



# **Drinking Water Infrastructure Needs Survey and Assessment Third Report to Congress**

# SCOPE OF THE ASSESSMENT AND SURVEY METHODS

*The 2003 Drinking Water Infrastructure Needs Survey and Assessment represents the collective efforts of the states, EPA, and thousands of water systems—all of which participated in identifying and documenting infrastructure needs. This chapter provides an overview of the methods used by these participants to assess drinking water needs. It also describes the refinements made to the methods used in the 1995 and 1999 Needs Assessments to improve the accuracy of the results, and the extent of reliance on the 1999 Needs Assessment in determining the need for small, American Indian, Alaska native village, and not-for-profit noncommunity water systems.*

## Scope of the Assessment

**Goal and Purpose.** EPA's goal for the 2003 Drinking Water Infrastructure Needs Survey and Assessment was to document the 20-year national infrastructure needs for the approximately 53,000 community and 21,400 not-for-profit noncommunity public water systems eligible to receive DWSRF assistance. Needs were assessed for the 20-year period beginning January 1, 2003, and ending December 31, 2022. A total of approximately 4,000 medium- and large-population public water systems completed the 2003 Drinking Water Infrastructure Needs Survey and Assessment questionnaire. Medium and large systems' infrastructure needs projected over the next 20 years (excluding costs to comply with the recently promulgated Arsenic rule) constituted 82 percent of the total need.

- **States.** The 1996 Safe Drinking Water Act (SDWA) Amendments direct EPA to assess the needs of water systems, and to use the results of the assessment to allocate DWSRF funds. To this end, the Agency designed an assessment that would provide accurate estimates of need for each of the states. The DWSRF funds are allocated based on each state's share of the total national need (although, under SDWA, each state receives a minimum allotment of 1 percent).

The survey of medium and large systems was designed to provide a high level of precision for each state's estimate of need. For most of the survey, a precision target of 95 percent  $\pm$  10 percent was established.

- **Territories.** The results of the assessment are also used to allocate the 0.33 percent of the DWSRF appropriation designated for the Pacific island territories. Therefore, the workgroup designed the assessment to generate separate estimates of need for Guam, American Samoa, the Commonwealth of Northern Mariana Islands, and the U.S. Virgin Islands. Needs for the Virgin Islands were determined by adjusting 1999 needs to 2003 dollars. The assessment results dictate what percentage of the 0.33 percent will go to each territory.
- **American Indian Communities and Alaska Native Villages.** For this assessment, the need determined from the 1999 Needs Assessment was adjusted and used to determine the 2003 need. The results are used to help determine how to allocate funds that are available through the DWSRF to American Indian and Alaska native village water systems.



*This corroded, valveless filter is badly in need of replacement.*

**Eligible Needs.** Since the purpose of the assessment is to allocate DWSRF funds, EPA included only projects that met the eligibility criteria established under the DWSRF program.<sup>11</sup> In general, projects eligible for DWSRF funding facilitate compliance with the SDWA's National Primary Drinking Water Regulations or otherwise significantly further the health protection objectives of the Act.

**Categories of Need by Project Type.** Each project was assigned to one of five categories of need based on the project type: source, transmission and distribution, treatment, storage, or "other." This classification shows where the nation's water systems need to make capital investments.

- The source water category includes projects necessary to obtain adequate quantity and quality of surface water and ground water supplies. Examples include wells, surface water intakes, and spring collectors.
- The transmission and distribution category includes the needs associated with installing or rehabilitating raw and finished water transmission pipes, distribution water mains,

pumping stations, flushing hydrants, valves, water meters, and backflow prevention devices.

- The treatment category includes projects needed to deal with microbial pathogens and chemical contaminants present in the water supply.
- The storage category includes projects to construct new or rehabilitate existing finished-water tanks.
- The "other" category is reserved for needs that cannot be assigned to one of the four major categories. Examples include emergency power generators not assigned to specific types of projects, computer and automation projects, and projects to address security.

**Current and Future Needs.** For the 2003 Needs Assessment, EPA distinguished between current and future needs for the 20-year period from January 1, 2003, through December 31, 2022. Current needs are projects that systems consider a high priority for near-term implementation that will enable a water system to continue to deliver safe drinking water. An example of a current need is replacement of a section of distribution line that is susceptible to breaks or leaks.

Future needs are projects that are not necessary at the time of the assessment but that water systems expect to undertake within the next 20 years. These include routine rehabilitation and replacement projects. For example, a system may anticipate that it will need to rehabilitate a storage tank in approximately 10 years, or that it needs to replace a certain length of distribution pipe every year over the 20-year period to phase out old pipe. These future needs were underreported in previous assessments, in part due to limitations of the planning documents.

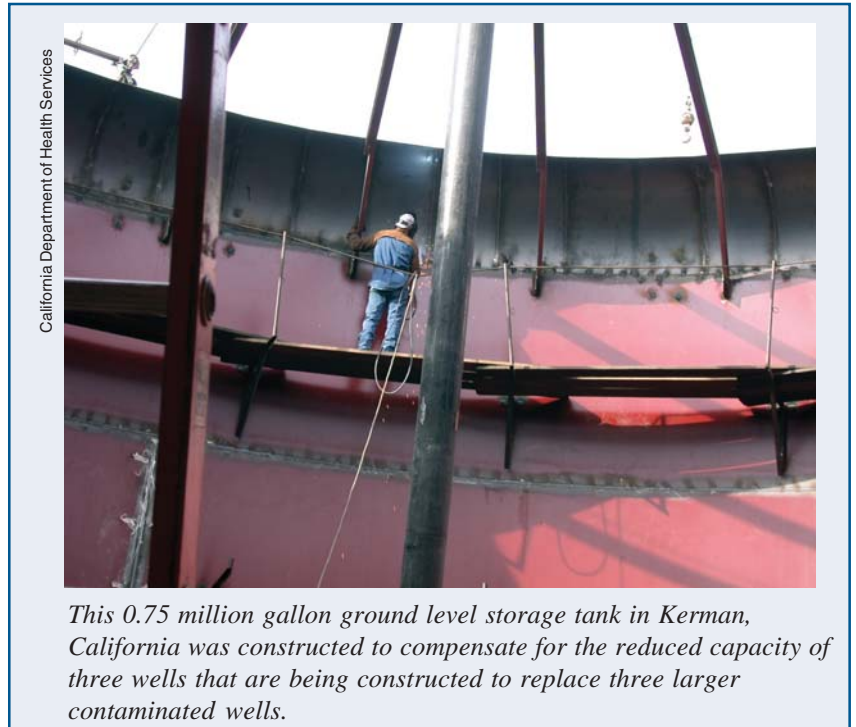
<sup>11</sup> EPA's assessment excluded DWSRF-eligible needs which do not involve the installation, replacement, or rehabilitation of infrastructure; for example, refinancing loans, conducting studies, and acquiring other water systems.

To mitigate underreporting for this assessment, EPA made changes in the format of the questionnaire and trained state coordinators on needs assessment tools. The new questionnaire asked systems to review their entire inventory of infrastructure assets and consider what projects might be necessary to manage those assets through the end of 2022. The questionnaire also provided examples of appropriate projects and related documentation. The Agency encouraged states to help systems review their inventories and identify realistic estimates of system needs. Many states visited or called each system within their jurisdictions to facilitate completion of the questionnaires. States used in-house inventories (where available) to ensure that all major infrastructure was considered. Some states used their own analyses of infrastructure condition to identify needs.

**Reasons for Need.** The questionnaire also asked systems to identify and code the reason, or reasons, each project was needed. Options included:

- Projects for existing infrastructure that is, or will be, old or deteriorated by the end of the 2003 Needs Assessment period.
- Projects to correct a deficiency in source water quantity caused by current user demand.
- Projects to correct a deficiency in storage capacity caused by current user demand.
- Projects to correct existing pressure problems not related to fire flow.
- Projects to obtain or maintain compliance with an existing regulation.
- Projects to obtain or maintain compliance with a secondary standard.

- Projects for consolidation with and/or connection to an existing public water system.
- Projects for extending service to existing homes without adequate water quantity or quality.



Not surprisingly, a majority of the systems and states listed “replacement or rehabilitation of old or deteriorated infrastructure” as the primary reason for need. Sixty-seven percent of projects listed “old and deteriorated infrastructure” as the only reason for need, and 77 percent listed this as at least one of the reasons for need if more than one reason was provided.

**Security Needs.** Projects intended wholly or in part to address security needs were separated into the following categories:

- Projects to prevent or detect an intrusion or security violation.
- Major security projects.

- Communication needs for security.
- Projects for redundancy or to respond to a security breach.
- Projects to address safety issues.

## Assessment Methods

The 2003 Needs Assessment consisted of two components: a new survey of needs for large and medium systems; and an estimate of needs for systems serving 3,300 or fewer persons, not-for-profit noncommunity water systems, American Indian systems, and Alaska native village systems. These two components are discussed below.

A workgroup of state and EPA representatives developed the methods for the 2003 Drinking Water Infrastructure Needs Survey and Assessment. The workgroup decided to adopt the general approach of the 1995 and 1999 Needs Assessments. However, the workgroup refined the questionnaire to prompt more complete assessment of needs. These refinements were based on lessons learned from the 1999 Needs Assessment regarding effective interview methods for capturing needs that are not included in relatively short-term water system planning documents. The workgroup also revised some documentation policies to reduce the burden on systems without compromising the validity of the data. Communications options made available by changes to the Internet also allowed more efficient information exchange on specific projects between EPA and states.

## Conducting the State Survey for Large and Medium Systems

EPA and the states developed a questionnaire used to collect infrastructure needs from large and medium community water systems. The questionnaires were provided to all of the nation's water systems serving over 40,000 people and from a random sample of systems serving 3,301 to 40,000 people. Each

system received a package containing the questionnaire, instructions, an example of a completed questionnaire, and a list of frequently asked questions.

Systems returned the questionnaires and accompanying documentation to their state contacts. The states reviewed each questionnaire to ensure that systems identified all of their needs and that the projects fulfilled the eligibility and documentation criteria. If these criteria were not met, the states had the option of contacting the system to obtain more information. EPA conducted a final review of each project and entered the information into a database. Web-based communications allowed the states to review the data, including any changes made by EPA. Using the project Web site, states could identify projects not meeting the established criteria and submit additional documentation of the project need or the cost to support a project.

## Improvements for the 2003 Needs Assessment of Medium and Large Systems

Compared with the previous two assessments where EPA had a substantial role in data collection, the 2003 Needs Assessment placed the responsibility for collecting data primarily on the states. To assist states, EPA held 2-day training sessions at eight regional locations. These training sessions were designed to educate state coordinators, staff, and their contractors on the approach, available needs assessment tools, and documentation criteria. EPA also worked directly with each state in reviewing responses for the first five questionnaires to maintain consistency.

As an improvement over the 1999 questionnaire, the workgroup modified the design of the 2003 questionnaire to prompt systems to more thoroughly consider their entire infrastructure inventory and projects that might be needed over the next 20 years. The 2003 questionnaire asked the system about the length and diameter, or number and size, of major pieces of existing infrastructure. The questionnaire

included tables to record the gross infrastructure inventory and asked follow-up questions to prompt the system to consider the 20-year need for rehabilitation or replacement of the infrastructure and whether it was adequate to meet the needs of existing consumers. The questionnaire provided examples of projects and acceptable documentation, and simplified the data collection format into three category-related tables—transmission and distribution; source, treatment, storage, pumping, and other; and backflow prevention devices/assemblies, flushing hydrants, service lines, valves, and water meters.

The workgroup reconsidered some policies that had been adopted for the 1999 Needs Assessment. Specifically, the workgroup decided that it was not necessary to require systems to identify ownership of backflow prevention devices or non-lead service lines. If the projects were identified as needs, the workgroup assumed that they were likely the responsibility of the public water system.

Advances in Internet technology prompted the development of an interactive Web site that allowed states and EPA to track survey progress and

communicate questionnaire and project status updates. States were able to identify projects that required additional documentation and to respond to most issues via the Web site.

Another policy change was related to the eligibility of domestic water meter projects. In the 1999 Needs Assessment, systems were limited to metering currently unmetered systems or replacing meters that were currently malfunctioning. In 2003, recognizing the value of metering to water audits, conservation programs, and asset management, the workgroup allowed metering of unmetered systems and a single replacement of each existing meter over the 20-year assessment period. Under the new policy, the meter projects for large and medium systems accounted for \$12.1 billion in need. This amount is included in the total transmission and distribution category of need.

For the 1999 Needs Assessment, if a project was categorized as a regulatory need, systems were required to include as part of their documentation a laboratory report showing an actual or imminent violation of a maximum contaminant level (MCL) or treatment technique requirement. For the 2003 Needs Assessment, the workgroup decided that an actual laboratory slip was not needed as part of the documentation.

## Method for Estimating the Small System, Not-for-Profit Noncommunity System, and American Indian and Alaska Native Village Need

**Small Systems and Not-for-Profit Noncommunity Systems.** Small systems serving 3,300 or fewer people and not-for-profit noncommunity systems generally lack the personnel and planning documents necessary to complete the questionnaire. Therefore, for the 1999 Needs Assessment, EPA conducted site visits to determine the infrastructure needs of these systems.

The screenshot displays the web application interface for the 2003 Drinking Water Infrastructure Needs Survey. The main content area shows a table titled 'System Status - All Systems within Washington' with 12 rows of data. The table columns include PWSID, Received By EPA, Initial Weight, Last Updated, and State Notes. The 'Current Filters' sidebar on the right shows filters for Project (Not Applicable) and System (All Systems, Small, Medium, Large), with 'Washington' selected in the Area dropdown.

PWSID*	Received By EPA	Initial Weight	Last Updated	6	0	27	25	State Notes
WAS300050	11/21/2003	3.5	6/17/2004	6	0	27	25	Aberdeen (mod sent/done)
WAS301300	11/21/2003	1	6/9/2004	2	0	1	40	AldenwoodWD (done)
WAS302600	11/21/2003	1.625	2/27/2004	13	0	8	56	Annapolis (done)
WAS303350	11/21/2003	1	3/26/2004	2	0	1	161	Auburn (done)
WAS304700	11/21/2003	1.625	3/11/2004	1	0	0	41	Battleground (done)
WAS305575	11/21/2003	1	7/16/2004	3	0	4	13	Belleue (done)

*The user-friendly Web site allowed EPA and states to communicate the status of the survey and projects submitted.*

EPA believes that the needs captured from the site visits in 1999 represented a fair and complete assessment of these systems' 20-year needs. Findings from 1999 were very similar to the findings in 1995, indicating that system's needs did not change significantly over a 4-year period. Because there was a high level of confidence in the data obtained from the site visits, EPA decided that it could estimate 2003 needs by adjusting the 1999 needs to 2003 dollars. The total national small system need was then reallocated to each state based on the number of systems that existed in each stratum in 2003.

The 1999 not-for-profit noncommunity needs were likewise adjusted to 2003 dollars and assigned to each state's need.

#### **American Indian and Alaska Native Village Needs.**

During the 1999 Needs Assessment EPA helped the American Indian and Alaska native village water systems complete their questionnaires.

- **American Indian Systems.** In 1999, all 19 medium-sized American Indian systems completed a questionnaire with technical support from EPA. The Agency conducted site visits at 78 randomly selected small systems to represent the 781 small American Indian systems.
- **Alaska Native Village Systems.** In 1999, questionnaires were mailed to the two medium-sized systems. For the 172 small systems, representatives from the Alaska Native Village Health Consortia, the IHS, and the Village Safe Water completed the questionnaires, with assistance from EPA.

Because of the high level of confidence in the findings from 1999, EPA did not survey these systems again in 2003. Instead, EPA adjusted the data from 1999 to 2003 dollars to estimate the 2003 needs for these systems.

## **Documented Costs and Cost Models**

If systems had documented cost estimates for a given project, EPA converted these costs to January 1, 2003 dollars and applied the cost to the system's total need. If no costs were available, the questionnaire requested information about the project so that EPA could model a cost for the project. For example, if a system identified a need to replace a section of leaking pipe, but lacked cost documentation, the system supplied the length and diameter of pipe to be replaced. Based on this information, EPA modeled the cost for this project.

The number of projects submitted without cost documentation increased in 2003 compared with the previous assessments. Of the 105,000 accepted projects, 82 percent were submitted without costs. This increase resulted in a heavy reliance on cost modeling.

### **Acceptable Documentation**

#### For Need and/or Cost Documentation:

- Capital Improvement Plan or Master Plan
- Facilities Plan or Preliminary Engineering Report
- Grant or Loan Application Form
- Engineer's Estimate

#### For Need Documentation Only:

- Intended Use Plan/State Priority List
- Indian Health Service Sanitary Deficiency System Report
- Comprehensive Performance Evaluation (CPE) Results
- Sanitary Survey
- Monitoring Results
- Other Need Document

#### For Cost Documentation Only:

- Cost of Previous Comparable Construction
- Other Cost Document (such as manufacturer's catalog costs)

In addition to developing requirements for documenting needs, the workgroup set rigorous documentation criteria for assessing the legitimacy and scope of project costs. If systems submitted project costs, there had to be documentation showing that the cost had undergone an adequate degree of professional review. These would have included Capital Improvement or Master Plans developed for the system by professional engineers, tabulations of bids received for a project developed by contracting firms, or costs of previously completed projects of comparable scope. Documentation had to be detailed enough that EPA could review all component costs included in the estimate. This enabled EPA to model portions of the project that had been omitted from a cost estimate, or to delete DWSRF-ineligible portions of the submitted cost (such as interest payments).

In general, EPA used the models developed from the 1999 Needs Assessment data and adjusted the 1999 data to 2003 dollars for the 2003 Needs Assessment. For the 1999 Needs Assessment, 59 models were developed to assign costs to infrastructure needs—from replacing broken valves to building new treatment plants. Most of the cost models were derived from projects that listed both cost estimates and modeling parameters. For some types of need, the 1999 Needs Assessment data proved inadequate for a statistically significant model. Therefore, for 19 of the models, EPA obtained cost data from additional sources—engineering firms and state DWSRF programs—to supplement data submitted by respondents.

For the 2003 Needs Assessment, EPA derived new models for transmission and distribution piping and meters. A new meter model was needed to accommodate improvements in standard technology. Since the 1999 Needs Assessment, the standard technology for domestic water meters changed from predominantly manual-read meters to radio-read meters. This new technology had a higher cost, so a new model was appropriate.

EPA also updated the cost models for transmission and distribution pipe based on cost information received from the 2003 Needs Assessment. These models had not been updated since the 1995 Needs Assessment. Because the transmission and distribution category represents the largest percentage of need, developing up-to-date models was a high priority.

## Information Quality

The findings of the 2003 Needs Assessment are reinforced by adherence to EPA's Guidelines for Information Quality,<sup>12</sup> which implement the Data Quality Act for the Agency. Appendix C of this report contains more detail on information quality.

**Quality Assurance.** The most fundamental requirement for information quality is the Agency's Quality System. EPA implements the system on a project basis through the development of a quality assurance project plan (QAPP), the cornerstone of which is the definition of data quality objectives (DQOs). The Agency uses the results of this assessment to allocate DWSRF capitalization grants to states. Allocations are made on the basis of proportional state need for water systems eligible for DWSRF funding. Therefore, this project (like those that preceded it in 1995 and 1999) sought to maximize the accuracy of the state-level estimates of infrastructure needs. Decisions about precision levels were also established by a state/EPA workgroup that met regularly during the 2003 Needs Assessment.



*Many water systems are improving the efficiency and accuracy of water usage data collection by replacing old and outdated water meters with new radio-read meters. Hand-held radio meter units communicate with the meter transmitter from a remote location, such as a vehicle. This dramatically reduces labor hours needed to collect water usage data.*

<sup>12</sup> U.S. Environmental Protection Agency, "Guidelines for Ensuring and Maximizing the Quality, Objectivity, and Integrity of Information Disseminated by the Environmental Protection Agency," EPA/260R-02-008 (October 2002).



Accuracy was maximized through the following steps. First, since this was a sample survey, the workgroup established targets for precision of estimates (acceptable sampling error). These decisions shaped sample design. Second, EPA used quality assurance (QA) procedures from the QAPP to ensure that “eligible infrastructure” was clearly defined and that documentation standards were rigorously enforced. For a project to be included in the 2003 Needs Assessment, systems and states had to submit documentation describing the purpose and scope of the project for each need. The documentation was reviewed by EPA to determine if each project submitted for the 2003 Needs Assessment met the eligibility criteria for DWSRF funding and allowability criteria set for the 2003 Needs Assessment. The workgroup established the documentation requirements so that uniform criteria were applied to all questionnaires. These requirements not only lend credibility to the findings, but also address the issue of fairness when the results are used by EPA to apportion DWSRF funds.

Of the 128,600 projects submitted to the survey, EPA deleted 18 percent that failed to meet the documentation criteria, or appeared to be ineligible for DWSRF funding. Some projects were adjusted to correct a variety of measurement problems: overlaps between two projects (raising the issue of double-counting), inconsistency with project documentation,

and use of overly aggressive infrastructure life cycles by states where system planning documents were not used or available.

To adjust for the use of aggressive infrastructure life cycles, EPA made technical adjustments to individual projects based on engineering literature and benchmarks of engineering practices. The Agency tailored adjustments to the unique assumptions implemented by each state and then negotiated with state officials. EPA’s general direction of these adjustments was to place a cap on the state’s assumptions about the rate of rehabilitation and replacement of pipe, unless there was project-specific documentation of a need provided by the water system.

Other subjects discussed in the QAPP were: training and certification of staff working on data collection and evaluation; standards for questionnaire design and survey implementation; procedures for manual editing, coding, and data entry; automated data validation; database quality assurance; tabulation quality assurance; and QA for report preparation.

**Transparency and Reproducibility.** EPA’s Guidelines on Information Quality explain that influential information (such as this report) “should be subject to a higher degree of quality (for example, transparency about data and methods). Such

### Quality Assurance

The 2003 Needs Assessment followed the Agency’s Guidelines for Ensuring and Maximizing Information Quality (2002). EPA’s goal for these guidelines is to ensure the quality, objectivity, utility, and integrity of information disseminated by the Agency. These guidelines are particularly important for projects such as the 2003 Needs Assessment, which influences public policy decisions.

The 2003 Needs Assessment workgroup implemented the guidelines through quality assurance and reproducibility of its results. Also, given the influential nature of the report, EPA ensured a high degree of transparency regarding data, assumptions, analytic methods, and statistical procedures.

For more information on quality assurance, see Appendix C. For more information on data, assumptions, analytic methods, and statistical procedures, see Appendix B.

transparency facilitates reproducibility of this information, and reproducibility should meet commonly accepted standards.”

The 2003 Needs Assessment (like those in 1995 and 1999) maintained high standards of transparency. For example, all decisions about the study approach, analytical methods, cost models, and statistical methods, were presented to the workgroup for their review. All data collected by this study were made available on-line to state experts for their review and comment.

Appendix B contains information on the statistical methods and cost modeling procedures that were used in the preparation of this report. Given this information, and access to the database, any qualified third party could reproduce the results of this assessment.

