United States Environmental Protection Agency
Office of Water (4101)
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January 1997

Drinking Water Infrastructure Needs Survey

First Report to Congress

Jim Walasek

Cincinnati's surface water treatment plant was upgraded in 1995 to include deep bed carbon filtration. This process removes organic contaminants found in Cincinnati's source, the Ohio River. The treatment plant (1) and untreated water storage (2) are shown in the foreground. The intake (3) is shown on the opposite bank of the river. The city and elevated finished-water storage tanks can be seen in the background.

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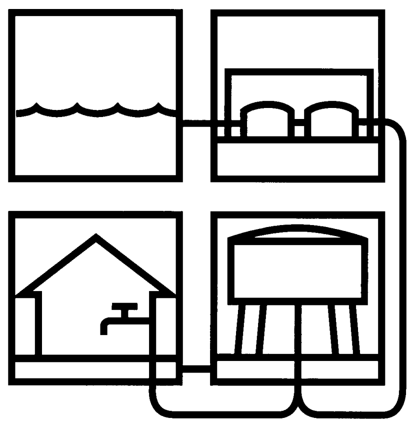

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Office of Ground Water and Drinking Water
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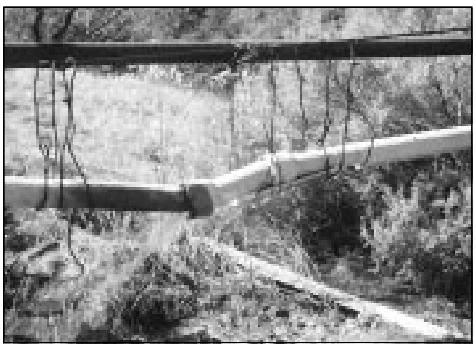

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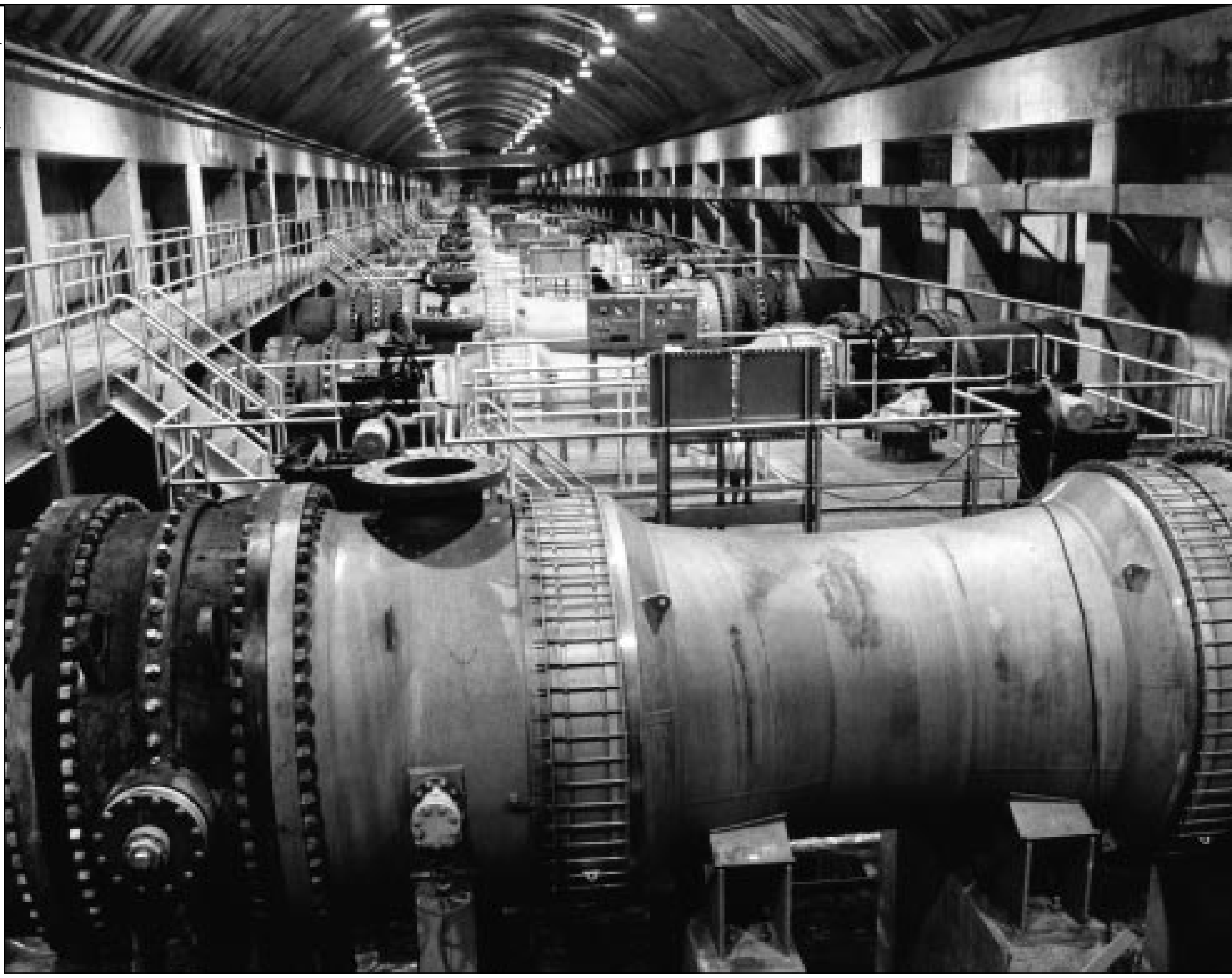

Carl Ambrose, New York City DEP

New York City's recently completed Van Cortlandt Park valve chamber regulates the flow of water into the city. The chamber houses 34 valves with a total capacity of over 1 billion gallons per day.

Acknowledgments

Many dedicated individuals contributed to the Drinking Water Infrastructure Needs Survey. We would like to thank the American Indian, Alaska Native, State, and EPA Needs Survey Coordinators for their active support and continuing interest in the survey. Not listed are the operators and managers of the approximately 4,000 water systems that spent their valuable time searching through their records and completing the questionnaires we sent to them. We thank them for their assistance.

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* EPA thanks individuals who participated in the pilot test conducted to ensure that this survey could be implemented as planned.
† EPA thanks individuals who provided information on the cost of infrastructure for smaller water systems.

Dean Chaussee

This partially demolished million gallon elevated storage tank had exceeded its useful service life. Needs Survey respondents reported that elevated tanks of this size would cost an average of $1 million.

Executive Summary

The nation's 55,000 community water systems must make significant investments to install, upgrade, or replace infrastructure to ensure the provision of safe drinking water to their 243 million customers. This first-ever national survey estimates that these systems must invest a minimum of $138.4 billion over the next 20 years. Of this total, $12.1 billion is needed now to meet current Safe Drinking Water Act (SDWA) requirements.

Over the past two years, the U.S. Environmental Protection Agency (EPA) has sponsored a national survey of drinking water infrastructure needs. In this unprecedented study, 4,000 community water systems documented their infrastructure improvement needs for the next 20 years.

SDWA Need

- The current Safe Drinking Water Act (SDWA) need totals $12.1 billion.[1] Current SDWA needs are capital costs for projects needed now to ensure compliance with existing SDWA regulations.

  Treatment for microbiological contaminants under the SDWA accounts for $10.2 billion—about 84 percent of the current SDWA need. Microbiological contaminants, regulated under the Surface Water Treatment Rule (SWTR) and Total Coliform Rule (TCR), can lead to gastrointestinal illness and, in extreme cases, death. The SWTR and TCR need is for construction of new infrastructure at systems not now in compliance and for replacement of existing infrastructure that no longer functions adequately. In addition to the need associated with the SWTR and TCR, almost $0.2 billion is needed to meet standards for nitrate, which causes acute health effects in children, and $1.7 billion is needed for contaminants that pose chronic health risks.

  It is important to note that 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 savings in design and building costs. 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.

[1] This figure is comparable to the capital needs estimate from the 1993 Chafee-Lautenberg Report to Congress.

The Drinking Water Infrastructure Needs Survey is intended to meet the requirements of Sections 1452(h) and 1452(i)(4) of the Safe Drinking Water Act.

- In addition to the $12.1 billion needed now to comply with the SDWA, $4.2 billion will be needed through the year 2014 for infrastructure replacement or improvement to comply with existing SDWA regulations.

- Another $14.0 billion will be needed for proposed regulations that will protect against microbiological contaminants and disinfection byproducts.

- An additional $35.7 billion is needed for replacement of distribution piping that poses a threat of coliform contamination. Approximately $22.3 billion of this total is needed now. 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 to the extent that problems would be detected without the TCR.

Exhibit ES-1: Total 20-Year Need by System Size (in billions of Jan. '95 dollars)

System Size	Total Need
Large Systems (serving more than 50,000 people)	$58.5
Medium Systems (serving 3,301 to 50,000 people)	$41.4
Small Systems (serving 3,300 and fewer people)	$37.2
American Indian and Alaska Native Systems	$1.3
Total	**$138.4**

Total Need

- The total infrastructure investment need is large—$138.4 billion. As shown in Exhibit ES-1, the largest share of the need, $58.5 billion, is for infrastructure improvements at large water systems. Medium and small water systems also have substantial needs at $41.4 billion and $37.2 billion. American Indian and Alaska Native water systems have needs totaling $1.3 billion. The total need includes the SDWA need.

- Over $76.8 billion is for infrastructure improvements that are needed now to protect public health. Projects for these improvements are defined as current needs. Current needs include projects such as source, storage, treatment, and water main improvements necessary to minimize the risk of contamination of water supplies.

  The remaining $61.6 billion is for future needs, which are projects designed to provide safe drinking water through the year 2014. Future needs include projects to replace existing infrastructure. A portion of the future need is for proposed regulations.

  The estimate of total need is conservative. Many systems were unable to identify all of their needs for the full 20-year period. In some cases, systems were not able to provide documentation for all of their identified needs. In addition, the survey examined only the needs of community water systems; non-community water systems, such as schools and churches with their own water systems, were not included. Needs associated solely with future growth were also excluded from this survey.

Categories of Need

- The single largest category of need is installation and rehabilitation of transmission and distribution systems. As shown in Exhibit ES-2, the total 20-year need for this category is $77.2 billion.

  Sound transmission and distribution systems are critical to protecting the public from contaminants that cause acute illness. Deteriorated distribution piping can allow water in the distribution system to become contaminated and can lead to interruptions in water service. Transmission line failure can lead to interruptions in treatment and water service. Most needs in this category involve the replacement of existing pipe. In some cases, wooden mains that have been in service for more than 100 years must be replaced. In other instances, pipe that is severely undersized, or that has exceeded its useful service life, must be replaced. Such pipe often leaks and is prone to high rates of breakage, which can lead to contamination.

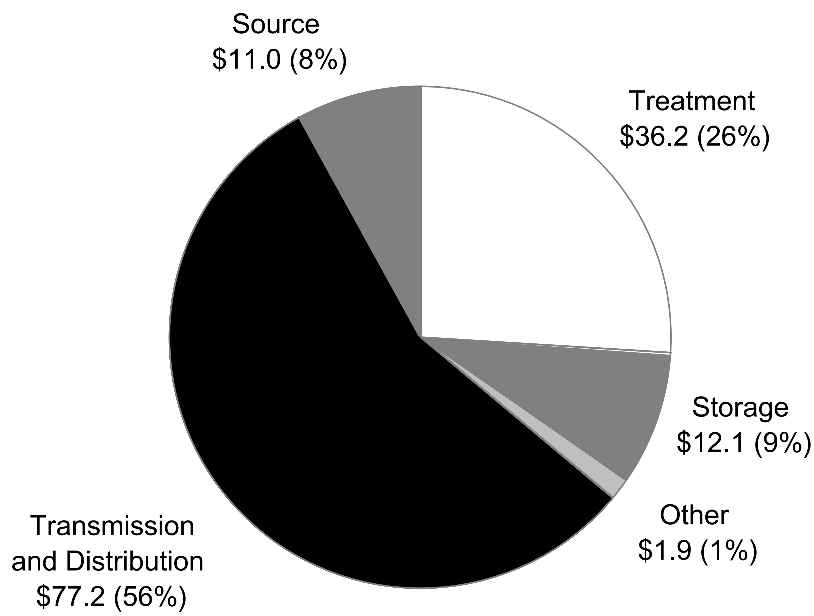
- Treatment needs constitute the second largest category of need. The total 20-year need for this category is $36.2 billion.

  All surface water and a significant percentage of ground water must be treated before it can be considered safe to drink. Over half of all treatment needs ($20.2 billion) are to reduce the threat from contaminants that can cause acute health effects. One in every four systems needs to improve its treatment for these contaminants. In addition, treatment infrastructure must be installed, upgraded, or replaced to improve treatment for contaminants that pose chronic health risks, or for contaminants that cause taste and odor or other aesthetic problems.

- Storage needs are the third largest category of need. The total 20-year need for this category is $12.1 billion.

  Storage ensures the positive water pressure necessary to prevent contaminants from entering the system. Storage also provides water during periods of peak usage. Storage facilities require periodic rehabilitation to ensure their structural integrity and to prevent the entry and growth of microbiological contaminants.

Exhibit ES-2: Total 20-Year Need by Category (in billions of Jan. '95 dollars)



- The fourth category of need is source rehabilitation and development. The total 20-year need for this category is $11.0 billion.

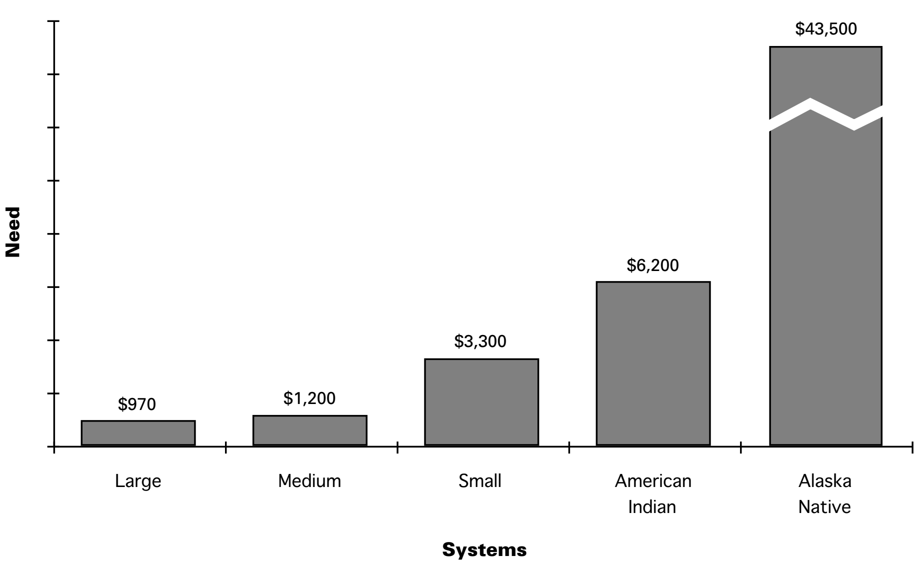
  Source rehabilitation and development is necessary for systems to continue to provide an adequate quantity and quality of drinking water.

- An additional $1.9 billion in need is categorized as "other." These needs include projects to protect water systems against earthquake damage, automate treatment plant operations, and improve laboratory facilities.

Unique Needs of Small Systems

Of the nation's 55,000 community water systems, approximately 46,500 are small systems which serve up to 3,300 persons each. There are small systems in every State, and together they serve about 10 percent of the nation's population.

Exhibit ES-3: Average 20-Year Per-Household Need (Total need in Jan. '95 dollars)



The total need facing these systems is $37.2 billion, about 27 percent of the total national need. Exhibit ES-3 shows per-household need by system size. Customers of small systems face a particularly heavy burden because these systems lack economies of scale. As a result, their average per-household costs are significantly higher than those of medium and large systems.

American Indian and Alaska Native Systems

Estimated needs for the 884 American Indian and Alaska Native systems total $1.3 billion over 20 years. American Indian and Alaska Native systems have a small total need compared to systems regulated by the States, but their need is significant in terms of household cost and impact on public health and quality of life. Per-household needs are high for the customers of these systems — they average $6,200 for American Indians and $43,500 for Alaska Natives over the 20-year period covered by the survey.

More than 98 percent of American Indian and Alaska Native water systems are small. These systems share challenges common to most small systems.

American Indian and Alaska Native systems are often located in arid regions, where water sources are difficult to obtain. Natural conditions such as permafrost can make construction very expensive. Many small systems minimize costs by joining with other water systems. But since American Indian and Alaska Native water systems are often remote, this option is rarely available to them. They must find, treat, and distribute their own water.

Households Not Served by Community Water Systems

This survey does not address the needs of the approximately 16 million households not served by community water systems. Many of these households have safe sources of running water, but an undetermined number do not. Some households that lack safe running water are close to existing community water systems, and some survey respondents estimated costs for connecting this type of household. Six billion dollars is a partial estimate for providing water to households that do not have a safe source of drinking water. Unfortunately, connecting to an existing community water system is not an option for all such homes. Further study is necessary to determine the full scope of this problem.

Methodology

The Drinking Water Infrastructure Needs Survey was a joint effort of the nation's drinking water utilities, State drinking water regulatory agencies, representatives of American Indians and Alaska Natives, the Indian Health Service (IHS), and EPA. The survey benefited from the unanimous support of every organization representing drinking water utilities.

The survey included community water systems from every State, Puerto Rico, the District of Columbia, the Virgin Islands, American Samoa, the Northern Mariana Islands, and Guam, as well as American Indian and Alaska Native systems. The survey's scope ranged from systems serving more than 15 million people to those serving only 25. Urban and rural water systems, both publicly and privately owned, were surveyed.

Of the 794 large water systems, which serve more than 50,000 people, 784 participated through a mail survey. All systems serving more than 110,000 people responded to the survey. Of the 6,800 medium systems serving a population of 3,301 to 50,000, a random sample of 2,760 systems was drawn. Ninety-three percent of these systems responded to the mail survey. To ensure an accurate estimate of infrastructure needs for the 46,500 small systems nationwide, drinking water professionals made on-site determinations of need for 537 systems serving 3,300 or fewer people. The small system needs assessment covered every State. The results of the statistical surveys were extrapolated to estimate needs for small and medium community water systems.

Wisconsin Department of Natural Resources

All 15 medium American Indian systems responded to the questionnaire. Of the 869 small American Indian and Alaska Native systems, needs were assessed for 77 representative systems. Needs for these sampled systems, in conjunction with IHS data, were used to derive needs for American Indian and Alaska Native systems.

EPA and State drinking water regulators thoroughly reviewed each system's estimates and supporting documents to ensure the validity and accuracy of the proposed projects and associated costs. The most common sources of documentation were capital improvement plans and engineers' estimates.

Conclusions

Community water systems need to invest significant amounts of money in infrastructure improvements if they are to continue providing water that is safe to drink. Much of the nation's drinking water infrastructure suffers from long-term neglect and serious deterioration. Recent events—including waterborne disease outbreaks and extended boil-water notices in major cities—have focused national attention on the dangers associated with contamination of public water supplies. Current needs for minimizing health threats from microbiological contaminants—those needs associated with the SWTR and the TCR—are especially critical.

Water systems around the country must make immediate investments in infrastructure to protect public health and ensure the availability of safe drinking water.

A distribution main break resulted in extensive damage to this Brooklyn street.

Reuters

Dan Fraser

This dug well is vulnerable to contamination from nearby farming and grazing. After rainfall, water from the well is cloudy and often contains microbiological contaminants. Water from this well must be filtered and disinfected before it can be considered safe to drink. The bottles contain water taken from the well after rainfall.

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.

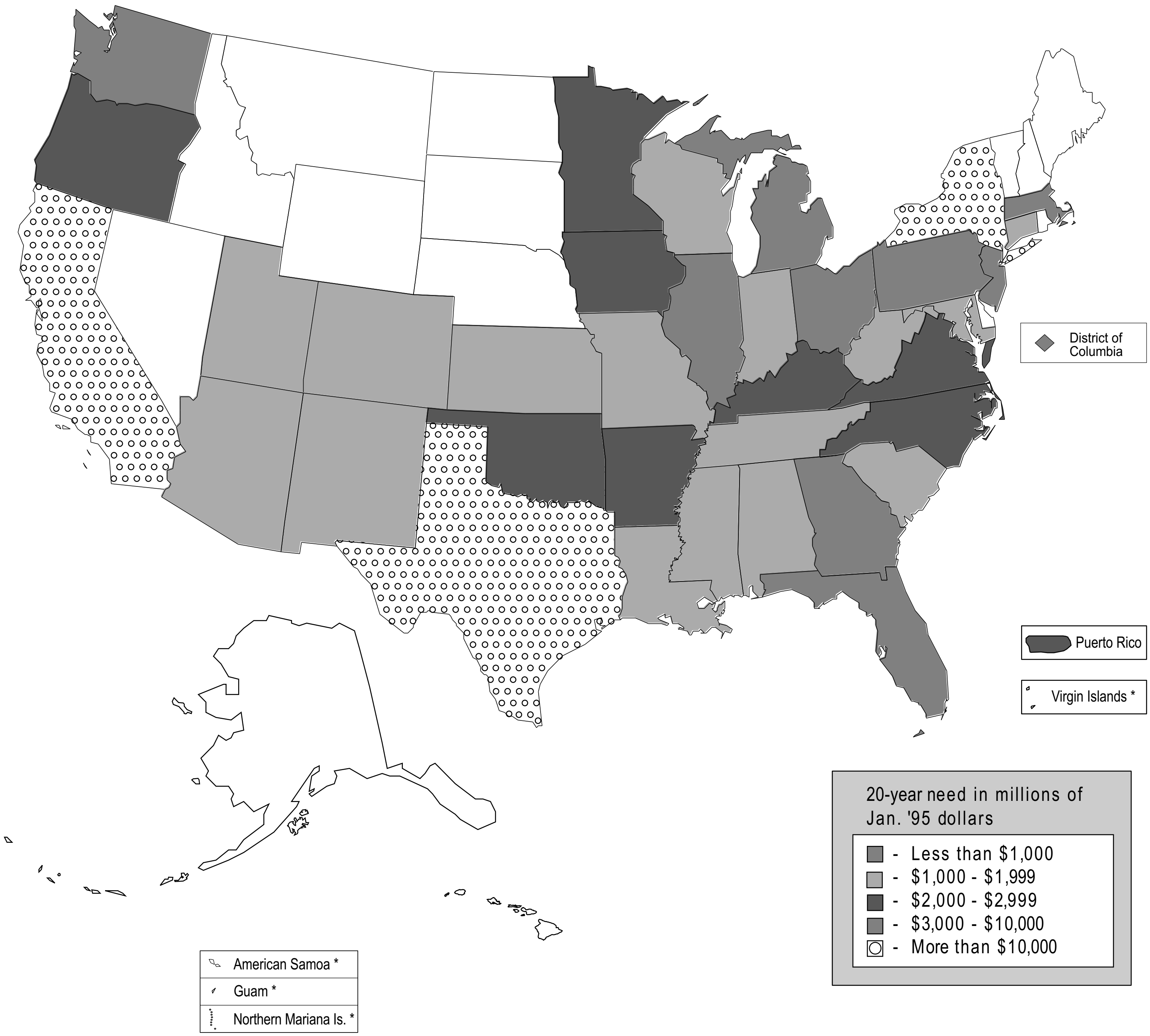
Exhibit 2 shows the total infrastructure need by category and water system size. Exhibit 3 shows need on a State-by-State basis.

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†

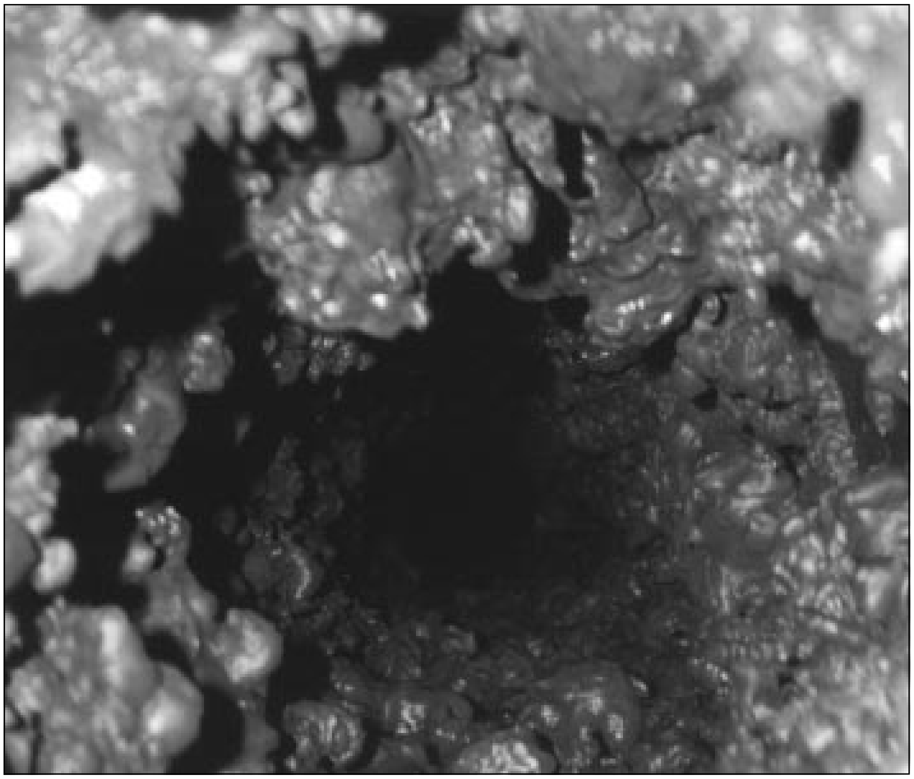


† Needs for American Indian and Alaska Native water systems are not included in this exhibit.

Not to scale

* 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.

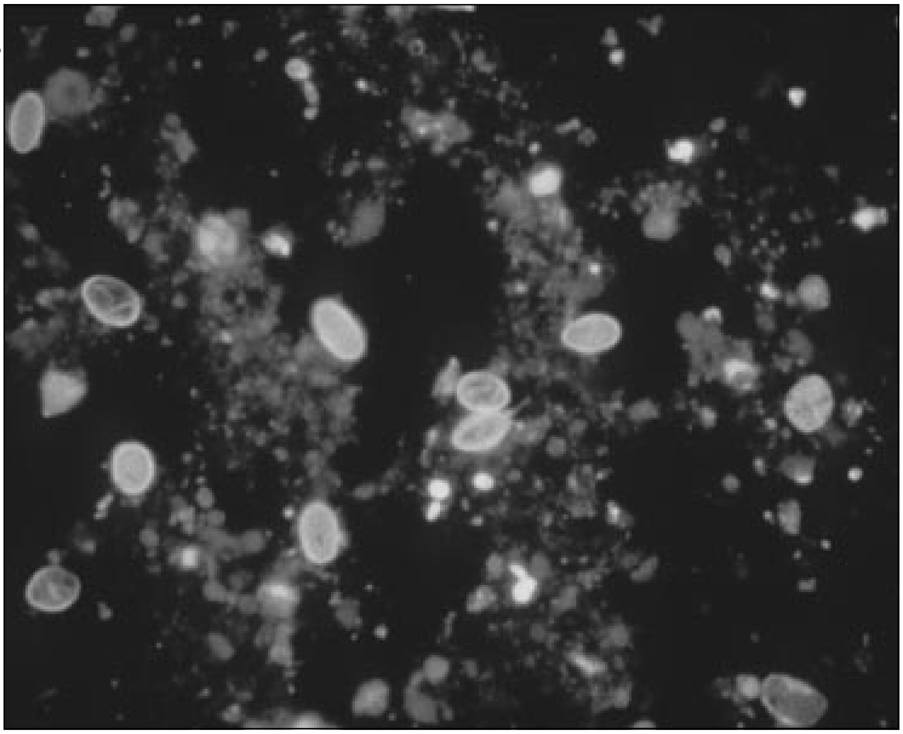
Butte, MT—Butte was developed as a mining community in the late 1800's and much of the infrastructure that was installed then remains in place today. The distribution system was constructed primarily of 6-inch diameter thin-walled steel pipe. Some wooden pipe was also used, but most of it has been replaced. 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

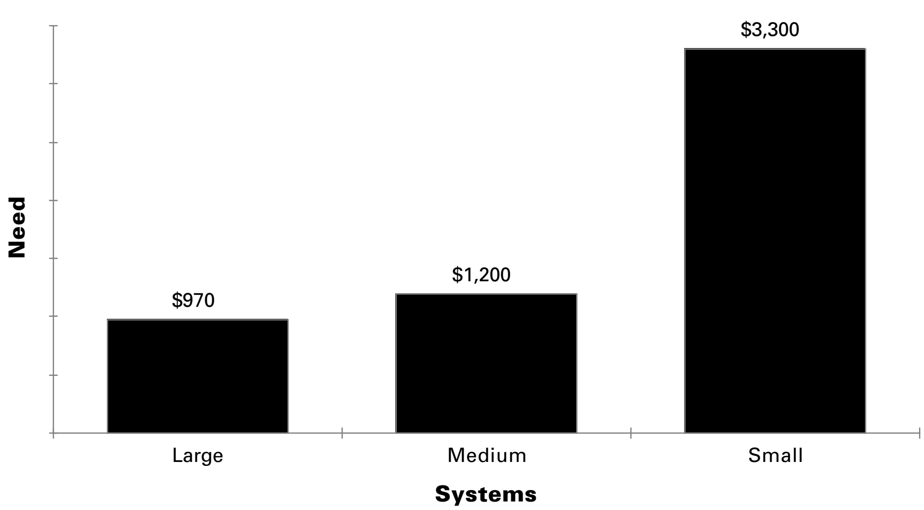
MWRA's Fells Reservoir is used for storage of finished water.

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.

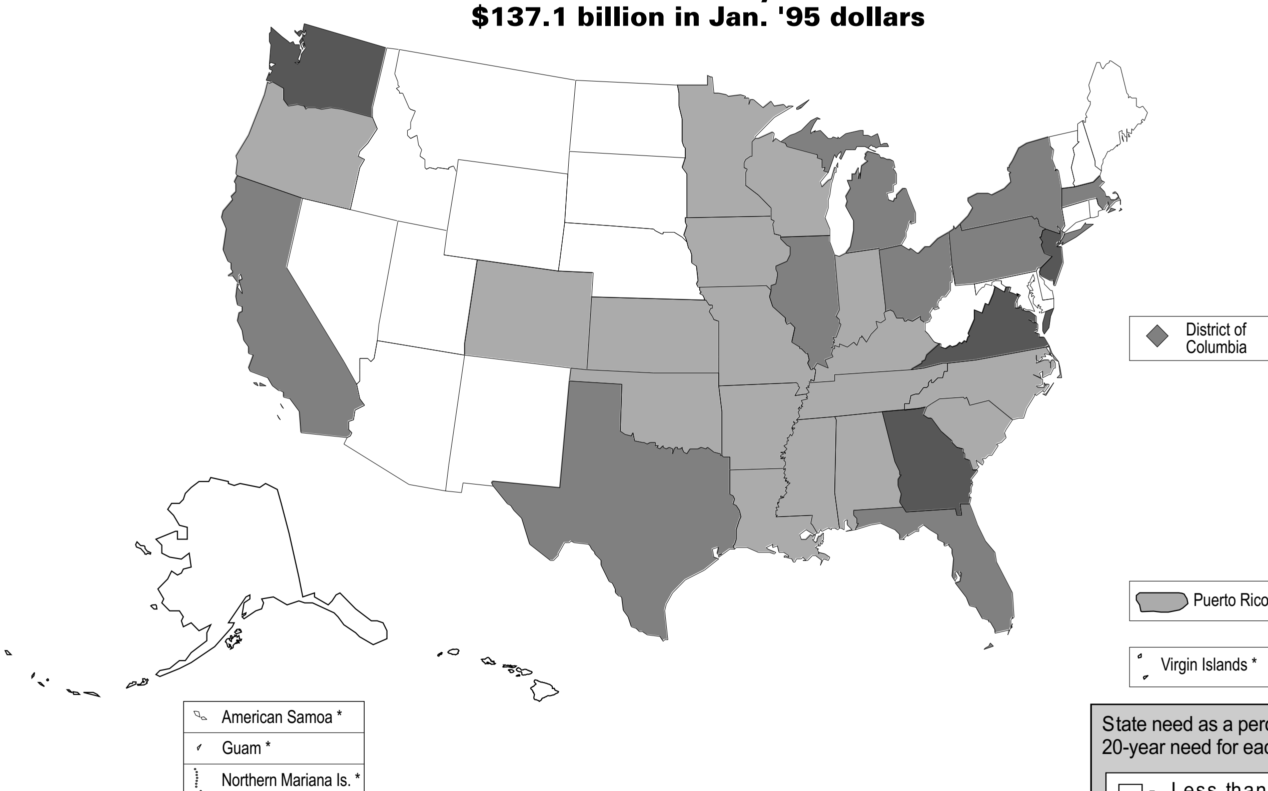
Two-thirds of small systems need to improve their sources, which are usually wells. Older wells often become clogged with sediment or encrusted with calcium carbonate or iron bacteria.

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†

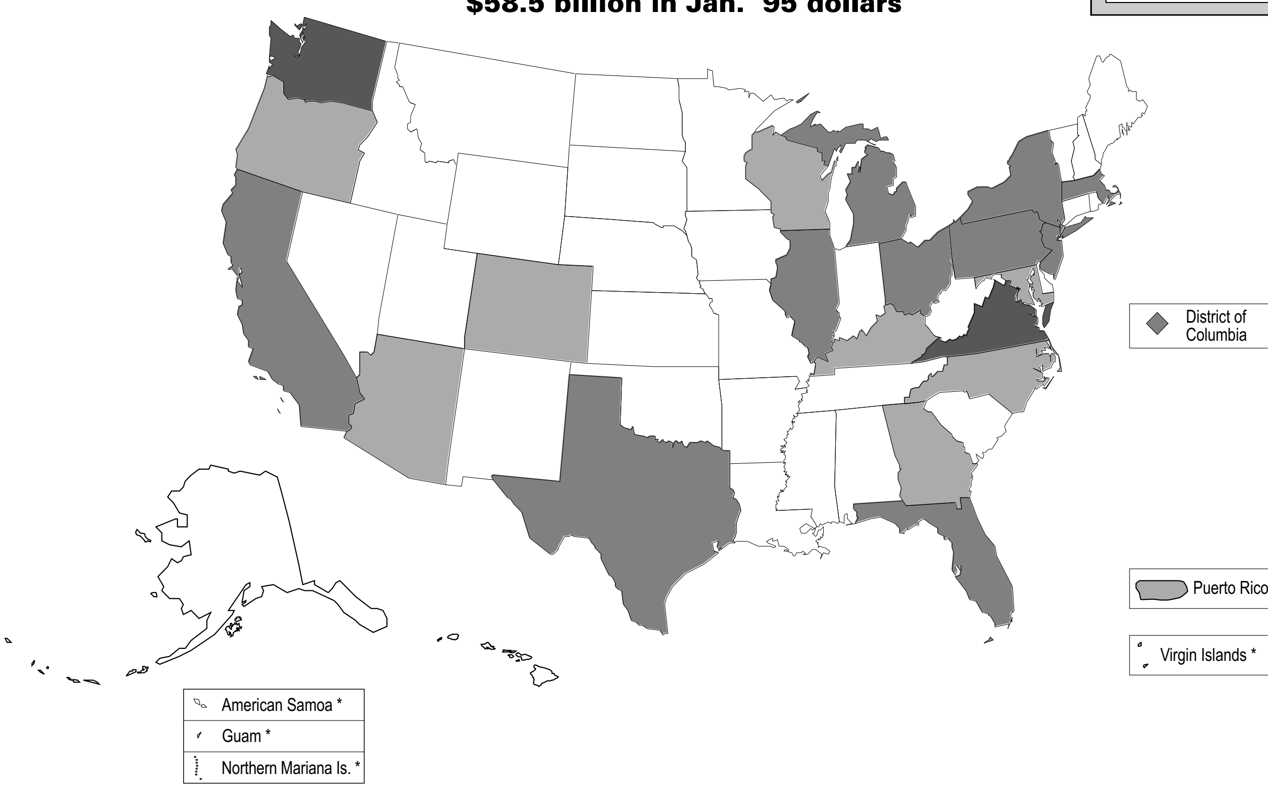
Total Need for All System Sizes
$137.1 billion in Jan. '95 dollars



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

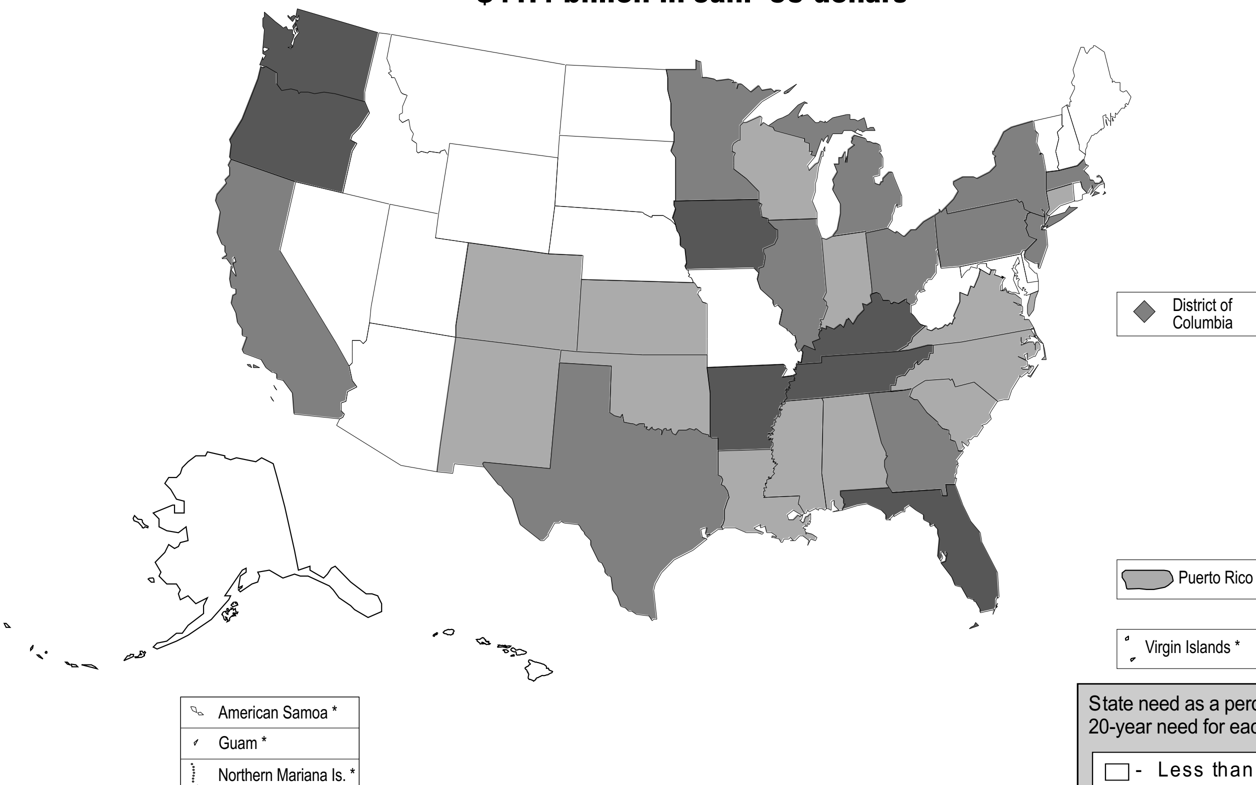


Not to scale

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

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

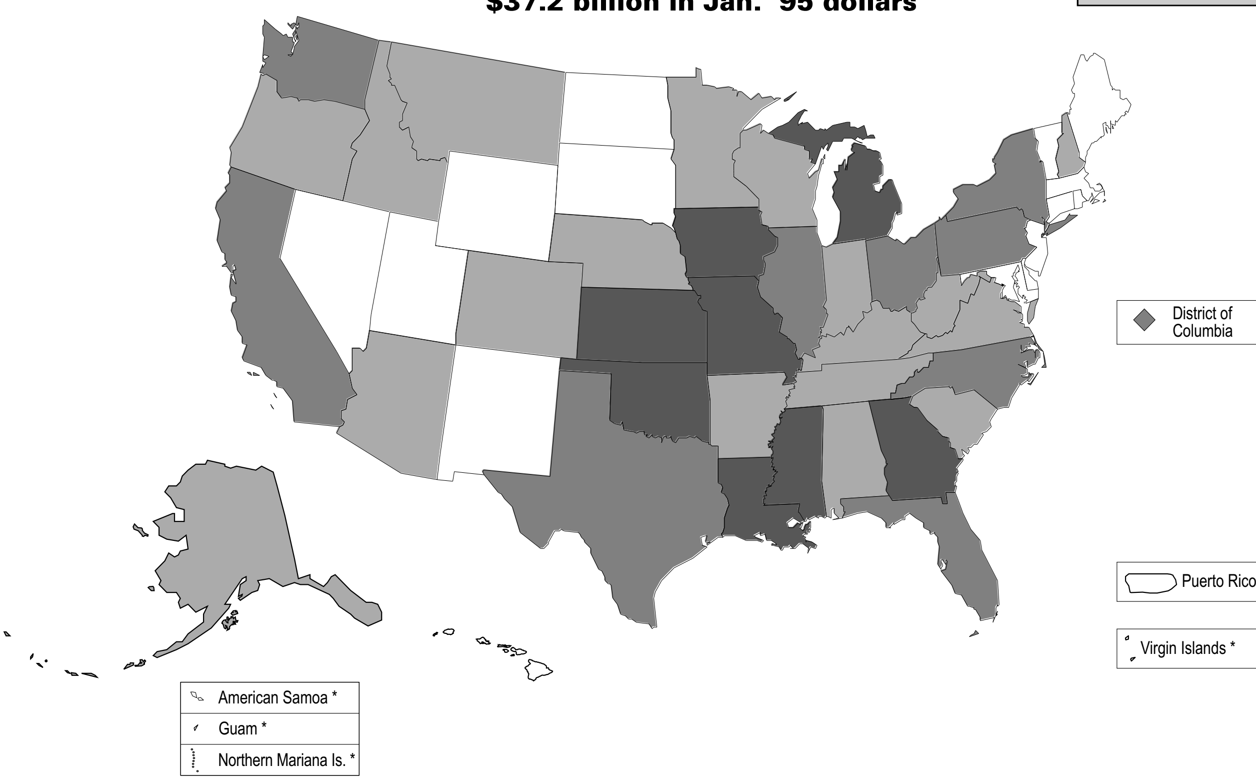
Medium System Need
$41.4 billion in Jan. '95 dollars



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

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)

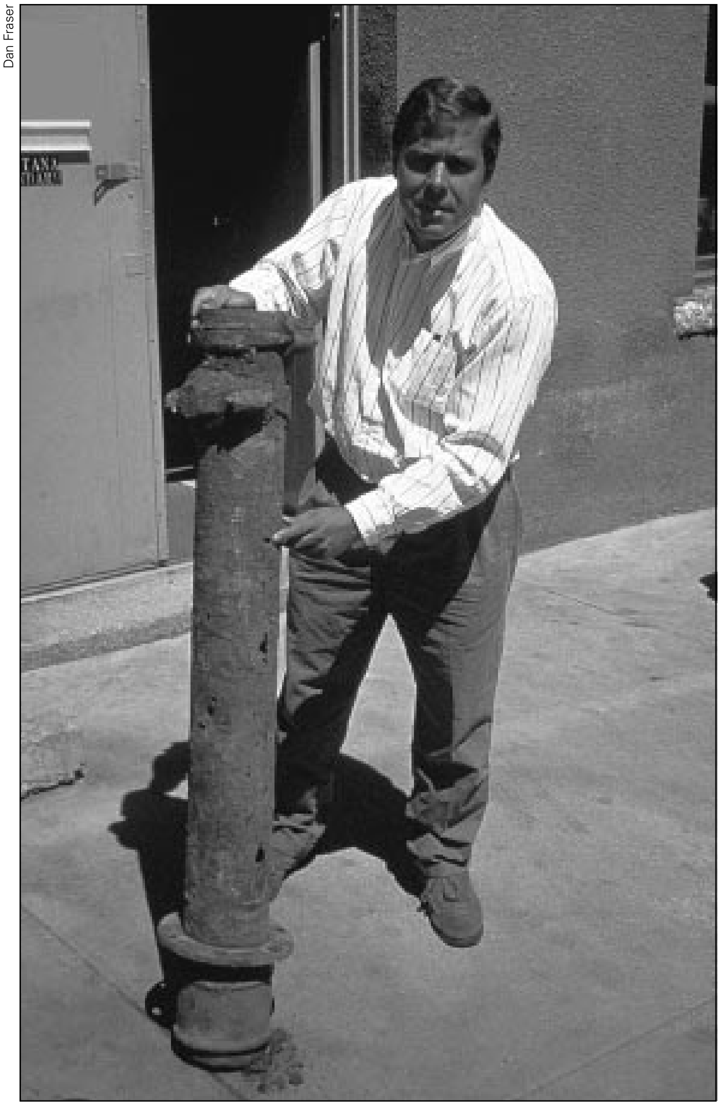
Other existing regulations. Nationwide, an estimated $0.2 billion is needed for treatment of nitrate. The entire amount is needed now. Although the need for nitrate is a small percentage of the total need, the nature of the health threat makes the need significant for systems that exceed allowable limits. 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.

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.*

Fayer and Unger, 1987

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.

Need for American Indian and Alaska Native Water Systems

The total 20-year need for the 884 American Indian and Alaska Native water systems is $1.3 billion; $0.56 billion for American Indian systems and $0.77 billion for Alaska Native systems. Of this total, approximately $1.1 billion is needed now to replace existing infrastructure or to extend a water system's service to nearby households that do not have safe running water. The survey of American Indian and Alaska Native water systems was conducted in consultation with IHS. American Indian and Alaska Native representatives participated in survey design and implementation.

This section of the report provides an overall picture of the needs of American Indian and Alaska Native water systems. The IHS Sanitary Deficiency System (SDS) provides information on specific needs and ranks communities' needs based on threats to public health.

Needs reported here for American Indian and Alaska Native systems are conservative. Projects solely for future growth were not included, nor were needs for non-community water systems. But more importantly for the American Indian and Alaska Native survey, only needs associated with existing water systems were collected. Data were not gathered for homes or groups of homes that do not currently have running water and are too distant from existing water systems for interconnection. A greater proportion of American Indian and Alaska Native households lack running water than do households in the country as a whole.

The Drinking Water Infrastructure Needs Survey places the total 20-year need for American Indian and Alaska Native water systems at $1.3 billion.

Needs for American Indian and Alaska Native water systems are high, averaging almost $43,500 per household for Alaska Native communities and over $6,200 per household for American Indian systems for the 20-year period covered by the survey. These needs are high for a number of reasons. Many American Indian and Alaska Native people now carry their water from a public watering point at a community water system. Providing piped water to these households often involves substantial expansion and modification of existing facilities. This is especially true in Alaska Native communities.

Indian Health Service

The remoteness of American Indian and Alaska Native communities often requires that communities bring in equipment and construction material by unconventional means.

Dan Fraser

Distribution mains in many arctic Alaska Native communities must be constructed above ground because ice-rich permafrost soils are often unstable. Water must be circulated and heated so that it does not freeze during arctic winters.

Because many American Indian and Alaska Native systems are located in areas remote from other communities, tying into a larger water system or joining with other communities to form a consolidated water system is often impractical. Some of these systems face significantly higher costs because of the difficulty in obtaining and transporting materials. American Indian and Alaska Native systems encounter additional problems because of arid or permafrost conditions, both of which make water sources difficult to find. Finally, like other small communities, they often lack economies of scale.

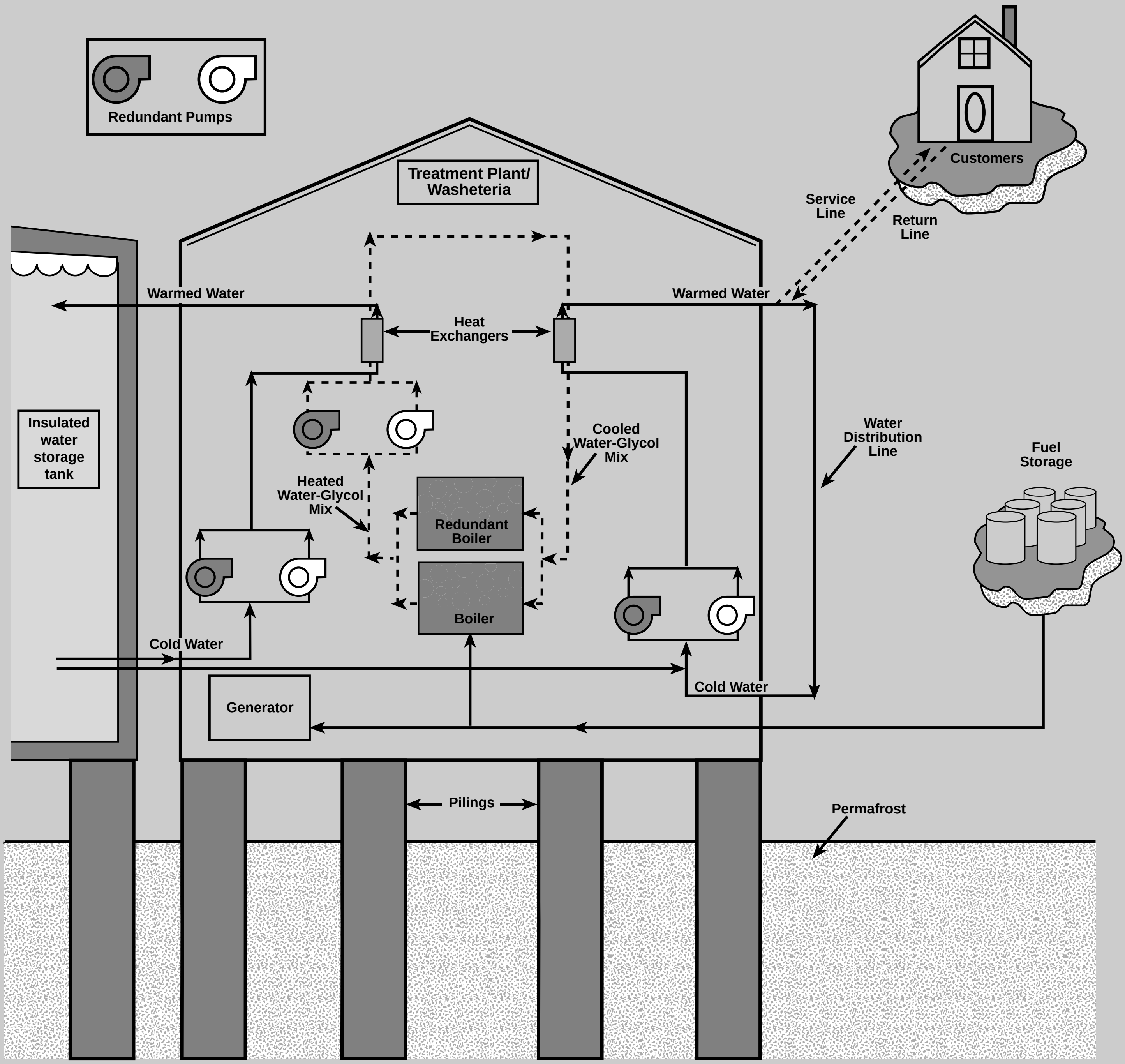
These problems are made worse by the fact that about 30 percent of American Indians and Alaska Natives have incomes below the poverty level. Many American Indian and Alaska Native people live through traditional subsistence farming, hunting, and fishing and do not generate significant cash income.

Like other systems throughout the country, most needs faced by American Indian and Alaska Native systems are associated with transmission and distribution and with treatment. Alaska Native systems, because of the limited availability of sources during the winter, also have high storage costs. These categories and unique aspects of the needs of American Indian and Alaska Native water systems are discussed in greater detail below.

Alaska Native Water Systems

Transmission and Distribution. Transmission and distribution account for about half of the total Alaska Native water system need. Alaska Native communities often face unique challenges in constructing transmission and distribution systems. Because of freezing and structural stability problems associated with permafrost, they are frequently unable to use construction methods typical of the lower 48 States. This is particularly true for communities located near or north of the Arctic Circle. Often, the most cost effective construction method available to these communities is aboveground construction of housed and insulated mains called "utilidors." To be effective and reliable, mains must be constructed in "loops" so that water can be heated and continually circulated to prevent freezing. For the same reasons, water must be circulated to and from homes through looped circulating service lines. Many system components, including circulation pumps, boilers, and generators, must be paired to provide the redundancy necessary to minimize risk of failures that would result in frozen water lines and pumps. Such failures would be certain to cause extended loss of service and require extensive repair or complete replacement of the system.

Schematic of an Arctic Alaska Water System



Supplying water in arctic conditions presents unique engineering challenges. To be structurally sound, heated facilities such as the water treatment facility and storage tank must be constructed on pilings or large pads made of imported gravel. In addition to the components diagramed here, the water treatment plant often houses a washeteria with showers, toilets, and laundry facilities.

Treatment and Storage. Together, projects to install or replace treatment and storage facilities for Alaska Native communities represent over a third of their reported need. Approximately 80 percent of Alaska Native water systems have needs for treatment. Approximately 85 percent of Alaska Native water systems have needs for storage.

Approximately half of all Alaska Native communities rely on surface water sources; the rest rely on ground water. Treatment of ground water and surface water present very similar problems and expenses in arctic conditions. The limited ground water sources available are often of poor quality, containing very high concentrations of iron and manganese. These contaminants must be removed by techniques commonly associated with surface water treatment as practiced in the lower 48 States. As a result, the processes employed for treating ground water and surface water sources, and the associated capital improvement costs, are very similar despite differences in the contaminants and associated health risks.

Treatment of surface water in arctic conditions can present unusual and difficult problems. Winter darkness, permafrost, frozen source water, subzero temperatures, and arctic weather conditions can make it impractical to pump water from a surface water source to the treatment plant. Some communities in Alaska's North Slope Borough have a "window of opportunity" for treatment which lasts only six to eight weeks during the summer. These communities treat a full year's supply of water in this short period of time. Successful operation of this type of system requires insulated and heated storage facilities with capacity of 365 days of water as compared to the one or two days storage common to systems in more

Atqasuk, an Alaska Native water system, is located north of the Arctic Circle. Water for the community must be treated and stored for the winter during a brief "window of opportunity" when ice melts each summer. The cartridge filters below cannot provide adequate treatment and need to be replaced with a conventional filtration plant. Also, the water system does not have adequate storage to provide the community with running water year-round. New insulated storage, like the tank shown, is needed.

Dan Fraser

Dan Fraser

temperate climates. Compounding problems and expenses, facilities must be capable of treating and pumping water at six or more times the rate that would be needed if they could treat daily. Finally, paired components such as boilers, pumps, and standby generators are necessary to heat and circulate water to keep storage, treatment, and distribution systems from freezing.

The total capital improvement costs for Alaska Native communities are driven upward further due to the short construction season and the cost of transporting equipment and materials. In many cases, materials and equipment must be brought in on barges when summer temperatures make rivers navigable. In some cases, airlifting materials becomes necessary.

American Indian Water Systems

Transmission and Distribution. American Indian water systems can also face problems associated with their location. Many American Indian communities are distant from other towns and communities, so they must construct and maintain their own water systems. The cost-saving option of connecting to and purchasing water from an existing system usually is not available for these systems because they are so remote. Because of the rural, widely-dispersed nature of many American Indian communities, more linear feet of water transmission and distribution line is necessary per customer served. Almost 40 percent of American Indian needs are for transmission and distribution.

Treatment. About a third of American Indian needs are for treatment. Water sources can be difficult to find in the arid country in which many American Indian communities are located and, when found, water is often of poor quality. American Indian communities frequently are forced to use sources that are expensive to treat. Over half of American Indian systems have needs for treating their ground water sources, while about 30 percent of similarly-sized ground water systems regulated by the States have treatment needs.

For many American Indian water systems, surface waters are the best sources available. Treatment of surface water is usually more expensive than ground water treatment and is crucial because of the potential health threat from microbiological contaminants. Seventy-five percent of American Indian surface water systems have capital improvement needs for treatment, compared to 50 percent of similarly sized surface water systems regulated by the States.

Exhibit 9 shows the location of American Indian Tribal lands and Alaska Native water systems. A detailed breakdown of American Indian and Alaska Native need can be found in Appendix B, Exhibits B-6 through B-8.

Dan Fraser

Pictured is a recently drilled well being tested and developed for an American Indian water system in Northeast Washington State. Previously drilled wells near the community have dried up. Several miles of transmission main are needed to bring water from this new well.

Dan Fraser

Top of mesa where the traditional community is located.

The Hopi Indian community of Polacca in northeastern Arizona provides water to traditional American Indian homes located on the top of a mesa. Provision of safe drinking water under these circumstances presents some unusual and difficult problems. Water from the town's wells must be pumped, via an aboveground transmission line, up the rock face of the mesa to the homes. The exposed transmission line is subject to breaks caused by freezing and corrosion. When the pipe breaks, water pressure in the mesa system can be lost, making the upper community vulnerable to contamination. In addition, the mesa community relies on a hydropneumatic tank to provide pressure in the water system. During power failures, water is pulled down the transmission main by gravity, causing negative pressure in distribution piping on the mesa and inviting contamination of the system. To prevent these health risks, the transmission main would have to be protected from freezing by being buried below the frost line or by other methods of insulation and/or heating. Also, standby power or an elevated storage tank would have to be provided on the mesa top.

Dan Fraser

Chuck Villa, water system operator, looking down at the exposed transmission main ascending the face of the cliff.

Exhibit 9: Location of American Indian Tribal Lands and Alaska Native Water Systems

Not to scale

Non-Community Water Systems

Because of resource constraints, the Needs Survey did not include non-community water systems. Non-community water systems are made up of transient non-community water systems and non-transient non-community water systems. Transient non-community water systems serve at least 25 persons more than 60 days out of the year, but do not regularly service any given 25 more than 6 months of the year. Examples of these systems are gas stations and road side rest areas. A few are day camps for children. Non-transient non-community water systems regularly serve at least 25 of the same persons more than 6 months of the year where those person are not full-time residents. Examples of this type of system are factories, schools, and office buildings.

Only those non-community water systems that are not-for-profit are eligible to receive funding from the Drinking Water State Revolving Loan Fund. These are the only non-community water systems that would be included in the Needs Survey. EPA estimates that 10 percent of the roughly 90,000 transient non-community water systems and that approximately half of the 20,000 non-transient non-community water systems are not-for-profit organizations. In total, approximately 19,000 non-community water systems are not-for-profit systems.

With the data on hand, it is impossible to accurately estimate the need of not-for-profit non-community water systems. However, it is likely that their needs are less than those of community water systems serving the same number of people. Non-community water systems usually have fewer sources with less capacity, smaller storage and treatment facilities, and very limited transmission and distribution systems. Source, storage, and treatment facilities are smaller for non-community water systems because the population served is often not in full-time residence. The peak demands faced by community water systems—due to morning showers and night-time meal preparation, for example—do not occur at many non-community water systems. Also, non-community water systems do not have to provide capacity for fire protection or for irrigation of residential lawns. More importantly, most non-community water systems consist of one or perhaps a few buildings and do not have substantial distribution and transmission networks.

A rough estimate that significantly overstates the need of not-for-profit non-community water systems could be made by examining the source, storage, and treatment needs of the smallest community water systems. This methodology results in a need of $125,000 per system. When this need is applied to the not-for-profit non-community water systems on a State-by-State basis, the relative distribution of need among States is not significantly affected. For this reason and because resource constraints prevented EPA from developing a high-quality need estimate for non-community water systems, an estimate of need for these systems was not included in this report.

Separate State Estimates

The Needs Survey did not include estimates for all types of need. Two States felt that it was important to report costs associated with needs not included in the survey. One reported needs for anticipated future growth, and the other reported needs for refinancing existing loans for drinking water projects. The need reported by the States in their separate State estimates totals $197 million. A list of the estimates is available in Appendix D. Separate State estimates were not included in estimates of need listed elsewhere in the report.

Alaska Area Native Health Service, OEHE

These Alaska Native children haul water from a public watering point. Many Alaska Native people do not have water in their homes.

Need for Households Not Served by Community Water Systems

The Needs Survey was not designed to estimate the total need for households not served by community water systems. Statistics from the 1990 Census show that approximately 16 million households in the United States are not served by community water systems. Of these, close to 15 million households are served by private drilled or dug wells and over 1 million households take their water from other sources such as cisterns, springs, rivers, lakes, or other untreated surface water sources. The risks faced by households not served by community water systems are not well understood because of a lack of information, but the available data show that public health risks are significant for many of them.

Hauled Water and Untreated Surface Water Sources. The more than 1 million households that take water directly from cisterns, springs, rivers, lakes, and other untreated surface water sources make up just over 1 percent of the total households in the nation. Census data show that 2 percent of American Indian households on federally recognized Tribal lands and 20 percent of mainland Alaska Native households take their water from these sources.

Hauled water and water from untreated surface water sources can be provided as running water, but often it is stored in barrels. Hauled water and water from untreated sources may contain microbiological contaminants that can make people ill. A 1984 EPA study of national rural water conditions found that total coliform bacteria were present in the water supplies of 78 percent of households that use these sources.[3] Coliform bacteria are an indication that disease-causing microbiological contamination could be present.

Households without running water are of particular concern because opportunities for people to become ill are abundant when running water is not available. Running water is important to basic sanitation. It is needed to flush toilets, wash hands, prepare food, and bathe. Living conditions for households without running water are below those that most of us take for granted. Because of a lack of data, we do not know how many households do not have running water, but homes without running water can be found across the nation.

[3] U.S. EPA. Office of Drinking Water. *National Statistical Assessment of Rural Water Conditions.* EPA 570/9-84-003, June 1984.

Hauled Water and Untreated Sources—Three Examples

Colonias—*Colonias* along the Mexican border often do not have a safe supply of running water. In many of these communities, people haul water from a central watering point or untreated surface water source. Even in cases where water is piped, many households draw untreated water from irrigation canals or unsafe ground water sources that present a significant threat of disease. In 1995, it was estimated that 339,000 residents lived in *colonias* in Texas border counties alone. Waterborne and communicable diseases are common throughout the border area. In some towns on the Texas-Mexico border, one-third of children contract hepatitis A by age 8, and nine out of ten adults by age 35.[4] In a few border counties, the rate of hepatitis A is more than triple that of the rest of the State. The lack of safe piped water and wastewater disposal is a significant factor contributing to the high incidence of disease.

The Navajo Shonto Chapter—Water for the Navajo Shonto area is available from one central watering point that is in need of rehabilitation. The area served covers approximately a 15-mile radius. A photograph of this watering point is in Appendix B. Although no official count has been taken of the people served by this watering point, it is estimated that 400 to 500 people haul water from this location to their homes. Hauled drinking water faces a risk of contamination during loading, unloading, transport, and storage.

Washeterias Serving Alaska Communities—Especially during cold weather, the only drinking water available to many Alaska Native communities is from the community washeteria. A washeteria is a single building with showers, toilets, and washing machines. The washeteria often doubles as a water treatment plant with heated water storage. Residents haul drinking water back to their homes from a watering point at this location. In most cases, water is hauled on a boardwalk that is also used to haul sewage to disposal sites. Sewage spills are not uncommon and the risk of contamination is great.

José Rodriquez

The pump (insert) draws water from this irrigation pond and distributes it, without treatment, to this colonias *community.*

[4] Comptroller of the State of Texas, *Fiscal Notes,* July 1995, p.l.

Private Wells. Approximately 15 million households in the U.S. are served by private wells. Most of these private wells provide an adequate quantity of high-quality water. Much like community water systems, however, some of these wells produce ground water that is not safe to drink. Unlike community water systems, very little is known about the degree of contamination at private wells. Although private wells are tested occasionally for microbiological contaminants and nitrate, almost no testing is done for pesticides, solvents, and inorganic chemicals. Often, private wells are tested only once, immediately after being drilled. According to the National Ground Water Association, 24 States do not require private wells to be tested at all.

Two studies examined the occurrence of total coliform bacteria in water produced by private wells. A 1995 CDC survey of more than 5,500 private wells in nine midwestern States estimates that approximately 41 percent of the wells in those States are contaminated with total coliform bacteria.[5] Even more significantly, the CDC study shows that over 27 percent of the private wells produced samples that were contaminated with *E. Coli*. The presence of this bacteria indicates recent fecal contamination. The results of the National Statistical Assessment of Rural Water Conditions, published by EPA in June 1984, support the findings of the CDC. This nationwide study found total coliform bacteria in over 40 percent and fecal coliform bacteria in 20 percent of households served by private wells.

Microbiological contaminants are the greatest health risk faced by owners of private wells, but other contaminants also pose a risk. In January 1996, the Michigan Department of Public Health recommended that owners of private wells in 10 counties test their water for arsenic. State testing indicates that water from about 2 percent of wells State-wide might exceed the current community water system standard of 50 μg/l.

Communities and households with private wells, especially those in agricultural areas, face the additional risk of nitrate contamination. Nitrate contamination causes “blue baby syndrome” and can lead to the death of infants. In 1986, the United States Geological Survey performed a National Water Quality Assessment case study of the Delmarva Peninsula, which includes most of Delaware and the eastern shores of Maryland and Virginia.[6] The study covered over 6,000 square miles, nearly half of which is used for farming. Fifteen percent of the wells sampled exceeded the EPA maximum contaminant level of 10 mg/l for nitrate. Seven other State and national studies of private rural well conditions report nitrate concentrations in excess of 10 mg/l in 2.4 percent to 23 percent of the wells sampled.

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[5] Center for Disease Control and Prevention, et.al. *A Survey of the Presence of Contaminants in Water in Private Wells in Nine Midwestern States*. Report in Draft.

[6] Hamilton, Pixie and Robert J. Shedlock. *Are Fertilizers and Pesticides in the Ground Water? A Case Study of the Delmarva Peninsula, Delaware, Maryland, and Virginia.* United States Geological Survey Circular 1080. U.S. Government Printing Office: 1993

One reason for contamination at private wells may lie in improper siting and construction of older wells. Although all States now have well construction standards, an unknown number of private wells were constructed before those standards were established. Because of space constraints, a lack of understanding of health implications, and a desire to minimize cost, some older private wells are located too close to the home's septic system or other sources of contamination.

Several States provided partial cost estimates for needs associated with establishing new water systems at communities without safe running water. These communities include those that lack running water and those that depend on contaminated private wells. Estimates from those States are provided below, but are not included in totals elsewhere in the report.

State	Cost Estimate
Minnesota	$5.4 million
New York	$276.4 million
South Dakota	$578.9 million
Texas	$147.9 million
Virginia	$12.1 million
Washington	$5.4 million

Possible Solutions. A lack of information makes it impossible to understand fully the needs for households without a safe supply of running water. Many community water systems are making efforts to address a portion of this problem by extending their service. Some Needs Survey respondents estimated needs for connecting nearby existing homes that do not have a safe or adequate supply of water. These conservative estimates show that the need for connecting these homes would be at least $6.0 billion.

Another potential solution for households without a safe supply of running water is reconstruction of older existing wells. Older existing wells could be upgraded to modern construction standards or replaced by new wells that are drilled away from sources of contamination. Constructing a new well may be the best solution for a household or group of households that do not have a supply of safe running water. In many cases, an aquifer is available to provide safe drinking water, but wells must be properly sited and constructed to make this solution successful. Further study is necessary to understand the needs faced by households not served by community water systems.

Water System Expansion - An Example

Counties in Alabama planned to spend $4.3 million in FY 1995 for expansions of existing water systems to serve rural areas. Within Clay county, the city of Ashland has agreed to add 74,000 feet of water mains, 175 service connections, and 30 fire hydrants in an effort to extend transmission lines beyond city limits. Private wells in this county have shown fecal contamination and contain high levels of iron. When this project is completed, Ashland will have provided service to 471 additional people.

Jim Wendte

Some homes without water service from public water systems store drinking water in cisterns like the one being filled in the photograph above.

Dean Chaussee

Hydropneumatic storage tanks use compressed air to pressurize small water systems. The insert is a close-up of corrosion on this tank. As these tanks age, corrosion can cause water quality to deteriorate and even pose a direct threat to safety. Hydropneumatic tanks can explode if they lose structural integrity. More than 6,500 small water systems currently need new hydropneumatic tanks or need to have their tanks refurbished.

Appendix A—Methodology

A workgroup was convened in 1994 to develop an approach for determining the drinking water infrastructure need for community water systems nationwide. The workgroup included staff and representatives of State drinking water agencies, American Indian and Alaska Native water systems, the Indian Health Service, and EPA regions and headquarters. The workgroup met in January 1994, August 1994, June 1995, and September 1995 to develop the survey methodology and design the resulting Report to Congress.

The methodology took into account the strengths and resource constraints of the different sizes of drinking water systems and developed different processes for collecting information from each one. Systems were broken down into three size classifications: large (those serving more than 50,000 people), medium (those serving from 3,301 to 50,000 people), and small (those serving 3,300 and fewer people). Exhibit A-1 shows the data collection method used, target precision levels, and number of systems surveyed for each size classification. American Indian and Alaska Native water systems were surveyed separately.

Estimating Needs for Water Systems in the States: Large and Medium Systems. All 794 large community water systems and 2,760 of the 6,800 medium systems in the States received a mailed questionnaire package. Systems were asked to complete a matrix identifying those capital projects needed to continue supplying safe drinking water to their customers. The matrix included descriptions of each need, cost estimates for the project, and documentation. The questionnaire also requested information that could be used to model costs for those infrastructure projects that did not include a cost estimate.

Exhibit A-1: Approach to Statistical Survey in the States

Small Systems	Medium Systems	Large Systems
Up to 3,300 people	3,301 - 50,000 people	More than 50,000 people
Site Visit	Questionnaire	Questionnaire
Sample	Sample	Census
95% ± 10% Precision Nationally	95% ± 10% Precision by State	
540 Sampled 537 Completed	2,760 Sampled 2,563 Completed	794 Sampled 784 Completed

All questionnaires completed by water systems in States were sent to State drinking water staff for review. State staff reviewed the needs of the systems to ensure that all documentation was adequate, and forwarded the questionnaires to EPA headquarters for final review. Following this review, responses were entered into a database containing drinking water infrastructure needs from all systems surveyed.

Acceptable Documentation

The following types of documents were used to justify the need for projects. Asterisks indicate documents that also provide acceptable cost estimates.

Capital Improvement Plan*
Master Plan*
Facilities Plan*
Preliminary Engineer's Estimate*
State Priority List
Bilateral Compliance Agreement
Administrative Order/Court Order/Consent Decree
EPA or State Filtration or Ground Water Under Direct Influence Determination
Documentation of a Maximum Contaminant Level Violation, Treatment Technique Violation, or Lead and Copper Rule Exceedance
Grant or Loan Application Form*
Comprehensive Performance Evaluation Results
State-Approved Local/County Comprehensive Water and Sewer Plan
Sanitary Survey
Signed and dated statement from State, site-visit contractor, or system engineer clearly detailing infrastructure needs.

Many large and medium drinking water systems were able to provide high-quality documented estimates of the cost of the infrastructure need they had identified. If documented cost estimates were not provided, EPA used cost models to generate costs for documented projects. Cost models were developed from the estimates provided by other large and medium water systems. For a limited number of infrastructure needs, the survey collected insufficient information to develop cost models. Costs for these needs were modeled based on engineers' reports for similar projects around the country. All costs were converted to January 1995 dollars.

State-by-State and national needs for large drinking water systems were determined by summing the documented costs and modeled costs for all large systems. Large systems that did not respond were assigned a need of zero. For medium water systems, EPA calculated each State's need by extrapolating the results from the sample to the State as a whole. To assure accurate estimates of total State costs, EPA visited States to verify the number and size of the water systems in each State's database. This process allowed EPA to extrapolate with confidence to arrive at a total medium-system need for each State.

Estimating Needs for Systems in the States: Small Systems. The workgroup estimated small water system needs using a national statistical model. To identify needs, EPA staff visited 537 of the over 46,500 small water systems to determine needs through on-site assessments. In most cases, State representatives accompanied EPA staff on the visits. Information collected during these assessments was reviewed by State and EPA staff and then entered into the national database.

Most small systems did not have documented cost estimates for the projects identified. Because of this, data provided by States, engineering firms, and larger systems were used to develop cost models for small water system needs. The costs derived from these models were used to extrapolate total costs from the systems surveyed to the nation as a whole. State inventories of small systems were checked for accuracy.

Estimating Needs for American Indian and Alaska Native Water Systems. American Indian and Alaska Native water systems fall into two size categories: medium and small. There are 15 medium American Indian systems. All 15 were sent questionnaire packages. These systems and their Tribal governments completed the questionnaires in the same manner as the large and medium systems in the States. The completed questionnaires were sent to the appropriate EPA region and then to EPA headquarters for review. In cases in which project costs were unavailable, EPA estimated costs using models developed for medium systems in the States. Responses and modeled costs represent the total needs for medium American Indian water systems.

Over 98 percent of American Indian and all Alaska Native systems are small. The workgroup's procedure for estimating needs for these systems used existing IHS databases and information collected from a sample of water systems. The IHS databases provided system-by-system information on the need, taking into account the individual characteristics of each one. These databases, however, did not contain information on all the needs collected by the survey. Therefore, data from sampled systems were used to develop adjustment factors for the IHS data. These adjustment factors reflect the difference between the IHS costs and the costs reported by the systems surveyed. Separate adjustment factors were developed for American Indian and Alaska Native systems. Total needs for American Indian and Alaska Native water systems were derived from the IHS data and the adjustment factors.

For small American Indian systems, information was collected from 57 of the 682 systems nationwide. EPA staff or contractors, often accompanied by Tribal representatives, EPA regional Indian Coordinators, and Indian Health Service representatives, made on-site assessments at each of these systems and identified needs. Project costs were estimated using the models developed for small systems in the States.

Drinking water infrastructure needs for the 187 Alaska Native communities were estimated by a roundtable of the Alaska Native Health Board, the Alaska Area Native Health Service (part of the IHS), the Alaska Department of Environmental Conservation (Village Safe Water), and EPA. This group selected 20 representative Alaska Native water systems and identified needs for those systems. Five of the 20 systems were then visited to verify the accuracy of the needs assigned by the roundtable.

Needs Associated with the Safe Drinking Water Act. A portion of the needs collected in the survey are attributable to the SDWA. For existing regulations, systems were able to identify projects needed for compliance. In these cases, survey responses were used to derive the SDWA need. However, most systems were unable to identify projects needed to comply with proposed and recently promulgated regulations. Needs for these SDWA regulations are based on the national cost estimates published in the Federal Register when the regulations were proposed. Needs for other future regulations were taken from preliminary economic analyses prepared in anticipation of promulgating regulations.

Alaska Area Native Health Service, OEHE

Rudimentary roof catchments provide drinking water for some households in the United States.

Appendix B—Summary of Findings

* Needs for water systems in the States do not include needs for American Indian and Alaska Native water systems. Needs for Palau (approximately $17.2 million) are not included in this report because Palau is not eligible to participate in the Drinking Water State Revolving Fund.

Distribution and transmission line breaks result in loss of service and can lead to contamination. Breaks can sometimes be dramatic. The road collapsed under these cars, at right, after a water main break in Fort Lauderdale. Below, a work crew repairs a water main break in San Francisco.

Courtesy of the Fort Lauderdale Sun-Sentinel

San Francisco Chronicle

Exhibit B-1: (facing page)

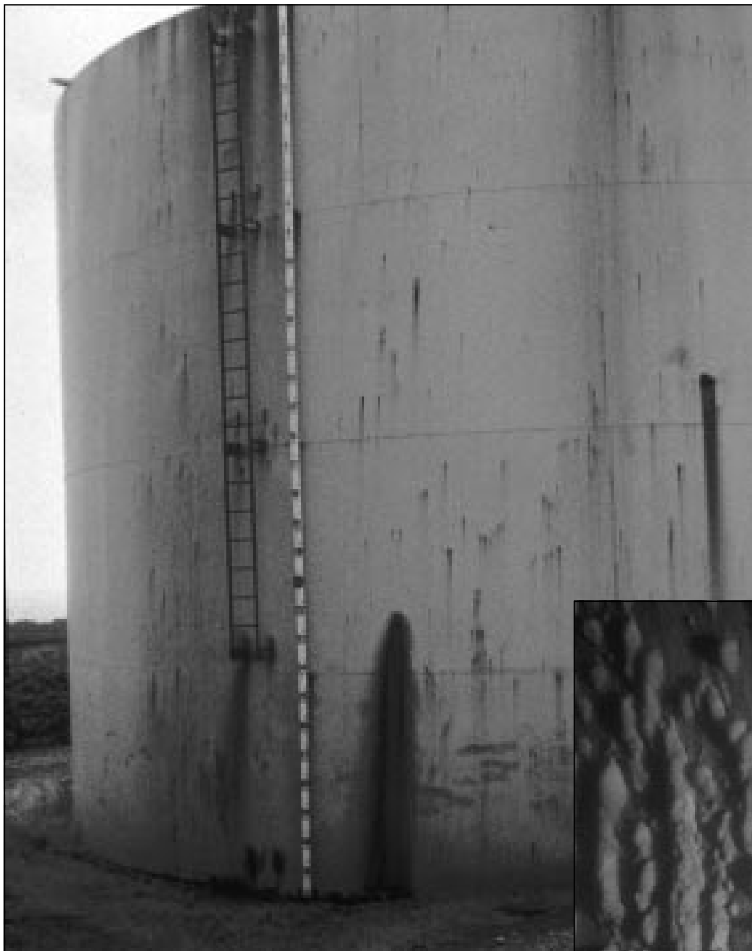
Total Need by Category

The total infrastructure need for water systems regulated by the States is $137.1 billion.

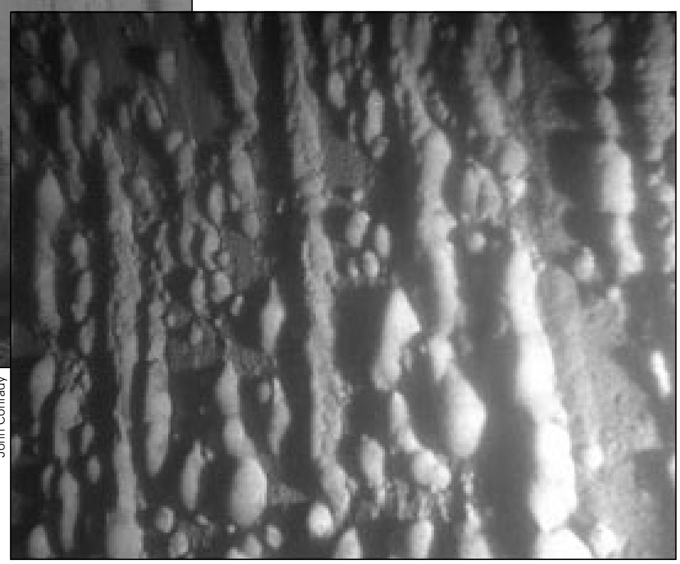
Exhibit B-1: Total Need by Category (20-year need in millions of Jan. '95 dollars)

State	Transmission and Distribution	Treatment	Storage	Source	Other	Total
Alabama	869.8	483.4	189.9	111.2	4.9	1,659.2
Alaska	478.3	143.5	93.3	49.5	6.6	771.2
Arizona	522.5	640.7	112.4	70.9	7.3	1,353.7
Arkansas	1,012.6	780.8	144.2	83.0	3.9	2,024.5
California	8,833.8	4,979.1	1,544.1	2,812.3	644.5	18,814.0
Colorado	929.2	631.7	149.3	199.4	39.5	1,949.1
Connecticut	805.6	352.3	104.0	83.6	11.2	1,356.7
Delaware	248.3	62.4	30.3	27.6	3.0	371.6
District of Columbia	110.8	12.7	8.2	0.0	0.0	131.6
Florida	2,170.5	1,317.3	402.1	362.5	82.9	4,335.3
Georgia	1,897.7	895.4	229.8	265.5	6.4	3,294.8
Hawaii	137.3	152.4	46.9	93.1	1.2	430.9
Idaho	337.9	111.2	70.1	69.3	1.7	590.2
Illinois	3,067.9	1,502.0	469.8	228.9	80.9	5,349.7
Indiana	925.2	470.9	173.5	79.7	25.4	1,674.7
Iowa	1,612.9	368.4	167.5	91.6	15.5	2,255.9
Kansas	1,181.5	521.7	169.3	97.3	6.6	1,976.5
Kentucky	1,349.9	575.9	136.7	152.1	9.6	2,224.2
Louisiana	1,046.5	573.7	190.7	131.3	11.2	1,953.5
Maine	545.6	199.1	83.3	32.5	4.9	865.5
Maryland	721.3	302.7	143.5	69.6	47.7	1,284.7
Massachusetts	3,636.8	1,536.8	442.0	281.5	47.9	5,945.1
Michigan	2,751.1	1,252.3	222.7	171.9	38.9	4,436.8
Minnesota	1,374.4	537.0	222.6	275.4	28.3	2,437.6
Mississippi	1,031.2	251.4	170.4	118.2	4.9	1,576.1
Missouri	938.1	520.8	242.7	113.8	63.5	1,878.9
Montana	378.5	165.2	71.6	44.8	2.5	662.6
Nebraska	471.3	306.4	78.1	90.7	6.3	952.9
Nevada	252.6	162.7	42.0	58.6	9.0	524.9
New Hampshire	402.6	170.0	94.3	47.9	2.2	717.0
New Jersey	2,469.8	658.2	290.5	163.5	31.2	3,613.2
New Mexico	589.0	168.9	95.2	176.3	13.3	1,042.7
New York	6,600.3	2,057.0	535.4	760.0	129.8	10,082.5
North Carolina	1,491.8	738.3	255.4	218.8	9.8	2,714.1
North Dakota	321.4	179.7	53.5	30.1	2.2	586.9
Ohio	2,680.6	1,316.7	538.1	271.2	99.7	4,906.3
Oklahoma	1,083.1	670.7	177.8	85.1	14.7	2,031.4
Oregon	1,063.9	550.6	266.1	255.8	11.8	2,148.2
Pennsylvania	2,854.7	1,269.2	428.1	179.1	25.0	4,756.0
Puerto Rico	1,172.6	591.2	217.5	271.9	0.8	2,254.0
Rhode Island	429.2	170.5	31.3	17.9	7.7	656.7
South Carolina	718.9	511.9	122.4	103.4	4.2	1,460.8
South Dakota	306.4	141.4	63.8	53.0	4.2	568.7
Tennessee	972.7	661.2	179.6	44.7	13.0	1,871.2
Texas	7,157.6	3,078.5	995.5	1,018.1	114.9	12,364.6
Utah	536.4	316.1	105.7	75.1	12.1	1,045.4
Vermont	267.8	108.9	48.8	31.6	2.2	459.3
Virginia	1,416.9	965.8	218.7	275.6	66.9	2,943.9
Washington	2,345.8	732.0	607.1	240.5	105.4	4,030.8
West Virginia	576.7	340.8	105.7	63.7	3.3	1,090.2
Wisconsin	1,025.3	525.4	177.5	125.2	13.9	1,867.2
Wyoming	213.4	113.2	29.4	33.0	1.8	390.7
Subtotal	**76,336.0**	**35,846.0**	**11,788.6**	**10,807.3**	**1,906.2**	**136,684.2**
American Samoa	12.2	4.8	3.3	1.9	0.3	22.5
Guam	33.3	5.6	10.6	57.1	0.0	106.7
Northern Mariana Is.	10.5	18.7	2.4	2.6	1.0	35.1
Virgin Islands	139.5	44.4	34.0	5.1	0.2	223.1
Subtotal	**195.4**	**73.4**	**50.4**	**66.6**	**1.5**	**387.3**
Total	**76,531.5**	**35,919.4**	**11,839.0**	**10,873.9**	**1,907.7**	**137,071.5**

Dan Fraser



John Conrady



Periodically, storage tanks must be drained, sandblasted, and covered with epoxy paint. If this refurbishment is not done, water quality can deteriorate and microbiological contamination can occur. Pictured above is an outside view of a storage tank needing rehabilitation. The insert is an underwater photo of the inside wall of a water storage tank that is overdue for rehabilitation. These are rust deposits that can harbor bacteria and lower water quality. Over one third of the water systems in the country need to rehabilitate storage tanks.

Exhibit B-2: (facing page)

Current Need by Category

Approximately $75.7 billion is for projects needed now to protect public health at water systems regulated by the States.

Exhibit B-2: Current Need by Category (in millions of Jan. '95 dollars)

State	Transmission and Distribution	Treatment	Storage	Source	Other	Total
Alabama	478.4	101.4	134.6	80.4	0.0	794.8
Alaska	335.3	43.0	65.8	37.1	0.0	481.3
Arizona	382.4	375.5	91.0	49.7	0.0	898.6
Arkansas	789.6	427.1	108.5	50.2	0.0	1,375.4
California	5,522.9	2,085.2	978.9	2,465.7	1.2	11,053.8
Colorado	487.1	233.7	86.3	117.0	0.0	924.1
Connecticut	265.7	82.8	47.3	38.9	0.0	434.8
Delaware	151.3	6.6	17.1	17.0	0.0	192.1
District of Columbia	101.1	0.0	8.2	0.0	0.0	109.3
Florida	1,618.1	397.0	333.5	305.3	0.0	2,654.0
Georgia	1,282.2	336.5	148.9	145.2	0.0	1,912.8
Hawaii	108.1	85.1	43.3	90.9	0.0	327.4
Idaho	188.7	26.4	40.6	43.4	0.0	299.1
Illinois	1,486.2	330.7	239.6	183.5	0.0	2,240.0
Indiana	612.0	116.9	124.3	60.9	0.0	914.1
Iowa	1,181.9	70.5	93.1	48.2	0.0	1,393.8
Kansas	866.2	256.3	131.8	60.1	0.0	1,314.4
Kentucky	674.4	134.2	90.9	38.5	0.0	938.0
Louisiana	729.7	191.5	141.9	85.4	0.0	1,148.6
Maine	392.4	66.9	52.2	19.8	0.0	531.3
Maryland	543.6	143.2	98.7	39.6	0.0	825.1
Massachusetts	2,301.7	399.3	404.5	219.7	0.0	3,325.1
Michigan	1,798.8	412.4	135.7	120.0	0.0	2,466.8
Minnesota	313.9	55.9	115.9	113.8	0.0	599.5
Mississippi	671.7	29.0	127.0	84.0	0.0	911.7
Missouri	545.2	136.5	175.1	85.5	0.0	942.3
Montana	190.3	35.9	40.3	23.4	0.0	290.0
Nebraska	254.8	176.7	48.2	69.8	0.0	549.5
Nevada	145.0	53.6	29.2	17.3	0.0	245.2
New Hampshire	210.6	42.8	34.9	22.6	0.0	310.9
New Jersey	1,409.1	149.0	153.8	94.9	0.0	1,806.8
New Mexico	475.7	92.6	75.3	164.4	0.0	807.9
New York	4,639.1	1,061.9	392.6	679.6	0.0	6,773.2
North Carolina	1,134.2	176.6	191.1	152.2	0.0	1,654.1
North Dakota	114.0	37.9	35.8	12.5	0.0	200.2
Ohio	1,419.8	418.9	356.8	182.4	0.0	2,377.9
Oklahoma	815.7	278.6	139.1	66.4	0.0	1,299.8
Oregon	525.0	178.2	161.9	89.5	0.0	954.6
Pennsylvania	1,924.1	388.8	327.9	139.0	0.0	2,779.9
Puerto Rico	680.4	312.0	67.2	258.4	0.0	1,317.9
Rhode Island	187.3	47.6	29.1	14.7	0.0	278.7
South Carolina	382.7	173.3	87.5	50.0	0.0	693.5
South Dakota	156.5	37.2	29.8	23.0	0.0	246.5
Tennessee	525.3	223.6	98.7	32.1	0.0	879.8
Texas	4,103.7	1,106.2	576.3	413.0	0.0	6,199.2
Utah	280.3	74.8	69.9	59.7	0.0	484.6
Vermont	161.1	37.8	32.6	25.0	0.0	256.6
Virginia	1,097.8	454.7	166.7	164.7	0.0	1,884.0
Washington	1,336.0	317.8	459.5	174.2	0.0	2,287.5
West Virginia	429.1	158.8	82.8	54.0	0.0	724.8
Wisconsin	488.8	164.1	132.9	83.9	0.0	869.8
Wyoming	132.6	38.2	20.9	29.3	0.0	221.1
Subtotal	**47,047.9**	**12,781.0**	**7,875.6**	**7,696.4**	**1.2**	**75,402.1**
American Samoa	9.5	1.7	2.7	1.6	0.0	15.6
Guam	31.1	0.7	10.4	57.0	0.0	99.2
Northern Mariana Is.	7.7	1.3	2.3	2.5	0.0	13.7
Virgin Islands	108.6	12.2	24.0	3.3	0.0	148.1
Subtotal	**156.9**	**15.9**	**39.4**	**64.4**	**0.0**	**276.6**
Total	**47,204.8**	**12,796.9**	**7,915.0**	**7,760.7**	**1.2**	**75,678.7**

New York City is in the process of constructing tunnels designed to add redundancy and deliver hundreds of millions of gallons of water per day to city residents. Workers, at right, are drilling holes for dynamiting. A worker, below, inspects a recently concreted tunnel to ensure it is ready to be put on line. Redundancy will help the city ensure an adequate water supply in the event of a tunnel failure and will enable inspections and maintenance of the city's two other main tunnels.

Carl Ambrose, New York City DEP

Carl Ambrose, New York City DEP

Exhibit B-3: (facing page)

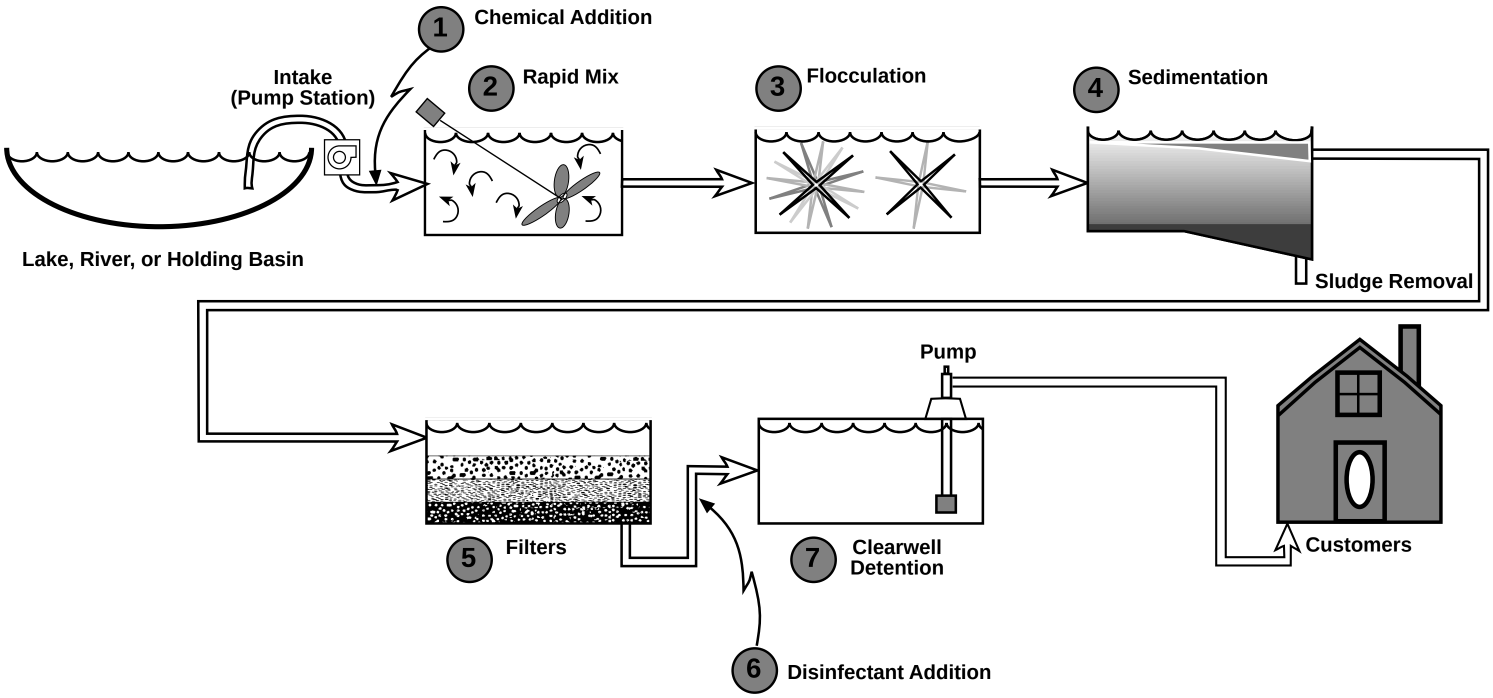
Total Need by System Size

The largest share of the total need is for infrastructure improvements at large water systems, those serving more than 50,000 people.

Exhibit B-3: Total Need by System Size (20-year need in millions of Jan. '95 dollars)

State	Large Systems	Medium Systems	Small Systems	Total
Alabama	387.4	687.9	584.0	1,659.2
Alaska	90.7	136.4	544.1	771.2
Arizona	584.5	344.2	425.0	1,353.7
Arkansas	257.6	1,101.5	665.4	2,024.5
California	13,475.1	3,306.0	2,032.9	18,814.0
Colorado	679.1	627.6	642.4	1,949.1
Connecticut	541.7	466.1	348.9	1,356.7
Delaware	189.2	21.7	160.7	371.6
District of Columbia	131.6	0.0	0.0	131.6
Florida	1,960.9	1,182.8	1,191.6	4,335.3
Georgia	946.3	1,429.8	918.8	3,294.8
Hawaii	17.8	326.2	86.9	430.9
Idaho	81.4	105.2	403.6	590.2
Illinois	1,791.9	2,178.4	1,379.4	5,349.7
Indiana	337.2	656.9	680.6	1,674.7
Iowa	306.9	1,168.2	780.8	2,255.9
Kansas	519.3	614.5	842.7	1,976.5
Kentucky	612.2	1,015.7	596.3	2,224.2
Louisiana	473.2	659.4	820.9	1,953.5
Maine	230.2	326.6	308.6	865.5
Maryland	746.5	273.9	264.4	1,284.7
Massachusetts	3,266.8	2,425.2	253.0	5,945.1
Michigan	1,817.4	1,711.4	908.1	4,436.8
Minnesota	519.4	1,257.6	660.7	2,437.6
Mississippi	25.0	573.8	977.3	1,576.1
Missouri	476.4	369.9	1,032.6	1,878.9
Montana	82.4	203.7	376.6	662.6
Nebraska	230.6	250.1	472.2	952.9
Nevada	287.1	90.7	147.1	524.9
New Hampshire	72.5	225.0	419.4	717.0
New Jersey	1,905.4	1,383.2	324.6	3,613.2
New Mexico	273.3	426.1	343.3	1,042.7
New York	6,388.4	1,645.4	2,048.7	10,082.5
North Carolina	621.7	823.2	1,269.3	2,714.1
North Dakota	129.5	227.5	229.9	586.9
Ohio	2,252.3	1,521.5	1,132.5	4,906.3
Oklahoma	399.5	543.9	1,088.0	2,031.4
Oregon	655.6	828.2	664.4	2,148.2
Pennsylvania	1,896.9	1,258.1	1,601.0	4,756.0
Puerto Rico	1,103.4	786.2	364.3	2,254.0
Rhode Island	449.6	159.9	47.1	656.7
South Carolina	350.4	674.8	435.6	1,460.8
South Dakota	76.7	176.4	315.6	568.7
Tennessee	231.9	1,162.0	477.4	1,871.2
Texas	6,195.8	2,782.1	3,386.7	12,364.6
Utah	448.2	317.1	280.0	1,045.4
Vermont	21.2	129.9	308.2	459.3
Virginia	1,626.8	589.8	727.4	2,943.9
Washington	1,282.9	1,232.0	1,515.9	"4,030.8
West Virginia	114.8	281.5	693.8	1,090.2
Wisconsin	725.4	456.1	685.7	1,867.2
Wyoming	91.8	94.1	204.8	390.7
Subtotal	**58,379.6**	**41,235.2**	**37,069.5**	**136,684.2**
American Samoa	—	6.2	16.2	22.5
Guam	79.1	20.0	7.6	106.7
Northern Mariana Is.	—	31.4	3.7	35.1
Virgin Islands	—	111.7	111.3	223.1
Subtotal	**79.1**	**169.3**	**138.9**	**387.3**
Total	**58,458.7**	**41,404.5**	**37,208.4**	**137,071.5**

TREATMENT OF SURFACE WATER



Usually, surface water is treated using a conventional filtration process designed to remove suspended solids, organic and inorganic contaminants, pathogenic organisms, and tastes and odors. Almost 40 percent of water systems with surface water sources have a need to build, rebuild, or improve surface water treatment plants. This schematic shows how these plants work.

1. Chemical Addition: Chemicals, usually coagulants and disinfectants, are added to untreated surface water to make contaminants, including pathogenic organisms, easier to remove.

2. Rapid Mix: In this stage, chemicals are quickly blended with untreated water to facilitate chemical reactions.

3. Flocculation: The water is slowly mixed in flocculation basins. The slow, gentle mixing allows chemically destabilized particles to come into contact with each other so that larger, more easily removable "floc" particles are formed.

4. Sedimentation: "Floc" particles are allowed to settle out of the water and are subsequently removed as "sludge." Many of the contaminants from the source water and chemicals added in Step 1 are removed in this process. The cleaner, "clarified" water is then transferred to the filters.

5. Filters: The remaining "floc" particles are removed as the water passes through the granular media of the filters. The clean, filtered water is collected in piping manifolds beneath the filters.

6. Disinfectant Addition: Disinfectant (usually chlorine) is added to the filtered water as it is transferred to the clearwell or finished water storage.

7. Clearwell Detention: The water is held in the clearwell long enough to allow the disinfectant to inactivate any remaining pathogens. A disinfectant residual is maintained in the distribution system to protect against contamination that might occur after the water has left the treatment plant.

Exhibit B-4: (facing page)

Current Safe Drinking Water Act Need

Approximately $12.1 billion is needed now to meet current SDWA requirements. Eighty-four percent of this need is to protect against microbiological contaminants that pose an acute risk to health.

Exhibit B-5: (pages B-10 and B-11)

Total SDWA and SDWA-Related Need

Over the next 20 years, approximately $16.2 billion is for compliance with existing SDWA regulations, and $14.0 billion is for compliance with proposed SDWA regulations. Another $35.7 billion is for SDWA-related need.

Exhibit B-4: Current Safe Drinking Water Act Need (in millions of Jan. '95 dollars)

State	SWTR	TCR	Nitrate	Lead and Copper Rule	Phase I, II, V	TTHMs	Other*	Total
Alabama	63.6	0.4	0.0	4.1	0.4	3.1	2.9	74.6
Alaska	27.3	1.7	0.2	6.8	0.0	0.0	0.5	36.6
Arizona	181.4	1.5	6.6	5.0	0.0	0.0	0.4	195.0
Arkansas	376.9	0.8	0.1	2.2	0.4	32.8	3.0	416.1
California	1,318.7	6.2	171.8	15.0	232.6	67.6	4.1	1,816.0
Colorado	213.4	1.2	0.1	2.0	0.3	0.1	2.3	219.4
Connecticut	72.1	1.4	0.2	4.3	1.5	0.0	0.8	80.3
Delaware	2.8	0.6	0.1	1.1	0.0	0.0	0.1	4.6
District of Columbia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Florida	266.9	3.7	0.4	42.3	2.0	12.2	0.6	328.1
Georgia	301.0	2.7	0.3	6.1	0.2	0.1	1.6	311.9
Hawaii	37.9	0.2	0.0	0.4	0.1	0.0	0.0	38.7
Idaho	17.2	1.5	0.2	0.9	0.4	0.0	0.6	20.7
Illinois	207.2	2.3	13.1	62.1	28.9	2.3	13.9	329.9
Indiana	98.5	2.7	0.2	26.5	7.8	0.1	1.2	136.9
Iowa	61.7	2.0	0.2	2.4	0.4	0.1	1.1	67.8
Kansas	226.7	1.2	7.3	2.3	3.7	0.4	3.2	244.8
Kentucky	108.8	0.3	0.0	1.8	0.6	0.3	4.9	116.7
Louisiana	69.9	2.9	0.2	6.5	47.7	0.7	48.2	176.1
Maine	52.8	0.7	0.1	3.4	0.1	0.1	1.3	58.5
Maryland	118.1	0.9	0.1	0.6	0.0	0.0	1.1	120.8
Massachusetts	378.8	0.6	0.1	32.0	18.1	0.6	0.9	431.0
Michigan	379.0	2.4	0.2	29.1	1.6	0.1	2.2	414.7
Minnesota	37.5	8.4	0.8	8.5	0.0	0.0	0.4	55.8
Mississippi	1.1	4.4	0.2	2.2	0.0	0.0	0.2	8.0
Missouri	104.2	3.4	0.2	4.0	4.4	23.8	2.5	142.6
Montana	26.7	1.3	0.2	0.9	0.1	0.0	0.6	29.8
Nebraska	156.1	1.1	8.4	2.3	1.1	0.0	0.2	169.2
Nevada	31.1	0.5	0.1	0.6	0.3	0.5	8.4	41.5
New Hampshire	30.0	1.7	0.2	1.1	1.7	0.1	1.2	36.0
New Jersey	45.9	0.9	0.1	103.8	11.2	0.3	13.4	175.6
New Mexico	28.1	1.3	0.2	3.6	0.0	0.0	0.5	33.7
New York	1,064.3	5.4	0.9	139.9	27.3	1.1	6.1	1,245.0
North Carolina	137.0	4.1	0.5	5.6	0.4	1.0	3.8	152.4
North Dakota	15.8	0.5	0.1	0.7	0.0	13.1	0.4	30.6
Ohio	358.1	2.4	0.3	221.1	14.3	0.1	2.5	598.7
Oklahoma	233.5	1.1	3.0	11.2	0.6	3.2	10.4	263.0
Oregon	143.4	3.0	0.2	7.4	6.7	0.1	2.3	163.1
Pennsylvania	315.8	4.1	0.5	77.8	1.3	0.3	4.7	404.4
Puerto Rico	285.9	0.3	0.0	1.9	0.2	8.5	1.7	298.6
Rhode Island	40.1	0.1	0.0	4.3	0.0	0.0	0.1	44.8
South Carolina	154.7	3.2	0.1	6.8	0.3	0.2	1.6	166.9
South Dakota	26.5	0.8	1.9	1.7	0.1	0.0	0.7	31.7
Tennessee	159.8	0.3	0.0	2.3	0.3	0.2	2.6	165.5
Texas	999.6	6.6	0.7	12.4	1.2	6.5	10.6	1,037.6
Utah	51.8	0.6	5.9	0.6	0.6	0.0	7.4	66.9
Vermont	29.5	0.8	0.1	2.0	0.1	0.0	0.8	33.4
Virginia	335.6	2.2	0.3	20.1	0.2	0.2	2.2	360.8
Washington	269.0	7.5	0.6	10.6	0.4	0.2	3.2	291.5
West Virginia	125.5	3.3	0.1	5.7	2.5	0.3	4.6	141.9
Wisconsin	143.4	2.8	0.2	20.0	5.8	0.0	0.4	172.7
Wyoming	36.7	0.4	0.1	0.5	0.1	0.0	0.6	38.3
Subtotal	**9,967.8**	**110.2**	**227.6**	**936.4**	**428.1**	**180.5**	**188.7**	**12,039.3**
American Samoa	1.4	0.0	0.0	0.0	0.0	0.0	0.0	1.5
Guam	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Northern Mariana Is.	1.2	0.0	0.0	0.0	0.0	0.0	0.0	1.2
Virgin Islands	10.2	0.0	0.0	1.2	0.0	0.0	0.0	11.4
Subtotal	**13.3**	**0.0**	**0.0**	**1.2**	**0.0**	**0.0**	**0.1**	**14.7**
Total	**9,981.1**	**110.2**	**227.6**	**937.7**	**428.1**	**180.5**	**188.8**	**12,053.9**

* Includes arsenic, barium, cadmium, chromium, fluoride, mercury, selenium, combined radium-226, -228, and gross alpha particle activity.

Exhibit B-5: Total SDWA and SDWA-Related Need (20-year need in millions of Jan. '95 dollars)

	Existing Regulations							
State	SWTR	TCR	Nitrate	Lead and Copper Rule	Phase I, II, V	TTHMs	Other*	Subtotal
Alabama	122.0	2.1	0.0	4.4	0.4	3.1	2.9	134.8
Alaska	33.4	2.0	0.2	11.4	0.0	0.0	0.5	47.6
Arizona	182.8	1.7	6.6	5.4	0.0	0.0	0.4	197.1
Arkansas	471.4	1.0	0.1	2.5	0.4	32.8	3.0	511.1
California	1,694.1	7.6	172.0	18.1	250.4	79.4	4.1	2,225.8
Colorado	277.3	1.4	0.1	4.8	0.3	0.1	2.3	286.4
Connecticut	111.7	1.6	0.2	10.8	1.5	0.0	0.8	126.6
Delaware	6.3	0.7	1.6	1.3	0.0	0.0	0.1	9.9
District of Columbia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Florida	283.3	4.5	0.4	43.5	2.0	12.2	0.6	346.5
Georgia	383.6	3.2	0.3	10.5	0.2	0.1	1.6	399.5
Hawaii	38.1	0.2	0.0	0.5	0.1	0.0	0.0	38.9
Idaho	28.5	1.7	0.2	1.2	0.4	0.0	0.6	32.7
Illinois	320.2	6.9	13.1	85.4	55.1	2.3	13.9	497.0
Indiana	108.9	6.2	0.2	27.9	7.8	0.1	1.2	152.2
Iowa	114.6	2.4	0.2	3.2	0.4	0.1	1.1	122.0
Kansas	249.0	1.4	7.3	6.0	3.7	0.4	3.2	271.1
Kentucky	180.2	0.3	0.0	32.2	0.6	0.6	4.9	218.9
Louisiana	85.5	3.5	0.2	7.2	47.7	1.8	48.2	194.0
Maine	96.3	0.8	0.1	5.9	0.1	0.1	1.3	104.6
Maryland	145.4	1.0	0.1	1.0	0.0	0.0	1.1	148.7
Massachusetts	894.4	0.7	0.1	48.8	18.1	0.6	0.9	963.6
Michigan	412.1	2.9	0.2	102.3	7.8	0.1	2.2	527.6
Minnesota	96.9	8.8	0.8	188.1	0.0	0.0	0.4	295.1
Mississippi	1.3	7.5	0.2	4.0	0.0	0.0	0.2	13.0
Missouri	146.0	3.9	0.2	4.7	4.4	23.8	2.5	185.6
Montana	66.3	1.6	0.2	1.4	0.1	0.0	0.6	70.0
Nebraska	168.7	1.4	8.4	4.3	1.1	0.0	0.2	184.1
Nevada	34.2	0.6	0.1	0.7	9.5	0.5	8.4	54.1
New Hampshire	59.2	1.9	0.2	2.1	1.7	0.1	1.2	66.3
New Jersey	62.0	1.1	0.1	124.1	11.2	0.3	13.4	212.1
New Mexico	38.7	1.5	0.2	3.9	0.0	0.0	0.5	44.8
New York	1,142.2	6.4	0.9	217.4	47.0	1.1	6.1	1,421.1
North Carolina	194.5	4.8	0.5	13.7	0.4	1.0	3.8	218.6
North Dakota	67.8	0.6	0.1	1.0	0.0	13.7	0.4	83.5
Ohio	524.4	2.9	0.3	229.4	14.3	0.1	2.5	773.8
Oklahoma	304.4	1.3	11.4	12.3	0.6	3.2	10.4	343.6
Oregon	296.3	3.3	0.2	7.8	6.7	0.1	2.3	316.6
Pennsylvania	353.7	4.9	0.5	288.3	4.3	0.3	4.7	656.7
Puerto Rico	314.9	0.4	0.0	2.0	0.2	8.5	1.7	327.8
Rhode Island	63.4	0.2	0.0	45.5	0.0	0.0	0.1	109.2
South Carolina	200.2	3.4	0.1	7.1	0.3	0.2	1.6	212.9
South Dakota	53.6	0.9	1.9	1.9	0.1	0.0	0.7	59.2
Tennessee	230.0	0.4	0.0	2.5	10.0	0.2	2.6	245.7
Texas	1,371.6	8.1	0.7	14.7	1.6	6.5	10.6	1,413.8
Utah	63.9	0.8	5.9	1.4	0.6	0.0	7.4	80.0
Vermont	33.3	1.0	0.1	2.2	0.1	0.0	0.8	37.5
Virginia	374.8	2.6	0.3	20.6	0.2	0.2	2.2	400.9
Washington	318.6	8.5	0.6	12.2	0.4	0.2	3.2	343.7
West Virginia	144.1	3.4	0.1	5.9	2.5	0.3	4.6	160.8
Wisconsin	169.7	3.2	0.2	110.6	5.8	0.0	0.4	290.0
Wyoming	40.4	0.5	0.1	0.6	0.1	0.0	0.6	42.2
Subtotal	**13,174.3**	**140.0**	**237.7**	**1,764.5**	**520.4**	**194.3**	**188.7**	**16,219.8**
American Samoa	1.8	0.0	0.0	0.0	0.0	0.0	0.0	1.9
Guam	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Northern Mariana Is.	1.2	0.0	0.0	0.0	0.0	0.0	0.0	1.2
Virgin Islands	14.0	0.0	0.0	1.2	0.0	0.0	0.0	15.2
Subtotal	**17.6**	**0.0**	**0.0**	**1.2**	**0.0**	**0.0**	**0.1**	**19.0**
Total	**13,191.9**	**140.0**	**237.7**	**1,765.7**	**520.4**	**194.3**	**188.8**	**16,238.8**

* Includes arsenic, barium, cadmium, chromium, fluoride, mercury, selenium, combined radium-226, -228, and gross alpha particle activity.

Exhibit B-5: Total SDWA and SDWA-Related Need (cont.)

	Proposed Regulations				SDWA-Related Need
State	D/DBPR	ESWTR	Information Collection Rule	Subtotal	Distribution Improvement (TCR)
Alabama	174.2	97.8	0.7	272.7	372.7
Alaska	25.4	17.5	0.1	43.0	226.8
Arizona	94.3	46.8	0.7	141.8	271.2
Arkansas	116.7	73.9	0.5	191.2	643.6
California	1,037.3	593.7	10.1	1,641.1	3,868.9
Colorado	157.9	108.6	1.1	267.6	421.8
Connecticut	113.9	71.1	0.8	185.9	531.4
Delaware	24.1	11.2	0.2	35.5	153.2
District of Columbia	7.3	5.2	0.1	12.7	75.6
Florida	280.6	56.8	3.1	340.5	1,135.3
Georgia	260.2	148.9	1.8	410.8	769.5
Hawaii	14.7	1.7	0.1	16.5	59.4
Idaho	28.1	10.4	0.1	38.5	183.6
Illinois	488.3	295.1	2.8	786.2	1,455.3
Indiana	148.0	70.8	0.9	219.7	619.6
Iowa	95.4	41.8	0.6	137.8	486.8
Kansas	92.1	61.1	0.5	153.7	632.8
Kentucky	193.4	143.0	1.0	337.4	484.8
Louisiana	174.1	75.0	1.1	250.1	626.8
Maine	39.9	25.4	0.2	65.5	371.0
Maryland	66.1	35.3	0.5	101.9	332.5
Massachusetts	314.3	183.6	2.1	499.9	1,816.3
Michigan	362.8	221.4	2.5	586.7	1,335.4
Minnesota	91.9	26.8	0.4	119.1	536.9
Mississippi	77.6	7.4	0.1	85.0	637.2
Missouri	131.7	63.9	0.6	196.2	557.4
Montana	34.0	19.4	0.2	53.5	251.9
Nebraska	33.0	7.2	0.1	40.3	262.9
Nevada	49.0	30.8	0.4	80.2	75.8
New Hampshire	41.2	24.2	0.2	65.6	237.3
New Jersey	233.6	113.2	1.6	348.4	1,127.8
New Mexico	27.4	7.2	0.1	34.7	267.2
New York	390.7	241.1	2.4	634.3	2,485.9
North Carolina	244.3	149.3	1.4	395.0	737.9
North Dakota	36.1	21.0	0.3	57.3	220.1
Ohio	349.1	184.5	2.4	535.9	1,321.3
Oklahoma	140.0	106.6	0.8	247.3	604.7
Oregon	106.0	65.2	0.5	171.6	455.4
Pennsylvania	438.9	277.9	2.8	719.7	1,661.5
Puerto Rico	134.2	85.9	0.8	220.8	137.6
Rhode Island	56.3	36.8	0.5	93.6	238.3
South Carolina	154.0	93.8	0.8	248.6	261.1
South Dakota	29.6	15.6	0.1	45.3	146.3
Tennessee	182.5	118.0	0.8	301.4	363.2
Texas	793.4	482.8	5.3	1,281.6	2,700.8
Utah	120.7	74.5	0.9	196.1	317.8
Vermont	28.5	17.7	0.1	46.3	159.3
Virginia	236.8	159.7	1.8	398.3	524.8
Washington	166.1	72.1	0.8	238.9	1,281.4
West Virginia	74.8	60.2	0.3	135.3	330.3
Wisconsin	142.9	60.6	1.0	204.5	582.8
Wyoming	33.2	24.4	0.2	57.7	104.3
Subtotal	**8,886.3**	**5,043.9**	**59.2**	**13,989.4**	**35,463.5**
American Samoa	0.8	0.7	0.0	1.4	4.9
Guam	3.3	1.1	0.0	4.4	30.2
Northern Mariana Is.	0.5	0.0	0.0	0.5	3.4
Virgin Islands	4.0	7.6	0.0	11.6	58.4
Subtotal	**8.5**	**9.3**	**0.0**	**17.9**	**96.9**
Total	**8,894.9**	**5,053.2**	**59.2**	**14,007.3**	**35,560.4**

Permafrost conditions and arctic temperatures make water system construction in Alaska Native communities challenging. A utilidor, shown to the right, houses drinking water distribution mains. Often distribution mains cannot be placed underground because ice-rich permafrost soils can be unstable and burying the lines is not cost effective. Above ground, piping must be insulated from arctic conditions. Even when pipes are insulated, the water must be circulated and heated with diesel boilers to prevent freezing. When a community does not have a distribution system that delivers water to households, residents must haul water from a watering point like the one shown below. The danger of contamination is significant because the water is hauled on the same board walk used to carry away human waste.


Dan Fraser

Dan Fraser


Alaska Area Native Health Service, OEHE

Exhibit B-6: (facing page)

Total Need for American Indian and Alaska Native Water Systems by EPA Region

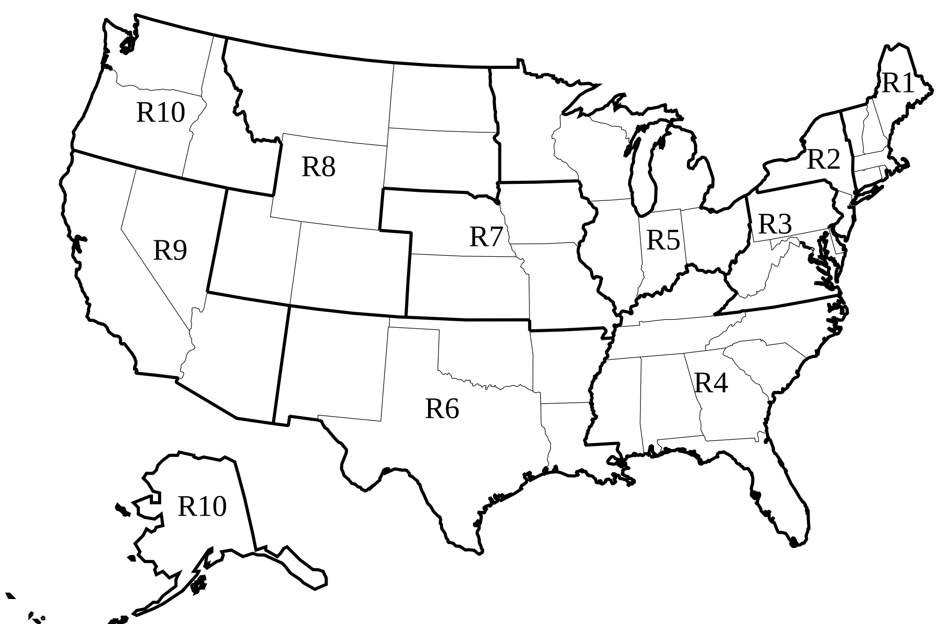
The needs for American Indian and Alaska Native water systems totals $1.3 billion.

Exhibit B-6: Total Need for American Indian and Alaska Native Water Systems by EPA Region (20-year need in millions of Jan. '95 dollars)

EPA Region	Total Need
Region 1	0.3
Region 2	1.8
Region 3 [1]	– –
Region 4	15.6
Region 5	41.2
Region 6	34.5
Region 7	5.7
Region 8	95.5
Region 9 [2]	320.5
Region 10 [3]	45.5
Alaska Native Systems	772.0
Total	**1,332.6**

Note: Numbers may not total due to rounding.

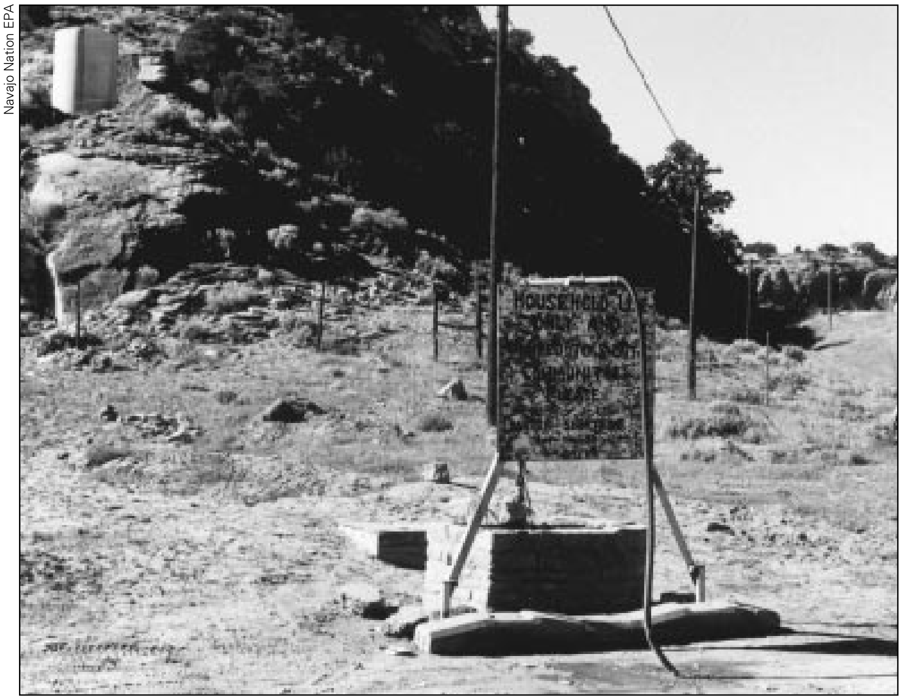
[1] There are no American Indian water systems in EPA Region 3.
[2] Navajo water systems are located in EPA Regions 6, 8, and 9, but for the purposes of this report, all Navajo needs are shown in EPA Region 9.
[3] Needs for Alaska Native water systems are not included in the EPA Region 10 total.



Locations of EPA Regions

Many American Indians get their drinking water from watering points. The Shonto watering point, pictured to the right, provides water to over 400 Navajo people. Residents use trucks to haul water to their homes up to 15 miles away. The sign at the watering point states that there is a water shortage and asks that the water be used for household purposes only. Hauled water is vulnerable to microbiological contamination. The fill hose, as well as containers for storage and transport, can cause contamination. The pump jack at Burnham, shown below, operates a watering point that serves 150 Navajo people. The pump jack is solar powered, but has a diesel backup for cloudy days. Fuel stored in the metal tank poses a direct threat of contamination to the aquifer and the well. The Navajo Nation EPA is working with both communities to improve sanitary conditions and safety precautions.

Navajo Nation EPA



Navajo Nation EPA

Exhibit B-7: (facing page)

Need by Category for American Indian and Alaska Native Water Systems

Approximately $1.1 billion is needed now to address problems that pose public health risks. Almost $0.2 billion is needed in the future to ensure the availability of safe drinking water over the next 20 years.

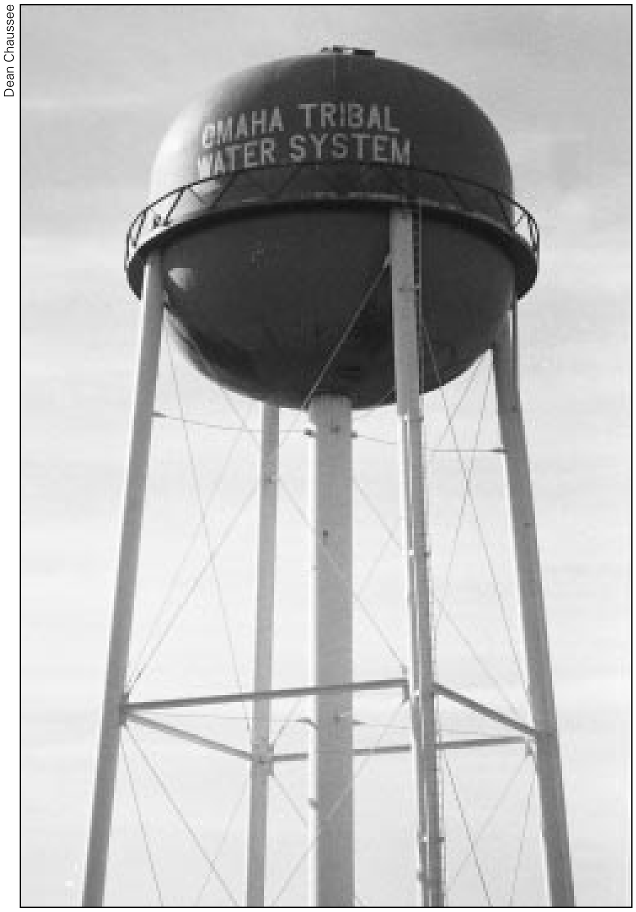
Exhibit B-7: Need by Category for American Indian and Alaska Native Water Systems (20-year need in millions of Jan. '95 dollars)

Category of Need	Current Need	Future Need	Total Need
Transmission and Distribution	606.8	42.5	649.3
Treatment	186.2	92.8	279.0
Storage	239.2	34.4	273.7
Source	72.7	25.3	98.0
Other	31.2	1.5	32.7
Total	**1,136.1**	**196.5**	**1,332.6**

Note: Numbers may not total due to rounding.

If adequate storage is not available, the distribution system can lose pressure. This condition is dangerous because it can lead to contaminants being drawn into the distribution system. The elevated tank, shown to the right, is severely corroded and should be replaced. In some cases, systems replace elevated storage tanks with stand pipes, pictured below. These stand pipes have recently been constructed on a hillside at Polacca, a Hopi community in Arizona. Even without the hillside location, these cost-effective tanks can be tall enough to pressurize a water system and hold substantial reserves of water.

Dean Chaussee



Dan Fraser

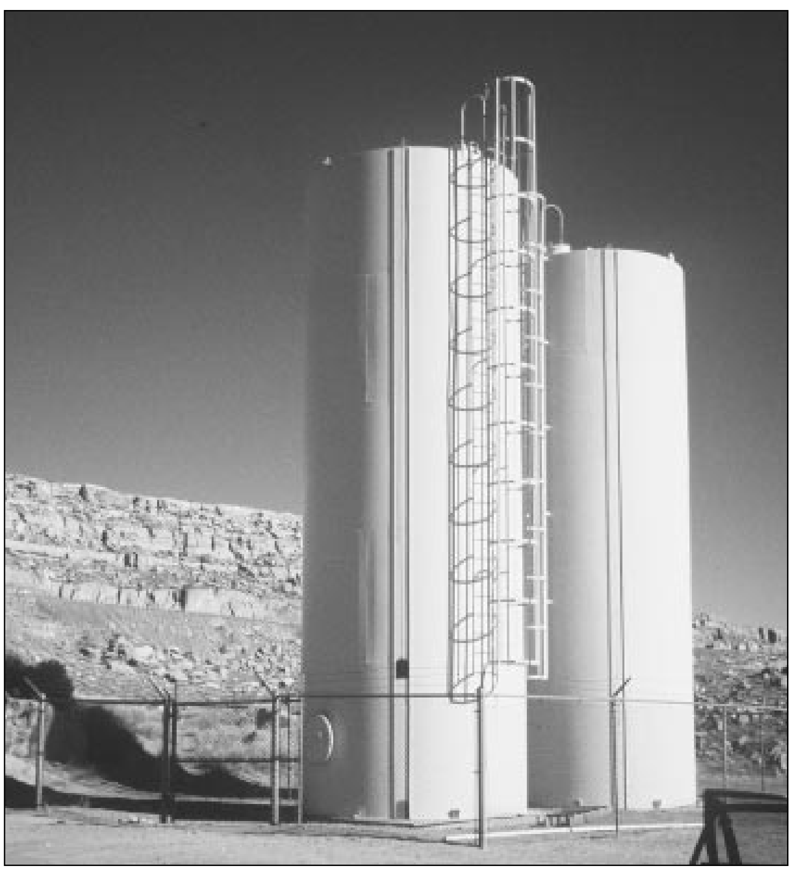


Exhibit B-8: (facing page)

Total SDWA and SDWA-Related Need for American Indian and Alaska Native Water Systems

For American Indian and Alaska Native water systems, the need for compliance with existing SDWA regulations is $96.6 million, approximately $75.6 million of which is needed now. A total of $26 million is for compliance with proposed SDWA regulations. Another $185 million is for SDWA-related need.

Exhibit B-8: Total SDWA and SDWA-Related Need for American Indian and Alaska Native Water Systems (20-year need in millions of Jan. '95 dollars)

Regulation	Current Need	Future Need	Total Need
Existing Regulations			
Regulations for Contaminants with Acute Health Effects [1]	74.8	21.0	95.8
Regulations for Contaminants with Chronic Health Effects [2]	0.8	—	0.8
Subtotal	**75.6**	**21.0**	**96.6**
Proposed Regulations			
Disinfectants and Disinfection Byproducts Rule	—	18.0	18.0
Enhanced Surface Water Treatment Rule	—	8.0	8.0
Information Collection Rule [3]	—	—	—
Subtotal	**—**	**26.0**	**26.0**
SDWA-Related Need			
Distribution Improvements (TCR)	174.4	10.9	185.3

Note: Numbers may not total due to rounding.

[1] Regulations for contaminants with acute health effects include the Surface Water Treatment Rule, the Total Coliform Rule, and the nitrate standard.
[2] Regulations for contaminants with chronic health effects include the Lead and Copper Rule, the Phase I, II, and V rules, and safety standards for TTHMs, arsenic, barium, cadmium, chromium, fluoride, mercury, selenium, combined radium-226, -228, and gross alpha particle activity.
[3] No capital costs are associated with the ICR for American Indian and Alaska Native water systems.

Portland Water Bureau

The Bull Run watershed is Portland, Oregon's drinking water source.

Appendix C—Future Regulations Not Included in the Total Need

In the future, EPA may set new or revised safety standards for additional contaminants. Future regulations being considered under the SDWA are for radon and other radionuclides, arsenic (revision), and sulfate. Needs for these future regulations are not included as part of the total need in this report because regulatory scenarios and cost estimates 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 C-1 shows the estimated range of need 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.

Exhibit C-1: Estimated Need for Future Regulations Not Included in the Total Need (in millions of Jan. '95 dollars)

Regulation/ Contaminant	Range of Options		Range of Need Estimate	
	Least Stringent	Most Stringent	Low Estimate	High Estimate
Radon	3,000 pCi/l	200 pCi/l	$102.1	$2,594.9
Radionuclides other than Radon	varies by contaminant	varies by contaminant	$1,270.8	$4,587.1
Arsenic	20 μg/l	2 μg/l	$278.9	$7,126.8
Sulfate	500 mg/l, alt. source for infants/public ed.	500 mg/l, central treatment required	$27.9	$460.3
Total			**$1,679.7**	**$14,769.1**

EPA has analyzed a range of alternatives for regulating radon and the other radionuclides—radium-226, radium-228, uranium, adjusted gross alpha, and beta and photon emitters. The high and low cost estimates in Exhibit C-1 reflects costs for regulating radon at 200 pCi/l and 3,000 pCi/l. Exhibit C-1 also shows cost estimates for regulating radium-226 and radium-228 at 5 pCi/l and 20 pCi/l, uranium at 20 μg/l and 80 μg/l, and adjusted gross alpha at 15 pCi/l. No capital costs are expected to be associated with beta and photon emitters.

Arsenic is currently regulated at 50 μg/l, but EPA has analyzed the cost of regulating this contaminant at a more stringent level. Exhibit C-1 shows estimated costs for regulating arsenic at levels of 2 μg/l and 20 μg/l.

EPA has proposed four alternatives for regulating sulfate at 500 mg/l. The least capital-intensive options (reflected in the low cost on Exhibit C-1) require water systems with high sulfate levels to provide alternative sources of water to infants and, under one scenario, provide public education to exposed adults. The most capital-intensive option (reflected in the high cost on Exhibit C-1) requires central treatment, which is usually reverse osmosis.

Dean Chaussee

The small system operator shown above is flushing iron from the water system's distribution system. More than 3,100 small systems have an unmet need to treat for iron and manganese. These secondary contaminants make water reddish-brown and stain sinks and laundry.

Appendix D—Separate State Estimates

The Drinking Water Infrastructure Needs Survey did not include some types of need. Two States felt it was important to report costs associated with these needs. In response, EPA provided States with the opportunity to submit separate estimates of need that include these costs. Exhibit D-1 shows each State's estimate. Maine's estimate is for refinancing existing loans for filtration plants. New Mexico's need estimate is for planned growth in Albuquerque. These estimates were not included in estimates of need listed elsewhere in the report.

Exhibit D-1: Separate State Estimates

State	Separate State Estimate (in millions)
Maine	$97.2
New Mexico	$100.1

Indian Health Service

Nitrate contamination can cause "blue baby syndrome" and lead to the death of infants. When their well became contaminated with nitrate, residents of Sil Nakya, a Tohono O'Odham community, were forced to find another source of water. The pictured transmission line now brings water from a neighboring community 11 miles away.

Indian Health Service

Appendix E–Glossary

Acute health effects: health effects resulting from exposure to a contaminant that causes severe symptoms to occur quickly—often within a matter of hours or days. Examples include gastrointestinal illness and “blue baby syndrome.”

“Blue baby syndrome”: a potentially fatal condition for infants where nitrate reduces the blood’s ability to carry oxygen.

Capital improvement plan (CIP): a document produced by a local government, utility, or water system that thoroughly outlines, for a specified period of time, all needed capital projects, the reason for each project, and their costs.

Chafee-Lautenberg Report to Congress: a Report to Congress prepared in response to a request in EPA's 1993 Appropriation Act. The Chafee-Lautenberg Report included a figure of $8.6 billion in 1991 dollars for capital costs for SDWA compliance. Inflated to the 1995 dollars used in the Needs Survey, this equates to $9.7 billion. (EPA Publication Number 10-R-93-000, September 1993)

Chronic health effects: health effects resulting from long-term exposure to low concentrations of certain contaminants. Cancer is one such health effect.

Coliform bacteria: a group of bacteria whose presence in a water sample indicates the water may contain disease-causing organisms.

Community water system: a public water system that serves at least 15 connections used by year-round residents or that regularly serves at least 25 residents year-round. Examples include cities, towns, and communities such as retirement homes.

***Cryptosporidium parvum*:** a protozoan parasite (often referred to as *Cryptosporidium)* that causes the disease cryptosporidiosis. This pathogenic organism is ubiquitous in surface water, including surface water used as a drinking water source. *Cryptosporidium* lives in the digestive tract of warm-blooded animals and most often reaches surface water bodies through contamination from sewage, agriculture (e.g., run-off from cattle feed lots and pastures), or wildlife activity.

Current infrastructure needs: new facilities or deficiencies in existing facilities identified by the State or system. Water systems should begin construction for current needs as soon as possible to avoid a threat to public health.

Engineer's report: a document produced by a professional engineer that outlines the need and cost for a specific infrastructure project.

Existing regulations: drinking water regulations promulgated under the authority of the Safe Drinking Water Act by EPA before publication of this report; existing regulations can be found in the Code of Federal Regulations (CFR) at 40 CFR 141.

Finished water: water that is considered safe and suitable for delivery to customers.

Future infrastructure needs: infrastructure deficiencies that a system expects to address in the next 20 years due to predictable deterioration of facilities. Future infrastructure needs do not include current infrastructure needs. Examples are storage facility and treatment plant replacement where the facility currently performs adequately, but will reach the end of its useful life in the next 20 years. Needs solely to accommodate future growth are not included in the report.

***Giardia lamblia*:** a protozoan parasite (often referred to as *Giardia*) that causes the disease giardiasis. This pathogenic organism is ubiquitous in surface water, including surface water used as a drinking water source. *Giardia* lives in the digestive tract of warm-blooded animals and most often enters surface water bodies through contamination from sewage, run-off from cattle feed lots, or wildlife activity.

Ground water: any water obtained from a source beneath the surface of the ground.

Ground water under the direct influence of surface water: any water obtained from a source beneath the surface of the ground that has vulnerabilities to contamination similar to surface water. For regulatory purposes, direct influence is determined for individual sources in accordance with State law, regulation, and policy.

Growth: expansions of population, service area, or industrial uses projected to occur after the time of the survey. Capital improvement needs planned solely to accommodate projected future growth are not included in the survey. Projects can, however, be designed for growth expected during the design-life of the project. For example, the survey would allow a treatment plant needed now and expected to treat water for 20 years. Such a plant could be designed for the population anticipated to be served at the end of the 20-year period.

Infrastructure needs: the capital costs associated with ensuring the continued protection of public health through rehabilitating or building facilities needed for provision of safe drinking water. Categories of need include source development and rehabilitation, treatment, storage, and transmission and distribution. Operation and maintenance needs are not considered infrastructure needs and are not included in this report. A portion of infrastructure needs is for SDWA compliance.

Large water system: in this report, this phrase refers to a community water system serving more than 50,000 people.

Medium water system: in this report, this phrase refers to a community water system serving from 3,301 to 50,000 people.

Microbiological contamination: the significant occurrence in a water supply of protozoan, bacteriological, or viral contaminants.

Non-community water system: a public water system that is not a community water system and that serves a non-residential population of at least 25 individuals or 15 service connections daily for at least 60 days of the year. Examples include schools and churches.

Pathogen: a disease causing organism.

Public water system: a system for the provision of water for human consumption, if the system has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year.

Safe Drinking Water Act (SDWA): a law passed by Congress in 1974 and amended in 1986 and 1996 to ensure that public water systems provide safe drinking water to consumers. (42 U.S.C.A. §§300f to 300j-26)

SDWA need: a capital expenditure required for compliance with SDWA regulations.

SDWA-related need: a capital expenditure required for distribution piping replacement. Distribution piping replacement is considered a SDWA-related need because the monitoring required under the TCR helps to identify problems in the distribution system.

Small water system: in this report, this phrase refers to a community water system serving 3,300 people or fewer. This definition was chosen based on resource constraints and system capabilities. Other definitions have been used. For example, the SDWA at §1452(a)(2) defines a small system as a system that serves fewer than 10,000 people.

Source rehabilitation and development: a category of need that includes the costs involved in developing or improving sources of water for communities.

State: in this report, this term refers to all 50 States of the United States, Puerto Rico, the District of Columbia, American Samoa, Guam, the Northern Mariana Islands, and the Virgin Islands. (See definition of "Water systems in the States.")

Storage: a category of need that addresses finished water storage needs faced by community water systems.

Surface water: all water which is open to the atmosphere and subject to surface run-off including streams, rivers, and lakes.

Transmission and distribution: a category of need that includes replacement or rehabilitation of transmission or distribution lines which carry drinking water from the source to the treatment plant or from the treatment plant to the home.

Treatment: a category of need that includes conditioning water or removing microbiological and chemical contaminants. Filtration of surface water sources, pH adjustment, softening, and disinfection are examples of treatment.

Waterborne disease outbreak: the significant occurrence of acute infectious illness, epidemiologically associated with the ingestion of water from a public water system.

Water systems in the States: in this report, this phrase refers to water systems regulated by any of the 50 States of the United States, Puerto Rico, the District of Columbia, American Samoa, Guam, the Northern Mariana Islands, and the Virgin Islands. This includes those States and territories for which the EPA serves as the primary regulatory body. This group does not include American Indian or Alaska Native water systems.

Watering point: a central source from which people without piped water can draw drinking water and transport it to their homes.