Giardia and Giardiasis Edited by: Stanley Erlandsen and Ernest Meyer, 1985

Scanning electron micrograph of the pathogen Giardia lamblia *in the trophozoite stage of its life cycle.* Giardia *is a microbiological contaminant that can cause acute illness. About 84 percent of current SDWA need is to protect against microbiological contaminants.*

Findings

Community water systems nationwide face significant infrastructure needs to protect public health and ensure the availability of safe drinking water. This section of the report presents the estimated capital costs for SDWA compliance and the total 20-year infrastructure need. It also describes the infrastructure need by category and discusses how the need impacts each system size. The section discusses needs for American Indian and Alaska Native water systems. Appendix B contains a detailed breakdown of the need.

Need for Compliance

Community water systems nationwide need $12.1 billion now for compliance with the SDWA. Eighty-four percent of this need is to protect against microbiological contaminants that pose an acute health risk.

The current need attributable to the SDWA is overstated. SDWA projects often include components that are not required for compliance but are undertaken at the same time to realize efficiencies in operation as well as savings in design and building costs. For instance, a state-of-the-art computerized system for monitoring and control of operations in the entire system may be included in a project for a new filter plant. Only the filter plant—and the component of the computer system used for the filter plant—is a SDWA need, but the Needs Survey is likely to have recorded the need for both as one SDWA project. Another component of the need would exist even in the absence of the SDWA because of State and local requirements and communities' efforts to provide a consistent level of water quality.

The Drinking Water Infrastructure Needs Survey places the current Safe Drinking Water Act need at $12.1 billion.

In addition to the $12.1 billion needed now for SDWA compliance, $18.2 billion is a future need to maintain compliance over the next 20 years. Taken together, the largest portion of the current and future SDWA need is for installing or upgrading filtration plants to treat for microbiological contaminants. Projects to install or upgrade storage tanks or transmission lines for disinfectant contact time are also included. Other SDWA needs include projects to address exceedances of EPA safety standards for nitrate, which has an acute health effect, or for contaminants that cause chronic health effects.

Community water systems have an additional current need of $22.3 billion and a future need of $13.5 billion for replacing deteriorated distribution piping. These needs are categorized as SDWA-related because the monitoring required under the TCR helps to identify problems in the distribution system. However, these problems would exist even in the absence of TCR monitoring and would eventually degrade water quality and service to the extent that problems would be detected without the TCR.

Total 20–Year Need

Drinking water infrastructure needs for the nation's community water systems total $138.4 billion. Of this total, $76.8 billion is for current needs to protect public health. Current needs are projects to treat for contaminants with acute and chronic health effects and to prevent contamination of water supplies. A portion of these needs are for SDWA compliance.

Of the $138.4 billion total, $61.6 billion is for future need. Projects for future need are designed to provide safe drinking water through the year 2014. Future needs include projects for replacing infrastructure and for the Disinfectants and Disinfection Byproducts Rule (D/DBPR), the Enhanced Surface Water Treatment Rule (ESWTR), and the Information Collection Rule (ICR).

The needs in this report are conservative because many systems were not able to identify all of their needs or document them well enough to meet the survey's criteria. In addition, needs for non-community water systems are not included. Needs associated solely with future growth were not included in this survey.

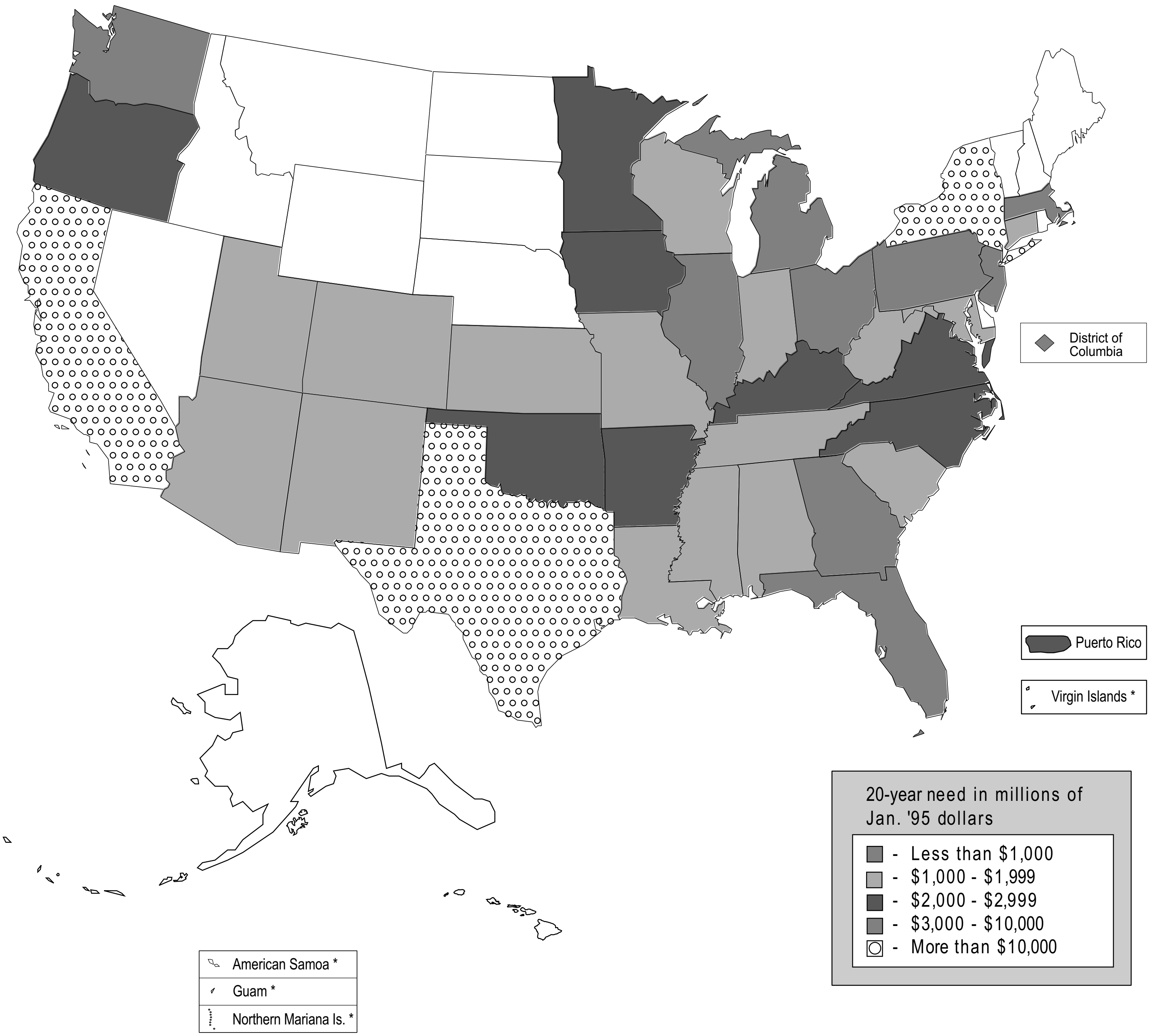
Exhibit 2 shows the total infrastructure need by category and water system size. Exhibit 3 shows need on a State-by-State basis.

Exhibit 2: Total 20-Year Need

System Size	Total Need (in billions of Jan. '95 dollars)					
	Transmission and Distribution	**Treatment**	**Storage**	**Source**	**Other**	**Total**
Large Systems (serving more than 50,000 people)	$30.5	$17.2	$3.5	$5.6	$1.6	$58.5
Medium Systems (serving 3,301 to 50,000 people)	$22.2	$12.0	$4.2	$2.8	$0.3	$41.4
Small Systems (serving 3,300 and fewer people)	$23.8	$6.7	$4.2	$2.5	$0.04	$37.2
American Indian and Alaska Native Systems	$0.6	$0.3	$0.3	$0.1	$0.03	$1.3
Total	**$77.2**	**$36.2**	**$12.1**	**$11.0**	**$1.9**	**$138.4**

Note: Numbers may not total due to rounding.

Exhibit 3: Overview of Need by State†

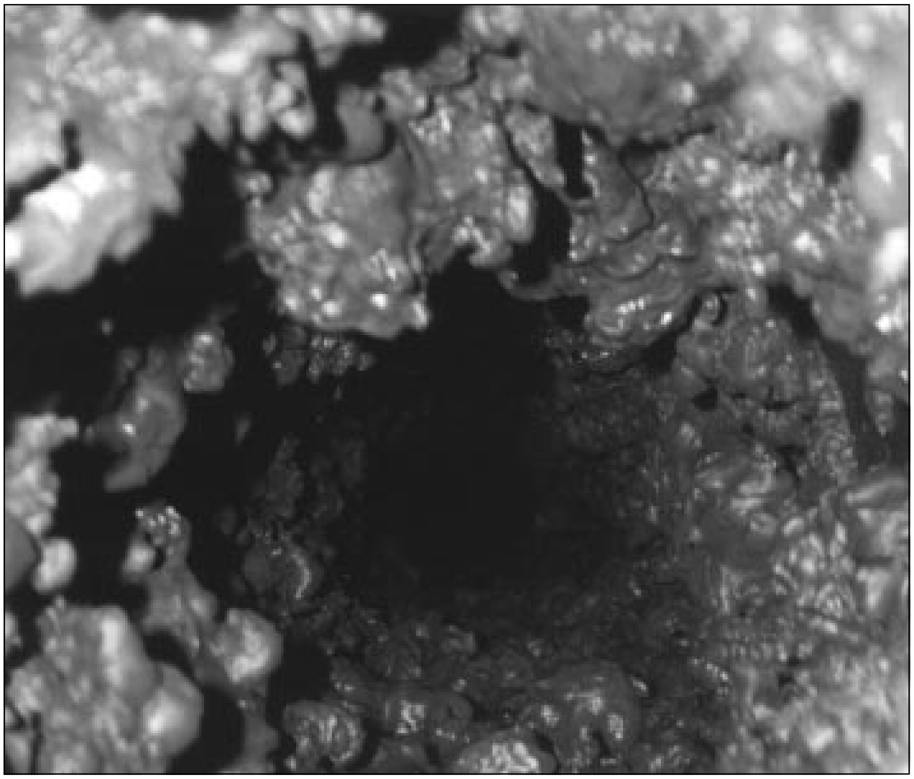


Not to scale

† Needs for American Indian and Alaska Native water systems are not included in this exhibit.

* The need for American Samoa, Guam, the Northern Mariana Islands, and the Virgin Islands is less than $1 billion each.

Montauk Services Inc.



Tuberculation is a condition that affects the interior of pipes in many water systems. Tuberculation can decrease water quality and leads to loss of energy and capacity.

Total Need by Category

There are four major categories of need: transmission and distribution, treatment, storage, and source. Exhibit 2 (on page 8) shows the need by category. A portion of each category is attributable to the SDWA.

Transmission and Distribution. Transmission and distribution needs account for $77.2 billion, more than half of the total need for community water systems. Deteriorating distribution infrastructure threatens drinking water quality and can cause violations of the SDWA. Even in systems with excellent treatment, leaking pipes can lead to a loss of pressure and cause back-siphonage of contaminated water. Leaks also waste water and energy as treated water escapes from the distribution system. Deteriorating transmission and distribution infrastructure is common throughout the nation, particularly in older systems.

Back-Siphonage

Water mains are pressurized to deliver water to residents and to keep contaminants from entering the water system. Systems can lose pressure or even experience a partial vacuum during fire flows, repairs, or line breaks. Loss of pressure is dangerous because it can lead to back-siphonage, where contaminants are drawn into the water system through leaks. The danger becomes greater as the condition of the pipe becomes worse, allowing more leaks and more opportunities for the water to be contaminated.

Transmission and Distribution Needs—Three Examples

Niagara Falls, NY—During World War II, the federal government installed approximately 8 1/2 miles of "victory pipe" as large diameter transmission and distribution mains to ensure a reliable water supply for defense industries in the city. Because of demand for metal during the war, this pipe is thin-walled and prone to frequent and costly line breaks. The deteriorating victory pipe constitutes only 3 percent of the total pipe in the city, but claims one quarter of the city's expenditures for water main repair and replacement. Breaks and leaks in the victory pipe could lead to microbiological contamination of the water supply and seriously threaten public health.

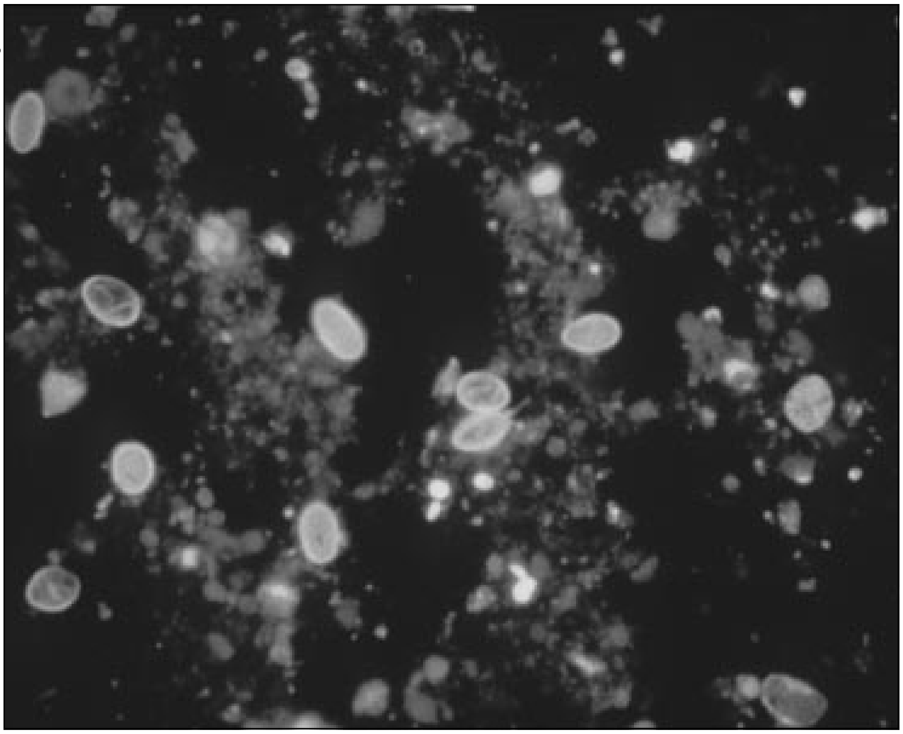
Butte, MT—Butte was developed as a mining community in the late 1800's and much of the infrastructure that was installed then remains in place today. The distribution system was constructed primarily of 6-inch diameter thin-walled steel pipe. Some wooden pipe was also used, but most of it has been replaced. While 30,000 feet of the steel pipe has been replaced, the water system estimates that an additional 100,000 feet is still in service. A four person "leak gang" works six days a week in Butte, fixing up to 600 leaks and breaks per year.

Huntington, IN—In December 1995, city residents were forced to boil their water for a week when a city water main broke. The 7-foot crack in the main caused businesses and schools in the area to close temporarily.

Dan Fraser

Three members of the Butte, Montana leak gang.

Carrie Hancock, C.H. Diagnostics



Scanning electron micrograph of the pathogen Giardia lamblia *in the cyst stage of their life cycle.* Giardia *is one microbiological contaminant found in surface waters throughout the country.*

Treatment. Treatment is the second largest category of need, representing $36.2 billion (26 percent) of the total infrastructure need for community water systems.

About $20.0 billion is needed for treatment of microbiological contaminants which can cause acute health effects. These contaminants are usually associated with gastrointestinal illness and, in extreme cases, death. They can strike in a matter of hours or days. To minimize the risk of microbiological contamination, 35 percent of systems that use surface water sources need to install, replace, or upgrade filtration plants.

A smaller portion of the treatment need, approximately $0.2 billion, is associated with nitrate. Nitrate poses an acute health threat. High levels can interfere with the ability of an infant's blood to carry oxygen. This potentially fatal condition is called "blue baby syndrome."

Almost $10.7 billion is needed for treatment of contaminants with chronic health effects. These effects include cancer and birth defects. The largest needs among contaminants with chronic health effects are treatment for byproducts of disinfection and for lead. Some disinfection byproducts are toxic and some are probable carcinogens. Exposure to lead can impair the mental development of children.

Another $5.3 billion is needed for treatment of secondary contaminants. Secondary contaminants affect the taste, odor, and color of water.

The Costs of Failed Treatment—Three Examples

Washington, DC—In 1993, the DC metropolitan area experienced a decrease in source water quality that coincided with operational problems. Water not meeting federal standards entered the distribution system. The problem was identified and EPA and the State of Virginia issued a boil-water notice to area residents, preventing any reported cases of illness. But the lapse in treatment did carry a cost. According to conservative estimates, the four-day boil notice cost the city and its residents approximately $24 million and inconvenienced residents and tourists who were forced to find alternative sources of drinking water.

Cost of the DC Boil Notice
(Estimated in '93 dollars)

Boiling Tap Water	$7,000,000
Purchase Bottled Water	$8,000,000
Purchase Alternative Beverages	$3,340,000
Purchase Safe Ice*	$4,000,000
Costs to Hospitals	$126,500
Costs to Restaurants	$1,484,800
Total	$23,951,300

* And other water-based products

Milwaukee, WI—In 1993, Milwaukee experienced a decrease in treated water quality similar to that in Washington, DC. The consequences for residents of Milwaukee, however, were far more serious than for residents of Washington. Contamination in the Milwaukee water supply led to over 400,000 reported cases of illness and some 100 deaths. Milwaukee has since upgraded its filtration facilities.

Ethete, WY—This small American Indian community uses direct pressure filtration to treat a surface water source which deteriorates in quality during spring run-off. The existing plant, though well-maintained and well-operated, is unable to treat the highly turbid water adequately, and the community must issue boil-water orders for extended periods of time during the spring and summer. The community has considered alternative ground water sources, but this option is not feasible because of quality and quantity problems. Therefore, the community needs to build a more appropriate treatment plant for the existing surface water source.

Dan Fraser

Pressure filters at Ethete

Dan Fraser

This rural midwestern well is poorly located. Grazing and farming around the well house pose a threat through microbiological and nitrate contamination.

Storage. Projects to build new storage or rehabilitate existing facilities constitute $12.1 billion, or 9 percent of the total need. Storage is critical because it ensures the positive water pressure necessary to prevent contaminants from entering the system. It also provides water for periods when demand exceeds the capacity of source and treatment facilities. Two-thirds of water systems reported a need for improvements to storage facilities.

Storage needs usually include building or repairing conventional tanks. Another significant need is associated with uncovered finished-water reservoirs. These large reservoirs are vulnerable to contamination. Covering these reservoirs is a priority for most cities that have them.

Source. Needs for source rehabilitation or development account for more than $11.0 billion, or 8 percent of the total need. Source development is a small portion of the total need, but an important step in the provision of safe drinking water and compliance with the SDWA. Poor-quality source water can threaten public health and force a system to use expensive treatment.

Adequate source quantity is also an important consideration. A source must meet demand on a hot summer day or during fire flow to prevent back-siphonage of contaminated water. Back-siphonage results from low pressure in the distribution system. Source needs range from huge new surface water reservoirs for large metropolitan areas, such as Los Angeles, to new wells for very small systems.

Storage and Source Needs—Two Examples

Metropolitan Boston, MA—Many systems reported needs for covering reservoirs used to store finished water—water that is ready for human consumption. Uncovered reservoirs can be contaminated through surface water run-off or through direct human and animal contact. According to a recent analysis completed by the Massachusetts Water Resources Authority (MWRA) Advisory Board, water quality is lower in communities that receive water from uncovered reservoirs than in communities that receive water from covered storage reservoirs and tanks. The possibility of contamination of water in MWRA's Fells Reservoir threatens drinking water quality for several cities north of Boston. MWRA has plans to construct a 20 million gallon covered storage facility at the site of the current Fells Reservoir.

San Juan, Puerto Rico—Due to the high organic and inorganic content of its source waters, sediment collects quickly in San Juan's reservoirs. Sedimentation has caused a severe shortage of supply and degraded aesthetic and biological water quality. The two reservoirs serving this area, Lago Loíza and Lago La Plata, have experienced capacity reductions of 54 percent and 53 percent respectively. To restore capacity, the reservoirs will be dredged for a combined cost of about $150 million. Shortages of safe drinking water have led to mandatory water rationing throughout the island.

Terry Bickford, Massachusetts Water Resources Authority

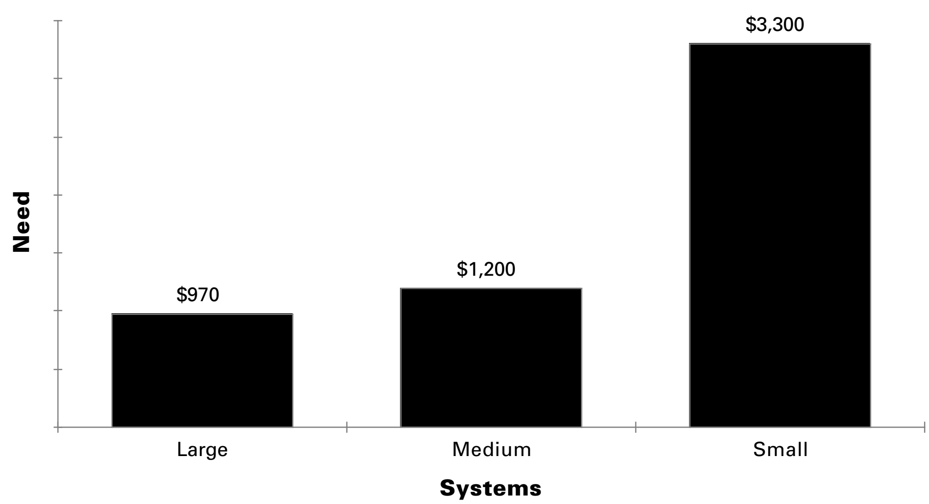
MWRA's Fells Reservoir is used for storage of finished water.

Need by System Size

The need attributable to large, medium, and small water systems is different in each State. Exhibit 5 (on pages 18 and 19) shows State-by-State need for each system size.

Large drinking water systems constitute a small fraction of the community water systems in the nation, but they provide water to more than half of the population served by community water systems. Small systems, in contrast, make up the vast majority of systems, but serve only about 10 percent of the population. In spite of their differences, the survey found that all system sizes had similar types of needs. For example, the largest category of need for all three system sizes was transmission and distribution. This category accounted for over half of the needs for each system size.

Exhibit 4: Average 20-Year Per-Household Need (Total need in Jan. '95 dollars)



The total need for large systems is significantly higher than the need for medium or small systems—$58.5 billion. On a per-household basis, however, this need is the smallest of the three system sizes, as shown in Exhibit 4.

Medium systems have the second-largest total need—$41.4 billion. These systems typically serve small metropolitan areas and suburban towns. They serve about a third of the population nationally and provide water to over half of the residents in 10 States, including Alabama, Idaho, Maine, Minnesota, Mississippi, North Dakota, South Carolina, Vermont, West Virginia, and Wyoming. The smallest of the medium systems have operating and financial characteristics similar to small systems.

Unique Needs of Small Systems

The infrastructure need for small systems totals $37.2 billion. Although this is the smallest need of the three system sizes, it represents the largest per-household need, as shown in Exhibit 4. Small systems are located throughout the country. Most States have hundreds of these systems. Some are villages or small towns, others are retirement communities and mobile home parks. Although many small systems are located in rural areas, a significant number are found in metropolitan areas.

Per-household costs are high for small systems because they lack economies of scale. The fixed costs of infrastructure must be spread over a small customer base, resulting in a higher cost for each gallon produced.

In many instances, water from small systems poses public health risks because system components were improperly designed and constructed. Many small systems were built without review of plans and specifications and were not required to adhere to minimum design and construction standards. In some cases, entire water systems must be replaced.

Eighty-one percent of small systems need to upgrade distribution systems. Systems with poorly designed distribution mains often suffer from low pressure problems and the associated risk of contamination.

Most small systems use ground water sources. In this type of system, the absence of disinfection can be a pressing public health concern. Disinfection minimizes the threat from microbiological contaminants that can cause severe gastrointestinal illness and sometimes lead to death. Over 10 percent of small ground water systems have a current need to install or replace disinfection.

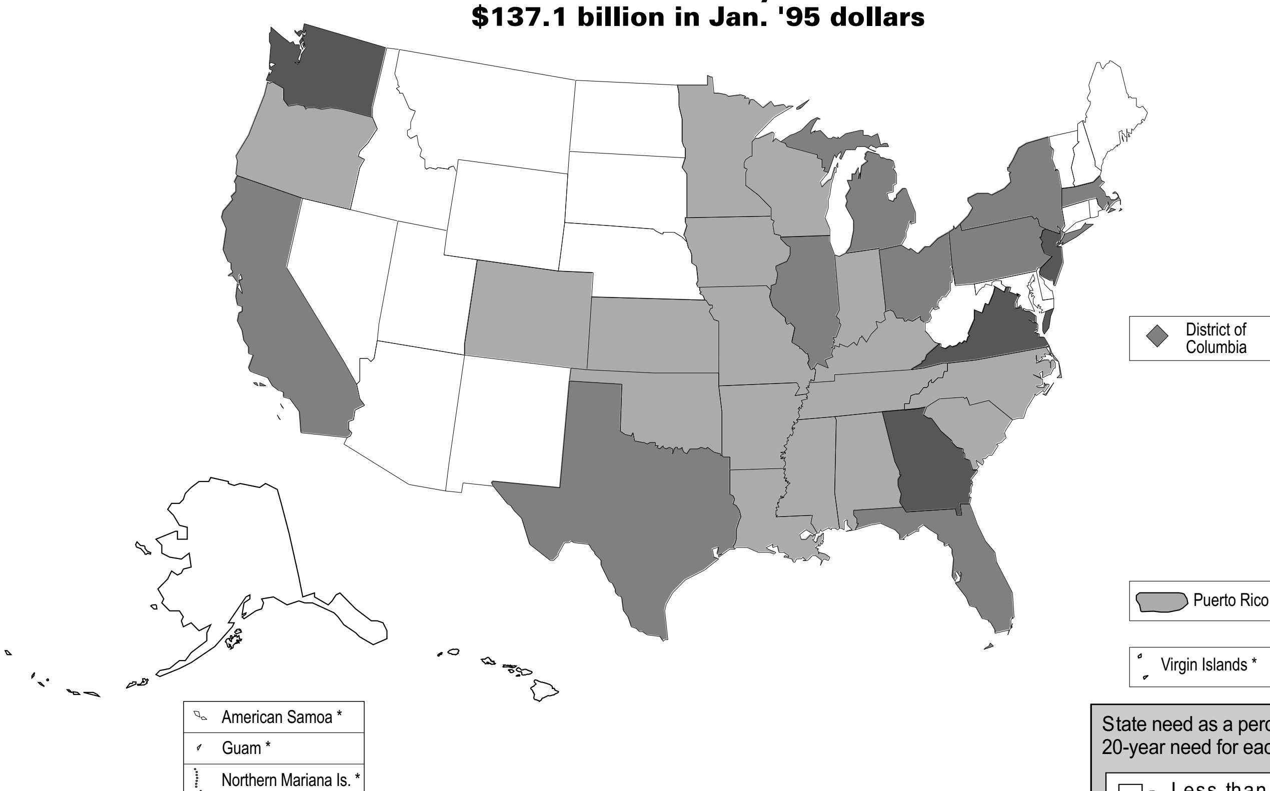
Two-thirds of small systems need to improve their sources, which are usually wells. Older wells often become clogged with sediment or encrusted with calcium carbonate or iron bacteria.

Dan Fraser

This water system on the Mexican border serves a minority community of about 175 people. The system stores its water in a deteriorated hydropneumatic tank. Small diameter galvanized steel mains make up the distribution system, and service lines consist of ordinary garden hoses. The condition of this system currently presents acute health risks to the residents of this community. The small diameter mains pose a threat through back-siphonage. The hoses pose a threat through accidental cross-connection or breakage. While one solution to the community's water problems is to replace all system components, another is to replace the distribution system and to connect to the city system, which has a main only 50 feet away. Connecting to the larger system would be the best and most cost effective solution.

Exhibit 5: Overview of Need by System Size†

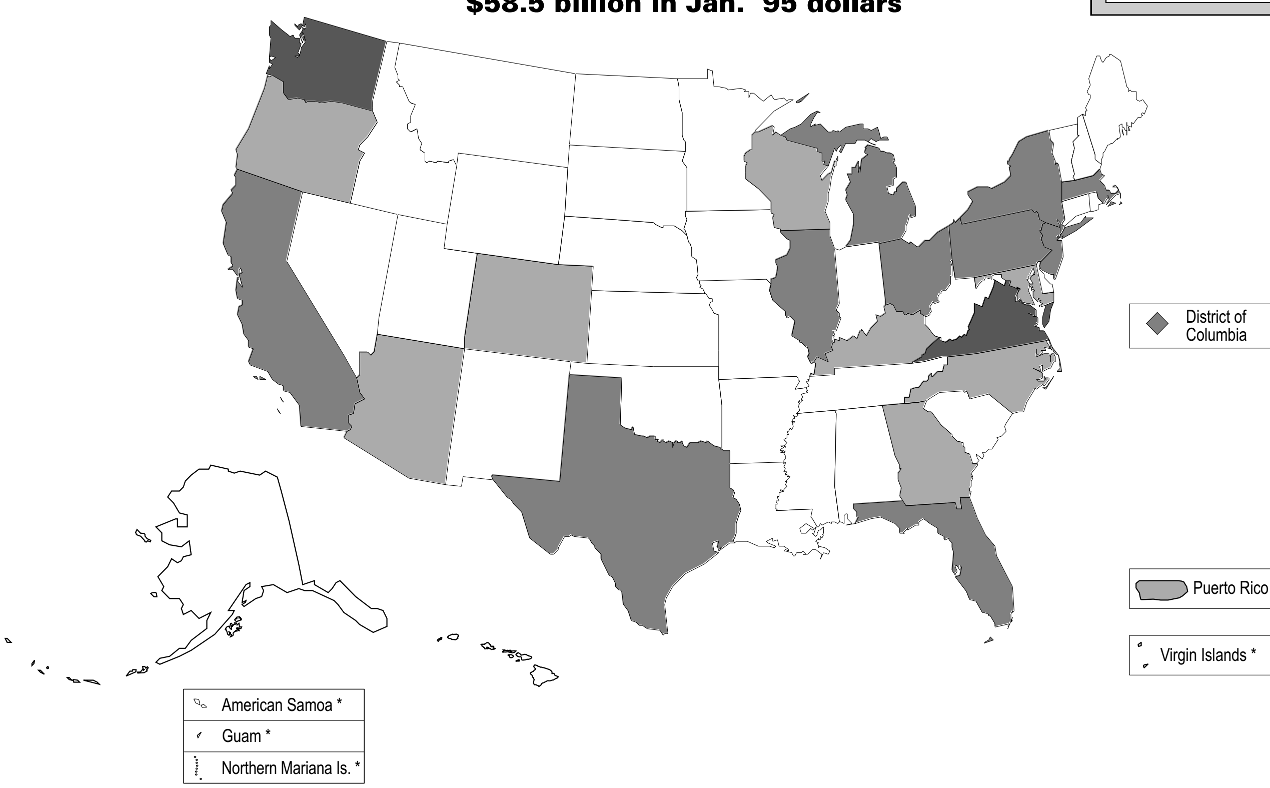
Total Need for All System Sizes
$137.1 billion in Jan. '95 dollars



State need as a percent of the total 20-year need for each system size.

- Less than 1 percent
- 1 to 1.99 percent
- 2 to 2.99 percent
- 3 percent or more

Large System Need
$58.5 billion in Jan. '95 dollars

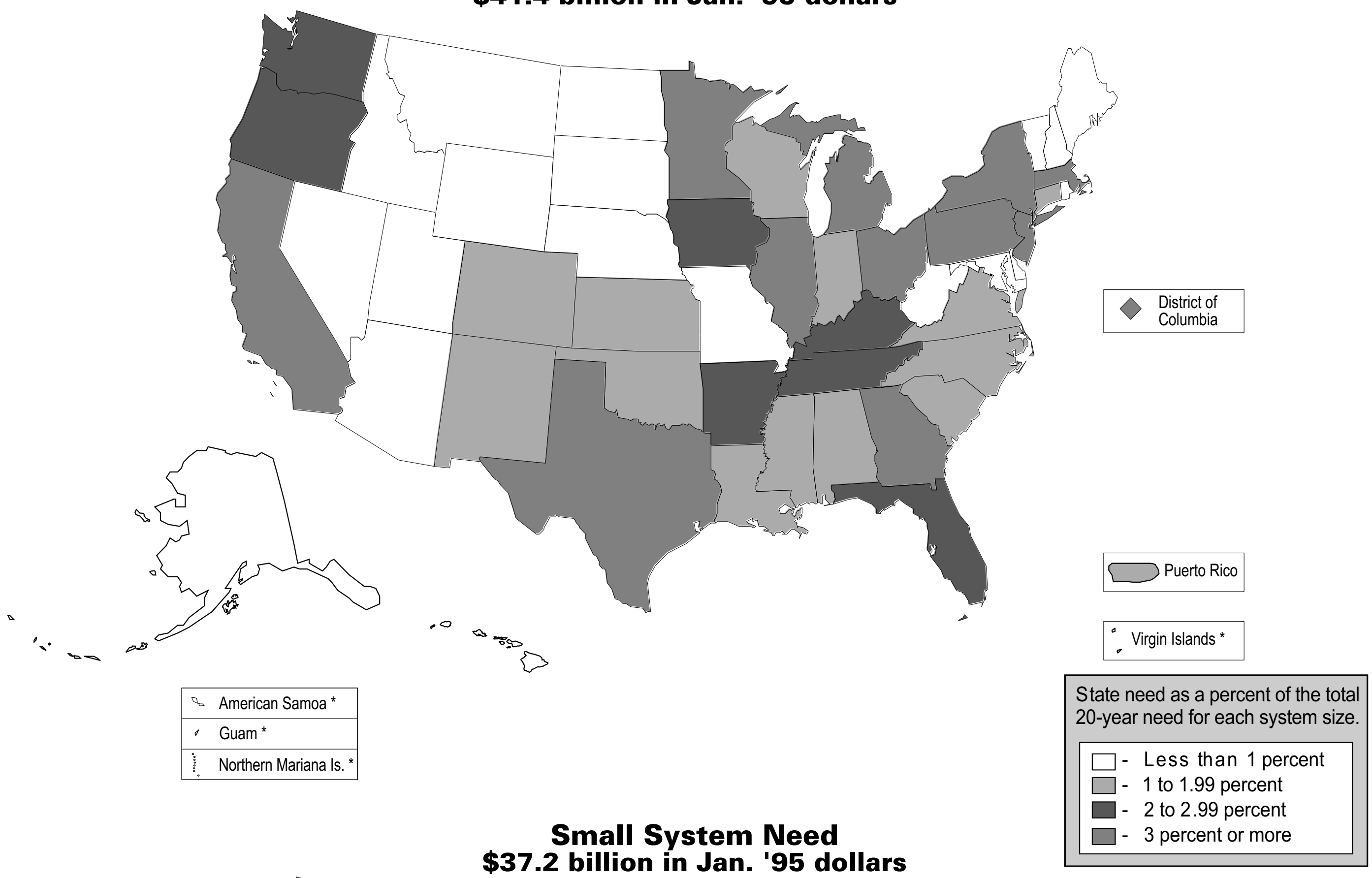


Not to scale

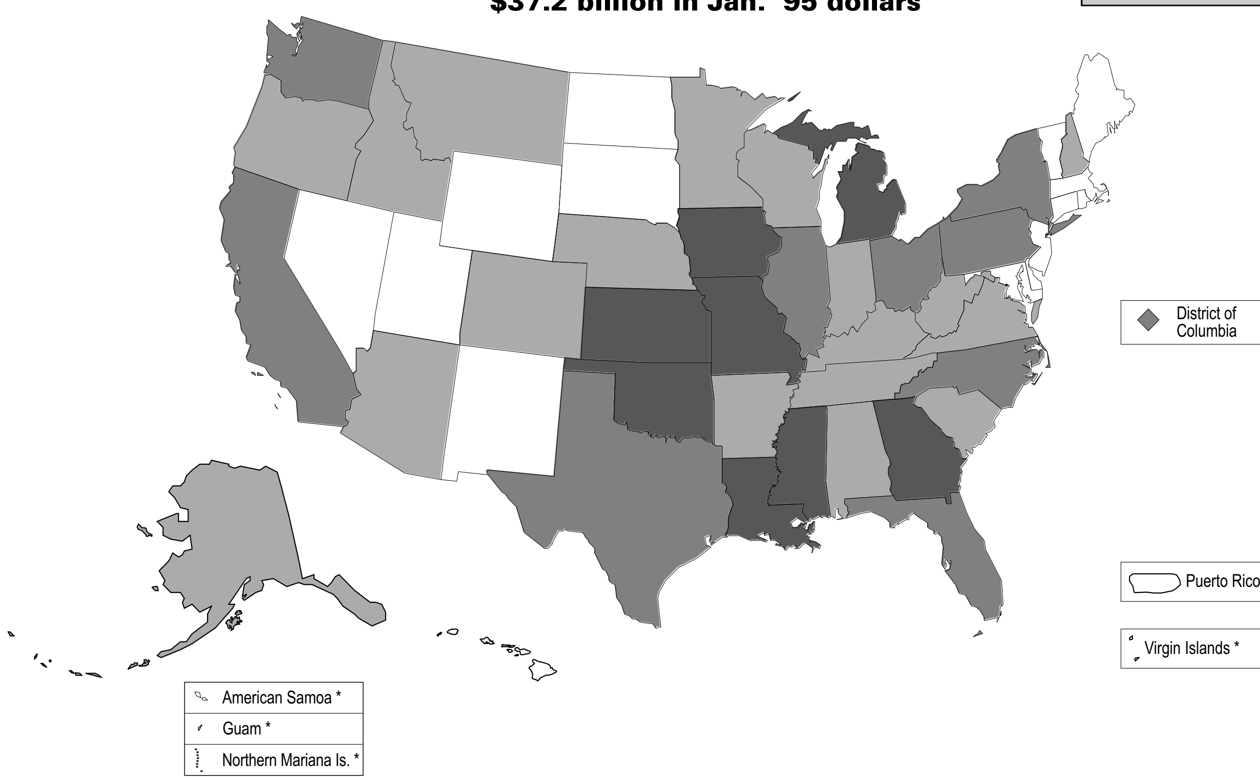
†Does not include the need for American Indian or Alaska Native water systems.

Exhibit 5: Overview of Need by System Size (cont.)

Medium System Need
$41.4 billion in Jan. '95 dollars



Small System Need
$37.2 billion in Jan. '95 dollars



Not to scale

* The need for American Samoa, Guam, the Northern Mariana Islands, and the Virgin Islands is less than 1 percent each.

Dan Fraser

This well in New York State supplies water to a small system. The well is located in a pit, making it vulnerable to contamination through flooding. The pit is also an unventilated confined space. In such spaces, the atmosphere can become poisonous and dangerous for the operator. The chlorine bottles are evidence that short-term ineffectual attempts have been made to control microbiological contamination. This well should be reconstructed so that it can provide safe water and not pose a threat to the operator.

Poorly constructed wells can also lead to public health risks. Water drawn from improperly constructed wells faces an increased risk of microbiological contamination. Poor siting can also lead to contamination. For example, wells located near sources of contamination such as septic systems, feed lots, fuel tanks, or pesticide storage are at risk.

Small systems also have a substantial need to treat for secondary contaminants such as iron and manganese. Over 5,000 small systems have a need to treat for these contaminants, at a cost of $2.2 billion. Although these contaminants do not pose a direct health risk, they affect taste, odor, and color. As a result, consumers may seek alternative drinking water sources that are aesthetically acceptable, but may contain contaminants that pose serious health risks.

For small systems located near larger systems, the least costly way to resolve infrastructure needs may be to connect with a larger system. According to the survey, this would be the most cost effective way to protect public health for over 13 percent of small systems.

Need by Safe Drinking Water Act Regulation

Needs for maintaining compliance with the SDWA constitute a portion of each category of need. SDWA needs include projects for treatment of contaminants regulated under the Act. SDWA needs also include projects to replace contaminated sources and storage or to improve transmission lines that provide disinfectant contact time.

Current SDWA Need

Capital costs for projects needed now to ensure compliance are defined as current SDWA needs. Exhibit 6 summarizes the current SDWA and SDWA-related need.

Existing Regulations. Approximately $12.1 billion is needed now for compliance with the SDWA. Treatment for microbiological contaminants regulated under the SWTR and the TCR accounts for $10.2 billion—about 84 percent of the current SDWA need. These contaminants can lead to gastrointestinal illness and, in extreme cases, death. Almost $0.2 billion is needed to meet standards for nitrate, which has acute health effects for children, and $1.7 billion is needed for contaminants that pose chronic health risks.

The current SDWA need is overstated. Many SDWA projects include components that are related but not attributable to the SDWA. Also, federal regulations are one of many factors that drive investment in drinking water facilities. States had standards in place prior to the SDWA that would have eventually required systems to invest in many of the projects included in the survey. Regardless of regulations, infrastructure approaching the end of its useful life must be rehabilitated and replaced to provide a consistent level of water quality and service. The enactment of the SDWA and the promulgation of its regulations has, however, placed more stringent monitoring and treatment requirements on many systems. In many cases, these requirements have prompted systems to act sooner to solve their public health problems than they would have in the absence of the SDWA. It is impossible to ascertain how much of the need would exist in the absence of the SDWA.

Exhibit 6: Current Safe Drinking Water Act Need (in billions of Jan. '95 dollars)

Existing Regulations	**Need**
Surface Water Treatment Rule*	$10.1
Total Coliform Rule*	$0.1
Nitrate Standard*	$0.2
Lead & Copper Rule	$0.9
Phase I, II, & V Rules (chemical contaminants)	$0.4
Total Trihalomethanes Standard	$0.2
Other Standards†	$0.2
Total Existing Regulations	**$12.1**
SDWA-Related Need	**Need**
Distribution Improvements (TCR)*	$22.3
Total SDWA-Related Need	**$22.3**

Note: Numbers may not total due to rounding.
* Regulations for contaminants that cause acute health effects.
† Includes arsenic, barium, cadmium, chromium, fluoride, mercury, selenium, combined radium -226, -228, and gross alpha particle activity.

Existing regulations for microbiological contaminants. Regulations to minimize microbiological contamination account for $10.2 billion of the current SDWA need. Microbiological contaminants regulated under the SWTR and the TCR can pose a health risk to consumers, especially to those with weakened immune systems. According to conservative estimates from the Centers for Disease Control and Prevention (CDC), waterborne disease outbreaks between 1986 and 1992 led to illness in approximately 47,600 people.

Almost all of the need for projects to minimize microbiological contamination is associated with the SWTR. This regulation accounts for almost $10.1 billion. The SWTR ensures that water systems using surface water sources treat to minimum standards to control microbiological contaminants such as *Giardia lamblia*, viruses, and *Legionella*. The SWTR also applies to ground water systems with sources containing microbiological contaminants typically found in surface waters.

Almost 40 percent of water systems covered by the SWTR reported a treatment need to maintain compliance with the rule. A portion of this need, approximately $1.9 billion, is for projects to install filtration plants for water systems that are currently unfiltered. These systems now use disinfection as the sole treatment barrier for microbiological contaminants. Also included in the SWTR need are upgrades to plants where current facilities cannot ensure continued compliance with the rule. A few examples of cities that need to install or replace filtration plants are offered in the accompanying sidebar.

Need to Install, Replace, or Upgrade Filtration Plants (in millions of Jan. '95 dollars)

New York City, NY*	$533
Metropolitan Boston, MA	$452
Metropolitan Los Angeles, CA	$276
San Diego, CA	$210
Detroit, MI	$180
Sacramento, CA	$120
Omaha, NE	$109
Macon, GA	$105
Seattle, WA	$97
Tulsa, OK	$76
Greenville, SC	$59
Newport News, VA	$56
Kansas City, KS	$55

*Covers only the Croton supply (approximately 10% of total NYC supply)

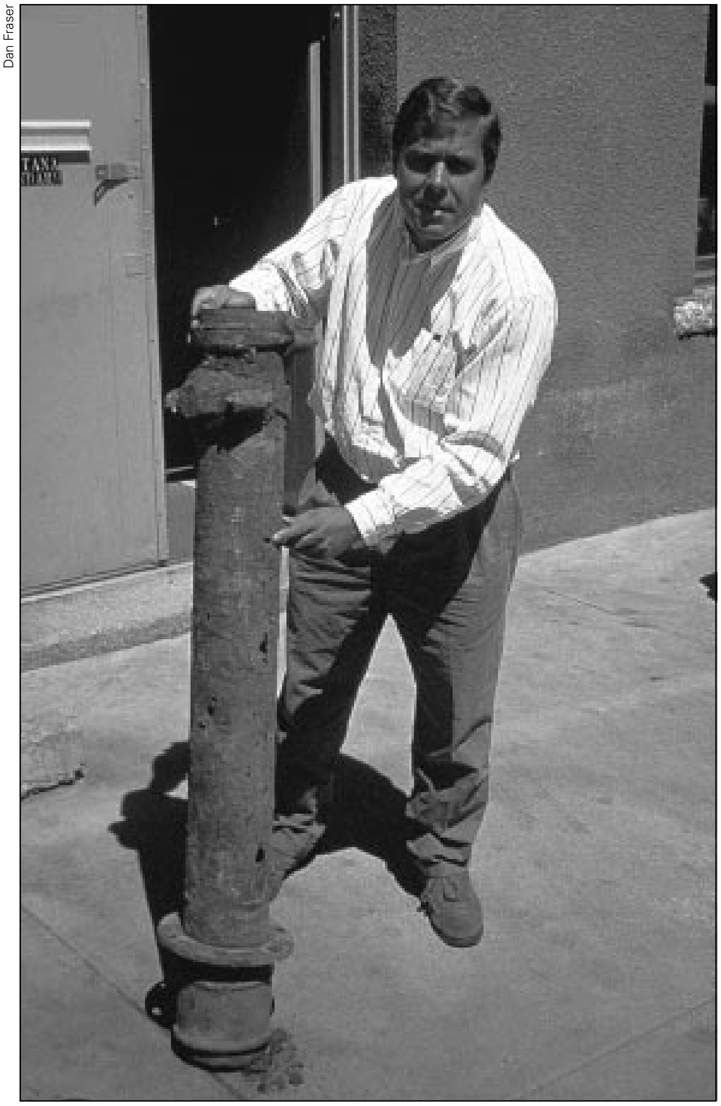
Other existing regulations. Nationwide, an estimated $0.2 billion is needed for treatment of nitrate. The entire amount is needed now. Although the need for nitrate is a small percentage of the total need, the nature of the health threat makes the need significant for systems that exceed allowable limits. Exposure to high levels of nitrate is dangerous to infants and pregnant women because it causes “blue baby syndrome.” In addition, treating for nitrate or developing alternative sources can be expensive. Survey respondents with high levels of nitrate reported needs averaging $6.7 million per system to treat existing sources or develop new sources.

Current needs identified by water systems to address contaminants with chronic health risks total $1.7 billion. Chronic health effects include cancer and, in the case of lead, alterations in the physical and emotional development of children. Some of the most frequently reported treatment needs in this category are associated with lead, trihalomethanes, tetrachloroethylene, trichloroethane, and atrazine.

SDWA-Related Need. An additional $22.3 billion is needed now to replace deteriorated distribution piping that poses a threat of coliform contamination. Distribution piping replacement is categorized as a SDWA-related need because the monitoring required under the TCR helps to identify problems in the distribution system. However, these problems would exist in the absence of TCR monitoring and would eventually degrade water quality and service to the extent that problems would be detected without the TCR.

Deteriorated piping can break or leak, allowing fecal matter to enter drinking water, carrying disease-causing organisms. The TCR provides water systems with a framework for monitoring the microbiological status of their distribution systems. By early detection of microbiological contamination, systems can avoid outbreaks of illness. Occasionally, microbiological contamination from pipe breaks or leaks can be severe. One extreme case occurred in the town of Cabool, Missouri, where in 1989 four people died when a pipe break led to contamination of water in the town's distribution system.[2]

Dan Fraser



This pipe section was replaced because it had sprung numerous leaks, posing a threat of microbiological contamination.

[2] William C. Levine, William T. Stephenson, and Gunther F. Craun, "Waterborne Disease Outbreaks, 1986-1988," *CDC Surveillance Summaries,* March 1990. *MMRW* 39(No. SS-1):1; Barbara L. Herwaldt, et al. "Waterborne Disease Outbreaks, 1989-1990," *CDC Surveillance Summaries,* December 1991. *MMRW* 40(No.SS-3):1; Anne C. Moore, et al. "Surveillance for Waterborne Disease Outbreaks— United States, 1991-1992," *CDC Surveillance Summaries*, November 1993. *MMRW* 42(No. SS-3):1-2

Exhibit 7: Future Safe Drinking Water Act Need (in billions of Jan. '95 dollars)

Existing Regulations	Need
For contaminants with acute health effects*	$3.3
For contaminants with chronic health effects†	$0.9
Total Existing Regulations	**$4.2**
Proposed Regulations	**Need**
Disinfectants and Disinfection Byproducts Rule	$8.9
Enhanced Surface Water Treatment Rule	$5.1
Information Collection Rule (promulgated)	<$0.1
Total Proposed Regulations	**$14.0**
SDWA-Related Need	**Need**
Distribution Improvements (TCR)	$13.5
Total SDWA-Related Need	**$13.5**

Note: Numbers may not total due to rounding.
* Includes Surface Water Treatment Rule, Total Coliform Rule, and the Nitrate Standard
† Includes lead and copper, Phase I, II, and V Rules, total trihalomethanes, arsenic, barium, cadmium, chromium, fluoride, mercury, selenium, combined radium -226, -228, and gross alpha particle activity.


Fayer and Unger, 1987

Scanning electron micrograph of sporozoites of the parasitic protozoan Cryptosporidium *leaving the protective shell of the oocyst.* Cryptosporidium *in this life-cycle stage colonizes the small intestine and can cause severe illness.* Cryptosporidium, *a priority for regulation, is much more resistant to typical disinfection practices than microbiological pathogens currently regulated under the SDWA.*

Future SDWA Need

Future SDWA needs are projects needed for compliance over the next 20 years. Exhibit 7 summarizes the future SDWA and SDWA-related need.

Existing Regulations. In addition to the $12.1 billion needed now to comply with the SDWA, $4.2 billion will be needed over the next 20 years for existing SDWA regulations. This need is for replacing infrastructure that assures compliance now, but, due to aging and deterioration, will require replacement in the next 20 years. Over 75 percent of this need, almost $3.3 billion, is to protect against microbiological contaminants. A smaller portion of this need, $0.8 billion, is for lead service line replacement under the Lead and Copper Rule.

Proposed Regulations. An estimated $14.0 billion will be needed to comply with recently promulgated regulations and proposed regulations that are priorities for promulgation. These regulations include the D/DBPR ($8.9 billion), the ESWTR ($5.1 billion) and the recently promulgated ICR ($60 million).

The proposed D/DBPR will minimize the undesirable reaction that occurs between disinfectants and the organic material and bromide that are present naturally in water. The reaction forms hundreds of disinfection byproducts. Some of the disinfection byproducts are known to be toxic or are probable human carcinogens. Under the ESWTR, EPA plans to regulate *Cryptosporidium,* a parasitic protozoan that is responsible for several waterborne disease outbreaks and many other cases of acute illness in the United States. The ICR was designed to gather data needed to design the D/DBPR and the ESWTR.

Cost estimates for these regulations were taken from the preambles of the Federal Register notices proposing the rules. These estimates are based on EPA's best knowledge of existing infrastructure and on estimates of the paths most likely to be taken by water systems to reach compliance. They are rough cost estimates, and should not be considered as accurate as the cost estimates for existing regulations derived from the Needs Survey. Estimates for these regulations include needs for non-community water systems, which are not included elsewhere in this report. Needs for non-community water systems, however, are a very small portion of the projected need for these regulations.

SDWA-Related Need. An additional $13.5 billion is needed for future replacement of distribution piping. Deterioration of this piping will pose a threat of coliform contamination if it is not replaced on schedule.

Future Regulations Not Included in the Total Need

EPA may promulgate additional SDWA regulations. Future regulations being considered under the SDWA are for radon and other radionuclides, arsenic (revision), and sulfate. Needs for these future regulations are not presented elsewhere in this report because safety standards, cost estimates, and regulatory approaches have not been finalized. New or revised standards for these contaminants may result in needs ranging between $1.7 billion and $14.8 billion, depending on how they are regulated. Exhibit 8 shows the estimated range of cost by regulation. Needs for the Ground Water Disinfection Rule, which is a priority for regulation, are not included in this report because cost estimates have not been developed. More information on regulations that may be promulgated in the future is in Appendix C.

SDWA Need by Category

A portion of the total in each category of need—transmission and distribution, treatment, storage, and source—is for compliance with the SDWA. The largest portion of the current and future SDWA need is for treatment. Also, there is a significant need for distribution system repair, which is considered a SDWA-related need.

Exhibit 8: Estimated Need for Future Regulations Not Included in the Total Need (in billions of Jan. '95 dollars)

Regulation/ Contaminant	Range of Need Estimate	
	Low Estimate	High Estimate
Radon	$0.10	$2.59
Radionuclides other than Radon	$1.27	$4.59
Arsenic	$0.28	$7.13
Sulfate	$0.03	$0.46
Total	**$1.68**	**$14.77**

Note: Numbers may not total due to rounding.

Treatment accounts for almost 90 percent of the current SDWA need ($10.7 billion of $12.1 billion) and over 95 percent of the future SDWA need ($17.3 billion of $18.2 billion). These SDWA treatment needs are for treatment of contaminants currently regulated or proposed for regulation under the Act. Non-SDWA treatment needs include projects for ground water disinfection, which minimizes the threat from microbiological contaminants. Non-SDWA treatment needs also include treatment for secondary contaminants and other unregulated contaminants, installation of fluoridation facilities, and projects to upgrade process control measures at treatment plants.

A significant portion of the transmission and distribution need is SDWA-related. Current SDWA-related needs total $22.3 billion and future SDWA-related needs total $13.5 billion. These needs are for replacement of deteriorated distribution piping, which can lead to microbiological contamination. Distribution piping replacement is considered a SDWA-related need because the monitoring required under the TCR helps to identify problems in the distribution system.

This pipe has just been replaced. The steel bands are evidence of past leaks and illustrate that the pipe had exceeded its useful service life.

Dave Schultz

In addition to the SDWA-related need for compliance with the TCR, a small portion of the transmission and distribution need is for compliance with other SDWA rules. About $0.8 billion of the transmission and distribution need is for current SDWA compliance, and $0.8 billion is for future compliance. This need consists mainly of transmission lines to improve disinfectant contact time and replacement of lead service lines. Non-SDWA needs include transmission mains to carry water from the source to treatment or from treatment to the distribution system. In addition, distribution lines to extend service to existing households not currently connected to the water system are not attributed to the SDWA. Although they are not required for compliance with the SDWA, these transmission and distribution needs are essential for ensuring a safe supply of water for drinking and other uses.

Only a small portion of storage and source needs—$0.6 billion of the current need and $0.1 billion of the future need—are attributable to the SDWA. These needs are for projects to replace contaminated sources or improve disinfectant contact time. Non-SDWA source and storage needs are for new or rehabilitated wells, surface supplies, or storage facilities. Projects for these needs are to ensure continued water service or to provide an adequate supply of water during periods of peak usage.