary Programs.* Private borrowing by nonprofit land trusts and other groups can leverage private resources for water quality improvements. For example, a nonprofit can match a grant from an individual or foundation with an SRF loan to complete a conservation or restoration project. Over a dozen states allow private borrowing, including California and Illinois.
3. *Proactively promote the use of State Revolving Funds and Nonpoint Source Grant Program Funds for a wide variety of water quality projects, including land conservation and restoration.* Many potential borrowers do not know that federal rules allow these funds to be used for watershed protection or restoration, estuary management projects, and source water protection measures. State programs, such as Ohio's Restoration Sponsorship Program, have been very effective for promoting the use of funds for nontraditional projects.
4. *Provide state funding and mandates for implementing source water protection plans.* Currently there are no guidelines or provisions for implementing on-the-ground strategies, only a mandate to complete assessments. State funding or mandates could ensure that the effort that went into developing Source Water Assessment Plans results in actions to protect source waters.

Local stakeholders can also impact how federal conservation programs are structured and how funds are spent at the local level, particularly in the category of state-directed programs. Specifically, they can communicate with state program administrators about how these funds could most effectively address high-priority water quality problems. Generating applications for projects that address nonpoint source pollution and source water protection is another way to demonstrate local demand for NPS funding. And finally, local governments can encourage states to implement innovative grant and loan programs that leverage other local and state dollars. Where there has been a strong desire at the local level to use SRFs to fund nonpoint source projects, states have responded with creative loan structures and high funding levels.

CASE STUDY

Ohio's Restoration Sponsorship Program

With funding from the federal Clean Water State Revolving Fund (CWSRF) loan program, the Ohio Environmental Protection Agency has created an innovative program to address threats

© 2001 AL FUCHS

Northern Ohio's Edison Woods, located just south of Lake Erie, was permanently protected with funding from the Ohio EPA's Water Resource Restoration Sponsorship Program.

from nonpoint source pollution. Since its inception, Ohio's Water Pollution Control Loan Fund (WPCLF), which is funded through the federal CWSRF, has significantly reduced the impact of wastewater treatment on water quality. However, nonpoint source runoff and habitat degradation are impeding that progress and are threatening to reverse water quality improvements if not addressed.

Because of this growing threat, Ohio EPA officials are taking a broader perspective on water quality and how to protect and improve it. Rather than just looking at discharges from sewage treatment plants, they are looking at effects on water quality from storm water washing off roadways, loss of forested land to new development, and degraded stream corridors.

In 2000, the Ohio EPA created the Water Resource Restoration Sponsorship Program, which offers drastically reduced loan rates to utilities and local governments for traditional wastewater treatment work if the loan recipient either implements or "sponsors" a watershed protection or restoration project. "We're trying to get people to think more broadly to improve and protect water resources and at least to provide an incentive financially to encourage them to do that," said Robert Monsarrat, a manager within the Ohio EPA's division of environmental and financial assistance.[82]

Communities applying to the Water Resource Restoration Sponsorship Program for wastewater treatment loans can either implement their own watershed restoration project or sponsor a land trust, park district, or another entity's watershed protection or restoration project. The loan recipient receives a reduced rate for their loan equal to the principal and interest costs of the project, plus an additional reduction of 0.1 percent as an incentive. The savings they receive through the reduced interest rate is then granted to the watershed protection project. The result is the creation of new grant dollars for watershed protection projects and a total repayment cost for loan recipients that is lower than if they had borrowed solely for a wastewater project.

For example, if a utility borrows $1 million for a plant upgrade or expansion, they receive a standard interest rate of about 3.8 percent and have a total repayment of about $1,437,000, including principal and interest. If they borrow $1 million for a plant upgrade and an additional $393,000 for implementing a restoration or protection project, their interest rate would drop to 0.2 percent, resulting in a total loan repayment of $1,422,000—a savings of $15,000 on the total loan repayment. The utility can either use the $393,000 to implement the protection project themselves or grant it to a nonprofit partner to implement the project. Projects eligible for the Water Resource Restoration Sponsorship Program include the purchase of easements on riparian corridors, stream channel restoration projects, and wetland restoration and protection projects.

In the first two years of the program alone, communities used $24 million in loan funds to protect and restore 1,850 acres of riparian land and wetlands and 38 miles of Ohio's stream corridors. Efforts such as the protection of Sawmill Creek, the drinking water source for 400,000 Ohioans, and the protection of Edison Woods, a 1,300-acre reserve that is part of the National Estuarine Reserve System, illustrate the tremendous success of this innovative program in protecting and improving Ohio's valuable water resources.

CONTACT: Robert Monsarrat, Section Manager
ADDRESS: Ohio EPA, Division of Environmental and Financial Assistance, P.O. Box 1049, Columbus, OH 43216-1049
PHONE: 614-644-3655
WEB SITE: http://www.epa.state.oh.us/defa

In addition to state-directed programs, federal conservation funds are made available to state and local governments and to nonprofit organizations through appropriations, grants, and incentives. The Federal Funding Sources box below gives an overview of some of the most common federal funding programs for land conservation. Although none of these funding sources are directed specifically at source protection activities, many can be used for land protection strategies that protect source waters. Communities need to think creatively about how these funds can support their source protection goals.

Many of these programs require matching funds, underscoring the need to secure state, local, and private funds. Federal funds reach the local level in a variety of ways, depending on the program. Some funds are fully administered by state agencies; in others, the federal agency takes a more direct role. State agencies often provide information about federal funding sources, procedures, and contacts. For current and detailed information on federal funding sources for land acquisition, search TPL's Federal Programs at *www.tpl.org*. For detailed information on federal funds for all watershed protection activities use the EPA's online searchable Catalog of Federal Funding Sources for Watershed Protection at www.epa.gov/safewater/dwsrf.html.

CASE STUDY

Rockaway Township and Morris County, New Jersey

In Rockaway Township, New Jersey, funding from multiple sources reached a $7 million goal to protect local water resources. Local property taxes in Morris County and Rockaway Township contributed $1.5 million. The funding was supplemented by $2 million from the state's Green Acres program. The federal Forest Legacy Program and the state grant portion of the federal Land and Water Conservation Fund contributed another $2 million, and private foundations contributed more than $1 million.

Rockaway Township's success models how the presence of one funding source can help secure other funding. New Jersey's Department of Environmental Protection has successfully partnered federal Clean Water State Revolving Funds with state funding to finance the implementation of various water supply, wastewater, storm water, and nonpoint source pollution management projects through low-interest loans.

The U.S. EPA provides annual grants to states under a Clean Water State Revolving Fund. The money is generally used to provide

FEDERAL FUNDING SOURCES

Land and Water Conservation Fund (LWCF) is the largest source of federal money for parks, wilderness, and open space acquisition. The program's funding comes primarily from offshore oil- and gas-drilling receipts. At the national level, funds are used to acquire and protect new national forests, parks, wildlife areas, and other public lands. In FY 2002, Congress appropriated $429 million for specific acquisitions in these federal units. Stateside LWCF is a matching grant program that provides funds to states for planning, development, and acquiring land and water areas. In FY 2000, Congress reinstated funding for Stateside LWCF and funded it at $144 million in FY 2002.

Forest Legacy Program is administered by the U.S. Forest Service under its State and Private Forestry Division and provides matching funds to states to assist in forest protection. States may receive federal Forest Legacy grants of up to 75 percent of the total cost of the acquisition, with the remainder to be matched by nonfederal funds. In FY 2002, Congress appropriated $65 million for this program.

The North American Wetlands Conservation Act promotes voluntary public-private partnerships to conserve wetland ecosystems for waterfowl and other migratory birds. Acquired or restored habitat can be owned or managed by any federal, state, or nonprofit organization involved in land management. In FY 2002, Congress appropriated $43.5 million for this program.

The Cooperative Endangered Species Conservation Fund (Section 6 of the Endangered Species Act) provides matching grants to states for conservation projects that benefit not only species listed as endangered but also those that are candidates, or proposed for the list, on state, private, and other nonfederal land. In FY 2002, Congress appropriated more than $96 million for this program.

The Farmland Protection Program provides federal matching funds for state and local farmland protection efforts. To be eligible, a state, county, or local jurisdiction must have a complementary program of funding for the purchase of conservation easements. The 2002 Farm Bill provides $600 million over six years for this program.

The Transportation Efficiency Act for the 21st Century (TEA-21) provides states with funds to acquire land for historic preservation, trails, scenic beautification, and water pollution mitigation related to surface transportation through its Transportation Enhancements Program. The Recreational Trails Program provides funds for bike and pedestrian trails, and the Congestion Mitigation and Air Quality Improvement Program funds projects that improve air quality.

The City of San Antonio, Texas, in partnership with the Trust for Public Land, was awarded a $3.5 million grant by the U.S. Fish and Wildlife Service through the Habitat Conservation Plan Land Acquisition grant program, authorized under the Endangered Species Act (ESA). The grant will be used to protect land over the Edwards Aquifer Recharge Zone that provides critical habitat for nine federally listed endangered invertebrate species, as well as two endangered songbirds, the black-capped vireo and the golden-cheeked warbler. "This grant opens the door for the community to make critical additions to existing parkland, protect significant endangered species habitat and ensure clean drinking water for San Antonio and beyond," explains Jason Corzine with the Trust for Public Land.[83]

loans for wastewater treatment plants, but several states, including New Jersey, have used the money to help local governments and nonprofits purchase watershed land, restore watersheds, and reduce flooding. To qualify for the CWSRF, states must match federal funds with 20 percent of their own money. In addition to providing loans to public and private borrowers directly from the CWSRF, states have the option of pooling the grant money, from which bonds can be issued to augment funds available for projects.

New Jersey also revised its conservation funding selection criteria in 2002 so that projects with a water supply protection benefit receive three times the weight of other projects. Although the parcel must demonstrate water quality benefits, it does not have to be a drinking water source.

In the fall of 2000, the combined CWSRF and Green Acres funding program received 34 applications for the protection of 13,000 acres of land, for a total cost of $250,000. According to program managers, between 15 and 20 of those applications will probably be funded.

CONTACT: Terrance Nolan
ADDRESS: Trust for Public Land, 20 Community Place, 2nd Floor, Morristown, NJ 07960
PHONE: 973-425-0360
FAX: 973-425-0366
EMAIL: terrance.nolan@tpl.org
WEB SITE: http://www.tpl.org

Conclusion

The protection of source lands provides many benefits to a community: safe drinking water, natural resource protection, recreation amenities, and growth management. Local communities across the country are increasingly realizing such benefits, and source protection is gaining support once again as the cornerstone of the multiple-barrier approach to safe drinking water.

In fact, support for source protection is growing at all levels, from the passage of Safe Drinking Water amendments at the federal level that promote source water protection to state programs that encourage funding for nonpoint source protection projects, including land conservation. Yet public health and the delivery of clean, safe drinking water are ultimately local responsibilities that demand a committed, comprehensive, and sustainable response from water suppliers and local government.

Careful planning, leadership, and partnerships are essential. Local stakeholders must design and implement a publicly and politically viable plan to protect lands that provide critical drinking water supplies. This requires a complete understanding of the watershed and its threats, the identification and prioritization of key source lands, and the use of an array of conservation tools. To pay for the plan, local stakeholders should seek dedicated local funds that can leverage additional resources from federal, state, and private sources.

Local governments should also work with state and federal partners to improve and better integrate federal Clean Water and Safe Drinking Water programs and to increase their effectiveness at addressing nonpoint source pollution. Funding flexibility is the key: more creative uses of federal and state dollars, such as the Drinking Water State Revolving Fund and Section 319 of the Clean Water Act, allow local governments to secure more nonpoint source pollution funds for source protection.

Partnerships among federal, state, local, and private stakeholders extend beyond funding, providing opportunities to share essential planning data and expertise. Networks, partnerships, and resources are growing and should be utilized at every stage of the process. In many communities, innovative partnerships are also being forged with other local jurisdictions, landowners, watershed associations, land trusts, and a variety of nonprofit organizations.

Investments in watershed protection are becoming more a necessity than an option. State programs and local water suppliers support the notion that watershed planning and protection activities are key to a multiple-barrier approach. Voters support it too, with poll after poll showing support for new taxes for land conservation that protects water quality. At the federal level, the EPA supports many of these activities in principal, yet it can also work to enhance tools, promote new technology, and create more flexible funding options that help state and local programs make source protection activities a key focus in the multiple-barrier approach.

Glossary

Aquifer
An underground layer of rock, gravel, or sediment containing water. An aquifer may be confined between two impervious surfaces, or it may be unconfined.

Best Management Practices (BMPs)
Regulatory or voluntary procedures that can reduce the threat to water supplies posed by normal activities in homes, businesses, or farms.

Bioretention
A BMP that utilizes soils and both woody and herbaceous plants to remove pollutants from storm water runoff.

Emerging Contaminants
Diseases or chemicals that either are new to the environment or have been recently identified as potential health threats.

GIS Mapping and Modeling
Tools that enhance geography-related decision making. Maps and models are created from spatial and attribute data, and they are housed in a computerized Geographic Information System (GIS).

Nonpoint Source Pollution
Pollution that occurs when surface water runoff from rainfall or snowmelt moves across or into the ground, picking up pollutants and carrying them into streams, lakes, wetlands, or groundwater.

Pathogen
Any microbiological agent capable of producing disease in healthy peoples, plants, or animals.

Physical, Chemical, and Biological Monitoring
Three measurable components of water quality monitoring: Physical measurements may include temperature, flow, water color, and the condition of streambanks and lakeshores. Dissolved oxygen, suspended sediments, nutrients, metals, oils, and pesticides are examples of chemical measurements. The abundance and variety of aquatic plant and animal life are biological measurements.

Point Source Pollution
Pollution from a distinct, identifiable source, such as a feedlot or factory.

Purchase of Development Rights (PDR) and Easements
Agreement in which the residential, commercial, or industrial development rights of a particular parcel are transferred from landowner(s) to a different party. In most cases, *PDR* and *conservation easement* are interchangeable terms.

Riparian Zones
Vegetated areas abutting lakes, rivers, and streams that function as filters for polluted runoff, stabilize banks and channels, and provide habitat for fish and wildlife.

Total Maximum Daily Load (TMDL)
The amount of a particular pollutant that a stream, lake, estuary, or other body of water can contain without violating state water quality standards.

State Source Water Protection Contacts

ALABAMA

Joe Alan Power
Public Water Supply Branch
Alabama Department of Environmental Management
P.O. Box 301463
Montgomery, AL 36130-1463
PHONE: 334-271-7773
EMAIL: jp@adem.state.al.us

ALASKA

Sue Braumiller
Drinking Water Program
Alaska Department of Environmental Conservation
555 Cordova Street
Anchorage, AK 99501
PHONE: 507-269-3076
EMAIL: sbraumil@envircon.state.ak.us
WEB SITE: http://www.state.ak.us/dec/deh/water/protect.htm

ARIZONA

Mary Simmerer
Drinking Water Monitoring and Assessment Section
Water Quality Division, ADEQ
3033 North Central Avenue
Phoenix, AZ 85012-2809
PHONE: 602-207-4427
FAX: 602-207-4634
EMAIL: simmerer.mary@ev.state.az.us
WEB SITE: http://www.adeq.state.az.us/water/safe/swap.htm

ARKANSAS

Lyle Godfrey
Arkansas Department of Health
Division of Engineering
4815 West Markham Street, Mail Slot 37
Little Rock, AR 72205-3867
PHONE: 501-661-2623
FAX: 501-661-2032
EMAIL: lgodfrey@mail.doh.state.ar.us
WEB SITE: http://health.state.ar.us/eng/swpframe.htm

CALIFORNIA

Alexis Milea
Office of Drinking Water
California Department of Health Services
2151 Berkeley Way, Room 461
Berkeley, CA 94704
PHONE: 510-540-2177
FAX: 510-540-2152
EMAIL: hw1.amilea@hw1.cahwnet.gov
WEB SITE: http://www.dhs.ca.gov/ps/ddwem/dwsap/DWSAPindex.htm

COLORADO

Kim Parker
Colorado Department of Health and Environment WQCD-OA-B2
4300 Cherry Creek Drive South
Denver, CO 80246-1530
PHONE: 303-692-3582
FAX: 303-782-0390
EMAIL: kim.parker@state.co.us
WEB SITE: http://www.cdphe.state.co.us/wq/sw/swaphom.html

CONNECTICUT

Rob Hust
Connecticut Department of Environmental Protection
Water Management Bureau
79 Elm Street
Hartford, CT 06106-5127
PHONE: 860-424-3718
FAX: 860-424-4067
EMAIL: Robert.Hust@po.state.ct.us
WEB SITE: http://dep.state.ct.us

Lori Mathieu
Connecticut Department of Public Health
410 Capitol Avenue
MS#51 WAT
P.O. Box 340308
Hartford, CT 06134
PHONE: 860-509-7343
FAX: 860-509-7359

DELAWARE

John T. Barndt, P.G.
Water Supply Section
Division of Water Resources
Delaware Department of Natural Resources and Environmental Control
P.O. Box 1401
Dover, DE 19903
PHONE: 302-739-4793
FAX: 302-739-2296
EMAIL: jbarndt@dnrec.state.de.us
WEB SITE: http://www.dnrec.state.de.us/frames1.htm

FLORIDA

Donnie McClaugherty, P.G.
Water Standards and Classifications Section
Bureau of Water Resources Protection
Department of Environmental Protection
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400
PHONE: 850-921-9438
EMAIL: mclaugher_d@dep.state.fl.us

GEORGIA

Nolton Johnson
Water Resources Branch
Georgia Environmental Protection Division
East Floyd Towers, Suite 1362
205 Butler Street SE
Atlanta, GA 30334
PHONE: 404-651-5168
FAX: 404-651-9590
EMAIL: nolton_johnson@mail.dnr.state.ga.us
WEB SITE: http://www.dnr.state.ga.us/dnr/environ/pdfdoc/swappl12.pdf

HAWAII

Bill Wong
Safe Drinking Water Bureau
Hawaii Department of Health
919 Ala Moana Boulevard, Room 308
Honolulu, HI 96814
PHONE: 808-586-4258
FAX: 808-586-4370
EMAIL: waterbill@aol.com
WEB SITE: http://www.aloha.net/~will/hiswap.html

IDAHO

Lance Nielsen
Drinking Water and Waste Water Bureau
Idaho Division of Environmental Quality
1410 North Hilton
Boise, ID 83706
PHONE: 208-373-0502
EMAIL: lnielsen@deq.state.id.us
WEB SITE: http://www2.state.id.us/deq/Water.htm

Scott Short
Wellhead Protection Program
Idaho Department of Health and Welfare
Division of Environmental Quality
1410 North Hilton
Boise, ID 83706
PHONE: 208-373-0542
FAX: 208-373-0576
EMAIL: sshort@deq.state.id.us

ILLINOIS

Rick Cobb
Division of Public Water Supplies
Illinois Environmental Protection Agency
P.O. Box 19276
Springfield, IL 62794-9276
PHONE: 217-785-4787
FAX: 217-782-0075
EMAIL: epa3188@epa.il.us
WEB SITE: http://www.epa.state.il.us/water/source-waterassessment-and-protection/index.html

INDIANA

Lance Mabry
Ground Water Section
Indiana Department of Environmental Management
P.O. Box 6015
Indianapolis, IN 46206-6015
PHONE: 317-308-3318
FAX: 317-308-3339

IOWA

Dennis Alt
Iowa Department of Natural Resources
Wallace Office Building
900 East Grand
Des Moines, IA 50319-0034
PHONE: 515-281-8998

KANSAS

Jim Pennington
Kansas Department of Health and Environment
Building 283, Forbes Field
Topeka, KS 66620
PHONE: 785-296-5505

KENTUCKY

Jack Wilson
Division of Water
Natural Resources and Environmental Protection Cabinet
14 Reilly Road
Frankfort, KY 40601
PHONE: 502-564-3410
EMAIL: wilson_ja@mail.nr.state.ky.us
WEB SITE: http://water.nr.state.ky.us/dow/swap

LOUISIANA

Howard Fielding
Louisiana Department of Environmental Quality
Ground Water Protection Division
P.O. Box 82215
Baton Rouge, LA 70884-2251
PHONE: 225-765-0578
EMAIL: howardf@deq.state.la.us

MAINE

Paul Hunt
Maine Drinking Water Program
Bureau of Health, Division of Health Engineering
10 State House Station
Augusta, ME 04333-0010
PHONE: 207-287-6196
FAX: 207-287-4172
EMAIL: paul.hunt@state.me.us
WEB SITE: http://www.state.me.us/dhs/eng/water/swappage1.htm

MARYLAND

John Grace
Water Supply Program
Water Management Administration
2500 Broening Highway
Baltimore, MD 21224
PHONE: 410-631-3714
EMAIL: jgrace@mde.state.md.us
WEB SITE: http://www.mde.state.md.us/health/swap

MASSACHUSETTS

Tara Gallagher
Massachusetts Department of Environmental Protection
Drinking Water Program
One Winter Street
Boston, MA 02108
PHONE: 617-292-5930
FAX: 617-292-5696
EMAIL: tara.gallagher@state.ma.us
WEB SITE: http://www.state.ma.us/dep/brp/dws/dwspubs.htm

MICHIGAN

Elgar Brown
Ground Water Supply Section
Drinking Water and Radiological Division
Michigan Department of Environmental Quality
P.O. Box 30630
Lansing, MI 48909-8130
PHONE: 517-335-8312
FAX: 517-335-8298
EMAIL: BrownElg@state.mi.us
WEB SITE: http://www.deq.state.mi.us/dwr/swa/swa.htm

MINNESOTA

Bruce Olsen
Special Services Unit
Drinking Water Protection Section
Minnesota Department of Health
P.O. Box 64975
St. Paul, MN 55164-0975
PHONE: 612-215-0796
FAX: 612-215-0979
EMAIL: bruce.olsen@health.state.mn.us
WEB SITE: http://www.health.state.mn.us/divs/eh/dwp/swp/swp.pdf

MISSISSIPPI

Bill Wall
Division of Water Supply
Mississippi State Department of Health
2423 North State Street
P.O. Box 1700
Jackson, MS 39215
PHONE: 601-960-7518
EMAIL: billwall@mail.misnet.com

MISSOURI

G. Lawson Penny
Public Drinking Water Program
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102
PHONE: 573-526-5449
WEB SITE: http://www.cares.missouri.edu/swap

MONTANA

Joe Meek / Russell L. Levens
SWAP Section, Pollution Prevention Bureau
Montana Department of Environmental Quality
Metcalf Building, Box 200901
Helena, MT 59620-0901
PHONE: 406-444-4806 / 0471
FAX: 406-444-1374
EMAIL: jmeek@mt.gov / rlevens@mt.gov

NEBRASKA

Marty Link / Stephanie Vap
Nebraska Department of Environmental Quality
P.O. Box 98922, State House Station
Lincoln, NE 68509-8922
PHONE: 402-471-4270 / 7784
EMAIL: deq076@deq.state.ne.us / deq244@mail.deq.st.ne.us
WEB SITE: http://www.deq.state.ne.us/GroundW/nsf/TOC

NEVADA

Jon Palm
State Health Division
Bureau of Health Protection Services
1179 Fairview Drive, Suite 201
Carson City, NV 89701-5405
PHONE: 775-687-4750 ext. 229
FAX: 775-687-5197

NEW HAMPSHIRE

Sarah Pillsbury
New Hampshire Department of Environmental Services
Water Supply Engineering Bureau
6 Hazen Drive
P.O. Box 95
Concord, NH 03302
PHONE: 603-271-1168
FAX: 603-271-2181
EMAIL: s_pillsbury@des.state.nh.us
WEB SITE: http://www.state.nh.us/des

NEW JERSEY

Sandy Kreitzman
New Jersey Department of Environmental Protection
Bureau of Safe Drinking Water, CM426
East State Street
Trenton, NJ 08625-0426
PHONE: 609-292-5550
EMAIL: skreitzman@dep.state.nj.us
WEB SITE: http://www.state.nj.us/dep/dsr/swap.html

NEW MEXICO

Darren Padilla
Drinking Water Bureau
New Mexico Environment Department
P.O. Box 26110
Santa Fe, NM 87501
PHONE: 505-827-7536
EMAIL: darren_padilla@nmenv.state.nm.us

NEW YORK

Claudine Jones Rafferty
New York State Department of Health
2 University Place, Room 410
Albany, NY 12203
PHONE: 518-458-6743
EMAIL: cfj02@health.state.ny.us
WEB SITE: http://www.health.state.ny.us/nysdoh/water/swap.htm

NORTH CAROLINA

Robert Midgette
Public Water Supply System
North Carolina Department of Environmental, Health, and Natural Resources
P.O. Box 29536
Raleigh, NC 27626-0536
PHONE: 919-733-2321
EMAIL: robert_midgette@mail.enr.state.nc.us
WEB SITE: http://www.deh.enr.state.nc.us/pws/index.htm

NORTH DAKOTA

Dave Glatt
Ground Water Protection Program
Division of Water Quality
1200 Missouri Avenue
Bismarck, ND 58504
PHONE: 701-328-5217
FAX: 701-328-5200
EMAIL: dglatt@state.nd.us
WEB SITE: http://www.health.state.nd.us/ndhd/environ/wq/gw/gwindex.htm

OHIO

Mike Baker
Division of Drinking and Ground Waters
Ohio Environmental Protection Agency
P.O. Box 1049
Columbus, OH 43216-1049
PHONE: 614-644-2752
FAX: 614-644-2909
EMAIL: mike.baker@epa.state.oh.us
WEB SITE: http://www.epa.ohio.gov/ddagw/pdu/swap.html

OKLAHOMA

Mike Houts / Mike Harrell
Water Quality Division
Oklahoma Department of Environmental Quality
1000 NE 10th Street
Oklahoma City, OK 73117-1212
PHONE: 405-702-8100
EMAIL: michael.houts@OKLAOSF.state.ok.us / mike.harrell@OKLAOSF.state.ok.us

OREGON

Dennis Nelson
Oregon Department of Human Services
Drinking Water Program
442 A Street
Springfield, OR 97477
PHONE: 541-726-2587
FAX: 541-682-7499
EMAIL: dennis.o.nelson@state.or.us
WEB SITE: http://www.ohd.hr.state.or.us/cehs/dwp/swp.htm

Sheree Stewart
Drinking Water Protection Program
Oregon Department of Environmental Quality
811 SW 6th Avenue
Portland, OR 97204-1390
PHONE: 503-229-5413
FAX: 503-229-6037
EMAIL: sheree.stewart@state.or.us

PENNSYLVANIA

Joseph Lee
Division of Water Supplies, 11th Floor
Pennsylvania Department of Environmental Resources
400 Market Street, Box 8467
Harrisburg, PA 17105-8467
PHONE: 717-772-4018
EMAIL: lee.joseph@a1.dep.state.pa.us
WEB SITE: http://www.dep.state.pa.us/dep/deputate/watermgt/wsm/WSM_DWM/SrceProt/TACSWPSM.htm

RHODE ISLAND

Clay Commons
Rhode Island Department of Health
Office of Drinking Water Quality
3 Capital Hill
Providence, RI 02908-5097
PHONE: 401-222-6867 ext. 2237
FAX: 401-222-6953
EMAIL: clayc@doh.state.ri.us
WEB SITE: http://www.health.state.ri.us/environment/swaphome.htm

SOUTH CAROLINA

David Baize, Director
Bureau of Water
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201-1708
PHONE: 803-734-5323
EMAIL: baizedg@columb32.dhec.state.sc.us
WEB SITE: http://www.state.sc.us/dhec/srcewtr.htm

SOUTH DAKOTA

Anita Yan / Tricia Sebes
South Dakota DENR
Joe Foss Building
523 East Capitol
Pierre, SD 57501-3181
PHONE: 605-773-3296
FAX: 605-773-6035
EMAIL: anitay@denr.state.sd.us / tricias@denr.state.sd.us
WEB SITE: http://www.state.sd.us/denr/DES/Ground/Sourcewater/sourcewater.htm

TENNESSEE

Tom Moss
Ground Water Management Section
Division of Water Supply
Department of Environment and Conservation
401 Church Street
Nashville, TN 37243-1549
PHONE: 615-532-0170
EMAIL: tmoss@mail.state.tn.us
WEB SITE: http://www.state.tn.us/environment/dws/index.html

TEXAS

Brad Cross
Public Drinking Water Section (MC-155)
Texas Natural Resource Conservation Commission
P.O. Box 13087
Austin, TX 78711-3087
PHONE: 512-239-6020
FAX: 512-239-6050
EMAIL: bcross@tnrcc.state.tx.us
WEB SITE: http://www.tnrcc.state.tx.us/water/wu/swap

UTAH

Sumner Newman / Dan Hall
Utah Department of Environmental Quality
Division of Drinking Water
P.O. Box 144830
150 North 1950 West
Salt Lake City, UT 84114-4830
PHONE: 801-536-4195 / 4206
FAX: 801-536-4211
EMAIL: snewman@deq.state.ut.us / dhall@deq.state.ut.us

VERMONT

Elizabeth Hunt
Water Supply Division
Department of Environmental Conservation
103 South Main Street
Waterbury, VT 05671
PHONE: 802-241-3409
FAX: 802-241-3284
EMAIL: elizh@dec.anr.state.vt.us
WEB SITE: http://www.anr.state.vt.us

VIRGINIA

Gerald Peaks
Office of Water Programs
1500 East Main Street, Room 109
Richmond, VA 23219
PHONE: 804-371-2882
EMAIL: gpeaks@vdh.state.va.us

WASHINGTON

David Jennings
Division of Drinking Water
Department of Health
P.O. Box 47822
Olympia, WA 98504-7822
PHONE: 360-586-9041
FAX: 360-586-5529
EMAIL: dgj0303@hub.doh.wa.gov

WEST VIRGINIA

Bill Toomey
West Virginia Department of Health
Environmental Engineering Division
815 Quarrier Street, Suite 418
Charleston, WV 25301
PHONE: 304-558-2981
FAX: 304-558-0691
EMAIL: wtoomey@wvdhhr.org

WISCONSIN

Jeff Helmuth
Wisconsin Department of Natural Resources
Bureau of Drinking Water and Groundwater
P.O. Box 7921
Madison, WI 53707-7921
PHONE: 608-266-5234
FAX: 608-267-7650
EMAIL: helmuj@dnr.state.wi.us
WEB SITE: http://www.dnr.state.wi.us/org/water/dwg/gw/SWP.HTM

WYOMING

Kevin Frederick / Beth Pratt / Maggie Davison
Wyoming Department of Environmental Quality
Water Quality Division
Herschler Building
122 West 25th Street
Cheyenne, WY 82002
PHONE: 307-777-5985 / 7079 / 7092
FAX: 307-777-5973
EMAIL: kfrede@missc.state.wy.us / bpratt@missc.state.wy.us / mdavis@missc.state.wy.us

DISTRICT OF COLUMBIA

Sharon Gonder
DC Department of Health
Water Quality Division
2100 Martin Luther King Drive, Suite 200
Washington, DC 20020
PHONE: 202-645-6601 ext. 3087
FAX: 202-645-5622
EMAIL: sgonder@mail.environ.state.dc.us

PUERTO RICO

Olga I. Rivera
Puerto Rico Department of Health
Public Water Supervision Program
P.O. Box 70184
Edificio A. Centro Medico
San Juan, PR 00909

U.S. VIRGIN ISLANDS

Austin Moorehead
Virgin Islands DPNR/DEP
Water Gut Homes 1118
Christiansted, St. Croix 00820-5065
PHONE: 340-773-0565

Notes

1. George E. Dissmeyer, *Drinking Water from Forests and Grasslands: A Synthesis of the Scientific Literature* (Southern Research Station, Forest Service, United States Department of Agriculture, 2000), General Technical Report SRS-39.

2. Adjusted R Squared was .55 for single regression and .50 for multiple regression, including other landuse percentages such as cropland, pasture, and residential/commercial.

3. Chris S. Crockett and Chad E. Pindar, *Tools and Techniques for Modernized Source Water Protection* (Philadelphia Water Department, Office of Watersheds—Source Protection Program; prepared for the American Water Works Association—Source Protection Symposium, 2003).

4. U.S. EPA, *Our Built and Natural Environments: A Technical Review of the Interactions between Land Use, Transportation, and Environmental Quality* (Development, Community, and Environment Division, United States Environmental Protection Agency, 2001), EPA 231-R-01-002.

5. According to a recent report produced by the World Wildlife Fund and the World Bank, *Running Pure*, protecting forests—which reduce erosion and sediment, improve water quality, and in some cases capture storm water—is an effective way to clean drinking water and reduce treatment costs. Nigel Dudley and Sue Stolton, *Running Pure: The Importance of Forest Protected Areas to Drinking Water* (Washington, DC: The World Bank and WWF Alliance for Forest Conservation and Sustainable Use, 2003), Retrieved January 2004 from http://lnweb18.worldbank.org/ESSD/envext.nsf/80ByDocName/ProtectedAreasProtectedAreasManagementRunningPure.

6. National Research Council, *Assessing the TMDL Approach to Water Quality Management* (Washington, DC: National Academy Press, 2001).

7. Dissmeyer.

8. U.S. EPA, *National Water Quality Inventory: 1998 Report to Congress* (United States Environmental Protection Agency, 1998), EPA841-R-00-001.

9. Stephanie Von Feck, U.S. EPA, Office of Water (Personal communication, November 2003).

10. U.S. EPA, *Report to Congress—Paying for Water Quality: Managing Funding Programs to Achieve the Greatest Environmental Benefit* (Office of Water, United States Environmental Protection Agency, 2003), EPA 832-R-03-003. Retrieved January 2004 from http://www.epa.gov/OW-OWM.html/cwfinance/cwsrf/rtc0703.pdf.

11. U.S. EPA, *Nonpoint Source Pollution: The Nation's Largest Water Quality Problem, National Water Quality Inventory 1994* (United States Environmental Protection Agency, 1996), EPA841-F-96-004A. Retrieved January 2004 from http://www.epa.gov/owow/nps/facts/point1.htm.

12. Kimberley Roy, U.S. EPA, Office of Water (Personal communication, November 2003).

13. Luna B. Leopold, *Water, Rivers and Creeks* (Sausalito, CA: University Science Books, 1997).

14. Jim Sedell et al., *Water and the Forest Service* (Forest Service, United States Department of Agriculture, 2000), FS-660; Macara Lousberg and Jon D. Witten, *Tools for Water Resource Protection* (Materials from local government workshop, May 2002, at Midland University, Washington, DC).

15. FISRWG, *Stream Corridor Restoration: Principles, Practices and Processes* (Federal Interagency Stream Restoration Working Group, FISRWG, 1998), retrieved January 2004 from http://www.usda.gov/agency/stream_restoration.

16. Leopold.

17. Sedell et al.

18. Dissmeyer.

19. World Water Council, *World Water Vision* (London: Earthscan, 2000); Dudley and Stolton.

20. American Rivers, *Paving our Way to Water Shortages: How Sprawl Aggravates the Effects of Drought* (American Rivers, August 28, 2002), p. 5.

21. Leopold.

22. American Rivers, p. 5; U.S. EPA, *Clean Water Through Conservation* (April 1995), EPA 841-B-95-002; R. Sakrison, *Water Use in Compact Communities: The Effect of New Urbanism, Growth Management and Conservation Measures on Residential Water Demands* (Seattle: University of Washington, 1997); T. Schueler, "The Peculiarities of Perviousness," *Watershed Protection Techniques* 2:1 (1995).

23. American Rivers, p. 5.

24. Dissmeyer.

25. Ibid.

26. National Research Council, *Safe Water from Every Tap: Improving Water Service to Small Communities* (Committee on Small Water Supply Systems, Water Science and Technology Board, Commission on Geosciences, Environment and Resources, National Research Council; Washington, DC: National Academy Press, 1997).

27. The U.S. Environmental Protection Agency defines a small water system as one that serves fewer than 10,000 people.

28. U.S. EPA, *Community Water System Survey 2000* (United States Environmental Protection Agency, 2002), EPA 815-R-02-005A. Retrieved January 2004 from http://www.epa.gov/safewater/cwssvr.html.

29. National Research Council, *Safe Water from Every Tap: Improving Water Service to Small Communities.* NRC also recommends purchasing from a nearby utility, if possible, before investing in new technologies.

30. Jennifer Palmiotto, Northeast Rural Water Association (Personal communication, October 2003).

31. Jeffrey K. Griffiths, *Why Are We Protecting Source Water?: The Public Health Connection* (Graduate Programs in Public Health, Tufts University School of Medicine; presented at the 2003 National Source Water Protection Conference sponsored by the U.S. Environmental Protection Agency, June 2003).

32. Ibid.

33. Timothy E. Ford and Rita R. Colwell, *A Global Decline in Microbiological Safety of Water: A Call for Action* (Washington, DC: American Academy of Microbiology, 1996). Retrieved January 2004 from http://www.asmusa.org/acasrc/acal.htm.

34. National Research Council, *Identifying Future Drinking Water Contaminants* (1998 Workshop on Emerging Drinking Water Contaminants, Water Science and Technology Board, Board on Environmental Studies and Toxicology, Commission on Geosciences, Environment, and Resources; Washington, DC: National Academy Press, 1999).

35. Dissmeyer.

36. National Research Council, *Identifying Future Drinking Water Contaminants.*

37. Ibid.

38. Griffiths.

39. Chris Crockett, Philadelphia Water Department (Personal communication, October 2003).

40. Britt E. Erickson, "Analyzing the Ignored Environmental Contaminants," *Environmental Science and Technology* 36(7):140A–45A (April 2002).

41. U.S. EPA, *The Incorporation of Water Treatment Effects on Pesticide Removal and Transformations in Food Quality Protection Act (FQPA) Drinking Water Assessment* (Office of Pesticide Programs, United States Environmental Protection Agency, 2001).

42. USGS, *USGS Recent Highlights—Environmental Effects on Human and Wildlife Health: Pathogenic Microorganisms in Public Water Supplies* (United States Geological Survey, Department of the Interior, 1997), FS-189-97. Retrieved April 2001 from http://www.usgs.gov/themes/FS-189-97/.

43. Neil J. Hoxie et al., "Cryptosporidium—Associated Mortality Following a Massive Waterborne Outbreak in Milwaukee, Wisconsin," *American Journal of Public Health* 87, no. 12 (1997).

44. Dennis R. O'Connor, *Report of the Walkerton Inquiry: The Events of May 2000 and Related Issues* (Toronto: Ontario Ministry of the Attorney General, Queen's Printer for Ontario, 2002).

45. Carol Storms, New Jersey American Water Company (Personal communication, October 2003).

46. Erickson.

47. National Research Council, *Identifying Future Drinking Water Contaminants.*

48. USGS, *The Quality of Our Nation's Waters: Nutrients and Pesticides—A Summary* (United States Geological Survey, Department of the Interior, 1999), FS-116-99. Retrieved January 2004 from http://water.usgs.gov/nawqa; United States Congress, *Federal Incentives Could Help Promote Land Use That Protects Air and Water Quality* (United States General Accounting Office, Report to Congressional Requesters, 2001), GAO-02-12.

49. Dudley and Stolton.

50. Adjusted R squared was .55 for single regression and .50 for multiple regression, including other land-use percentages, such as cropland, pasture, and residential/commercial.

51. Ruth Samuelson, County Commissioner, Mecklenburg County (Personal communication, September 2003).

52. Caryn Ernst, Richard Gullick, and Kirk Nixon, "Protecting the Source: Land Conservation as a Source Water Protection Tool," *Opflow* (American Water Works Association, May 2004).

53. These are the averages for the 27 respondents in the survey, which included only suppliers using primarily surface water.

54. Kirk Nixon, San Antonio Water System (Personal communication, August 2003).

55. Bruce A. McCarl, *Costs of Water Treatment Due to Diminished Water Quality: A Case Study in Texas* (College Station: Department of Agricultural Economics, Texas A&M University, 1997), p. 2.

56. *Federal Register* 68, no. 154 (August 11, 2003).

57. O'Connor.

58. For more information, see Maureen Costello, "Cost to Clean Town's Water Goes Up, Voters Will Be Asked to Borrow Funds for Plants," *The Boston Globe*, October 5, 2001.

59. Lousberg and Witten.

60. Timothy E. Ford and Rita R. Colwell, *A Global Decline in Microbiological Safety of Water: A Call for Action* (Washington, DC: American Academy of Microbiology, 1996). Retrieved January 2004 from http://www.asmusa.org/acasrc/acal.htm.

61. Ed Holland, Orange Water and Sewer Authority (Personal communication, April 2003).

62. Bruce Peterson, "Control of Nitrogen Export from Watersheds by Headwater Streams," *Science* 292:86–90 (2001).

63. Ibid.

64. Dissmeyer.

65. Ibid.

66. Steve Specht, Brick Municipal Utility Authority (Personal communication, October 2003).

67. Chris Crockett, Philadelphia Water Department (Personal communication, November 2003).

68. U.S. EPA, *Elements of a State Water Monitoring and Assessment Program* (Assessment and Watershed Protection Division, Office of Wetlands, Oceans and Watershed, United States Environmental Protection Agency, 2003), EPA 841-B-03-003. Retrieved January 2004 from http://yosemite.epa.gov/ncepihom/nsCatalog.nsf/

EPATitle?SearchView&Query=Field+MediaISBNs+Contains+841B03003.

69. Chris Crockett (Personal communication, October 2003).

70. Carol Storms (Personal communication, November 2003).

71. Chris Crockett (Personal communication, October 2003).

72. Charles L. Convis, Jr., *Conservation Geography: Case Studies in GIS, Computer Mapping, and Activisim* (Redlands, CA: ESRI Press, 2001).

73. Crockett and Pindar.

74. Ibid.

75. Chris Crockett (Personal communication, October 2003).

76. Billy Turner, Columbus Water Works (Personal communication, October 2003).

77. Crockett and Pindar.

78. Ed Holland (Personal communication, February 2003).

79. Suzanne Flagor, Seattle Public Utilities (Personal communication, November 2003).

80. Trust for Public Land, *Landvote 2003* (Washington, DC: The Trust for Public Land and the Land Trust Alliance, 2004); Trust for Public Land, *Landvote 2002* (Washington, DC: The Trust for Public Land and the Land Trust Alliance, 2003).

81. U.S. EPA, *Report to Congress—Paying for Water Quality: Managing Funding Programs to Achieve the Greatest Environmental Benefit* (Office of Water, United States Environmental Protection Agency, 2003), EPA 832-R-03-003. Retrieved January 2004 from http://www.epa.gov/OW-OWM.html/cwfinance/cwsrf/rtc0703.pdf.

82. For more information, see "Loan's Aim Is Cleaner Water: EPA Incentive Gets Attention in Vermillion," *Plain Deal Reporter*, September 25, 2000.

83. Jason Corzine, Trust for Public Land (Personal communication, October 2003).

Design, composition, and production by
Wilsted & Taylor Publishing Services,
Oakland, California

PUBLICATIONS *by*

THE TRUST *for* PUBLIC LAND

Order your copies online at www.tpl.org/publications

Local Greenprinting for Growth

Using Land Conservation to Guide Growth and Preserve the Character of our Communities

A four-part series guiding agencies and conservation professionals protecting open space. The handbooks focus on Greenprinting, a long-term strategy for guiding development and growth. The four volumes include: an overview; defining a conservation vision; securing conservation funds; and acquiring and managing park and conservation lands.

By Kim Hopper

$15 for each volume $25 for set of four

Conservation Easement Handbook

AVAILABLE FALL 2004

Published with the Land Trust Alliance

Conservation easements are the premier legal tool for addressing strategic land conservation priorities in America's communities. This expanded handbook—an update of the 1988 original—is the definitive practical and technical resource on conservation easements and best practices for their use. For conservation professionals navigating the legal complexities of easements.

By Elizabeth Byers and Karin Marchetti Ponte $40

Conservation Finance Handbook

How Communities are Paying for Parks and Land Conservation

Between 1996 and 2003, TPL's Conservation Finance Program helped states and communities design and promote ballot measures that created more than $35 billion in new park and open space funding. Now TPL conservation finance experts have created a handbook for communities seeking to raise conservation funds at the ballot box—from initial demographic research to post election analysis. Topics Include: measuring public opinion, designing a winning measure, and running a conservation campaign.

By Ernest Cook and Kim Hopper $21.95

Source Protection Handbook

AVAILABLE FALL 2004

Using Land Conservation to Protect Drinking Water Supplies

Local governments, water suppliers and agencies, and community drinking water advocates will benefit from this new how-to handbook containing guidance for identifying source water conservation opportunities, implementing source water conservation programs, and acquiring and protecting the lands that will help keep drinking water clean.

By Kim Hopper and Caryn Ernst $25

American Water Works Association

6666 West Quincy Avenue,
Denver, CO 80235
tel 800-926-7337 / fax 303-347-0804
www.awwa.org

The Trust for Public Land

116 New Montgomery Street,
Fourth Floor, San Francisco, CA 94105
tel 800-714-5263 / fax 415-495-4103
www.tpl.org

$15.00

ISBN 1-932807-02-0

printed on recycled paper