National Regulatory Research Institute

The Water Industry at a Glance

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The Water Industry at a Glance

I. Introduction

This document provides a brief summary and description of the drinking water industry in the United States. **Part II** is an overview of the structure of the industry, including numbers, sizes and ownership status of water systems. **Part III** describes physical, technical, and chemical aspects of drinking water systems, including sources of drinking water, physical infrastructure and its security, water quality and water treatment processes. **Part IV** looks at the regulatory roles of the federal government, state environmental and resources agencies, and state regulatory commissions. **Part V** discusses five key issues facing the water industry and regulatory commissions that have jurisdiction over water systems.

II. Industry Structure Overview

There are 156,000 "public" drinking water systems in the United States, serving over 306 million people.[1] The U.S. Environmental Protection Agency (EPA) defines "public water system" as "a system for the provision to the public of water for human consumption through pipes or other constructed conveyances, if such system has at least fifteen service connections[2] or regularly serves at least twenty-five individuals." Public systems provide drinking water to about 90% of the U.S. population. The remaining 10% are primarily served by individual private wells.

A. Ownership

About 70% of public water systems are privately owned.[3] About 20% are owned by local governments (e.g., cities, counties, towns or villages). The remaining 10% are owned by

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[1] All data in Part II come from the U.S. Environmental Protection Agency, Safe Drinking Water Information System (SDWIS), fiscal year 2007 data, http://www.epa.gov/safewater/sdwisfed/sdwis.htm

The phrase "public water system" refers to the concept that water produced by the system is *provided* to the public; the phrase does not refer to the ownership status of the system. "Public" water systems may be owned by a public entity, such as a municipality, or may be owned by a private entity, such as a water company. We discuss ownership in Part II.A.

[2] A "service connection" refers to the pipes, valves, and connectors necessary to connect a customer to a water distribution system to obtain water service.

[3] Private ownership of a public water system refers to ownership by a private entity. That entity may be publically or privately held and may be for-profit or not-for-profit. It may be a private corporation whose principal business is producing and providing drinking water (e.g., a water company), or it may be an entity whose principal business is something else for which providing water meets an integral need (e.g., a mobile home park).

other entities (e.g., state or federal governments, Native American tribes, water districts or cooperatives, or homeowner associations).

Even though most water systems are privately owned, more people are served by water systems owned by local governments. Local governments provide drinking water to about 77% of the population served by public systems. Public water systems under private ownership serve about 18% of the population. Systems owned by other entities serve about 5% of the population.

B. Size

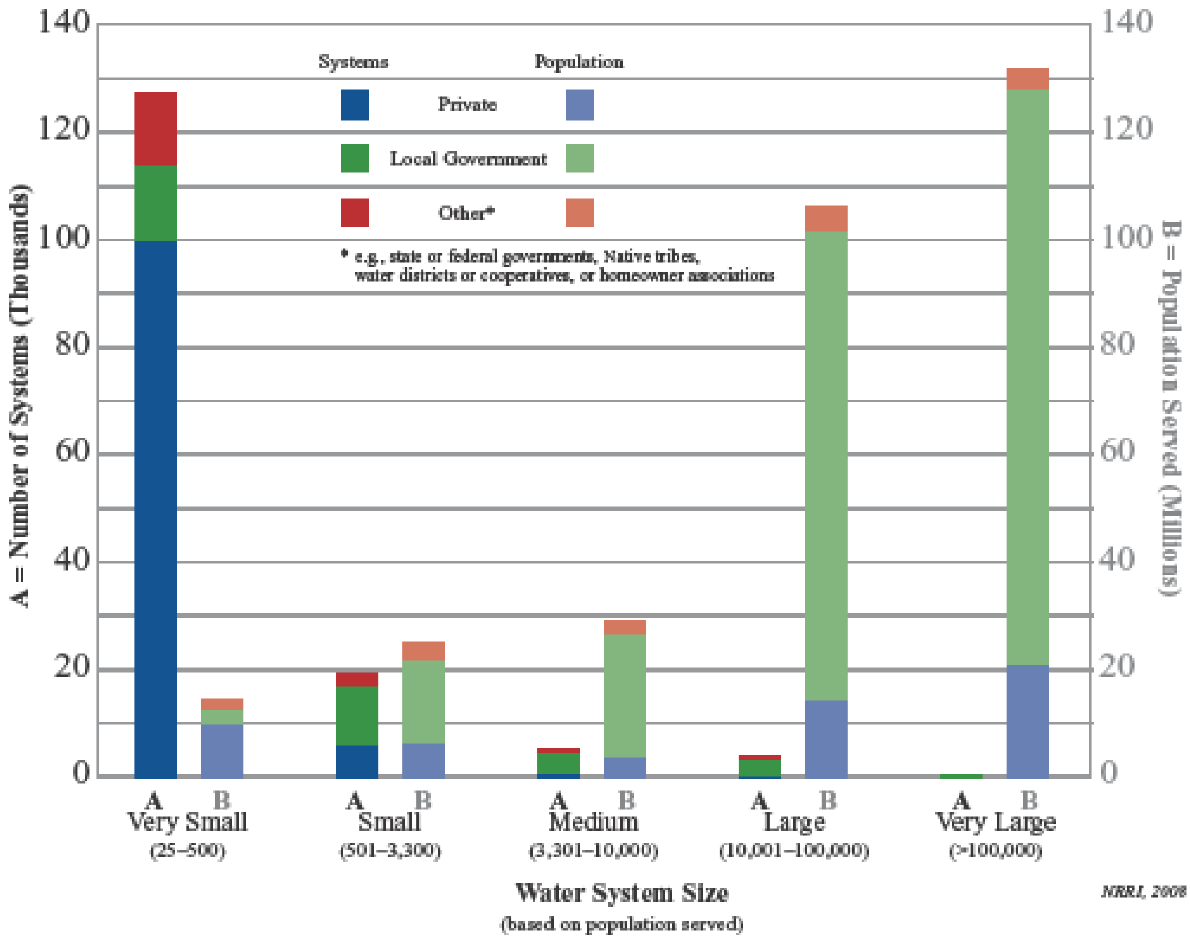
EPA classifies public water systems according to the number of people they serve. Classified as *very small* are systems that serve between 25 and 500 people; *small,* between 501 and 3,300 people; *medium*, between 3,301 and 10,000 people; *large*, between 10,001 and 100,000 people; and *very large*, 100,001 or more people.

Privately owned systems are generally smaller (i.e., serve fewer people) than systems owned by local governments (e.g., cities and counties). Their small size accounts for the fact that a greater number of privately owned systems serve fewer people than systems owned by local governments. The figure on the next page shows the population served by various-size systems under private, local government, and other ownership.

Number and Service Populations of Water Systems by Size and Ownership

		Very Small	Small	Medium	Large	Very Large	Total
Private	Systems	100,153	6,065	681	505	66	107,470
	Population	10,180,224	6,706,056	3,899,880	14,230,568	21,221,469	56,238,197
Local Gov't	Systems	13,805	10,826	3,929	3,055	327	31,942
	Population	2,571,548	15,426,399	22,820,219	87,575,811	106,718,556	235,112,533
Other	Systems	13,231	2,428	434	179	9	16,281
	Population	1,583,135	3,107,577	2,408,429	4,347,855	3,739,630	15,006,626
Total	Systems	127,189	19,319	5,044	3,739	402	155,693
	Population	14,334,907	25,240,032	29,128,528	106,154,234	131,679,655	306,357,356

Source: U.S. Environmental Protection Agency, Safe Drinking Water Information System, 2007



III. Drinking Water Systems

A. Water sources

Drinking water comes from one of two sources. It is either drawn from a ground water aquifer[4] or taken from a surface water body (e.g., river or lake). Small water systems usually pump ground water, while most large water systems use surface water supplies.

1. Ground water use

According to EPA data, about 95% of small and very small water systems use ground water. 60% of medium size systems use ground water. About 40% of large and very large systems use ground water sources.

2. Surface water use

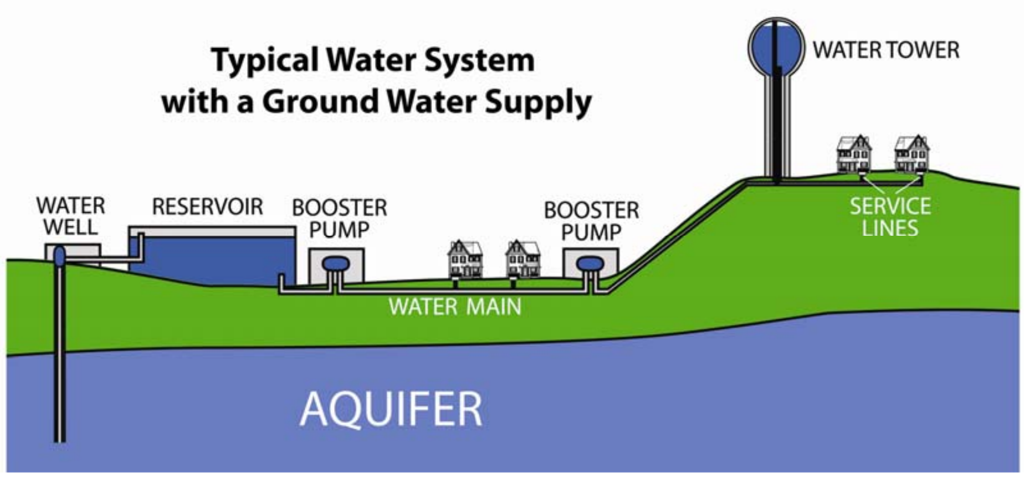
Less than 10% of all water systems use surface water. Because these are the largest systems in the country, however, a majority (65%) of people get their water from a surface water source. About 60% of large and very large systems use surface water sources.

B. Physical infrastructure

1. Extraction methods

a. Ground water systems

Ground water systems drill wells into an aquifer to extract water. A pumping system in the well brings water to the surface where it can be treated and distributed to consumers.



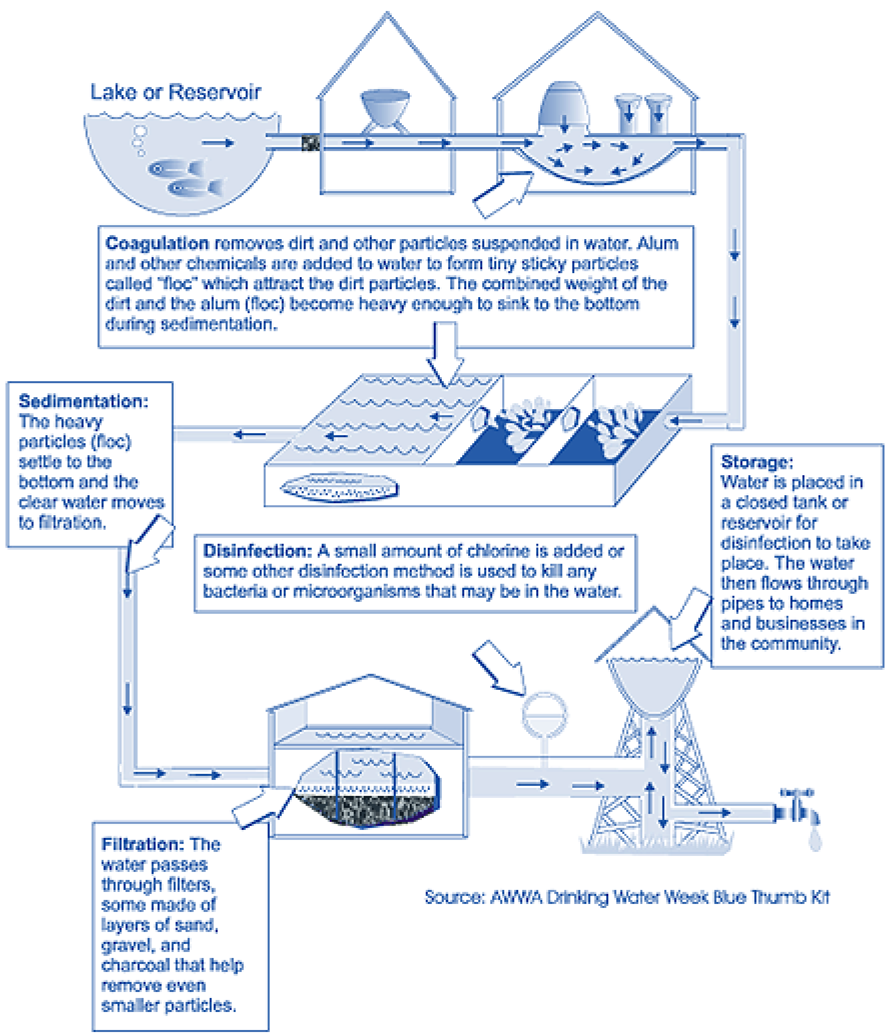
[4] An aquifer is an underground layer or body of water-bearing, permeable rock or unconsolidated material (e.g., gravel, sand, silt or clay) from which ground water can be extracted using a water well.

b. Surface water systems

Surface water systems rely on an intake structure in a surface water body to extract water. The intake consists of a pipe or other water channel through which water flows from the water body to a treatment plant.

2. Treatment systems

Facilities are required for drinking water treatment, which typically consists of coagulation, sedimentation, filtration, and disinfection. Treatment may also include fluoride treatment for the prevention of tooth decay and other treatment processes. (See Part III.C.4 below for more detail about treatment processes.) The diagram below illustrates the facilities and processes included in a typical water treatment system.



a. Ground water systems

Ground water systems generally require less water treatment than surface water systems. Ground water is usually naturally filtered in the rock (e.g., sandstone) formation through which it passes before reaching the well bore where it is extracted. Water obtained from such an aquifer is usually of high quality (i.e., free of contaminants) and therefore needs little or no additional treatment before being provided to consumers. It is, however, usually treated with low levels of chlorine as a disinfectant to prevent microbial growth as it travels through water mains to customers' taps. Chorine treatment normally occurs in the same facility that houses the well, before the water is pumped to a storage reservoir. If fluoride is added to the water, it is added at the same time and location as the chlorine treatment.

b. Surface water systems

Surface water systems require facilities for coagulation and sedimentation, as well as manmade filter systems for drinking water treatment. Compared to ground water systems, surface water systems usually require more extensive disinfectant and, possibly, other treatment since surface water supplies are more susceptible to contamination. Like ground water systems, chlorine is added to maintain disinfection as the water moves through the distribution system.

c. Ground water under the influence of surface water

"Ground water under the influence of surface water" refers to a situation in which a well is used to extract water from the ground, but there is a direct connection between the aquifer and surface water sources. Under these conditions, there is little if any protection of the ground water from potential contamination sources at the surface. For the purposes of treatment and water quality regulation, such water sources are treated as surface water systems.

3. Water storage

Drinking water utilities maintain treated water in storage until it is needed to meet demand. If chorine is the disinfectant treatment, storage reservoirs also serve to allow sufficient contact time between water and chlorine for proper disinfection before water is distributed to customers. The amount of storage needed for any given system is driven primarily by instantaneous demand requirements for fire protection.

4. Pumps and pressure

Pressure is needed to move water through a water system. *Hydraulic head* is a measurement of water pressure, based on the weight of a column of water. When left unrestricted, water will move from a point of higher hydraulic head to a point of lower hydraulic head. The difference in pressure between the two points is the *hydraulic gradient*.

Water utilities typically maintain system pressures between 30 and 100 pounds per square inch (psi) at customers' taps. Below this range, there would be insufficient water pressure for normal use. Above this range, water pressure could damage the seals and gaskets in plumbing fixtures that prevent the fixtures from leaking. Utilities control system pressures through the use of pumps, storage reservoirs, water towers, and pressure-reducing valves.

Within a water system, both pumps and gravity are used to create hydraulic head, which maintains system pressure and moves water from Point A to Point B. If a storage reservoir or water tower is at a higher elevation than the customers it serves, gravity may create sufficient head to move the water from the reservoir or tower to the consumer. If there is insufficient elevation to create a proper hydraulic gradient, booster pumps may be used to increase the hydraulic head. Booster pumps may also be used to lift water into an elevated storage tank or water tower. The force of gravity on the stored and elevated water then applies consistent pressure for the water system.

5. Water mains

Water mains are the pipes through which water is distributed from supply and treatment facilities to utility customers. The term *distribution system* refers to a utility's system of water mains. Water mains are usually buried in rights-of-way and beneath streets. They are typically 6 inches to 24 inches in diameter, depending on the water flow volumes needed to meet demand at different points in the system. Flow volumes needed for fire protection are the highest volumes required of water systems. Fire flow needs, consequently, dictate the size of water mains.

Broken and leaking water mains are a normal part of water system maintenance. The condition and reliability of water mains depend on many factors, such as age, pipe material, pipe size, type of soil in which it is buried, and the corrosivity of water.

Pipe material and manufacturing techniques have changed over time. Following World War II, for example, the lack of availability of iron resulted in lower-quality water mains. In many cities, some cast iron water mains are still in service after 100 or 150 years, while mains installed only 50 or 60 years ago have reached the end of their useful lives.

There is a great deal of variability in the stability of the unconsolidated deposits (e.g., soils, sand, silt, and clay) in which water mains are buried. Unstable deposits can result in movement and breakage of the pipe. In cold climates, mains are buried deep enough to be below the frost line to minimize freezing and frost heaving, but main breaks and leaks are still a common occurrence.

6. Service lines and meters

Service lines, or "laterals," are smaller-diameter pipes tapped into a water main, running perpendicular to the water main. They carry water from the main to individual customers. Typical residential service lines range from ⅝-inch to 1-inch diameter.

Different states handle the ownership of service lines differently. In most states, the portion of the service line from the water main to the property line is owned by the water utility, and the portion from the property line to the home or business is owned by the property owner. Typically there is a shut-off valve at or near the property line that demarcates the change in service line ownership. In some states, however, the water utility owns the service line from the water main to the home or business. In others, the property owner owns the entire service line.

Utilities install water meters on service lines to measure, for billing purposes, the amount of water used by customers. The meter may be located in a pit at or near the property line. In cold climates where meters would freeze in an outside pit, they are installed at the end of the service line inside the customers' basements.

7. Security[5]

The Safe Drinking Water Act of 1974 (SDWA)[6] and its amendments is the major federal law that provides for the quality and safety of the nation's drinking water. It also regulates the public water supply and its sources. The SDWA established the first mandatory national program designed to protect public health by providing for safe drinking water.

Following the terrorist attacks of September 11, 2001, The *Public Health Security and Bioterrorism Preparedness and Response Act of 2002* (Bioterrorism Act)[7] and a series of Homeland Security Presidential Directives (HSPD)[8] expanded upon and further defined responsibilities for the safety and security of drinking water supplies and infrastructure. The Bioterrorism Act and presidential directives gave EPA responsibility for: (1) assessing vulnerabilities of water utilities, (2) developing strategies for responding to and preparing for emergencies and incidents, (3) promoting information exchange among stakeholders, and (4) developing and using technological advances in water security.

Under EPA rules promulgated in response to the Bioterrorism Act and presidential directives, water utilities serving more than 3,300 people were required to assess their vulnerabilities to terrorist attack and to prepare emergency response plans. EPA has also established the Water Security Initiative, which addresses the risk of intentional contamination of drinking water distribution systems, and the Water Sector-Specific Plan (Water SSP). The Water SSP is a water critical-infrastructure protection strategy developed under the Department of Homeland Security's National Infrastructure Protection Plan. The Water SSP provides utilities with information on goals, identifying assets, assessing risk, prioritizing infrastructure, developing and implementing protective programs, measuring progress, and research and development.

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[5] Source for Part III.B.7: U.S. EPA, www.epa.gov/safewter/watersecurity

[6] Pub. L. 93-523; 42 U.S.C. § 300f et seq. December 16, 1974.

[7] Pub. L. 107-188, June 12, 2002.

[8] HSPD-7: Critical Infrastructure Identification, Prioritization and Protection, December 17, 2003.
HSPD-8: National Preparedness, December 17, 2003.
HSPD-9: Defense of United State Agriculture and Food, January 30, 2004.
HSPD-10: Biodefense for the 21st Century, April 28, 2004.

C. Water quality

Drinking water quality depends on a number of factors, including the quality of the source water, the treatment processes applied, conditions in the distribution system, and the application of point-of-use treatment (e.g., home filters). Drinking water quality is regulated at the federal and state levels (see Part IV, below).

Drinking water can become contaminated from a variety of sources. The contamination may occur naturally or as the result of human development and activities. All sources of water have some level of contamination (no water in nature is pure hydrogen and oxygen; i.e., H_20). In fact, some contaminates in water are desirable and necessary for human health. Concern arises, however, when the level of any particular contaminant in drinking water is high enough to pose a risk to human health.

1. Types and sources of contaminants

a. Microbial organisms

Microbial organisms (e.g., bacteria and viruses) are ubiquitous in nature and are found naturally in water. Human activities may also be responsible for the presence of microorganisms in drinking water supplies (e.g., runoff from farm lots, seepage of septic systems, and leaking of sewer pipes).

b. Inorganic compounds

Inorganic compounds (IOC) are salts, metals, and minerals (e.g., arsenic, barium, calcium, fluoride, copper, lead, iron, magnesium, manganese, mercury, nitrate, nickel, sodium). Their presence in water may be naturally occurring or can result from human activity, such as storm water runoff, wastewater discharge or farming. Some IOC, such as lead, copper and iron, can leach from the pipes in a water system. Ground water, in particular, typically has naturally occurring minerals dissolved in it. Water with dissolved IOC (particularly calcium and magnesium) is referred to as *hard water*.

c. Synthetic organic compounds

Synthetic organic compounds (SOC) include pesticides and herbicides, which can contaminate a water source from agricultural activities, storm water runoff or residential uses.

d. Volatile organic compounds

Volatile organic compounds (VOC) are derived from petroleum products or from solvents and cleaners (e.g., benzene, carbon tetrachloride, chloroform, trichloroethylene, trihalomethanes, and vinyl chloride). They may also form as a byproduct when chlorine is added to water that contains organic matter. VOC may get into a water supply through discharges from chemical plants, refineries, factories, dry cleaners and industrial activities.

e. Radionuclides

Radionuclides (e.g., radon and radium) are elements that emit radiation. They can enter drinking water supplies from the decay or erosion of either natural deposits or man-made sources.

2. Protecting water supply sources from contamination

Ground water supplies have more natural protection from contaminants than surface water supplies. They still can become contaminated, however, by seepage of contaminants from the surface through soil and substrate or by leakage of contaminants down improperly sealed well bores.[9] To help prevent contamination of aquifers, many ground water systems have established wellhead protection programs that monitor and restrict development around wells.

The best way to protect surface water supplies is to take a watershed approach.[10] Any potential contaminant in the watershed of a surface water supply has the possibility of contaminating the supply. Water systems routinely identify potential sources of contamination throughout the watershed and monitor those sources to help protect their drinking water supply.

3. Monitoring and testing for contaminants

Federal rules, promulgated by the EPA pursuant to the Safe Drinking Water Act (SDWA), provide standards for over 80 potential contaminants that may occur in drinking water and pose a risk to human health. The rules provide maximum contaminant levels (MCLs)—the highest level a contaminant may be present in drinking water—and other standards to minimize health risk. The federal rules are binding on all public water systems.

The federal rules require all public water systems to monitor and test for potential contaminants on a regular basis to ensure that their drinking water meets federal standards. The tests determine whether and how the water needs to be treated to meet standards for consumption, as well as the effectiveness of existing treatment processes.

4. Water treatment processes

Treatment processes for drinking water vary depending on the purity of the source water and on the type and amount of contaminants present. (See diagram above in Part III.B.2 for common processes.) In general, they may consist of any one or more of the following:

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[9] The top portion of a well bore is cased and sealed to prevent contaminants on or near the surface from moving down the well bore and contaminating the well. If improperly cased or if the seal deteriorates over time, a well bore itself may act as a conduit for contamination.

[10] A *watershed*, also referred to as a *drainage basin*, is the area of land from which water (from rain or snow melt) drains into a particular body of water (e.g., a river, lake or aquifer that serves as a drinking water supply).

a. Coagulation and sedimentation

A coagulant is a substance (e.g., alum) that is added to water to attract solid matter. The coagulant removes the solid matter from suspension by causing it to settle to the bottom of a sedimentation chamber. The clear water, free of large particles, then is drawn from the top of the chamber for filtration.

b. Filtration

Water passes through filters to remove small particles that cannot be removed by coagulation and sedimentation. Even microscopic organisms such as viruses and bacteria can be removed through filtration.

c. Ion exchange

This process removes inorganic contaminants (IOC) that cannot be removed adequately with sedimentation or filtration. The most common form of ion exchange water treatment is the household water softener used to treat hard water.

d. Absorption

Organic contaminants and compounds that cause undesirable color, taste and odor can be removed from drinking water through absorption onto the surface of granular or powdered activated carbon.

e. Air stripping

Volatile organic compounds (VOC) can be removed from drinking water with this treatment, which creates a water spray to maximize the exposure of water particles to air, causing VOCs to be released from the water into the air.

f. Disinfection

One or more disinfection methods (e.g., chlorine, chloramines, chlorine dioxide, ozone and ultraviolet radiation) are applied to kill bacteria or microorganisms that may be in the water. The final disinfection method in any treatment system is typically chlorination, which provides a chlorine residual in the water as it moves through the distribution system. The chlorine residual kills any microorganisms that may get into the water in the distribution system or in a home plumbing system.

g. Fluoridation

Some water systems add fluoride to the drinking water as a treatment to reduce tooth decay in their community.

h. Point-of-use (POU) systems

POU treatment is any water treatment at the home or business where it is consumed. Businesses such as food processors may want additional treatment to meet quality standards that exceed federal drinking water standards. Many homeowners elect to maintain POU treatment in the form of a home filter system. POU treatment is particularly effective in some water systems for improving water aesthetics (i.e., color, taste, and odor) by removing minerals (e.g. iron and manganese) that can come out of solution and form suspended particles as the water moves through the distribution system.

IV. Drinking Water Regulation

A. U.S. Environmental Protection Agency (EPA)

The Safe Drinking Water Act (SDWA) was passed by Congress in 1974 and later amended in both 1986 and 1996. The law requires the EPA to establish national health-based standards for drinking water to protect against contaminants (both naturally occurring and man-made). Amendments to the SDWA include expanded requirements for the EPA to establish rules for source water protection, operator certification, funding water system improvements, and providing public information. The Bioterrorism Act of 2002 and subsequent presidential directives (discussed in Part III.B.7 above) require the EPA to regulate public water system vulnerability assessments and emergency response plans.

B. State environmental and natural resources agencies

Direct oversight of EPA requirements for public water systems is conducted through state drinking water programs. States that adopt standards at least as stringent as the federal standards can obtain authority from the EPA to implement the SDWA within their jurisdictions. The state agencies responsible for this oversight (typically a state environmental or natural resources agency) are referred to as "primacy" agencies, since they have primary responsibility for enforcing the SDWA.

C. State regulatory commissions[11]

Forty-six state commissions regulate water utilities. These commissions, however, only regulate about 20% of all public water systems. The types of water utilities that are regulated and the scope of commission authority over those utilities vary from state to state.

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[11] Data and other information in Part IV.C come from: Beecher, Janice A., *1995 Inventory of Commission-Regulated Water and Wastewater Utilities*, School of Public and Environmental Affairs—Indiana University, Pub. No. 95-E18, November 1995.

Dr. Beecher (now with the Institute of Public Utilities at Michigan State University) is currently working on a project to update this data. This section will be updated when new information becomes available.

1. Ownership of regulated utilities

All 46 states that regulate water utilities regulate privately-owned systems. Eleven states regulate some or all municipally-owned water systems. Twelve states regulate water systems under other ownership (e.g., cooperatives, water districts, homeowner associations).

State regulatory authority over non-private water utilities is often limited. A municipal water utility, in some states, may only be regulated if it extends service outside the municipal boundary. Customers outside the municipality may have little, if any, political input or control over their service provider. State regulation provides assurance that costs and services are fair and reasonable in such cases. In some states, municipalities may choose whether or not to be regulated by their state commission. About one-third of states provide an exemption from regulation to utilities under a specified size.

2. Scope of regulatory authority

All 46 commissions that regulate water utilities have authority to set utility rates and require annual financial and operating reports. Forty-five out of 46 states initiate financial audits. Forty-four review mergers and acquisitions and hear customer complaints. Forty-one require management audits and have authority over financial issuances of the utility. About three-quarters of commissions certify new systems and authorize service areas and expansions. Just over half the commissions can also require utilities to conduct forecasting and planning processes. Some commission scope of authority is limited further. In some states, for example, commissions may only require certain types of information (e.g., financial plans and demand forecasts) as part of an active rate case.

These data indicate that many state commissions lack regulatory control in areas such as certifying new systems, approving service area expansion, and requiring forecasts and plans. Such lack of authority may limit a commission's ability to address a number of issues facing water utilities and their customers.

V. Key Issues

This section describes some issues facing water utilities and regulatory commissions. It is not meant to be a comprehensive list or a thorough discussion of the issues. It provides a short description of a few key issues that regulatory commissions are facing or are likely to face. Additional information about these issues may be found in the NRRI sources cited.

A. Small water systems[12]

[12] Source: Stanford, Melissa J., *Small Water Systems: Challenges and Recommendations*, NRRI, Pub. 08-02, February 7, 2008.

Ninety-four percent of public water systems in the U.S. are classified by EPA as small or very small (serving less than 3,300 people). Seventy-three percent of those systems are privately owned and likely regulated by a state commission. Many small water utilities struggle to achieve economies of scale, financial stability, managerial excellence and technical proficiency. They have difficulty operating effectively and efficiently, maintaining their equipment and infrastructure, complying with federal and state regulations, providing reasonable rates and high standards of customer service and, in some cases, simply staying in business. Despite federal programs such as the Drinking Water State Revolving Fund (DWSRF) and the capacity development provisions of the SDWA amendments of 1996,[13] problems persist for small water systems. The situation is likely only to worsen as infrastructure replacement needs increase and as new regulatory requirements demand increased investment in water systems.

Some state commissions have implemented effective practices, policies, procedures and regulations to assist small utilities and their customers. These include: (1) providing technical assistance and advice, (2) simplifying rate procedures, (3) modifying rate designs and structures, (4) establishing policies to advance consolidation and regionalization, (5) strengthening certification requirements for new small systems, and (6) working closely with primacy agencies and other stakeholders to improve small system conditions.

The challenges for state commissions in addressing small water system issues cannot be solved through rate cases alone. Strong and creative involvement by commissions and their staff is needed. Whatever alternatives are used by state commissions to help small systems, essential elements of a lasting solution include: (1) improved communication between state commissions and small utilities; (2) improved working relationships between commissions and other regulatory agencies and stakeholders; (3) increased small water utility attention to economies of scale; (4) small system managers accessing and using the tools available to assist them; and (5) sufficient state commission authority and resources to implement the policies, procedures, regulations, and standards needed.

B. Water conservation, efficiency, and sustainability[14]

Water conservation programs have become commonplace across the country, even in areas with relatively abundant water supply. In arid western states, water conservation has become a necessary fact of life. Other areas of the country frequently experience periodic short-term drought that trigger water conservation measures, especially during hot summer months. Regions that have not experienced long-term drought are not exempt, as experienced by Atlanta, Georgia in 2007. Some of the fastest growing areas in the country, such as Las Vegas, Nevada,

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[13] The DWSRF is a loan fund established by the SDWA and administered by state primacy agencies for the purpose of providing funding to utilities for infrastructure improvement, training, source water protection, and capacity development. Capacity development refers to SDWA provisions requiring evaluation and improvement in the technical, financial and managerial capacities of drinking water utilities.

[14] Source: NRRI, *Water and Wastewater Research Agenda*, February 5, 2008, pp. 7-9.

are in areas with very limited water supply. The effects of global climate change threaten to create water shortages in areas that have not previously been affected.

In addition to helping sustain water supplies, water conservation programs defer construction of new facilities. Growing communities can delay construction of wells, storage reservoirs and treatment systems if they reduce their per capita water demand.

The great majority of water utility costs are fixed costs, such as payroll, benefits, and debt service associated with capital assets. Water conservation programs do little to reduce existing fixed costs of a utility (although they can defer, as just explained, "future fixed costs"). Traditional rate structures recover fixed costs through variable charges (i.e., dollars per gallons of water sold). Under traditional rate structures, therefore, water conservation reduces a utility's ability to recover its fixed costs.

Water utilities and state commissions must look for innovative ways to promote and gain the benefits of water conservation and efficiency while maintaining financial stability. This can be accomplished through supply-side techniques, demand-side programs and rate structure and design.

C. The water-electric nexus[15]

Producing and delivering safe drinking water is a power-intensive operation, involving extensive use of pumps and treatment systems. Generating electricity uses large quantities of water, primarily for cooling. Consequently, reducing water use reduces demand for electricity, and reducing electric demand in turn reduces use of water.

Water systems are often one of the biggest power users in their communities. Power costs are typically a major budget item for water and wastewater utilities. Water and wastewater operations account for 19% of the total annual power use in California. Reduction of power use in the water sector would thus have a measurable effect on reducing electric demand and would simultaneously improve efficiency and reduce costs of water operations.

Regulatory commissions and utilities that can promote water conservation through supply-side (e.g., distribution system leak detection and repair) and demand-side (e.g., low-flow fixture promotion) programs will also have a positive effect on energy efficiency. The effectiveness of water conservation programs should always include an evaluation of their effect on energy use.

D. Infrastructure replacement and asset management[16]

Surveys conducted by EPA suggest that the need for water and wastewater infrastructure improvement and replacement (both privately and publicly owned) over the next 20 years is

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[15] Source: NRRI, *Water and Wastewater Research Agenda*, February 5, 2008, pp. 9-10.

[16] Source: NRRI, *Water and Wastewater Research Agenda*, February 5, 2008, pp. 1-4.

between $500 billion and $1 trillion. This dollar level reflects a growing need across the Nation to replace water and sewer pipes and other water and wastewater facilities as they approach the end of their useful lives.

The reason for this surge in infrastructure needs stems from the population boom and economic growth at the end of World War II. During those post-war years, there was unprecedented industrial, business, commercial and residential development, along with the water and wastewater infrastructure to support it. That infrastructure is now reaching the age when it is beginning to wear out and needs to be upgraded or replaced. Water and wastewater utilities need to manage those assets actively or risk adverse economic consequences, such as unplanned system failures, increased maintenance costs, and unbudgeted repair and replacement costs. Depending on the length of the useful life of various components, the need to replace this infrastructure will continue over the next several decades.

Many utilities have conducted plans consisting of a complete assessment of utility facilities and assets, including a determination of the condition and remaining useful life of each component of the system, right down to each segment of buried pipe. Components of the system are also rated in terms of criticality for operation of the system. A model is often developed based on asset condition, criticality and other relevant factors to prioritize the infrastructure replacement and improvement needs over time. Costs are then applied to determine reinvestment needs over time.

The goal of these plans is to determine a reinvestment timeline that will allow continued operation of critical infrastructure throughout its useful life, but will ensure replacement before it fails and before maintenance costs increase dramatically. Planners then can prepare infrastructure replacement schedules and budgets that will spread out the costs of improvements over a pre-established planning horizon. This scheduling and budgeting will avoid unplanned maintenance and capital costs to the utility while maintaining efficient operation of the system.

This situation poses several challenges for utilities and regulatory commissions. One challenge is how to finance the necessary infrastructure replacements such that (a) rates increase gradually (as opposed to sudden spikes in rates), while (b) maintaining the utilities' financial stability. A second challenge is ensuring that the large expenditures are made prudently, so as to win and sustain customer trust and political credibility. Adding to the challenge is the absence, for most utilities, of a designated fund available to replace aging infrastructure—an absence attributable to ratemaking practices which have kept depreciation rates low and have disallowed or discouraged rate recovery of contributions in aid of construction.

E. Water quality[17]

The SDWA provides that EPA may grant a state primary enforcement responsibility if the state adopts drinking water regulations that are no less stringent than federal rules. If a state does not adopt such regulations, EPA will enforce the federal rules in that state. A state with primacy status may adopt regulations that are more stringent than federal rules.

[17] Source: NRRI, *Water and Wastewater Research Agenda*, February 5, 2008, pp. 1-4.

Some local (i.e., substate) jurisdictions establish water quality standards that are more stringent than both federal and state standards. Utilities and local officials can choose to enforce the federal guidelines or their own standard. They might enforce a stricter standard to increase public confidence in the drinking water system.

State utility commissions are responsible for utility rate setting and quality of service issues. When they issue certificates of public convenience for water treatment systems and when they rule on rate hikes for capital investment and operating expenses related to water quality, they are affecting water quality decisions by determining what cost levels are appropriate for the community.

Federal agencies, state environmental and resource agencies, state regulatory commissions, local governments and utilities all have some say in making and enforcing drinking water quality standards in a community. Lines of authority, however, are not always clear, and decisions by these various agencies are not always coordinated, consistent or fully informed.

Drinking water quality concerns have become more pronounced. Customers and community leaders have become better informed and more vocal about water quality standards. These factors have increased the need for regulatory commission involvement in water quality issues. Utilities are increasingly seeking rate recovery and construction approvals for water quality activities and facilities. Commissions and their staff need to be well informed about water quality problems and concerns and the most effective utility responses so they can make optimal decisions.