

GAO

Report to the Ranking Minority Member,
Committee on Environment and Public
Works, U.S. Senate

March 2004

WATER INFRASTRUCTURE

Comprehensive Asset Management Has Potential to Help Utilities Better Identify Needs and Plan Future Investments



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Highlights of [GAO-04-461](#), a report to the Ranking Minority Member, Committee on Environment and Public Works, U.S. Senate

WATER INFRASTRUCTURE

Comprehensive Asset Management Has Potential to Help Utilities Better Identify Needs and Plan Future Investments

Why GAO Did This Study

Having invested billions of dollars in drinking water and wastewater infrastructure, the federal government has a major interest in protecting its investment and in ensuring that future assistance goes to utilities that are built and managed to meet key regulatory requirements. The Congress has been considering, among other things, requiring utilities to develop comprehensive asset management plans. Some utilities are already implementing asset management voluntarily. The asset management approach minimizes the total cost of buying, operating, maintaining, replacing, and disposing of capital assets during their life cycles, while achieving service goals. This report discusses (1) the benefits and challenges for water utilities in implementing comprehensive asset management and (2) the federal government's potential role in encouraging utilities to use it.

What GAO Recommends

Among other things, GAO is recommending that the Environmental Protection Agency (EPA) (1) better coordinate its own activities to facilitate information sharing and reduce the potential for duplication and (2) ensure that water utilities have access to information they can use by establishing a Web site focused on asset management. In commenting on a draft of this report, EPA generally agreed with the report and its recommendations.

www.gao.gov/cgi-bin/getrpt?GAO-04-461.

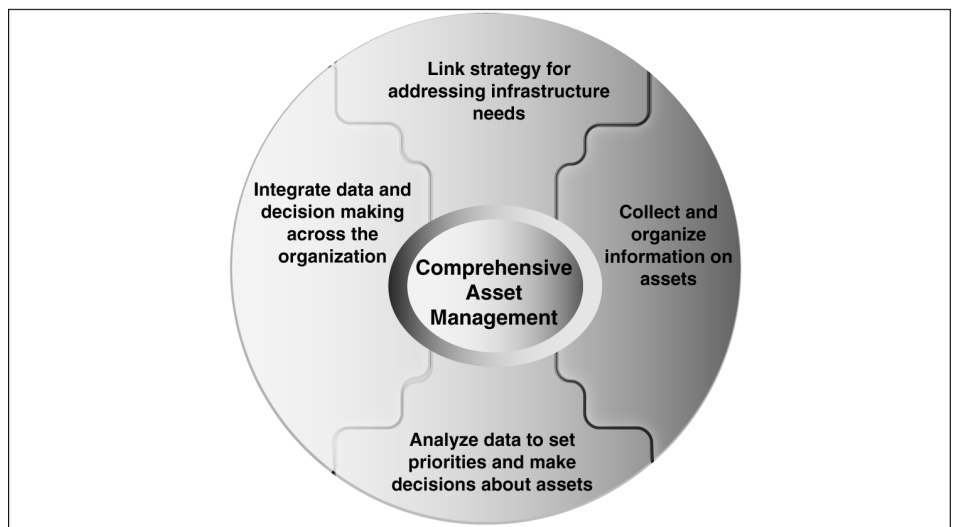
To view the full product, including the scope and methodology, click on the link above. For more information, contact John B. Stephenson (202) 512-3841 or stephensonj@gao.gov.

What GAO Found

Drinking water and wastewater utilities that GAO reviewed reported benefiting from comprehensive asset management but also finding certain challenges. The benefits include (1) improved decision making about their capital assets and (2) more productive relationships with governing authorities, rate payers, and others. For example, utilities reported that collecting accurate data about their assets provides a better understanding of their maintenance, rehabilitation, and replacement needs and thus helps utility managers make better investment decisions. Among the challenges to implementing asset management, utilities cited collecting and managing needed data and making the cultural changes necessary to integrate information and decision making across departments. Utilities also reported that the shorter-term focus of their governing bodies can hamper long-term planning efforts.

EPA currently sponsors initiatives to promote the use of asset management, including educational materials, technical assistance, and research. While this is a good first step, GAO found that EPA could better coordinate some activities. For example, EPA has no central repository to facilitate information sharing within and across its drinking water and wastewater programs, which would help avoid duplication of effort. Water industry officials see a role for EPA in promoting asset management as a tool to help utilities meet infrastructure-related regulatory requirements; they also noted that establishing an EPA Web site would be useful for disseminating asset management information to utilities. The officials raised concerns, however, about the implications of mandating asset management, citing challenges in defining an adequate asset management plan and in the ability of states to oversee and enforce compliance.

Elements of Comprehensive Asset Management



Source: GAO.

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Abbreviations

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| EPA | Environmental Protection Agency |
| GAO | General Accounting Office |

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United States General Accounting Office
Washington, D.C. 20548

March 19, 2004

The Honorable James M. Jeffords
Ranking Minority Member
Committee on Environment and Public Works
United States Senate

Dear Senator Jeffords:

In response to your request, this report examines (1) the potential benefits of comprehensive asset management for drinking water and wastewater utilities and the challenges that could hinder its implementation and (2) the role that the federal government might play in encouraging utilities to implement asset management.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies to appropriate congressional committees, the Administrator of the Environmental Protection Agency, and the Director of the Office of Management and Budget. We will also make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at <http://www.gao.gov>.

Please call me at (202) 512-3841 if you or your staff have any questions. Major contributors to this report are listed in appendix III.

Sincerely yours,

John B. Stephenson
Director, Natural Resources
and Environment

Executive Summary

Purpose

Mounting evidence suggests that the integrity of the nation's drinking water and wastewater infrastructure is at risk without a concerted effort to improve the management of key assets—pipelines, treatment plants, and other facilities—and a significant investment in maintaining, rehabilitating, and replacing these assets. According to recent studies by the Environmental Protection Agency (EPA) and other organizations, drinking water and wastewater utilities will need to invest hundreds of billions of dollars in their capital infrastructure over the next two decades. However, if utilities maintain current spending levels, financing the needed investments could be problematic. Based on a survey of several thousand drinking water and wastewater utilities, GAO reported in August 2002 that a significant percentage of the utilities—29 percent of the drinking water utilities and 41 percent of the wastewater utilities—were not generating enough revenue from user rates and other local sources to cover their full cost of service.¹ Furthermore, roughly one-third of the utilities (1) deferred maintenance because of insufficient funding, (2) had 20 percent or more of their pipelines nearing the end of their useful life, and (3) lacked basic plans for managing their capital assets.

Each year, the federal government makes available billions of dollars to help local communities finance drinking water and wastewater infrastructure projects. However, concerns about the condition of existing infrastructure have prompted calls to increase this financial assistance and, at the same time, ensure that the federal government's investment is protected. The Congress has been considering a number of infrastructure-related proposals, including requirements for local utilities to have asset management plans. Some utilities have turned to comprehensive asset management on their own initiative. This approach to managing capital infrastructure focuses on minimizing the total cost of acquiring, operating, maintaining, replacing, and disposing of capital assets over their life cycle and doing so in a way that achieves the level of service customers desire. Among other things, comprehensive asset management allows utility managers to obtain better information on the age and condition of existing assets, determine the level of maintenance needed to optimize asset performance and useful life, assess the risks associated with the failure of various assets and set priorities for their maintenance and replacement, understand the trade-offs and implications of management decisions about

¹See U.S. General Accounting Office, *Water Infrastructure: Information on Financing, Capital Planning, and Privatization*, GAO-02-764 (Washington, D.C.: Aug. 16, 2002).

the assets, and use better information to justify proposed rate increases or capital investments. Water industry officials agree that by making informed decisions about investments in capital assets, drinking water and wastewater utilities can better justify the rate increases associated with making needed improvements to their infrastructure.

The Ranking Minority Member of the Senate Committee on Environment and Public Works asked GAO to examine (1) the potential benefits of comprehensive asset management for drinking water and wastewater utilities and the challenges that could hinder its implementation and (2) the role that the federal government might play in encouraging utilities to implement asset management.

To address the first issue, GAO conducted initial interviews with 46 U.S. drinking water and wastewater utilities identified by knowledgeable government and water industry officials as implementing comprehensive asset management. To obtain more detailed information on the benefits and challenges associated with implementing asset management, GAO conducted structured interviews with 15 of these utilities, selected because they (1) reported or anticipated achieving quantitative benefits from asset management or (2) represented smaller entities. Our results are not generalizable to the larger universe of domestic drinking water and wastewater utilities. Because asset management is a relatively new concept for domestic water utilities, GAO supplemented the structured interviews by obtaining information from 6 utilities and five government agencies in Australia and New Zealand—two countries that have taken the lead in implementing comprehensive asset management in their drinking water and wastewater utilities—and two private companies with long-standing experience in using comprehensive asset management in their respective fields, which provided additional information on benefits and challenges.

To address the second issue, GAO discussed options for a federal role in promoting asset management with the 15 utilities selected for structured interviews, water industry associations, and EPA. In addition, based on contacts with a variety of organizations and officials experienced in asset management, GAO identified the U.S. Department of Transportation as being at the forefront of federal involvement in this issue. GAO obtained information about the department's initiatives from the Office of Asset Management, within the Federal Highway Administration.

We conducted our work between March 2003 and March 2004 in accordance with generally accepted government auditing standards.

Background

At its most basic level, comprehensive asset management involves the systematic collection of key data and the application of analytical tools such as life-cycle cost analysis and risk assessment. Asset management thus provides information that managers can use to make sound decisions about their capital assets and allows decision makers to better identify and manage needed investments in their organization's infrastructure. By following this approach, organizations also change the process they use to make decisions, including the types of information they bring to bear and which segments of the organization participate in the decision-making process. Using a fully integrated decision process, many segments of an organization, including accounting, engineering, finance, maintenance, and operations, are expected to exchange relevant information, share in the decision making, and take an organizationwide view when setting goals and priorities. For drinking water and wastewater utilities, an integral part of a comprehensive asset management program is ensuring that adequate funds are available through user rates or other means so that asset management decisions can be implemented (e.g., ensuring that planned maintenance can be conducted and capital assets can be repaired, replaced, or upgraded on schedule).

Comprehensive asset management is a relatively new concept for drinking water and wastewater utilities in the United States. Domestic utilities implementing asset management are generally large and vary considerably in terms of their approach. For example, some are applying the concepts of asset management on a utilitywide basis and others are beginning in specific departments or facilities. In implementing asset management, domestic utility managers have drawn from the experiences of international utilities that are considered to be at the forefront of asset management for drinking water and wastewater infrastructure. For example, in Australia and New Zealand, where the concept has been strongly endorsed by the national governments, water utilities have used comprehensive asset management for about 10 years. In each country, a key impetus for the move toward asset management was legislation that called for water utilities to improve their financial management, requiring utilities to recover the full cost of service in Australia and, in New Zealand, to annually depreciate their assets and use cost-benefit analysis.

In the United States, the Congress has been considering proposals to require utilities to adopt key components of asset management, such as inventorying critical assets, evaluating their condition and performance, and developing plans to (1) maintain, repair, and replace assets and (2) fund such activities. These proposals typically link the use of asset management to a utility's eligibility for federal financial assistance in making infrastructure improvements.

The universe of drinking water and wastewater utilities indicates that efforts to adopt asset management may vary considerably because of the utilities' sizes and their ability to marshal resources for the effort. In the United States, about 54,000 community water systems supply most of the nation's drinking water and about 16,000 wastewater treatment systems provide sewer service. Larger utilities account for much of the projected infrastructure needs; for example, drinking water systems serving more than 10,000 people account for approximately 65 percent of the estimated needs for such utilities. However, most utilities are small, with 93 percent of community drinking water systems and 71 percent of wastewater systems serving 10,000 people or fewer. EPA has found that smaller utilities are less likely to have the financial, managerial, and technical capacity to meet regulatory requirements and are less likely to cover their full cost of providing services.

Results in Brief

U.S. drinking water and wastewater utilities that GAO contacted reported benefiting from applying the concepts of asset management to their operations but have also encountered certain challenges. Utilities are seeing benefits from (1) improved decision making because they have more accurate and integrated information about their capital assets and (2) more productive relationships with governing authorities, ratepayers, and other stakeholders because they can provide better information in a more transparent way. For example, utilities reported that collecting accurate data about their assets provides a better understanding of their maintenance, rehabilitation, and replacement needs, which helps utility managers make better investment decisions. While water industry officials identified financial and other benefits from using asset management, reported savings should be interpreted carefully. According to the utilities that GAO contacted, the challenges associated with implementing asset management included collecting and managing needed data and making the cultural changes necessary to integrate information and decision making across departments. Utilities also reported that the shorter-term focus of their governing bodies can hamper long-term planning efforts.

Although smaller utilities face more obstacles to implementing asset management, largely as a result of limited resources, such utilities can also benefit from applying asset management concepts.

EPA can play a stronger role in encouraging water utilities to use asset management by leveraging ongoing efforts within and outside the agency. EPA currently sponsors initiatives to promote the use of asset management, such as developing educational materials; providing technical assistance, particularly to smaller utilities; and funding research related to asset management. Nevertheless, GAO found that some activities could be better coordinated. For example, EPA's Office of Ground Water and Drinking Water and Office of Wastewater Management fund state and university-based training and technical assistance centers that have developed guidance manuals, tools, and training materials to assist small utilities with asset management. However, no central repository exists to facilitate information sharing within and across the drinking water and wastewater programs and thereby avoid duplication of effort. GAO also found that opportunities exist for EPA to coordinate with other federal agencies, such as the Department of Transportation, that have already developed tools and training materials on asset management. When asked for their views on a potential federal role in asset management, water industry officials said that EPA should assume a greater leadership role in promoting asset management. For example, they see asset management as a tool to help utilities meet regulatory requirements that depend on maintaining an adequate infrastructure and believe that EPA should establish a Web site to serve as a central repository of information on implementing asset management. However, the officials raised concerns about the implications of mandating asset management, citing challenges in defining an adequate asset management plan and in the ability of states to oversee and enforce compliance. GAO is making recommendations to strengthen EPA's existing efforts to promote water utilities' use of asset management.

Principal Findings

Utilities See Benefits from Using Comprehensive Asset Management, but Face Implementation Challenges

Utilities that have started using comprehensive asset management report benefits for several aspects of their operations. For example, collecting, sharing, and analyzing data on capital assets has allowed utilities to make more informed decisions about how best to manage the assets. In particular, utilities are using the information they collect to allocate their maintenance resources more effectively and make better decisions about whether to rehabilitate or replace aging assets. Utilities also report that asset management fosters information sharing across departments as well as coordinated planning and decision making. These improvements help utility managers reduce duplication of effort and improve the allocation of staff time and other resources.

Utilities also report that comprehensive asset management benefits their relations with external stakeholders, such as local governing bodies, ratepayers, and credit rating agencies. For instance, several utilities have used, or expect to use, the information collected through comprehensive asset management to persuade elected officials to increase user rates to help pay for needed improvements in drinking water and wastewater infrastructure. Although water industry officials identified financial and other benefits from using asset management, reported savings should be viewed with caution because, for instance, comprehensive asset management may be implemented concurrently with other changes in management practices or operational savings may be offset by increases in capital expenditures.

Despite the acknowledged benefits of comprehensive asset management, utilities report several key challenges that can hinder efforts to implement this approach. For example, collecting the appropriate data on utility assets and managing the information efficiently can be difficult when existing data are incomplete and inaccurate or the data come from multiple departments and are maintained using different and incompatible software programs. Utilities reported that another major challenge is overcoming resistance to cultural change and fostering more communication among departments that do not regularly exchange information. Utility officials believe that it is essential to change the management culture to encourage more interdepartmental coordination and information sharing. Finally, although asset management provides utilities with better information to justify needed rate increases, their justifications may not be effective

because of pressure to keep rates low and competing priorities for local revenues. Utility and water industry officials cited the difficulty of trying to implement long-term capital improvement plans when governing bodies have a shorter-term focus as a key challenge to asset management. Smaller utilities may have more difficulty implementing asset management because they typically have fewer financial, technological, and staff resources. On the other hand, because such utilities have fewer capital assets to manage, they can turn to low-cost management alternatives that do not require expensive or sophisticated technology.

EPA Can Promote the Use of Asset Management By Strengthening Existing Initiatives

EPA currently sponsors initiatives to encourage the use of comprehensive asset management through its partnerships with water industry associations and state and university-based training and technical assistance centers. These initiatives include developing training and informational materials, providing technical assistance, and funding research related to asset management. While this is a good first step, GAO found that better coordination of these efforts within and across the drinking water and wastewater programs could reduce the potential for duplication of effort and help ensure that limited resources are used effectively. GAO also found opportunities for EPA to leverage its resources by adapting the asset management tools and informational materials available from other federal agencies with experience in asset management, such as the Federal Highway Administration in the Department of Transportation.

When asked for their views on a potential federal role, water industry and utility officials said that given the benefits of asset management, it is in EPA's interest to assume a greater leadership role in promoting its use. For example, the officials indicated that one useful option would be educating utilities about the potential for asset management to help them comply with certain regulatory requirements that focus to some degree on the adequacy of utility infrastructure and the management practices that affect it. As a case in point, the officials cited requirements for ensuring that drinking water utilities have the financial, managerial, and technical capacity they need to provide safe drinking water over the long term. GAO also found support for an EPA Web site that would serve as a central repository of information on comprehensive asset management and provide drinking water and wastewater utilities with direct and easy access to implementation tools and training materials developed by EPA and others. Water industry associations and individual utilities questioned the feasibility of proposed requirements for asset management plans,

particularly as a condition of receiving federal financial assistance. While the proposals are consistent with what GAO has found to be the leading practices in capital decision making,² the officials expressed concerns about, among other things, (1) whether state regulators have the resources to assess the adequacy of asset management plans and oversee compliance and (2) the potential for a mandate to limit the flexibility utilities need to tailor asset management to their individual circumstances.

Recommendations for Executive Action

Given the potential of comprehensive asset management to help water utilities better identify and manage their infrastructure needs, the Administrator, EPA, should take steps to strengthen the agency's existing initiatives on asset management and ensure that relevant information is accessible to those who need it. Specifically, the Administrator should

- better coordinate ongoing and planned initiatives to promote asset management within and across the drinking water and wastewater programs to leverage limited resources and reduce the potential for duplication;
- explore opportunities to take advantage of asset management tools and informational materials developed by other federal agencies;
- strengthen efforts to educate utilities on how implementing asset management can help them comply with certain regulatory requirements that focus in whole or in part on the adequacy of utility infrastructure and the management practices that affect it; and
- establish a Web site to provide a central repository of information on comprehensive asset management so that drinking water and wastewater utilities have direct and easy access to information that will help them better manage their infrastructure.

Agency Comments

GAO provided a draft of this report to EPA for review and comment. GAO received comments from officials within EPA's Office of Water and Office of the Chief Financial Officer, who generally agreed with the information

²See U.S. General Accounting Office, *Executive Guide: Leading Practices in Capital Decision-Making*, GAO/AIMD-99-32 (Washington, D.C.: December 1998).

presented in the report and GAO's recommendations. They further noted that while EPA has played a major role in bringing asset management practices to the water industry, significant additional activity could be undertaken, and they have placed a high priority on initiating activities similar to those suggested by GAO. The officials also made technical comments, which GAO incorporated as appropriate.

Introduction

Drinking water and wastewater utilities are facing potentially significant investments over the next 20 years to upgrade an aging and deteriorated infrastructure, including underground pipelines, treatment, and storage facilities; meet new regulatory requirements; serve a growing population; and improve security. Adding to the problem is that many utilities have not been generating enough revenues from user charges and other local sources to cover their full cost of service. As a result, utilities have deferred maintenance and postponed needed capital improvements. To address these problems and help ensure that utilities can manage their needs cost-effectively, some water industry and government officials advocate the use of comprehensive asset management. Asset management is a systematic approach to managing capital assets in order to minimize costs over the useful life of the assets while maintaining adequate service to customers. While the approach is relatively new to the U.S. water industry, it has been used by water utilities in other countries for as long as 10 years.

Each year, the federal government makes available billions of dollars to help local communities finance drinking water and wastewater infrastructure projects. Concerns about the condition of existing infrastructure have prompted calls to increase financial assistance and, at the same time, ensure that the federal government's investment is protected. In recent years the Congress has been considering a number of proposals that would promote the use of comprehensive asset management by requiring utilities to develop and implement plans for maintaining, rehabilitating, and replacing capital assets, often as a condition of obtaining loans or other financial assistance.

The Federal Government Has Played a Major Role in Funding and Setting Requirements for Water Infrastructure

The federal government has had a significant impact on the nation's drinking water and wastewater infrastructure by (1) providing financial assistance to build new facilities and (2) establishing regulatory requirements that affect the technology, maintenance, and operation of utility infrastructure. As we reported in 2001, nine federal agencies made available about \$46.6 billion for capital improvements at water utilities from fiscal years 1991 through 2000.¹ The Environmental Protection Agency (EPA) and the Department of Agriculture alone accounted for over 85 percent of the assistance, providing \$26.4 billion and \$13.3 billion, respectively, during the 10-year period; since then, the funding from these two agencies has totaled nearly \$15 billion.² EPA's financial assistance is primarily in the form of grants to the states to capitalize the Drinking Water and Clean Water State Revolving Funds, which are used to finance improvements at local drinking water and wastewater treatment facilities, respectively.³ As part of the Rural Community Advancement Program, Agriculture's Rural Utilities Service provides direct loans, loan guarantees, and grants to construct or improve drinking water, sanitary sewer, solid waste, and storm drainage facilities in rural communities.

In addition to its financial investment, EPA has promulgated regulations to implement the Safe Drinking Water Act and Clean Water Act, which have been key factors in shaping utilities' capital needs and management practices. For example, under the Safe Drinking Water Act, EPA has set standards for the quality of drinking water and identified effective technologies for treating contaminated water. Similarly, under the Clean Water Act, EPA has issued national minimum technology requirements for municipal wastewater utilities and criteria that states use to establish water quality standards that affect the level of pollutants that such utilities are permitted to discharge. Thus, the federal government has a major stake in protecting its existing investment in water infrastructure and ensuring that

¹See U.S. General Accounting Office, *Water Infrastructure: Information on Federal and State Financial Assistance*, [GAO-02-134](#) (Washington, D.C.: Nov. 30, 2001). We adjusted the dollar amounts from the report to constant 2003 dollars.

²From fiscal year 2001 to fiscal year 2004, EPA provided \$8.8 billion for water infrastructure and Agriculture provided \$6 billion, in constant 2003 dollars.

³The Clean Water State Revolving Fund may also be used for other water quality improvement projects, such as nonpoint source pollution control and estuary management, in addition to wastewater treatment facilities.

future investments go to utilities that are built and managed to meet key regulatory requirements.

Projected Drinking Water and Wastewater Infrastructure Needs Are Significant

Drinking water and wastewater utilities will need to invest hundreds of billions of dollars in their capital infrastructure over the next two decades, according to EPA; the Congressional Budget Office; and the Water Infrastructure Network, a consortium of industry, municipal, state, and nonprofit associations. As table 1 shows, the projected needs range from \$485 billion to nearly \$1.2 trillion. The estimates vary considerably, depending on assumptions about the nature of existing capital stock, replacement rates, and financing costs. Given the magnitude of the projected needs, it is important that utilities adopt a strategy to manage the repair and replacement of key assets as cost-effectively as possible and to plan to sustain their infrastructure over the long term.

Table 1: Recent Estimates of the Cost of Meeting Infrastructure Needs at Drinking Water and Wastewater Utilities

Dollars in billions

| Organization | Period covered | Estimate | | | | | |
|---|----------------|-------------------------|------------|------------|----------------------------------|------------|--------------|
| | | Capital investment only | | | Capital investment and financing | | |
| | | Drinking water | Wastewater | Total | Drinking water | Wastewater | Total |
| Congressional Budget Office^a | 2000-2019 | | | | | | |
| --Low | | | | | 232 | 260 | 492 |
| --High | | | | | 402 | 418 | 820 |
| EPA^b | 2000-2019 | | | | | | |
| --Low | | 154 | 331 | 485 | 178 | 402 | 580 |
| --High | | 446 | 450 | 896 | 475 | 719 | 1,194 |
| Water Infrastructure Network^c | 2000-2019 | 380 | 360 | 740 | 480 | 460 | 940 |

Source: GAO summary of infrastructure estimates from the Congressional Budget Office, EPA, and the Water Infrastructure Network.

Note: We did not assess the reliability of these data.

^aSee Congressional Budget Office, *Future Investment in Drinking Water and Wastewater Infrastructure*, (Washington, D.C.: November 2002). According to the report, the difference between the low and high estimates is attributable primarily to assumptions about the rate at which drinking water pipes are replaced, the savings associated with improved efficiency, the costs of controlling combined sewer overflows, and the length of the borrowing term. The estimates represent infrastructure costs as financed and thus include the estimated debt service paid from 2000 to 2019, whether for newly built projects or projects built before 2000.

^bSee U.S. Environmental Protection Agency, *The Clean Water and Drinking Water Infrastructure Gap Analysis*, EPA-816-R-02-020 (September 2002). According to the report, the difference between the low and high estimates is attributable to differing assumptions about infrastructure replacement rates.

^cSee Water Infrastructure Network, *Clean & Safe Water for the 21st Century* (April 2000). The estimates for capital investment and financing represent the capital costs associated with all investments during the 2000-2019 period as well as the interest paid over time on those investments. They differ from costs-as-financed estimates because they include debt service (principal and interest) paid after 2019 on investments during the two decades instead of debt service paid during that time on pre-2000 investments.

Local drinking water and wastewater utilities rely primarily on revenues from user rates to pay for infrastructure improvements. According to EPA's gap analysis, maintaining utility spending at current levels could result in a funding gap of up to \$444 billion between projected infrastructure needs and available resources.⁴ However, EPA also estimates that if utilities' infrastructure spending grows at a rate of 3 percent annually over and above inflation, the gap will narrow considerably and may even disappear. EPA's report concludes that utilities will need to use some combination of increased spending and innovative management practices to meet the projected needs.

The nation's largest utilities—those serving populations of at least 10,000—account for most of the projected infrastructure needs. For example, according to EPA data, large drinking water systems represent about 7 percent of the total number of community water systems, but account for about 65 percent of the estimated infrastructure needs. Similarly, about 29 percent of the wastewater treatment and collection systems are estimated to serve populations of 10,000 or more, and such systems account for approximately 89 percent of projected infrastructure needs for wastewater utilities. Most of the U.S. population is served by large drinking water and wastewater utilities; for example, systems serving at least 10,000 people provide drinking water to over 80 percent of the population.

Pipeline rehabilitation and replacement represents a significant portion of the projected infrastructure needs. According to the American Society of Civil Engineers, U.S. drinking water and wastewater utilities are responsible for an estimated 800,000 miles of water delivery pipelines and between 600,000 and 800,000 miles of sewer pipelines, respectively. According to the most recent EPA needs surveys, the investment needed

⁴Simply stated, the funding gap is equal to the estimated infrastructure needs less projected spending.

for these pipelines from 1999 through 2019 could be as much as \$137 billion.⁵

Several recent studies have raised concerns about the condition of the existing pipeline network. For example, in August 2002, we reported the results of a nationwide survey of large drinking water and wastewater utilities.⁶ Based on the survey, more than one-third of the utilities had 20 percent or more of their pipelines nearing the end of their useful life; and for 1 in 10 utilities, 50 percent or more of their pipelines were nearing the end of their useful life. In 2001, a major water industry association predicted that drinking water utilities will face significant repair and replacement costs over the next three decades, given the average life estimates for different types of pipelines and the years since their original installation.⁷ Other studies have made similar predictions for the pipelines owned by wastewater utilities.

Many Factors Have Contributed to Deteriorating Utility Infrastructure

EPA and water industry officials cite a variety of factors that have played a role in the deterioration of utility infrastructure; most of these factors are linked to the officials' belief that the level of ongoing investment in the infrastructure has not been sufficient to sustain it. For example, according to EPA's Assistant Administrator for Water, the pipelines and plants that make up the nation's water infrastructure are aging, and maintenance is too often deferred. He predicted that consumers will face sharply rising costs to repair and replace the infrastructure. Similarly, as the Water Environment Research Foundation reported in 2000, "years of reactive

⁵U.S. Environmental Protection Agency, *Drinking Water Infrastructure Needs Survey: Second Report to Congress*, EPA 816-R-01-004 (Washington, D.C.: February 2001) and U.S. Environmental Protection Agency, *Clean Watersheds Needs Survey 2000: Report to Congress*, EPA 832-R-03-001 (Washington, D.C.: August 2003).

⁶See [GAO-02-764](#), 3. We sent questionnaires to 1,425 drinking water systems and 2,391 wastewater systems serving more than 10,000 people. In our analysis, utilities were weighted to account statistically for all utilities serving populations greater than 10,000, including those not selected for our sample.

⁷American Water Works Association Water Industry Technical Action Fund, *Dawn of the Replacement Era: Reinvesting in Drinking Water Infrastructure* (Denver, Colo.: May 2001).

maintenance and minimal expenditures on sewers have left a huge backlog of repair and renewal work.”⁸

Our nationwide survey of large drinking water and wastewater utilities identified problems with the level of revenues generated from user rates and decisions on investing these revenues.⁹ For example:

- Many drinking water and wastewater utilities do not cover the full cost of service—including needed capital investments and operation and maintenance costs—through their user charges. Specifically, a significant percentage of the utilities serving populations of 10,000 or more—29 percent of the drinking water utilities and 41 percent of the wastewater utilities—were not generating enough revenue from user charges and other local sources to cover their costs.
- Many drinking water and wastewater utilities defer maintenance and needed capital improvements because of insufficient funding. About one-third of the utilities deferred maintenance expenditures in their most recent fiscal year;¹⁰ similar percentages of utilities reported deferring minor capital improvements and major capital improvements. About 20 percent of the utilities had deferred expenditures in all three categories.
- For many utilities, a significant disparity exists between the actual rehabilitation and replacement of their pipelines and the rate at which utility managers believe rehabilitation and replacement should occur. We found that only about 40 percent of the drinking water utilities and 35 percent of the wastewater utilities met or exceeded their desired rate of pipeline rehabilitation and replacement. The remaining utilities did not meet their desired rates. Roughly half of the utilities actually rehabilitated or replaced 1 percent or less of their pipelines annually.

Utility managers also lack the information they need to manage their existing capital assets. According to our survey, many drinking water and

⁸Water Environment Research Foundation, *New Pipes for Old: A Study of Recent Advances in Sewer Pipe Materials and Technology* (2000), 4-1.

⁹GAO-02-764, 7, 35, 42.

¹⁰We do not have specific information on the fiscal years covered in utilities’ responses; however, we sent our survey out during September 2001.

wastewater utilities either do not have plans for managing their assets or have plans that may not be adequate in scope or content. Specifically, nearly one-third of the utilities did not have plans for managing their existing capital assets. Moreover, for the utilities that did have such plans, the plans in many instances did not cover all assets or did not contain one or more key elements, such as an inventory of assets, assessment criteria, information on the assets' condition, and the planned and actual expenditures to maintain the assets.¹¹

Comprehensive Asset Management Focuses on Efficiently Managing Capital Assets

Comprehensive asset management has gained increasing recognition within the water industry as an approach that could give utilities the information and analytical tools they need to manage existing assets more effectively and plan for future needs. Using asset management concepts, utilities and other organizations responsible for managing capital infrastructure can minimize the total cost of designing, acquiring, operating, maintaining, replacing, and disposing of capital assets over their useful lives, while achieving desired service levels. Figure 1 shows some of the basic elements of comprehensive asset management and how the elements build on and complement each other to form an integrated management system.

¹¹For the purposes of our survey, we focused on the asset planning elements identified by the Governmental Accounting Standards Board in a June 30, 1999, statement that made comprehensive changes in state and local governments' financial reporting requirements. Among other things, it requires, for the first time, the governments to report information about public infrastructure assets, including their drinking water and wastewater facilities. Specifically, the governments must begin reporting depreciation of their capital assets or implement an asset management system. See *Governmental Accounting Standards Board Statement No. 34, Basic Financial Statements—and Management's Discussion and Analysis—for State and Local Governments*.

Figure 1: Elements of Comprehensive Asset Management



Source: GAO.

Experts within and outside the water industry have published manuals and handbooks on asset management practices and how to apply them.¹² While the specific terminology differs, some fundamental elements of implementing asset management appear consistently in the literature.

- *Collecting and organizing detailed information on assets.* Collecting basic information about capital assets helps managers identify their infrastructure needs and make informed decisions about the assets. An inventory of an organization's existing assets generally should include (1) descriptive information about the assets, including their age, size, construction materials, location, and installation date; (2) an assessment of the assets' condition, along with key information on operating, maintenance, and repair history, and the assets' expected and remaining useful life; and (3) information on the assets' value, including historical cost, depreciated value, and replacement cost.
- *Analyzing data to set priorities and make better decisions about assets.* Under asset management, managers apply analytical techniques to identify significant patterns or trends in the data they have collected on capital assets; help assess risks and set priorities; and optimize decisions on maintenance, repair, and replacement of the assets. For example:
 - *Life-cycle cost analysis.* Managers analyze life-cycle costs to decide which assets to buy, considering total costs over an asset's life, not just the initial purchase price. Thus, when evaluating investment alternatives, managers also consider differences in installation cost, operating efficiency, frequency of maintenance and repairs, and other factors to get a cradle-to-grave picture of asset costs.
 - *Risk/criticality assessment.* Managers use risk assessment to determine how critical the assets are to their operations, considering both the likelihood that an asset will fail and the consequences—in

¹²For example, see (1) *Managing Public Infrastructure Assets to Minimize Cost and Maximize Performance*, developed by the Association of Metropolitan Sewerage Agencies in partnership with the American Water Works Association, the Association of Metropolitan Water Agencies, and the Water Environment Federation (2002); (2) *International Infrastructure Management Manual*, published jointly by the Association of Local Government Engineering New Zealand, Inc., and the Institute of Public Works Engineering of Australia (2002); (3) *Asset Management Primer*, published by the U.S. Department of Transportation (December 1999); and (4) *Executive Guide: Leading Practices in Capital Decision-Making*, published by GAO (GAO/AIMD-99-32; December 1998).

terms of costs and impact on the organization's desired level of service—if the asset does fail.¹³ Based on this analysis, managers set priorities and target their resources accordingly.

- *Integrating data and decision making across the organization.* Managers ensure that the information collected within an organization is consistent and organized so that it is accessible to the people who need it. Among other things, the organization's databases should be fully integrated; for instance, financial and engineering data should be compatible, and ideally each asset should have a unique identifier that is used throughout the organization. Regarding decision making, all appropriate units within an organization should participate in key decisions, which ensures that all relevant information gets considered and encourages managers to take an organizationwide view when setting goals and priorities.
- *Linking strategy for addressing infrastructure needs to service goals, operating budgets, and capital improvement plans.* An organization's goals for its desired level of service—in terms of product quality standards, frequency of service disruptions, customer response time, or other measures—are a major consideration in the organization's strategy for managing its assets. As managers identify and rank their infrastructure needs, they determine the types and amount of investments needed to meet the service goals. Decisions on asset maintenance, rehabilitation, and replacement are, in turn, linked to the organization's short- and long-term financial needs and are reflected in the operating budget and capital improvement plan, as appropriate.

Implementing the basic elements of asset management is an iterative process that individual organizations may begin at different points. Within the water industry, for example, some utilities may start out by identifying their infrastructure needs, while other utilities may take their first step by setting goals for the level of service they want to provide. The interrelationship between the elements of asset management can alter an organization's strategy for managing its assets. For example, once an organization has completed a risk assessment, it may scale back its efforts to compile a detailed inventory of assets to focus initially on those assets

¹³For example, in the case of a drinking water utility, a water main serving the local hospital might be identified as a critical asset because the consequences of a water main break could be significant.

determined to be critical. Similarly, as information on infrastructure needs and priorities improves, managers reexamine the level of planned investments, considering the impact on both revenue requirements and the level of service that can be achieved. According to advocates of asset management, while many organizations are implementing certain aspects of the process, such as maintaining an inventory of assets and tracking maintenance, these organizations are not realizing the full potential of *comprehensive* asset management unless all of the basic elements work together as an integrated management system.

Strategy for Adopting and Progress toward Implementing Comprehensive Asset Management Varies

As the description of asset management indicates, implementing this approach is not a step-by-step, linear process. Asset management is an integrated system that utilities and other organizations can implement in a number of different ways, depending on what makes sense for their particular organization. In the United States, some drinking water and wastewater utilities, for example, are taking a more strategic approach, initially investing their resources in planning for asset management. Other utilities are focusing initially on collecting data. Another variation is that some utilities are adopting asset management on a utilitywide basis, while others are piloting the approach at a single facility or department or are targeting critical assets utilitywide. The level of sophistication with which asset management concepts are applied within a utility can also vary, depending on the size and complexity of the operations and the resources that the utility can devote to implementation.

Comprehensive asset management is a relatively new concept for drinking water and wastewater utilities in the United States. According to EPA and major water industry organizations, few utilities are implementing comprehensive asset management, and those that have done so are almost exclusively larger entities. In addition, for the most part, the domestic utilities that have adopted asset management are in the early stages of implementation. Few utilities have been involved in the process for longer than 2 to 3 years.

Although relatively new to the U.S. water industry, comprehensive asset management has been used for about 10 years by water utilities in Australia and New Zealand, where the national governments have strongly endorsed the concept. In each case, the driving force behind the use of asset management was legislation that called for water utilities to improve their financial management. In Australia, the law requires utilities to recover the full cost of service, while in New Zealand the law requires utilities to

depreciate their assets annually and use cost-benefit analysis, among other things. The national governments of Australia and New Zealand each published guidebooks on asset management, and engineering groups in the two countries jointly developed a comprehensive manual on managing infrastructure assets.¹⁴

Asset management is seen as a means of improving utility infrastructure elsewhere in the world. For example, in the United Kingdom, utilities must develop asset management plans that identify the level of investment required to maintain and improve capital assets every 5 years; annual audits help ensure that planned improvements are made. Similarly, in 2002, the legislature in Ontario, Canada enacted a law requiring municipalities to develop plans for recovering the full cost of service to ensure that drinking water and wastewater systems are adequately funded.

Objectives, Scope, and Methodology

The Ranking Minority Member, Senate Committee on Environment and Public Works, asked us to examine the use of comprehensive asset management at drinking water and wastewater utilities in the United States. This report examines (1) the potential benefits of asset management for water utilities and the challenges that could hinder its implementation and (2) the role that the federal government might play in encouraging utilities to implement comprehensive asset management.

To conduct our work, we reviewed relevant studies, handbooks, training materials, and other documents related to comprehensive asset management and its implementation, particularly for managing the infrastructure at drinking water and wastewater utilities. At the federal level, we obtained information from EPA's Office of Ground Water and Drinking Water and Office of Wastewater Management, the offices that, along with the states, are responsible for overseeing drinking water and wastewater utilities. We also obtained information on other federal agencies with experience in asset management, predominantly the Federal Highway Administration in the U.S. Department of Transportation, and financial standards promulgated by the Governmental Accounting Standards Board. For site-specific information, our review included over

¹⁴See *International Infrastructure Management Manual*, published jointly by the Association of Local Government Engineering New Zealand, Inc., and the Institute of Public Works Engineering of Australia (2002).

50 individual utilities from the United States, Australia, and New Zealand—including 15 U.S. utilities at which we conducted structured interviews.

Other sources of information included the following:

- state associations, including the Association of State Drinking Water Administrators and the Association of State and Interstate Water Pollution Control Administrators;
- major industry groups, including the American Public Works Association, American Water Works Association, Association of Metropolitan Sewerage Agencies, Association of Metropolitan Water Agencies, National Association of Water Companies, National Rural Water Association, Water Environment Federation, and Water Services Association of Australia;
- engineering and consulting firms with experience in helping utilities implement asset management, including Brown and Caldwell; CH2M Hill; Metcalf and Eddy, Inc.; Municipal and Financial Services Group; PA Consulting Group; and Parsons Corporation in the U.S.; GHD Pty. Ltd. in Australia; and Meritec in New Zealand;
- several state and regional regulatory agencies in Australia and New Zealand; and
- EPA-funded state and university-based training and technical assistance centers.

To obtain information on the benefits and challenges of asset management, we conducted initial interviews with 46 domestic drinking water and wastewater utilities that knowledgeable government and water industry officials identified as implementing comprehensive asset management. To obtain more detailed information, we conducted structured interviews with officials from 15 of the 46 utilities. We selected the 15 utilities based on two criteria: (1) they reported or anticipated achieving quantitative benefits from asset management or (2) they represented smaller entities.¹⁵ (See

¹⁵We were interested in learning about the applicability of asset management at small utilities because they represent the vast majority of the regulated systems, with 93 percent of community drinking water utilities and 71 percent of wastewater utilities serving 10,000 people or fewer.

app. I for a list of the 15 utilities we selected for structured interviews.) In total, 12 of the 15 utilities were relatively large, serving populations ranging from 300,000 to 2,500,000; the remaining three were significantly smaller, serving populations ranging from 3,000 to 67,100. Because of the small number of utilities that we interviewed in depth and the way in which they were selected, our results are not generalizable to the larger universe of domestic drinking water and wastewater utilities.

Because of the utilities' limited experience in implementing asset management, we supplemented the information obtained from domestic utilities with information from six utilities and five government agencies in Australia and New Zealand, two countries that have taken the lead in implementing comprehensive asset management. (See app. II for a list of the utilities and government agencies we contacted in Australia and New Zealand.) Outside the water industry, we consulted with the Private Sector Council, which identified two companies—The Gillette Company and SBC Communications, Inc.—with long-standing experience in using comprehensive asset management in their respective fields. We interviewed officials from these companies to obtain their perspectives on the benefits and challenges of implementing asset management.

For information on the potential federal role in promoting asset management at water utilities, we obtained information from EPA's Office of the Chief Financial Officer, Office of Ground Water and Drinking Water, and Office of Wastewater Management on the activities that EPA is currently sponsoring, including the development of informational materials on asset management; activities by EPA-funded, state and university-based training and technical assistance centers; and various studies and research projects. We also discussed options for a federal role in promoting asset management with officials from water industry associations, EPA, and the 15 utilities selected for structured interviews. In addition, with the help of organizations and officials experienced in asset management, we identified the U.S. Department of Transportation as being at the forefront of federal involvement in this issue. We obtained and reviewed information about the department's initiatives from the Office of Asset Management within the Federal Highway Administration.

We conducted our work between March 2003 and March 2004 in accordance with generally accepted government auditing standards.

**Comments from the
Environmental
Protection Agency**

We provided a draft of this report to EPA for review and comment. We received comments from officials within EPA's Office of Water and Office of the Chief Financial Officer, who generally agreed with the information presented in the report and our recommendations. They further noted that while EPA has played a major role in bringing asset management practices to the water industry, significant additional activity could be undertaken, and they have placed a high priority on initiating activities similar to those we suggested. The officials also made technical comments, which we incorporated as appropriate.

Water Industry Officials Report Many Benefits from Asset Management Despite Implementation Challenges

While comprehensive asset management is relatively new to most drinking water and wastewater utilities in the United States, some utilities say they have already benefited from this approach and have also encountered certain challenges. The utilities reported benefiting from (1) improved decision making because they have better information about their capital assets and (2) improved relationships with governing authorities, ratepayers, and other stakeholders because they are better able to communicate information on infrastructure needs and improvement plans. While water industry officials identified benefits associated with comprehensive asset management, we found that reported savings should be viewed with caution.

Among the challenges of implementing asset management, utility officials cited the difficulty of (1) collecting the appropriate data and managing it efficiently and (2) making the cultural changes necessary to integrate information and decision making across departments. In addition, the officials reported that the short-term budget and election cycles typical of utility governing bodies make it difficult to meet the long-term capital investment planning needs of asset management. Although smaller utilities face more obstacles to implementing asset management than larger utilities, principally because of limited resources, they can also benefit from applying asset management concepts.

Utilities Cite Many Benefits from Asset Management and Some Cautions About Reported Savings

U.S. utilities expect to reap significant benefits from the data they collect, analyze, and share through an asset management approach. With these data, utilities expect to make more informed decisions on maintaining, rehabilitating, and replacing their assets, thereby making their operations more efficient. Utilities can also use these data to better communicate with their governing bodies and the public, which should help them to make a sound case when seeking rate increases. Although water industry officials identified financial and other benefits from using asset management, reported savings should be viewed with caution because, for instance, comprehensive asset management may be implemented concurrently with other changes in management practices or operational savings may be offset by increases in capital expenditures.

Comprehensive Asset
Management Can Improve
Decisions about
Maintaining, Rehabilitating,
and Replacing Capital
Assets

Collecting, sharing, and analyzing data through comprehensive asset management can help utilities to make more informed decisions about maintaining, rehabilitating, and replacing their assets. In particular, utilities can use the information collected and analyzed to prevent problems and allocate their maintenance resources more effectively. For example:

- Better information enabled the Massachusetts Water Resources Authority to improve its maintenance decisions and eliminate some unneeded maintenance activities.¹ For example, in an effort to optimize maintenance practices in one of their treatment plants, utility officials reassessed maintenance practices for 12 equipment systems, such as different types of pumps. By using the assessment results to improve maintenance planning for these assets, the utility decreased the labor hours spent on preventive maintenance by 25 percent from the hours recommended by the original equipment manufacturers, according to utility officials. Similarly, in analyzing its maintenance practices, the Massachusetts Water Resources Authority found it was lubricating some equipment more often than necessary. By decreasing the frequency of oil changes, the utility reported it saved approximately \$20,000 in oil purchase and disposal costs. In addition, the utility extended the life of its assets by decreasing the lubrication—over-lubrication can cause equipment parts to fail prematurely.
- Seattle Public Utilities used asset management to better target its maintenance resources.² As part of the utility’s asset management strategy, officials used a risk management approach, calculating the likelihood and impact of a rupture for the utility’s sewer and drainage pipes. To determine the likelihood of rupture, officials considered such factors as a pipe’s age, material, and proximity to a historical landfill or steep slope. To determine the impact of a rupture, they examined factors such as a pipe’s size, location, and historical cost of repair. As a result of this analysis, utility officials identified 15 percent of their pipes as high risk, or “critical”—such as larger, older pipes located beneath downtown Seattle. They shifted resources to maintain and rehabilitate

¹The Massachusetts Water Resources Authority provides water and sewer services to approximately 2.5 million people.

²Seattle Public Utilities is a utility serving approximately 1.3 million drinking water customers and about 500,000 wastewater customers.

these pipes. The officials considered the remaining 85 percent of pipes as noncritical, or, lower risk, because their failure was less likely or because a breakage would affect a limited number of customers, be repaired relatively quickly, and require minimal resources. For these pipes, the utility decided not to perform any preventive maintenance activities, only making repairs as needed. By taking this approach, utility officials believe they are using their staff resources more efficiently and that, over time, they will reduce their maintenance costs.

Comprehensive asset management also helps managers to make more informed decisions about whether to rehabilitate or replace assets, and once they decide on replacement, to make better capital investment decisions. For example:

- According to utility managers at the Louisville Water Company, the utility developed its Pipe Evaluation Model in the early 1990s as a tool for ranking its 3,300 miles of aging pipes and water mains for rehabilitation and replacement.³ The pipe program includes many of the key principles and practices of comprehensive asset management: for instance, it integrated data about the age of the pipes with data about their maintenance history. In analyzing this information, managers discovered that two vintages of pipes—those built between 1862 and 1865 and between 1926 and 1931—had the highest number of breaks per 100 miles of pipeline. Consequently, they decided to replace the pipes from those two periods. The model also showed that pipes installed between 1866 and 1925 were fairly reliable, thus these pipes were targeted for rehabilitation rather than replacement. The utility is lining the interior of these pipes with cement, which is expected to extend their life by about 40 years. Furthermore, utility managers told us that their pipe model and other practices that use asset management principles have helped reduce the frequency of water main breaks from 26 to 22.7 per hundred miles and the frequency of leaks from joints from 8.2 to 5.6 per hundred miles.
- In implementing its asset management approach, managers at the Sacramento Regional County Sanitation District reassessed a proposed

³ The Louisville Water Company provides water services to approximately 800,000 people in the Louisville, Kentucky, area and in parts of Oldham and Bullitt counties.

investment in new wastewater treatment tanks and decided on a less expensive option, thereby saving the utility approximately \$12 million.⁴ During this reassessment, managers found that increasing preventive maintenance on existing tanks would lower the risk of shutdown more cost-effectively than adding a new set of tanks. Utility officials commented that their implementation of asset management helped change their decision-making process by, among other things, bringing together staff from different departments to ensure more complete information, and more effectively using the data to understand investment options.

- As a part of its asset management strategy, Seattle Public Utilities established an asset management committee, comprised of senior management from various departments, to ensure appropriate decision making about the utility's capital improvement projects. For every capital improvement project with an expected cost over \$250,000, project managers must submit a plan to the committee that (1) defines the problem to be solved, (2) examines project alternatives, (3) estimates the life-cycle costs of the alternatives, (4) analyzes the possible risks associated with the project, and (5) recommends an alternative. According to utility officials, implementing this process has led to deferring, eliminating, or altering several capital improvement projects, and contributing to a reduction in the utility's 2004 capital improvement project budget for water of more than 8 percent. For instance, after drafting new water pressure standards, the utility eliminated the need for some new water mains. It developed an alternative plan to provide more localized solutions to increase water pressure, resulting in expected savings of \$3 million. In another case, the utility reassessed alternatives to replacing a sewer line located on a deteriorating trestle, ultimately opting to restore and maintain the existing wood trestle and make spot repairs to the sewer line, which resulted in an estimated savings of \$1.3 million.

Finally, comprehensive asset management helps utilities share information across departments and coordinate planning and decision making. In this way, utility managers can reduce duplication of efforts and improve the allocation of staff time and other resources. For example, managers at Eastern Municipal Water District used asset management to improve their

⁴The Sacramento Regional County Sanitation District is a California wastewater utility serving approximately 482,000 customers in the Sacramento area.

business practices, which they saw as compartmentalized and inefficient.⁵ In one instance, they examined their decentralized maintenance activities. The utility had two maintenance crews who worked throughout the system, in different shifts and reported to managers at four different facilities. In addition, the utility's work order system was inefficient; for example, when different crew members independently reported the same maintenance need, managers did not notice the duplication because the problem was described in different terms (e.g., as a "breaker failure" by one crew member and as a "pump failure" by another). Finally, in some instances, work crews would arrive at a site only to find that needed maintenance work had already been completed. To improve the system, utility officials (1) centralized maintenance by making one person responsible for scrutinizing and setting priorities for all work orders and (2) established a standardized classification of assets, which helped maintenance staff use the same terminology when preparing work orders. Utility officials report that taking these steps allowed them to identify and eliminate work orders that were unnecessary, already completed, or duplicates, which ultimately reduced their maintenance work backlog by 50 percent.

The private sector companies we visited agreed that using a comprehensive asset management approach improved their decision making. Specifically, by improving their data, analyzing these data, and centralizing management decision making, managers at SBC Communications, Inc., reported that they have made better capital investment decisions and allocated resources more efficiently. Managers at The Gillette Company reported that they consider life-cycle costs and other factors to assess investment alternatives and, ultimately, make better investment decisions.

Comprehensive Asset Management Can Help Utilities Justify Rate Increases and Proposed Projects to Their Customers and Governing Bodies

The utilities we contacted reported that comprehensive asset management also benefits their relations with external stakeholders by (1) making a sound case for rate increases to local governing bodies and ratepayers; (2) improving their bond rating with credit rating agencies, and (3) better demonstrating compliance with federal and state regulations.

⁵Eastern Municipal Water District is a water and wastewater utility serving approximately 501,000 customers in Southern California.

Making a Sound Case for Rate
Increases

Some utilities have used, or expect to use, the information collected through comprehensive asset management to persuade elected officials to invest in drinking water and wastewater infrastructure through rate increases. For example, the Louisville Water Company reported that in the early 1990s it used the asset information it had gathered and analyzed to convince its local governing board that its current rates would not cover its expected costs and that the utility needed a rate increase to cover its anticipated rehabilitation and replacement needs. The board approved a set-aside of \$600,000 for an infrastructure rehabilitation and replacement fund as a part of the requested rate increase in 1993, and, according to one utility official, has been supportive of including funds for asset rehabilitation and replacement as a part of rate requests since then. Furthermore, the utility manager requested that the amount of the set-aside gradually increase to \$3 million over the next 5 years. According to this official, the board not only approved this request, it also increased the rates to support the fund sooner than the utility manager had requested. According to several other utilities that have begun to implement comprehensive asset management, this approach should enable them to justify needed rate increases from their governing bodies. Similarly, Australian and New Zealand officials we interviewed stated that the data from asset management helps utilities make a more credible case for rate increases from their governing bodies.

Utility managers can also use the information they provide to their governing boards as a basis for evaluating and deciding on trade-offs between service levels and rates. For example, according to an official at South Australian Water Corporation, using asset management practices, he was able to suggest a range of funding alternatives to the utility's governing body.⁶ The utility managers conducted statistical modeling on the asset information they collected (e.g., pipe performance history and financial information) and, using this analysis, predicted the approximate number of pipe breaks at various levels of funding. Understanding the trade-offs between lower rates and higher numbers of pipe breaks, the governing body could make an informed decision about what the appropriate level of service was for their community.

⁶The South Australian Water Corporation, an Australian utility located in the state of South Australia, provides water and wastewater services for approximately 1.4 million people.

Improving the Bond Rating

Comprehensive asset management also has the potential to improve a utility's bond rating, a benefit that translates into savings through lower interest rates on loans and bonds. When deciding on a utility's bond rating, credit rating agencies consider criteria related to comprehensive asset management, such as the utility's management strategies and its planning for asset replacement. For example, according to a representative from one credit rating agency, asset management shows that a utility is considering future costs. He would therefore expect a utility with an asset management plan that looks at future capital and operating costs and revenues to receive a higher bond rating than a utility that does not sufficiently consider those future needs, even if that utility has a better economy and a higher tax base.

Some local officials believe that comprehensive asset management played a role in the bond ratings they received, or will do so in the future. For example, the finance director of the small northeastern city of Saco, Maine, told us that she believes that the city's decision to use asset management practices—such as maintaining an up-to-date asset inventory, periodically assessing the condition of the assets, and estimating the funds necessary to maintain the assets at an acceptable level each year—contributed to the credit rating agencies' decision to increase the city's bond rating, which resulted in an expected savings of \$2 million over a 20-year period.⁷ Similarly, a utility official at Louisville Water Company told us that asset management practices, such as strategically planning for the rehabilitation and replacement of its aging assets, helps the utility maintain its strong bond rating.

⁷Saco, Maine, is a city of approximately 16,800 people. Among other services, the city government is responsible for providing wastewater treatment. The city asked to have its bond rating reassessed before beginning a school renovation project.

Better Demonstrating
Compliance with Federal and
State Regulations

According to several utility managers we interviewed, comprehensive asset management can be used to help comply with regulations. For example:

- Comprehensive asset management practices played a role in improving their utility's compliance with existing regulations. Specifically, among other things, asset management practices such as identifying and maintaining key assets led to fewer violations of pollutant discharge limitations under the Clean Water Act. At Western Carolina Regional Sewer Authority, for instance, the number of these violations decreased from 327 in 1998 (about the time that the utility began implementing asset management) to 32 violations in 2003.⁸
- At the Charleston Commissioners of Public Works,⁹ utility officials told us that if they had not had asset management in place it would be difficult to meet the rehabilitation program and maintenance program elements of EPA's draft capacity, management, operation, and maintenance regulations for wastewater utilities.¹⁰ For instance, the draft regulations would require that wastewater utilities identify and implement rehabilitation actions to address structural deficiencies. Because the utility has implemented asset management practices, such as assessing the condition of its pipes and identifying those most in need of rehabilitation, it can better target its resources to rehabilitate pipes in the worst condition, and, in the process, meet the proposed standards for rehabilitation.

⁸Western Carolina Regional Sewer Authority provides wastewater treatment services to approximately 360,000 customers in Greenville County, South Carolina, and portions of Spartanburg, Laurens, and Anderson counties.

⁹The Charleston Commissioners of Public Works provides water and wastewater services to more than 400,000 customers in the Charleston, South Carolina, area.

¹⁰These regulations are under consideration. EPA proposed the regulations in January 2001, but in accordance with the incoming administration's regulatory review plan, withdrew the proposal to give the administration an opportunity to review it.

Although Water Industry
Officials Identified Financial
and Other Benefits from
Asset Management,
Reported Savings Should Be
Viewed with Caution

Many of the U.S. utilities we interviewed were still in the early stages of implementing asset management and most had not measured financial savings. However, many water industry officials expect asset management to result in overall cost savings. Specifically, several officials told us they expect that asset management will slow the rate of growth of utilities' capital, operations, and maintenance costs over the coming years. Nevertheless, total costs will rise because of the need to replace and rehabilitate aging infrastructure.

At least one U.S. utility has estimated the overall savings it will achieve using comprehensive asset management. Specifically, an engineering firm projected that asset management would reduce life-cycle costs for the Orange County Sanitation District by about \$350 million over a 25-year period.¹¹ Among other data, the engineering firm used the utility's available operating expenditure information (operations, maintenance, administration, and depreciation data) and capital improvement program expenditures (growth/capacity, renewal/replacement, and level of support data) to model the projected life-cycle cost savings.

Additionally, some of the Australian utilities we interviewed reported financial savings. For example, officials at Hunter Water Corporation reported significant savings in real terms between fiscal years 1990 and 2001: a 37 percent reduction in operating costs;¹² improved service standards for customers, as measured by such factors as water quality and the number of sewer overflows; and a reduction of more than 30 percent in water rates for customers.¹³ Hunter Water officials believe that they achieved these efficiencies as a result of asset management.

Though utility officials have made some attempts to quantify the impact of asset management, they also cited reasons for exercising caution in interpreting reported savings and other benefits. First, benefits such as operating cost reductions should not be considered in isolation of other utility costs. A utility cannot consider reductions in operating costs a net

¹¹The Orange County Sanitation District provides wastewater services for approximately 2.3 million people living in central and northwest Orange County, California.

¹²The operating cost reductions were measured per property, or for each residential or community property connected to the water and sewer supply.

¹³Hunter Water Corporation is an Australian utility that provides water and wastewater services to almost 500,000 people in parts of New South Wales.

benefit if, for instance, savings in operational costs are offset by an increase in the utility's capital expenditures. Furthermore, reductions in operating costs may be caused by increases in capital expenditures because, for example, newer assets may require less maintenance and fewer repairs. In the case of the Hunter Water Corporation, the utility's capital expenditures were at about the same level in 2001 as in 1991, despite some fluctuation over the period.¹⁴

Second, other factors might have contributed to financial and other benefits. For example, a utility may be implementing other management initiatives concurrently with asset management and may not be able to distinguish the benefits of the various initiatives. In addition to using an asset management approach, for instance, some U.S. utilities we interviewed used an environmental management system, which shares some of the same components as asset management.¹⁵ Some of these utilities told us that they could not separate the benefits of asset management from those achieved as a result of their environmental management systems.

In addition, reported savings from asset management can be misleading without complete information on how the savings estimates are derived. For example, a widely distributed graph shows an estimated 15 percent to 40 percent savings in life-cycle costs for 15 wastewater utilities in Australia. EPA and others used the graph as a basis for projecting savings for U.S. utilities. However, the graph was mislabeled at some point—the reported reductions in life-cycle costs were actually reductions in operating costs.¹⁶ As we have already noted, operating costs reductions alone do not provide enough information to determine the net benefit of implementing asset management.

¹⁴Hunter Water's capital expenditures fluctuated during the 10-year period, decreasing from about \$40 million in 1990/1991 to about \$10 million in 1997/1998, then spiking to about \$62 million in 2000/2001, then decreasing to about \$40 million again. Utility officials attribute the spike in capital expenditures to growth and a regulatory upgrade of the utility's wastewater treatment system and transport system.

¹⁵An environmental management system is a management tool to help an organization improve its environmental performance, prevent pollution, and meet regulatory requirements.

¹⁶EPA used these mislabeled Australian estimates as a basis for projecting life-cycle cost savings of 20 to 30 percent for U.S. utilities using asset management. Additionally, it appears that the engineering firm that predicted about \$350 million in life-cycle cost savings for Orange County Sanitation District used the same estimates in its model.

Utilities Face Challenges in Successfully Implementing Comprehensive Asset Management

Despite the acknowledged benefits of comprehensive asset management, utilities face three key challenges that may make implementing this approach difficult. First, to determine the condition of current assets and the need for future investment, utilities have to gather and integrate complete and accurate data, which may require significant resources. Second, successful implementation requires cultural change—departments long accustomed to working independently must be willing to coordinate and share information. Finally, utilities may find that their efforts to focus on long-term planning conflict with the short-term priorities of their governing bodies. These three challenges may be more difficult for smaller utilities because they have fewer financial, staff, and technical resources.

Asset Management Requires Utilities to Collect Complete and Accurate Data

The difficulties utilities experience gathering data to implement asset management depend on the (1) condition of their existing data, (2) ability to coordinate existing data across departments, (3) need to upgrade technology, and (4) ability to sustain complete and accurate data. One industry official noted that larger utilities, in particular, may have a more difficult time gathering and coordinating data because they typically possess a substantial number of assets. Nevertheless, utility officials and water association representatives agree that utilities should not allow these data challenges to prevent them from implementing asset management. These officials emphasized that utilities should begin implementing asset management by using the data they already possess, continuing data collection as they perform their routine repair and maintenance activities, or focusing data collection efforts on their most critical assets.

Existing Data May Be Incomplete and Inaccurate

Domestic and international water officials emphasize the importance of obtaining, integrating, and sustaining good data for decision making. This is no small challenge. According to the Association of Metropolitan Sewerage Agencies and the *International Infrastructure Management Manual*, utilities generally need the following types of data to begin implementing asset management:

- age, condition, and location of the assets;
- asset size and/or capacity;
- valuation data (e.g., original and replacement cost);
- installation date and expected service life;

- maintenance and performance history; and
- construction materials and recommended maintenance practices.

According to utility officials and industry handbooks, utilities sometimes have incomplete or inaccurate historical data about their assets. For example:

- An official at the Augusta County Service Authority noted that the utility did not possess a great deal of detailed historical data about its assets.¹⁷ For example, its asset ledger would indicate that “a pump station was installed at a particular location in 1967,” but would not provide any additional information about the assets, such as the individual components that make up this system. Similarly, the official told us that the utility’s prior billing system did not maintain historical data about its customers’ water usage rates. As a result, the management team found it difficult to adequately forecast their needed rate increases because they lacked historical information about water consumption.
- According to an East Bay Municipal Utility District official, the utility lacked detailed maintenance data on its assets before 1990 because maintenance workers had not consistently reported repairs to a central office.¹⁸

Given these problems, utility managers may have to invest a significant amount of time and resources to gather necessary data, particularly data about the condition of their thousands of miles of buried pipelines. Understandably, utilities are unwilling to dig up their pipelines to gather missing data. However, utilities may be able to derive some information about the condition of these pipes to the extent they have information on the pipes’ age, construction material, and maintenance history. In addition, utilities may choose to align their data collection with their ongoing maintenance and replacement activities. These approaches, however, may require new technology, which may mean a financial investment. For example:

¹⁷Augusta County Service Authority serves a population of approximately 67,000 people in Virginia.

¹⁸East Bay Municipal Utility District supplies water and provides wastewater treatment to approximately 1.3 million drinking water customers and 640,000 wastewater customers in parts of Alameda and Contra Costa counties in northern California.

- Tacoma Water equipped its staff with laptop computers, which allows them to access their geographic information system—software that can track where assets are located—while they are in the field.¹⁹ As the staff perform their routine repair and rehabilitation activities, they can record and update data about an asset’s condition, performance, and maintenance history.
- Similarly, the Department of Public Works in Billerica, Massachusetts, provided its field staff with handheld electronic devices programmed with a simple data collection template, which allows its staff to more accurately record information about its assets and their condition.²⁰ Consequently, the field staff can enter more accurate information about the utility’s assets into its central asset inventory.

Utilities also reported difficulty collecting and applying information about the manufacturer’s recommended techniques for optimizing their maintenance practices for their assets. Since no central clearinghouse of information on optimal maintenance practices is readily available, these utilities have had to invest their own time and resources to develop this information. For example:

- According to an official at Des Moines Water Works, the utility discovered that the manufacturer’s recommended maintenance practices often conflicted with the utility’s experience with the same asset.²¹ This official pointed out that the manufacturer’s estimate for maintenance was always higher than the utility’s experience. Given these inconsistencies, the official noted, all utilities would benefit from the development of a central industry clearinghouse that provided information about the recommended maintenance practices for certain assets.
- Similarly, an official at East Bay Municipal Utility District noted a significant difference between the manufacturer’s recommended

¹⁹Tacoma Water serves approximately 300,000 customers in the city of Tacoma, Washington, and portions of Pierce and South King counties.

²⁰The Department of Public Works in Billerica, Massachusetts, serves a population of approximately 10,000 people.

²¹Des Moines Water Works distributes water to a population of approximately 300,000 in Des Moines, Iowa, and its surrounding communities.

maintenance practices and the utility's experience with optimized maintenance. As a result, the utility has invested a significant amount of time in developing optimal maintenance practices for its assets and minimizing the risk of asset failure.

While utilities need complete and accurate data for decision making, they also need to balance data collection with data management. Utilities may fall prey to data overload—collecting more data than they have the capacity to manage. For example, according to an official at the Augusta County Service Authority, while the utility has collected extensive infrastructure data, it has not invested enough of its resources into making these data useful for decision making. This official told us that utilities need to develop a data management strategy that identifies the types of data they need and the uses of these data for decision making. Without such a strategy, utilities gathering data will reach a point of diminishing returns. According to an official at the National Asset Management Steering Group in New Zealand, utilities should begin to implement asset management by identifying their critical assets and targeting their data-gathering activities toward the critical information they need in order to make decisions about these assets. An official also recommended that utilities begin implementation by using their existing data—even though the data may not be completely accurate—and refine this information as they improve and standardize their data collection processes.

Coordinating Data Across Departments May Be Difficult

According to utility officials, coordinating data can be difficult because the data come from several different departments and from different sources within the departments. Furthermore, one industry handbook notes that a utility's departments typically maintain different types of data about the same assets, which are formatted and categorized to meet each department's individual needs and objectives.²² For example, the finance department may record an asset's size in terms of square footage, while the engineering department may define an asset's size in terms of pipeline diameter. Utilities adopting asset management need to coordinate these data to develop a central asset inventory. Table 2 shows the typical sources of data for a central inventory.

²²See *Managing Public Infrastructure Assets to Minimize Cost and Maximize Performance*, 57.

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Table 2: Typical Sources of Data for a Central Asset Inventory

| Department maintaining data | Source of data | Types of data that may be available |
|------------------------------------|------------------------------------|--|
| Operations and Maintenance | Operations and maintenance manuals | Location, size, manufacturer, and materials of construction |
| | Maintenance management system | Location, size, manufacturer, materials of construction, performance history, maintenance history, and original cost |
| | Records of original asset drawings | Location, size, manufacturer, and materials of construction |
| Engineering | Geographic information system | Location, size, and materials of construction |
| | Records of original asset drawings | Location, size, manufacturer, and materials of construction |
| Finance | Fixed asset inventory | Size (e.g., square footage or acreage), installation date, and estimated value |

Source: GAO.

Note: Summary of material from two industry handbooks, *Managing Public Infrastructure Assets to Minimize Cost and Maximize Performance* and the *International Infrastructure Management Manual*.

Utility managers told us it was challenging to develop a standard data format for their central asset inventories. For example:

- As previously noted, Eastern Municipal Water District’s work order system was inefficient because crew members from different facilities did not use the same terms in describing maintenance problems. To eliminate these inefficiencies, the utility invested a great deal of time and resources to standardize its terms and asset classification and implement a computerized maintenance management system.
- According to a Louisville Water Company official, improving and validating the utility’s data was a challenge. Over the years, the utility has acquired between 12 and 20 smaller utilities. Each of these smaller utilities maintained its own asset data, which were not always reliable or maintained in the same format. The utility invested a great deal of time to validate these data and coordinate them into its central asset inventory.

Utilities May Need to Upgrade Their Technology

- Similarly, according to an official at the South Australian Water Corporation, developing a central asset inventory was particularly difficult because each of the utility's departments used different terms to refer to the same asset. The utility refined its data collection practices by training its employees on how to record data in a standard format.

The utility officials we spoke to also had to address problems in coordinating data maintained in different and incompatible software programs. A Water Environment Research Foundation survey of utility managers, regulators, and industry consultants cited developing an asset information management system that meets the needs of all users as the most difficult element of asset management to implement. Without an integrated information management system, utilities found it difficult to develop data for decision making, and they found that they had to invest time and money to enter these data into a central database. For example:

- According to a Greater Cincinnati Water Works official, the utility wanted to integrate information about its assets' location and maintenance history to efficiently dispatch staff to repair sites.²³ However, the data for this report were stored in two separate and incompatible computer systems. To produce this information, the utility needed to re-enter the relevant data from each of these systems into a central asset database.
- Similarly, an official at Melbourne Water Corporation said that as his utility began to adopt asset management, it realized that it maintained relevant data in different computer systems, such as its computerized maintenance management system and its geographic information system.²⁴ To address this fragmentation, the utility had to assign staff to consolidating its data into a central database to allow for easy integration.

As utilities coordinate their data systems, they may need to upgrade their existing technology, which can represent a significant financial investment.

²³Greater Cincinnati Water Works provides water to approximately 1.2 million customers.

²⁴Melbourne Water Corporation manages the city of Melbourne's water catchments and major distribution system. The utility supplies approximately 500,000 megaliters of water annually to its three retail water companies.

For example, Augusta County Service Authority has requested \$100,000 to purchase data integration software, which would allow it to coordinate information from several different computer systems. However, as of September 2003, this request had not been approved, in part because the software may not directly affect the utility's profits or improve its service, making the governing body reluctant to finance the purchase. Similarly, St. Paul Regional Water Services recognized that it would need to purchase a geographic information system as the basis for integrating all departments' data.²⁵ However, the official noted that the utility could not purchase this system for another 4 years because it would cost several million dollars to purchase the system, enter data, and train its staff to operate the new system.

Utilities Face Challenges in Maintaining Complete and Accurate Data

As utilities continue to obtain and integrate data, they still face the challenge of maintaining complete and accurate data about their assets. The *International Infrastructure Management Manual* notes that data collection is a continuous process and that utilities need to remain consistent in gathering data and updating their central asset inventory as they repair, replace, or add infrastructure. Regular updating ensures that the information remains useful over time. To sustain the benefits garnered from its efforts to compile an accurate inventory, the Eastern Municipal Water District adopted a policy whereby employees must document changes to the inventory whenever assets are added, repaired, or removed. The utility has also developed methods to enforce its policy to make sure that the inventory is updated as required.

Interdepartmental Coordination and Information Sharing Present Difficult Cultural Challenges

According to industry officials, one of the major challenges to implementing asset management is changing the way utilities typically operate—in separate departments that do not regularly exchange information. It is essential to change this management culture, these officials believe, to encourage interdepartmental coordination and information sharing.

To encourage interdepartmental communication, utilities may have to train their employees in using the resources of other departments. For example, at the Orange County Sanitation District, the management team found it

²⁵St. Paul Regional Water Services provides drinking water to approximately 415,000 residents of St. Paul, Minnesota, and its surrounding communities.

difficult to demonstrate to its employees that their job responsibilities do indeed affect the functions of the other departments. The utility's field staff possesses extensive information about the condition and performance of assets because they maintain these assets every day. However, these employees did not understand that the engineering department needs feedback on how the assets that the engineering department constructed are performing in the field. Such feedback could change future designs for these assets to improve their performance. As the utility implemented asset management, it established a work group to examine the conditions of asset failure, which provided a forum for the maintenance and engineering departments to collaborate. While this work group is still ongoing, one utility official noted that collaboration between these two departments will result in more efficient maintenance schedules for the utility's assets.

Similarly, the Eastern Municipal Water District reported that its middle-management team resisted some of the asset management changes because they believed these changes would limit their authority to manage their staff and workload. Before asset management, the utility maintained four different treatment facilities, each with its own maintenance staff. The utility believed that it could optimize its maintenance resources by combining all of the maintenance activities and staff at the four plants under one department. However, the managers at these treatment plants were reluctant to relinquish managerial control over their maintenance staff and feared that their equipment would be neglected. Once the new maintenance department was formed, however, these plant managers realized that centralizing these functions resulted in faster maintenance because the larger team could more effectively allocate time among the four facilities.

In some instances, utility employees may be reluctant to accept comprehensive asset management because it requires them to take on additional responsibilities when they are already pressed for time in their "day jobs." Additional time may indeed be necessary. According to officials at different utilities we visited, asset management requires staff throughout the organization to attend a variety of training programs—introductory, refresher, and targeted training by function or job—to ensure that they understand the value of asset management to both their own jobs and the operation of the utility.

Utilities' Efforts to Increase
Focus on Long-Term
Planning Conflict with
Short-Term Priorities

While asset management provides utilities with information to justify needed rate increases, their justifications may not be effective because their governing body and their customers want to keep rates low. According to utility officials, governing bodies' reluctance to increase rates may be linked to constituent pressure to hold down user rates. In 2002, we reported that 29 percent of drinking water and 41 percent of wastewater utilities serving populations over 10,000 did not cover their full cost of service through user rates in their most recent fiscal year. Furthermore, about half of these utilities did not regularly increase their user rates; rather, they raised their user rates infrequently—once, twice, or not at all—from 1992 to 2001.

Utility officials and water industry organizations also note that utilities may have to respond to governing bodies' interests rather than to the long-term plan they developed using comprehensive asset management. For instance, while the Orange County Sanitation District's governing board has supported comprehensive asset management, it overrode utility plans for some capital projects and instead funded a \$500 million secondary sewage treatment plant, which was not a utility priority. The board took this action in response to public concerns that the operating sewage plant was inadequate and had contaminated the water. A subsequent report showed, however, that the contamination more than likely did not result from an inadequate treatment plant. However, the utility will probably have to defer other priorities in order to design and build this new facility. In addition, the governing body may shift funding originally budgeted to implement the next phase of Orange County's asset management program to fund the new plant.

Several industry officials also pointed out that governing bodies for municipally owned utilities tend to make financial decisions about their drinking water and wastewater utilities in light of competing local needs that may be a higher priority for the electorate. One industry official also reported that locally elected officials tend to focus their efforts on short-term, more visible projects, while utility managers must focus on sustaining the utility's operation in the long term. For example, a utility's governing body may decide to forgo infrastructure repairs in order to build a new school or baseball field.

Smaller Utilities Can Benefit from Asset Management Despite Challenges Posed by Limited Resources

Smaller utilities can also benefit from the improved data, coordination, and informed decision making that result from asset management. Although small utilities represent a substantial portion of the water and wastewater industry,²⁶ officials recognize that these utilities may have more difficulty implementing asset management because they typically have fewer financial, technological, and staff resources. In addition, EPA has reported that small systems are less likely to cover their full cost of providing services because they have to spread their fixed infrastructure costs over a smaller customer base. However, EPA believes that comprehensive asset management will enable smaller systems to increase knowledge of their system, make more informed financial decisions, reduce emergency repairs, and set better priorities for rehabilitation and replacement.

Even the most rudimentary aspects of asset management can produce immediate benefits for small communities. For example, the Somersworth, New Hampshire, Department of Public Works and Utilities avoided a ruptured sewer main because it had collected data through its asset management initiative that mapped the location of critical pipelines.²⁷ As a result, when a resident applied for a construction permit to build a garage, the utility determined that one critical pipeline lay in the path of the proposed construction and could rupture. Therefore, the city of Somersworth denied the permit.

Similarly, the Department of Public Works in Denton, Maryland, which provides both drinking water and wastewater services, obtained positive results from applying asset management concepts without having to invest in sophisticated software or perform a complicated analysis. In this case, Denton's city council was apprehensive about investing in new trucks for the utility even though some of the existing trucks were in poor condition. Council members believed that it would be less expensive to continue repairing the existing fleet. However, using data collected through their asset management initiative, utility managers were able to track the maintenance and depreciation costs associated with these vehicles. As a result, they could demonstrate to their governing body that it was more

²⁶As noted earlier, most U.S. utilities are small, with 93 percent of the 54,000 community drinking water systems and 71 percent of the 16,000 wastewater systems serving 10,000 people or fewer.

²⁷Somersworth is a New Hampshire city with approximately 11,000 residents. Somersworth's Department of Public Works and Utilities is responsible for water and wastewater services for the city.

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cost-effective to purchase new vehicles than to continue repairing the older trucks.

Because smaller utilities have fewer capital assets to manage, industry officials noted that these utilities can implement asset management by turning to low-cost alternatives that do not require expensive or sophisticated technology. The small utilities can implement asset management using their existing asset data and recording this information in a central location that can be accessed by all of its employees, such as a set of index cards or an Excel spreadsheet. Similarly, the utility can adopt the practices of asset management incrementally, by initially making asset decisions based on their existing data.

EPA Can Encourage Water Utilities to Use Asset Management by Strengthening Existing Initiatives

Opportunities exist for EPA to encourage water utilities' use of asset management by strengthening existing initiatives. Currently, EPA sponsors several initiatives to promote the use of asset management, such as training and informational materials, technical assistance, and research. While this is a good first step, the entities involved in these initiatives are not systematically sharing information within and across the drinking water and wastewater programs. With better coordination, however, EPA could leverage limited resources and reduce the potential for duplication within the agency. EPA could supplement its own efforts to disseminate information on asset management by taking advantage of similar efforts by other federal agencies, such as the Department of Transportation. Water industry officials also see a role for EPA in educating utility managers about how asset management can be a tool to help them meet regulatory requirements related to utility management. However, the officials raised concerns about the implications of mandating asset management as proposed in legislation being considered by the Congress.

EPA Sponsors Several Initiatives to Promote Utilities' Use of Asset Management

Through partnerships with water industry associations and universities, EPA has supported the development of training and informational materials to help drinking water and wastewater utilities implement asset management. In particular, EPA contributed funding toward the development of a comprehensive industry handbook on asset management, which was published in 2002 under a cooperative agreement with the Association of Metropolitan Sewerage Agencies.¹ The handbook lays out the principles of asset management and describes how utilities can use this approach to improve decision making, reduce costs, and ensure the long-term, high-level performance of their assets.

EPA has also sponsored materials specifically directed at small utilities. For small drinking water systems, EPA's Office of Ground Water and Drinking Water published a handbook in 2003 that describes the basic concepts of asset management and provides information on how to develop an asset management plan.² In addition, to help entities such as

¹The Association of Metropolitan Sewerage Agencies developed the handbook, *Managing Public Infrastructure Assets to Minimize Cost and Maximize Performance*, in partnership with the American Water Works Association, the Association of Metropolitan Water Agencies, and the Water Environment Federation.

²U.S. Environmental Protection Agency, *Asset Management: A Handbook for Small Water Systems*, EPA 816-R-03-016 (Washington, D.C.: September 2003).

mobile home parks and homeowners' associations that own and operate their own water systems, the office is developing a booklet on preparing a simple inventory of the systems' assets and assessing their condition.³ EPA's Office of Wastewater Management is funding the development of a "toolkit" by a university-based training center to help small wastewater utilities implement asset management. The toolkit is currently being field tested and is scheduled for release in 2006. Among other things, it includes self-audit instruments to help utility managers to analyze their systems' needs, training materials, and a summary of lessons learned in the field.

In addition to various informational materials on asset management, EPA has sponsored a number of training and technical assistance programs. For example, the Office of Wastewater Management, along with representatives from a major utility and an engineering firm, developed a 2-day seminar on asset management, which will be held at several locations around the country during fiscal year 2004. For smaller drinking water and wastewater utilities, EPA funds state and university-based centers that provide training and technical assistance to small utilities on a variety of matters, including asset management. Specifically

- EPA's Office of the Chief Financial Officer funds nine university-based "environmental finance centers" that assist local communities in seeking financing for environmental facilities, including municipal drinking water and wastewater utilities. In fiscal year 2003, the nine centers shared a total of \$2 million in funding from the Office of the Chief Financial Officer; some centers also receive funds from EPA program offices for specific projects. According to an official in EPA's Office of Ground Water and Drinking Water, at least three of the finance centers have efforts related to asset management planned or underway to benefit drinking water utilities. For example, the centers at Boise State University and the University of Maryland provide on-site and classroom training on establishing an asset inventory; collecting data on the age, useful life, and value of capital assets; recordkeeping; financing; and setting rates high enough to cover the full cost of service. Regarding the latter topic, Boise State's finance center developed a simplified software program, called CAPFinance, which can help smaller systems collect and analyze the data they need in order to set

³EPA has drafted the booklet, *Taking Stock of Your Water System*, and expects to publish the final version sometime in 2004.

adequate user rates; much of this information can be used to create a rudimentary asset management program.

- Another eight university-based technical assistance centers receive funding under the Safe Drinking Water Act to help ensure that small drinking water systems have the capacity they need to meet regulatory requirements and provide safe drinking water. In fiscal year 2003, the eight centers shared about \$3.6 million in funding from the Office of Ground Water and Drinking Water. According to an official from that office, three of the centers are holding workshops or developing guidance manuals that focus on sustaining the financial viability of small systems in some way; the official believes that much of this material is relevant to implementing asset management.
- The Office of Wastewater Management funds 46 state and university-based environmental training centers under the Clean Water Act to train wastewater utility officials on financial management, operations and maintenance, and other topics. According to an official with EPA's wastewater program, one of the 46 centers is developing a series of six training courses to help small wastewater utilities implement some of the basic elements of asset management, such as inventorying system assets and assessing their condition.⁴ Once this effort is completed, the center will disseminate the course materials to the remaining 45 centers so that staff from the other centers will be able to teach the asset management courses to operators of small wastewater utilities across the country.

EPA has also funded research projects related to asset management. For example, one project—sponsored by EPA, the Water Environment Federation, and the Association of Metropolitan Sewerage Agencies—examined the interrelationship between asset management and other management initiatives, such as environmental management systems, that have received some attention within the water industry.⁵ The project found

⁴The training courses are being developed by the environmental training center located at the College of Southern Maryland, which is also responsible for the asset management toolkit for small wastewater utilities. To fund this work, EPA awarded the center a 3-year grant totaling \$450,000, covering the period from August 2002 to August 2005.

⁵An environmental management system is a management tool to help an organization improve its environmental performance, prevent pollution, and meet regulatory requirements.

that to varying degrees, the initiatives share a common focus on continuous improvement through self-assessment, benchmarking, and the use of best practices and performance measures. The final report, issued in September 2002, concluded that while the initiatives overlap substantially, they are generally compatible.⁶

EPA also contributed \$75,000 toward a 2002 report by the Water Environment Research Foundation, which summarized the results of a 2-day workshop held to develop a research agenda for asset management.⁷ Workshop participants, who included utility managers, regulators, and industry consultants, identified areas in which they need improved tools and technical approaches, established criteria for evaluating asset management research needs, and identified and set priorities for specific research projects. According to the foundation's report, the workshop ultimately recommended 11 research projects, 2 of which will get underway in 2004. EPA is contributing \$200,000 to one of these projects, which will develop protocols for assessing the condition and performance of infrastructure assets and predictive models for correlating the two. The foundation will fund the second project, which is scheduled to begin in March 2004, and will develop guidance on strategic planning for asset management. According to EPA, the second project will also develop a Web-based collection of best practices on asset management; utilities will be able to purchase licenses to gain access to the materials.

The remaining research projects identified in the workshop highlight the need for practical tools to help utilities implement the most fundamental aspects of asset management. They include projects to

- establish methodologies for determining asset value, compiling inventories, and capturing and compiling information on the assets' attributes;

⁶Water Environment Federation and Association of Metropolitan Sewerage Agencies, *Moving Toward Comprehensive Utility Management Systems: Report of the Environmental Management Systems (EMS) for Public Utilities Integration Project* (Alexandria, Va.; Washington, D.C.: September 2002). EPA provided a grant of \$256,888 for this project.

⁷See Water Environment Research Foundation, *Research Priorities for Successful Asset Management: A Workshop* (Alexandria, Va.: 2002).

- develop methodologies for calculating life-cycle costs for infrastructure assets;
- construct predictive models for infrastructure assets that project life-cycle costs and risks;
- identify best practices for operating and maintaining infrastructure assets by asset category, condition, and performance requirements; and
- identify best practices for integrating water and wastewater utility databases.

In addition, workshop participants recommended a project to assess the feasibility of establishing an Asset Management Standards Board for the drinking water and wastewater industry.

EPA's Efforts to Promote Asset Management Could Be Strengthened by Leveraging Ongoing Efforts Within and Outside the Agency

EPA could build on its efforts to promote asset management at drinking water and wastewater utilities by better coordinating ongoing and planned initiatives in the agency's drinking water and wastewater programs. In addition, EPA could leverage the efforts of other federal agencies, such as the Department of Transportation, that have more experience in promoting asset management as well as informational materials and tools that could potentially be useful as EPA and the water industry develop similar materials.

Improving Coordination Within and Across Drinking Water and Wastewater Programs Could Help Maximize Limited Resources

While some of EPA's efforts to promote the use of asset management, such as sponsoring the comprehensive industry handbook, have involved both the drinking water and wastewater communities, it appears that other efforts are occurring with little coordination between the drinking water and wastewater programs or other offices within EPA. For example, the Office of the Chief Financial Officer, the Office of Ground Water and Drinking Water, and the Office of Wastewater Management have funded parallel but separate efforts to develop handbooks, software, or other training materials to help small drinking water and wastewater utilities implement asset management or related activities such as improving financial viability. According to our interviews with EPA officials and representatives of the university-based training and technical assistance centers, no central repository exists for EPA to track what the university-

based centers are doing and ensure that they have the information they need to avoid duplication and take advantage of related work done by others. The centers that share information do so primarily within their own network, as in the case of the environmental finance centers, or share information on an ad hoc basis. As a result, the centers are likely to miss some opportunities to exchange information. Similarly, the drinking water and wastewater program offices do not regularly exchange information on what they or their centers are doing to develop informational materials, training, or technical assistance on asset management.

EPA officials explained that, to some extent, the organizational framework within which the centers operate contributes to limited information sharing and duplication of effort. As a result, EPA is not maximizing the resources it devotes to encouraging utilities' use of asset management. In the case of the environmental finance centers, for example, each one negotiates a work plan with the EPA regional office it serves. Although EPA headquarters also has some influence over what the centers work on, the centers primarily focus on regional priorities and work with the states within the regional office's jurisdiction. Occasionally, EPA's drinking water and wastewater program offices fund projects at the environmental finance centers that are independent of their regional work plans. For example, the drinking water program provided some funds to the center at Boise State to develop an evaluation tool that states can use to assess utilities' qualifications for obtaining financial assistance from state revolving loan funds. For the most part, however, the training and technical assistance centers operate autonomously and do not have a formal mechanism for regularly exchanging information among the different center networks or between the drinking water and wastewater programs.

EPA Could Supplement Its Efforts to Promote Asset Management by Using Information Available from Other Federal Agencies

EPA has not taken advantage of the guidance, training, and implementation tools available from other federal agencies, which would help EPA leverage its resources. For the purposes of our review, we focused on the Department of Transportation's Federal Highway Administration because it has been involved in promoting asset management for about a decade and has been at the forefront of developing useful tools and training materials. In 1999, the Federal Highway Administration established an Office of Asset Management to develop tools and other materials on asset management and encourage state transportation agencies to adopt asset management programs and practices.

According to officials within the Office of Asset Management, the basic elements of asset management are the same regardless of the type of entity responsible for managing the assets or the type of assets being managed. Simply put, every organization needs to know the assets it has, their condition, how they are performing, and the costs and benefits of alternatives for managing the assets. Over the years, the Office of Asset Management has published several guidance documents on asset management and its basic elements. While the purpose of the guidance was to assist state transportation agencies, Transportation officials believe that the general principles contained in their publications are universally applicable. The office's guidance includes, for example,

- a general primer on the fundamental concepts of asset management;
- a primer on data integration that lays out the benefits of and tools for integrating data, the steps to follow in linking or combining large data files, potential obstacles to data integration and ways to overcome them, and experiences of agencies that have integrated their data;⁸ and
- a primer on life-cycle cost analysis that provides information on how to apply this methodology for comparing investment alternatives and describes uncertainties regarding when and how to use life-cycle cost analysis and what assumptions should be made during the course of the analysis.⁹

Transportation's Office of Asset Management has also developed a software program to assist states in estimating how different levels of investment in highway maintenance will affect both user costs and the highways' future condition and performance. In addition, to disseminate information on asset management, the office established a Web site that includes its most recent tools and guidance and links to external Web sites with related asset management information, including a link to an asset management Web site jointly sponsored with the American Association of State Highway and Transportation Officials.

⁸U.S. Department of Transportation, Federal Highway Administration, Office of Asset Management, *Data Integration Primer* (Washington, D.C.: August 2001).

⁹U.S. Department of Transportation, Federal Highway Administration, Office of Asset Management, *Life-Cycle Cost Analysis Primer* (Washington, D.C.: August 2002).

As EPA began its efforts to explore the potential of comprehensive asset management to help address utility infrastructure needs, officials from the Office of Water met with staff from Transportation's Office of Asset Management and obtained a detailed briefing on its asset management program. Although EPA officials expressed concerns about having relatively limited resources to promote asset management, they have so far not pursued a closer relationship with Transportation or other federal agencies with experience in the field. For example, EPA may find opportunities to adapt Transportation's guidance materials or use other efforts, such as a Web site that brings together asset management information from diverse sources, as a model for its own initiatives.

Water Industry Officials Favor an Expanded Role for EPA in Promoting Asset Management, but Raised Concerns About Additional Regulatory Requirements

Water industry officials support a greater role for EPA in promoting asset management, both as a tool for better managing infrastructure and for helping drinking water and wastewater utilities meet existing or proposed regulatory requirements. However, they stopped short of endorsing legislative proposals that would require utilities to develop and implement plans for maintaining, rehabilitating, and replacing capital assets, often as a condition of obtaining loans or other financial assistance.

Water Industry Officials See Role for EPA in Linking Asset Management to Regulatory Requirements and Other Initiatives Aimed at Improving Utility Management

To obtain views on the role that EPA might play in encouraging the use of asset management, we talked with officials from water industry associations and the 15 utilities that we selected for structured interviews. With few exceptions, the officials agreed that EPA should be promoting asset management in some way, although opinions varied on what activities would be most appropriate. One of the options that garnered the support of many was a greater leadership role for EPA in promoting the use of asset management. For example, 11 of the 15 utilities indicated that based on their own experience, asset management can help utilities comply with certain regulatory requirements that focus in whole or in part on the adequacy of utility infrastructure and the management practices that affect it. While EPA recognizes the link between asset management and regulatory compliance—and has noted the connection in some agency publications and training—some utility officials believe that EPA should increase its efforts in this regard. As examples of regulatory requirements

for which asset management is particularly germane, officials from industry associations and individual utilities cited both the existing “capacity development” requirements under EPA’s drinking water program and regulations for capacity, management, operation, and maintenance under consideration in the wastewater program, as follows:

- *Capacity development requirements for drinking water utilities.* To be eligible for full funding under the Safe Drinking Water Act’s State Revolving Fund program, state regulatory agencies are required to have strategies to assist drinking water utilities in acquiring and maintaining the financial, managerial, and technical capacity to consistently provide safe drinking water. To assess capacity, states evaluate, among other things, the condition of the utilities’ infrastructure, the adequacy of maintenance and capital improvement programs, and the adequacy of revenues from user rates to cover the full cost of service. Drinking water utilities that are determined to lack capacity are not eligible for financial assistance from the revolving loan fund.¹⁰
- *Capacity, management, operation, and maintenance requirements for wastewater utilities.* As part of its wastewater management program under the Clean Water Act, EPA is considering regulations designed to improve the performance of treatment facilities and protect the nation’s collection system infrastructure by enhancing and maintaining system capacity (i.e., peak wastewater flows), reducing equipment and operational failures, and extending the life of sewage treatment equipment. Among other things, wastewater utilities would be required to prepare capacity, management, operation, and maintenance plans for their operations. The regulations would also require utilities to assess the condition of their physical infrastructure and determine which components need to be repaired or replaced.

According to industry officials, implementing asset management is consistent with meeting these requirements, and it enhances utilities’ ability to comply with them. For the requirements being considered for wastewater utilities, for example, EPA has concluded that three basic components are a facility inventory, a condition assessment, and asset

¹⁰States may nevertheless provide financial assistance if the use of such assistance will ensure compliance with regulatory requirements and the water utility has agreed to make the necessary changes in operations to ensure that it has the financial, managerial, and technical capacity to comply over the long term.

valuation—all of which are important elements of asset management. Consequently, the officials believe that it makes sense for EPA to place more emphasis on the use of comprehensive asset management.

Some water industry officials also told us that EPA should use the relationship between asset management practices and the financial reporting requirements under Governmental Accounting Standards Board Statement 34 as a means of promoting the use of asset management. Under these new requirements, state and local governments are required to report information about public infrastructure assets, including their drinking water and wastewater facilities. Specifically, the governments must either report depreciation of their capital assets or implement an asset management system.¹¹

Given the infrastructure-related regulatory requirements and utilities' other concerns about the condition of their assets, it is not surprising that 11 of the 15 utilities we interviewed in depth saw a need for EPA to set up a clearinghouse of information on comprehensive asset management. Several utilities suggested that EPA establish a Web site that would serve as a central repository of such information. This site could provide drinking water and wastewater utilities with direct and easy access to information that would help them better manage their infrastructure. For example, the Web site could gather in one place the guidance manuals, tools, and training materials developed by EPA or funded through research grants and its training and technical assistance centers. The site could also contain links to asset management tools and guidance developed by domestic and international water associations or other federal agencies, such as Transportation's Office of Asset Management. Several officials also commented that it might be useful to have a site where drinking water and wastewater utilities could share lessons learned from implementing asset management. Other utilities also supported the idea of a Web site, but were uncertain about whether EPA was the appropriate place for it. In commenting on a draft of this report, EPA generally agreed that an EPA Web site devoted to asset management would be worthwhile and is considering developing such a site.

¹¹Privately owned utilities are not required to comply with financial reporting requirements from the Governmental Accounting Standards Board. About half of the nation's drinking water systems and an estimated 20 percent of the wastewater systems are privately owned, according to EPA and industry sources.

Water Industry Officials Cite Implementation Challenges if Asset Management Were to Be Mandated

In recent years, the Congress has considered several legislative proposals that would, in part, promote the use of asset management in some way. These proposals generally call for an inventory of existing capital assets; some type of plan for maintaining, repairing, and replacing the assets; and a plan for funding such activities. All but one of the proposals made having the plans a condition of obtaining federal financial assistance. The proposals are consistent with what we have found to be the leading practices in capital decision making. As we reported in 1998, for example, routinely assessing the condition of assets allows managers to evaluate the capabilities of existing assets, plan for future replacements, and calculate the cost of deferred maintenance.¹² However, according to key stakeholders, implementing and enforcing requirements for asset management could be problematic at this time.

We asked water industry groups, associations of state regulators, and individual utilities for their views on the proposed mandate of asset management plans. While most of them endorse asset management, they raised several concerns about a statutory requirement. For example:

- Officials from water industry associations believe that drinking water and wastewater utilities are already overburdened by existing regulatory requirements and that many utilities lack the resources to meet an additional requirement for developing asset management plans.
- The Association of State Drinking Water Administrators and the Association of State and Interstate Water Pollution Control Administrators both said that the states lack the resources to oversee compliance and determine the adequacy of asset management plans. Both the state and industry associations questioned the feasibility of defining what would constitute an adequate plan.
- Officials at 12 of the 15 utilities where we conducted in-depth interviews had serious reservations about a requirement. For example, some utility managers were concerned that EPA and the states would attempt to standardize asset management and limit the flexibility that utilities need to tailor asset management to their own circumstances. Another concern was that the states lack financial and technical resources and thus are ill equipped to determine whether utilities' asset management

¹²GAO/AIMD-99-32, 26.

plans are adequate. Finally, some utility officials also questioned the burden that such a requirement would place on small utilities.

Other utility officials either support a requirement or support the concept of asset management but question whether mandating such a requirement is an appropriate role for the federal government. One of the officials commented that whether or not asset management is required, utilities should manage their infrastructure responsibly and charge rates sufficient to cover the full cost of service. The National Association of Water Companies, which represents investor-owned utilities, supports a requirement for asset management to ensure that public water and wastewater utilities are operating efficiently and are charging rates that cover the full cost of service.

Conclusions

Comprehensive asset management shows real promise as a tool to help drinking water and wastewater utilities better identify and manage their infrastructure needs. Even with their limited experience to date, water utilities reported that they are already achieving significant benefits from asset management. EPA clearly recognizes the potential of this management tool to help ensure a sustainable water infrastructure and has sponsored a number of initiatives to support the development of informational materials and encourage the use of asset management. However, in an era of limited resources, it is particularly important for EPA to get the most out of its investments by coordinating all of the asset management-related activities sponsored by the agency and taking advantage of tools and training materials developed by others—including domestic and international industry associations and other federal agencies with experience in asset management.

Establishing a central repository of all asset management-related activities could not only foster more systematic information sharing but also help minimize the potential for duplication and allow EPA-sponsored training and technical assistance centers to build on each other's efforts. As EPA has recognized, improving utilities' ability to manage their infrastructure cannot help but improve their ability to meet regulatory requirements that focus on the adequacy of utility infrastructure and management practices. Consequently, it is in the agency's best interest to disseminate information on asset management and promote its use. Establishing a Web site, perhaps as part of the repository, would help ensure that such information is accessible to water utilities and that EPA is getting the most use out of the materials whose development it funded. Moreover, EPA could use the

site as a means of strengthening its efforts to educate utility managers on the connection between effectively managing capital assets and the ability to comply with relevant requirements under the Safe Drinking Water Act and Clean Water Act.

Recommendations for Executive Action

Given the potential of comprehensive asset management to help water utilities better identify and manage their infrastructure needs, the Administrator, EPA, should take steps to strengthen the agency's existing initiatives on asset management and ensure that relevant information is accessible to those who need it. Specifically, the Administrator should

- better coordinate ongoing and planned initiatives to promote comprehensive asset management within and across the drinking water and wastewater programs to leverage limited resources and reduce the potential for duplication;
- explore opportunities to take advantage of asset management tools and informational materials developed by other federal agencies;
- strengthen efforts to educate utilities on how implementing asset management can help them comply with certain regulatory requirements that focus in whole or in part on the adequacy of utility infrastructure and the management practices that affect it; and
- establish a Web site to provide a central repository of information on comprehensive asset management so that drinking water and wastewater utilities have direct and easy access to information that will help them better manage their infrastructure.

Utilities Selected for Structured Interviews

Augusta County Service Authority, Verona, Virginia

Charleston Commissioners of Public Works, Charleston, South Carolina

Greater Cincinnati Water Works, Cincinnati, Ohio

Denton Department of Public Works, Denton, Maryland

Des Moines Water Works, Des Moines, Iowa

East Bay Municipal Utility District, Oakland, California

Eastern Municipal Water District, Perris, California

Louisville Water Company, Louisville, Kentucky

Massachusetts Water Resources Authority, Boston, Massachusetts

Orange County Sanitation District, Fountain Valley, California

Sacramento Regional County Sanitation District, Mather, California

Seattle Public Utilities, Seattle, Washington

Somersworth Department of Public Works and Utilities, Somersworth,
New Hampshire

Tacoma Water, Tacoma, Washington

Western Carolina Regional Sewer Authority, Greenville, South Carolina

GAO Contacts in Australia and New Zealand

| Government agency | State or region | Country |
|---|------------------------|----------------|
| Department of Treasury and Finance | Victoria | Australia |
| Essential Services Commission | Victoria | Australia |
| Independent Pricing and Regulatory Tribunal | New South Wales | Australia |
| Manawatu District Council | Manawatu-Wanganui | New Zealand |
| Queensland Audit Office | Queensland | Australia |
| Utility | State or region | Country |
| Citiwater | Queensland | Australia |
| Hunter Water Corporation | New South Wales | Australia |
| Melbourne Water Corporation | Victoria | Australia |
| South Australian Water Corporation | South Australia | Australia |
| Sydney Water Corporation | New South Wales | Australia |
| Watercare Services Limited | Auckland | New Zealand |

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