Protecting the Source

Summary & Quick Facts

Protecting the Source (2004) is part of an ongoing effort by the Trust for Public Land and the American Water Works Association to promote land conservation as a critical approach to drinking water protection. Protecting the Source, authored by Caryn Ernst, explores scientific, economic, and public health rationales for using land conservation for drinking water protection and presents best practices for successful implementation locally.

Summary

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

Contents

Key Findings

Each of the key findings are direct quotes from Protecting the Source. The full scientific studies can be found by referencing the (#) at the end of each sentence below with document page 50.

Collaborative Solutions

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, suppliers 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.

- 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)

Water Sources

The impact of non-point source pollution on the quality of un-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.

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

Groundwater

- [R]emoving 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)
- 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. 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. (64)(65)

Surface Water

- 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. Because small headwater and tributary streams comprise most of the drainage network in watersheds, they strongly influence the quantity, timing, and quality of streamflow. (62)
- 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)
- 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)

Healthy Watersheds

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.

- 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)
- 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)

Development

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.

- 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)
- Increased sprawl and development brings increased pressure to develop land in drinking water source areas. Once development infringes on source areas, the [natural] controls designed to protect water quality become stressed. Compounding the problem is the loss of wetlands, forestlands, and grasslands, which naturally filter water and serve as buffers to water supplies. (5)

- 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)
- 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.

Non-point Source Pollution

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.

- According to the U.S. Environmental Protection Agency, the leading cause of source water degradation is nonpoint source pollution (8).
- Non-point source pollution from runoff from lawns, farms, cities, and highways, as well as leachate from rural septic systems and landfills, accounts for 60% of all pollution in US Waterways (11).

Treatment Costs

Occasional spikes in pollutant loads can be very expensive for water suppliers, who must upgrade their treatment facilities to deal with maximum loads.

- 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)
- 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. (55)
- 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. (55)
- 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)

Drinking Water Standards

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.

- 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)

Human Health

Throughout history, the contaminants in source waters have changed, as has our understanding of what is safe and what is not. The threat to public health from emerging contaminants presents the most compelling reason to protect drinking water source. With an understanding of the threats comes an ability to provide clean and plentiful drinking water supplies into the future.

- 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—leaving people served by these systems even more vulnerable to outbreaks of waterborne illness. (25)(26)
- 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, share similar characteristics. They tend to be: 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. (32)(33)
- In addition to pathogens, emerging contaminants include chemicals, metals, and pharmaceuticals…. new knowledge about the health impacts of chemicals has made them a primary concern among epidemiologists studying emerging threats in drinking water. (36)
- 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)
- 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)

- 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)