Ground Water & Source Water Protection

Key Message

Access to clean, safe drinking water is the essential ingredient to a healthy and viable community. Severe human health, ecological, and economic consequences follow from losses of current and future drinking water sources—losses that can be prevented. The potential for contamination of drinking water, coupled with the high cost of treating water and locating and developing alternate water sources, makes it imperative that federal, state, and local entities adopt and implement effective strategies for long-term protection of drinking water sources.

Congress and USEPA have taken the first step in developing such strategies by requiring assessments of all public water systems—termed Source Water Assessment and Protection. To be most effective, assessments and strategies must be based on an understanding of the factors that affect water quality and quantity, including how surface water interacts with ground water, how water quality factors into water availability, and how the management of potential water contamination involves everyone.

Our Source Water Protection Imperative

"When we honor water, we honor ourselves and the rest of life."

Veer Bhadra Mishra

why Source Water Protection matters to ground water...

All drinking water sources, both public and private, are vulnerable to contamination from an array of human activities such as septic system discharges, waste-site releases, underground storage system leaks, nonpoint-source pollution, and agricultural chemicals. Without diligent attention to managing these potential sources of contamination, our drinking water will come at a higher cost over time. This cost includes the increasing need for water treatment, monitoring, remediation, finding alternate water supplies, providing bottled water, consultants, staff time, and litigation. Source water protection is simpler, less expensive, and more reliable over the long term.

Drinking water wells are rarely as visibly contaminated as the water from this well, which is being pumped to waste, at a former wood treating facility in Minnesota. Routine monitoring is necessary to determine water quality; however, even with monitoring, it is often difficult to pinpoint an actual cause of contamination and many pollutants are not even looked for or assessed.

Prevention Costs a Whole Lot Less

If an aquifer that supplies drinking water to a community becomes contaminated, the cost of restoring clean drinking water to that community skyrockets far beyond what it costs to treat water. Research is needed to quantify the costs and benefits of source water protection so that cost/benefit analysis tools can be developed to help communities and stakeholders quantitatively assess the potential merit of source water protection. Some rough estimates were collected from USEPA Region 10. (See Table 1.)

Burlington, North Carolina, is a good example of how a community can save money by going the source water protection route. When the herbicide atrazine was found in the water supply, Burlington worked to eliminate the pollutant rather than pay to treat an ongoing contamination problem. Using water quality monitoring and guidance from the Water Resources Research Institute (WRRI), the city was able to trace the atrazine to agricultural operations in parts of the water supply watershed. With the help of Cooperative Extension Service agents, farmers came to understand that

Key Term

SOURCE WATER

Untreated water from rivers, streams, lakes, or aquifers that is used to supply public drinking water.

DELINEATED SOURCE WATER PROTECTION AREA

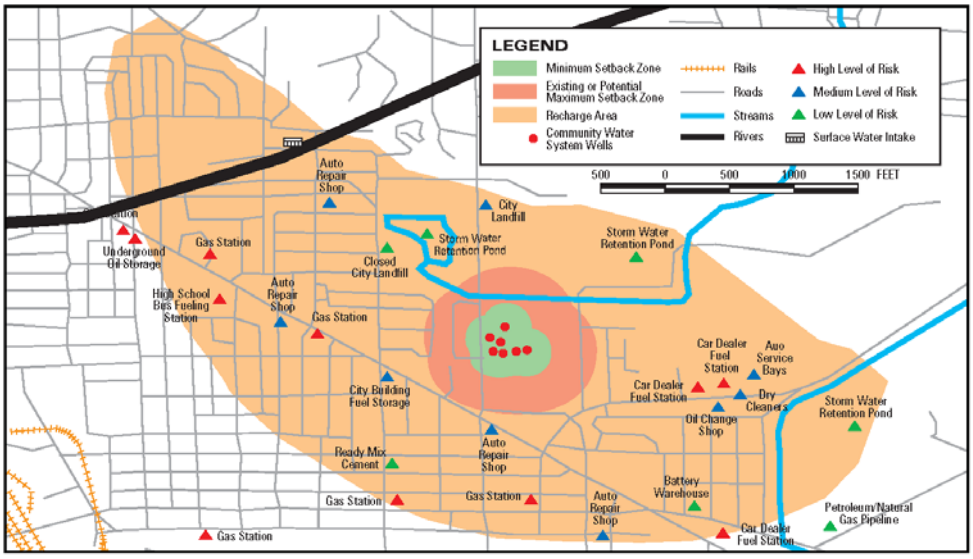

Figure 1. *This sample map shows the delineation of a Source Water Protection Area and includes locations of known and potential sources of contamination to drinking water sources in that area.*

Source: Consider the Source: A Pocket Guide to Protecting Your Drinking Water, USEPA.

the water treatment plant did not remove atrazine and, with subsidies from the city, they transitioned to other pesticides and practices.

This approach resulted in a total cost to Burlington of $30,000 (for lab analyses and subsidies to farmers). Contrast that one-time expense with an estimated cost of $108,000 per year to treat contaminated ground water with activated carbon. By implementing source protection, Burlington not only has clean drinking water again, it has eliminated the source of the problem. (North Carolina Division of Water Quality, 2002)

The Big Push for Local Source Water Protection

While public water system operators have primary responsibility for delivering safe drinking water, they do not control the many potentially harmful land-use activities and decisions that take place beyond their operational jurisdiction—often the source areas of the water they collect from water intakes or wells. This responsibility lies primarily with community decision makers, such as planning and zoning boards, municipal administrators, health departments, public works departments, and the general public. Protection of private ground water sources is typically left to the well owner and the health department.

In many instances, public and private drinking water source water areas extend beyond a community's or a private well owner's jurisdiction—out of their immediate control. To adequately protect source water, the identification of potential sources of contamination, elimination of threats, and application of best management practices to address these threats must occur

COMMUNITY	CONTAMINATION COST	BASIC SOURCE WATER PROTECTION COST	RATIO OF CONTAMINATION TO SOURCE WATER PROTECTION
Gilbert	$547,323	$2,744	200:1
Norway	$545,904	$101,014	5:1
Tumwater	$570,813	$22,073	26:1
Gettyburg	$4,015,351	$22,579	178:1
Dartmouth	$1,176,646	$99,052	12:1
Middletown	$491,823	$22,761	22:1

Table 1. *Examples of relative costs of source water contamination versus prevention measures in selected USEPA Region 10 communities.*
Source: Eric Winiecki, USEPA Region 10.

Photo: Brian Hicks

Photo: Donald Childs Jr.

Top: Sacramento River water intake sign.
Bottom: Sacramento river and intake facility.

throughout the geographic area influencing the aquifer or surface water source.

Our challenge is to ensure that both public and private sectors take ground water resource protection into account in development plans, ordinances, public works practices, construction practices, and other land-use decisions. Indeed, all citizens share responsibility for source water protection.

The 1996 Safe Drinking Water Act (SDWA) Amendments took a bold and essential step forward in protecting sources of drinking water by requiring every state to take a serious look at potential contamination threats to public drinking water supply sources, including ground water sources. These new requirements set the stage for providing citizens with a better understanding of potential threats to drinking water. The underlying principle in source water protection is that prevention is the most effective and efficient method to assure long-term safe water.

This program has gotten off to a promising start; however, it must be nurtured. The states' ability and willingness to sustain these efforts is uncertain, since the SWDA placed no requirements on communities to follow up on the state programs and implement the steps needed to protect source water, nor did it provide funding to carry out the implementation.

DRINKING WATER SOURCES AND HUMAN ACTIVITY

Any human activity that alone or cumulatively degrades the quality of source water is a threat to source water. Many types of land uses have the potential to contaminate ground water—spills from tanks, trucks, and railcars, leaks from buried containers,

LAND AREA CONTRIBUTING TO GROUND WATER RECHARGE

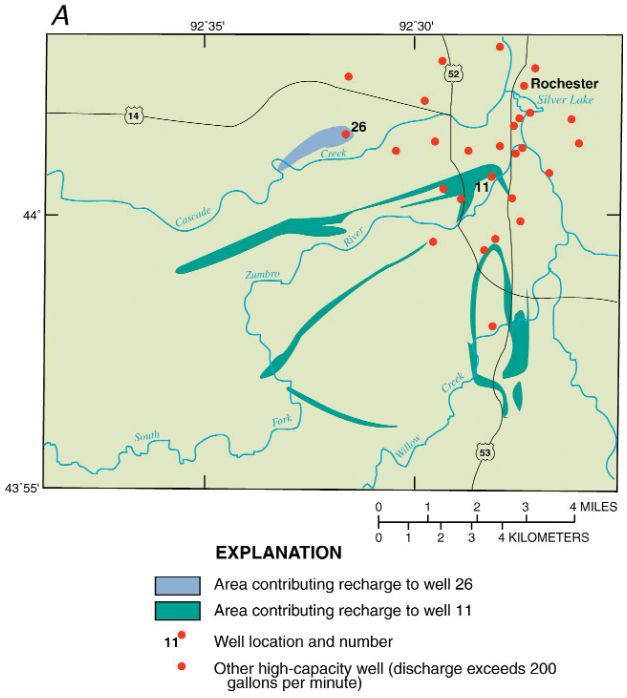

Figure 2. *Most human-derived contaminants enter ground water after passing through unsaturated soil. A second important point of contaminant entry is at the beds and banks of streams, reservoirs, lakes, and wetlands. One approach to protecting public ground water supplies is to estimate the area contributing recharge to public supply wells and then to implement ground water protection practices within that area. This map shows the recharge area for the wells for the City of Rochester, Minnesota.*

Source: USGS, http://water.usgs.gov/ogw/pubs/Circ1174/circ1174.pdf

failed septic systems, burial or injection of wastes underground, use of fertilizers, pesticides, and herbicides, road salting, and polluted urban and agricultural runoff. While catastrophic contaminant spills or releases can wipe out a water resource, ground water degradation, in particular, can also result from a plethora of small releases of harmful substances, such as gasoline from a nearby service station or perchlorethylene from a dry cleaner.

Ground water degradation can be acute, the result of a sudden event, or it can be the gradual and insidious erosion of water quality. Contaminants can cumulatively impact the resource and degrade it over time. According to USEPA, nonpoint-source (NPS) pollution (when water runoff moves over or into the ground, picking up pollutants and carrying them into surface water and ground water) is the leading cause of water quality degradation.

Photo: Paul Jehn

Nationally, states rank agriculture as the second most prevalent and threatening potential source of contamination for both ground and surface water sources of drinking water. Pathogens that can be carried in animal waste include E. coli, salmonella, cryptosporidium, and giardia. Source water from waste generated from upstream concentrated animal feeding operations require additional treatment and may require additional technology to achieve required results. There are many efforts at all levels of government to prevent contaminants from animal feedlots from entering source waters.

Pathogens and the Ground Water Rule

Viral and bacterial pathogens are present in human and animal feces, which can, in turn, contaminate drinking water. Fecal contamination can reach ground water sources, including drinking water wells, from failed septic systems, leaking sewer lines, and by infiltrating soil and fractured bedrock. The Centers for Disease Control and Prevention reports that, between 1991 and 2000, ground water systems were associated with 68 outbreaks that caused 10,926 illnesses.

To provide for increased protection against microbial pathogens in public water systems that use ground water sources, USEPA issued its Ground Water Rule in November 2006. There are several components to this rule that apply to all community and noncommunity water systems. They include determining the sensitivity of the groundwater system; performing additional monitoring for total coliform-positive samples; correcting significant deficiencies identified in the system's sanitary survey; and taking corrective actions after certain triggers are exceeded. Systems must begin to comply with the new requirements by Dec. 1, 2009. For more information on the Ground Water Rule see: *http://www.epa.gov/safewater/disinfection/gwr/index.html*

Source Water and Ubiquitous Pesticides

Our world is filled with potential threats to ground and surface water, but one such threat is remarkably widespread—the array of pesticides (including herbicides) used on agricultural fields, lawns, gardens, golf courses, along highways, and even around the home. As a society, we are somewhat lax about our use of pesticides, not necessarily considering the potential health risks associated with exposure. Adding to this is the fact that many contaminants and their breakdown products do not have drinking water standards or guidelines. A 2007 USGS report, *Pesticides in the Nation's Streams and Ground Water,* 1992–2001, says, for example, that only about half the pesticides and volatile organic compounds (VOCs) measured by the USGS National Water Quality Assessment (NAWQA) Program have current USEPA standards.

EPA's Office of Pesticides relies on USGS for high-quality, nationally consistent monitoring data for pesticide registration and for its assessments of pesticide exposure. The federal Food Quality Protection Act (FQPA) requires USEPA to factor potential exposures to pesticides through drinking water into already complex procedures used to set pesticide "tolerance levels" in foods. NAWQA data helps guide USEPA's decisions on the commonly detected herbicides aldicarb, alachlor, and acetochlor, and the insecticides

chlorpyrifos, diazinon, and carbofuran.

State source water assessments (see page 4•7) have shown that both agricultural and residential land uses are in the top five most prevalent and most threatening potential sources of ground water contamination. According to USGS, we need to better understand the correlations of pesticide occurrence with the amounts and characteristics of pesticides used so that we can anticipate and prioritize the pesticides most likely to affect water quality in different land-use settings.

The entire hydrologic system and its complexities must be considered in evaluating the potential for pesticide contamination of source water. Protection efforts must be made at the local level, and they are very challenging. Many times the solution is educating people in all sectors on the proper use of pesticides, which boils down to finding ways to minimize use or find less threatening alternatives.

OVERVIEW OF PESTICIDE OCCURRENCE

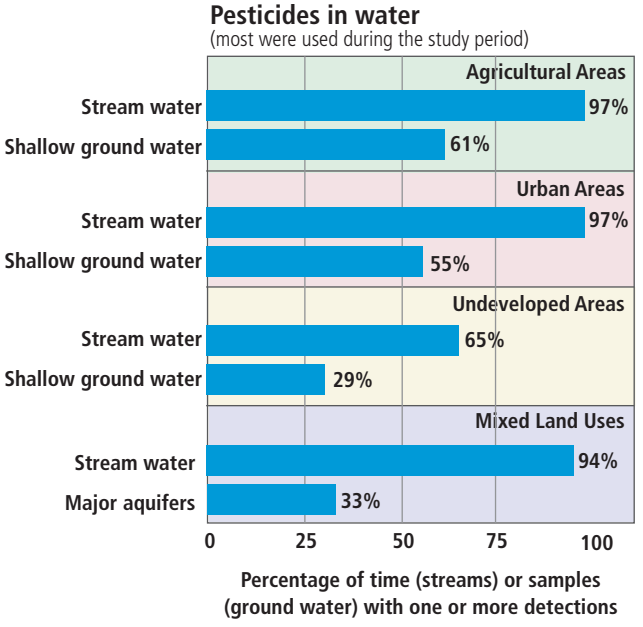

Figure 3. *In this NAWQA study,* Pesticides in the Nation's Streams and Ground Water, 1992 – 2000, *one or more pesticides were detected in water more than 90 percent of the time during the year in streams draining watersheds with agricultural, urban, and mixed land uses. In addition, some organochlorine pesticides that have not been used in the United States for many years were detected along with their degradates and by-products in most samples of whole fish or bed sediment from streams sampled. Pesticides were less common in ground water, but were detected in more than 50 percent of wells sampled to assess shallow ground water in agricultural and urban areas.*

Source: USGS http://pubs.usgs.gov/circ/2005/1291/pdf/circ1291.pdf

Photo:USGS

The most intensive pesticide applications are in agricultural and urban areas, including substantial use for residential lawn and garden pest control. Reducing the use of pesticides is the most effective way to reduce their concentrations in the hydrologic system.

Looking at the Entire Hydrologic System and Its Complexities

Ground water protection and drinking water protection overlap to a considerable extent. Protection of any drinking water source must be carried out in the context of the land area that influences the water supply, whether it is the area upstream of a surface water intake or a wellhead protection area. For ground water supplies, an understanding of ground water hydrology within a delineated watershed or aquifer system provides the basis for evaluating the vulnerability and sustainability of that source water and the means for determining how it can be protected and preserved.

Regardless of its intended use (drinking or other purposes), all water is a segment of a watershed's or aquifer system's water budget, which must be maintained at a healthy level to be viable. Watershed viability requires that we apply exact hydrologic science and facts before we transfer water across basins. Where we locate new development, the degree to which we draw down existing water resources, and how well we provide for future and/or alternative water sources are all functions of the watershed or aquifer budget, and therefore source water protection.

SOURCE WATER ASSESSMENT PLANS

Although many states, water systems, and localities have had watershed and wellhead protection programs since the 1980s, the 1996 SDWA Amendments broadened the focus of these programs by requiring all states to develop a Source Water Assessment Plan (SWAP). The state SWAPs include the following required assessment activities:

- Delineate the source water protection area for all public water supply sources (wellhead protection area for ground water sources; watershed area for surface water sources)—160,000 nationwide.
- Conduct an inventory of potential sources of contamination in each delineated area.
- Determine the susceptibility of each water supply to those contamination sources. (The information from these three steps is compiled into a report called a source water assessment.)
- Release the results of the assessments to water systems and to the public.

The ultimate goals of this program are to prevent contamination of public drinking water sources, avoid the costs of dealing with contamination, and protect public health by motivating water suppliers and concerned citizens to develop and implement local Source Water Protection programs (SWP programs). Source water protection, by its very nature, requires the effective integration of key federal, state, and local functions. The success of the program depends on the ability of communities to adopt protective measures and strategies and develop partnerships with water suppliers, businesses, states, and the local citizenry.

MOST PREVALENT POTENTIAL CONTAMINATION SOURCES

GROUND WATER (46 states reporting)	SURFACE WATER (46 states reporting)
1. Commercial/Industrial	1. Commercial/Industrial
2. Agriculture	2. Agriculture
3. Wastewater	3. Wastewater
4. Residential	4. Transportation
5. Contamination sites	5. Residential

Table 2. *National Source Water Assessment Summary data showing top five most prevalent potential contamination sources.*

MOST THREATENING POTENTIAL CONTAMINATION SOURCES

GROUND WATER (46 states reporting)	SURFACE WATER (46 states reporting)
1. Commercial/Industrial	1. Commercial/Industrial
2. Agriculture	2. Agriculture
3. Residential	3. Wastewater
4. Contamination sites	4. Transportation
5. Wastewater	5. Residential

Table 3. *National Source Water Assessment Summary data showing top five most threatening potential contamination sources.*

REGIONAL SUMMARY DATA

SOURCE WATER ASSESSMENTS COMPLETE			
	% CWS	% all NC	% all PWS
National Total	**99%**	**98%**	**99%**

SOURCE WATER PROTECTION STRATEGIES (NATIONAL TOTALS)		
	CWS	Pop
Protection Strategy in Place	**43%**	**50%**
Protection Strategy Substantially Implemented	**24%**	**34%**

2005 data used for states that did not report in 2006 (SD, WY, and CA). Total percentages based on systems/population in SDWIS (Q4 2005).

Table 4. *A 2006 summary of USEPA regional data showing percent of completed source water assessments for community water supplies (CWS), noncommunity water supplies (NC), and public water supplies; percent of strategies in place; and strategies substantially implemented for CWS and total population.*

Source: US EPA

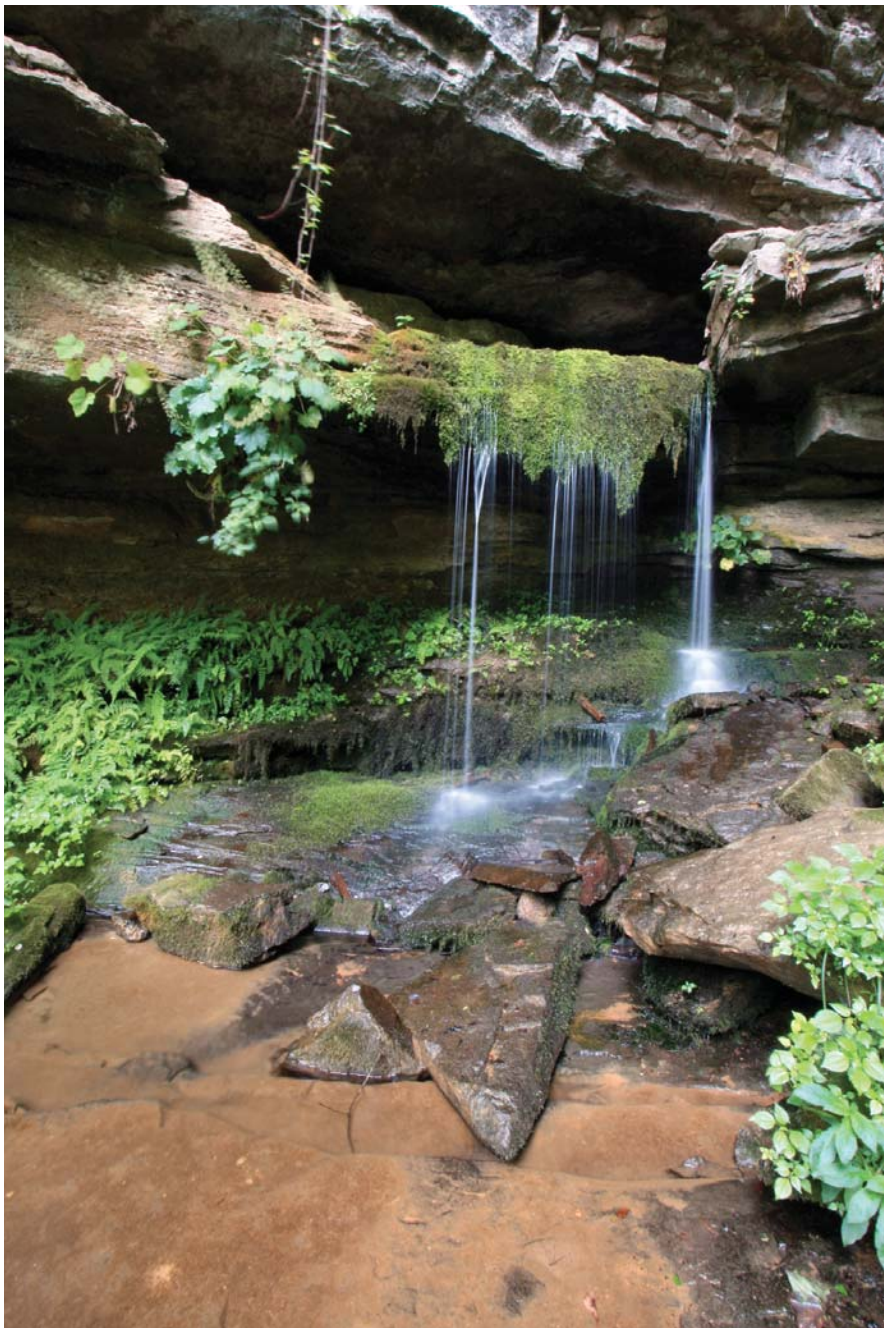

Photo: Alan Cressler

Tennessee is blessed with an abundance of high-quality ground water. The vulnerability, quantity, and quality of the state's ground water sources are inextricably linked to the geology, particularly karst terrain (limestone characterized by caves, sinkholes, and springs) and in unconfined sand aquifers. This vulnerability is particularly true for contamination from volatile organics (e.g., chlorinated solvents, gasoline components), which are highly mobile and widely used. In Tennessee, approximately 1.5 million people rely on public water systems that use ground water as a drinking water source.

Are the Assessments Improving Source Water Protection?

Most states have completed their source water assessments for public water systems and have made the assessments available to the public. Each assessment provides a concise summary of available information regarding the source(s) (e.g., well, lake, river) supplying a public water system. These documents are normally produced by state source water protection staff and are intended to provide basic information to public water suppliers and the general public regarding: (1) where their drinking water comes from, and (2) the degree to which it may be impacted by potential sources of contamination. (See Tables 2 and 3.)

States are at various stages of developing and implementing their source water protection strategies. Though states are not mandated to implement source protection, they are expected to develop their own Source Water Protection programs and strategic plans. States are using their assessment reports in different ways. Drinking water agencies are using them to help improve their programs by prioritizing overall protection efforts, upgrading contaminant inventories, and targeting education and outreach efforts. Some state agencies are also looking seriously at coordinating source water protection with other overlapping programs, such as underground storage tanks and onsite sewage disposal.

States have provided the completed assessment reports to their public water system owners and appropriate municipal officials. However, use of the assessments has been limited at the local level (USEPA, 2005). This is not surprising, in that many local governments lack the technical and human resources to facilitate developing and implementing source protection strategies—some may also lack sufficient motivation.

Typically, communities and public water suppliers need encouragement and assistance from state agencies and/or non-government organizations, such as state chapters of the National Rural Water Association, Trust for Public Land, and Cooperative Extension Service, and involvement from agricultural, industrial, and development sectors within the community. They need help in understanding how to use the assessments as tools for developing a source protection strategy and interpreting the results. In this type of collaboration among various sectors of the community, it is critical to maintain a focus on source water protection planning as well as the implementation of identified protection measures.

The Importance of Keeping Track

Source Water Protection programs have started off well. However, the initial assessments are just a springboard for putting effective long-term protection measures in place. Next steps will require adequate federal support to the states and in turn adequate

KING & QUEEN COUNTY, VIRGINIA,WATER QUALITY: SOURCE DRINKING WATER SUPPLY

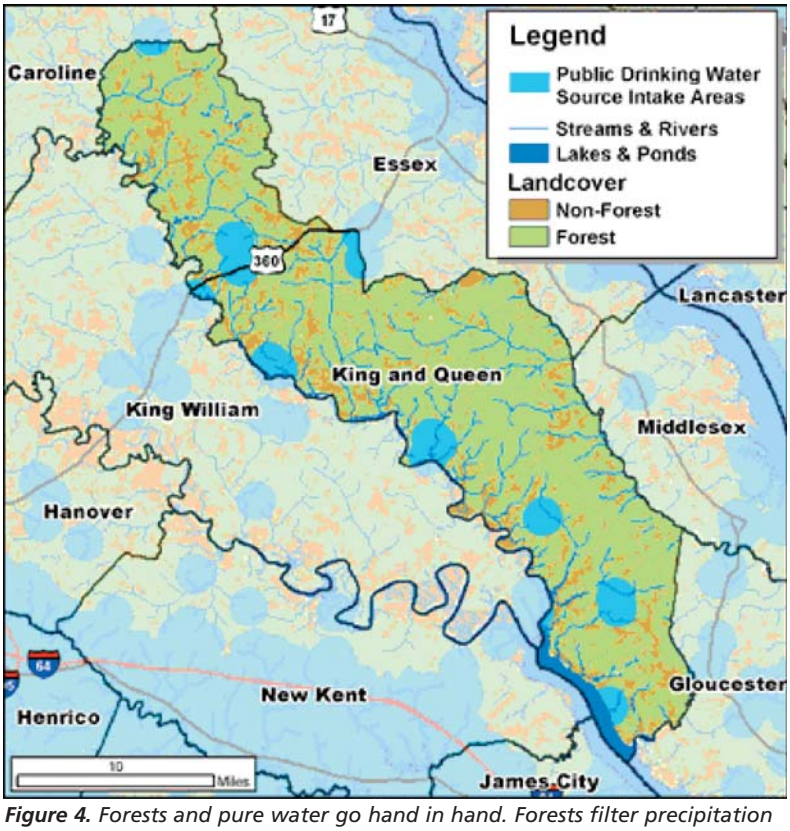

Figure 4. *Forests and pure water go hand in hand. Forests filter precipitation as it infiltrates ground water. Forests also diminish the impact of powerful storms by intercepting rainfall and filtering stormwater.*

Source: Virginia Department of Forestry http://www.dof.virginia.gov/R2/kaq-wq-source-water.shtml

NEW HAMPSHIRE MOVES FORWARD ON MUNICIPAL SOURCE WATER PROTECTION ACTIVITIES

New Hampshire's Drinking Water Source Protection Program emphasizes local implementation of source water protection in addition to state-level activities. Prompted by USEPA's annual request for water system–specific information on source water protection, the N.H. Department of Environmental Services (NHDES) had developed a fairly complete picture of protection measures implemented by water suppliers. Missing, however, was information on the extent to which municipal ground water protection ordinances helped protect public water supply sources.

Beginning with a survey of municipalities and a review of local ordinances in cooperation with the state's Office of Energy and Planning and with the assistance of the Ground Water Protection Council (with USEPA funding), NHDES compiled a geographic database of local ground water protection ordinances that will serve as a planning resource for local communities. The project revealed, for example, that 12 percent of community water system ground water sources are protected using local land-use restrictions in at least 50 percent of their wellhead protection areas.

The data set is also being used by NHDES to target activities it will undertake to help fill in the gaps in local protection and to provide guidance to municipalities on improving their ground water protection-related ordinances. NHDES is also working to extend the data set to include the protection of surface water sources through local shoreland protection ordinances.

Photo: NH DES

A private well in New Hampshire.

state support to communities and utilities (USEPA, 2005). In order to maintain federal funding, tracking and reporting progress is particularly important.

This track record is a means of informing Congress about where funding, such as Drinking Water State Revolving Funds (DWSRFs) set-asides for drinking water protection, is necessary. States also need to know what is occurring at the local level and, thus, need a means for gathering, tracking, interpreting, and reporting on local source water protection efforts. Measuring and characterizing state and local SWPs can provide the data and information states need to inform decision makers about where to target or refine source water protection activities.

GAPS AND OBSTACLES

While Congress mandated that the states develop a state Source Water Assessment Plan (SWAP) and complete their source water assessments, the state Source Water Assessment and Protection programs are not mandated. Congress and EPA anticipated that states and locales would voluntarily take the assessments and develop source protection programs that would address local issues and many are trying to do this. But given the serious lack of financial and human resources, when it comes to tasks states are required to do by federal mandate versus others that are not mandated but that also need to be done (voluntarily), state environmental and health agencies find themselves pushed into a corner, making choices based on mandates and funding.

Federal and state programs can lose sight of the need for long-term water-supply protection as they balance resources between regulatory requirements and long-term goals. There has also been a lack of effective coordination among state SWPs and other federal programs, such as USEPA's clean water program, U.S. Department of Agriculture, Bureau of Land Management, U.S. Forest Service, and their affiliated state counterparts.

Water suppliers and municipalities are expected to make use of their source water assessments voluntarily, but in most cases this cannot happen without education, financial and technical assistance, and a local champion. Utilities that supply drinking water are often not able to focus on source water protection for several reasons:

- The land encompassed in source water areas is not under their ownership or jurisdiction.
- They must meet daily challenges of delivering water.
- They are busy maintaining the infrastructure, treatment, and monitoring.
- They are concerned with complying with regulatory requirements.
- They must position themselves to accommodate growth.

There are several significant gaps associated with the current federal source water requirements that underscore why protecting all ground water regardless of use is critical. First, while the assessments provide an initial snapshot of threats, there is no requirement for the routine reassessment of potential contaminant sources, and new development typically brings new threats to source water. Second, the program addresses only current sources of public water, not potential future sources. If we strive to protect only current drinking water sources, we not only put future sources at risk, we also allow for the potential that unprotected sources will influence the quality of current sources.

Furthermore, the Source Water Protection program addresses only public drinking water covered by the federal Safe Drinking Water Act, not private water wells. More than 42 million people in the United States obtain water from private wells (Solley et al., 1998), which may or may not draw from the same

ground water as public supplies. In some cases, private wells have a greater vulnerability to contamination, especially if they are inadequately constructed or if their water quality is not routinely checked. States and private organizations have, however, taken steps to provide homeowners with information on how to protect their water wells.

Congress and USEPA need to set attainable goals, provide technical guidance and information management assistance, and make a financial commitment to ensure successful development of state Source Water Protection programs. According to a 2005 USEPA Inspector General's report, "There is no consistent and secure source of funding for source water protection activities." The report says that states rely heavily on DWSRF set-asides and annual appropriations, which several other competing regulatory programs also rely on, for source water protection program administration and implementation. There are also some limited funding options available through other state and federal programs. Without a sustained commitment to source water protection at both the federal and state levels, the significant health and economic benefits of source water protection will remain limited.

SOME SUCCESSFUL STRATEGIES

The clear intent of the SWAP Program was to analyze existing and potential threats to the quality of public drinking water. To accomplish this, states made a tremendous investment in time and money. Nationwide, approximately 160,000 water systems were assessed. Now that this effort is complete, a new question has emerged: What is the best way to build upon SWAP results and achieve tangible progress in source water protection?

Despite various obstacles, there are numerous examples of states that have found opportunities for achieving more widespread implementation of source water protection. Statewide approaches that partner, integrate, and leverage federal, state, and local programs can effectively drive source water protection goals and have a positive outcome for many related pubic health program goals.

Sharing information among programs can greatly improve effectiveness. Many state drinking water programs have posted source protection areas on their websites or shared data by other means to encourage other agencies and municipalities to take these areas into consideration with regard to making land-use and permitting decisions and setting cleanup priorities.

The USEPA Office of Ground Water and Drinking Water (OGWDW) has been advocating for more effective integration of existing federal programs with source water protection objectives. This has taken the form of encouraging both federal and state agencies to seek opportunities such as those described above for cross-program integration.

Photo: Zachary Jean Paradis - http://www.flickr.com/photos/zacharyparadis/499059710/

A drinking water intake and "crib" in Lake Michigan. A water crib collects water from close to the bottom of a lake to supply a pumping station onshore. At this facility, water is collected and then transported via pipes 200 feet below the lake's surface to pumping stations at purification plants at the shores of the lake; from there the water continues on its journey to the Chicago area.

Photo: K.M. Neitzert, USGS

A well house for a municipal well in Tripp County, South Dakota.

Much success has been made in improving coordination between OGWDW and USEPA's Office of Underground Storage Tanks, specifically with promoting and enabling inspection, enforcement, and cleanup prioritization in source water areas. This successful initiative could be duplicated with other programs as well. Opportunities for such program/agency integration include Clean Water Act programs (e.g., NPDES, TMDL, other watershed initiatives, standards, water quality criteria, monitoring, stormwater, onsite wastewater treatment), Resource Conservation and Recovery Act programs (e.g., small- and large-quantity generators, solid waste, household hazardous waste), pesticides and other agricultural programs, forestry, transportation, and CERCLA (Superfund) programs.

Louisiana – The Louisiana Source Water Assessment Program illustrates how state programs can work together to each other's advantage using source water as a prioritization tool. For example, the Louisiana Department of Environmental Quality's (LADEQ's) Source Water Program is notified by the Louisiana Department of Health and Hospitals (DHH) when new wells come on line or when wells go out of service so that LADEQ can update its SWAP database and conduct a Source Water Assessment for the new wells. This keeps Source Water Assessments current and available for use by DHH when it conducts sanitary surveys.

The Louisiana Department of Natural Resources (LADNR) lets the Source Water Program know when high-volume wells are applying for a permit so they can evaluate whether a drinking water supply will be adversely impacted. LADNR is involved with aquifer quantity issues while the LADEQ Program focuses on aquifer quality issues. Both assist local Source Water Protection Committees and give public presentations on water quantity issues throughout the state. In addition, the Natural Resource Conservation Service (NRCS) has access to all of the Source Water Protection Areas in the state and can use this information to induce farmers to take farm land out of production in these areas as part of the Conservation Reserve Program.

THE LAKE CHAMPLAIN BASIN ATLAS

Phosphorus Loads

Initial (1995) and Target Phosphorus Loads by Lake Segment Showing Adjacent Watersheds in Metric Tons/Year (mt/yr)

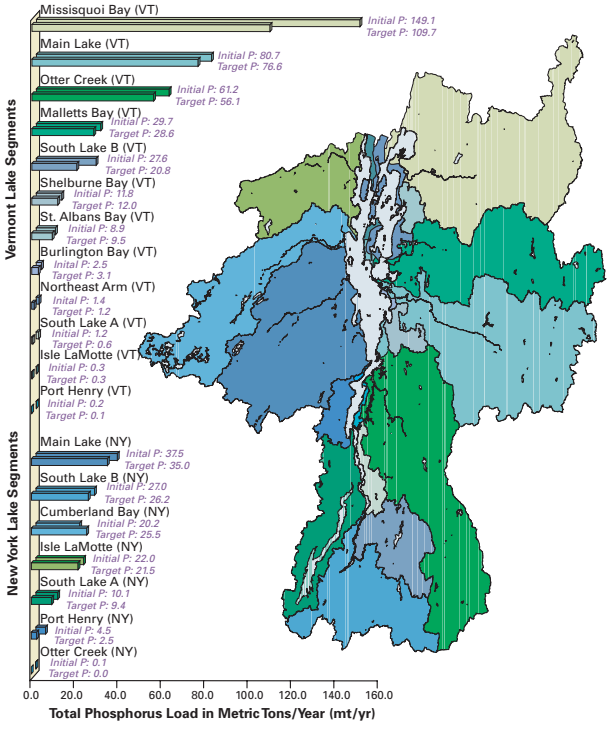

Figure 5. *Lake Champlain is a reservoir of about 188,000 people, or 32% of the basin population. Almost all (about 98%) of these people obtain their water from 100 public water supplies monitored and regulated by three jurisdictions—Vermont has 73 systems, New York has 26, and Quebec, Canada, has one. Phosphorus, found in lawn fertilizers, manure, and human and other animal waste, causes algal blooms and excessive aquatic plant growth in the lake. These plants and the water quality problems that occur when they decompose can harm fish and other organisms and affect public water supplies. The three jurisdictions have agreed to reduce phosphorus loads to each of Lake Champlain's segments. This Phosphorus Loads Map shows the area draining to each of the lake segments and both the initial (1995) and target phosphorus loads for each.*
Source: http://www.lcbp.org/ATLAS/HTML/is_pload.htm

LADEQ is most proud of its direct efforts to work with local communities. Department representatives work with local communities to form teams of local citizens, water suppliers, and government officials and to provide technical assistance in developing community-based Source Water Protection programs.

Oregon – The Oregon Drinking Water Protection Program has had success communicating directly with county planners, other state agencies, and public water providers. The Oregon Drinking Water Program (ORDWP) staff/management team meets regularly to discuss feedback and concerns from its partners. The drinking water assessment GIS data was sent to each county's board of commissioners, land-use planners, health departments, and GIS departments for incorporation into land-use planning and special-area designations at the local and county levels.

Counties and cities are now able to directly overlay the identified drinking water source areas onto other planning information available to them. The program is now working to integrate the drinking water protection work with the existing watershed approach used for other Clean Water Act implementation both at the Oregon Department of Environmental Quality (ORDEQ) and other state agencies such as the Oregon Department of Transportation, Oregon Department of Agriculture, and Oregon Department of Forestry.

Early in the state's source water protection implementation efforts, it became clear that a method was needed to prioritize water systems based on their susceptibility to contamination and the specific risks they faced. This prioritization was undertaken statewide to create a risk ranking (Tiers 1 – 4) of surface water and ground water systems. The state is focusing technical assistance toward high-risk systems first.

To assist the individual ground water supply systems with their protection efforts, the Oregon Department of Human Services (ORDHS) and the ORDEQ developed an Implementation Matrix, which presents information on relative risk in a format that water systems can use to identify and prioritize their own efforts. Prior to meeting with a community, the state calculates a "relative benefit" score for each identified potential contaminant source (PCS) based on the susceptibility of the drinking water source to a specific PCS and the location of that PCS within the source water protection area. This score reflects the relative benefit to the community of reducing the risk from this PCS.

The Drinking Water Protection Program then links the activity-appropriate best management practices (BMPs) to each PCS. This information is then taken to the community where, under the community's direction, the relative benefit is compared to the ease (time or cost) of implementing the appropriate BMP. The individual PCSs are then transferred to the implementation matrix. Presented in this manner, the cost-benefit of protection strategies can be easily understood, providing city councils or other local government officials with a mechanism for prioritizing drinking water protection strategies.

North Carolina – North Carolina has recently embraced a strategy to build upon its source water assessments and achieve tangible results for source water protection. The state Source Water Assessment and Protection (SWAP) program is attempting to insert SWAP priorities into the agendas of other agencies and programs. The initial response has been positive. For example, the Natural Resources Conservation Service has adopted drinking water protection as a statewide priority within its Environmental Quality Incentives Program. The North Carolina Division of Soil and Water Conservation has supported SWAP priorities within

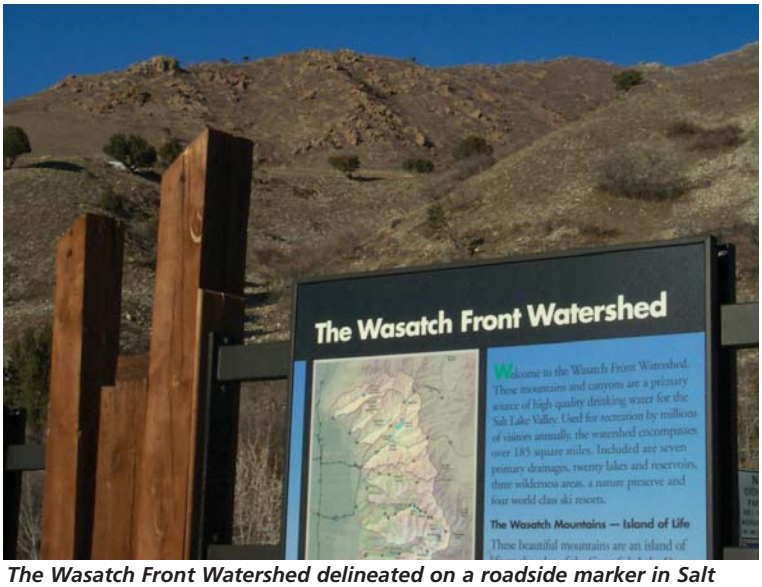

Photo: Robin Davis

The Wasatch Front Watershed delineated on a roadside marker in Salt Lake City, Utah.

its Agriculture Cost Share and Urban Cost Share programs. These three programs alone allocate more than $20 million annually for projects related to environmental protection and conservation.

In addition, the SWAP program has entered into discussions with the North Carolina Clean Water Management Trust Fund and other land conservancies that are eager to consider SWAP priorities to evaluate potential projects. North Carolina believes that results from these partnerships can have a significant impact on drinking water protection throughout the state.

There are multiple benefits associated with establishing SWAP priorities within other programs. Building active partnerships with other agencies raises awareness of the SWAP program and its objectives. Moreover, source water protection activities are promoted and financed using the resources of cooperating agencies. Finally, arrangements with participating agencies provide ready incentives and solutions to stakeholders developing local Source Water Protection plans.

SOURCE WATER PROTECTION AT THE LOCAL LEVEL

While other stakeholders have a role, state drinking water programs have a variety of ways to motivate and assist local source water protection implementation. An important feature of an effective strategy for motivating local actions is the availability of easy-to-use tools that target local capabilities and interests. Other motivational possibilities include:

- Phase II/V chemical monitoring waivers.
- Grants funded with DWSRF set-asides (funding available for state programs is expanded significantly with DWSRF set-asides).
- Requirements for communities to develop source water protection plans.
- Outreach, training, and partnerships with entities such as regional planning groups and National Rural Water Association chapters.
- Initiatives by other organizations.
- Model land-use ordinances for local governments.

GROUNDWATER GUARDIANS—SOURCE WATER PROTECTION MOVERS AND SHAKERS IN THEIR COMMUNITIES

Groundwater Guardian, a program of The Groundwater Foundation, encourages communities to begin ground water and source water awareness and protection activities at the local level, supports the communities in their efforts, then recognizes their achievements. This program began in 1994 with eight test-year communities and is now working with communities in more than 32 states.

Communities begin the process by forming a Groundwater Guardian team consisting of citizens, business and/or agricultural representatives, educators, and local government officials. These teams then develop Result-Oriented Activities (ROAs) to address the community's ground water protection concerns and keep the goals active for implementation. ROAs fall into many categories including education and awareness, pollution prevention, public policy, conservation, and best management practices. Communities represent diverse settings, including rural areas, large incorporated cities, Tribal Lands, and watersheds in the United States and Canada.

Photo: The Groundwater Foundation and Rock River Coalition Groundwater Guardian Team

Wisconsin Rock River Coalition Ground Guardians at work.

The Groundwater Foundation provides information and materials helpful to the communities as they implement their ROAs, such as the Groundwater Guardian Assistance Kit, *The Aquifer*, and "hot topic" materials, such as the *Drinking Water Source Assessment and Protection Workshop Guide. (http://www.groundwater.org/gg/gg.html)*

- Sharing information, especially GIS data.
- Meetings with stakeholders.
- Continuing education units (CEUs) for drinking water utility operators who attend training sessions on source water protection.

USEPA's Office of Ground Water and Drinking Water (OGWDW) has produced a compendium of products in CD format called *Safe Drinking Water Tools for Public Water Systems.* The CD and companion website provide a one-stop portal for many of OGWDW's products and tools already in print. *(http://www.epa.gov/safewater/pws/tools/index.html)*

FINANCING SOURCE WATER PROTECTION

States and communities have an assortment of source water protection funding options. Chief among these options has been DWSRF set-asides for state programs, which significantly expanded funding available for source water protection. But there are also a number of funding opportunities outside of state set-asides. There are several websites that states, communities, and public water systems can explore to learn more about source water funding options. Among these are:

- EPA Catalog of Federal Funding Sources for Watershed Protection *(http://cfpub.epa.gov/fedfund/)*
- Environmental Finance Center *(www.efc.umd.edu/)*
- EPA Clean Water State Revolving Fund *(http://www.epa.gov/owm/cwfinance/cwsrf/)*
- Directory of Watershed Resources *(http://sspa.boisestate.edu/efc/)*

THE SOURCE WATER COLLABORATIVE

In 2006, USEPA and 14 national organizations, including the Ground Water Protection Council, committed to work in partnership to protect present and future drinking water sources. They formed the Source Water Collaborative, which is focusing efforts on improving our understanding and management of the land-water connection at the local level in order to protect water resources. The Collaborative provides a powerful national network of affiliates, and the member organizations offer diverse expertise and resources that can then be filtered down to the state and local levels.

Photo: Mary Ann Massie, Virginia Department of Environmental Quality

Sixth graders model backpacks they received at the 2006 Natural Resources/Ground Water Festival held at the Russell County Fairgrounds in Castlewood, Virginia. A group of 212 students participated in 14 learning stations covering topics as varied as topographic maps, onsite sewage disposal systems, soils, the water cycle, caves, and mining. Citizen-involved education events provide much needed support for ground water protection efforts at the community level.

For example, the Delaware Source Water Protection program has retained its original Source Water Citizen and Technical Advisory Committee (CTAC), which was formed to advise the state's Source Water Protection program on the delineation process. In 2001, the Delaware General Assembly passed the Source Water Protection Law expanding the CTAC's authority and requiring local communities with 2,000 or more citizens to develop SWP ordinances and adopt the SWP areas in their Comprehensive Land Use Plans by December 2007.

The CTAC, which provides broad-based input to the state Source Water Protection program, has provided advice during development of the Source Water Assessments and development and distribution of state protection guidance to local governments, and on research projects. The committee maintains a regular meeting schedule. Members reflect state-level

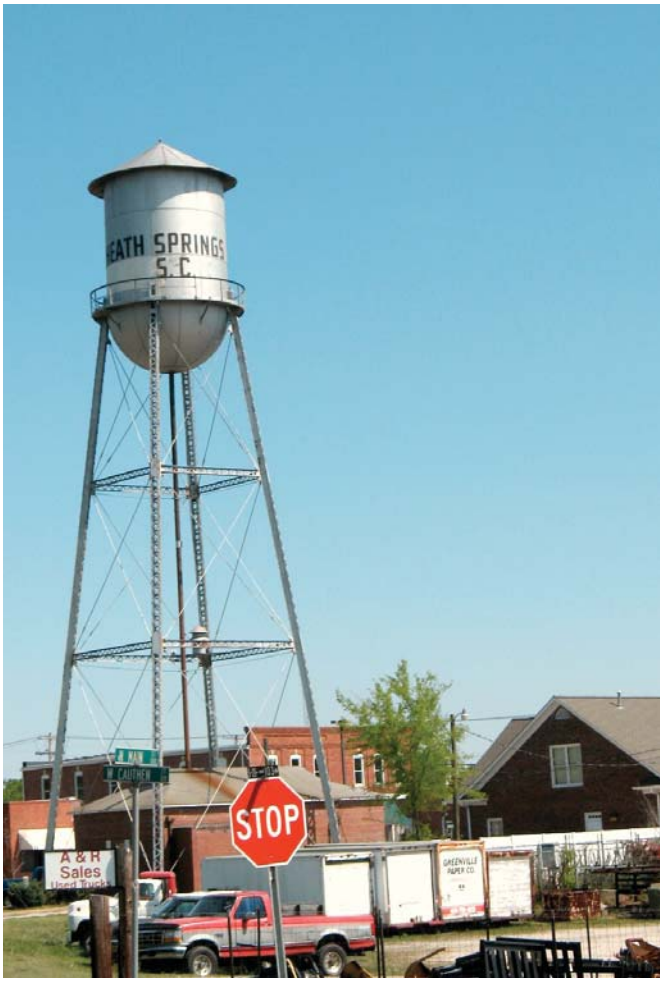

Photo: Doug Short

This water tower in Heath Springs, South Carolina, is located in rural Lancaster County. More than 50 percent of the state's residents rely on ground water as their source of drinking water. Most of this water is still at or near its natural excellent quality and is suitable for drinking with no treatment, which is an enormous economic and public-health benefit. The South Carolina Department of Health and Environmental Control's source water protection website provides a collection of tools and outreach materials to assist local source water protection efforts. See http://www.scdhec.gov/environment/water/srcewtr.htm

representatives from many of the organizations represented on the national Source Water Collaborative, including health, agriculture, and other programs that manage potential contaminant sources; representative local governments (cities and counties); the Delaware Rural Water Association; environmental groups; water utilities; USGS; academic institutions; land-use experts; community development, and the agricultural sector.

The Source Water Collaborative has established a website, *www.ProtectDrinkingWater.org*, to facilitate networking and resource sharing. Through the website and other modes, the group will identify opportunities and tools that local decision makers and practitioners can use to incorporate water resource protection into their community planning and land-use practices.

Other activities under development include a summary of research needs on costs and benefits (including monetary benefits) of source water protection; a financing guide; and a framework of best practices for local decision-makers for drinking water protection.

Source Water Collaborative members include:

American Planning Association
American Water Works Association
Association of Metropolitan Water Agencies
Association of State Drinking Water Administrators
Association of State and Interstate Water Pollution Control Administrators
Clean Water Fund
Environmental Finance Center Network
Groundwater Foundation
Ground Water Protection Council
National Association of Counties
National Ground Water Association
National Rural Water Association
North American Lake Management Society
River Network
Trust for Public Land
U.S. Department of Agriculture
U.S. Environmental Protection Agency
U.S. Geological Survey

"There shall be no man or woman dare to wash any unclean linen, wash clothes, nor rinse or make clean any kettle, pot, or pan or any suchlike vessel within twenty feet of the old well or new pump. Nor shall anyone aforesaid, within less than a quarter of a mile of the fort, dare to do the necessities of nature, cinse [sic] by these unmanly, slothful, and loathsome immodesties, the whole fort may be choked and poisoned."

by order of Governor Gage of the Jamestown Colony in 1610.

Recommended Actions

To USEPA:

- Incorporate source water protection considerations into other programs at the federal level (e.g., hazardous waste, underground injection control [UIC], Clean Water Act) and allow for flexibility so that state programs can do the same.
- Sustain a federal-level Source Water Protection program.
- Provide additional financial support and incentives for state and local Source Water Protection programs.
- Integrate ground water value into Source Water Protection programs.

To State Agencies:

- Establish and sustain a statewide Source Water Protection program that coordinates the activities of all agencies responsible for natural resources and environmental protection programs so that they proactively address potential source water impacts. This includes periodically evaluating the effectiveness of current source water protection efforts. (See *Elements of an Effective State Source Water Protection Program,* a joint Ground Water Protection Council (GWPC) and Association of State Drinking Water Administrators (ASDWA) document, October 2006.)

To Local Governments:

- Create, or participate in creating, a municipal watershed or regional-level comprehensive Source Water Protection Plan that includes:
  - Strategies for managing threats and protecting resources.
  - A combination of voluntary and regulatory strategies.
  - A long-term vision, short-term strategies, and measurable goals.
  - A strategy for how to fund the activities in the plan.
- Coordinate land-use planning with source water protection plans, incorporate source water protection as an element of the local comprehensive plan, and integrate source water areas into land-use planning and zoning regulations.

Our challenge is to ensure that both public and private sectors take ground water resource protection into account in development plans, ordinances, public works practices, construction practices, and other land-use decisions. Indeed, all citizens share responsibility for source water protection.

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Suggested Reading:

How to Update and Enhance Your Local Source Water Protection Assessments. September 2006. EPA816-K-06-004.

Water Today...Water Tomorrow? Protecting Drinking Water Sources in Your Community: Tools for Municipal Officials. 2004. New England Interstate Water Pollution Control Commission. *http://www.neiwpcc.org/sourcewateroutreach/index.asp*

Photo: Joshua McDill

A recreational area of Barton Springs, Austin, Texas. The Barton Springs aquifer is an important ground water resource for municipal, industrial, domestic, recreational, and ecological needs. Approximately 50,000 people depend on water from the aquifer as their sole source of drinking water. Various spring outlets are the only known habitats of the endangered Barton Springs salamander. However, the amount of ground water available to meet current and future needs is limited, owing to the combined effects of drought and substantial pumping. A 2004 report by the Barton Springs/Edwards Aquifer Conservation District evaluated the potential impacts on ground water availability in the Barton Springs segment of the aquifer during a recurrence of drought-of-record (1950s) conditions and various rates of pumping. Results indicate that water levels and spring flow would be significantly impacted—wells going dry, water levels dropping below pump levels, intermittent yields. In addition, there is the potential for saline water to flow from the saline-water zone into the freshwater aquifer, which would affect water supply wells and endangered species. *Source: http://www.bseacd.org/graphics/SYM_Final_Report.pdf*