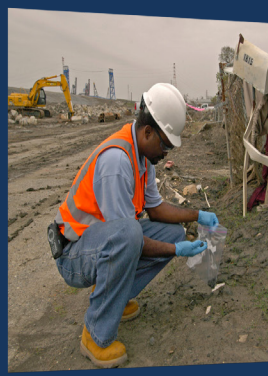
ASDWA

# Insufficient Resources
## for State Drinking Water Programs
# Threaten Public Health

*An Analysis of State Drinking Water Programs' Resources and Needs*








December 2013

Association of State Drinking Water Administrators
December 2013

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# ACRONYMS

| | |
|---|---|
| ASDWA | Association of State Drinking Water Administrators |
| AWWA | American Water Works Association |
| CCL | Contaminant Candidate List |
| DBP | Disinfection Byproduct |
| DWSRF | Drinking Water State Revolving Fund |
| EPA | U.S. Environmental Protection Agency |
| FTE | Full-time Equivalent |
| FY | Fiscal Year |
| HAA5 | Haloacetic Acids |
| IOC | Inorganic Chemical |
| MCL | Maximum Contaminant Level |
| MTBE | Methyl Tertiary Butyl Ether |
| PCB | Polychlorinated Biphenyl |
| PHS | U.S. Public Health Service |
| PPG | Performance Partnership Grant |
| PWSS | Public Water System Supervision |
| SDWA | Safe Drinking Water Act |
| SDWIS | Safe Drinking Water Information System |
| SOC | Synthetic Organic Chemical |
| TCE | Trichloroethane |
| TTHM | Total Trihalomethanes |
| UCMR | Unregulated Contaminant Monitoring Rule |
| ULO | Unliquidated Obligation |
| VOC | Volatile Organic Compound |

# INTRODUCTION

The Association of State Drinking Water Administrators (ASDWA), in collaboration with the United States Environmental Protection Agency (EPA), has conducted four national assessments of state drinking water program resource needs in recent decades, including two since the 1996 Safe Drinking Water Act (SDWA) Amendments. The assessments (in 1989, 1993, 1999 and 2001) were based on models that estimated state agencies' workloads to implement the Public Water System Supervision (PWSS) program. Taken together, the assessments demonstrate that state workload has increased with the promulgation of additional drinking water regulations and statutory requirements, even as resources remained flat or declined over many years.

Since the most recent state drinking water program resource needs assessment was conducted in 2001 (and published in April 2003), several new regulations have been promulgated by EPA. Additional new or revised regulations are either underway or are being considered through the regulatory development and review processes outlined in the SDWA. New policies for enforcement against water systems with unaddressed compliance problems have also been implemented to enhance public health protection. During this period, state drinking water programs have continued to implement the PWSS program with limited resources and under administrative constraints.

In 2011, ASDWA determined that an updated model and needs assessment was needed to understand the effects of these changes on state drinking water programs. Accordingly, a new model was developed to assess current and projected future state resource needs. A state advisory panel comprising ASDWA and ten program directors from the states of California, Colorado, Connecticut, Indiana, Kentucky, Montana, New Jersey, New York, Oklahoma and Pennsylvania supported the model's development and reviewed its assumptions and outputs. The modeling, data analysis and overall state drinking water program summary efforts were supported by EPA and its contractor, The Cadmus Group, Inc. This report presents the results of the most recent state resource needs assessment.

- Chapter 1 describes the history of the SDWA and its mission of public health protection for the nation's water systems, and introduces the challenges that states face in achieving that mission.

- Chapter 2 outlines the responsibilities of state drinking water programs and the activities that they undertake to support the SDWA. Additional activities initiated by states to address local concerns are also described.

- Chapter 3 summarizes the results of the 2011 needs assessment and the implications for state staffing and funding. The chapter identifies the funding sources available for state programs and describes barriers that states face in fully implementing the drinking water protection program.

The results of the needs assessment analysis show that significant investment is needed to enable state drinking water programs to fulfill their role in implementing the SDWA and protecting public health. Specific recommendations for meeting the funding gap are presented in a separate document, entitled *Insufficient Resources for State Drinking Water Programs Threaten Public Health: Recommendations from the Association of State Drinking Water Administrators.*

# EXECUTIVE SUMMARY

## Importance of the Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) was passed by Congress in 1974 and significantly amended in 1986 and 1996 to ensure an ever-increasing level of protection to consumers who receive their drinking water from one of the 152,000 public water systems in the United States. Prior to the 1996 SDWA Amendments, states already performed many activities fundamental to public health protection, including monitoring for regulated contaminants, enforcing public health standards when water systems were non-compliant, providing technical support to design and build water systems and conducting routine site visits to water systems to identify potential threats to water system integrity. The 1996 Amendments added many new required elements to state drinking water programs: new contaminants for which safety standards must be maintained and enforced; enhanced monitoring programs designed to pinpoint more precisely where contamination occurs; source water assessments; right-to-know provisions to communicate with the public; operator certification requirements; administration of loan programs to fund infrastructure improvements and assessment of the technical, managerial and financial capabilities of water systems to sustainably provide safe water. Following the terrorist attacks on September 11, 2001, Congress added water security to state drinking water program responsibilities, and recent large-scale natural disasters have elevated the importance of "all hazards" emergency response planning and training.

As the public health risks posed by drinking water contaminants and other constituents of concern in drinking water (such as high levels of turbidity) become more complex and pressing, state program responsibilities for adequately managing sources of drinking water, overseeing the treatment of drinking water and supervising water systems all increase. The 1996 SDWA Amendments instituted a water-system-specific approach to public health protection, which can be cost-effective for the water system and enhances public health protection, but demands more state resources. In general, smaller water systems often require technical support from state staff as they implement monitoring schedules and use contaminant-removal technologies. Technologies to remove or reduce contaminants in drinking water have become more complex since the 1996 SDWA Amendments, and the effectiveness of these technologies also can be affected by seasonal or extreme weather, such as droughts or heavy rains. As water quality, technologies and program requirements change, the degree of technical expertise necessary to understand and manage these issues increases. Additionally, states and water systems also are challenged by aging and deteriorating infrastructure, a well-documented problem which will require significant investments to protect public health and ensure reliable delivery of safe water.

The challenge of effectively protecting public health—through monitoring, treatment, training, technical assistance and infrastructure investment—requires significant resources. State staff must be diligent and skilled as they provide the necessary oversight to water system staff. Investments in infrastructure are just as critical to ensure that water systems maintain their ability to provide safe water over many years. These combined efforts are highly time- and resource-intensive undertakings for state programs, but in their absence, water systems may experience preventable operational or managerial failures which pose potentially severe public health threats for consumers and even greater workloads for state staff in response.

Safe drinking water is important to our communities in many ways. Proactively avoiding incidents such as waterborne disease outbreaks can prevent loss of life and reduce considerable health care costs.

Businesses need high quality water to meet strict standards associated with their operations or manufacturing processes. Yet in many states, investments in the drinking water program may be perceived by the public as a relatively low priority, because state drinking water programs can be "victims of their own success": a successful prevention-based program makes few headlines and operates largely outside the public eye, which can make it harder to explain the importance of adequate funding to sustain a good record. But the success of these important state programs is not guaranteed, and states continue to face fiscal crises that compromise their effectiveness.

## Estimating Resource Needs and Available Resources

As in previous resource needs assessments conducted in 1989, 1993, 1999 and 2001, the United States Environmental Protection Agency (EPA) and the Association of State Drinking Water Administrators (ASDWA) partnered to measure the resources currently available to state programs and the resources needed to implement the SDWA. Through a survey of its members, ASDWA determined current staffing and funding levels that serve as the baseline resource level for the national analysis. EPA's contractor, The Cadmus Group, Inc., developed a resource needs model to estimate the resources states would need between 2012 and 2021. The model was "ground-truthed" by ASDWA and 10 state directors, and the model's assumptions were revised as needed to reflect states' direct experience implementing the SDWA. Workload estimates for program activities related to drinking water standards established since 2001 were based on assumptions from the formal regulatory development process. While the model was based upon rule-specific and task-specific workload elements, the model is not sufficiently sensitive to allow projections of resources needed on a rule-specific or program component basis.

The SDWA outlines many programs that collectively provide a foundation for states' efforts to oversee water quality from the water source to the consumer's faucet. However, states also implement a variety of additional programs. Therefore, the model produces two estimates of resource needs. The first, an estimate of "minimum base" requirements measures the workload stemming from the program activities specifically mandated by the SDWA or an associated EPA primacy requirement. The second estimate reflects an assessment of state workload for a comprehensive drinking water program, a program that includes the minimum base activities plus additional activities undertaken by states to achieve the public health protection vision and goals established by the SDWA. Such activities include: expanded emergency response planning; efforts to address emerging contaminants; and initiatives to minimize threats of contamination to ground and surface water. State drinking water programs sometimes also undertake efforts that fall outside of the scope of the SDWA vision: for instance, they may regulate or help consumers with issues concerning private wells or bottled water. The cost of such non-SDWA-related activities, and a corresponding proportional amount of state drinking water programs' administrative and overhead budgets, are excluded by ASDWA from the calculation of the cost of comprehensive drinking water protection programs. This adjustment makes the figures realistic and conservative.

Taking the approach outlined above, ASDWA estimates that state drinking water programs currently have approximately 3,100 full-time equivalents (FTEs) implementing the minimum base program requirements, out of an estimated total 3,800 FTEs implementing all activities (representing the comprehensive program). In contrast, ASDWA estimates that the staffing level needed to implement minimum base programs across all states during the period 2012-2021 period peaks at approximately 5,400 FTEs and that approximately 6,500 FTEs will be needed for all states to implement comprehensive programs.

The estimated annual costs of the projected national minimum base and comprehensive programs are approximately $625 million and $748 million, respectively, but current state-reported funding levels (from all sources, federal and state) are $385 million for the minimum base program and $440 million for the comprehensive program. As a result, this analysis confirmed a significant funding deficit given the full scope of state responsibilities under the SDWA. Closing this deficit would require federal and state investments approximately 62 percent greater than 2011 funding levels to meet minimum base program needs and as much as a 70 percent increase to implement comprehensive program needs. In the face of these deficits, state programs are likely to incur implementation delays and are unlikely to be able to fully achieve the public health benefits envisioned in the SDWA. The tables below summarize states' funding and personnel gaps in fiscal year (FY) 2013.

| FY 2013 | Available Resources (from all sources) | Needed Resources (from all sources) | Funding Gap |
|---|---|---|---|
| **Minimum Base Program** | $385 million | $625 million | ***$240 million*** |
| **Comprehensive Program** | $440 million | $748 million | ***$308 million*** |

| FY 2013 | Available FTEs | Needed FTEs | Personnel Gap |
|---|---|---|---|
| **Minimum Base Program** | 3,100 | 5,400 | ***2,300 FTEs*** |
| **Comprehensive Program** | 3,800 | 6,500 | ***2,700 FTEs*** |

## The Needs Deficit

This analysis shows that the outlook for state drinking water program resources has not improved since 2001. Twenty-seven states have seen decreases in the amount spent for FTEs and in 17 of these states, spending decreased by more than 20 percent. While workloads increased, states saw a decrease in available resources: between 2001 and 2011, states lost almost 1,100 FTEs, which amounts to a 26 percent reduction. Where the nominal value of some funding sources remained flat between 2001 and 2011, the value of those funds has eroded due to inflation. At the same time, the cost of an FTE increased by about 25 percent since 2001, putting further pressure on flat or declining budgets. In the current economic climate, states have limited ability to generate additional revenue for drinking water programs through fees or introduce new revenue proposals. Figure ES-1 illustrates trends since 2001: the increase in the number of regulated constituents[1]

[1] The count of regulated constituents includes contaminants, such as chemicals and microorganisms, and other parameters that are not considered contaminants per se, such as turbidity, for which EPA also has established performance standards in regulations.

that trigger additional workload for states, the decrease of FTEs available to handle the workload and the decrease in funding available.

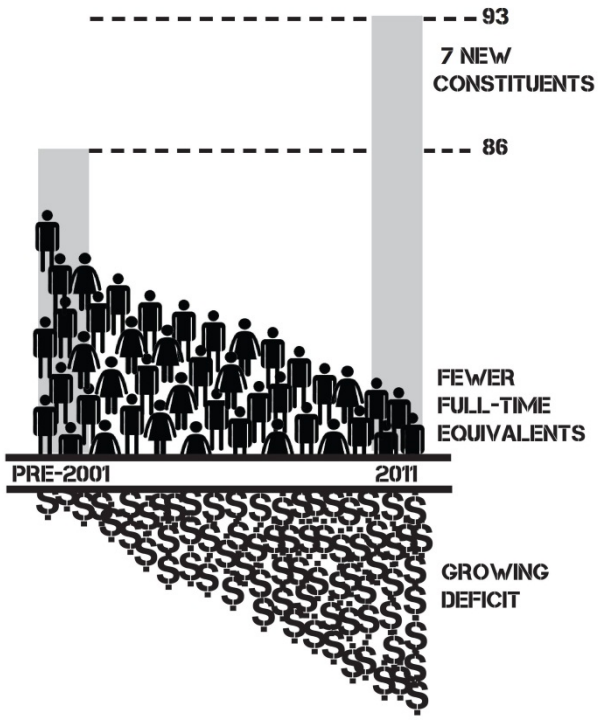



**FIGURE ES-1. GROWING IMPLICATIONS OF INADEQUATE RESOURCES**

States rely on four main sources of funding for implementing their programs. Federal funding comes from Congress in the form of the Public Water Supply Supervision (PWSS) Grant Program and as funds set aside for state program activities from the infrastructure-focused Drinking Water State Revolving Fund (DWSRF). States provide funds through two avenues: general funds from state legislatures and state-established fee programs.

## Overcoming Barriers to Additional Funding and Staffing

States seeking to fulfill their role in implementing the SDWA and protecting public health, even to implement the minimum base program statutorily required under the SDWA, face a substantial deficit between needs and resources. This funding gap was noted in earlier analyses of state resource needs. Since the most recent assessment in 2001, drinking water program requirements have become more complex and funding has further diminished. State drinking water programs have been forced to rely more and more heavily on DWSRF capitalization grants to fund operations, effectively limiting the availability of future loans for infrastructure improvements. While states have worked diligently to prioritize their activities and resources to be as cost-effective as possible in implementing the SDWA, the resource gap ultimately leads to greater public health risk. It forces states to make tough choices about how to use their limited resources and results in fewer inspections and site visits to water systems; less protection of drinking water sources; less assistance to public water systems; and less ability to prevent situations that can compromise public health. ASDWA offers detailed recommendations on ways to address the resource gap in a companion document to this report,

entitled *Insufficient Resources for State Drinking Water Programs Threaten Public Health: Recommendations from the Association of State Drinking Water Administrators*.

# 1 PROTECTING DRINKING WATER


*In order to ensure public health is protected, this newly installed 100,000 gallon elevated storage tank must be properly maintained by the water system with oversight by the state drinking water program staff.*
*(Wheeler & Frankstown Water Association, Mississippi)*

# WHAT IS THE IMPORTANCE OF PROTECTING OUR NATION'S DRINKING WATER?

The SDWA was passed by Congress in 1974 and significantly amended in 1986 and 1996 to ensure an ever-increasing level of health protection to consumers who receive their drinking water from one of the 152,000 public water systems in the United States. Proactively avoiding incidents such as waterborne disease outbreaks can prevent loss of life and reduce considerable health care costs, and businesses need high quality water to meet strict standards associated with their operations or manufacturing processes.

## How Do States Address Complex Public Health Risks?

As the public health risks posed by drinking water contaminants are better understood, state program responsibilities for adequately managing drinking water resources, overseeing the treatment of drinking water and supervising water systems becomes increasingly complex and sophisticated. Water systems often require support from state staff as they implement utility-specific monitoring schedules and oversee contaminant-removal technologies, as well as technical assistance and training to maintain public health protection. Technologies to remove contaminants from water are more complex now than they were prior to the promulgation of the 1996 SDWA Amendments, and the effectiveness of these technologies is also often affected by seasonal or extreme weather conditions. Finally, states and water systems are also challenged by aging and deteriorating infrastructure.

Effectively protecting public health—through monitoring, treatment, training, technical assistance and infrastructure investment—requires significant resources. State staff must be diligent and skilled to provide the necessary oversight to water system staff. Investments in infrastructure are just as critical to ensure that water systems maintain their ability to provide safe water over many years. These combined efforts are highly time- and resource-intensive undertakings for state programs, but in their absence, water systems may experience preventable failures which create public health consequences for consumers and even greater workloads for state staff.

## What Additional Technical Challenges Affect Compliance?

State drinking water programs must confirm that water systems meet multiple safety standards at the same time. “Simultaneous compliance,” as it is called, can be a significant challenge as steps undertaken to treat for one contaminant, such as adjusting the pH level to reduce lead in the water, can create other public health concerns, such as the formation of some disinfection byproducts (DBPs). Understanding and managing simultaneous compliance issues requires a high degree of technical expertise. States and water systems must assess the risks and benefits of treatment and operational changes and their likely effects on compliance. Managing such complex public health issues and meeting the associated technical challenges requires sufficient resources.

# CHAPTER 1

Under the SDWA, EPA establishes safety standards designed to ensure that consumers served by water systems across the country receive high quality drinking water. In addition to public health protection benefits, achieving the goals of the SDWA provides economic benefits. Proactively avoiding incidents such as waterborne disease outbreaks can prevent loss of life and reduce considerable health care costs, and businesses need high quality water to meet strict standards associated with their operations or manufacturing processes.

As envisioned under the SDWA, EPA delegates to states primary enforcement authority of the national safe drinking water program. In turn, state programs strive to ensure consistent implementation of SDWA requirements by providing training, technical assistance, oversight, and as necessary, enforcement to ensure that water systems meet the minimum federal standards.[1] Water system operators rely on the continued support of state staff to fulfill their responsibilities for monitoring and maintenance of drinking water quality. This partnership between state public health professionals and water system professionals is central to the protection of public health. When problems occur, all partners must be positioned to immediately detect and resolve any issues (see text box "Alamosa, Colorado: Water System and State Response to *Salmonella* Outbreak").

Given the vital role that states play in public health protection, ASDWA, directors of state drinking water programs and EPA partnered to assess the state resources needed to manage this important program. This report presents the results of that assessment. The analysis calculates state resource needs to implement the SDWA over the next 10 years, and accounts for changes to state drinking water programs since 2001, when EPA and ASDWA last performed a similar evaluation.

**STATES SUPPORT OVER**

**~152,000**

**PUBLIC WATER SYSTEMS NATIONWIDE THAT SERVE DRINKING WATER TO APPROXIMATELY**

**290 MILLION**

**UNITED STATES CITIZENS.**

# ALAMOSA, COLORADO: WATER SYSTEM AND STATE RESPONSE TO *SALMONELLA* OUTBREAK

RESPOND


*Local, state and federal officials meet to find a solution (top). Alamosa issued a bottled water advisory (middle). The entire water system was flushed to remove contamination (bottom).*

In March and April 2008, the City of Alamosa, Colorado experienced a waterborne disease outbreak of *Salmonella* bacteria. The outbreak resulted in 442 reported illnesses (122 confirmed through laboratory analyses) and one death. Up to 1,300 people may have become ill as a result of this incident. An investigation concluded that the outbreak was likely caused by animal fecal contamination of a water storage reservoir, which then spread throughout the water system. The storage reservoir was observed to have several small cracks that led to the fecal contamination.

Prior to the outbreak, the City's drinking water was not disinfected. During the outbreak, residents were advised to drink bottled water or boil water from the public water system. The entire water system was flushed and disinfected with chlorine to eliminate the *Salmonella* bacteria. Following this event, the Alamosa water system made system-wide infrastructure and operational improvements, including adding disinfection.

The state-wide response to the outbreak lasted about one month. The Colorado Safe Drinking Water (SDW) program provided immediate and effective technical support to the City and other emergency responders. The SDW program is using its limited funds to develop and implement several strategies to further reduce the likelihood of waterborne disease outbreaks in other public water systems within the state.

Considering the well-documented aging of America's water infrastructure, the experience in Alamosa, Colorado is likely to be repeated elsewhere. As other water systems face the challenge of waterborne disease outbreaks, state drinking water programs will need to have the resources to provide immediate and effective support.

## States Must Address Complex Public Health Risks

Protecting our nation's drinking water requires intensive effort on a daily basis and is a task that grows increasingly challenging in the face of emerging contaminants and other threats, such as water security risks (see text box "Safe Drinking Water Act: An Increasingly Complex Statute"). EPA and states implement regulations that protect consumers from these threats.[2] These regulations establish either public health standards for levels of contaminants in drinking water or treatment approaches to prevent contamination. Figure 1-1 illustrates some of the types of contaminants or other constituents of concern in drinking water that states and water systems manage and the increasing workload required to protect public health.

Between July 2010 and June 2011, more than 7,200 public water systems, which serve more than 18 million people, supplied water that exceeded (violated) a public health standard.[3] Although this is a small fraction of all public water systems and millions of Americans are served safe water daily, responding to the needs of water systems that exceed standards, or to ones that are nearing a threshold that could cause problems, requires significant state resources. ASDWA and states estimate that assistance for a water system with recurring compliance problems requires, on average, twice as many hours of staff time as a water system that has no compliance problems, and that some noncompliant systems can require ten times as much work as compliant systems. Together, water systems needing additional assistance in 2012 were projected to require approximately an additional 650,000 hours of state staff time, which was approximately 7.5 percent of the nationally-projected state drinking water program workload for that year. These increases in state staff hours are significant, but they are necessary to ensure public health protection. The tasks performed by state staff to review water systems and avoid crises are described in more detail in Chapter 2.

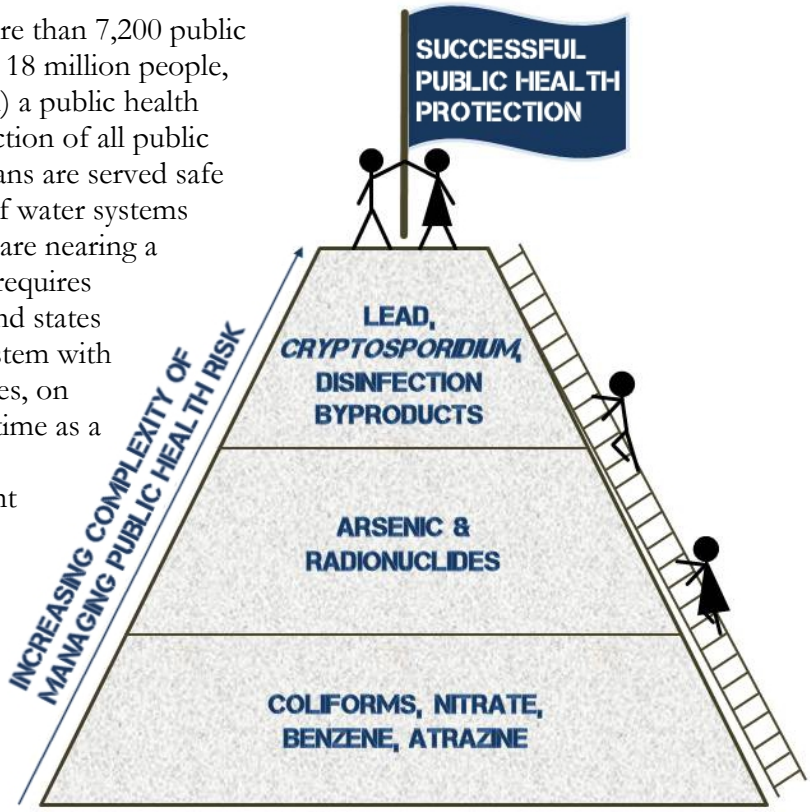



**FIGURE 1-1. INCREASING COMPLEXITY OF MANAGING PUBLIC HEALTH RISK**

Water systems also are significantly challenged by aging and deteriorating water system infrastructure. More systems could face challenges similar to those outlined in the Alamosa, Colorado case study as infrastructure ages and many water systems struggle to find funds to install and maintain needed treatment and distribution systems. The likelihood of massive failures, such as a major water main break, increase as the useful life of water systems' infrastructure is reached, and also as water systems are challenged to afford timely infrastructure replacement or refurbishment. EPA's Aging Water Infrastructure Research page notes that there are 240,000 water main breaks per year in the United States.[4] Failing infrastructure can cause serious public health threats, such as waterborne disease

outbreaks. Homeowners must boil water in order to avoid serious and immediate threats of disease. Failing infrastructure also can compromise the economic viability of businesses that rely on the water. Responding to such emergencies imposes both a financial cost and an increase in staff workload. The implications of these failures as well as emergencies that arise from natural disasters are discussed further in Chapter 3.

**FIGURE 1-2. YEAR-ROUND WELL INSPECTIONS**

*State staff need to be in the field at all times of the year to inspect drinking water facilities like this one in the State of Maine.*

## Simultaneous Compliance Adds Technical Challenges

Changing the chemical or biological characteristics of the water to address one contaminant may have unintended consequences for managing public health risks from other contaminants. For example, treating bacteria or viruses in water requires the operator to balance the risk posed by these microbiological contaminants with the risk of exposure to unsafe levels of disinfectants such as chlorine or DBPs formed by interaction of chlorine with organic matter from the water source. Understanding and managing these "simultaneous compliance" issues can require a high degree of technical expertise. For example, treating water to comply with lead and copper standards can increase some DBP levels in water and vice versa. Changes in water treatment can increase concentrations of inorganic contaminants, which can impact water taste or odor or increase corrosivity, potentially increasing the lead content in water.

Simultaneous compliance can pose a significant challenge to systems that modify their treatment practices, as was the case for Washington, D.C. (see text box "Simultaneous Compliance Challenge"). States and water systems must closely monitor treatment processes to prevent problems and ensure that the public is quickly informed of water quality concerns.

### SIMULTANEOUS COMPLIANCE CHALLENGE

In 2000, Washington, D.C.'s water system switched from free chlorine to chloramines in order to reduce DBP levels in its distribution system. DBPs form when chlorine reacts with organic matter found in the drinking water source, and they can pose health risks to consumers. After the switch, elevated lead levels were found in samples from homes with lead service lines as the new disinfectant changed the water's pH, and this chemical change led to leaching of lead from the service lines. Significant effort was required by drinking water program staff and the water system to determine the cause of the problem and identify the correct remedy. To address the lead corrosion problem, the District began adding orthophosphate in 2004. The treatment has been effective in reducing lead levels in District households with lead service pipes and other household lead sources. More information about how the District of Columbia Water and Sewer Authority's orthophosphate helps keep their water in compliance with the 15 parts per billion standard for lead is available at http://www.dcwater.com/lead/water_2000_2004.cfm.

# SAFE DRINKING WATER ACT: AN INCREASINGLY COMPLEX STATUTE

During the past century, the public's demand for safe, reliable drinking water spurred action to protect water resources.* The earliest drinking water protection efforts primarily targeted aesthetic considerations, such as taste, color and clarity, with minimal standards for bacteriological contamination. However, as science advanced, so did our understanding of public health risks of contaminants in drinking water, which was reflected in the SDWA of 1974 and its major amendments in 1986 and 1996. Managing these increasingly complex risks, however, requires a level of resources that supports new technologies to remove contaminants, and expertise to understand when, where and how to use these technologies to protect public health.


Drinking water protection efforts primarily targeted aesthetic considerations, with filtration and some minimal disinfection added to some water systems

U.S. Public Health Service (PHS) established the first federal, non-mandatory public health standard for drinking water bacteriological quality.

By 1962, the PHS standards existed for 28 substances. States adopted them and made them mandatory.

Congress passed the SDWA to ensure consistent drinking water protection in the United States. EPA initially adopted the 1962 PHS standards.

Concern about the health effects of suspected carcinogens prompted the 1986 SDWA Amendments. The Act included requirements that led to the development of standards for 93 constituents, treatment of surface water sources, wellhead protection and risk evaluations for materials used in water distribution systems. Early programs were focused on drinking water quality standards, rather than technology.

The 1996 SDWA Amendments emphasized contamination prevention and addressed water quality from source to tap. This increasingly comprehensive approach to drinking water protection relies on the cooperation of water systems, consumers, local watershed protection groups, businesses, local health boards, state drinking water programs and federal officials. Today's state drinking water programs devise water-system-specific solutions to prevent and respond to water quality problems. Key new provisions include: new and stronger approaches to preventing drinking water contamination, including strengthened protection from microbial contamination and control of disinfection byproducts; financing mechanisms; customized compliance solutions for water system; better information for consumers and regulatory development improvements.

*United States Environmental Protection Agency. 1999. 25 Years of the Safe Drinking Water Act: History and Trends. http://permanent.access.gpo.gov/websites/epagov/www.epa.gov/safewater/sdwa/trends.html

## Meeting Challenges of Complex Public Health Risks and Simultaneous Compliance Requires Significant State Resources

Protecting public health requires minimizing risks from drinking water contaminants, providing ongoing education and technical assistance and ensuring the sustainability of the nation's drinking water infrastructure. State drinking water programs are responsible for these critical but complex and costly tasks (see text box that describes *Cryptosporidium*). Performance metrics and monitoring schedules for drinking water treatment plants, among other requirements, can vary according to drinking water source type and water system customer base (including number of people served and their exposure rate). States are responsible for developing and communicating appropriate monitoring and treatment regimens for each public water system.

Additionally, the 1996 SDWA Amendments recognized that risks may be heightened at different locations in the water delivery system. Therefore, water systems now collect samples that are analyzed for certain contaminants at multiple locations, including the point where the water leaves the treatment plant and enters the distribution system, one or more points within the distribution system and at the consumer's tap (see Figure 1-4). States must work with the water system to identify the most appropriate monitoring sites to sample for contaminants. In the case of some DBPs that may form in distribution systems, for example, water systems must perform systematic preliminary sampling at multiple monitoring sites in the distribution system to find out where the levels are highest, and then perform ongoing compliance monitoring at those locations. Such system-specific monitoring regimens allow states and water systems to accurately identify and quickly address any potentially dangerous levels of contamination. However, this approach necessitates additional training for states and water systems, as well as more intensive ongoing technical assistance and compliance oversight from state staff, all of which can be highly resource-intensive.


**FIGURE 1-3. STATE INSPECTIONS OF WATER TREATMENT FACILITIES**

*A new EPA drinking water standard for arsenic required many water systems to install treatment to protect public health. States must inspect the facilities and monitor their operation as in this treatment plant in Nevada.*

## *CRYPTOSPORIDIUM*: PARTNERING TO CONTROL A HIGH-RISK CONTAMINANT

The example of *Cryptosporidium* control illustrates how regulators and water system operators work together to prevent public health problems in drinking water.

*Cryptosporidium* is a microbiological contaminant that commonly occurs in waters such as lakes and rivers, including those used as drinking water sources. It is highly resistant to chlorine disinfection and has caused serious waterborne disease outbreaks. Consuming water contaminated with *Cryptosporidium* can cause gastrointestinal illness, which may be severe in people with weakened immune systems (e.g., infants and the elderly) and sometimes fatal in people with severely compromised immune systems (e.g., cancer and AIDS patients).

Many water systems must treat for *Cryptosporidium*, a complex process that often involves multiple steps. States review design plans, conduct on-site reviews to identify operational or other deficiencies and offer technical assistance to water system operators. State and water system staff must have an understanding of each step in the treatment process and how they work together to provide public health protection.

*Cryptosporidium* is unlike most other contaminants, in that even a temporary degradation of source water quality can threaten the health of consumers. Water systems must meet treatment standards that require careful operations and monitoring to adjust to changing water quality conditions. Water system operators confirm that the water is free from contamination on a daily basis. They meet frequent and detailed reporting requirements that allow the state to confirm that the treatment is adequate. The state workload is significantly higher due to this tightly controlled regimen, which is necessary to ensure public health protection.

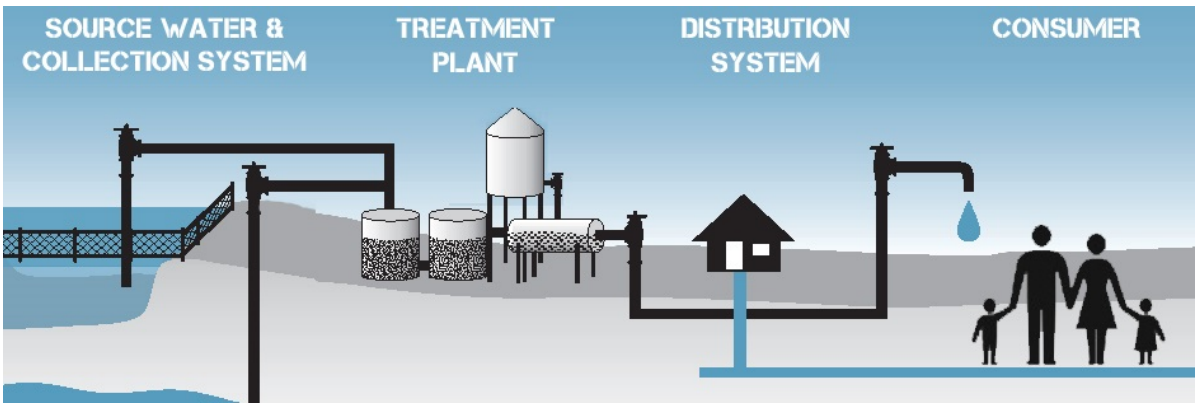


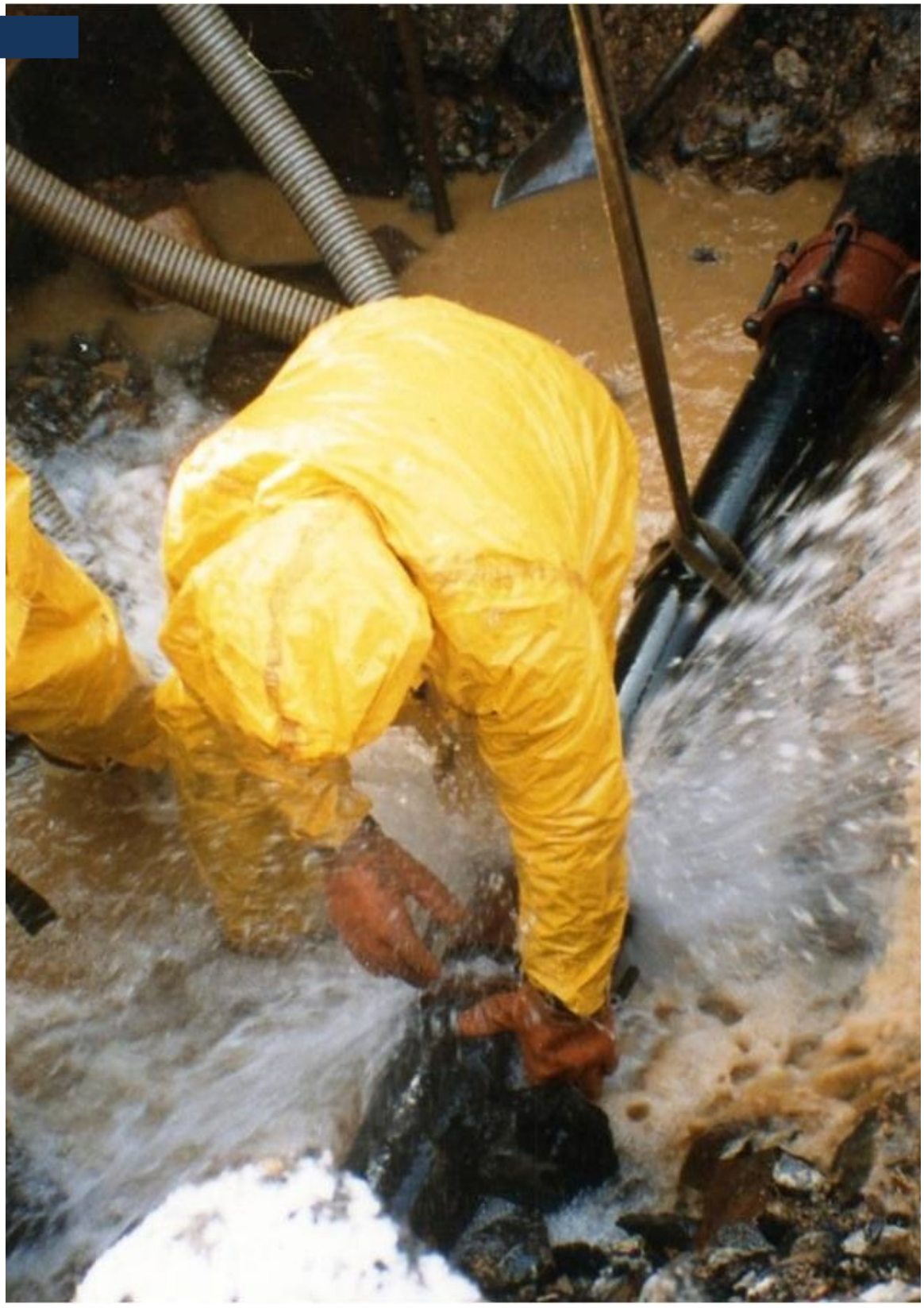

FIGURE 1-4. OVERVIEW OF A WATER SYSTEM

SDWA implementation activities place increasing demands on state time and expertise, even as competition for funding increases, as described in Chapter 3. With fewer resources, states must scale back or possibly eliminate some kinds of support for water systems. ASDWA is concerned that these reductions in resources may increase the risk of contamination events. Providing the full health protection benefits promised by the SDWA will be challenging under these conditions.

**FIGURE 1-5. STATE INSPECTION OF A WATER TREATMENT PLANT**

*State drinking water program staff inspecting a water treatment plant in Missouri.*

# 2 THE ROLE OF STATE PROGRAMS



*Utility workers repair underground water infrastructure during Hurricane Irene.*

# HOW DO STATE DRINKING WATER PROGRAMS PROTECT PUBLIC HEALTH?

## What Is the Meaning of Primacy for State Drinking Water Programs?

EPA has granted all states except Wyoming primary enforcement responsibility (i.e., primacy) for the drinking water program. The Navajo Nation and five U.S. territories, including Puerto Rico, U.S. Virgin Islands, American Samoa, Guam and the Commonwealth of Northern Mariana Islands, are additional non-federal primacy agencies. These entities, collectively called "states" in this report, are required to implement and enforce drinking water programs that are at least as stringent as the requirements established by EPA. States may adopt regulations that are more stringent and implement additional programs that reflect local concerns and priorities.

## What Key State Activities Ensure Safe Drinking Water?

Prior to the 1996 SDWA Amendments, states undertook many activities fundamental to public health protection, including monitoring for regulated contaminants, enforcing the regulations when water systems were non-compliant, providing technical support in the design and building of water systems and conducting routine site visits to water systems to identify potential threats to water system integrity. The 1996 Amendments added new responsibilities: new regulated contaminants; more complicated monitoring programs to pin-point whether contamination occurred at the source, within the distribution system or at the tap; source water assessment; right-to-know provisions to communicate with the public; operator certification; administration of loan programs to fund infrastructure improvements and assessment of the technical, managerial and financial capabilities of water systems to sustainably provide safe water. Following the attacks on September 11, 2001, water security was added to state program responsibilities, and recent large-scale natural disasters have elevated the importance of "all hazards" emergency response planning and training.

## Why Is State Workload Increasing?

The more holistic approach to public health protection outlined in the 1996 SDWA Amendments requires more robust state drinking water protection programs. In addition to conferring greater responsibility for public health protection, the 1996 Amendments increased the sophistication of water quality monitoring, with system-specific monitoring locations and schedules. Treatment approaches are often customized as well, as states and water system operators now must evaluate public health risks in multiple locations throughout the water system, from the water source to the consumers' tap, weighing risks and managing the challenges of simultaneous compliance issues. Implementing these new programs requires that the state staff who supervise the water systems, track compliance and provide training and technical assistance to the systems are themselves trained and up-to-date in a complex and rapidly changing field.

CHAPTER 2

The design of the SDWA reflects Congress' vision of a national drinking water program with consistent and strong safety standards for all consumers of water from public water systems, coupled with flexibility for states as they implement their drinking water programs. State drinking water programs are the critical link between federal standards and the water system professionals who are ultimately responsible for maintaining the high level of public health protection established under the SDWA.[5] States:

- Oversee drinking water system compliance activities;
- Inform and educate water systems about regulations;
- Provide critical hands-on technical assistance;
- Manage and interpret vast quantities of compliance data;
- Ensure that laboratories and water system operators are properly certified;
- Respond to natural disasters and other emergencies that threaten the safety of drinking water supplies;
- Conduct inspections and other site visits;
- Take enforcement actions when needed; and
- Review/approve construction plans and permits.

Refer to Appendix A for a summary of the regulations promulgated under the SDWA, and to Appendix B for a comprehensive overview of the types of constituents of concern in drinking water that states must manage and the health risks associated with those constituents.

## Primacy for SDWA Implementation

Currently, all states except Wyoming have applied for and obtained enforcement authority for the SDWA, or "primacy" status, from EPA.[6] The Navajo Nation and five U.S. territories, including Puerto Rico, the U.S. Virgin Islands, American Samoa, Guam and the Commonwealth of Northern Mariana Islands are additional non-federal primacy agencies. These entities, collectively called "states" in this report, have the responsibility to implement and enforce drinking water requirements that are at least as stringent as the federal requirements. This responsibility includes enforcing new standards established by EPA through the rule development process described in Appendix A.[7]

Primacy entails a significant amount of responsibility, including providing education and technical assistance to water systems and ensuring enforcement against water systems that are not in compliance with the minimum federal requirements. States are allowed to adopt regulations that are more stringent than the federal requirements and implement additional programs above and beyond those required by the SDWA. Primacy also provides states with a certain amount of flexibility in how they ensure public health protection, to take account of local concerns and priorities.

## State Activities Ensure Safe Drinking Water

Consistent with the SDWA, the focus of all state drinking water program efforts is to protect public health from unsafe drinking water, especially contaminants that cause acute health issues, such as immediate and severe gastrointestinal problems. Protecting public health requires intensive involvement by state staff in all aspects of water system operations from the water source to the consumers' tap, proactively engaging with utility staff on new regulations and quickly responding to emergencies. The assessment presented in this report divides state drinking water program activities into two different categories: minimum base activities that satisfy the requirements of the SDWA, and additional state-specific activities that, when added to the minimum base activities, comprise a comprehensive program. These additional activities, which contribute to the mission of public health protection described in the SDWA but are not primacy requirements, include source water protection, programs designed to build system-level sustainability, emergency or natural disaster response and water security programs designed to counter terrorism and vandalism. State drinking water programs sometimes perform non-SDWA-related functions as well, for instance involving private wells and bottled water; these are not considered part of the comprehensive program as defined in this report.

### Minimum Base Program Activities

Prior to the enactment of the 1996 SDWA Amendments, EPA already had established dozens of drinking water standards and monitoring requirements for chemical and some microbiological contaminants, with a particular emphasis on water systems that use surface water (e.g., lakes or rivers) as their source of drinking water.[8]

States are responsible for implementing and enforcing those longstanding requirements. Activities include supporting water systems in monitoring for contaminants, educating water system staff about the requirements and providing technical support or enforcement when water systems do not comply with the requirements (see "Minnesota: Technical Assistance" for an example of proactive steps taken to help systems). These activities form the foundation for state drinking water programs' responsibilities.

#### MINNESOTA: TECHNICAL ASSISTANCE

The Minnesota Department of Health Noncommunity Water Supply Unit aims to ensure that water supplies at schools, churches, motels and other non-residential institutions are in compliance with all drinking water requirements. These types of public water systems typically have less expertise, as serving water is not their primary business. The Unit assigns a multi-disciplinary team of state staff to each water system to provide comprehensive assistance, including site visits, sampling and on-site technical assistance, support for source water protection, laboratory services and more.

State staff also conduct required site visits to identify any potential risks due to problems with the water system's condition. Working in concert with water system operators, state staff survey the condition of the water system and provide recommendations for improving conditions and system integrity. These surveys assess a water system's source, infrastructure (e.g., storage and water mains), treatment facilities and procedures, and help to ensure that the water system's operational, monitoring, reporting and recordkeeping practices meet the requirements.

States also oversee the approval process for new drinking water sources and treatment plants. States must review the engineering plans and specifications for design, development and construction of any modification to an existing water system. States must also approve distribution system upgrades and new treatment system installations. Once approval is given, states must continue to review a water system's performance and evaluate the operators' abilities to meet public health protection requirements.

Other longstanding minimum base activities include:

- Certifying laboratories to ensure that the laboratories responsible for analyzing water quality samples meet the quality standards outlined in EPA and state regulations; and
- Ensuring that there is adequate laboratory capacity within the state to meet the demands of all water systems.

States also invest significant resources in training water system operators on new and existing requirements to improve their technical capacity to provide safe drinking water. States may modify EPA materials or develop their own training materials, and they may use training sessions as a platform for helping water systems to begin designing effective treatment and monitoring strategies. (See text box "Massachusetts: New Regulation Training" for an example of how the state has delivered training over the past few years.)

## MASSACHUSETTS: NEW REGULATION TRAINING

Historically, Massachusetts conducted new rule trainings in each of its four geographic regions. The four trainings were preceded by a dry-run internal staff training event. Massachusetts is now only able to hold these trainings as resources allow. While four trainings were held in 2009, no trainings were held in 2010. In 2011, the state offered online trainings, but received feedback from water systems that they are able to learn more effectively in face-to-face training sessions. The state plans to hold in-person trainings selectively in the future (e.g., for the Revised Total Coliform Rule).

## SHARING DATA WITH THE PUBLIC

States are increasingly interested in enabling the public to view data beyond the required minimum that shows their water systems' compliance with regulations. Sharing data helps consumers to understand the quality of their drinking water, and allows water system owners and operators to verify state data.

Collecting and managing all of the data needed for program management is a considerable responsibility for states. Many states have developed sophisticated data management systems to generate schedules for the water systems to tell them when they must take their samples. These data systems store and manage data about water samples received from laboratories and data about water system design (e.g., type of treatment utilized). They are also used to automate the process for determining the water systems' compliance with regulations. These data systems provide states with immediate access to critical information and facilitate data reporting to EPA. States also provide EPA with data to use in its periodic review of regulations and its assessment of occurrence rates for unregulated contaminants.[9] (See text box "Sharing Data with the Public" for a discussion of the public's expanded interest in data accessibility.)

### *1996 SDWA Amendments Expand Scope of Minimum Base Programs*

The 1996 SDWA Amendments established a robust public health risk management framework which expanded the scope of minimum base programs, and states began to institute water-system-specific solutions to ensure compliance with new regulations.[10]

As required under the 1996 Amendments, states also established new preventive programs or expanded upon existing ones, including:

- Operator certification programs;[11]
- Capacity development programs;[12]
- Source water assessment programs;[13]

- Ground water protection programs;[14]
- DWSRF loan administration;[15] and
- Programs to improve communication to consumers regarding the quality of their water.[16]

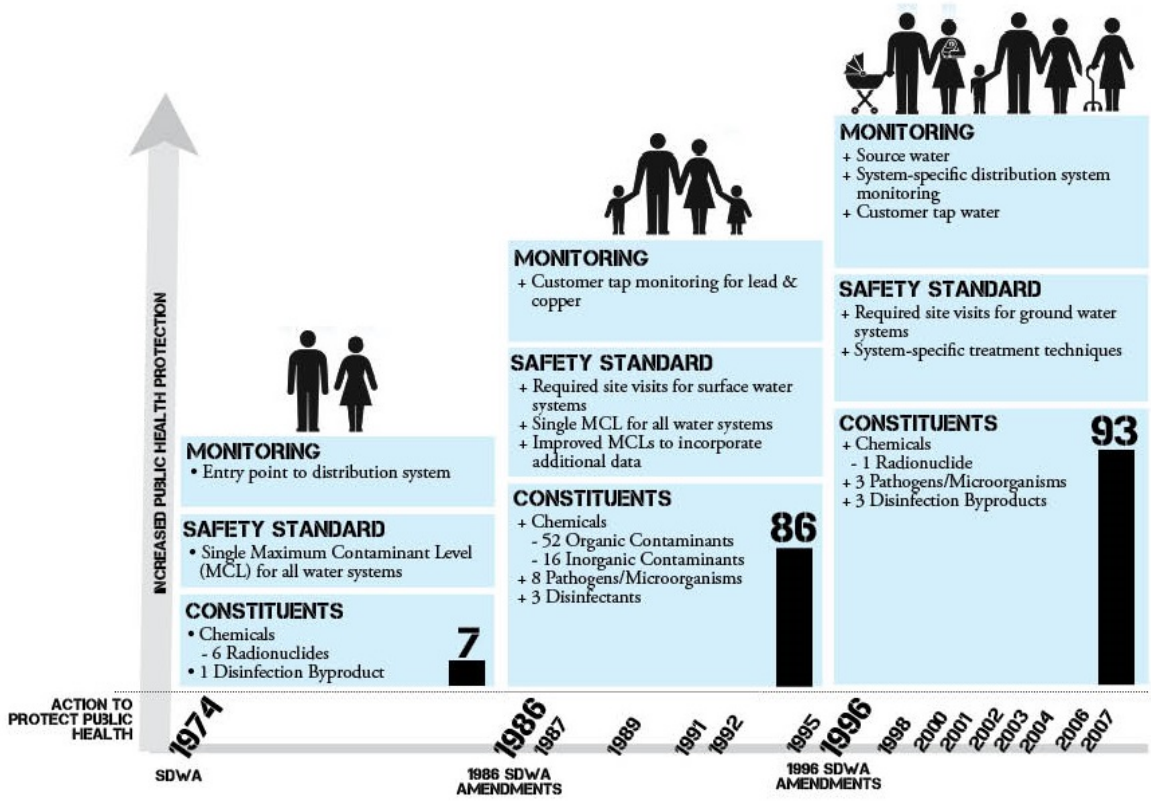
Capacity development is a key program established under the 1996 Amendments. Under the capacity development program, state drinking water programs to help water systems improve their technical, managerial and financial capacity to provide safe drinking water. The capacity development program is especially important to help smaller water systems achieve the same public health protection for their consumers as their larger counterparts. Technical capacity building can take the form of assistance addressing regulatory violations or making technical or operational changes required to comply with new regulations, among other things.

Collectively, the minimum base program activities as defined by the 1996 Amendments form a "multiple barrier approach" to public health protection. Under this approach, protection occurs at every step of a water system's process, from the source of drinking water into the treatment plant, and through the distribution system to the consumer.

In addition, under the 1996 Amendments Congress established the DWSRF to provide affordable financing to water systems to help fund necessary drinking water infrastructure improvement projects and to support the state drinking water programs and key activities. State drinking water programs are responsible for managing and administering the loan program.

**PROTECTING THE PUBLIC FROM CONTAMINANTS REQUIRES MORE COMPLEX STRATEGIES TODAY THAN WERE IN PLACE BEFORE THE 1996 SDWA AMENDMENTS.**

Figure 2-1 shows the progression of public health risk management envisioned in the SDWA from the original statute in 1974 to the 1996 Amendments, which define the minimum base program today. It shows how the program has grown over time, as the number of drinking water constituents identified as threats to public health has increased and more proactive approaches have been developed to protect consumers from these threats.




## FIGURE 2-1. PUBLIC HEALTH RISK MANAGEMENT: MONITORING LOCATIONS, SAFETY STANDARDS AND CONSTITUENTS*

*Since the 1996 Amendments, regulations now specifically address threats to the health of children and other sensitive sub-populations. Prior to 1996, these categories of individuals were incidentally protected based on the single standard for all consumers.*

* The dates in this figure represent significant regulatory actions for drinking water constituents. For more information about these actions, including the regulations and their purposes, see Appendix A.

No longer is monitoring conducted only at a single location to determine whether the water meets the standard set for a limited number of contaminants. Using the multiple barrier approach, water systems must now collect water samples from several sites within the water system and perform various calculations to confirm water quality. Today, states provide more technical assistance and detailed inspections during site visits to help water system operators flag potential problems before contamination occurs. Figure 2-2 illustrates how this multiple barrier approach protects public health and shows how the public is informed when an incident occurs.

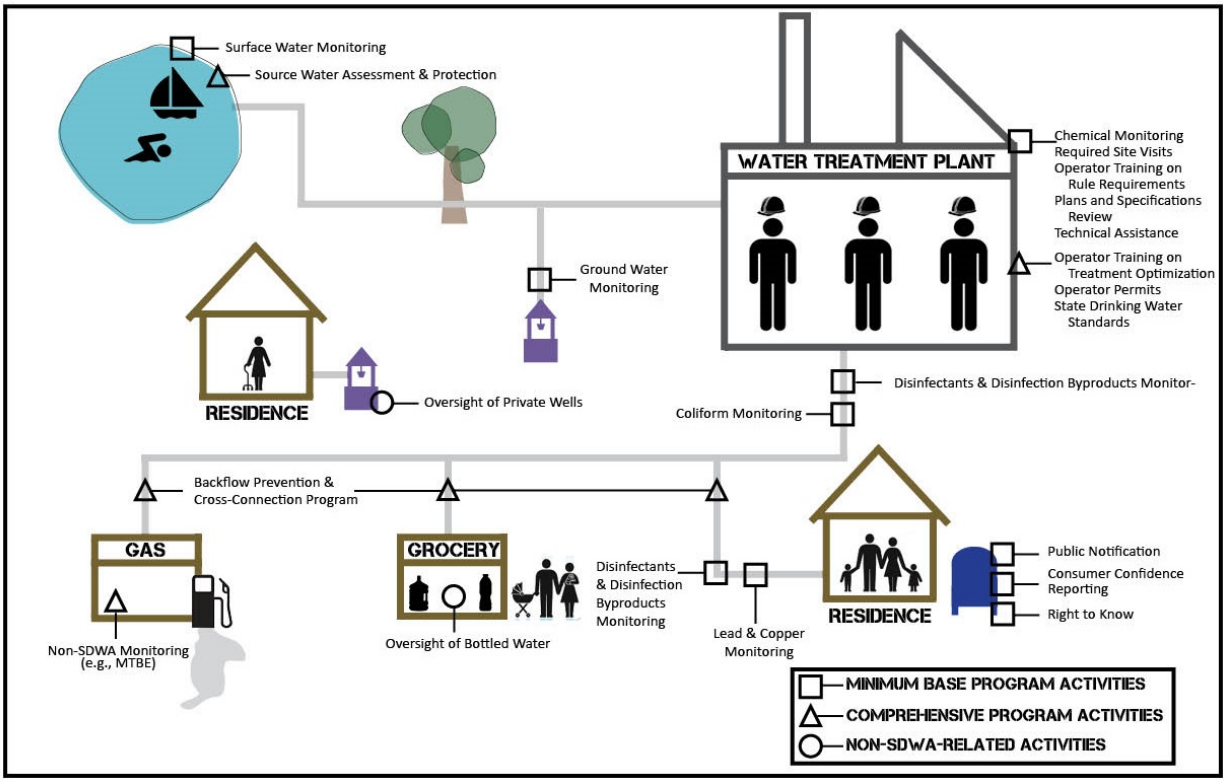



**FIGURE 2-2. COMPREHENSIVE PUBLIC HEALTH PROTECTION**

## Comprehensive State Program Activities

The requirements of the SDWA define the minimum base program activities that are the core of state drinking water programs. However, to ensure that more comprehensive public health protection is achieved, all states conduct additional activities that build on the required elements of SDWA programs to better achieve the SDWA mission of safe public drinking water. Some examples of these additional activities include:

- Emergency response planning: States go beyond the Bioterrorism Preparedness and Response Act of 2002 provisions on emergency response planning[17] to address emerging contaminants, such as those brought on by climate change; and

- Source water protection: States go beyond source water assessment activities required under the SDWA[18] to promote source water protection at all ground and surface water systems.

These activities build on minimum base programs. For example, under the minimum base program states assessed areas around the sources of drinking water in their state to identify potential routes of contamination. Under the comprehensive program the states can use this information to generate solutions to protect vulnerable drinking water sources. These source water protection activities require time-consuming collaborative approaches with a host of stakeholders—federal, state and local—since state drinking water programs lack all of the authorities and resources needed to protect sources of drinking water on their own.

States are also facing a number of challenging issues that threaten the safety and sustainability of public drinking water systems. One issue some states are currently managing is algal blooms. Above-average summertime temperatures, combined with nitrogen and phosphorus pollution, stimulates the rapid growth of algae, or "algal blooms," in some surface water sources.[19] Algal blooms are difficult to treat, and can contribute to the formation of DBPs and release of algal toxins (see a state's experience in the text box "Oklahoma: Algal Blooms Pose Challenges"). Higher-than-normal temperatures have also resulted in exponential growth of bacteriological contamination incidents in some states, incidents that can cause gastrointestinal disease and pose higher risks for children, the elderly and immune-compromised populations. State drinking program personnel devote significant time to coordination with water systems, elected officials, the general public and other utilities to ensure continued public health protection from these contaminants. Droughts also require state drinking water staff and water systems to closely monitor water sources to help ensure that both water quality and water quantity needs are met. States work with communities to institute water conservation programs and to help explore alternative sources of water in worst cases. In addition, in response to recent droughts, some states now require drought management planning for "at risk" water systems. This will help minimize the workload placed on the state drinking water programs when the next drought occurs and will help eliminate the need for the state to re-prioritize other state activities to address the drought. Such drought management planning may include identification of both *demand*-oriented approaches (e.g., water conservation techniques and pricing structures) and *supply*-oriented approaches (e.g., use of recycled water for non-potable water needs) to make water supplies as "drought-proof" as possible. (See how a state drinking water program mitigates the impacts of drought in the text box "North Carolina: Planning for Water Shortages".)

## OKLAHOMA: ALGAL BLOOMS POSE CHALLENGES

Reservoirs in Oklahoma are experiencing blue-green algae blooms due to hotter than usual summer temperatures and high levels of nitrogen and phosphorus from agricultural runoff, treatment plants and septic systems. The state passed a new law in May 2012 regarding harmful algal blooms that requires sampling for toxins, establishes thresholds of concern for recreational and drinking water uses and mandates public education. Addressing this issue consumes significant staff time.

## NORTH CAROLINA: PLANNING FOR WATER SHORTAGES

Severe droughts in recent years have required North Carolina to expend considerable state resources to mitigate immediate effects on water systems and develop long-term solutions. State staff have:

- Assisted in local negotiations for water purchases and interconnections to minimize short-term and long-term risks from water shortages;
- Helped systems run emergency water lines; this included being on-site during installation of the emergency (typically overland) lines, providing on-site guidance during flushing and approving the use of the line for potable uses;
- Expedited and streamlined review and approval procedures for emergency situations;
- Mandated withdrawal reductions in aquifers significantly dewatered from overuse; and
- Maintained close contact with water systems to help determine what state support or intervention may be needed.

Some systems have created larger combined distribution systems and interconnections. However, increased problems with DBPs, as well as other simultaneous compliance issues for disinfection and lead and copper, have arisen. State staff work closely with water systems and provide expert assistance in devising a treatment regime that meets all regulatory requirements.

The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 added drinking water security provisions to the SDWA. In consultation with EPA and states, water systems are responsible for preventing and responding to water security threats, [20] and for taking steps to ensure

that they are prepared for emergencies. States facilitate information sharing and provide technical assistance and training to meet this mandate.

Other activities that some states undertake as part of a comprehensive drinking water protection program include:

- Requiring additional monitoring for contaminants not regulated by EPA, such as methyl tertiary butyl ether (MTBE), an automotive fuel additive that has been found in some ground water sources, or perchlorate, which is found in the solid propellant for rockets, missiles and fireworks;

- Enforcing state laws that set limits for drinking water constituents that are not the subject of EPA regulations (e.g., MTBE).

- Overseeing the approval process for treatment and pilot studies to help water systems make decisions about treatment choices; and

- Developing water resources to ensure that water systems will have adequate water supplies for their customers both now and in the future.

All of these efforts impact the states' abilities to continue to manage the day-to-day demands of their drinking water programs, which are already constrained by limited staff resources. In the case of major disruptive events, states may have to significantly re-prioritize their workload (e.g., reduce on-site inspections or technical assistance), as they did, for example, in the aftermath of Hurricane Katrina and Tropical Storm Irene. (See "Connecticut: Assessing Emergency Preparedness," for a description of the efforts undertaken by a state in the wake of two storms in 2011.)

### Non-SDWA-Related Activities

Some state drinking water programs conduct additional activities that go beyond the scope of the SDWA's public-drinking-water mission. Examples include regulating or helping consumers and businesses with issues concerning private wells (which are not covered in the SDWA), or bottled water (which falls within the purview of the Food and Drug Administration rather than EPA), or leaking underground storage tanks (a source of contamination that is the subject of programs managed at the federal level by EPA's Office of Solid Waste and Emergency Response). Non-SDWA-related activities undertaken by state drinking water programs are not considered part of the comprehensive program as defined in this report.

# CONNECTICUT: ASSESSING EMERGENCY PREPAREDNESS

*Damage from snowstorm (top); Hurricane Irene (middle); Emergency response vehicles (bottom).*

Connecticut was heavily affected by two storms in 2011—Tropical Storm Irene in August and an early snowstorm in October. Both storms caused lengthy power outages that impacted large areas of the state and caused many water systems to lose water pressure, making them susceptible to contamination. Numerous water systems issued boil water advisories that lasted many days.

- **TROPICAL STORM IRENE**: 137 small water systems (serving 16,624 customers) issued boil water advisories to their consumers for an average of five to six days.
- **EARLY SNOWSTORM**: 121 small water systems (serving 20,212 customers) issued boil water advisories to their consumers.

Post-storm evaluations determined that many small water systems were ill-prepared for an extended period without power and lacked adequate technical, managerial and financial capabilities to handle the crisis. Large water systems faced other challenges. Most large water systems were able to sustain access to their water supplies and maintain water pressure, but some water systems were forced to run generators for large pump stations and treatment plants for more than seven days. Water systems found it difficult to communicate with local and state emergency managers (not part of the state drinking water program) about the urgent need to restore street power to areas where water system components, such as water treatment plants, were located.

The devastation of the two storms prompted the Connecticut Department of Public Health to develop an emergency preparedness strategy to ensure that a safe and adequate water supply is reliably available for the 2.7 million Connecticut residents served by community public water systems. In the future, these systems will have emergency power capacity and will be better trained and equipped to maintain water quality in emergencies, avoiding the need for lengthy boil water advisories and preventing increased risks to public health.

## Why State Workload Continues to Increase

As noted previously, the 1996 SDWA Amendments initiated a more holistic approach to public health protection than was required previously. State staff and water system operators now must evaluate public health risks from the water source to the consumers' tap, weighing risks and managing the challenges of simultaneous compliance in a way that is tailored to each system's individual circumstances. However, the added level of public health protection that this approach provides demands more resources. States require more personnel and financial resources than ever to implement both minimum base program activities and all additional activities that make up a comprehensive drinking water program.

**THE SYSTEM-SPECIFIC APPROACH TO PUBLIC HEALTH PROTECTION, WHILE COST-EFFECTIVE FOR THE WATER SYSTEM, DEMANDS MORE STATE RESOURCES.**

Implementing new requirements or revising existing ones can create significant additional workload for a state because these changes necessitate additional training of water system operators and state personnel, as well as significant changes in how states ensure water systems are in compliance with the requirements.

The progression of rules to protect the public from the adverse effects of DBPs demonstrates how the program envisioned in the original SDWA has grown increasingly sophisticated and system-specific as a result of the 1986 and 1996 Amendments (see Figure 2-3). This progression reflects concerns about the health risks posed by newly identified contaminants, and the need to revise existing requirements after new information confirmed unforeseen risks. The modifications profoundly changed both the number and types of contaminants considered, as well as the range of sites that should be sampled and the methods used to test for them. Figure 2-3 shows the evolution of risk management for this one group of contaminants; it shows a progression that is similar to the "Constituent" boxes in Figure 2-1, illustrating the evolution of regulation from few to many constituents of concern in drinking water over time.

Activities undertaken by states to carry out the requirements of the SDWA, and to provide the additional protections that complete a comprehensive drinking water program as envisioned in the SDWA, provide assurance of robust public health protection. Chapter 3 describes what resources are needed to maintain minimum base and comprehensive drinking water protection programs.

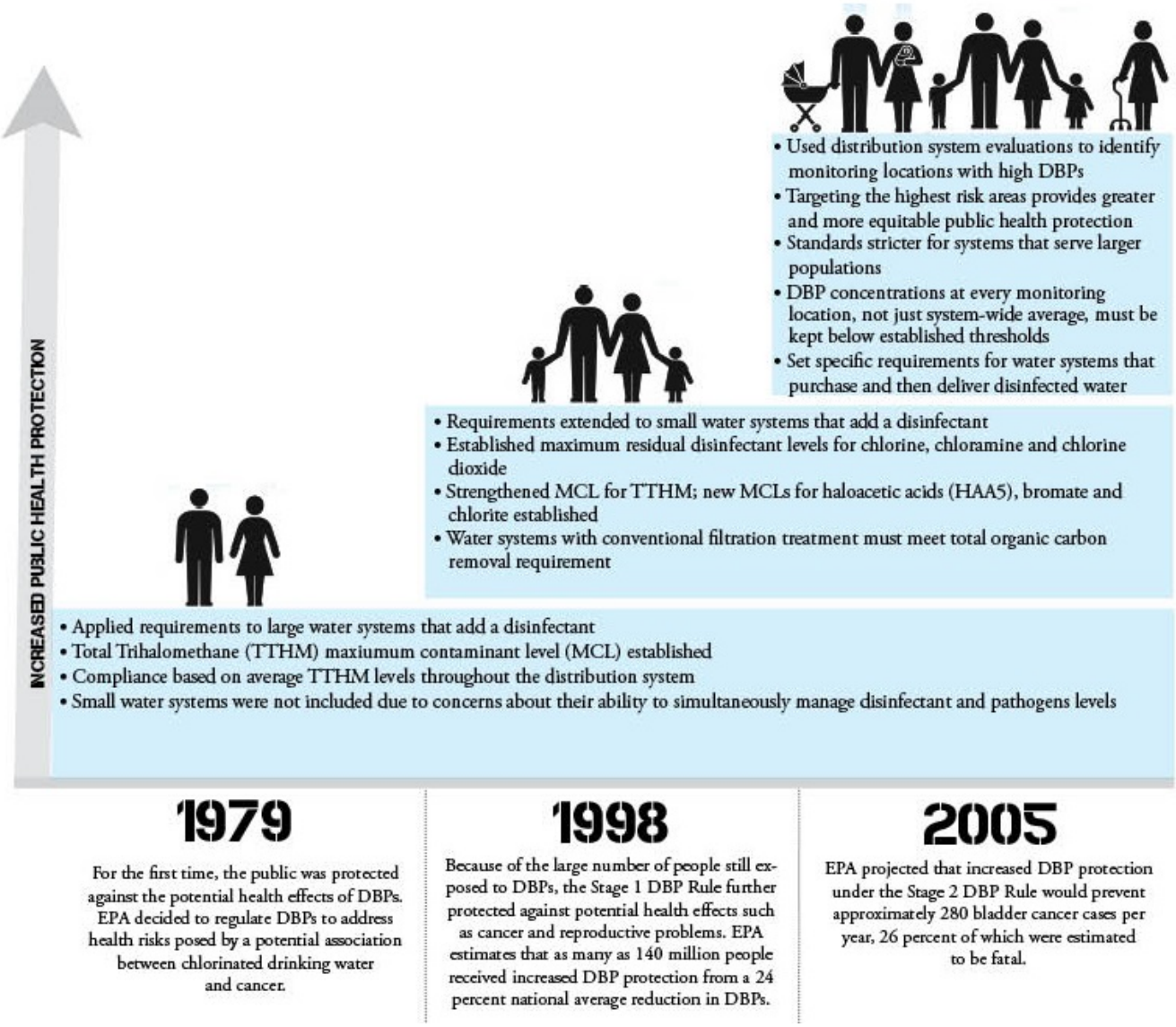



**FIGURE 2-3. DISINFECTION BYPRODUCTS (DBPS): AN EVOLVING REGULATORY APPROACH**

*Note: Early regulations did not specifically address threats to the health of children or other sensitive sub-populations. However, these individuals were incidentally protected based on the single standard for all consumers.*

# 3 STATE NEEDS: A LARGE GAP

*Black Canyon of the Gunnison National Park is located in western Colorado. Trapped in the channel, the high-volume, high-velocity Gunnison River works its way through the gap in the hard Precambrian basement rocks of the Gunnison Uplift to form a canyon over 2,000 feet deep and only 40 feet wide in some locations.*

# STATE RESOURCE NEEDS: A LARGE GAP

## What Are the State Program Needs?

State drinking water programs currently have approximately 3,100 FTEs to implement minimum base program activities and an estimated 3,800 FTEs to implement comprehensive program activities. In contrast, the resource model estimates that the peak staffing level to implement the minimum base program will be approximately 5,400 FTEs and that approximately 6,500 FTEs will be needed for the comprehensive program. The associated annual cost of the minimum base program is approximately $625 million and approximately $748 million for the comprehensive program. Without sufficient funding to implement drinking water standards, manage data and attract and retain qualified staff, state programs may face implementation delays or may not be able to fully achieve the public health benefits promised by the new regulations.

## What Are the Key Revenue Sources for States?

State drinking water programs rely on funding provided by the federal government, state governments and state fee-based programs to implement and maintain critical public health protection efforts. Federal funds include the PWSS Grant and a portion of the DWSRF capitalization grant that may be used for state program activities. State general funds and state-established fee programs provide the state share. Shrinking state and federal budgets have led to cuts to state drinking water program funding, and efforts to increase fee revenues have not met with widespread success. Over the last decade, federal funds for state programs have increased 12 percent while state funding has decreased 33 percent, and funding is down 9 percent overall. Current federal revenue sources would only fund 44 percent of the minimum base program in 2012. State drinking water programs, which face competing intra- and inter- agency priorities for funding and sometimes struggle to meet matching requirements attached to some federal funding, are increasingly concerned about the long-term stability of vital funding sources. Most critically, the high profile and urgency of infrastructure needs across the country can create pressure on state drinking water programs to fund infrastructure projects in lieu of using DWSRF set-aside funds needed for state drinking water program activities.

## What Is the Current Drinking Water Program Staff and Funding Gap?

Based on the analysis presented in this report, ASDWA estimates that in 2013, collectively, states will need as much as 73 percent more FTEs than they currently have to effectively implement a comprehensive program to ensure safe drinking water for the public. The analysis also confirms that states are underfunded, and will require an investment of approximately 62 percent over 2011 funding levels to meet the minimum base program and as much as a 70 percent increase to implement a comprehensive program. In short, the funding outlook for state program resources has not improved since 2001, and in some respects the trend is worsening. Twenty-seven states have decreased the amount spent for FTEs and 17 states have decreased spending by more than 20 percent. In the current economic climate, states have limited ability to generate additional state revenue or introduce new revenue proposals.

States have reviewed their programs to find efficiencies, streamline workloads and introduce efficiencies to counteract the increases in workload. These measures may have partially mitigated the effects of the continued deficit, but cannot address the entire resource gap. In the absence of additional resources, states have been forced to make difficult decisions on how to limit their support for water systems while still maintaining public health protections. The cumulative effect of the resource gap has serious implications for states' ability to protect public health under the SDWA.

# CHAPTER 3

Across the country, state drinking water programs are severely constrained by the limited resources forthcoming from state and federal sources. The resource needs analysis presented in this chapter projects what resources are needed for state drinking water programs to implement the minimum base program activities required by the SDWA between 2012 and 2021. It estimates the workload associated with each activity state programs undertake, calculates the associated funding requirements and compares those requirements to current funding. A second component of the analysis tabulates the state workload to provide a comprehensive drinking water program that addresses the wider range of activities needed to protect drinking water quality envisioned by the SDWA and described in Chapter 2. These additional activities include source water protection, emergency response and counter-terrorism, backflow and cross connection prevention programs and state-specific programs to monitor for contaminants of local concern. Non-SDWA-related activities, and a corresponding proportional amount of state drinking water programs' administrative and overhead costs, are excluded from the calculation. This adjustment makes the totals for the comprehensive program realistic and conservative.

The model takes into account capital expenditures and the costs of future regulations, two items for which costs cannot be estimated with great precision. The uncertainties surrounding these items are described in the table on the next page.

Figure 3-1 depicts the overlapping relationship between the minimum base and the comprehensive programs. For example, source water assessments are performed by states, but the steps taken to protect source water are the responsibility of the water systems and the communities that surround them.[21] The SDWA envisioned these partnerships, and provides funding that states may award for protection activities, with an expectation that state staff would be involved.

However, states, in conjunction with water systems, must make difficult choices with limited resources to determine what services should be funded to achieve the best public health protection.[22] Given existing funding levels, many of the public health protections envisioned by Congress in the SDWA will not be fully achieved.

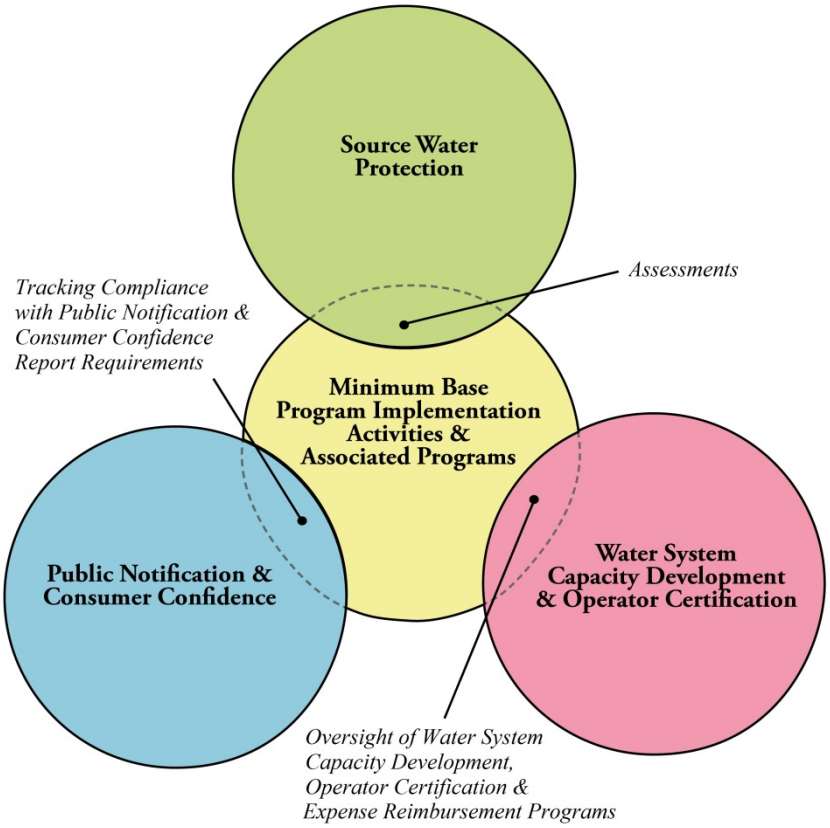



**FIGURE 3-1. THE FEDERAL APPROACH TO STATE DRINKING WATER PROGRAMS**

# ADDITIONAL MODEL VARIABLES

*The resource analysis model considers two categories of costs that are highly uncertain and variable: capital costs and the costs of implementing future regulations.*

## Capital Costs

Capital costs include costs for computers, software, improvements to databases, travel, water sampling, costs for source water protection and fleet costs. The biggest capital expenditures identified in the 2001 resource needs survey were for data systems and sampling. The current analysis estimated the capital costs of each state as a percentage of each state's FTE costs in each year, based on ASDWA data from seven states of varying sizes. Of the $385 million reported by states for current program funding for the minimum base program, approximately 27 percent ($102 million) was estimated to be capital costs. ASDWA therefore calculates $111 million to $134 million in capital costs for the years 2012-2021.

## Costs of Future Drinking Water Standards

In keeping with the iterative regulatory determination process required in the SDWA, EPA must evaluate the occurrence of unregulated contaminants in drinking water and conduct public health risk assessments to determine the potential threat they pose. Periodically, EPA must decide whether or not to establish a standard for new contaminants from a contaminant candidate list (see Appendix A for more information on the drinking water contaminant candidate list). EPA may also elect to revise standards for currently regulated contaminants as a result of regulatory review conducted once every six years. The analysis presented in this chapter assumes that new or revised drinking water standards or treatment requirements will be promulgated over the next 10 years. To date, EPA has made a determination to regulate perchlorate and several carcinogenic volatile organic compounds from the contaminant candidate list, and has made a determination to revise the Total Coliform Rule as a result of the Six-Year regulatory review process. No new regulations have yet been promulgated. Due to uncertainty associated with future regulations, ASDWA estimated the workload to implement the Revised Total Coliform Rule and conservatively assumed that over the next 10 years, up to three new regulations will be promulgated, all during the last 3 years of the analysis period (2018-2021). ASDWA also assumed only basic state rule start-up activities in response. If a new rule is promulgated sooner than assumed, the full suite of state activities related to rule implementation will very likely be more resource- and time-intensive than this analysis is predicting. State activities would include individualized training for water systems, technical assistance to water system operators and compliance assurance activities. For example, the estimated national workload required to implement the recently promulgated Stage 2 Disinfectants and Disinfection Byproducts Rule indicates that in 2012 states will need $11.7 million and 128 FTEs to implement the requirements (see Appendix A for a list of current drinking water regulations, including their purposes and public health benefits).

## Projected State Program Needs

Based on internal data and data provided by states, ASDWA estimates that state drinking water programs currently have staff resources of approximately 3,100 FTEs to implement minimum base program activities. The model estimates that states need staff resources of up to approximately 5,400 FTEs for the peak workload of the minimum base program in 2013 (see Figure 3-2). The associated annual cost of a minimum base program is estimated to peak at $625 million in 2013 (see Figure 3-2) but will remain significant throughout the entire 10-year period. When the comprehensive cost of the program is measured, the gap between current resources and need is much greater. States report that they have staff resources of approximately 3,800 FTEs to implement comprehensive program activities. States needs peak at approximately 6,500 FTEs with a total annual cost of $748 million in 2013 (see Figure 3-3). In 2013, when state workload is projected to be highest, states will need approximately 73 percent more staff than they reported having in 2011. Figure 3-4 illustrates the resource deficits projected through 2021. The current state funding and state FTEs portrayed in Figures 3-2 and 3-3 are supported by the aggregation of all existing sources of federal and state funding: state general funds, state fees, federal PWSS Grant Program funds and DWSRF set-asides. The relative amounts of these various sources are discussed in more detail later in Chapter 3.

Over the past decade, workload driven by the SDWA has increased, but states did not see a corresponding increase in resources. In fact, the opposite occurred. According to ASDWA data, states lost almost 1,100 FTEs between 2001 and 2011, which amounts to a 26 percent reduction. Some funding sources remained relatively flat over the timeframe, but the value of those funds has eroded, not only with inflation, but also as the average cost per FTE has increased by 25 percent from 2001.[23] As the text box on this page explains, other barriers also prevent states from hiring new staff. The staffing deficit has limited states' ability to implement new regulations, keep pace with existing requirements, manage larger data sets or seek to attract and retain qualified staff.

### STAFFING CHALLENGES

State budget deficits translate into several staffing challenges, including:

- Furlough days, hiring freezes and reductions in employee benefits;
- Salary freezes and low wages that will not attract qualified replacements;
- Vacancies from attrition that cannot be filled, sometimes resulting in permanent reductions in staff and loss of critical expertise;
- Use of contractors to replace state positions or terminations of key contractors; and
- Reduced opportunities for staff development, including training and out-of-state travel.

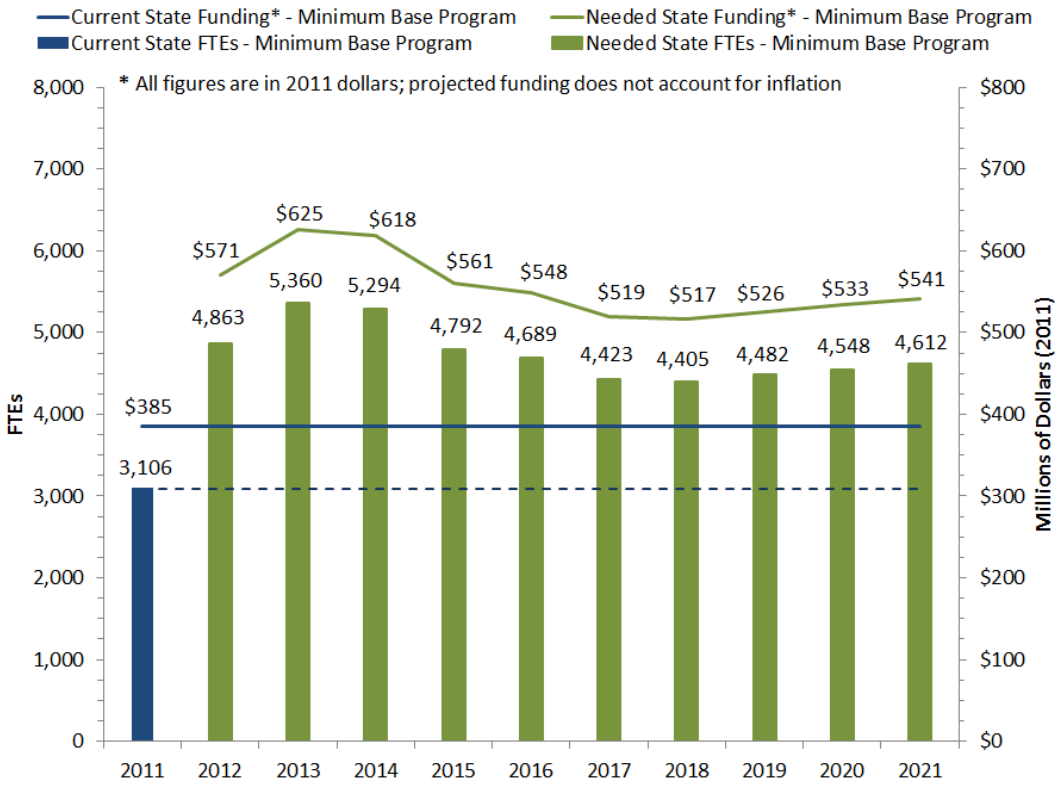



**FIGURE 3-2. PROJECTED FUNDING AND STAFFING NEEDS FOR THE MINIMUM BASE PROGRAM**

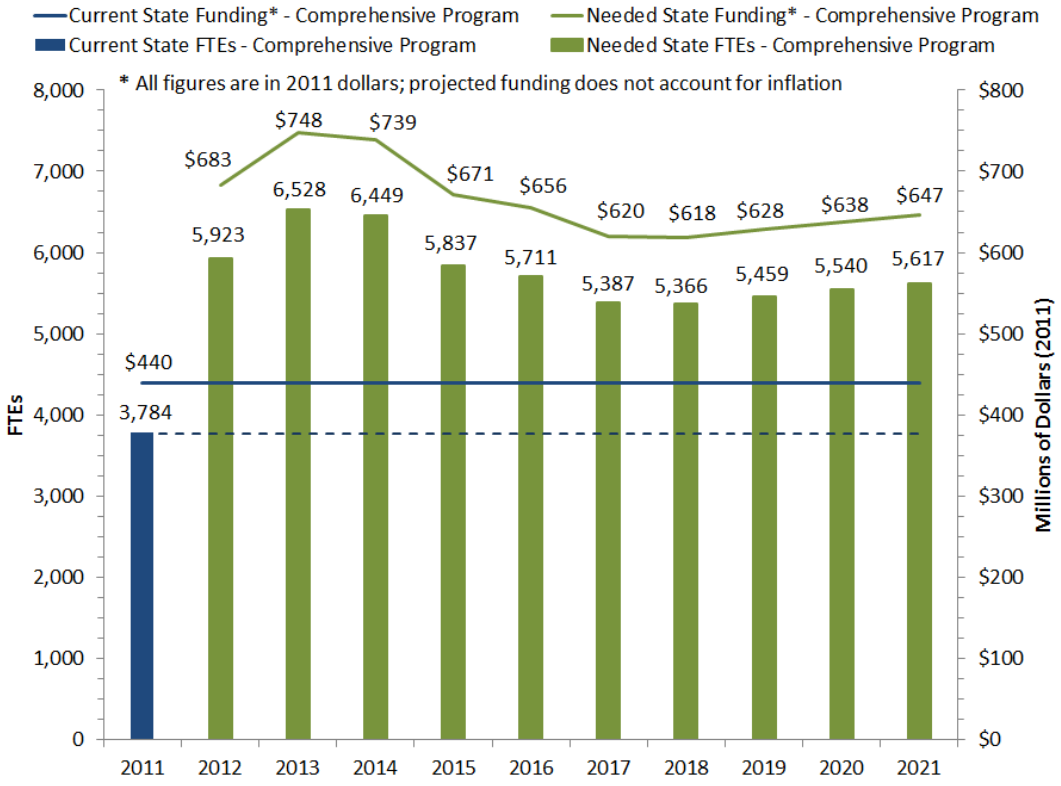



**FIGURE 3-3. PROJECTED FUNDING AND STAFFING NEEDS FOR THE COMPREHENSIVE PROGRAM**

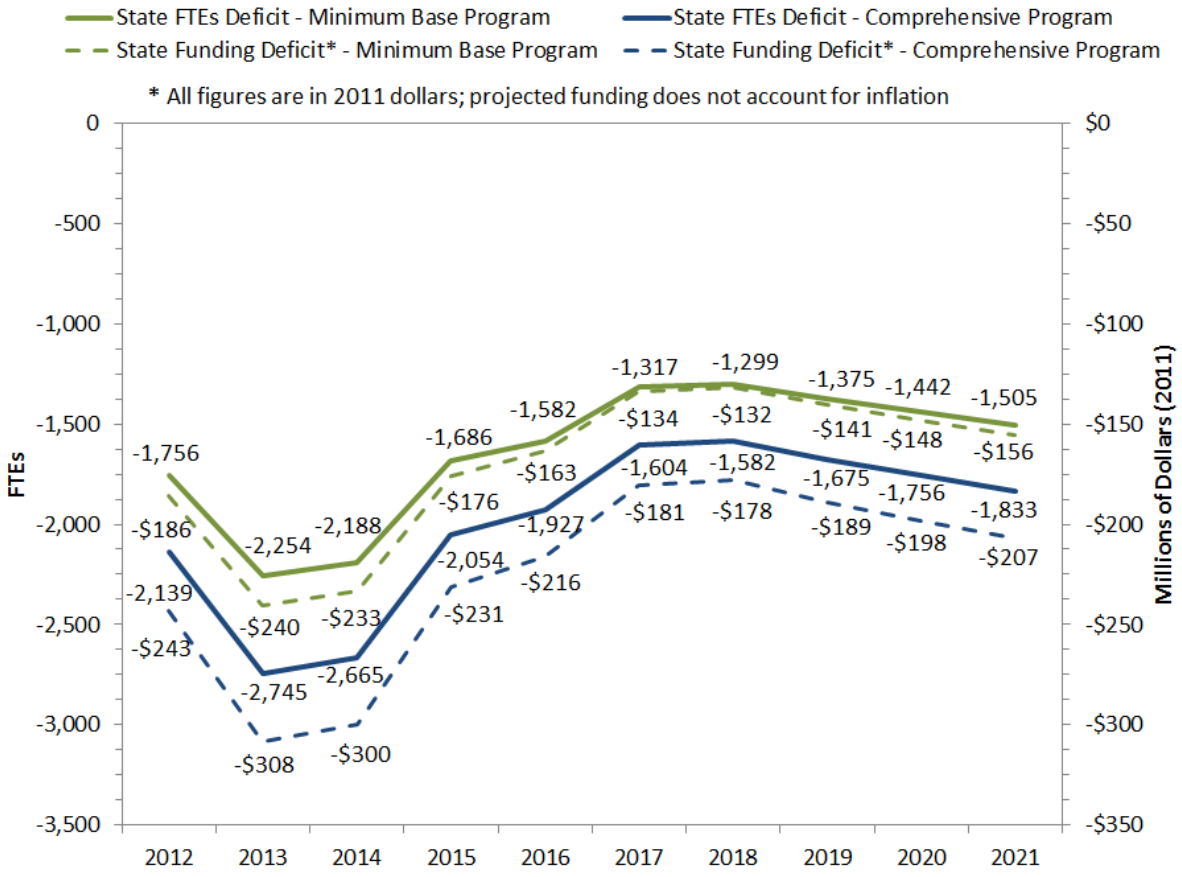



**FIGURE 3-4. PROJECTED FUNDING AND STAFFING DEFICITS FOR THE MINIMUM BASE AND COMPREHENSIVE PROGRAMS**

### *Implementing Drinking Water Standards*

The SDWA prescribes a timetable of two years, or, with an extension request, no more than four years for states to adopt new program requirements, a timeframe which poses a significant challenge for states working to implement their existing program requirements at current resource levels. For each new drinking water standard, states must determine its applicability to water systems in their jurisdictions; establish monitoring schedules and design treatment or other solutions to ensure public health is protected. Without sufficient funding for the staff resources needed to implement new standards, state programs may face implementation delays or may not be able to fully implement the new standard.

Limited resources also affect states' capacity to determine whether water systems are in compliance with drinking water requirements. For example, EPA audits of state drinking water programs have determined that states often cannot conduct site visits at the required frequency, which may allow critical problems at water systems to go undetected for a longer period. EPA's audits also indicate that some state staff have been unable to review drinking water sampling results promptly. This delays the determination of whether the water systems are in compliance with the requirements, and slows the state's ability to follow up with water systems whose results show that their water is close to or has exceeded the allowable levels.

When faced with inadequate staffing levels and resources, states must make difficult decisions about what activities can be accomplished (see text box "Effects of Shortfalls in State Personnel").

## EFFECTS OF SHORTFALLS IN STATE PERSONNEL

According to ASDWA and individual state program directors, when state drinking water programs are faced with inadequate staffing levels and resources, they may be forced to:

- Severely limit on-site field assistance to water systems, including sampling assistance for contaminants;
- Curtail staff and water system operator training courses for complex public health management;
- Limit implementation of pipe leak detection activities and cross-connection control programs;
- Offer less robust source water protection programs;
- Curtail programs designed to assist small water systems in technical, managerial and financial capacity development, including water rate-setting assistance;
- Cancel or curtail water-security-related assistance;
- Use outdated laboratory instrumentation and technologies;
- Discontinue special grants that help small water systems achieve compliance; and
- Delay necessary minimum base program activities, with results that include overdue sanitary surveys, unaddressed violations, time delays for receiving permits, etc.

These examples include curtailment of both minimum base and comprehensive program activities. In either case, limiting state implementation efforts may lead to less effective state drinking water programs and reduced public health protection at water systems.

**FIGURE 3-5. MONITORING DURING SYSTEM EVALUATIONS**

*Monitoring turbidity during a Comprehensive Performance Evaluation at a water treatment plant in Iowa. With reduced staffing levels, states can be forced to eliminate much of their on-site technical assistance to water systems—assistance that may be required to help resolve compliance problems.*

### *Attracting and Retaining Qualified Staff*

ASDWA and states noted that resource constraints also have made it difficult to retain and attract qualified staff, a challenge that is compounded by the impending retirement of many experienced drinking water personnel.[24] Many state personnel are retiring from careers that span the passage of the SDWA in 1974 and its 1986 and 1996 Amendments. At the same time, the water industry faces large-scale retirements of water utility professionals. The implication of a retiring work force for state drinking water programs is significant: the simultaneous loss of highly skilled and experienced water system professionals and the most experienced state staff represents a critical loss of institutional knowledge. The loss of experienced staff is accelerated by voluntary early retirement incentives. Retaining critical knowledge requires mentoring, succession planning, career development processes and development of standard operating procedures, as well as technological solutions, such as intranet site development and automation.[25]

## RESOURCE CONSTRAINTS HINDER STATES' ABILITY TO HIRE AND RETAIN STAFF TO REPLACE RETIRING PERSONNEL.

ASDWA and states also note that it is sometimes difficult to reassign state personnel to drinking water from other state programs, and due to hiring "freezes," legislative limits on authorized program FTE levels or lack of funding for authorized FTEs, state drinking water programs often cannot hire staff quickly, replace retired personnel or increase staffing to meet growing program obligations to protect public health. These restrictions can diminish morale, as state employees grow more overworked and underpaid. States must also face increasing competition with the private sector to find and retain qualified staff. In some cases, states have been able to compensate for the loss in staff through contracted services with third-party technical assistance providers, which help water systems understand requirements, prepare for emergencies and conduct rate audits, among other efforts, but this alternative also requires adequate funding over time.

In the absence of highly skilled or experienced applicants, states sometimes cannot fill vacancies, or states may elect to hire qualified but less skilled or experienced staff whose development requires an investment in on-the-job and classroom training. Training is a vital tool for ensuring that state personnel have the skills and knowledge that are necessary to ensure public health protection.[26] However, funding for new employee training or for training existing employees on new requirements is yet another challenge. State employees face growing constraints on their ability to develop or attend trainings. Not unexpectedly, decreased funding has resulted in fewer offerings of classroom or in-person training. Where resources allow, states encourage their staff to participate in online training (see text box "Online Training"). However, some training, such as how to evaluate a water system for defects, is more effectively done in the field at operating water systems.

### ONLINE TRAINING

Faced with dwindling training budgets and/or state prohibition on staff travel, states increasingly rely on EPA and trade association webinars for training on new regulations. Recognizing that new and reassigned staff need training on existing regulations and programs, EPA is developing the Drinking Water Training System, which will cover all drinking water regulations.

## Funding Levels for States Are Insufficient to Meet Program Needs

State drinking water programs rely on a combination of funding to implement and maintain critical public health protection efforts. Federal funding is provided through the PWSS Grant Program and a portion of the DWSRF capitalization grant that may be used for state program activities. State funding is provided through state general funds and state-established fee systems. The proportion of current funds provided by each funding source is shown in Figure 3-6. The different funding sources are explained below.

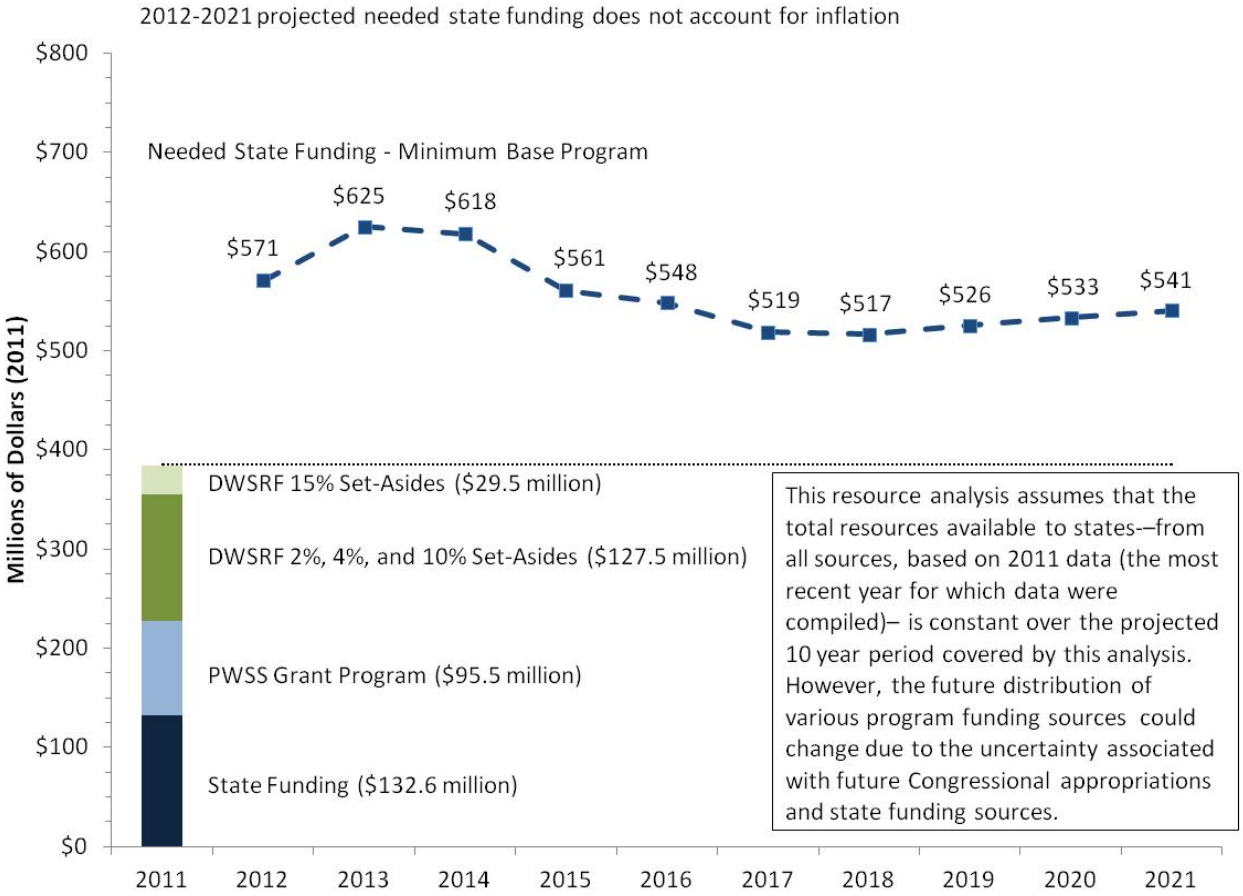



**FIGURE 3-6. 2011 FUNDING AND PROJECTED FUNDING NEEDS FOR THE MINIMUM BASE PROGRAM**

For many states, the availability of funding from each of these sources has decreased over time—in some cases, dramatically so. The ASDWA analysis shows that over the last decade, federal funds have increased 12 percent while state funding across the nation has decreased 33 percent, and funding levels are down 9 percent overall. Figure 3-7 shows the proportion contributed by each funding source in 2011 and the shift that has occurred since 2001.

ASDWA and states report that current federal funding levels are far from adequate to meet federal program requirements. Federal sources contribute approximately 66 percent of the current funding for state programs collectively. The state resource needs model used for the ASDWA analysis assumes that

both federal grant funding and needs projections will remain constant in nominal terms over the next 10 years. Given this assumption, federal funding would only cover 40 percent of the minimum base program activities in the peak future year projected by the model, and only 38 percent of the comprehensive program described in Chapter 2. If federal funding does not increase, inflation will create an even greater deficit than projected in this report. States face challenges in using available funds due to competing priorities for funding or constraints on access or use of funds, and they struggle to meet matching requirements attached to some DWSRF funding. ASDWA and states remain concerned about the long-term stability of critical funding sources.

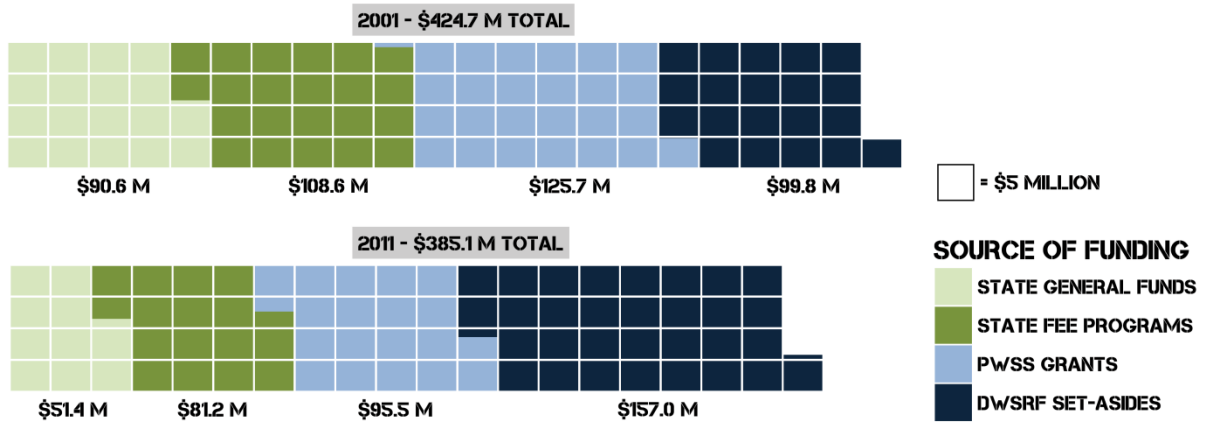



**FIGURE 3-7. COMPARISON OF FUNDING FOR STATE PROGRAMS BETWEEN 2001 AND 2011**

## Federal Funding

Federal funding accounted for approximately 66 percent of program funding in 2011, or $253 million. The PWSS Grant Program covered 25 percent of total state program expenses. The DWSRF covered 41 percent of total state program expenses, making it the single largest funding source for state programs.

### *PWSS Grant Program*

In the original SDWA, Congress authorized funding to assist states with implementation of their drinking water programs.[27] This funding was distributed through PWSS Grants that states could use for activities such as oversight of public water systems, conducting required site visits, enforcing drinking water standards and providing technical assistance to local communities. As directed under SDWA section 1443, EPA distributes PWSS Grants to states based on an allotment formula that considers the state population, geographical area and number and different types of water systems in each state (water systems are differentiated based on whether they serve primary residences and how transient the customer base is). To be eligible for a PWSS Grant, a state must come up with an additional 25 percent in matching funds. In fact, the data gathered in support of this analysis show that the 2011 PWSS Grants only accounted for 15 percent of the state's funding *need* for the minimum base program in 2012. Therefore, states must use other sources of revenue to support their programs.

Existing PWSS Grant funding levels are no longer sufficient to help meet state resource needs. According to ASDWA's 2011 survey of state drinking water programs conducted for this report, 48 states experienced a decrease in their PWSS Grant allocations as a result of inflation, and seven of those states experienced additional reductions due to changes in PWSS Grant allocation factors. (For

example, some states have addressed deficiencies in water system capacity by encouraging, where appropriate, water system consolidation. This has resulted in decreases in water system inventory, which in turn has decreased those states' share of PWSS Grant funding, because the allocation formula is based in part on system inventory.) Of these 48 states, 29 experienced a decrease of more than 20 percent. Nationally, the trends over time show that, when adjusted for inflation, PWSS Grant funding has decreased steadily since the 1996 Amendments, as can be seen in Figure 3-8. The table in Figure 3-9 shows that the most recent appropriation, adjusted for inflation,[28] is the third-lowest amount of PWSS Grant funding states that have received since the 1996 SDWA Amendments.

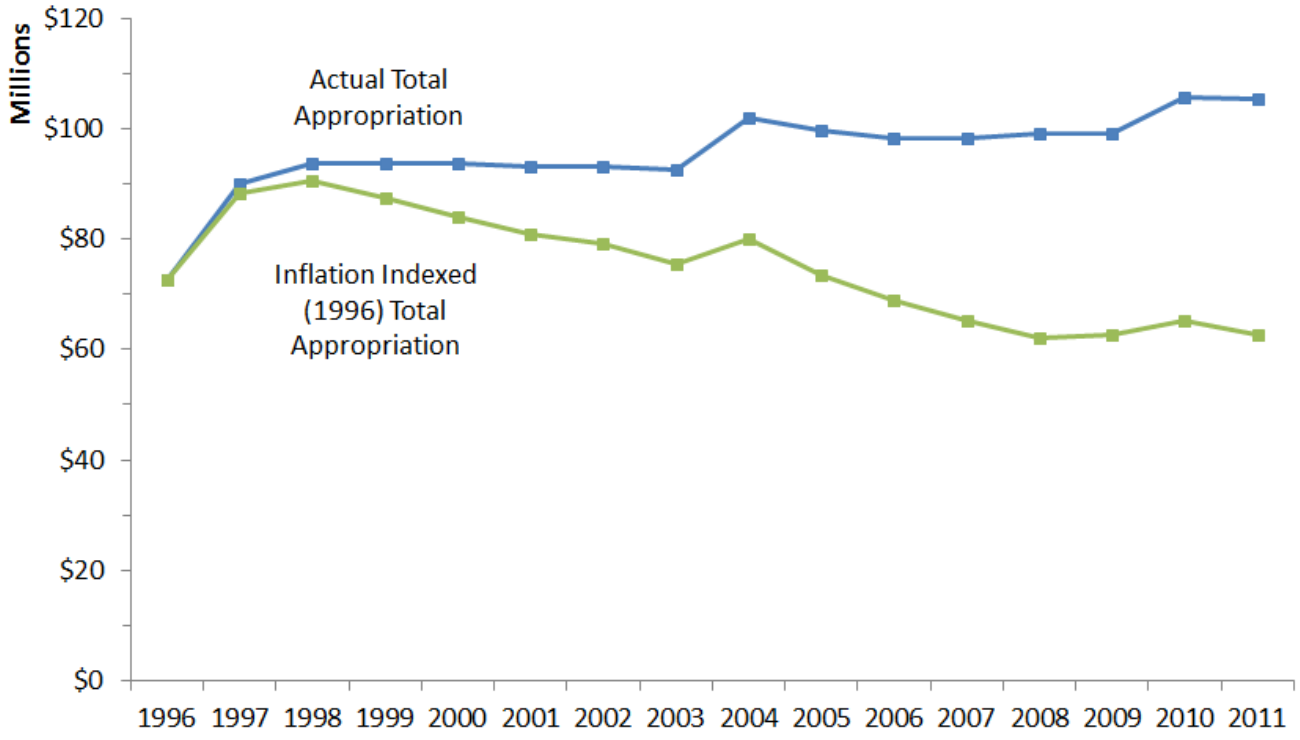



**FIGURE 3-8. TREND IN PWSS GRANT APPROPRIATIONS, 1996-2011**

| Inflation Adjusted (1996) PWSS Grant Appropriation (Sorted from Highest to Lowest) | | |
|---|---|---|
| **Fiscal Year** | **Actual Total Appropriation** | **Inflation Indexed (1996) Amount** |
| **1998** | $93.8 M | $90.7 M |
| **1997** | $90.0 M | $88.3 M |
| **1999** | $93.8 M | $87.6 M |
| **2000** | $93.8 M | $83.9 M |
| **2001** | $93.1 M | $80.8 M |
| **2004** | $102.0 M | $80.0 M |
| **2002** | $93.1 M | $79.2 M |
| **2003** | $92.5 M | $75.5 M |
| **2005** | $99.7 M | $73.6 M |
| **1996** | $72.5 M | $72.5 M |
| **2006** | $98.3 M | $68.9 M |
| **2007** | $98.3 M | $65.3 M |
| **2010** | $105.7 M | $65.2 M |
| **2011** | $105.5 M | $62.8 M |
| **2009** | $99.1 M | $62.6 M |
| **2008** | $99.1 M | $62.2 M |

**FIGURE 3-9. NOMINAL AND ADJUSTED PWSS GRANT APPROPRIATIONS, 1996-2011**

PWSS funding is also limited by competing state priorities. Some states combine federal funds for multiple environmental and health programs into a broader block grant from EPA called a Performance Partnership Grant (PPG). The states then allocate the combined funds to their state programs according to their priorities. Depending on the drinking water program's ranking among the state's priorities and funding available for higher priorities, the drinking water program may receive less funding than it contributes to the PPG through the PWSS Grant.

From 2002 to 2009, Congress also appropriated approximately $5 million in annual grants for water security. These grants were instrumental in allowing states to establish and sustain state drinking water security programs. They supported salaries for state personnel engaged in security work, security training for water systems and purchases of security equipment. Elimination of this appropriation in FY 2009 forced many states to eliminate or dramatically reduce their drinking water security programs.

### *DWSRF*

In the 1996 SDWA Amendments, Congress created the DWSRF to provide financing for infrastructure improvements at water systems. Congress envisioned a program operating in perpetuity from which the principal and interest payments on old loans would be used to issue new loans, and from which a portion of each state's allotment could be "set aside" for state drinking water programs to provide regulatory oversight and direct assistance to water systems.[29] Each year, Congress appropriates a capitalization grant, and each state receives its allocation based on the infrastructure needs of its water systems, as determined by water system inventory, population served and geographic area. States must provide 20 percent in matching funds in order to receive the capitalization grant.

States may reserve, or set aside, up to 31 percent of their capitalization grant to fund certain activities that support state drinking water programs, enhance the management of water systems or support programs that protect sources of drinking water (see Figure 3-10). The set-asides enable states to improve water system operation and management, emphasizing institutional capacity as a means of achieving sustainable water system operations. However, the setting aside of funds for programs must

be balanced with the need to fund infrastructure, because any dollars set aside by the state programs are not spent directly on construction projects and will not be paid back into the state's DWSRF. Each state must decide how much money to spend implementing the state program through set-aside funding and how much to loan to water systems for repairing or replacing water system infrastructure (see text box "Understanding the DWSRF Set-Asides" for an explanation of the possible funding from set-asides.) See Appendix C for more information on the DWSRF set-asides.

## UNDERSTANDING THE DWSRF SET-ASIDES

State DWSRF set-aside funding can be quantified in three ways:

1) Maximum Available for Set-Asides: 31 percent of the DWSRF is the limit established in the statute;
2) Total Set-Asides Awarded: Funding received through an EPA-approved work plan; and
3) Total Set-Asides Expended: Actual expenditures by states in a given fiscal year.

As can be seen in Figure 3-10, the Congressional appropriation for the American Recovery and Reinvestment Act of 2009 substantially increased the annual appropriation and funds awarded in 2010, and expenditures tracked upwards as well. However, this one-time infusion did not reverse the long-term downward trend in federal funding through the DWSRF.

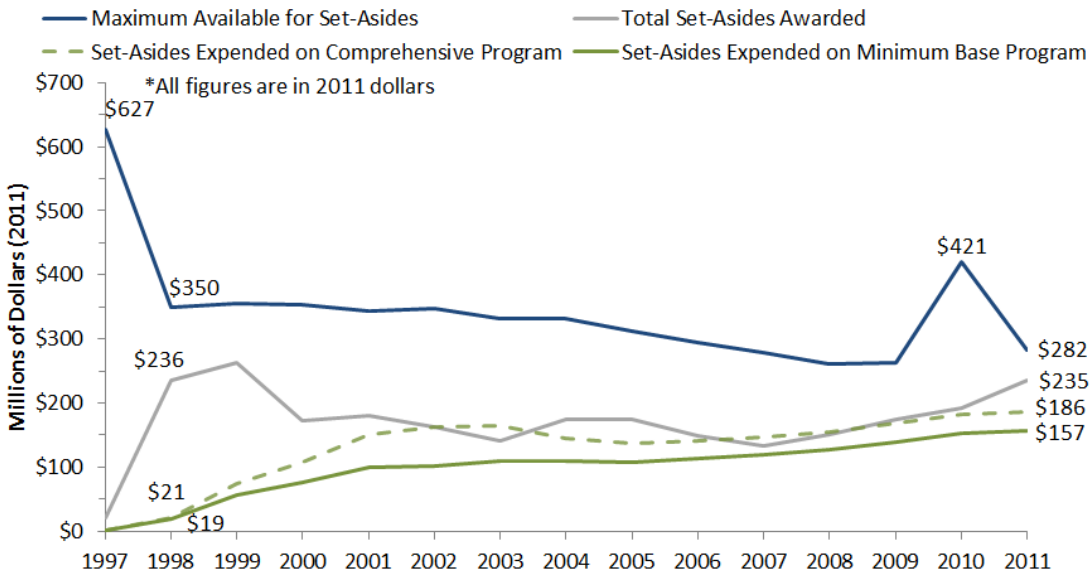



**FIGURE 3-10. DWSRF SET-ASIDE ALLOCATIONS AND EXPENDITURES**

Four set-asides are available from the capitalization grant. They are: a 2 percent set-aside for small system technical assistance; a 4 percent set-aside for DWSRF-related administrative costs and technical assistance; a 10 percent set-aside for state program management; and a 15 percent set-aside for local assistance and other state programs.

EPA's DWSRF database shows that set-asides have accounted for a greater portion of the states' overall funding over time. (The amount that states elect to set aside is reflected in the awarded funds depicted in Figure 3-10.) However, states do not necessarily use all of the set-aside funding for state program activities. Out of the maximum available set-asides in 2011 of $282 million, states were awarded $235 million. Of the $282 million, states only expended $157 million (56 percent) on minimum base activities. If the comprehensive program activities are considered, states still only expended $186 million (66 percent) of the funding available. (The amount of set-aside funds spent by the state on their programs is shown in Figure 3-10.)

Since 1999, states generally have increased use of the 2 percent and 4 percent set-asides available to them. However, states have requested fewer set-aside funds than have been available to them for program management (up to 10 percent) and local assistance (up to 15 percent). In 2011, states used approximately 81 percent of the $91 million available for the 10 percent set-aside and approximately 39 percent of the $136 million available for the 15 percent set-aside to support comprehensive drinking water program activities. An explanation of why states historically have not fully utilized the 15 percent set-aside for state drinking water program activities is included in the text box "States Take Greater Advantage of the 15 Percent Set-Aside."

## STATES TAKE GREATER ADVANTAGE OF THE 15 PERCENT SET-ASIDE

The 15 percent set-aside accounts for most of the increase in state drinking water program budgets that came from DWSRF set-aside funding. At the time of the last resource needs assessment in 2001, states did not use the 15 percent set-aside for drinking water program activities; rather, they devoted all funds in this account to source water protection activities such as land acquisition. But in 2011, states anecdotally reported that they used some of the 15 percent set-aside to implement water system technical, managerial and financial capacity building programs.

Of all the DWSRF set-asides, the program management set-aside offers states the most flexibility in funding their PWSS programs, but states do not request the full value of this set-aside for a number of reasons. One reason is the matching requirement: in addition to the 20 percent match towards the capitalization grant (discussed above), states that opt to request the program management set-aside must contribute a dollar-for-dollar match. Effectively, for every dollar of the 10 percent set-aside that states elect to use, they must provide a match of $1.20. ASDWA estimates that $50 - $70 million per year in DWSRF set-asides for program management have gone unrequested and unrewarded because of this requirement. ASDWA and states also note that the extraordinarily high 120 percent matching requirement is inconsistent with other matching requirements in the SDWA. For example, the matching requirement for the PWSS Grant under section 1443(a) of the SDWA is only 25 percent. Similarly, section 106 of the Clean Water Act does not require any monetary match for state grant funds, and the Clean Water Act only requires a 20 percent state match for the capitalization grant provided under the Clean Water State Revolving Fund.

## 120 PERCENT SET-ASIDE MATCHING REQUIREMENT

Largely because some states cannot reach the (effectively) 120 percent matching requirement for the 10 percent set-aside, ASDWA estimates that $50 - $70 million per year in program management set-asides from the DWSRF grants have gone unrequested and unawarded.

## ASDWA NOTES THAT MOST STATES FACE SIGNIFICANT BARRIERS TO ACCESSING THE FULL 31 PERCENT SET-ASIDE FUNDING FOR PROGRAM ACTIVITIES.

Another reason states do not request the maximum amount of set-asides from the DWSRF is that any funds used for set-asides reduces the amount available for water system infrastructure improvements. As noted previously, states and water systems must continually repair or replace aging or failing water system infrastructure. In 2007, EPA estimated a 20-year need of $334.8 billion in drinking water infrastructure improvements.[30] The American Society of Civil Engineers gave the nation's drinking water infrastructure a grade of "D" in 2009, stating that staggering public investments are needed over the next 20 years to address aging facilities and to keep water systems in compliance.[31] The American

Water Works Association (AWWA), the largest organization of water professionals in the United States, also acknowledges the dire state of United States' infrastructure in its report *Buried No Longer: Confronting America's Water Infrastructure Challenge*—and calculates a $1 trillion 20-year drinking water infrastructure need. The AWWA report stresses that a large proportion of U.S. water infrastructure is approaching, or has reached, the end of its useful life. Any delay in making infrastructure upgrades could have severe consequences, such as degraded water service, increased water service disruptions and increased expenditures for emergency repairs.[32] The high profile of these infrastructure needs across the country adversely affects the ability of state drinking water programs to use set-asides to fund state drinking water program activities. Even in the face of these constraints, Figure 3-10 shows that state reliance on the set-asides has increased steadily over the past decade, even as the total amount available to them (in adjusted dollars) has decreased.

However, the risks of relying on the DWSRF set-asides as a predictable and reliable source of funding have increased in recent years. State officials have expressed concerns that increasing reliance on set-asides over time could adversely affect the longevity of the DWSRF, as the funds spent on set-aside activities do not "revolve"(i.e., they are not returned to the DWSRF as the loan funds are paid back by recipients). Without repayment, the value of the state revolving fund will decrease. This effect can be amplified as DWSRF appropriations diminish and the amounts available for both infrastructure and set-asides are reduced. In addition, both the federal budget climate and the protracted federal appropriations process over the past several years, under which the availability of DWSRF funds to states has been delayed until late in the federal fiscal year, have caused a great deal of uncertainty with regard to federal financial support for state drinking water programs. Should federal appropriations for the DWSRF decrease, state programs would have to find alternative ways to fund critical program activities. As this report describes, however, funding from alternative sources, such as the PWSS Grant Program, fee systems or state general fund revenue, are inadequate to meet minimum base program needs.

Concern about long delays in receiving capitalization grants and associated set-aside funds from EPA due to the increasingly protracted Congressional budget cycle, coupled with the risk of decreased overall appropriations for the DWSRF, can lead to delays in state spending of awarded set-aside funds, or relatively slow spending of the funds. Delays in expending obligated grant funds can also be caused by cumbersome grant administrative requirements, in conjunction with delays in infrastructure loan recipients "drawing down" project funds. For example, it may take several months for a water system and the state to develop and process a DWSRF loan application in a way that adequately ensures appropriate accountability for use of the funds. Delays in spending the money could, in turn, jeopardize future DWSRF appropriations. After EPA has allocated the funds according to its grant formula and awarded the funds to each state, the dollars have become obligated, meaning there is a legal liability for the federal government to make these funds available for their intended purposes. Delays in expending obligated set-aside funds can generate unliquidated obligations or "ULOs" that can build up over time, placing future federal appropriations at risk of being reduced in response.

ASDWA and states are committed to addressing this problem at the state level and already have identified and implemented steps designed to improve state grants management practices and help reduce ULOs, including: providing technical assistance to water systems to expedite their loan application and project development process; targeting a maximum, lower fixed level of carryover funds from year to year; using historical set-aside expenditures as a benchmark to avoid overestimating set-aside needs when requesting future DWSRF set-asides; and requesting that EPA allow states to reallocate unused DWSRF set-aside funds from prior years as part of an approved intended use plan to fund future water system infrastructure improvements.

**FIGURE 3-11. RUPTURE OF A 66-INCH WATER MAIN**

*This 2008 rupture caused 150,000 gallons of water per minute to cascade onto the road in standing waves 3 to 4 feet high.*

**FIGURE 3-12. INTERCONNECTING TWO WATER SYSTEMS**

*Boring underneath a river to provide an interconnection between two water systems in Nevada. DWSRF loans and other state financing make these projects possible. Regardless of how the infrastructure is financed, states must monitor the project to ensure it is correctly installed.*

### State Funding

States rely on two principal sources of revenue to meet the SDWA matching requirements of the PWSS Grant Program: appropriations from state general funds and fees collected from water systems.

### *General Funds*

Most state drinking water programs receive general funds appropriated by state legislatures. However, general funds in many states have diminished or been eliminated over the past 10 years. As a result, competition has increased within state programs for increasingly limited dollars. This pattern is reflected in the data ASDWA obtained from states. Although 15 state drinking water programs received increases in general funds from 2001 to 2011, general funds for drinking water programs decreased in 28 states, and in 22 of these states drinking water programs lost 50 percent or more of their general funds. Four state drinking water programs reported that general funds have been eliminated entirely as a funding source, and other state programs anticipate that their share of general funds will be cut in the next funding cycle. Overall, from 2001 to 2011 states lost $39 million from this funding source, a 43 percent drop.

**BETWEEN 2001 AND 2011, STATE GENERAL FUNDS FOR DRINKING WATER PROGRAMS DECLINED NATIONALLY BY 43 PERCENT: 22 STATE DRINKING WATER PROGRAMS LOST MORE THAN 50 PERCENT OF GENERAL FUND SUPPORT, AND FOUR PROGRAMS LOST 100 PERCENT OF GENERAL FUND SUPPORT.**

Eliminating barriers to accessing and spending state general funds (as discussed in the accompanying summary of recommendations, entitled *Insufficient Resources for State Drinking Water Programs Threaten Public Health: Recommendations from the Association of State Drinking Water Administrators*) would lessen but not eliminate the estimated funding gap. Of all of the impacts that shrinking state and federal budgets have had, the cuts in state drinking water program funding from general funds have been the most dramatic, particularly as seen in several states.

### *Fee Programs*

Because of the pressing need for more revenue beyond existing federal and state sources of funding, numerous state drinking water programs have instituted fee programs—and many more have sought, some unsuccessfully, to do so. These programs include fees for state services such as issuing water system permits, or water system user fees based on the volume of water used or on the number of service connections for each water system. Many states have had fee programs in place for many years, but the funds raised are insufficient to make up the shortfalls elsewhere in their budgets.

Forty-four states responded to a recent fee survey conducted by ASDWA. Thirty-six states currently collect fees that support their drinking water programs. Most (22 states) began collecting fees in 1990 or later, and eight states do not collect state fees. Over the past five years, two-thirds of the states with fee programs have attempted to increase their fees and other states have tried to add fee programs:

- 24 states tried to increase fees, and 17 were successful.
- Three states unsuccessfully tried to introduce fee programs.
- Five states never formally attempted to implement fee programs, citing barriers.

Although fees are used to replace declining general funds, in some states proposed fees were perceived as a new tax on consumers or water systems. In other states, communities were concerned that fees paid for drinking water would be used for other purposes, especially during difficult budget years. Other states were able to establish fee programs, but could not generate sufficient revenue from them to overcome the effects of decreases in other funding sources. Furthermore, the economic downturn affected fee revenue as fewer engineering plan review fees for water system expansions were collected in states where population growth stalled or decreased.

Even in those states that have successfully implemented fees, fee revenue has not replaced millions of dollars in general fund reductions. Overall, states saw a decline of $27 million in fee revenue collected between 2001 and 2011, a 25 percent reduction. In addition to declining fee revenue, states face other challenges in trying to replace general funds with fee revenue. In some states, fees may not be designated by law for use by the program that generates them. As a result, fee revenue can be available to multiple programs and open to re-designation if the state legislature identifies a different need for the funds.

Overall, ASDWA and state data show that fees by themselves are insufficient to support state programs or eliminate budget shortfalls, and attempts to establish or expand fee systems are not a viable option for many state drinking water programs in the current budget environment.

SUSTAIN

## STATE EFFORTS TO ADD FEE REVENUE

Forty-four states provided information to ASDWA about their efforts to establish or increase revenues from state fee programs. Although the purpose of fees is to replace declining general funds, in some states they were perceived as a new tax on consumers or water systems. In other states, communities were concerned that fees paid for drinking water would be used for other purposes, especially during difficult budget years. Other states were able to establish fee programs, but could not generate sufficient revenue from them. Furthermore, the economic downturn affected fee revenue as fewer engineering plan review fees for water system expansions were collected in states where population growth stalled or decreased.

Overall, fees by themselves are not enough to make up budget shortfalls, and attempts to establish or expand fee systems are not a viable option for many state drinking water programs in the current budget environment.

## Implications of the State Resource Deficits

ASDWA data for this state resource needs analysis shows that the budget outlook for state drinking water programs has not improved since 2001 and that the trend is worsening, given the expected increase in state workloads and decrease in funding available. As illustrated by the quote below, ASDWA believes the current resource gap is *already* compromising states' ability to provide comprehensive public health protection and a growing gap will only exacerbate that problem.

### AS ONE STATE NOTED, "IN MANY RESPECTS, WE DO LESS WITH LESS, BUT HOPEFULLY WE'RE DOING IT BETTER."

Over the last decade, states have taken steps to operate more efficiently by analyzing business processes and streamlining work flows (see examples in the text boxes on this page). These methods have helped mitigate some of the effects of funding cuts on state programs as the overall number of FTEs declined by 26 percent. States report that staff are more productive (on a per employee basis) as a result of efficiency measures, such as data management improvements, cross-program initiatives and online training.

More efficient operations, however, did not fully offset the decline in state budgets over the last decade, as 27 states have decreased the amount spent for FTEs, and 17 states decreased spending by more than 20 percent. In fact, this analysis indicates that states currently do not have enough funding for their minimum base program activities, much less the comprehensive programs envisioned in the SDWA.

As noted above, given their overall fiscal picture, states have limited ability to generate additional revenue to increase general funds for drinking water programs. Fee programs have proven to be one of the few avenues for generating additional revenues to support drinking water programs. However, numerous states are statutorily forbidden from instituting fee programs or have been unsuccessful in doing so.

In addition, although these measures may help, they cannot address the entire funding gap. As

#### NEW ELECTRONIC DATA TRANSFER AND COMPLIANCE DETERMINATION

Many laboratories have or are implementing a Laboratory Information Management System or other software to report data electronically to the state. Electronic reporting of laboratory results directly into state data management systems allows states to respond more quickly to potential contamination issues. Electronic reporting also saves money and improves data quality, but states with limited funds for data systems may be unable to take advantage of these efficiencies.

#### IDAHO: AUTOMATION

Idaho uses an automatic dialer to provide voicemail reminders to water systems regarding upcoming sampling requirements. This system cost less than $3,000 and provides hundreds of personalized and customizable reminders as well as a call log of all activities. The response from water systems has been overwhelmingly positive.

#### PUBLIC-PRIVATE PARTNERSHIPS

The water technology cluster initiative in the Ohio-Indiana-Kentucky area is a public-private partnership to encourage the development and adoption of new and innovative water technologies. The initiative provides support for new technologies through a federally funded grant program, and the opportunities it provides bring technology innovators and regulators together.

shown in Figures 3-2 and 3-3, resource needs are expected to peak in 2013 at $625 million for minimum base program activities and $748 million for the comprehensive activities envisioned by the SDWA. This peak is due largely to the workload associated with implementation of the Long Term 2 Enhanced Surface Water Treatment Rule, the Stage 2 Disinfectants and Disinfection Byproducts Rule and the anticipated Revised Total Coliform Rule. In addition, anticipated efficiencies (e.g., electronic reporting by laboratories) will not be fully implemented until after 2013. Although the need remains higher than projected available resources, the analysis shows a relatively small decline in anticipated needs after 2013. States anticipate fewer violations associated with the new regulations once water systems conduct initial monitoring and complete necessary water treatment modifications. States also anticipate that training and technical assistance activities for recently promulgated regulations will taper off as water systems begin to understand and address any identified challenges. The estimated resource need begins to trend upward again after 2018 due to the anticipated promulgation of future regulations, as discussed previously. However, this analysis has modeled only minimal anticipated costs associated with these potential future rules, because the nature and requirements of the regulations is unknown. The actual implementation cost could be significantly higher (see text box "Additional Model Variables").

ASDWA notes that in many states drinking water program personnel believe that their program is a relatively low funding priority in comparison to other state environmental and public health programs because they are a "victim of their own success." In other words, a successful prevention-based program attracts little public notice, making it harder to explain the importance of sufficient funding to sustain a good record.

As discussed previously, current state funding levels are far below the projected annual $517 to $625 million that will be needed for a minimum base program in the upcoming years. In 2011, according to the ASDWA survey data, states spent $385 million on minimum base program activities. As shown in Figure 3-6, $228 million of this spending came from PWSS Grant and state funding sources, an additional $127 million came from the 2 percent, 4 percent and 10 percent DWSRF set-asides combined, and the final $30 million came from the 15 percent DWSRF set-aside. This analysis estimates a peak gap of $240 million. To close this gap, an investment of approximately 34 to 62 percent over current funding levels would be needed. The gap for the comprehensive program is even greater, at $308 million.

This state resource needs analysis confirms the continuation of state fiscal trends previously identified in the 2001 resource needs analysis, which identified increasing deficits between program needs and spending as states implement the program activities created by the 1996 SDWA Amendments. Given the importance of state programs in implementing the SDWA, the cumulative effect of the gap in resources has serious implications for protecting the public health of Americans served by public water systems. For example, limiting states' resources have affected their ability to:

- Provide critical support to water systems in complying with key public health regulations, particularly to small water systems which may lack technical, managerial and financial capacity;
- Effectively implement state-specific programs, such as water audits and source water protection;
- Attract, train and retain qualified staff. Loss of key personnel, such as legal support or engineers, can result in fewer enforcement cases or complaint investigations. Some states report that vacant positions of this kind have been permanently lost;

- Contract with outside technical assistance organizations to provide specialized support to water systems; and

- Undertake timely surveillance and other proactive measures to prevent health-based violations and waterborne disease outbreaks.

ASDWA data show that significantly increased investment is needed to ensure the comprehensive public health protection envisioned under the SDWA. The data show that significant investment is required even to meet the requirements of the minimum base program, including assisting public water systems in developing customized monitoring programs and treatment solutions, as described in Chapter 2. In the absence of needed additional resources, states will continue to be forced to make increasingly difficult decisions about how to best provide a high level of public health protection.

Figure 3-13 illustrates how the balance of funding from these four main sources has shifted over the past 10 years at the state level.[2] Figure 3-14 aggregates these changes to show how these funding sources have shifted nationally. These two complementary figures convey both the changes in the make-up of state drinking water program budgets and the overall shifting budget landscape.

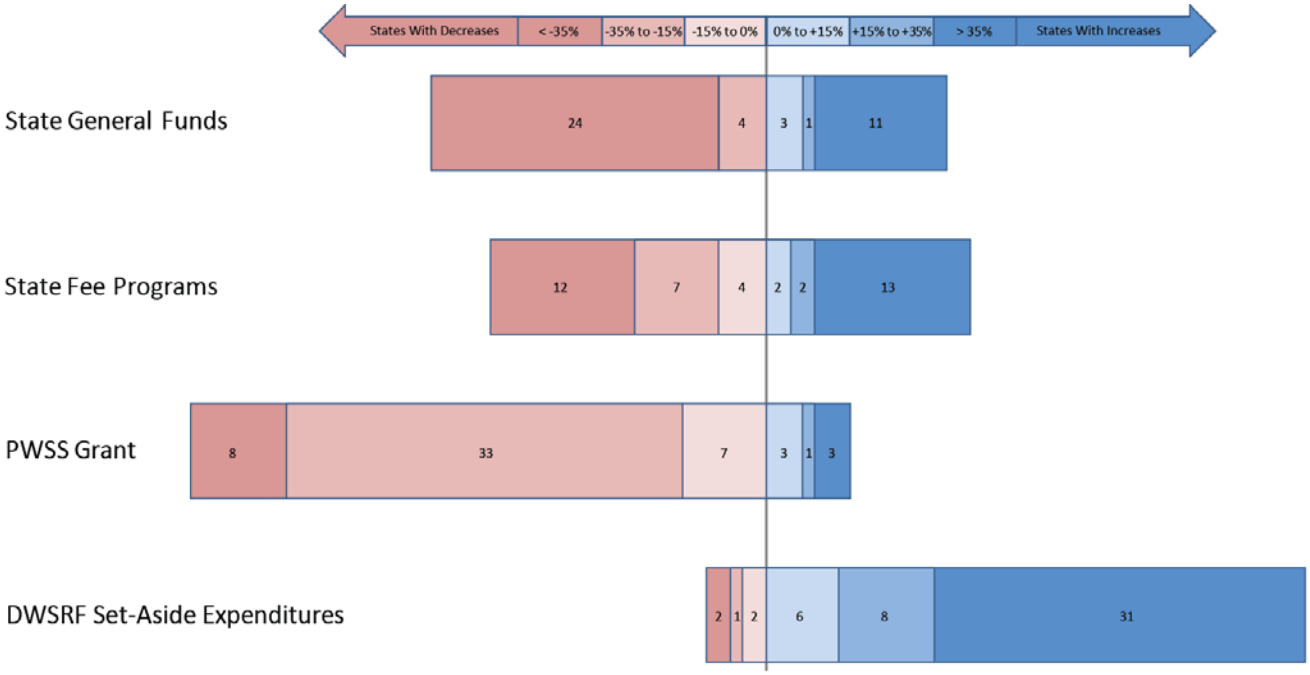



**FIGURE 3-13. CHANGE IN FUNDING LEVELS SINCE 2001, BY SOURCE**

[2] This graphic represents the change in expenditures, by funding source, between 2001 and 2011, in 2011 dollars. Some states did not experience changes in funding levels, either because they did not receive funding from a particular source or because the values remained the same. Therefore, the number of states represented in the graphic varies by funding source. In addition, four states did not report to ASDWA individual values for each revenue source: their values were reported as a single average four-state value. These four states are not included in this graphic.

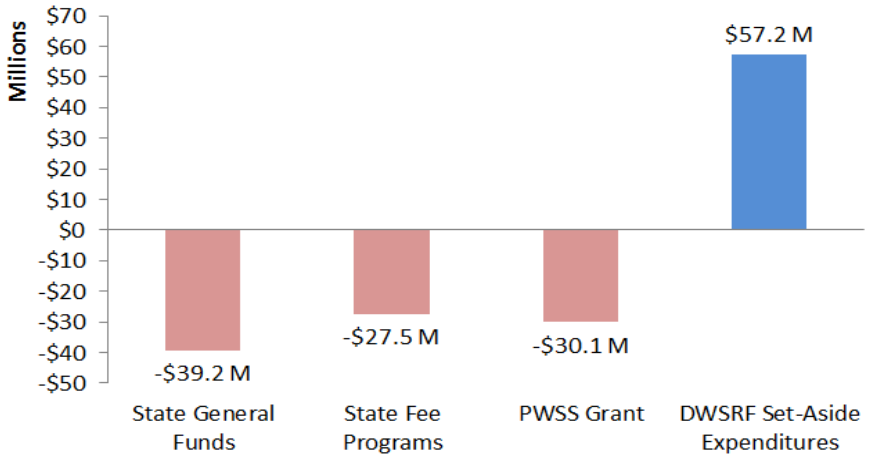



**FIGURE 3-14. TOTAL CHANGE IN EXPENSES BY FUNDING SOURCE, 2001 TO 2011**

## Summary

This report has explained the nature and complexity of the task of protecting our nation's drinking water, pointed out the vital role that states play in that process and documented both current and future resources needed for state drinking water programs to carry out that public health protection mission. ASDWA's analysis indicates that a significant gap has grown between the resources available to state drinking water programs and the resources they need to carry out their responsibilities under the SDWA and protect the public from water-borne threats. Workload projections indicate that the gap will continue to widen unless action is taken. In a companion document, entitled *Insufficient Resources for State Drinking Water Programs Threaten Public Health: Recommendations from the Association of State Drinking Water Administrators*, ASDWA has developed a series of recommendations to address that gap for consideration by all concerned parties, including Congress, EPA and states.

# APPENDIX A: DRINKING WATER REGULATIONS: PURPOSE, PUBLIC HEALTH BENEFITS AND PROCESS FOR DEVELOPMENT

This appendix describes the purposes and public health benefits of the existing federal drinking water regulations that primacy agencies must implement (see table below). Additionally, this appendix describes the process the United States Environmental Protection Agency (EPA) follows in developing new drinking water regulations and reviewing existing regulations.[3]

| Current Drinking Water Regulations: Purpose and Public Health Benefits | | |
|---|---|---|
| **Drinking Water Regulation (Year Promulgated)** | **Purpose** | **Public Health Benefits** |
| Total Coliform Rule (1989) | Improves public health protection by reducing fecal pathogens to minimal levels through control of total coliform bacteria, including fecal coliforms and *Escherichia coli* (*E. coli*). | • Reduction in risk of illness from disease-causing organisms associated with sewage and animal wastes. Disease symptoms may include diarrhea, cramps, nausea and possibly jaundice and associated headaches and fatigue. |
| Ground Water Rule (2006) | Reduces the risk of illness caused by microbial contamination in public ground water systems. | • Targeted protection for over 70 million people served by ground water sources that are either not disinfected or receive less than 4-log treatment.<br>• Avoidance of an estimated 42,000 viral illnesses and one related death annually. |
| Surface Water Treatment Rule (1989) | Improves public health protection through the control of microbial contaminants, particularly viruses, *Giardia lamblia* and *Legionella*. | • Increased protection against illnesses from *Giardia lamblia*, *Legionella* and other pathogens.<br>• Prevention of approximately 79,854 endemic cases of waterborne disease per year. |

[3] Since the time of the ASDWA analysis, EPA has promulgated a new final regulation: the Revised Total Coliform Rule (RTCR), published February 2013.

| Current Drinking Water Regulations: Purpose and Public Health Benefits | | |
|---|---|---|
| **Drinking Water Regulation (Year Promulgated)** | **Purpose** | **Public Health Benefits** |
| Interim Enhanced Surface Water Treatment Rule (1998) | Improves public health control of microbial contaminants, particularly *Cryptosporidium*.<br>Prevents significant increases in microbial risk that might otherwise occur when systems implement the Stage 1 Disinfectants and Disinfection Byproducts Rule.<br>Covers systems serving 10,000 or more persons. | • Increased protection against gastrointestinal illnesses from *Cryptosporidium* and other pathogens through improvements in filtration.<br>• Avoidance of between 110,000 and 463,000 cases of endemic illness from *Cryptosporidium* annually.<br>• Reduced likelihood of outbreaks of cryptosporidiosis. |
| Long Term 1 Enhanced Surface Water Treatment Rule (2002) | Improves public health protection through the control of microbial contaminants, particularly *Cryptosporidium*.<br>Prevents significant increases in microbial risk that might otherwise occur when systems implement the Stage 1 Disinfectants and Disinfection Byproducts Rule.<br>Extends provisions of IESWTR to public water systems serving fewer than 10,000 persons. | • Increased protection against gastrointestinal illnesses from *Cryptosporidium* and other pathogens through improvements in filtration.<br>• Avoidance of between 12,000 and 41,000 cases of endemic illness from *Cryptosporidium* annually.<br>• Reduced likelihood of outbreaks of cryptosporidiosis. |
| Long Term 2 Enhanced Surface Water Treatment Rule (2006) | Improves public health protection through the control of microbial contaminants by focusing on water systems with elevated *Cryptosporidium* risk.<br>Prevents significant increases in microbial risk that might otherwise occur when systems implement the Stage 2 Disinfectants and Disinfection Byproducts Rule. | • Substantial reduction in drinking-water-related exposure to *Cryptosporidium*, resulting in reductions of both illness and death associated with cryptosporidiosis.<br>• Avoidance of between 230,730 and 964,360 illnesses and between 52 and 207 deaths annually. |
| Filter Backwash Recycling Rule (2001) | Improves public health protection by assessing and changing, where needed, recycle practices for improved control of contaminants, particularly microbial contaminants. | • Reduction in risk of illness from microbial pathogens in drinking water, particularly *Cryptosporidium*. |

| Current Drinking Water Regulations: Purpose and Public Health Benefits | | |
|---|---|---|
| **Drinking Water Regulation (Year Promulgated)** | **Purpose** | **Public Health Benefits** |
| Stage 1 Disinfectants and Disinfection Byproducts Rule (1998) | Improves public health protection by reducing exposure to disinfectants and disinfection byproducts (DBPs). Some disinfectants and DBPs have been shown to cause cancer and reproductive effects in lab animals and suggested bladder cancer and reproductive effects in humans. | • As many as 140 million people receiving increased protection from DBPs.<br>• 24 percent national average reduction in Total Trihalomethanes (TTHM) levels.<br>• Reduction in exposure to the major DBPs from use of ozone (including bromate), and from chlorine dioxide (including chlorite). |
| Stage 2 Disinfectants and Disinfection Byproducts Rule (2006) | Increases public health protection by reducing the potential risk of adverse health effects associated with DBPs throughout the distribution system. Builds on the Stage 1 Disinfectants and Disinfection Byproducts Rule by focusing on monitoring for and reducing concentrations of two classes of DBPs—TTHM and haloacetic acids (HAA5)—in drinking water. | • Avoidance of between 103 and 541 bladder cancer cases per year.<br>• Potential reduction in adverse reproductive and developmental effects as well as other cancers potentially associated with DBP exposure. |
| Radionuclides Rule (1976, 2000) | Reduces exposure to radionuclides in drinking water to reduce the risk of cancer.<br>Improves public health protection by reducing exposure to all radionuclides. | • Reduction of uranium exposure for 620,000 persons.<br>• Protection from toxic kidney effects of uranium.<br>• Reduced risk of cancer. |
| Phase I/II/V Rules (1987, 1991/1992, 1995 and 1996) | Enhances public health protection by setting limits on 68 contaminants, prescribing the schedule under which water systems must test for the presence of the contaminants and describing the treatments which systems may use to remove a detected contaminant. | • Reduction of chronic risks from cancer; organ damage; and circulatory, nervous and reproductive system disorders.<br>• Reduction in the occurrence of methemoglobinemia or "blue baby syndrome" from ingestion of elevated levels of nitrate or nitrite. |
| Arsenic Rule (2001) | Improves public health by reducing exposure to arsenic in drinking water. | • Avoidance of 16 to 26 non-fatal bladder and lung cancers per year.<br>• Avoidance of 21 to 30 fatal bladder and lung cancers per year.<br>• Reduction in the frequency of non-carcinogenic diseases. |

| Current Drinking Water Regulations: Purpose and Public Health Benefits | | |
|---|---|---|
| **Drinking Water Regulation (Year Promulgated)** | **Purpose** | **Public Health Benefits** |
| Lead and Copper Rule (1991, revised 2000, 2003, 2004 and 2007) | Protects public health by minimizing lead and copper levels in drinking water, primarily by reducing water corrosivity. Lead and copper enter drinking water mainly from corrosion of lead- and copper-containing plumbing materials. | • Reduction in risk of exposure to lead, which can cause damage to brain, red blood cells and kidneys, especially in young children and pregnant women.<br>• Reduction in risk of exposure to copper, which can cause stomach and intestinal distress, liver or kidney damage and complications of Wilson's disease in genetically predisposed people. |
| Consumer Confidence Report Rule (1998) | Improves public health protection by providing educational material to allow consumers to make educated decisions regarding any potential health risks pertaining to the quality, treatment and management of their drinking water supply. | • Increased consumer knowledge of: drinking water sources, quality, susceptibility to contamination, treatment and drinking water supply management.<br>• Increased consumer awareness of potential health risks so they may make informed decisions to reduce those risks, including taking steps toward protecting their water supply.<br>• Increased dialogue between drinking water utilities and consumers to increase understanding of the value of drinking water and water supply services and to facilitate consumer participation in decisions that affect public health. |
| Public Notification Rule (1989, revised 2000) | Requires public water systems to notify the public of drinking water violations or other situations that may pose a risk to health. | • Language of various notices is calibrated to specific violations to alert the public about the seriousness of risks.<br>• In rule revisions, public notices were modified to be easier for consumers to read. |

EPA currently regulates 93 constituents in drinking water. These include chemical and microbial contaminants, as well as other parameters, such as turbidity, that are not considered contaminants but for which EPA has established performance standards in regulations. The 1996 Safe Drinking Water Act (SDWA) Amendments lay out a risk management process that EPA must follow to identify and list unregulated contaminants that may be future candidates for regulation in drinking water. EPA must periodically publish this list of contaminants (called the Contaminant Candidate List or CCL) and make decisions about whether or not to regulate at least five contaminants from the list (called Regulatory Determinations). Contaminants that have been included on the CCL include microbes, pesticides, industrial chemicals, inorganic compounds and natural and synthetic hormones, among others. Data on occurrence of unregulated contaminants in public water supplies gathered via the Unregulated

Contaminant Monitoring Regulation (UCMR) program help inform these decisions. States play an integral role in providing these data to EPA.

EPA makes regulatory determinations based on the best available scientific information about contaminant properties, health effects and occurrence, and takes into account public comments before finalizing the determinations. Preliminary and final regulatory determinations are published in the *Federal Register*. A positive regulatory determination initiates a rulemaking process to develop a national primary drinking water regulation for the contaminant. If EPA declines to establish a new national regulation for a contaminant, it may still issue a health advisory to assist states and public water systems in establishing guidelines and procedures to address possible contamination issues that are local in nature.

The SDWA also requires EPA to review each regulation at least once every six years and revise it, if appropriate. The purpose of the review, called the Six-Year Review, is to identify opportunities to strengthen the public health protection provided by regulations in light of recent health effects assessments, changes in technology and/or other factors. States also provide data and information to EPA for this review effort.

Figure A-1 depicts the interconnections between the CCL, UCMR, Regulatory Determination and Six-Year Review processes. The figure denotes where in the process public review and comment are included.

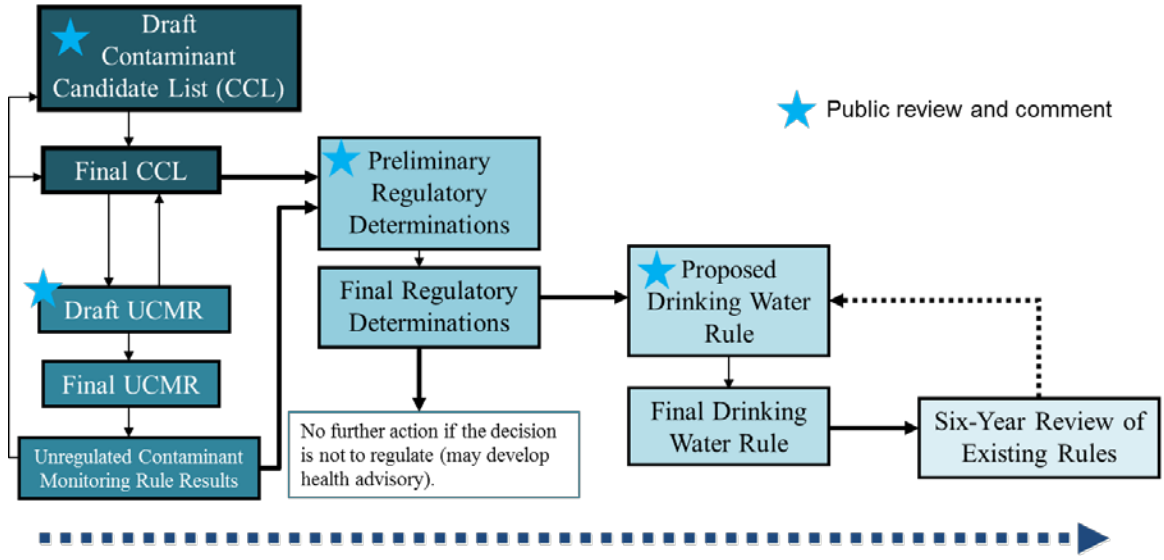



**FIGURE A-1. SDWA RISK MANAGEMENT APPROACH**

# APPENDIX B: CONSTITUENTS OF CONCERN GOVERNED BY THE SAFE DRINKING WATER ACT

The 1974 Safe Drinking Water Act (SDWA) was established to protect the quality of drinking water in the United States. The SDWA authorizes the United States Environmental Protection Agency (EPA) to set national health-based standards for drinking water to protect against both naturally-occurring and man-made contaminants that may be found in drinking water. EPA, states and water systems work together to ensure that these standards are met.

The states' role in ensuring public health protection from contaminants in drinking water has grown as additional potential health effects from new source of contamination have been identified. Prior to the SDWA, all states had adopted the federal standards published by the U.S. Public Health Service (PHS) for 28 substances that could endanger public health. Today, states oversee monitoring for 93 constituents of concern in drinking water. This list includes contaminants such as chemicals and microorganisms, as well as other parameters (such as turbidity) that are not considered contaminants, per se, but for which EPA has established performance standards in regulations. The expanding list of constituents of concern reflects the growing realization of the linkage between water quality concerns and public health and environmental impacts.

A major challenge for drinking water systems and state drinking water programs is how to balance the risk of contamination from multiple threats. For instance, the threat of pathogens is most commonly addressed by disinfection, such as the addition of chlorine. However, disinfection can lead to the formation of disinfection byproducts (DBPs), which also pose health risks. Management of these simultaneous compliance concerns requires routine monitoring to confirm that changing conditions, such as pH or temperature, have not affected water quality. State drinking water programs provide oversight to water systems as they carefully balance risk trade-offs and confirm that their treatment processes do not create adverse impacts.

Contaminants that may pose health risks in drinking water fall into several main categories, including pathogens and microorganisms, disinfectants, DBPs, inorganic chemicals, organic chemicals and radionuclides. Each of these categories is discussed briefly below. EPA's website (http://water.epa.gov/drink/contaminants/index.cfm) provides a comprehensive list of regulated contaminants in each category, along with regulatory standards, potential health effects from long-term exposure and sources of contaminants in drinking water.

## Pathogens/Microorganisms

Inadequately treated water may contain disease-causing organisms (i.e., pathogens). Pathogens include various types of bacteria, viruses, protozoan parasites and other organisms, including *Cryptosporidium*, *Giardia lamblia* and *E. coli*. These types of pathogens can cause gastrointestinal illness (e.g., diarrhea, vomiting, cramps). They may enter the water supply when soil run-off transfers human and animal fecal waste to ground or surface water. To control the potential risk of contamination, water systems, with state oversight, treat or filter water, undertake watershed or source water protection initiatives and closely monitor water quality and filtration effectiveness.

## Disinfectants

To protect drinking water consumers from pathogens, drinking water systems often add a disinfectant, such as chlorine, to drinking water. Because certain pathogens, such as *Cryptosporidium*, are highly resistant to traditional disinfection practices, high disinfectant doses are sometimes necessary. However, high levels of disinfectants in tap water could have an adverse impact on public health. Therefore, EPA has issued regulations to ensure that the disinfection residual that reaches the public is not excessive. Currently three disinfectant types are regulated, including chlorine, chloramines and chlorine dioxide. Chlorine and chloramines are often added to drinking water to control microorganisms. Chlorine dioxide also effectively controls microorganisms, as well as viruses, iron, manganese and sulfide levels.

## Disinfection Byproducts

Disinfectants are a needed component of drinking water system treatment; however, they can react with naturally-occurring materials in the water to form byproducts, such as trihalomethanes and haloacetic acids, which may pose health risks. Currently four categories of disinfectant byproducts are regulated. Consuming water with excessive amounts of these DBPs can lead to an increased risk of cancer, anemia or liver, kidney or central nervous system problems.

## Inorganic Chemicals (IOCs)

Sixteen inorganic chemicals are currently regulated, including contaminants such as arsenic, lead and cyanide. Effects of consuming inorganic chemicals in excessive amounts are wide-ranging, and include decreases in blood sugar, skin damage and problems with circulatory systems, increased risk of contracting cancer, increased blood pressure and kidney damage. Infants below the age of six months who drink water containing nitrate or nitrite that is in excess of the EPA standard could become seriously ill and, if untreated, may die. Some inorganic chemicals are naturally occurring and enter the water supply through erosion. Other inorganic chemicals enter the water supply as a result of discharges from industrial or commercial operations or corrosion of household plumbing systems.

## Organic Chemicals

### Volatile Organic Chemicals (VOCs)

Since volatile chemicals can dissipate or vaporize readily in the open air, these contaminants are more often found in ground water sources than in surface water sources. Among the most common VOCs are solvents (e.g., benzene, trichloroethane [TCE] and vinyl chloride) used in paint, cleaning agents, fuels, inks, cosmetics and pharmaceuticals. These chemicals are generally man-made and do not occur naturally in water. Currently there are 21 regulated VOCs. These chemicals often enter the water supplies due to accidental spills and leaks, industrial discharges and runoff. Improper storage and disposal of household wastes, particularly used motor oil and cleaning fluids, can also be a source of contamination. Effects of consuming drinking water with high levels of VOCs for an extended period of time may include liver and kidney damage, damage to the nervous system, damage to the circulatory system and an increased risk of cancer.

### Synthetic Organic Contaminants (SOCs)

SOCs are organic (carbon-based) chemicals that are less volatile than VOCs. They are man-made and do not naturally occur in the environment. Some SOCs, such as atrazine, dioxin and polychlorinated biphenyls (PCBs), are used as pesticides, defoliants or fuel additives. Currently, there are 30 regulated SOCs. These chemicals most often enter the water supplies through pesticide runoff, improper or illegal waste disposal, accidental releases or as a byproduct of incineration. Consumption of drinking

water with high levels of SOCs can have substantial health impacts. Acute (short-term) and chronic (long-term) exposure can lead to cardiovascular system or reproductive problems, anemia, liver or kidney problems, circulatory system or nervous system problems and an increased risk of cancer.

## Radionuclides

A radionuclide is an atom with an unstable nucleus that emits energy in the form of rays or high speed particles as it converts to a more stable state. The rays and high-speed particles can damage living cells by displacing electrons in important molecules like DNA, disrupting their function. Currently, radionuclide regulations cover alpha particles, beta particle and photon emitters, radium 226 and radium 228 (combined) and uranium. Radionuclides have properties that can be valuable in a number of applications. Some radioactive elements have uses in nuclear medicine for diagnosis, treatment or research; others are used in smoke detectors or can be used to kill pathogens and insects in food. However, consumers that drink water containing radionuclides in excessive amounts over many years may have an increased risk of contracting cancer. Exposure to uranium in drinking water may also result in kidney problems. Radionuclides can enter the water supply due to the erosion of natural deposits of certain radioactive minerals or from anthropogenic sources.

# APPENDIX C: DRINKING WATER STATE REVOLVING FUND SET-ASIDES

## Small System Technical Assistance (2 Percent Set-Aside)

Smaller water systems typically face greater challenges than larger systems. This set-aside allows state to use up to 2 percent of the capitalization grant to provide technical assistance and training to help small systems build the capacity they need provide to safe drinking water. States provide technical assistance to small waters systems (more precisely, year-round public water systems serving 10,000 or fewer persons), including assistance in planning new infrastructure projects, payments to third-party technical assistance providers and specialized small system training. In 2011, states spent approximately $18 million, which is approximately equal to 2 percent of the 2011 Drinking Water State Revolving Fund (DWSRF).

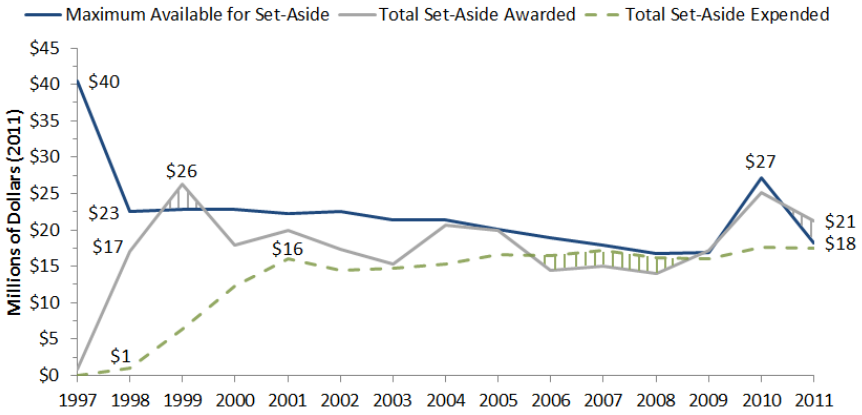



FIGURE C-1. 2 PERCENT DWSRF SET-ASIDE

## Administrative and Technical Assistance (4 Percent Set-Aside)

The administrative and technical assistance set-aside allows states to use up to 4 percent of the capitalization grant for costs associated with administering state DWSRF programs and providing technical assistance to systems of all sizes. Many states reserve this set-aside to cover a portion of the loan program administration costs. Others use the set-aside funds to: offer direct technical assistance to water systems in completing DWSRF loan applications; support various efforts to develop technical, managerial and financial capacities for water systems; and develop public information materials and reporting documentation. In 2011, states spent more than the 4 percent of the DWSRF on these activities and used carry-over funds from previous years to help fund the programs. States spent approximately $40 million.

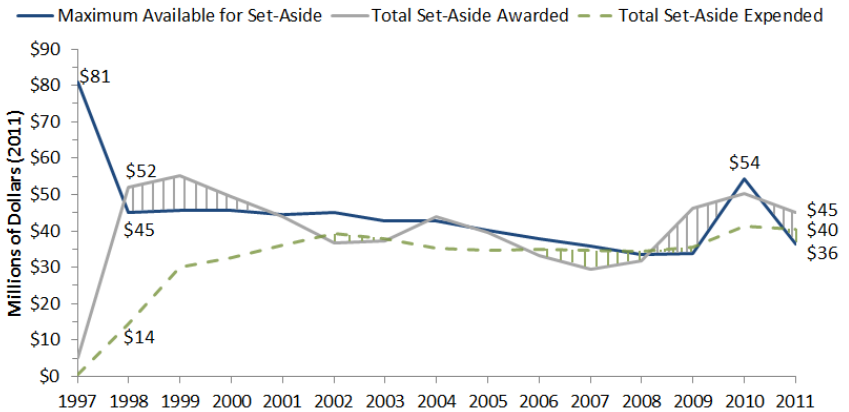



FIGURE C-2. 4 PERCENT DWSRF SET-ASIDE

## State Program Management (10 Percent Set-Aside)

The state program management set-aside allows states to use up to 10 percent of their annual allotment to develop and implement water system capacity development and operator certification programs, administer source water protection programs (which may include technical assistance to prevent contamination of sources) or fund a portion of the state drinking water program. In addition to the 20 percent match towards the capitalization grant (discussed in Chapter 3), states that opt to take the 10 percent set-aside must contribute a dollar-for-dollar match. While this set-aside is potentially the most useful for managing state drinking water programs, as discussed in Chapter 3, the additional matching requirement can place a significant burden on states. Records from the past 13 years shows that states do not fully utilize this funding source. In 2011, states used approximately 81 percent of the $91 million available from the 10 percent set-aside.

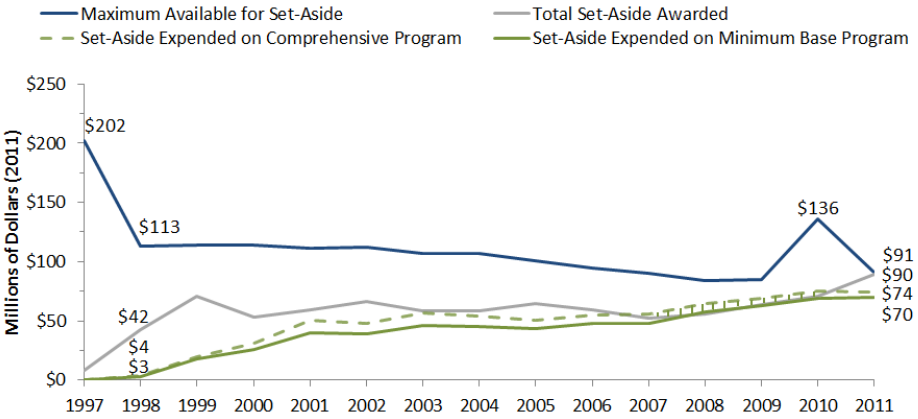



FIGURE C-3. 10 PERCENT DWSRF SET-ASIDE

## Local Assistance and Other State Programs (15 Percent Set-Aside)

The local assistance and other state programs set-aside allows states to use up to 15 percent of their annual capitalization grant to assist in the development and implementation of local drinking water initiatives and other state programs. A maximum of 10 percent of funds set aside can be spent on any single effort. Examples of funded efforts may include: providing loans to acquire land or conservation easements to protect source waters; providing loans for the implementation of voluntary, incentive-based source water quality protection measures; providing direct technical or financial assistance as part of a strategy to improve technical, managerial and financial capacity at water systems; and assisting water systems with wellhead protection. Because of the barriers discussed in Chapter 3, states have struggled to utilize this set-aside. In 2011, the numbers improved but not dramatically, with states spending approximately 39 percent of the $136 million available from this set-aside.

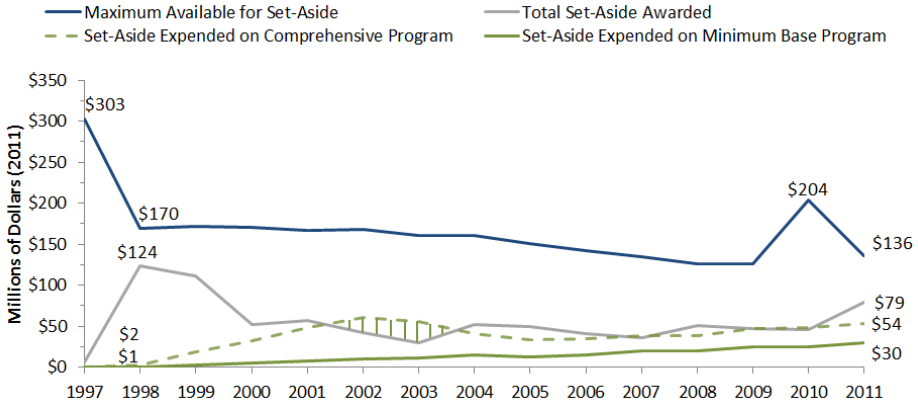



FIGURE C-4. 15 PERCENT DWSRF SET-ASIDE

# GLOSSARY OF TERMS

**Algal blooms** occur when algae grows very fast because too many nutrients enter the water.[33]

**Association of State Drinking Water Administrators (ASDWA)** is the professional trade association for state drinking water administrators.[34]

**Backflow prevention** blocks the flow of water (or other substances) into the distributing pipes of a public water supply from any source (or sources) other than the intended source.[35]

**Capacity development** is a strategy to assist public water systems in acquiring and maintaining technical, managerial and financial capacity.[36]

**Comprehensive Program** encompasses not only the minimum base program activities of a state drinking water program that are required under SDWA but also additional activities that are consistent with the goals and vision of the SDWA. The comprehensive program includes state-specific public drinking water actions to protect public health, such as a state drinking water standard with no federal counterpart, but excludes oversight of private wells or bottled water.

**Consumer Confidence Report** is supplied to consumers of year-round public water supplies, and summarizes information regarding sources used (i.e., rivers, lakes, reservoirs or aquifers), contaminant monitoring and regulatory compliance, plus educational information.[37]

**Cross-connection control** is a device or program designed to prevent the mixing of potable and non-potable waters.[38]

**Distribution system** is a network of pipes leading from a water treatment plant to drinking water customers.

**Drinking Water State Revolving Fund (DWSRF)** awards federal capitalization grant money to states to set up an infrastructure funding account from which assistance is made available to public water systems.[39]

**Fee systems** are designed to produce revenue from regulated public water systems or their customers that will help support a state drinking water program.

**Full-time equivalent (FTE)** is a unit of measurement that indicates the workload of an employed person in a way that makes workloads comparable across various contexts. Typically, the work year is measured as 52 weeks with 40 hours of paid work per week, or 2,080 hours per year. Deductions are made from this number to account for paid leave, such as vacation, holidays, sick leave and personal days to determine the number of hours that a person employed by the organization will be available to work. The resulting number of hours, whether worked by one individual or several, is considered one FTE.

**Laboratory certification** is required by EPA for laboratories that analyze drinking water samples. Certifying authorities (e.g., EPA regional laboratory certification officers) ensure that all laboratories analyzing drinking water samples are following approved methods as required under EPA's drinking water regulations.[40]

**Maximum contaminant level (MCL)** is the highest level of a contaminant that is allowed in drinking water.[41]

**Minimum Base Program** comprises those activities of a state drinking water program that stem directly from SDWA mandates, or 40 CFR 142 (primacy) requirements for state primacy or activities inferred as Congressional intent based on SDWA language.

**Operator certification** establishes minimum professional standards for the operation and maintenance of public water systems. Operator certification guidelines developed by EPA, specifying minimum standards for certification and recertification of the operators of water systems, are implemented through state certification programs.[42]

**Primacy agency** is the agency with the authority to implement the SDWA's Public Water System Supervision (PWSS) Program. The primacy agency for most water systems is the state drinking water agency. The primacy agency for water systems located in the Navajo Nation is the tribal office; five U.S. territories, including Puerto Rico, the U.S. Virgin Islands, American Samoa, Guam and the Commonwealth of Northern Mariana Islands have non-federal primacy over water systems in their jurisdiction, and the primacy agency for water systems located on other tribal lands, in Wyoming and in the District of Columbia is the applicable EPA regional office.

**Public notification (PN)** – see "Right-to-know."

**Public Water System** (sometimes simply called "water system") is a system for the provision of water to the public for human consumption through pipes or other constructed conveyances with at least 15 service connections or regularly serving at least 25 individuals. Public water systems are regulated by the Safe Drinking Water Act.

**Public Water System Supervision (PWSS) Program** is maintained by states that have primary enforcement authority (primacy) over the state's public water systems' compliance with the Safe Drinking Water Act and its amendments. States that do not have primacy are regulated by EPA directly. A PWSS Grant Program is in place to allow EPA to assist states, territories and tribes in carrying out their PWSS programs.

**Right-to-know** (or public notification) is a program under which EPA or the state requires a water system to distribute advisories to affected consumers when the system has violated maximum contaminant levels or other regulations. The notice advises consumers what precautions, if any, they should take to protect their health.

**Safe Drinking Water Act (SDWA)** is the main federal law that ensures the quality of Americans' drinking water. Under the SDWA, EPA sets standards for drinking water quality and oversees the states, localities and water suppliers who implement those standards. The SDWA was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply. The law was amended in 1986 and 1996 and provides the authority under which numerous regulations have been promulgated to protect drinking water and its sources.[43]

**Safe Drinking Water Information System (SDWIS)** is a database that stores information about public water systems. The state version (SDWIS/STATE) is maintained by states and is designed to help states run their drinking water programs. The federal version (SDWIS/FED) stores information provided by the states to EPA, to help EPA provide oversight and develop policy for approximately 153,000 public water systems.[44, 45]

**Simultaneous compliance** is comprehensive compliance with all existing Safe Drinking Water Act regulations.[46]

**Six-year regulatory review** requires EPA, under the Safe Drinking Water Act, to review each drinking water regulation at least once every six years and revise them, if appropriate.[47]

**Source water assessment** is conducted by states to provide basic information about the sources of drinking water at each public water system. Assessments vary based on the state's water resources and drinking water priorities. States, communities and public water systems can use information gathered through the assessment process to broaden their source water protection programs.[48]

**Technical assistance** provides public water systems with technical, financial and/or managerial support on aspects of their system operations. Technical assistance is provided by state drinking water staff or third-party providers.

**Water system capacity** – see "Capacity development."

# REFERENCES


*Chapter 1:*

[1] In this report the term "state" refers to any non-federal agency with primary enforcement responsibility (e.g., primacy) for the drinking water program. All states (except Wyoming), the Navajo Nation and five U.S. territories (Puerto Rico, U.S. Virgin Islands, American Samoa, Guam and the Commonwealth of Northern Mariana Islands) are non-federal primacy agencies.

[2] Safe Drinking Water Act (SDWA) Section 1412

[3] Safe Drinking Water Information System (SDWIS). Violation Codes for Fiscal Year 2011. Calculation includes 49 primacy states and non-excluded water systems.

[4] USEPA. 2013. Aging Water Infrastructure. http://www.epa.gov/sciencematters/april2010/scinews_aging-water-infastructure.htm.Accessed December 10, 2013.

*Chapter 2:*

[5] SDWA Section 1412

[6] SDWA Section 1413

[7] SDWA Section 1412

[8] SDWA Section 1412

[9] SDWA Section 1445

[10] SDWA Section 1412

[11] SDWA Section 1419

[12] SDWA Section 1420

[13] SDWA Sections 1452 and 1453

[14] SDWA Section 1429

[15] SDWA Section 1452

[16] SDWA Section 1414(c)

[17] SDWA Section 1413

[18] SDWA Section 1453

[19] USEPA. 2009. An Urgent Call to Action: Report of the State-EPA Nutrient Innovations Task Group. http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/upload/2009_08_27_criteria_nutrient_nitgreport.pdf. Accessed December 10, 2013.

[20] SDWA Section 1433

*Chapter 3:*

[21] SDWA Section 1453

[22] AWWA. 2010. State of the Industry Report 2010: How water professionals are meeting ongoing challenges and economic uncertainty. http://www.awwa.org/publications/journal-awwa/abstract/articleid/25666.aspx. Accessed December 10, 2013.

[23] This represents the cost per FTE adjusted to 2011 dollars. Price indexes used for inflation come from the Bureau of Economic Analysis. U.S. Bureau of Economic Analysis (BEA). Line 21 (State and local) in "Table 3.9.4. Price Indexes for Government Consumption Expenditures and Gross Investment." In National Income and Product Accounts Tables. http://www.bea.gov/iTable/iTable.cfm?reqid=9&step=3&isuri=1&910=X&911=0&903=97&904=1999&905=2012&906=A. Accessed December 10, 2013.

[24] Water Research Foundation. 2005. Succession Planning for a Vital Workforce in the Information Age.

[25] American Water Works Association (AWWA). 2006. Knowledge Retention: A Guide for Utilities." http://www.awwa.org/publications/journal-awwa/abstract/articleid/15517.aspx. Accessed December 10, 2013.

[26] AWWA. 2006. Workforce Development and Knowledge: Management in Water Utilities. http://www.awwa.org/publications/journal-awwa/abstract/articleid/15519.aspx. Accessed December 10, 2013.

[27] SDWA Section 1443

[28] Price indexes used for inflation come from the Bureau of Economic Analysis. U.S. Bureau of Economic Analysis (BEA). Line 21 (State and local) in "Table 3.9.4. Price Indexes for Government Consumption Expenditures and Gross Investment." In National Income and Product Accounts Tables. http://www.bea.gov/iTable/iTable.cfm?reqid=9&step=3&isuri=1&910=X&911=0&903=97&904=1999&905=2012&906=A. Accessed December 10, 2013.

[29] SDWA Section 1452

[30] USEPA. 2009. Drinking Water Infrastructure Needs Survey and Assessment: Fourth Report to Congress. http://water.epa.gov/infrastructure/drinkingwater/dwns/upload/2009_03_26_needssurvey_2007_report_needssurvey_2007.pdf. Accessed January 24, 2013.

[31] American Society of Civil Engineers. 2009. http://www.infrastructurereportcard.org/fact-sheet/drinking-water.Accessed December 10, 2013.

[32] AWWA. 2011. Buried No Longer: Confronting America's Water Infrastructure Challenge. http://www.awwa.org/portals/0/files/legreg/documents/buriednolonger.pdf. Accessed December 10, 2013.

### *Glossary:*

[33] USEPA. 2012. Glossary. http://water.epa.gov/learn/kids/estuaries/glossary_index.cfm. Accessed December 10, 2013.

[34] USEPA. Association of State Drinking Water Administrators http://www.asdwa.org/ Accessed June 19, 2012.

[35] USEPA. "Cross Connection Control: A Best Practices Guide." EPA 816-F-06-035. September 2006.

[36] The Safe Drinking Water Act Section 1420(c)

[37] USEPA. "Consumer Confidence Report." http://water.epa.gov/lawsregs/rulesregs/sdwa/ccr/index.cfm. Accessed on June 19, 2012.

[38] USEPA. "Cross Connection Control: A Best Practices Guide." EPA 816-F-06-035. September 2006.

[39] USEPA. 2000. "The Drinking Water State Revolving Fund: Protecting the Public through Drinking Water Infrastructure Improvements." EPA 816-F-00-028

[40] USEPA. Laboratory Certification Program. http://water.epa.gov/scitech/drinkingwater/labcert/. Accessed June 19, 2012.

[41] 40 CFR 141.153(c)(ii)

[42] USEPA. "Operator Certification." http://water.epa.gov/infrastructure/drinkingwater/pws/dwoperatorcert/index.cfm. Accessed June 19, 2012.

[43] USEPA. "Safe Drinking Water Act." http://water.epa.gov/lawsregs/rulesregs/sdwa.Accessed June 19, 2012.

[44] USEPA "Safe Drinking Water Information System." http://water.epa.gov/scitech/datait/databases/drink/sdwisfed/index.cfm. Accessed June 19, 2012.

[45] USEPA "Safe Drinking Water Information System." http://www.epa.gov/enviro/facts/sdwis/search.html. Accessed June 19, 2012.

[46] USEPA. 2007. Simultaneous Compliance Guidance Manual for the Long Term 2 and Stage 2 DBP Rules. EPA 815-R-07-017.

[47] USEPA. "Six-Year Review of Drinking Water Standards." http://water.epa.gov/lawsregs/rulesregs/regulatingcontaminants/sixyearreview/index.cfm. Accessed June 19, 2012.

[48] USEPA "Source Water Assessments." http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/sourcewaterassessments.cfm. Accessed June 19, 2012.

### *Cover Page Image Credits:*

USEPA. 2012. Infrastructure Task Force to Improve Access to Safe Drinking Water and Basic Sanitation in Indian country. http://www.epa.gov/tp/trprograms/infra-water-photos.htm. Accessed August 22, 2012.

Wikipedia Commons. 2006. Bubbler.jpg. http://commons.wikimedia.org/wiki/File:Bubbler.jpg. Accessed August 22, 2012.

Colorado Department of Public Health and Environment. ACE June 2010: "Lessons Learned from a Drinking Water Outbreak of Salmonellosis at Alamosa, Colorado."

FEMA. Louisiana Hurricane Katrina. Photography by Marvin Nauman. http://www.fema.gov/photolibrary/photo_details.do?id=20331. Accessed December 10, 2013.

Centers for Disease Control (CDC). 2010. A CDC microbiologist using immunological tests to diagnose parasitic infections. (CDC Photo). http://www.cdc.gov/parasites/lab_science.html. Accessed August 22, 2012.

USEPA. 2011. Aging Water Infrastructure. http://www.epa.gov/sciencematters/april2010/scinews_aging-water-infastructure.htm. Accessed December 10, 2013.

USEPA. 2012. Your Comments Sought on Drinking Water Quality Report. http://blog.epa.gov/healthywaters/2012/02/your-comments-sought-on-drinking-water-quality-report/. Accessed August 22, 2012.

USEPA. 2012. What Lurks Beneath. http://blog.epa.gov/healthywaters/2012/03/what-lurks-beneath/. Accessed August 22, 2012.

Wikipedia Commons. 2009. Diverse e Coli.png. http://commons.wikimedia.org/wiki/File:Diverse_e_Coli.png. Accessed August 22, 2012.

### *Back Page Image Credits:*

CDC. 2009. Cryptosporidiosis. http://www.dpd.cdc.gov/dpdx/html/imagelibrary/a-f/cryptosporidiosis/body_Cryptosporidiosis_il3.htm. Accessed August 22, 2012.

South Dakota Department of Environment & Natural Resources. 2012. Wellhead Protection Program. http://denr.sd.gov/des/gw/Wellhead/Wellhead_Protection.aspx. Accessed August 22. 2012.

Photo courtesy of Elisabeth Cianciola. Not for reuse without written permission of the photographer.

USEPA. 2012. Grants and Funding for Water Research. http://www.epa.gov/research/waterscience/water-grants-funding.htm. Accessed August 22, 2012.

Federal Emergency Management Agency (FEMA). Connecticut Electric Receives Assistance From Electric Crews From Around the Country. Photograph by Jocelyn Augustino. http://www.fema.gov/ar/media-library/assets/images/61353. Accessed December 10, 2013.

National Association of Water Companies. September 1, 2011. "NAWC commends water utility professionals, encourages infrastructure investment in the aftermath of Hurricane Irene." http://blog.nawc.org/?p=979. Accessed December 10, 2013.

Photo courtesy of Suzanne Ruminer. Not for reuse without written permission of the photographer.

USEPA. 2012. Federal Nutrient Water Quality Standards for the State of Florida's Estuarine, Coastal, and Southern Inland Flowing Waters (Coastal Rule). http://water.epa.gov/lawsregs/rulesregs/florida_coastal.cfm. Accessed August 22, 2012.

University of Washington, College of the Environment. 2012. Protection and Restoration of Marine Resources. http://jisao.washington.edu/research/protection. Accessed August 22, 2012.

USEPA. 2011. The New England Wadeable Streams Project (NEWS). http://www.epa.gov/region1/lab/news.html. Accessed August 22, 2012.

*Chapter 1 Image Credits:*

**Chapter Cover Image:**
USEPA. 2011. American Recovery and Reinvestment Act (ARRA) Site Inspection. Wheeler-Frankstown Water Association, Wheeler & Frankstown, Mississippi.

**Alamosa, Colorado: Water System and State Response to *Salmonella* Outbreak Images:**
Colorado Department of Public Health and Environment. ACE June 2010: "Lessons Learned from a Drinking Water Outbreak of Salmonellosis at Alamosa, Colorado."

*Chapter 2 Image Credits:*

**Chapter Cover Image:**
National Association of Water Companies. September 1, 2011. "NAWC commends water utility professionals, encourages infrastructure investment in the aftermath of Hurricane Irene." http://blog.nawc.org/?p=979. Accessed December 10, 2013.

**Connecticut: Assessing Emergency Preparedness Images:**
State of Connecticut. Disaster Preparedness and Recovery. http://www.ct.gov/cid/cwp/view.asp?Q=461660. Accessed December 10, 2013.

National Aeronautics and Space Administration (NASA). Hurricane Season 2011: Hurricane Irene (Atlantic Ocean). http://www.nasa.gov/mission_pages/hurricanes/archives/2011/h2011_Irene.html. Accessed December 10, 2013.

Federal Emergency Management Agency (FEMA). Connecticut Electric Receives Assistance From Electric Crews From Around the Country. Photograph by Jocelyn Augustino. http://www.fema.gov/ar/media-library/assets/images/61353. Accessed December 10, 2013.

*Chapter 3 Image Credits:*

**Chapter Cover Image:**
Black Canyon of the Gunnison National Park, Colorado. National Parks Service., U.S. Department of the Interior. http://nature.nps.gov/water/Homepage/images/BLCA.jpg. Accessed December 10, 2013.

**Figure 3-11: Rupture of a 66-inch Water Main:**
USEPA. 2013. Aging Water Infrastructure. http://www.epa.gov/sciencematters/april2010/scinews_aging-water-infastructure.htm. Accessed December 10, 2013.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