APPENDIX A

BENCHMARK INVESTIGATION OF SMALL PUBLIC WATER SYSTEMS ECONOMICS

PROJECT COMPLETION REPORT

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SOUTHERN ILLINOIS UNIVERSITY
Carbondale

Research Report of the
Department of Geography
Department of Agribusiness Economics
Southern Illinois University Carbondale
Carbondale, IL 62901

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BENCHMARK INVESTIGATION OF SMALL PUBLIC WATER SYSTEM ECONOMICS

PROJECT COMPLETION REPORT

Prepared for:

Midwest Technology Assistance Center
2204 Griffith Drive
Champaign, IL 61820-7495
(217) 333-6167

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Prepared by:

Ben Dziegielewski, Professor, Department of Geography
Roger Beck, Professor, Department of Agribusiness Economics
Tom Bik, Researcher, Department of Geography

Southern Illinois University Carbondale
Carbondale, IL 62901-4514
(618) 536-3375

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PURPOSE

The purpose of this study was to evaluate the potential of financial benchmarking as a management tool for small community drinking water systems. The study used a variety of investigative techniques to identify and solicit information from many sectors of the small drinking water system community. The study began by consulting the literature on small system economics and benchmarking. More than 70 sources were identified and organized into a Topical List of Relevant Publications that is included in Appendix A. Comprehensive annotations for more than half of these studies are also included in the same appendix.

The review of literature was followed by an E-mail consultation of acknowledged experts in the study and management of small systems. Their comments provided guidance for the organization of the study and insight into obstacles to financial benchmarking for small systems. Their observations are summarized in Chapter III and a complete record of their comments appears in Appendix B.

The study team met and consulted personally with members of the small drinking water system community during a series of focus groups sessions and on-site visits to community water systems. Small system managers, state and federal agency officials, and technical assistance providers offered their opinions on the potential of financial benchmarking during three focus group sessions. Their comments are summarized in Chapter III. Individual reports of the focus group sessions are included in Appendix C. Feedback from systems managers and observations made during a series of site visits to small systems are also summarized in Chapter III. A complete report of the site visits appears in Appendix D.

Finally, an investigation of economic and operational data for a stratified random sample of 350 small public water supply systems in ten Midwestern states was undertaken in order to determine the feasibility of developing benchmarking criteria and benchmark values that would be useful to system operators and managers. These survey data were supplemented with information collected during the focus group sessions and personal interviews.

KEY FINDINGS

The observations and data collected during this study constitute a significant body of information relating to the financial management of small drinking water systems. This information has been organized into a list of key findings, which pertain to the existing situation of the small systems in the Midwest.

The information collected suggests the following conclusions regarding benchmarking needs and practices as expressed by study participants:

- Benchmarking has become a pervasive management tool that has proven to be effective in improving the operation and management of businesses and governments. The American Water Works Association *QualServe Program* has adopted benchmarking as a key ingredient in its approach to exploring and improving the management of water systems that serve more than 50,000 people.

- Few programs to develop benchmark measures, or to introduce financial benchmarking practices to small systems, were found during a search of the literature. However, the capacity development provisions of the 1996 Safe Drinking Water Act, have created an urgency for state primacy agencies to develop methodologies for the evaluation of the financial conditions of small systems.

- Most members of the small drinking water community that participated in this study were unfamiliar with the concept of financial benchmarking. Those who were familiar with benchmarking were unsure of its role in improving the management of small water systems, given the host of other structural and institutional problems typically faced by these systems.

- Few of the precursor conditions necessary to implement benchmarking in small systems are currently in place. The awareness of the technique, felt-need for financial evaluation, baseline data, and institutional support, will need to be promoted, even as research into developing benchmark measures continues.

- This study demonstrated the difficulty in collecting financial and operating data from small water systems using a mail survey. The quality and quantity of data that were collected limited the development of a detailed set of benchmark measures for all systems size, source and ownership categories. Other techniques that focus on a small subset of the population of systems might prove more effective. The following findings were developed based upon the information provided by the 350 systems that did participate in the mail survey.

Several key findings of the study related to small water systems operations:

- The need to increase water rates was identified by two thirds of the survey respondents as one of the important decisions they will have to address in the next five years. Seventy percent of survey respondents ranked it as their #1 decision. The discussion of water rates also dominated the focus groups sessions and on-site interviews. Survey participants ranked decisions relating to the expansion of water services to new areas and finding sources of funding as #2 and #3.

- Water service reliability, as measured by "boil water orders", was a concern for one-fourth of the systems participating in the mail survey. Larger systems (both in terms of total number of connections and length of piping) and systems that have received grant funds were likely to experience more boil water orders. The probability of boil water orders is lower in publicly owned systems and systems with a higher financial operating ratio (total annual revenue divided by total operating expenses).

- Compliance with drinking water regulations is a problem for 20 to 30 percent of the small systems that participated in the survey. Monitoring and reporting violations during the 1996-1999 period were recorded for 98 systems with the highest incidence among private systems and systems serving mobile home parks. Maximum contaminant level (MCL) violations were recorded in 61 systems, with the highest number of violations found in systems using groundwater, as well as those systems serving mobile home parks and homeowners associations.

- Nearly two thirds of small systems that participated in the survey meter all of their service connections. Another nine percent meter more than 85 percent of their connections, and 24 percent do not have meters on individual connections. Limited metering is found primarily in very small systems (less than 100 persons served), groundwater systems, and systems serving homeowner associations and mobile home parks.

- Only 17 percent of systems participating in the survey provided data on unaccounted water. The median value of unaccounted use for these systems was 12 percent of total production. The reluctance of systems to report unaccounted use, or the unavailability of estimates of unaccounted water among small systems, suggests that many systems may not be tracking one of the most basic operational indicators.

- The price of water and tariff structure varied substantially among systems that participated in the survey. Residential monthly water charges, calculated at the consumption level of 6,000 gallons, ranged from $4.67 to $61.00, with a mean value of $25.80 per month. The median price of 1,000 gallons per month for residential customers was estimated to be $4.30. Median price charged by surface water and purchased water systems was respectively, 82 and 88 percent higher when compared to the median price for groundwater systems.

- System peaking factors (maximum–day to average-day pumpage ratio) were found to be the greatest for the smallest systems. Systems serving 100 persons or less had, on average, a max-day pumpage of nearly two and one-half times their average day. However, the smallest systems that participated in the survey were also more likely to have excess system capacity.

The key findings of the study, which pertain to the development of financial and economic benchmarks for small systems are:

- Only one-third of the survey respondents reported using one or more types of financial indicators in their systems, primarily the monthly or annual net revenues. Less than 10 percent reported the use of operating ratios or debt service ratios that have long been promoted as effective financial indicator measures by technical assistance organizations and regulatory agencies.

- The financial reports containing the data needed to calculate the most commonly used financial indicators appear to be available in the majority of small systems. More than 80 percent of systems reported they prepare some type of a financial report including annual budget, monthly financial reports, and income statements.

- Only fifty six percent of respondents provided sufficient financial information for their systems to calculate the operating ratio used in this study (total annual revenues to total annual operating expenditures). The reported data indicate that the operating ratio for 16 percent of participating systems was below 1.0, indicating insufficient revenues to cover the costs.

- Efforts to introduce benchmarking for small systems are likely to be hampered by the unavailability of routine and standardized record keeping systems at small systems.

FINANCIAL BENCHMARKS

One objectives of this study was to produce a set of benchmark measures which small system managers could use to assess the financial status of their systems. Ideally, these benchmarks would be disaggregated into a number of size, source and ownership categories to reflect the different operating conditions faced by each type of system. The methodology that was used to identify the measures that could best serve as indicators of system performance was to use logit analysis and linear regression to test the relationship between dependent variables for cost, compliance, and reliability and a set of potential independent variables.

The quantity and quality of data available for the analysis hampered the efficacy of this approach. Only 18 percent of systems returned the survey questionnaire, and many of those systems that did participate in the survey failed to complete some parts of the survey, especially those sections relating to water system finances. The low response and unavailability of financial data made it difficult to test the relationship of many potential indicator measures to the dependent variables, because the number of systems that could be included in any specific analysis dropped rapidly due to the number of missing data points.

The following tables present the distribution of values for a set of indicators of water systems performance. These indicators were judged to be relevant either because of the relationships established by the method described above, or because of their dominance in the expressed concerns of participants in this study (on surveys, or in interviews or focus groups). The distribution consists of percentile rankings, disaggregated by system source type, since this was observed to be the most relevant category for differentiating water system costs and revenues. A separate category of the values of “best performing” systems also appears in each table. These are the values for 30 participating systems that met a set of criteria that generally agreed with the common descriptions of sustainable water systems in the literature (see page VI-29 for the list of criteria).

The values presented in these tables represent the financial situation that was reported by more than 300 Midwestern water systems, and the best judgement of the research team. They do not represent any “magic numbers”, but rather are the expected levels of these indicators based on the evidence that was available. Individual systems will need to consider their own specific operating characteristics when reviewing the tables.

Benchmarks of expected levels of indicators are not the same as benchmarks that designate efficient levels of financial operations. In order to designate a benchmark value for efficient operation, it is necessary to determine whether the financial operation are efficient in terms of the range of operational values for specific economic conditions faced by types of water systems (size, ownership, customer density, source water quality, level of past investments in infrastructure, local economic conditions). The data used in this study did not provide sufficient information for establishing precise efficiency benchmarks. However, the variability of use among different systems, when “normalized for size, source and ownership type, provide an indication of current practices. These can be thought of as the existing average levels of efficiency in practice.

Operating Ratio and Debt Coverage Ratio

The most important financial activity for any water system is to be able to raise sufficient revenues to cover operating costs and to promptly make payments on any debt agreements. Two indicator measures have been almost universally recommend for small water systems to monitors of these activities are the operating ratio and debt coverage ratio. Table S1 shows the distribution of the values of operating ratio for alternatively defined groups of systems.

Table ES1. Distribution of the Operating Ratio among Small Systems

Group of Systems	***Sample Size***	***Percentiles***				
		10	***25***	***50***	***75***	***90***
All reporting	*196*	0.8	1.1	1.4	1.9	2.5
With OR>1.0	*164*	1.1	1.3	1.6	2.0	2.5
Groundwater	*103*	0.7	1.1	1.5	2.0	2.6
Surface water	*42*	0.7	1.0	1.4	1.8	2.4
Purchase water	*49*	0.8	1.1	1.3	1.9	2.5
Best performing	*30*	1.1	1.2	1.8	2.0	3.1

The operating ratio (total revenue divided by total operating expenses) ranges from 0.05 to 9.18 for all 196 reporting systems with a mean and median values of 1.61 and 1.44, respectively.

For “best performing” systems the median value of the operating ratio was 1.8. Given the percentile distribution of the operating ratio, a value of 1.8 can be recommended as a benchmark value, which if equaled or exceeded would place a small system in the upper 25th percentile.

The debt coverage ratio (gross revenue minus operating expenses plus depreciation divided by the sum of interest and principal payments) is one way that systems can assess whether or not the revenues that remain after paying all operating costs are adequate enough to make the debt payments that are owed by the system. Table S2 shows the distribution of debt coverage ratios among 45 reporting systems.

Table ES2. Distribution of the Debt Service Coverage among Small Systems

Group of Systems	***Sample Size***	***Percentiles***				
		10	***25***	***50***	***75***	***90***
All reporting	*45*	-1.0	0.7	1.4	2.3	3.6
Groundwater	*20*	-0.2	0.5	1.3	2.7	11.4
Surface water	*16*	-1.5	0.8	1.5	1.8	2.6
Purchase water	*9*	-5.8	0.8	1.9	2.7	3.0
Best performing	*6*	1.8	2.0	2.7	3.6	3.7

The debt service coverage ratio falls into a wide range between –5.8 to +11.4. However, 90 percent of best performing systems had net revenue greater than 1.8 times their principal and interest payments. The benchmark value for debt service coverage is 2.7.

Average Charge for Water

Separate benchmarks for average price (shown as monthly bill) have to be used for groundwater and non-groundwater systems. These benchmarks are $25 and $40 per 6,000 gallons of water use per month.

Table ES3. Distribution of the Residential Bill for 6,000 Gallons per Month among Small Systems

Group of Systems	***Sample Size***	***Percentiles***				
		10	***25***	***50***	***75***	***90***
All reporting	*263*	$10.00	$15.00	$25.00	$35.10	$43.00
Groundwater	*138*	8.57	11.71	17.28	24.98	38.41
Surface water	*51*	18.74	25.00	31.50	38.50	43.00
Purchase water	*72*	18.22	25.40	32.50	40.99	50.40
Best performing	*30*	10.95	15.25	24.50	37.92	46.65

Net Revenue per 1,000 Gallons

An appropriate benchmark value for net revenue is $1.00 per 1,000 gallons. This value represents the median value for the 30 best performing systems. Values ranging from $1.20 to $2.00 per 1,000 gallons would place systems in the upper 25th percentile.

Table ES4. Distribution of Annual Net Revenue per 1,000 gallons among Small Systems

Group of Systems	***Sample Size***	***Percentiles***				
		10	***25***	***50***	***75***	***90***
All reporting	*135*	-$0.99	-$0.05	$0.46	$1.34	$2.37
With NR>0	*98*	0.07	0.34	0.96	1.84	3.36
Groundwater	*61*	-0.99	0.04	0.42	1.23	1.85
Surface water	*31*	-1.73	-0.24	0.24	1.34	2.32
Purchase water	*42*	-1.68	-0.18	0.47	2.20	3.62
Best performing	*30*	0.12	0.42	0.99	2.11	3.73

Sixty systems (31 percent of reporting) had net revenues less than or equal to zero.

Operating Expenses per 1,000 Gallons

The benchmark value for operating expenses should capture the lowest expenses. The lower 25th percentile values can be used as separate benchmarks for groundwater, surface water and purchased water systems. These values are $1.30, $2.00, and $3.00 per 1,000 gallons respectively.

Table ES5. Distribution of Annual Operating Expenses per 1,000 gallons among Small Systems

Group of Systems	***Sample Size***	***Percentiles***				
		10	***25***	***50***	***75***	***90***
All reporting	*155*	$1.00	$1.74	$2.84	$4.48	$6.31
Groundwater	*75*	0.62	1.28	2.08	2.99	4.53
Surface water	*33*	1.19	1.97	3.38	4.19	5.75
Purchase water	*46*	1.96	2.84	4.68	6.22	8.48
Best performing	*30*	0.76	1.41	2.77	4.28	5.73

Other Findings

The main body of the report contains more that 75 tables that describe various financial and operating measures for the sample of water systems that participated in this study. In many cases, these tables are broken down by size, source, and ownership characteristics and provide additional opportunities for individual comparisons.

APPENDIX A: LITERATURE RESOURCES: TOPICAL LISTING OF PUBLICATIONS AND ANNOTATED BIBLIOGRAPHY

TOPICAL LISTING OF RELEVANT PUBLICATIONS

Five general topical areas are used to categorize the resources that were reviewed for this study. Annotations for many of these resources appear in the following section.

1) The small water system problem
These publications describe technical, managerial, social, and economic roots of the "small system problem" and the general character of water supply systems in the US.

American Water Works Association Research Foundation (AWWARF). 1986. *Guidance Manual: Institutional Alternatives for Small Water Systems,* Prepared by: Robert G. McCall. Contract 79–84.

Boisvert, Richard N. and Todd M. Schmidt. 1996a. *Distribution of Community Water Systems Across the United States with Emphasis on Size, Water Production, Ownership, and Treatment*, Working Paper, Cornell University, Dept. of Agricultural, Resource, and Managerial Economics, WP 96: 17.

Committee on Small Water Supply Systems, National Research Council. 1996. *Safe Water from Every Tap: Improving Water Service to Small Communities.* National Research Council, National Academy Press: Washington DC,

Congressional Budget Office (CBO). 1987. Financing Municipal Water Supply Systems: A Special Study.

Cromwell, John E., III, Walter L. Harner, Jay C. Africa, and J.Stephen Schmidt. 1992. "Small Water Systems at the Crossroads," *Journal of the American Water Works Association*: 40–48.

Cromwell, John E., III. 1994. "Strategic planning for SDWA compliance in small systems." *Journal of the American Water Works Association*: Vol. 86, #5 (May): 42–51.

General Accounting Office. 1995a. *Rural Development: Patchwork of Federal Water and Sewer Programs is Difficult to Use.* Report RCED-95-160 BR. April 13, 1995.

General Accounting Office. 1995b. *Rural Development: USDA's Approach to Funding Water and Sewer Projects.* Report RCED-95-258. September, 22, 1995.

Illinois Commerce Commission, Water Policy Committee. *Regulating Small Water and Sewer Utilities: Problems and Some Solutions*. Springfield, IL 1985.

Keegan, Mike and Tom Crawford. 1997. "EPA Compliance Data Clears Up Common Misperceptions on Small Water Systems." *http://www.ruralwater.org/sdwispaper.htm*. December 10, 1997.

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Shanaghan, Peter. "Small systems and SDWA reauthorization. ." *Journal of the American Water Works Association*: Vol. 86, #5 (May): 52–61.

USEPA. 1999. *National Characteristics of Drinking Water Systems Serving Populations Under 10,000..* Prepared by The Cadmus Group, Inc. National Drinking Water Advisory Council's Small Systems Working Group. EPA 816-R-99-010. July.

USEPA. Office of Water. 1997. *Community Water System Survey: Volumes I: Overview*, and *Volume II Detailed Survey Result Tables and Methodology Report*. EPA-815-R-97-001a and EPA-815-R-97-001b.

USEPA. Office of Water. 1995. *Restructuring small drinking water systems: options and case studies*. EPA 810-R-95-002.

USEPA. 1993. *Technical and Economic Capacity of the States and Public Water Systems to Implement Drinking Water Regulations*. EPA 810-R-93-001.

2) The economics of small community water systems

Many of the technical, financial and managerial challenges of small water systems can be directly linked to the unique economic, institutional, and public goods aspects of the provision of water supply. The following publications focus on the economic characteristics of small systems as well as some of the complicating factors of public management.

Aron, Gert and Stephen P. Coelen. 1977. *Economic and Technical Considerations of Regional Water Supply,* A report submitted to the US Army Engineer Institute for Water Resources, Institute for Research on Land and Water Resources, Penn State University. Contract Report 77-7.

Beecher, Janice. 1996. *The Regionalization of Water Utilities: Perspectives, Literature Review, and Annotated Bibliography*. The National Regulatory Research Institute. Columbus, OH.

Boisvert, Richard and Leo Tsao. 1996. *The Implications of Economies of Size in Providing Additional Treatment for Small community Water Systems.* Working Paper. Dept. of Agricultural, Resource, and Managerial Economics. Cornell University.

Boisvert, Richard N. and Todd M. Schmidt. 1996. *Economies of Size in Water Treatment vs. Diseconomies of Dispersion for Small Public Water Systems,* Working Paper, Cornell University, Dept. of Agricultural, Resource, and Managerial Economics, WP 96–15.

Castillo, Eloise Trabka, Scott Rubin, Sally Keefe and Robert Raucher. 1997. "Restructuring small systems." *Journal of the American Water Works Association*. Vol. 89. #1: (January): 65–74.

Clark, Robert. M. 1979. "Water Supply Regionalization: A Critical Evaluation," *Journal of Water Resources Planning and Management*. Vol. 105, No. 9 (Sept 1979): 279–294.

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Supalla, Raymond J. and Saeed Ahmad. 1997. *Defining the Financial Capacity of Rural Communities to Meet Sewer and Water Needs*. The Agricultural Research Division. Institute of Agriculture and Natural Resources, Report no, 175.

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Schmidt, Todd M. and Richard N. Boisvert. 1996. *Rural Utilities Service's Water and Waste Disposal Loan and Grant Program and its Contribution to Small Public Water System Improvements in New York State.* Cornell University, Dept. of Agricultural, Resource, and Managerial Economics, R.B. 96-18.

van Es, J.C., Robert H. Orr and Richard J. Quigley. 1975. *A Comparison of Decision Making and Administrative Organization for Municipal Water Supplies in Medium-Sized and Small Illinois Municipalities*. University of Illinois Water Resources Center. Report #106.

3) Performance assessment and the benchmarking process

Benchmarking has become one of the most commonly used tools in the search for performance improvement. A background understanding of the types of benchmarking, the benchmarking process, and the application of benchmarking in water supply system improvement is a necessary prerequisite to employ this tool to improve water system performance. The following publications include articles about benchmarking activities in other businesses and utilities as well as publications that discuss the inherent problems in the creation of performance benchmark measures.

Ammmons, David N. 1996. *Municipal Benchmarks: Assessing Local Performance and Establishing Community Standards*. Sage Publications. Thousand Oaks, CA.

Arn, Thomas and Elizabeth Oakland. 1996. "Publicly owned utilities: A benchmark approach," *American City and Country*: 70–73.

Leighton, Gregory M., Bob Liptak and Dan Long. 1977. "Defining a 'Common Language' for Operations and Financial Benchmarking," *WATER/Engineering and Management*: 26–28.

Mahon, Justin D. 1996. *Benchmarks for Surface Source Reliability.* Presented at the New Jersey AWWA Education Committee Seminar on Water System Reliability from Source to Tap, October 3, 1996.

National Performance Review. 1997. *Serving the American Public: Best Practices in Performance Measurement. Benchmarking Study Report*. June 1997.

National Research Council. Committee on Measuring and Improving Infrastructure Performance, *Measuring and Improving Infrastructure Performance*, 1995. Available on-line at: *http://www.nap.edu/catalog/4929.html*

Spendolini, Mike. 1991. *The Benchmarking Book*. American Management Association.

Tarricone, Paul. 1998. "Best Practices Make Perfect," *Facilities Design and Management*: 50–52.

4) Assessment tools for small water systems

Many different tools and resources have been developed to improve the financial management of small water systems. The following publications include samples of assessments that are already in use, articles discussing the development of assessment tools, financial guides, and articles containing examples of measurements used by specific groups.

Amatetti, Edward J. Managing the Financial Condition of Water Utilities. 1994. Journal of the American Water Works Association, 86, no. 4: 176–187.

Community Resource Group, Inc. (no date). *Small System Guide to Developing and Setting Water Rates*. Prepared for Rural Community Assistance Program. Springdale, AR.

Corssmit, C. (Kees) W. 1996. *Fiscal Health Scoreboard for Water and Wastewater Utilities*. Based on a Publication in "The Newsletter of the Special District of Colorado." Prepared by Integrated Utilities Group. Denver, Colorado.

Farmer, Haig and Sharon Rollins. 1991. *Managing Your Utility's Money: The Trainer's Manual*. USEPA Office of Water Publication. EPA 430/09-91–014..

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Peroo, Michael D. 1997. *Financial Accounting Guide for Small Water Utilities*. Seneca, KS: Kansas Rural Water Association.

Soelter, Alan D. and Ellen G. Miller. 1999. “Capacity development: the small system perspective,” *Journal of the American Water Works Association*. Vol. 91, no.4: 110–122.

Standard and Poor’s Ratings Service’s 1999. “A Conversation With Donald L. Correll, Chairman and CEO of United Water Resources Inc.” *Utilities and Perspectives. (http://www.standardandpoors.com/ratings/search/index.htm)*

USEPA. Office of Water. 1996. *Methods for Assessing Small Water System Capability: A Review of Current Techniques and Approaches*. Prepared by Apogee Research, Inc. EPA 810-R-96-001.

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Viability Assessment Advisory Group to the Water Supply Section, Environmental Protection Division, Iowa Department of Natural resources. 1999. *Report of Findings on Improving the Technical, Financial and Managerial Capacity of Iowa’s Public Water Systems*. September, 1999.

4a) Computer assisted assessment tools for small water systems

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Missouri Department of Natural Resources. Division of Environmental Quality. Technical Assistance Program. 2000. *Drinking Water User Charge Analysis Worksheets*. Available from: ..*http://www.dnr.state.mo.us/dep/tap/hometap.htm*

Northbridge Environmental Consultants. (undated) *SURF: Small Utility Rates and Finances*. Funded by the American Water Works Association and Hawaii Section of AWWA.

5) Small system assessment studies and benchmarking applications

Performance benchmarks can best be identified through the statistical analysis of water system data. Several different research designs have been used in the study of small water system benchmarks.

Apogee Research/Hagler Bailly and Cadmus Group Inc. *(no date) Evaluating Business Plans for Small Public Drinking Water Systems Manual.* Prepared for the Pennsylvania Department of Environmental Protection and the United States Environmental Protection Agency. *http://www.dep.state.pa.us/dep/subject/advcoun/techctr/evalbpmanualfinal3.doc*

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The author proposes three answers to the question: Why do financial planning?

1) to demonstrate viability to lending community and enhance credit rating
2) to prepare for new regulations
3) to expose the potential for cost-savings tradeoffs, and thus reduce long-term capital requirements

The author notes that deferred maintenance is a significant indicator of the poor risk of a water utility, and suggests several ways that rate structure is critical to efficient financial management:

- creditors like to see fixed costs paid for by fixed charges
- rate differentiation and efficient cost allocation improve the reliability of surplus funds (the difference between revenue and expenses and thus cash flow because rates charged are directly related to the costs incurred to generate customers' revenue)
- maintains relationship between revenue and expenditures
- minimizes variability of profits

He also notes that cash flow is enhanced by faster depreciation of assets (obsolete equipment), and that the faster recovery of construction expenses reduces need to borrow.

Ammons, David N. *Municipal Benchmarks: Assessing Local Performance and Establishing Community Standards*, Sage Publications: Thousand Oaks. 1996.

The intended audience of this book is "mayors, city council members, city managers, department heads, other municipal officials and citizens who want a measuring rod for local government services" (p.x). The book presents a brief introduction to performance measurement and benchmarking and then offers a collection of benchmarks collected from the literature and municipal documents for 22 different municipal activities.

The introduction to the book provides a discussion of the rationale for using benchmarking as well as guidance on the basic elements of the design and use of benchmark measures.

The author offers six reasons for measuring performance:

- accountability
- planning and budgeting
- program evaluation/measuring –by-objectives/performance appraisal
- reallocation of resources
- directing operations/contract monitoring

The basic guidance provided by performance assessment is straightforward: "unless you are keeping score, it is difficult to tell if you are winning or loosing." (p.11)

The author defines four different categories of performance measures:
1) Workload measures – amount of work performed or services received
2) Efficiency measures – relationship between work performed and resources required
3) Effectiveness measures – degree to which performance meets objectives
4) Productivity measures – combination of effectiveness and efficiency measures into a single indicator (p.12)

The choice of performance measures is critical to the success of any benchmarking effort. The author provides the recommends the following criteria for the selection of indicator measures:
- Valid – measure what they claim to measure
- Reliable – can make repeated measures with little variation
- Understandable – unmistakably clear meaning
- Timely – can be compiled promptly enough to be useful to managers
- Resistant to efforts to "beat the system" through actions that do not truly represent desired changes
- Comprehensive – measures capture the most important performance dimensions
- Non-redundant – each measure contributes something distinctive
- Sensitive to data collection cost – inexpensive enough in collection and analysis to be practical
- Focused on controllable facets of performance – emphasize measures that are immediately applicable

The development of benchmark measures requires the analysis of data that are readily available, or can be collected with little effort. Several sources are suggested:
- Existing records
- Time logs
- Surveys
- Trained observer ratings
- Specially designed data collection processes (p.14)

The author observes that members of any organization rarely greet the development and use of performance measures with open arms. He suggests there are a variety of fears and motives within any organization that may lead to resistance. He predicts three types are likely to occur:
1) You can't measure what I do.
2) You're measuring the wrong thing.
3) It costs too much and we don't have the resources.

He cautions that no efforts should be made unless there is the support to carry them far enough so that they result in real improvements in the organization. (p.19)

Performance measurement systems can be developed in a variety of ways. The author provides the following framework as a generic approach.

1) Secure managerial commitment
2) Assign responsibility for coordinating departmental efforts
3) Select departments/activities/functions for the development of performance measures
4) Identify goals and objectives
5) Design measures that reflect performance relevant to objectives;
6) Determine the desired frequency of performance reporting
7) Assign departmental responsibility for data collection and reporting
8) Assign centralized responsibility for data receipt, monitoring and feedback
9) Audit performance data periodically
10) Ensure that analysis of performance measures incorporates a suitable basis for comparison
11) Ensure a meaningful connection between the performance measurement system and important decision processes
12) Continually refine performance measures
13) Incorporate selected measures into public reporting

One of the techniques most often used in performance improvement is benchmarking. The author defines benchmarking as the "anticipated or desired results anchored either in professional standards or in the experience of respected municipalities" (p.23). "True" benchmarking involve four components:

1) the identification of best-in-class performers
2) the comparison of local performance outputs and results with those top performers
3) the analysis of practices that account for any performance gaps
4) the development and implementation of strategies to adjust performance in one's favor" (p.286)

Two major issues are involved in the identification of suitable benchmarks. The first is the issue of data availability, which the author has in part tried to correct this through the publication of the experiences of numerous communities in his book. The second is the issue of comparability. The authors cautions that practitioners must be "vigilant" in ensuring that measures that are selected are truly comparable.

The book contains an extensive list of suggested financial benchmark indicators for municipalities in the *Finance and Budgeting* chapter. The indicators suggested for municipal water enterprises are taken from Moody's *1988 Medians: Selected Indicators of Municipal Performance* are listed below:

Indicator for Water Enterprises	***1988 Median***	***Formula***
Operating Ratio	70.1%	Operating & maintenance expenses divided by total operating revenues
Net Take-Down	34%	Net revenues divided by gross revenue & income.
Interest Coverage	4.08	Net revenues divided by interest requirements for year.
Debt Service Coverage	2.18	Net revenues divided by annual principal & interest requirements.
Debt Service Safety Margin	23.6%	Net revenues less annual principal & interest requirements divided by gross revenue & income
Debt Ratio	33.1%	Net funded debt divided by the sum of net fixed assets plus net working capital.

The *Public Utilities* chapter of the book also contains a sample of two operating benchmarks for water utilities: average number of water failures per 1,000 miles and percentage of unaccounted for water. These averages are disaggregated by region, community size, population change (1970-1980), system size (in miles), and age of housing stock.

Barrar, Peter, Douglas Wood, and Julian Jones. *Benchmarking the Finance Function: A Practical Approach or Small and Medium-Sized Enterprises.* A Report to the Board for Chartered Accountants in Business. Manchester Business School. University of Manchester. August 1997.

Documented experiences with benchmarking have, for the most part, come from large business enterprises. In order to explore the applicability of benchmarking to smaller enterprises, a project was commissioned by the United Kingdom's Board for Chartered Accountants. The goal of the project was to develop a generic approach to benchmarking and find ways to provide access to benchmark data to members. Specifically, the project examines the role of benchmarking in the financial management of small to medium sized enterprises in the UK. The report includes a brief introduction to benchmarking, describes the design and results of the study, and presents a series of conclusions and recommendations.

The working definition of benchmarking used in the report is:

> The process of comparing business practices and performance levels between companies (or divisions) in order to gain new insights and to identify opportunities for making improvements. (p. 6)

The benchmarking process itself is described using the approach proposed by the American Productivity and Quality Center's International Benchmarking Clearinghouse (*www.apqc.edu*). The stated purpose of benchmarking is to determine "shortfalls in performance that occur across all activities when compared to best practice." Thus benchmarking identifies resources that can be freed up to support growth and better service levels, as well as the analysis of the where improvements can be made, the size of any gaps in performance that may exist, and where the priorities of the firm should be. (p. 16)

The project used a five step methodology to build a framework for benchmarking for the small business financial functions.

1) Focus groups were held to identify "key finance function processes and performance measurement issues in general". Nine "generic" finance functions were identified during the focus groups as the most critical activities to overall company performance.
2) Interviews were conducted with financial directors and controllers of over 40 companies, in order to identify barriers to benchmarking, and the performance metrics commonly used by these firms
3) A mail questionnaire was designed based upon (1) and (2). The questionnaire contained 3 main elements: first, questions identifying the profile of the respondent and firm; second, questions relating to the costs of supporting the finance function; and third, whether the company was apply benchmarking or informal measures of performance.
4) The survey was mailed to national sample of four thousand companies, of all sizes and in all sectors. The very smallest firms were excluded because the difficulty these firms would have in differentiating costs down to the required level of analysis.
5) The questionnaire data were analyzed using Data Envelopment Analysis (DEA), a form of linear programming that avoids many of the problems of using the simple ratio analysis that is common in financial analysis.

DEA is an analytical technique that is frequently used in benchmarking that allows that comparison between individual firms or sector averages to best in class performers. The technique also allowed comparisons to be made for particular segments of the database, for example businesses in a particular sector, or of a certain size. The report does not provide any details on the technique itself.

The project used "time spent" as a proxy for cost. This approach works very well for the accounting function since accountants and accounting records are frequently kept on this basis. It may prove similarly useful in some applications for water supply systems.

Five findings are reported based on the study and analysis. First the study found that many professionals considered benchmarking to be "the preserve of large organizations". Potential obstacles to benchmarking at small firms were reported (i.e., confidentiality, comparability). Second, relative efficiencies were determined for nine accounting functions, along with the percent of potential efficiency improvement (these are displayed using histograms in the report). Third, the report details the efficiency improvements for professional and non-professional staff. Fourth, the report found that only 20% of companies reported using any benchmarking of their financial operations. However, those that did were more likely to be closer to "best practice" than those that did not. Also, some functions were routinely benchmarked more often than others.

Finally, many companies were much more concerned with monitoring of internal activities using informal metrics than with external comparisons to other firms. Those companies that used informal measurements were much more likely to be among the best performers.

The two general conclusions made by the report are that (1) there is significant potential for improvement in many companies (based on the DEA analysis), and (2) the most productive firms are more likely to use benchmarking.

This report (available online at: *www.icaew.co.uk/depts/dsb/dsbbcab/bench/cover.htm*) suggests that benchmarking may indeed hold promise for small drinking water systems. It is important for its general findings that small firms, such as small water enterprises, can benefit from benchmarking. Equally important is the research approach used to conduct this benchmark study (focus groups/interviews/survey/analysis). The application of data envelopment analysis is also a technique that would be applicable for future benchmark studies of small drinking water systems.

Boisvert, Richard N. and Todd M. Schmidt. *Distribution of Community Water Systems Across the United States with Emphasis on Size, Water Production, Ownership, and Treatment*, Working Paper, Cornell University, Dept. of Agricultural, Resource, and Managerial Economics, WP 96-17. October 1996**.**

The purpose of this report is to "provide a descriptive summary of the operating and design characteristics of CWS's across the country" (p.1). This is the first of a series of small water system studies prepared by the authors for the USEPA, who describe the scope of this effort as a "modest", but "necessary first step". By presenting this descriptive analysis, they are able to "provide a typology of representative water systems that can be examined to better understand the regional effects of policy implementation" (p.1).

Data for this study came from the USEPA's *Federal Reporting Data System (FRDS-II)* which was established under the 1974 SDWA for the purpose of monitoring water system compliance. The data for FRDS are collected by state regulatory agencies and reported to USEPA on an annual basis. The data used in this study are from FRDS as of July 1, 1994.

Although the intention of the authors was to use the entire data set, many of the systems had either failed to completely report information or had provided obviously erroneous information. These systems were not included. The authors also chose to exclude the 700 systems that are located in US territories. The final data set used by the authors included information on about 45,600 systems, or about an 80 percent sample of all reports collected by EPA.

In order to ensure that the sample was representative, the authors compared their sample, by system size and source of water, to the entire population of water systems as reported in the 1993 USEPA report *Technical and Economic Capacity of States and Public Water Systems to Implement Drinking Water Regulations*. They used the Kolmogorov-Smirnov test for the similarity of distributions and found that, in general, the subset was representative of the entire population of systems, with the exception of the smallest size category. They did not believe that this unduly biased their results, arguing that the "general characteristics of very small systems are likely to be more homogenous than those of systems with retail service populations greater than 500" (p.5).

The authors loaded their final database into SAS and performed several different analyses. These are reported in a series of appendices.

Appendix A.
Describes the Kolmogorov-Smirnov test for the similarity of distributions.

Appendix B.
The following comparisons were described by USEPA Region:

- percentage distribution of CWS by size (population category), ownership, treatment classification, and water source
- percentage of the population served by CWS by population size category
- average water production (average daily flow) and design capacity of CWS
- percentage distribution of the water production and water source

Appendix C.
Contains the estimated statistical models for average flow and design capacity. The authors estimate the relationship between population served, system flow, and design capacity using two separate regression equations, and a sample of 11,000 water systems. These regression equations are then used to estimate these variables for water systems that failed to report them.

The first equation estimated average daily flow (in gpd) by regressing it against: size of the retail population, number of commercial hook-ups, and dummy variables for: primary water source, purchased water, residential or non-residential areas, located in MSA (and therefore "urban"), ownership (public/private), and regional location (grouping of EPA region for either South or West; Northeast was the default category – all ten EPA regions were put into these three, not mutually exclusive, categories).

The second equation estimated design capacity (in gpd), by regressing this variable against the same set of variables used in the first equation. Average daily flow was also included as an independent variable (in the form of log squared), under the hypothesis that expectations about average daily flow influence decisions about capacity (but not vice versa). Logarithmic form was used for the continuous variables in both equations so that the relationships could be estimated as elasticities. The cross products of the log of the population and the log of the hook-up variables were also included average daily flow equation.

Appendix D.
The FRDS database reports the treatment objectives of all systems. These are presented here in tabular form, by system size (5) categories.

Appendix E.
Tabular presentation of multiple water treatment objectives by system size (5) categories and water source (ground water vs. surface water).

Appendix F.
Tabular presentation of multiple water treatment processes by system size (5) categories and water source (ground water vs. surface water).

Appendix G.
Tabular presentation of estimated treatment needs (as reported in an earlier USEPA document) and actual treatment combinations (in percent), by system size (5) categories.

Attachment 1 Multiple objective combinations by population category and water source.

Attachment 2. Multiple treatment objective combinations by population category and water source.

The authors provide a detailed summary of their analysis of the FRDS database, reporting on the size, water source, ownership, treatment objectives, current treatment processes, and national distribution of small systems. From this analysis they make several policy observations.

- Less than 20 percent of the total US population is served by more than 90 percent of the nation's water systems. “Most would agree that even the logistics of dealing with well over 50,000 community water systems is problematic” (p.33). The authors also note that small water systems are more likely to be scattered across the landscape, with many in lower income areas.
- The proportion of small water systems is above average in New England and EPA's three western regions. This would predispose these areas for the establishment of regional technical support centers as required under the 1996 SDWA Amendments.
- Small water systems tend to use ground water sources. This is a positive finding since ground water sources require less treatment and are thus likely to be less expensive to bring up to SDWA standards.
- More than half of the systems that serve less than 10,000 people are privately operated and thus are only eligible for available funding assistance when they are judged to have the "greatest public health and financial need" (p.34).
- Small systems need small scale technology designed specifically to meet their needs, and monitoring flexibility, so that they do not have to test for contaminants that they have no chance of encountering (the 1996 SDWA Amendments do contain provisions for both of these conditions).
- The data reveal a discrepancy between the number of systems needing multiple treatments and those employing them, especially in small and medium sized systems. Priority areas for ground water systems should be disinfection and

corrosion control; for surface water systems: filtration, corrosion control and ion exchange.

- There is a need for cost estimates of jointly operated treatment processes, beyond the engineering estimates currently used by EPA.

Boisvert, Richard N. and Todd M. Schmidt. *Economies of Size in Water Treatment vs. Diseconomies of Dispersion for Small Public Water Systems,* Working Paper, Cornell University, Dept. of Agricultural, Resource, and Managerial Economics, WP 96-15. November 1996.

The purpose of this project was to "identify a method by which to determine the size for small water systems in New York state that will minimize the combined cost (of) treatment and delivery for commonly used treatment options and representative differences in the characteristics of rural service areas" (p.1).

Estimates of combined annualized capital and O&M costs for four treatment types were taken from an earlier study. Data used to estimate these costs came from 37 loan and grant files for water systems projects financed by New York Rural Development offices. The data from these files were adjusted as follows: (1) capital and operating costs were deflated to 1992 dollars (ENR Construction Cost Index & ENR Wage History), and (2) capital costs were annualized based on useful life of 20 years, using an eight percent discount rate.

Data for estimation of the transmission and distribution cost function came from 33 of the files used to estimate annualized capital and O&M costs. Files were selected that had detailed enough information to quantify:

- system size and water flow demand
- cost of excavation, backfill, restoration an d boring
- transmission and distribution line specifications and price
- cost of pipe fittings, valves, and existing system connection
- cost of water service and meter installation
- number and per unit costs of hydrant installation
- cost of specialized altitude, pressure and other valves
- construction, administration, and engineering contingency levels.

The authors state that water system cost can be divided between two distinctly different operations: treatment, and transmission and delivery. Therefore two separate models must be specified. Treatment costs can further be broken down into its capital cost component and the O&M component.

The authors use an exponential function to express the relationship of total treatment costs (annualized: TC_t) to some measure of output (P):

$$(1)\ TC_t = bP^a$$

Economies of size are defined as the "proportional increase in cost for a small proportional increase in output". This can be expressed as:

$$(2)\ SCE = 1 - \partial \ln TC_t / \partial \ln P$$

which is equal to 1-α, for the equation (1). Economies of size exist if SCE>0; diseconomies if SCE is negative.

The authors argue that this specification assumes that average costs continue to fall "regardless of how large the system becomes" (p.3). They also argue that it is likely that this is not the case, and that economies of scale may be exhausted at some point. They rewrite the cost function so that it can vary with the level of output:

$$(3)\ TC_t = \beta P^{\alpha + \delta \ln P}, \text{ and}$$

$$(4)\ SCE = 1 - (\alpha + 2\delta \ln P)$$

The parameters of this equation can be estimated using OLS by transforming (3) into logarithmic form:

$$(5)\ \ln TC_t = \ln \beta + \alpha \ln P + \delta (\ln P)^2$$

The measure of output chosen for this formula is "population served", because of its relationship to both design capacity and average daily flow. Since too few observations were available to estimate the scale of all treatment types a final zero-one variable was added to account for individual treatment types. For each type *i*:

$$(6)\ TC_t = \beta P^{\alpha + \delta \ln P + \sum_i \alpha_i d_i}, \text{ and}$$

$$(7)\ \ln TC_t = \ln \beta + \alpha \ln P + \delta (\ln P)^2 + \sum_i \alpha_i d_i \ln P$$

The specification for transmission is more complex than that for treatment. The authors acknowledge that their data do not allow them to disentangle the expenditures on energy costs into two different functions. They express the total cost of delivery in terms of the population served (P), linear feet of pipe (L), and the number of fire hydrants (H).

$$(8)\ TC_d = \gamma P^{\lambda} \left[\frac{L}{P}\right]^{\eta} \left[\frac{H}{P}\right]^{\omega},$$

which simplifies in log-linear form to:

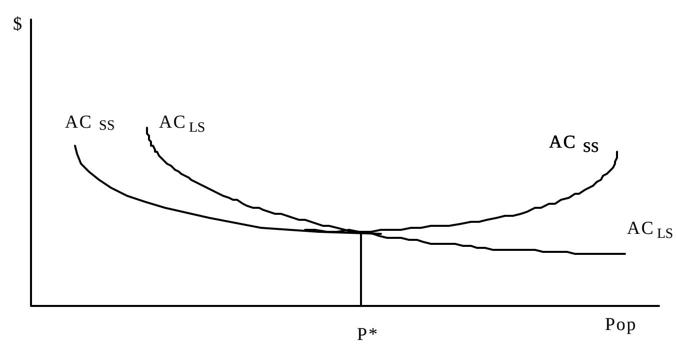
$$(9)\ \ln TC_d = \ln \gamma + (\gamma + \eta + \omega) \ln P + \eta \ln L + \omega \ln H.$$

The total system cost is the sum of the two specified equations. The authors state that although these functions could be expressed algebraically, they are complicated and are "not very enlightening" (p.6). The therefore instead turn to a graphic presentation.

The treatment cost function presents a classic example of the total cost function, rising first at a decreasing rate, and then and an increasing rate, with the minimum average cost located at the point of tangency from a ray drawn out from the origin. The function for distribution costs rise at an increasing rate continuously. Thus "the minimum average cost system size when both components are considered will be below that when only treatment costs are considered" (p.6).

The adjusted data collected from the 37 treatment projects were loaded into a SAS file and fitted to Equations (6) & (9). The equations were transformed to their logarithmic form and linear regression was used. Dummy variables were used to account for various treatment processes.

The output of the regression analysis enabled the authors to relate the economies of size to the population served. Results indicate that the economies of scale are nearly exhausted for systems of 7,500 people. In other words, the percentage of treatment costs above minimum average cost is small (i.e., 25 percent), even when system size is only a fraction of the size to achieve this minimum cost (i.e., 10 percent). The authors note that this differs from the acknowledged economies that exist in much larger systems. They attribute this to the small size of systems in the sample used in the analysis, and to the fact that the technology of the treatment systems "are substantially different" as they increase in size. They describe this difference graphically.



For systems serving populations below P* the choice of small system technology makes sense (as reflected in average cost curve ACss). Beyond a service population of P*, the larger systems technology (ACLS) is a better choice.

Clark, Morris Wm, Jr., Edward M. Pierce, G. Richard Dreese, and Llyoyd G. Antle. *PC-FINPACK, Version 1.010, Documentation Report and Computerized Spreadsheets*, IWR Report 93-E-7, USACE, Water Resources Support Center, Fort Belvoir, VA. March, 1993.

PC-FINPACK is a computerized financial analysis and simulation model for water supply and waste water disposal facilities. The "overriding rationale underlying the use of financial simulation models is the assumption that the firm's managers wish to maintain a given ratio of debt to equity in the firm's balance sheet …therefore, the rationale underlying the operation of PC-FINPACK is the major postulate that the constancy of the ratio of Total Operating Revenues to Total Assets is an appropriate basis for financial simulation analysis of the accounting data for water supply and waste water disposal facilities" (p.1).

The basic input data are a specific facilities number of hook-ups by user class, rates and annual growth of major activities. Users can also modify accounting and financial multipliers in the model which were derived from field studies of balance sheets and income statements of different categories of privately and publicly owned water supply and waste water disposal facilities.

The model was developed in order to support Army Corps of Engineer analysts "in their conduct of financial analyses of projects that public sponsors are preliminarily considering for privatization" (p.i). The model can also be used to determine the financial savings to a community from participating in a large, multi- jurisdictional water supply or waste water project rather than undertaking its own, smaller facility.

Clark, Robert. M. "Water Supply Regionalization: A Critical Evaluation," *Journal of Water Resources Planning and Management*. Vol. 105, No. 9, (September 1979): 279-294.

The author states that over 90 percent of the nation's water supplies serve fewer than 10,000 customers, accounting for less than 25 percent of the total population. These small systems will be seriously impacted by the Safe Drinking Water Act and should consider regionalization as a means of meeting new regulatory requirements. He then presents a well-documented discussion of the relationship between water system size and drinking water quality. The economies of scale for water treatment has led to an unstated policy "in favor of the single plant." Clark presents a case study to test the cost effectiveness of large single plants serving distant small utilities. His analysis demonstrates that "transportation costs are significant and can negate economies of scale." He concludes with a call for more research into the effects of regionalization on small systems.

Community Resource Group (CRG), Inc. *Small System Guide to Developing and Setting Water Rates*. Prepared for Rural Community Assistance Program. Springdale, AR (no date).

This publication is directed at the boards of directors of small system. It includes worksheets that can be used in the assessment and design of a water rate schedule. The guide recommends that water systems operate in a self-sufficient manner and use a rate structure that will completely cover the full cost of the water system operations.

Five events are considered as sufficient signals to trigger a rate review:

1) Revenue did not exceed expenses in each of 3 years
2) Unable to make scheduled debt payments
3) Out of compliance with drinking water standards
4) Unable to cover emergency and preventive maintenance expenses
5) No rate increase in the last three years

Committee on Small Water Supply Systems, National Research Council. *Safe Water From Every Tap: Improving Water Service to Small Communities*, National Research Council, National Academy Press: Washington DC, 1996.

This book reviews the risks of violating drinking water standards and discusses options for improving water service in small communities. It includes a detailed review of the available technologies that are appropriate for treating drinking water in small communities, and presents a variety of institutional options for improving the management efficiency and financial stability of water systems.

The authors discuss how small water systems face many of the same problems of small businesses, and describe the cycle of systems that are unable to raise adequate revenues: "without funding, water systems cannot afford to hire good managers, but without good managers, water systems will have trouble developing a plan to increase revenues" (p.7)

The authors suggest that water systems conduct "performance appraisals" that should include analyses of the following types of information:

- existence of health orders (for example, boil water orders) issued to the water system or waterborne disease outbreaks in the community;
- the system's record of response to these orders and outbreaks;
- violations of water quality standards, including monitoring requirements;
- the water system's methods for keeping track of its compliance with Safe Drinking Water Act standards;
- the number of staff and their levels of training;
- responses to sanitary surveys (on-site visits by state regulators to inspect system source water, facilities, and operations); and
- whether the water system has an adequate plan specifying how it will meet present and future demands at an affordable cost while complying with the Safe Drinking Water Act and other regulations. (p. 7 & 8).

Corssmit, C. (Kees) W. *Fiscal Health Scoreboard for Water and Wastewater Utilities*. Based on a Publication in “The Newsletter of the Special District of Colorado.” Prepared by Integrated Utilities Group. Denver, Colorado. 1996.

The scorecard is meant to be used as a “quick, back-of-the-envelope tool” for evaluating the fiscal health of water and wastewater utilities. It consists of 25 question, that can be rated “Yes”, “Nearly”, or “No”. A scoring scale allows managers to rate their systems. Questions refer to all key areas of system operation and finance. A sample of the questions appears below:

Questions	***Yes (4 pts)***	***Nearly (2 pts)***	***No (0 pts)***
Does your utility meet all regulatory requirements?			
Are user charge revenues sufficient to cover O&M?			
Is usage cost per customer stable compared with CPI?			
Are tap fees based on fixed asset costs?			
Do you have sufficient financial reserves including working capital (over 1/8 of annual O&M budget)?			

Cromwell, John E., III, and Jeffrey L. Jordan. “Linking Full-Cost Recovery and Sustainability,” in Joseph Cotuvo, Gunther Craun and Nancy Hearne, eds. *Providing Safe Drinking Water in Small Systems: Technology, Operations and Economics*. Boca Raton, LA: Lewis Publishers, 1999.

The authors note that criteria are being developed in US to evaluate the “sustainability” of systems. From an economic perspective sustainability is linked to full-cost recovery and is ultimately “reflected in the system’s finances.” “This reasoning leads to the hypothesis that the viability of a system can be evaluated through an examination of the extent to which it (the water system) is recovering the full costs of suitable operations through its finances.”

This paper summarize two studies (included elsewhere in this bibliography), noting that although they differ in sample size, statistical analysis, selection of variables, and underlying approach, they result in similar findings.

On the basis of these studies two indicators appear to be especially important in signaling problems with small water systems:

Operating ratio (revenues/O&M expenses) > 1.2
Cash flow coverage ([net income+depreciation]/[principal+interest]) > 1.5

For comparison the authors note that Moody’s Investment Service recommends 1.5 and 1.9 for these indicators. From the results of the two studies the authors suggests that sustainability requires three different types of capacity:

1) Capacity to obtain cash - Simple cost recovery is not enough. Systems must establish a buffer if they are to be sustainable (operating ratio > 1.2)
2) Capacity to hold onto cash; not allow diversion to other uses
3) Capacity to plan in enough detail in the intermediate term (5 years) to assess and cover future financial needs

Cromwell, John E., III, Scott J. Rubin, Frederick A. Marrocco, and Mark E. Levan. "Business Planning for Small System Capacity Development," *Journal of the American Water Works Association* 89, no. 1, (January 1997):47–57.

This article reviews the State of Pennsylvania's efforts, which predate the 1996 SDWA Amendments, to develop a viability program. The key to the framework for these efforts was the insistence that water systems be operated like a business. State actions thus have focused on efforts to assist systems with business planning and the coordination of state agencies to facilitate and fund effective planning and action.

Pennsylvania has developed two tools to assist systems with the development of business plans. The first, PAWATER, is a computerized cost-estimating model that can estimate total capital and operating costs. The second is a self-assessment manual that includes a list of simple diagnostic questions and a simplified worksheet that can be used to develop an elementary five-year capital and operating budget.

This article also summarizes the methodology and the findings of the "benchmark" study prepared for the Pennsylvania Department of Environmental Protection (included elsewhere in this bibliography). A combination of indicator percentiles and "warning flag" benchmarks serve as measures of the level of assurance that is provided by a system's business plan. System managers can use these as tools to measure their own performance; state agencies can use them as a way of assessing the overall needs of water systems in the state and designing programs to target specific problems areas. The authors caution that any system of assessment must be accompanied by a healthy dose of "common sense and experienced self-judgement".

Several charts and tables that illustrate the approach adopted by Pennsylvania are included in the article. Six types of indicators variables are included: system characteristics, demographic, calculated demographics, financial, calculated financial, violations. A portion of the table for municipal systems is reproduced below to illustrate some of the indicators that proved to be significant in the Pennsylvania study.

		Benchmarks	
Indicator	**Indicator Percentile 50th (median)**	**Yellow Warning Flag**	**Red Warning Flag**
Municipal Systems			
Av. production (gpd)	60,000	-	-
# of connections	318	-	-
Families in poverty (%, 1990)	7.3	8.0	9.5
Median household income (%, 1989)	27,112	-	-
Change in population (%, 1980-90)	-2.0	1.0	-2.0
Elderly households (%)	25.4	27.0	28.5
Operating revenue ($)	72,904	75,000	55,000
Operating expense ($)	54,835	65,000	50,000
Expense per 1,000 gal	2.20	-	-
Expense per connection ($)	189	175	160
Revenue per connection ($)	211	230	190
Operating ratio	1.2	-	-
Average revenue as % of median household income	0.8	-	-
Total MCL violations	0	-	-
Total monitoring and reporting violations	1	1 or more	1 or more

Cromwell, John E., III, and Scott J. Rubin. *Development of Benchmark Measures for Viability Assessment,* Bethseda, MD: Prepared for the Pennsylvania Department of Environmental Protection. Apogee Research, Inc. 1995.

This study arose from discussions about "viable" water systems as several states, including Pennsylvania, sought to find ways to address the regulatory dilemma caused by the proliferation of small water systems, and the inability of older small water systems to cope with the strain of changing socio-economic conditions, and increasing regulatory demands.

This report begins with the premise that the business plan "is the framework within which the water system makes an institutional commitment to be self-sustaining and to provide adequate technical, managerial, and financial capabilities to meet future challenges "(p.I-2). The purpose of this study was to develop a methodology to devise indicators and benchmarks to "measure the level of assurance provided in business plans for small water systems" (p.I-5). These indicators are intended to be used not to "determine" viability, but to focus on "assuring" viability (p.I-5). The authors based their approach on the assumption that if water systems are, in fact, businesses, then the methodologies used by investors to evaluate business plans should be applicable to water systems.

The authors cite several objectives for the development of viability assessment tools for small water systems:

1) to better characterize the problem and facilitate the introduction of other resources
2) to identify and target troubled systems so that they can receive assistance
3) to prevent other systems from slipping into trouble
4) to require greater assurances of viability as a condition of the formation of new water systems (p. I-1).

The study began with a search for "indicators"'; those pieces of information that might be related to the ability of a system to meet existing and future performance requirements. Likely candidate indicators were drawn from the physical, demographic, and financial characteristics of water systems serving less than 1,000 connections in the state of Pennsylvania. Data was collected from four state agencies, the US Bureau of Census (1990) and the Pennsylvania Manufactured Housing Association. The main analysis focused on those systems that had the most available data. Both private and publicly managed systems were included. The final data set that was available for analysis consisted of 244 systems, in three ownership categories: municipal authorities, municipality-owned systems, and investor-owned (Public Utility Commission-regulated) systems.

The authors also developed an independent field assessment tool in order to rank systems based on 16 criteria that relate to water systems performance. State drinking water officials who were familiar with the systems used this index to perform field assessments on the water systems included in the analysis. Indicators variables were statistically tested using these externally solicited judgments of performance (validation). Benchmark ranges were then determined to establish potential warning signals for each of the statistically relevant indicators (calibration). As a final step, the authors compared their benchmarks against rating systems developed by other researchers.

Separate sets of benchmarks were developed for public and private systems because of the "differences in tax laws, financing methods, bond covenants, accounting practices". Based on their research the authors propose 24 benchmarks that can be used to separate successful systems from unsuccessful systems in terms of yellow and red warning flags. The study also presents "indicator profiles" in the form of a distribution of values in each of the 47 different continuous variables used in the study. These profiles enable water system managers to evaluate the business plan prepared for their water systems to those of similar water systems. The authors caution that no one benchmark or profile can serve to tell the "whole story" of system performance, and just as in the case of investor evaluation of businesses, a healthy dose of subject judgement based upon knowledge of the situation of each water systems is required.

The authors draw several conclusions based on their research:

1) There are key differences between systems by ownership type.
2) The analysis of municipal systems is limited by the differences in accounting practices among municipalities, and the data found in balance sheets is particularly unreliable for this type of analysis. Income sheet data were much more likely to be comparable among systems.
3) The smallest systems analyzed in the study, mobile home parks and homeowner associations, lack the type of financial data that are necessary for this type of analysis.
4) The use of frequency distributions is a particularly good tool for the relative assessment of systems.
5) The "validation approach" used in the study seems to have worked well. The "intuition of field staff seems to be remarkably consistent with financial theory" (p.IV-6, & 7).

The analysis of indicator variables also provided some important conclusions:

1) *SDWA violations*: Monitoring and reporting violations *are* correlated to viability. Maximum contaminant level violations *are not*.
2) *Source water:* Surface water systems are overwhelmingly less able to meet operational demands.
3) *Size*: Groundwater systems serving less than 100 connections (<30,000gpd) and surface water systems serving less than 500 connections (<150,000gpd) are more likely to be in financial difficulty.
4) *Community demographics*: "Troubled systems are in troubled communities".
5) *Water system finances*: Adequate revenue is "absolutely essential to water systems capabilities and performance" and "the institutional structure of the water system is a critical determinant of whether adequate revenues are generated" (p. IV-8)

The following table presents the measures developed during this research project. The authors caution that these measures are "conceived as planning tools, intended to support the process of developing water system plans" (p.IV-4) and that the "ultimate measure of viability is the business plan" (p. IV-3). The major findings from the report were developed into a business plan manual that can be viewed on-line or download as an MS-Word file at:
(*http://www.dep.state.pa.us/dep/subject/advcoun/techctr/evalbpmanualfinal3.doc*).

Benchmark Indicators of Viability

Benchmark Indicator	Yellow Zone	Red Zone
For All Systems		
Primary source of water	Surface	Surface
Number of M&R violations in the last 3 years	1 or more	1 or more
Percent of families with incomes below poverty level in municipality	8.0%	9.5%
Median Household income in municipality as % of statewide median household income	95%	90%
Percent of households headed by a person age 65 or over in municipality	27%	28.5%
Percent change in population in municipality during last ten years	1%	-2%
Population of municipality	3,000	1,500
For Municipal Authorities		
Equity Ratio (equity/total assets)	70%	80%
Operating expense per 1,000 gallons	$3.40	$3.80
Net income per connection	$11	$1
Operating revenue per service connection	$310	$350
Operating revenue divided by operating expenses	115%	108%
Revenue per connection as a percent of median household income	1.3%	1.5%
For Municipality-Owned Systems		
Operating expense per service connection	$175	$160
Operating expenses	$65,000	$50,000
Operating revenues	$75,000	$55,000
Operating revenues per service connection	$230	$190
For Investor-Owned Systems		
Operating expense per 1,000 gallons	$2.00	$1.75
Operating revenue per service connection	$285	$220
Operating revenue divided by operating expenses	110%	100%
Revenue per connection as a percent of median household income	0.9%	0.8%
For Groundwater Systems		
Average production (gallons per day)	30,000	25,000
For Surface Water Systems		
Average production (gallons per day)	150,000	125,000
Operating expense per 1,000 gallons	$2.50	$3.00
(pIII-39)		

Cromwell, John E., III. "Strategic planning for SDWA compliance in small systems." *Journal of the American Water Works Association*: Vol. 86, #5 (May 1994): 42–51.

This short 1994 article the author offers decision makers a preview of what to anticipate from the changes that will be required under SDWA regulations. The article is meant to provide a way of being able to predict the total future costs of all of the expected changes, so that systems do not incrementally begin to make changes only to find out that their best long term alternatives may lie in another direction. Or in the analogy used by the author: “Should you invest a lot of money in the old car (i.e., the old approach to SDWA compliance), or is it time for a new one?” (p.42)

The article uses a “self-diagnostic” approach of posing a series of questions for small managers about their water systems in six key areas:

- Microbiological contamination
- Disinfection by-products
- Corrosion by-products
- Natural geologic contaminants
- Agricultural chemicals
- Industrial & commercial chemicals

The author argues that consumer awareness is “the ultimate compliance requirement”. “Nothing focuses the mind like cost estimates” and getting customers to appreciate the changes that must be needed in the system is the first step in ensuring that the financial resources will be there to make the tough choices needed to maintain compliance and protect the health of the community (p.50).

The article provides an example of the type of the simple assessment tools that can be provided to small systems to assist them in the process of developing long-term plans. These plans can highlight the many opportunities for cost saving alternatives that would be missed from the simple incremental process of meeting SDWA deadlines.

Dreese, G. Richard and Janice A. Beecher. “Developing Models for Assessing the Financial Health of Small and Medium-Sized Water Utilities,” *Journal of the American Water Works Association*, Vol. 85, no. 6 (June 1993): 54–60.

The purpose of this article is to present a review of the bankruptcy and failure-prediction models from the financial literature, discuss some of the problems in applying these models to water systems, and describe the development of a distress classification model for water utilities.

As might be expected, the interest in predicting business failure is great among financial institutions. Early research recognized that bankruptcy among small firms was greater than among larger firms. Bank failure research identified poor management, as the primary cause of failure and closure.

Later failure models were empirically derived, with no theoretical basis for choosing a variable other than the fact that it has been shown to be statistically significant. One of the most consistently significant predictor variables has been cash flow. The authors argue that the applicability of these models to water systems face several problems. They are mathematically complex, thus requiring statistical expertise. They are data intensive, thus requiring easy accessibility to the necessary databases. And the abundance of variables used in the models resulting in problems with multicollinearity.

Previous financial distress models had identified four common ratio types that are critical in the financial performance of any enterprise:
1) leverage
2) liquidity
3) profitability/income
4) historical earnings/profit trend

The authors examined 10 ratios that fit into these four types. For simplicity and because of the redundancy of these several of these ratios, the authors only used the variables having a negative relationship to failure. The distress score is calculated by summing the ratios.

Ratio type	***Ratio***
Profitability	(net income + depreciation) / (annual operating revenue)
Liquidity	(current assets) / (current liabilities)
Leverage	(current stock equity) / (total assets)
Profit trend	(retained earnings) / (common stock equity)
Growth and efficiency	(annual operating revenues) / (total assets)
Efficiency and profitability	(annual operating revenues) / (annual operating expenses)
Profitability	(net income) / (annual operating expenses)

The authors calibrated the model by calculating scores for the 15 strongest and weakest water systems in the NAWC (1993) database (based on their return on equity), and fitting them to a normal curve (using 1.5 standard deviations to capture 82 percent of all systems).

Classification	***Range of sum of ratio***
Good to excellent	≥ 4.00
Weak to marginal	3.01 to 3.99
Distressed	≤ 3.00
Bankrupt	Assets < Liabilities

Farmer, Haig and Sharon Rollins. *Managing Your Utility's Money: The Trainer's Manual*. USEPA Office of Water Publication. EPA 430/09-91-014. 1991**.**

The purpose of this manual (and associated workshop) is: "to present financial management and user fee information for local officials" - "help participants establish sound financial management practices, assess the financial health of water and wastewater systems and raise revenues through increasing user fees."(p.i.)

The manual states that the key to protecting the multi-billion dollar investment in water and wastewater treatment facilities is "municipal officials' ability to acquire sufficient operating revenues" (p.i.) and that the best source of revenues is also most politically difficult: user fees. The authors state: "The user service charge is the central and most important piece of a utility's puzzle" and "usually accounts for 80 to 90% of the utility's total revenues." (p.III-23)

The manual also contains "checklists" to identify recommended practices, and a primer on the principles of good financial management, and includes detailed definitions and sample worksheets for the calculation of key financial ratios. The authors stress that water and wastewater utilities must be run as self-supporting businesses.

The monitoring of several financial ratios is recommended. These should be calculated on a monthly basis (where applicable) to identify trends, predict future needs, and make comparisons to other systems. The following seven measures are recommended:

1) *Operating ratio = (total revenues/total expenses):* This should be calculated annually. Must be at least 1.00; greater than 1.00 if the utility has outstanding debt
2) *Coverage Ratio = (revenue available for debt service/debt service expenses),* where revenue available for debt service = (*total revenue - non-debt expenses*)
3) *Budgeted vs. Actual Revenues*
4) *Budgeted vs. Actual Expenses*
5) *Cash flow (total Revenues – total operating expenses). Cash flow must always be positive.*
6) *Unit Cost [(operations, maintenance and replacement cost + debt service cost)/total flow]*
7) *Equipment Replacement Fund %. (ERF%) = [(ERF/(total operating expenses-principal and interest payments)] X 100 %*

Fite, Steve. *Accounting for Rural Water Systems: A Practical Approach*. Prepared for the National Rural Water Association, under contract from the USDA Farmers Home Administration. Washington, 1980.

While this book is intended for the managers of rural water systems the author hopes that it will be useful to rural water boards, accountants, funding officials, and all rural water decision makers. It provides a complete guide to the establishment and maintenance of accounts that will meet Generally Accepted Accounting Principles, thus allowing small systems to easily conform to lending and management requirements. It also contains detailed description of accounts, and details on starting up a bookkeeping system.

The book provide details on how various cost and revenue elements can be allocated so that they can later be used to develop financial ratios to evaluate system performance. It also provides recommendations on how to handle inventories and depreciation, and serves as a reference source of financial definitions. The book contains a brief section on financial analysis using the information developed from the accounting system. The author recommends that the following accounting information should be routinely collected and reviewed.

Income Statement

- (Net Gain – Income) > Expenses
  - Shouldn't be too large - recommended that Gain <20% of total sales
  - Break even is ideal (when assets are properly depreciated)
  - Loss of more 10% of total sale dictates action (raise rates/reduce expenses) - Small systems have few areas to reduce expenses
- Average Income and Expense per meter
- Cost of producing water

Balance Sheet

Managers should observe trends in cash funds, reserve, total cost of system, remaining debt, membership fees, and retained earnings.

Water Loss

Managers should check this with their Master meters. Loss should not exceed 10 percent.

Grinnell, D. Jacque, and Richard F. Kochanek. *Water Utility Accounting* (Second Edition). Prepared for the American Water Works Association. 1980**.**

The purpose of this publication is to meet two basic needs: "1) to provide water utility managers with an understanding of how accounting information can aid them in performing the management function more efficiently and effectively" and (2) to help give trained accountants "insight into the information needed by the various groups interested in the activities of water utilities." (p.iii)

The book assumes that the reader has some knowledge of accounting and addresses the needs of both investor-owned and municipal water systems. Examples of all accounting concepts are presented using examples from actual water system accounts.

While some basic assessment techniques (historical comparisons, comparing actual and budgeted revenues/expenses, unit cost standards) are described the true value of the publication is as a complete reference source for the operation of water utility accounts. (note: A 3rd Edition of Water Utility Accounting was published in 1995 but could not be obtained for review)

Illinois Commerce Commission (ICC), Water Policy Committee. *Regulating Small Water and Sewer Utilities: Problems and Some Solutions*. Springfield, IL 1985.

This report focuses primarily on "subdivision" utilities. The problems: developers initially underwrite operating costs until subdivision is built-out, then they turn equipment over to owners who must face higher cost of operation; if subdivisions do not sell out homeowners are left with an overbuilt system; revenue from systems are inadequate to offset operation costs; inexperienced operators. Some solutions: Commission assistance for developers, encourage connection to larger systems;

encourage merger with professional water management company; better coordination with IEPA to prevent creation of small systems; revise regulatory requirements to ensure financial viability of small systems.

Iowa Department of Natural Resources (Iowa DNR). *Self Assessment Manual for Iowa Water System Viability.* September 1996.

These self-assessment manuals are designed for four different types of systems based on their ownership type (rural water association and municipal, privately-owned, mobile home parks, homeowner association and municipality-owned systems using a cash-basis accounting system).

Each manual has three parts: an introduction that describes the need for business-like behavior by water utilities and instructions on how to use the manual; a series of structured yes/no questions to assess system facilities, management, and finances; and a set of budgeting worksheets to use in planning the financial future of the system.

Although this method of self-assessment does not use benchmarks per se, it does guide system managers in the collection of basic financial and budgeting data. This allows managers to trace the performance of their own systems over time, and to alert them to imminent financial problems.

Copies of the manuals can be viewed or downloaded from the Iowa DER web site (*http://www.state.ia.us/government/dnr/organiza/epd/wtrsuply/viabilty/via.htm)*. A similar set of manuals is in use in Pennsylvania and are available on the Bureau of Water Supply Management, Financial and Technical Assistance Programs web site. *(http://www.dep.state.pa.us/dep/deputate/watermgt/wsm/wsm_tao/finan_tech_asst.htm)*

Jarocki, Bill and Timothy J. Wilkinson. *Idaho DEQ Water System Capacity Assessment Tool for SRF Loans: Managerial, Financial and Technical Capacity Indicators for Idaho* DWSRF *Loans,* Preliminary Report (version 2.0), Environmental Finance Center at Boise State University, March 1997. (available at: *http://sspa.boisestate.edu/efc/Publications/water_system_capacity.htm*)

This document was produced by the Environmental Finance Center at Boise State University in cooperation with the Idaho Division of Environmental Quality. The purpose of the assessment tool is to provide guidance to Idaho and other states as they prepare to meet the 1996 SDWA Amendments requirements to develop and implement a methodology that will yield a determination of public water supply capacity or capability.

The assessment tool is similar to others that have been developed by the USEPA, states, and researchers. The focus of the report is on producing measurement criteria for technical capacity, fiscal and financial management capacity and general management capacity. A decision-tree format is used in portions of the report and each component includes a section on “who” should be using the tool and “how to use the results”.

The report includes separate assessments for fiscal condition (ability to raise resources for proper operation) and financial management (how fiscal resources are managed). The format of the assessment consists of questions concerning system finances (i.e., frequency of rate review, additional revenues sources, bond rating, etc.) and calculations of various measures

Some of the measures/tests used in the tool include:

- *Revenue sufficiency:*
  Total user charge revenues – Total water systems expenses ≥ 0
- *Affordability:*
  Average residential user charge per month ≤ 1.5 percent of average median household income per month
  (Notes that: the State of Washington uses a “range of 1.25 to 1.75%; uses a “disadvantaged community threshold” of 2% of 80% of the statewide non-metropolitan average median household income; and recommends that any figure above 2% should be investigated).
- *Cash flow – contingency reserve*
  Operating cash (annual) ≥ 1/8 (O&M + G&A)
    O&M=> operating and maintenance expenses
    G&A=>general and administrative expenses

Jordan, Jeffrey L. ,Christopher N. Carlson, and James R. Wilson. “Financial indicators measure fiscal health,” *Journal of the American Water Works Association.* Vol. 89, no.8 (August 1997): 34-40

“The purpose of this article is to provide a set of financial indicators to aid utility managers in their efforts to measure financial health and performance.” (p.34)

Based on a review of past studies the author’s state that while water systems rarely go bankrupt, “nonviable” systems have two general weaknesses:
1) they are undercapitalized - no reserve or depreciation fund for capital replacement
2) they don’t raise enough money to operate an adequate operation and maintenance program.

The problems of water system finance can thus be summed up with two questions:

- Can the system pay its capital needs?
- Can the system cover the full cost of water?

Consequently, utility managers require two types of analytical tools: one to measure the system’s ability to raise cash, and another to analyze cash flow for revenue sufficiency.

In order to develop these tools the authors analyzed 1993 state financial audit data on 442 publicly owned utilities in Georgia. They separated these into 4 size categories based on the number of connections (<1000; 1,000 to 10,000; 10 to 50,000; >50,000), Using utility income statements and balance sheets, they collected 22 variables and created 96 non-redundant financial ratios.

Borrowing from the financial literature, the authors use a water analogy to describe financial health of a water system as a function of the size of liquid assets *(the reservoir)*, cash flow *(inflow into reservoir)*, debt (*measure of the potential drain*), and expenditures (*draining of liquid assets*). The likelihood of the business failure of the water system is then described in terms of these factors:

- The larger the reservoir – the smaller the chance of failure
- The larger the inflow (net cash flow), - the smaller the chance of failure.
- The larger the amount of debt – the greater the chance of failure.
- The larger the expenditures relative to revenues – the greater the chance of failure. (p. 36)

The authors divided the 96 financial ratios into four categories that represent the four elements of the reservoir model. Factor analysis was then used to reduce the number of ratios and to select a single best ratio to represent the four components of the model (size of liquid assets, cash flow, debt, expenditures). The four ratios selected by this process were:

Ratio	***Represents***	***Suggested range***
Current ratio: current assets/current liabilities	Size of the reservoir	1.5 - 2.1
Cash flow: Net income + depreciation / principal & interest	Inflow	1.5 +
Debt to equity: total debt/total equity	Potential drain on system	2.1 – 3.1
Operating ratio: Gross revenue / O&M charges:	Expenditures	1.2 and above
Return on assets Net income/net assets	Utility financial performance	6 - 10% (or as high as bond rates)

A fifth variable, Return on Assets (ROA) is also discussed at length in the article. ROA is described as an excellent measure of the how well the total assets of the system of the utility are performing.

The effectiveness of the variables as a financial tool were assessed by using an ordinary least squares regression test with ROA as the dependant variable to see if the four variables could explain the variation in the dependent variable. All four independent variables had a significant effect on ROA.

The authors state that the recommended variables and their values are comparable to those used by Moody's Investor Service. They advise system managers that these ratios will provide the most information by following them across time. The author's also note that these same ratios are used by the American Works Association's *QualServe Program.*

Jordan, Jeffery L., Christopher N. Carlson, and James R. Wilson, "Financial indicators measure fiscal health", *Water Resources Bulletin*, Vol 32, #1 (Feb 1996): 137-144.

The authors used financial information from 25 small water utilities in Georgia to develop a regression model for assessing the financial performance of water systems. The data included 24 data categories including income statements and retained earnings, from which 57 financial ratios were constructed. These financial ratios were subjected to principal component analysis and reduced to 27 ratios which were further grouped into four general categories which represented; (1) size of liquid assets, (2) cash flow, (3) size of debt, and (4) size of expenditures. The selected ratios are shown in the table below:

INDICATOR	***RATIO***	***MEASURES***
Size of liquid assets	Current Ratio = (Current Assets) / (Current Liabilities)	Easily obtainable indication of the extent of liquid assets available to the utility - if high may indicate a lack of new/young utilities in sample
Debt	Leverage (or debt to equity) = (total debt) / (total assets)	
Cash flow	Interest Coverage = (Net Income) / (Interest Expense) Return on Assets = (net income + depreciation)/(total assets)	Indicator of whether the utility can cover its debt requirements - it determines how much internally generated cash is available for capital expenditure and debt amortization (payback) Standard financial ratio for measuring the income generating ability of the utility's assets
Expenditures	Operating Ratio = (Operating Revenue/Operating Income) Operating Income = (total operating revenues-operating expenses + depreciation)	The higher this operating ratio, the higher revenue is than expenses

The authors argued that the best measure of system financial performance is debt service coverage (also referred to as "bond coverage" or "coverage ratio"). The "bond coverage" = (net revenue available for debt service)/(interest + principle). Where "net revenue" = (gross revenue from water services - operating and maintenance expenses (but w/o depreciation). The coverage ratio can be calculated using the following steps: (1) total all revenues, all sources (annual), (2) total all non-debt expenses (annual) and all operating expenses excluding principal and interest payments, (3) subtract and (4) divide by sum of yearly debt service expenses (interest plus principal). According to EPA; a common ratio is about 1.25. The resultant coverage ratio indicates if the utility has enough money to pay debt and still have enough left to cover contingencies or unexpected problems (i.e., a financial cushion for renewals and replacement).

The estimated regression model used the debt service coverage as the dependent variable. The estimated coefficient on five explanatory variables were:

$$C_i = b_o + 0.03CR_i + 0.37LE_i + 0.12INT_i + 25.24ROA_i + 0.31OR_i$$

Where:
C_i = debt service coverage of the ith water utility, CR_i = current ratio, LEV_i = debt to equity ratio, INT_i = interest coverage, ROA_i = return on assets and OP_i = operating ratio. The estimated equation explained 89 percent of the variation in debt coverage among the 25 utilities. A Probit model was also used and it correctly predicted the proper number of utilities in each of debt coverage category (i.e., it placed 15 of the 23 in the correct category, and was close on the rest).

The authors concluded that the liquid assets model used in the study accounts for two important components of financial viability, these are, the ability to raise capital, and the ability to cover the full cost of providing water services to the utility's customers. Also, the debt coverage ratio indicates the ability of a utility to meet all its revenue requirements and its debt payments and to have a reserve and replacement fund to address future needs.

The authors also concluded the specific ratios found to represent the theoretical categories of the model are probably sample specific and the reliability of any specific variable is limited to similar samples.

Kang, Suki. *Welfare Implications of Public Subsidies to Rural Water Systems.* Dissertation. Oklahoma State University. December, 1987.

The purpose of the study was to determine "whether the subsidy policy to rural water systems actually increases social welfare and how much" (p.28). Since the rural subsidy program is specifically intended to assist low-income families, Kang also investigates whether these benefits actually reach the target population. He argues that there are two distinct populations that live in rural areas: those who are there because of heritage or occupation; and those who are there to capture "locational benefits such as low rent, low land prices and/or high psychic prices" (p.6). He assume that this second group can be identified by their higher income, and that taxpayers would be unwilling to knowingly subsidize water supply for this group.

Kang performs a Cost Benefit Analysis (CBA) in order to evaluate the impact of the subsidies to rural water systems program (STRWS) . CBA is based upon welfare economics and involves the identification of social objectives and the measurement of welfare change due to policies or programs. Social objectives can be identified using "conventional" CBA, which adopts potential Pareto improvement (whether winners "could" pay losers), and/or non-conventional CBA, which incorporates a distributional weighting system. Kang chose to use both approaches in order to measure improvements in both economic efficiency and equity.

In order to measure the changes in benefits and cost, Kang uses a "with and without" approach. First, benefits and costs are measured without the subsidy. Then, they are measured with the subsidy. The difference in these two estimates is the marginal benefit and cost, or the impacts of the subsidy program.

The study describes two major forms of benefits from the STRWS assistance: direct benefits, which include a reduction of individual water bill and the increase in water consumption; and indirect benefits, such as the reduction in public health risks, and the psychic satisfaction to altruistic tax payers.

The direct costs of the STRWS to the government come in the form of grants, low-interest loans, and administrative costs. Direct costs to households come in the form of higher water bills due to the higher consumption encouraged by subsidized water prices. Indirect costs include the negative externalities associated with the dissatisfaction of taxpayers who pay for the subsidy, and the sprawl caused by the development of rural water systems.

Only direct costs and benefits were included in the analysis, because of the difficulty of quantifying indirect costs and benefits. Direct costs and benefits were considered to be summarized by changes in the consumer and producer surplus.

The initial data for the study came from a 1984 random sample survey of Oklahoma rural water systems, and households served by those systems, that was carried out by the Oklahoma State University Agricultural Economics Department. These data were combined with a complementary survey of 11 rural systems and households conducted in 1987. Water demand equations were derived from the first survey. Data from the second survey focused on water system characteristics (miles of line, number of connections, water supplied, years of operation, etc.), customer characteristics (income, consumption, family size) and the loans and grants received through the FmHA program.

Since the length of time in operation was different for the systems in the study, all cost and benefits estimates were annualized in order to make them comparable. Costs and benefits were also calculated per 1,000 gallons of supply and demand for the same reason.

The author draws 6 conclusions from this benefit cost analysis:
1) the public subsidy is inefficient as a whole;
2) one dollar of public costs is required to transfer 50¢ to private beneficiaries;
3) the subsidy is efficient for low-income groups;

4) marginal social benefits differ only slightly between the two income groups;
5) subsidy distribution was higher to higher income groups; lower for lower income;
6) substantial amounts of public funds go to the locational preference group.

Keegan, Mike and Tom Crawford. 1997. *"EPA Compliance Data Clears Up Common Misperceptions on Small Water Systems." http://www.ruralwater.org/sdwispaper.htm*. December 10, 1997.

In this article, researchers from the Rural Water Research and Education Foundation review national data from the USEPA Safe Drinking Water Information System for fiscal year 1996. The purpose of the analysis was to "get to the bottom of the common public perception that (small) public water systems in the U.S. do not provide safe drinking water to their customers". The document includes a breakdown of Type 21 (maximum contaminant level of acute total coliform) SDWA violations in FY1996 by violation type, system size, ownership type, and state.

The authors conclude that "small 'local government' water systems do not violate the most serious SDWA requirements more often than large publicly owned community water systems". The authors recommend that EPA develop a policy that targets systems having these type of violations, and provide assistance to immediately address the source of the problem that caused the violation. They argue that this approach would be more effective than the current "sustainability" tests that are being required of all community water systems.

Kingdom, Bill, John Knapp, Peter LaChance, and Myron Olstein, *Performance Benchmarking for Water Utilities,* AWWA Research Foundation and American Water Works Association, Denver, 1996.

The report does not attempt to present a long list of performance benchmark ratios, since these are "rarely of value because of the need to account for the range of factors that impact those ratios but which are outside the control of management" (p.xix). Rather, this report demonstrates how to go about performance benchmarking by describing all of the necessary steps in the process. The report does present a sample data set of quantitative performance ratios that can be used by practitioners to compare their performance, and "develops a series of models into which utilities can enter their own data to compare their performance to that of an 'average performing utility' faced with the same data values" (p.xx). The report also includes a chapter on sources of water utility data in North America and a case study to demonstrate performance benchmarking techniques. The authors view this study as a "first effort" to introduce benchmarking to water utilities.

The report is divided into two parts with a separate section dedicated to "metric" and "process" benchmarking. Metric benchmarking is defined as "the quantitative measurement of performance in terms of inputs, outputs, outcomes and the relationship between them". Process benchmarking is defined as the "mapping of one's own process and subsequent comparison of your process with those of other companies with exemplary performance in a similar process" (p.11).

The authors used a variety of research techniques in their approach to the investigation of benchmarking. A questionnaire was sent to utilities to determine the extent to which certain performance measures are used. Interviews were also conducted with several of the survey participants. The literature was surveyed to compile a list of available data sources, and the available data was compared with those needed to establish performance benchmarks. A small number of benchmarks were prepared from existing databases, using analytical techniques that ranged from simple ratios to multivariate regression models. A demonstration process benchmark evaluation was also conducted in conjunction with one of the participating utilities.

In the section on metric benchmarking the authors state that there are several requirements for effective performance measurement:

- a set of measures that captures most or all of the key features of the process or function of interest
- an understanding of those explanatory factors that are outside of the control of management that impact performance
- accurate, timely, consistent internal data that are related to the function of interest
- comparable external data from comparable external organizations
- analysis techniques (p.15)

The authors describe benchmarking as an eight step process.

1) Select process or function for benchmarking

Specific areas to be targeted for benchmarking can be derived from the utility's Mission Statement or Strategic Plan. The authors also suggest a list of questions that can be used to guide the selection process (i.e., What is essential to the organization's success?, Where are we currently experiencing problems? What are the critical outputs in the problem areas?, etc.(p.19))

2) Define how to measure performance

The set of measures used to capture performance must be focused on the function to be analyzed and small enough to be easily applied. The authors separate performance measures into two categories, outcome measures and efficiency measures. By their very nature water utilities impact key groups of stakeholders. *Outcome performance measures* are based upon the expectations these stakeholders. The report lists seven groups of stakeholders and presents measures that have been used to capture the needs of these groups. A sample of some of the measures related to these groups appears below:

Area of concern – Item	*Example of measure*
Adequacy measures – availability of raw water	Sprinkler ban not more than once every 10 years
Reliability measures – interruptions to supply	# of customers who experience an interruption in supply without notice
Quality measures - water quality at the customer tap	Volume of water entering system in violation of MCL for total coliform
Customer satisfaction – response to inquiries	Response time to remedy complaints
Staff – accidents or injuries	Industry average over last 3 years
Financial management – quality of management	Bond rating
Stewardship – main breaks	Number of main breaks per mile

Efficiency performance measures have commonly focused on operating and maintenance costs and are usually presented in the form of a single number. Ratios have long served as the standard measurement tool. However, the authors advise against the use of "headline ratios" of inputs to outputs (i.e., $/1,000 gal.) that are often more a result of the operating environment faced by the utility and thus are beyond the control of management. The report includes six appendices containing examples of efficiency measures for various components of water system operation (water resources, treatment, distribution, planning, and support).

3) Define explanatory factors

Explanatory factors are those elements of a water system beyond the control of management. It is important to group water systems by these factors so that comparisons are made between systems that are experiencing similar operational conditions. The report includes a list of 10 such factors

Factor	*Examples*
Physical size	Length of main (mile)
	# of customers (count)
	# of connections (count)
Expenses	Transmission and distribution costs ($ & KWH)
Customer demography	Customer class (# of residential, # of commercial, etc.)
Water consumption	Total (mgd) by class
	Per capita
Asset stock	Unaccounted for water (%)
Human Resources	Contracting out (% of total O&M costs contracted out)
Ownership structure	Type (investor, municipal, authority)
Sources of water	Type (% surface, % ground, % purchased)
Treatment facilities	Capacity (mgd)
Billing	Frequency (times per year)

4) Define data requirements

Data required for the analysis are selected based upon a review of the chosen performance measures, while still accounting for the explanatory factors. If the required data are not readily available from published databases, then the cost of surveying or other data collection efforts must be considered. The quality of the data must be assessed before it is used in any analysis.

5) Select comparison organizations
Organizations chosen for comparison should have explanatory variables that are similar to the subject utility. The number of comparison organizations will depend upon the cost of collecting the required information. The authors recommend a minimum of at least six.

6) Collect data
The authors caution that inaccurate data collection, or the collection of data that are improperly defined will reduce the level of confidence in the final analysis.

7) Analyze data and present findings
Several principal techniques for analysis are described in the report. *Outcome measurement* is a simple comparison of these measures between utilities or utility averages. *Performance ratio* analysis typically consists of "ranking tables" for indicators, which describe the dimension being measured, lists the utilities being compared and show the performance ratio of each. The listing is presented in rank order and utilities can see where their own performance fits into the range of ratios. Again, the authors caution that care must be taken to pay attention to explanatory variables during these comparisons. *Mathematical or statistical modeling* can be used to control for explanatory factors while making performance comparisons. The report contains a separate chapter that provides examples of each type of analysis (see below).

8) Initiate performance improvement program
The goal of performance assessment is to improve the effectiveness of the organization. Review of assessment analysis must be followed by actions that improve performance.

Quantitative Analysis
One chapter of the report is dedicated to providing demonstrations of the analytical techniques that recommended by the authors. All of the examples focus on operation and maintenance costs since it was assumed that there would be broad interest in these measures and "these costs are more likely to be consistent between utilities regardless of size and ownership structure" (p.65). Data from the 1990 AWWA Water Industry Database (WIDB) and the National Association of Water Companies 1993 Financial and Operating Database was used in the analyses. The *outcome measures* approach was demonstrated using a sample of response times to telephone inquiries from a sample of 12 utilities. The data are displayed in tabular form and "while the sample is too small to allow the setting of target performance levels" it clearly demonstrates which utilities have significant room for improvement (p.67).

The use of *performance ratios* is demonstrated through the analysis of eight ratios:

- Total O&M cost ($) per 1,000 gal. sold
- Production O&M cost ($) per 1,000 gal. produced
- Purification O&M cost ($) per 1,000 gal. produced
- Production & purification O&M cost ($) per 1,000 gal. produced
- Transmission & distribution O&M cost ($) per 1,000 gal. sold
- Transmission & distribution O&M cost ($) per mile of main
- Customer accounting cost ($) per account
- Administrative and general cost ($) per account (p.67)

The results from this analysis are displayed graphically, with the ratio values displayed on the y-axis that the "percent of companies less than value" on the x-axis. Each graph also includes a sidebar listing "typical explanatory factors".

A *univariate* regression model of the same 8 ratios is also demonstrated. A log-log form is used to "explicitly account for the economy of scale factors found in a water utility" (p. 73). The results appear in the table below:

Dependent variable (A)	***Independent variable (B)***	***Model***
Total O&M cost	Total annual water sold (mgd)	$A=7631B^{0.815}$
Production O&M cost	Total annual water produced (mgd)	$A=1168B^{0.865}$
Purification O&M cost	Total annual water produced (mgd)	$A=532B^{0.864}$
Production & purification O&M cost	Total annual water produced (mgd)	$A=1036B^{0.911}$
Transmission & distribution O&M cost	Miles of main in service	$A=1395B^{1.093}$
Transmission & distribution O&M cost	Total annual water sold (mgd)	$A=401B^{0.944}$
Customer accounting cost	Total # of customers	$A=42B^{0.949}$
Administrative and general cost	Total # of customers	$A=329B^{0.862}$

A *multivariate model* is presented to examine operating costs and staff numbers using the AWWA WIDB. Several checks were applied to the data and systems with inconsistent or missing data were removed from the analysis. A total of 266 utilities were included in the final analysis. These were grouped by ownership (public/private), services provide (water only/water & wastewater), and supplier (wholesale & retail /retail only).

A log model was again selected to capture economies of scale. The final model of operating *costs* (using 1990 data) was:

$$\ln(OpEx) = 3.534 + 0.434\ln(accounts) - 0.004543\%gw + 0.4327\ln(WDel)$$

where:

ln(OpEx) = natural log of annual operating and maintenance expenditure
ln(accounts) = natural log of total number of accounts
%gw = groundwater as a percentage of water produced and purchased
ln(WDel) = natural log of water delivered to customers (BGY)

The percent of variation accounted for by the model was 87.8.

The final model for the number of full time equivalent staff members was:

$$\ln(FTEs) = -2.208 + 0.4288 \ln(accounts) + 0.3222 \ln(WDel) + 0.0463\% sw\_lake$$
$$+0.0144 sw\_gw + 0.2091 \ln(length) + 0.00249\% sw\_river$$

where:

ln(FTEs) = natural log of number of full-time equivalent employees in 1990
ln(accounts) = natural log of total number of accounts
ln(WDel) = natural log of water delivered to customers (BGY)
%gsw_lake = surface water (lake) as a percentage of water produced and purchased
%gsw_gw = surface water blended with groundwater as a percentage of water produced and purchased
ln(length) = natural log of the length of pipe (miles)
%gsw_river= surface water (river) as a percentage of water produced and purchased

The percent of variation accounted for by the model was 87.3.

The predicted values derived from the models are used to compare against the actual operating expenses and FTEs. In effect, the values derived from the analysis of a large number of systems serve as a benchmark for individual utilities. Each utility can compare its actual values against the values predicted by the models.

The authors also include a chapter that reviews quality and availability of water data, as well as an appendix that lists some of the most readily available sources. The final chapter of the report reviews the current extent of benchmarking in the water industry. They conclude that a small number of measures are in use by virtually all water systems and that this will expand in the future. The final chapter also reviews some of the "challenges" to benchmarking. Six are listed:

- wide differences among US utilities
- difficulty in obtaining comparable financial data
- unreliability of reported operational data
- lack of consensus regarding best practices
- time demands of complex benchmarking
- lack of faith in the claimed benefits of benchmarking (p. 150)

Leighton, Gregory M., Bob Liptak and Dan Long. "Defining a 'Common Language' for Operations and Financial Benchmarking," *WATER/Engineering and Management* (February 1997): 26–28.

This article describes the approach used by one investor owned water company (consisting of 61 private water systems) to address one of the most difficult aspects of internal benchmarking: the lack of uniformity in how divisions define the elements that make up financial and operating data. The authors point out " even if the differences are not substantial, comparison of data from both within and without a company are subject to misinterpretation … Therefore, the search for best practices is compromised."(p.26) What is needed is a "common language" to ensure usefulness of comparisons.

The team developed a "fundamental principle" to use in the categorization of costs: "The process cost to which an expense is charged is not a function of who provided the service. The determination is governed by the functional operation to which the expense directly relates … all costs of a process should be charge to that process ... by more accurately reflecting the true cost of a process, the ability to manage the cost of that process is enhanced"(p.27)

Missouri Department of Natural Resources. Division of Environmental Quality. Technical Assistance Program. *Drinking Water User Charge Analysis Worksheets.* January 21, 2000. Available from: (*http://www.dnr.state.mo.us/dep/tap/hometap.htm)*

The format of this tool is an MS Excel spreadsheet. Users enter their data into highlighted fields. Users can also adjust some of the assumptions (such as inflation and interest rates) in fixed cells of the spreadsheet to match their particular situation.

This software can provide managers with several important types of information and outputs:

- Determine if current rates are high enough to produce adequate revenues to cover current costs and obligations
- Determine if rates are fair and equitable between user classes
- Print out pre-packaged overheads to use in decision making meetings and rate increase hearings
- Can produce projections of systems financial conditions for each of the next five years

The spreadsheet does require that users input a considerable amount of information about their system. The following information is required:

- Customer billing records for the analysis subject year
- Schedules of user charge rates
- Hook up and other relevant fees
- Financial records of the analysis subject year that include revenues and cost information
- Flow volume

- Equipment repair and replacement schedule
- Annual median household income of customers

The spreadsheet contains the following worksheets that can be printed out and used by systems to collect data to load into the model.

- Water customer usage – used to develop average monthly usage by class
- Water customer usage profile – for example: "typically 30 % of customers will use less than 4,000 gpm and use less than 10% of all water supplied"
- Revenue vs. customer usage – compares revenues with usage and revenues collected
- Water equipment repair and replacement schedule – helps examine system costs – helps decide how much money to set aside to make major replacements and future repairs
- Projected fixed costs/minimum water bill & projected variable costs/water unit charges

The spreadsheet allows users to print out several useful charts across a five year period:

- Coverage and operating ratio
- Unit charge and minimum charge
- Average rate increase and affordability index
- Working capital goals and net revenues
- Total operating revenues, total operating costs, net operating revenues

The accompanying documents recommend an operating ratio (defined as total operating revenues/total operating costs) of 1.15 noting that 1.0 is breakeven. Recommends a minimum coverage ratio of 1.25

Moody's Investor Service. Municipal Credit Research. *Rating Methodology*: *Analytical Framework for Water and Sewer System Ratings*. August 1999.

This document discusses many of the factors that Moody's Investor Service uses as they evaluate water and wastewater systems in preparation of bond ratings.

Moodys looks at several "rating factors":

- system size and assessment base (large is better)
- local economy and customer base and ability of system to meet future needs(diverse is better)
- governance (operation by an independent board is better)
- quality of management (adaptability is better)
- strategic focus – (multi-year cap improvement plans are better)
- rates, rate structure, and rate making (reasonable and affordable?)
- revenues (sufficient to cover all commitments, reserve for emergencies, asset maintenance, expansion?)
- liquidity (do debt service coverage ratios include recurring and one-time charges?)

Some of the specific measures that Moody's uses to evaluate these factors are:
Governance
- independent better
- staff training and certification
- staff retention

Nature of the system
- purchaser or seller
- type of source
- services offered
- agreements with other services (rating of wholesaler impacts buyers)

Asset Maintenance
- cap improvement plan that addresses maintenance and upgrades
- large capital projects supported by studies that consider technical, environmental, financial impacts

Deferred Maintenance
- line breaks
- balance sheet trends in value of fixed assets
- unaccounted for water or infiltration

Regulatory Compliance
- number of incidences and nature of MCL violations
- M&R viol = management problems
- MCL = source or treatment problems

Rates and Rate structure
- do rates reflect all financial commitments
- do revenues cover operating and maintenance expenses, debt service, contributions to reserve funds and retained earnings for future system improvements, expansions or replacements?
- fixed costs should be covered by fixed charges (connection fees and special assessments based on assessed property values or other measures of relative benefit)
- variable costs should be covered by a per volume charge based on metered water usage
- rate implications of capital improvement plan

Financial ratios
- debt service coverage (net revenue/(annual interest and principal payments))
- non-recurring revenues (e.g. hook-up charges) should cover the capital capacity of this new connection
- balance contributions (equal) from cash and debt are OK

Balance Sheet components:
- Net funded debt – (long term debt + accrued interest payable)-(balance in debt service fund and the debt service fund)
- Net fixed assets - (fixed assets – accumulated depreciation)
- Working capital – (net current assets + net assets of all funds not devoted to debt)
- Debt Ratio – (net funded debt/net fixed assets = net working capital)

Income statement components and ratios
- gross revenue and income – (operating + non-operating revenue)
- net revenues – (gross rev and income – O&M expenses)

- operating ratio(%) – (O&M expenses/total operating revenue)
- net take-down (%) – (net revenues/gross revenue and income)
- interest coverage – (net revenues /interest requirements for period)
- debt service coverage – (net revenues/principal & interest requirements for period)
- debt service safety margin (%) – (net revenues – principal & interest requirements for the period)/(gross revenue and income) (p9)

While acknowledging the importance of some form of payments-in-lieu-of-taxes to local units of governments, Moody's recommends limitations on these transfers so as to enable continued reinvestment in the water system and help to maintain credit strength. In general, Moody's considers the transfer of revenues from water systems to support general government operations to be detrimental to system performance.

The document points out that "surveys indicate that a higher percentage of small community water systems may have more financial difficulty than large ones, including operating deficits," that nearly all health-based violations occur in small systems, and that they are considered to be especially challenging to manage because of difficulties in hiring and retaining skilled operators. (p.6)

The document also mentions that age plays a factor in reducing the ability of systems to meet regulatory compliance. It also notes that land use policies to improve source water quality can help to reduce risk.

The report does not recommend any specific levels or benchmarks for any of the indicator measures and cautions that Moody's does not focus specifically on any single indicators but looks at the whole constellation of components that can be used to determine the long-term viability of a water system.

National Performance Review. *Serving the American Public: Best Practices in Performance Measurement; Benchmarking Study Report,* June 1997

The goal of the 1993 Government Performance and Results Act (GPRA) was to improve the management of federal programs through the use of strategic planning and performance measurement. This study, prepared by the National Performance Review (NPR), represents another step in the long history of administrative attempts to improve the efficiency of governmental activities. For this study, the NPR assembled a team of experts to identify some of the best practices from other governments and the private sector that might assist agencies in implementing "results-oriented performance measurement and performance management." The report outlines many of the basic definitions and procedures needed to understand and apply benchmarking in the public sector.

The report describes performance measurement as "a process of assessing progress towards predetermined goals, including information on the efficiency with which resources are transformed into goods and services (outputs), the quality of those outputs (how well they are delivered to clients and the extent to which clients are satisfied) and outcomes (the results of a program activity compared to its intended purpose), and the effectiveness of government operations in terms of their specific contributions to program objectives."

The study highlights four steps in the benchmarking process:

1) Establish and update performance measures, in order to ensure a narrow, strategic focus and to measure the right thing: "focus on the goal, measure the end results, don't focus on the measurement" (p.13).
2) Establish accountability for performance
3) Gather and analyze performance data. It is important that "data are collected and analyzed to get *answers*" (p.21 – italics in original)
4) Report and use performance information to improve operational efficiency.

Four reasons are cited for measuring performance:

1) set goals and standards
2) detect and correct problems
3) manage, describe, and improve processes
4) document accomplishments

Performance assessment requires the use of indicators or measures that accurately measure the process of interest. A number of criteria must be addressed in creating good measures. A good measure:

- is accepted by and meaningful to the customer
- tells how well goals and objectives are being met
- is simple, understandable, logical, and repeatable
- shows a trend
- is unambiguously defined
- allows for economical data collection
- is timely
- is sensitive

A successful performance measurement system:

- comprises a balanced set of a limited vital few measures
- produces timely and useful reports at a reasonable cost
- displays and makes readily available information that is shared, understood, and used by an organization
- supports the organization's values and the relationship the organization has with customers, suppliers, and stakeholders

Operational definitions for performance measures typically include:

- a specific goal or objective
- data requirements (ie, the pop the metric will include, the frequency of measurement, and the data source)
- the calculation methodology (equations and precise definitions of key terms)
- reports in which the data will appear and the graphic presentation that will be used to present the data

Several useful appendices are contained in the report, including a table listing the benchmarking activities from a survey of firms who participated in the report, a glossary of benchmarking terms, and a list of relevant government publications and contacts. The report is available on-line at: *http://www.npr.gov/initiati/benchmk/* .

Northbridge Environmental Consultants. *SURF: Small Utility Rates and Finances.* Funded by the American Water Works Association and Hawaii Section of AWWA. (undated)

"SURF is a self-guided, interactive spreadsheet application design to assist small drinking water systems in developing budgets." (p.2) The software was written to be used with Lotus 1-2-3 spreadsheet software using the Windows operating environment, but can be transferred to other spreadsheet programs.

The information required to complete SURFs data entry screen increase:

- Current number of service connections
- Average amount of water sold in past years and plan to sell in future years
- Last year's budget
- Receipts from system expenditures
- Employee salary and benefit records

Using this information the SURF spreadsheet allows users to create and reconcile budgets, calculate user rates, and track expenses.

Peroo, Michael D. *Financial Accounting Guide for Small Water Utilities*. Seneca, KS: Kansas Rural Water Association, 1997.

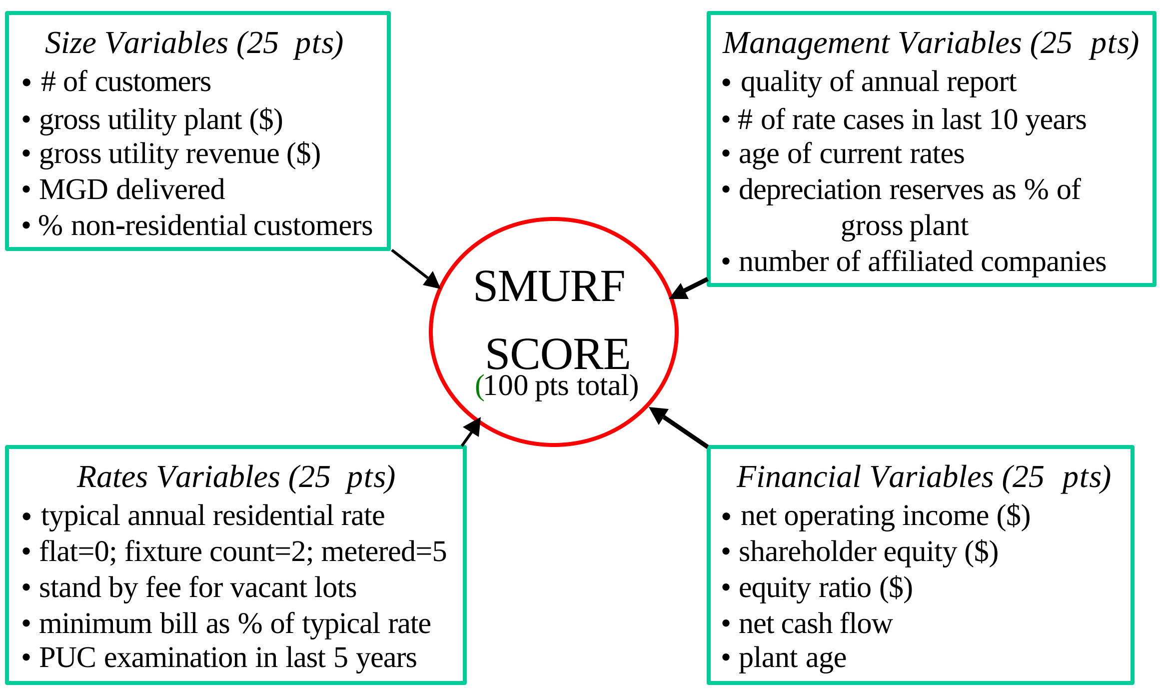
This is the third volume in the *Water Board Bible Series*, handbooks written specifically for small water and wastewater utilities. The guide shows how to set up a simple, workable accounting system that will provide the information needed to make financial decisions. It reviews basic accounting concepts and provides details on how to set up a complete accounting system.

Category/Ratio	*Measures*	*Calculated How*	*Benchmark*
Common size ratios			
Compare elements of the income state and balance sheet to total	e.g – compare salaries and wages to total revenue – use %s		Compare to previous years
Liquidity ratios	measures a water system's ability to meet current obligations or bills	(not given)	
Current ratio (aka working capital ratio	measures ability to meet current liabilities	(Current Assets) / (Current liabilities)	Current assets should be about twice current liabilities
Quick Ratio	measures ability to stay in business	(Cash+Short term investment + Recievables) / (Current Liabilities)	
Efficiency Ratios			
Days in receivable	How efficient the system is at recovering payments		
Days in inventory	how efficiently system is using supplies		Not often used in water systems
Solvency Ratios			
Debt service coverage	Ability to meet debt obligations including interest	(net income+interest expense+depreciation)/ (debt service)	Should be 1.25 or greater
Debt-to-equity ratio	Protective cushion of equity for creditors	(total liabilities /member's equity)	Higher ratio indicates higher risk
Profitability Ratios			
Gross margin ratio		(water sales –water purchases /water sales)	Only for systems that purchase water – higher is better – usually measured in %
Profit margin	Profit	(net income/total revenue)	
Return on Assets		(net income/total assets)	
Return on equity		(net income/member's equity)	
Other Helpful Ratios			
Salaries per meter per month	Personnel cost	(salaries/# of meters)/ (12 months)	Need to compare to nearby systems
Water loss percentage		[water produced or purchased (gallons)-water sales (gallons)] / water sales (gallons)	Need to compare to Industry average
Price comparison	Price		Compare locally and across industry

Rubin, Scott J. and Sean P. O'Neal, "A Quantitative Assessment of Viability of Small Water Systems in Pennsylvania", *Proceedings of the Eighth NARUC Biennial Regulatory Information Conference, IV*: 79-97 (Columbus, OH 1992), reproduced in Proceedings AWWA 1994 Annual Conference, Management and Regulations, pages 19-38.

Efforts to address issues of the issues of "capacity" and "viability" initially arose at state level, as public utility commissions looked for simple evaluation methods to help them assess alternative courses of action to improve the performance of small systems. In Pennsylvania a simple "index of viability" was developed by Rubin and O'Neal for the Pennsylvania Public Utility Commission. The Small Utility Ranking Formula (SMURF) uses 20 different indicators of viability, in four major areas: size, rates, management and finance.

Small Utility Ranking Formula
(SMURF Index)



The variables used in the index were based on two criteria: first that they "were indicative of an important factor related to the ability of a water system to operate as one would expect a public utility to operate: (p. 23) and second that they could be quantified using readily available information. A scoring system was established, with a possible rating of 5 for each of 20 variables, grouped into categories for size, rates, management, and finances.

The scoring system used in the index provides insight into the authors' judgement of the critical variables of small system performance, and the range of values that indicate adequate performance.

Indicator	***Requirements for a score of "0"***	***Requirements for a score of "5"***
Size	Less than 200	1,000 customers
Gross plant investment	$100,000 or less	$1 million
Total revenue	Less than $75,000	$375,000
Gallons delivered	Less than 10 mgd/yr	70 mgd/yr
% Non-Residential customers	0%	20%
Rates	<$100/yr or >$650/yr	Between $300-$450/yr
Type of Rate	Flat rates	Metered rates
Stand-by charge	Yes	No
Minimum bill	Less than 20% of typical	60% of typical
Rate case review	Not in 5 years	Within 5 years
Annual report	Scored by reviewers	
Rate cases in past 10 years	None	5 cases
Last rate change	10 years or more	Less than 52 years old
Average age of plant	Depreciation reserve 50% or more of gross plant	Depreciation reserve less than 10% of gross plant
Affiliated companies	None	8 companies
Net income	≤ 0	$\geq$$75,000
Equity	≤ 0	$\geq$$400,000
Equity ratio	≤ 0	$\geq$40%
Cash flow	≤ 0	$\geq$$75,000
Debt	$\geq$70%	<30%

The authors used a sample of 139 small water system to test their index-based assessment system. The overall average for the sample was 40.87, with 72% of the scores within one standard deviation from the mean. To confirm the accuracy of the index the authors performed in-depth reviews of the operations of a sample of water companies, and found that it provided "useful, generally accurate information". The SMURF scores were then used to categorize the small systems into six that "signified common approaches to handling small water systems". Each category used different combinations of scores from the size, rates, management, and finance criteria of the index.

1. Viable system
2. Well managed – Too small – Capacity to borrow
3. Well managed – Too small – Little capacity to borrow
4. Fair Size – Poor management
5. Non-viable systems
6. Basket cases

The authors concluded that the index worked well in identifying problem areas in small water systems. Based on their analysis they concluded that small "systems typically are poorly capitalized, have inadequate financial and managerial resources, and are generally less viable than larger water utilities." However, their analysis also determined that "size alone cannot be used to determine the viability of small water systems" and that "small systems can be viable" (p.35). They caution that their analysis represents only a "first step" is resolving the problems of small systems and encourage other states to modify their index to meet their own specific needs.

Rubin, Scott J. "Water: Why Isn't It Free. The Case of Small Utilities in Pennsylvania," In: Drew Hyman and John Shingler, eds. *Utilities, Consumers and Public Policy: Issues of Quality, Affordability, and Competition*. University Park, PA: Penn State. (May 15–17, 1995): 177-183.

The author reviews several of the publications that discuss the "small system problem," but notes that while many small systems have problems, there are others that do not. He observes that there are many small systems that provide "safe and reliable water service at an affordable price"(p.177). He describes the goals of the Pennsylvania "benchmarking" study to (1) "identify the key factors that separate good small systems from those that are having problems" (p.177) and (2) find ways to use this information to improve water service.

A comparison of water systems by ownership type (municipal vs. public utility commission regulated) is presented as an example of the process of searching for the factors that contribute to water system success or failure.

Information collected on the two types of systems revealed a considerable difference in the number of service connections, average net water system income, average median household income, average percent of households headed by an elderly person, and average expenses per 1,000 gallons. These differences were explained by the fact that municipal systems, for the most part, served older small municipalities while the PUC systems were likely to serve suburban areas and newer housing developments. However, because of these differences in the customer base (wealthier suburbs with smaller, less capitalized systems, and poorer municipalities, with larger, more established systems), the average revenue as percent of household income in the two types of systems is almost identical.

This example serves as a caution that it is a serious mistake to "lump together all 'small water systems' into a single category" (p.182). The many differences in systems are critical to assessments of their future performance. Development of a relatively simple assessment tool, based on readily available information could "help set priorities for planning, enforcement, and permitting … serve as a guidepost for encouraging regional solutions to drinking water problems" and "be used as an early warning system to identify systems that are likely to find themselves in trouble" (p.182).

Schmidt, Todd M. and Richard N. Boisvert. *A Hedonic Approach to Estimating Operation and Maintenance Costs for New York Municipal Water Systems*, Cornell University, Dept. of Agricultural, Resource, and Managerial Economics, WP 96-12. October 1996.

The purpose of this research is to increase the understanding of water system treatment costs by "accounting explicitly for system size, population densities, factor prices, water source, and water treatment technologies" in estimating water treatment cost functions (p.2). Estimates from this model could be combined with the total number of systems using these treatment technologies in order to provide better estimates of the cost of compliance by system size, both regionally and nationally. This could potentially assist the USEPA in identifying cost-effective technologies for small water systems.

Data for this study was obtained from several sources:

(1) annual financial data on water systems from the New York Division of Municipal Affairs for fiscal years 1987 to 1992. The data collected included:
- population
- population density
- all fund accounts - revenue, appropriation, and general ledger;

(2) specific water system characteristics from the USEPA's Federal Data Reporting System (FRDS-II) data base for January of 1993. The data collected included:
- population served
- service connections provided
- average daily water production
- system design capacity
- primary water source
- treatments applied to source water prior to distribution

(3) data for public water system wage rates (an input cost) was not available; a proxy was created by dividing county local government earnings by local government employment (from the Regional Economic Information System, 1987-1992) and were converted to 1992 dollars;

(4) electricity rate data (another input cost) was obtained from Annual Electric Utility Reports, 1987-92, and were converted to 1992 dollars.

Only data for municipalities operating community water systems was used in this analysis. The final sample, after eliminating municipalities where an accurate correspondence between municipal and system data could not be verified, included observations for 359 municipal governments. This represented 70 percent of the systems in the FRDS-II database and 60 percent of the municipalities with financial data for the State of New York. Six years of data were collected, representing a pooled time series of cross-sections with nearly 2,000 observations

In the model used in this study, the dependent variable is a hedonic variable, water output, "reflecting both the water production of the system measured in gallons per day and its associated treatment characteristics" (p.5). The production function used to derive hedonic indirect cost function is:

$$Q(Y; z_1, z_2, ..., z_s) = f(L, E, D, W)$$

where, Q is the index of firm output reflecting both quantity (Q) in gallons per day delivered and treatment characteristics (z_s), as a function of labor (L), energy (E), service area population density (D), and raw water (W) inputs.

The authors assume that public water utilities will operate in the short run to minimize costs by adjusting input levels, subject to demand. Thus there must be an indirect cost function that depends only on "exogenously determined input prices, quality adjusted output and a set of fixed factors" (p.5)

The hedonic cost function used by the authors is of the form:

$$C = C(Q(Y; z_1, z_2, ...z_s); r_1, r_2, ...r_i; F_1, F_2, ...F_m),$$

where annual O&M costs (C) are a function of the hedonic output (Q), factor prices (r_i), and mixed factors (F_m).

The authors next perform a translog transformation, derive equations for the factor shares of cost for each input factor, and impose several assumptions and cross-constraints. The final specification does not appear to be presented.

As a result of their analysis the authors are able to derive estimates of average O&M cost per capita of various treatment technologies. These are presented in a table, by type of technology and system size, as measured by population served. The authors discuss the costs of each treatment alternative and number of systems in the sample that are currently using each alternative. Several of the least expensive treatment alternatives, such as slow sand filtration, are not currently in widespread use, although the authors anticipate that this will change as older systems come to the end of their service lives and as water quality regulations become increasingly restrictive. They also discuss the cost of combinations of alternatives, and observe the universal reduction in O&M costs as system size increases. For small systems, costs are substantial for some technologies, but not for others. Financial burdens may still be substantial for small systems; rural systems have some cost advantage given input costs relative to urban areas (p.i)

The authors judged their hedonic specification approach to be a success and believe that they have identified the cost-efficient technologies that will help USEPA to assist small water systems in meeting various maximum contaminant regulations.

Schwartz, Donald. "The Strange World of the Very Small Water System" In: Drew Hyman and John Shingler, eds. *Utilities, Consumers and Public Policy: Issues of Quality, Affordability, and Competition*. University Park, PA: Penn State. May 15–17, 1995. 169–175.

In this conference presentation the author's purpose is to point out some of the reasons why very small water systems (those serving less than 100 homes or 250 persons) are "particularly sensitive to becoming non-viable as a result of several factors related to demographics, geographic isolation, and economies of scale"(p.169). He also puts forward several examples of systems that have escaped this generalization, and suggests some factors that may have contributed to their success.

From his experience working with the Northeast Rural Community Assistance Program he argues that systems with as few as 200 customers (about 500 people) have little trouble managing their systems. He poses the "Schwartz Rule for systems below this size: "The size of a very small water system in Pennsylvania is itself an excellent (if not perfect) indicator of a system's long-term viability. The critical range for this factor occurs somewhere between 100 and 200 households."

The author identifies several small systems that have been successful and concludes that in general he favors municipal ownership for small systems because of their easier access to state and federal grants, and the likelihood that their boards will behave more responsibly. He concludes the presentation by pointing out that many systems are predestined for trouble because of demographic and geographic circumstance and that the state will need to develop a plan for providing assistance to these systems.

Soelter, Alan D. and Ellen G. Miller. "Capacity development: the small system perspective," *Journal of the American Water Works Association*. Vol. 91, no.4 (April, 1999): 110–122.

Through the use of 15 telephone interviews and a meeting with drinking water administrators, technical assistance providers, consultants and system operators, the authors attempted to answer two questions:

- How will the states use the time remaining before they must implement the capacity assessment requirements of the 1996 Safe Drinking Water Act Amendments to help small and medium sized systems (<50,000 customers) conform with these requirements?
- What specific kinds of assistance do water systems need?

During their interactions with respondents they discovered that knowledge of capacity development varied widely. Many had received information from national organizations or searches on the Internet. Eight areas of concern were cited by respondents:

- Finances are key: rates must cover all costs.
- Cooperative efforts spell savings.
- Staff education is under-funded
- Technical assistance is available to those who seek it
- Professional assistance is worth the price
- Communicate with customers
- Checklists and self-help tools keep tasks under control
- Record keeping can take various forms

During their discussions with small systems five issues were repeatedly mentioned:

- Consolidation versus control
- Cooperative arrangements prove beneficial
- Continuing education extends beyond system employees to water boards and councils
- Information channels get the word out (The article contains a listing of printed and online sources that offer updated materials on capacity development)
- Systems must assess themselves

Based upon the information that they collected, the authors present three paradoxes about the effect of capacity development on small systems and suggest actions that can be taken by the states to make the best use of the time remaining before implementation deadlines go into effect.

1. *Capacity development brings both more risks and more opportunities.*
   Suggested actions:
   - Summit meeting would provide forum for exchange of information
   - Standard information materials should convey a common message
   - Systems need to know their option
2. *Capacity development requirements take time but save time*
   Suggested actions:
   - One-stop financing could save time.
   - Common TMF (technical/managerial/financial) documentation would eliminate duplication
   - On-site assistance could be made easier.
3. *Capacity development provisions allow states new flexibility while requiring them to help systems acquire and maintain capacity*
   Suggested actions:
   - Input matters
   - Open draft plans to critique.

The authors conclude by noting that “capacity development is a revolutionary requirement for PWS of every size”. Their study has highlighted the special leadership role of state primacy agencies in building a new partnership among stakeholders to improve the water supply industry.

Standard and Poor's Ratings Service "A Conversation With Donald L. Correll, Chairman and CEO of United Water Resources Inc." *Utilities and Perspectives. August 23, 1999 (*http://www.standardandpoors.com/ratings/search/index.htm*)*

In this interview Donald Correll states that aging infrastructure and increasingly stringent water quality standards are driving municipalities to consider public-private partnerships to lower costs and improve services. He argues that the trend is toward greater outsourcing of municipal water services is accelerating due to changes in tax rules and laws. The economic viability of contracts is based on an assessment of the existing cost and an evaluation of possible reductions through the use of new technology, training, and operating procedures.

The financial model used to determine a competitive contract price is based on a variety of financial forecasts--income, cash flow, operating margins, and internal rate of return. These are used to evaluate the returns to United Water over the terms of the contract and to develop pricing strategies to win bids in a competitive environment.

United Water focuses on large cities, as well as midsize communities and smaller towns that are adjacent to our existing utility territories or contract operations. Can provide a wide range of services, including customer service, metering, billing, and collections. Correll anticipates that the contract operations will accelerate to the point that revenues for the U.S. industry will approach $6 billion by 2010.

USEPA. Office of Water. *Methods for Assessing Small Water System Capability: A Review of Current Techniques and Approaches*. Prepared by Apogee Research, Inc. EPA 810-R-96-001. March, 1996**.**

This manual presents examples of three techniques for water systems self-assessment. It is directed at states regulatory agencies, to stimulate the development of additional techniques, and small system managers and technical assistance providers with the intent that the might be able to immediately apply them in the assessment of small water systems.

The introduction to the manual traces the history of small water systems in the US and describes the situations that have lead to the institutional inadequacies of small water systems. Frustrations over the persistent problems of small systems led state primacy agencies to

The manual defines capacity as: "the ability to consistently provide quality service, at an affordable price" (p.1-1). While the manual acknowledges the importance of technical, managerial and financial components of capacity, the lack of a dedicated flow of sufficient revenues impacts all three components.

Viability screening tools would need to consist of two components:
1) to be able to evaluate the ability of new systems to be sustainable
2) to determine whether existing systems could sustain themselves in a changing institutional environment

With assessment tools in hand state will then need to develop programs to (1) work with systems to assess their capabilities, (2) assist them in enhancing their capacities. The tools can also be used by individual systems for self-assessment of by state agencies as a means of identifying statewide system capacities so that legislators will have a means of determining the appropriate public policy.

The manual is not meant to be a cookbook of techniques but rather as a demonstration of approaches that will hopefully be adapted by individual sates for their own uses. Three systems are described in some detail in the manual.

PAWATER is microcomputer-based software application that was jointly developed by the State of Pennsylvania and the USEPA. PAWATER allows communities and developers to estimate and consider the full cost of running a water system before committing to build one. The computer model "provides a summary of the capital costs and annual cost per dwelling unit that is meaningful to developers." (p. 1-8).

The second method presented in the manual is a series of structured questions designed as a "diagnostic guide" of small water system capacity. This self-assessment tool was developed by the American Water Works Association's Guidance Committee to Small Water Systems and is intended to be used as the first step towards the development of a comprehensive water system plan.

The final tool presented in the manual is a summary of the Washington State Financial Viability Planning Manual. Washington has already implemented its own viability assessment procedure. Systems are required to submit a comprehensive Water System Plan that contains the following components:

- 20 year Capital Improvement Planning information for system expansion and improvements
- details of historical sources of revenue, and future sources of financing for capital
- a detailed six year budget of revenues and expenses
- the Financial Viability Test (FVT)

The FVT consists of 4 tests:
1) Revenues-Expenses>= 0
2) Operating cash reserve >= 1/8 (annual O&M Expenses = G&A Expenses)
3) Emergency Reserve>= The cost of the most Vulnerable System Component
4) Annual User Rate = 1.5% of customer median household income.

Along with the FVT system managers must be prepared to present the six year detailed budget of revenue sources and expenses. They must also be prepared to provide detailed information on:

- contingency reserves
- annual system charges per residence
- median household income in the service area.

USEPA. Office of Water. *Community Water System Survey: Volumes I: Overview, and Volume II Detailed Survey Result Tables and Methodology Report*. EPA-815-R-97-001a and EPA-815-R-97-001b. January 1997.

USEPA periodically collects information of the financial and operating characteristics of the water supply industry. The agency uses this information for regulatory, policy and compliance analyses. Previous CWS were conducted in 1976, 1982, and 1986. The Survey results represent only a single year of data (1995). Thus the conclusions that can be drawn are limited.

One of the stated potential uses of the CWS Survey database "is for the development of operational and financial performance measures for individual water systems to gauge their relative technical and financial performance (Vol.1, p. 34). Of the 40 questions included in the Survey, USEPA list 23 that could be used in financial analysis of small water systems (Vol. 1, p. 33). Volume II (section 5.8) contains a discussion of the barriers to consistent financial information and uniform analysis that derive from different accounting systems and the general lack of data in very small and ancillary systems.

The *Financial Characteristics* (3.2.2) section of the report discusses several financial rations and "their commonly applied thresholds" which "indicate a level of financial health.

Measure	***Defined as:***	***Threshold***
Operating ratio	(operating revenues/ O&M expense)	>1.2 = strong financial condition
Debt ratio	(total debt/annual revenue)	Lower is better
Debt service coverage ratio	(net available revenue/ annual principal and interest charges)	1.0 to 1.5 is acceptable
Net takedown ratio	(net available revenue/ total gross revenue)	>20%

Notes:
(1) Net available revenue = (Gross revenue-O&M expenses)/(gross revenues)
O&M expenses do not includes interest, other debt service payments, or depreciation
Gross revenues = operating plus non-operating revenues
Numerator represents annual net revenues available to pay debt service
Denominator is the amount of debt to be retired and the interest on that debt for one year
Debt service coverage ratio may be the subject of bond issue requirements for setting rates and for meeting tests before additional bonds may be issued.
(2) Net takedown ratio – indicates profitability
Total gross revenues = operating plus non-operating revenues

The report notes that these ratios focus on revenues. Thus private systems that must generate additional revenues to pay shareholders appear to be doing better. It also notes that larger systems do better in all areas. The report observes that water systems asset to revenue ratios decrease with system size, thus indicating the economies of scale that are present in the industry.

USEPA. Office of Water. *A Water and Wastewater Manager's Guide for Staying Financially Healthy*, EPA Publication 430-09-89-004. 1989.

This short guide from USEPA provides managers with the two "most important" indicators for the success of their utilities, and recommends action based upon these measures. Several other indicators are also recommended

The first measure is the *operating ratio (OR),* which is defined as total revenue divided by total operating expenses. Total revenue includes user charges, interest earnings and income from taxes and assessments. Total operating costs include wages and benefits, administrative overhead, chemical and electrical costs, parts and tools, and principal and interest of loans and bonds. The capital costs of new facilities and depreciation are not included in total operating costs.

The value of the *OR* will depend upon the debt situation of individual utilities, but a "bare minimum" of 1.0 is recommended. For utilities carrying any debt *OR* should be greater than 1.0. The Guide states that the trend in *OR* provides an early warning of trouble and could be thought of as the "pulse of the utility"

The second recommended measure is the *coverage ratio (CR)* which provides a measure of whether the utility has enough revenue to pay principal and interest on loans and still have enough money left over to deal with any problems that might occur. The *CR* is defined as the total annual revenue from all sources minus all non-debt operating expenses divided by the total annual amount paid in principal and interest payments. *CR* should be calculated annually. A falling *CR* signals trouble, and a $CR<1.25$ is a signal for a rate increase. Several other assessment tools and recommendations are also are also discussed:

- *Budgeted Expenses vs. Actual Expenses*
  The Guide recommends that utilities prepare both a revenue and expense budget annually. The *Budget vs. Actual* comparison predicts whether the utility is on track with its income and expenditure plans. By looking at the trend during the year and across years in individual line items of their budgets, managers can investigate and resolve problems before they impair utility operations.
- *Capital Investment Ratio*
  The CIR is a measure of how much of its resources a utility is putting into improving and replacing its long-lived, high cost, capital assets, such as buildings and treatment facilities. *CIR* is calculated by dividing annual expenses on capital assets by total

annual revenue. *CIR* will vary depending on the age of utility capital assets, and need to be compared over time.

The Guide also includes several “checklists” of practices that should be in place to ensure the sound financial management of utilities. The Guide recommends careful financial planning, a timely, cost-effective purchasing system, and a system of user charges that allows the utility to operate on a self-supporting basis. The long-term financial improvement depends on careful budgeting that “translates physical operations into a strong financial plan” and capital planning that acts as a blueprint for future improvements.

APPENDIX B:
EXPERT PANEL CONSULTATION

INTRODUCTION

Appendix B contains the documents that were used in the Expert Panel Consultation and a record of the responses that were received from panel participants.

Appendix B-1 contains consultation protocol used to contact panelist and a record of their responses. The questions from the protocol are restated before each set of responses. The comments of the participants appear in a slightly smaller font. Each participant was assigned a number that appears before the comment to each question. The responses were edited slightly to ensure the confidentiality of participants, and a few editorial comments are included in the text to provide clarification to some of the comments.

Appendix B-2 contains the introductory letter, summary of responses to the first round, and "working list" of survey questions that was sent to panelist in the second round of the consultation. It also contains the feedback that was received from panelists to these summaries and their general comments on effort to develop economic benchmarks for small drinking water systems.

B-1: EXPERT PANEL CONSULTATION PHASE 1 PROTOCOL AND RESPONSES

CONSULTATION PROTOCOL

Dear Colleague:

We are conducting research under the sponsorship of the Midwest Technology Assistance Center (MTAC), one of nine centers that were established and funded under §1420(f) of the 1996 Safe Drinking Water Act Amendments. The mission of these Centers is to address the needs of small public and Native American water systems.

We are writing to ask you to participate in a volunteer "expert panel" consultation. Input from this consultation will guide the development of benchmark indicators that will allow the managers of small community water systems to obtain the information they need to ensure the long-term financial integrity of their systems.

Participants in this expert panel consultation will be asked to respond to several statements and questions regarding the development and application of financial benchmarking tools for small water systems.

Participation in this consultation is voluntary. To participate, you only need to continue reading this E-mail message. Please let us know if you decide not to participate.

This project has been reviewed and approved by the SIUC Human Subjects Committee. Questions regarding your rights as a participant in this research may be addressed to the Committee Chairperson, Office of Research and Development Administration, Southern Illinois University, Carbondale, IL 62901-4709; phone (618) 453-4533.

Other questions or comments regarding this expert panel consultation, or the Benchmark Investigation, may be directed to Tom Bik at 618-453-1118, or <smallsys@siu.edu>.

Thank you for your assistance.

Sincerely,

Dr. Roger Beck
Associate Professor
SIUC Agribusiness Economics

Dr. Ben Dziegielewski
Associate Professor
SIUC

Benchmark Investigation of Small Public Water System Economics
Expert Panel Consultation

Objective

The objective of this consultation is to clarify issues related to the development and use of benchmarking tools for small water systems, and to develop specific recommendations for obtaining additional information through survey research.

How This Information Will Be Used

Final responses from the panel will be used to guide the research team in the development of a survey of approximately 1,000 water systems in the 10-state region covered by MTAC. A written report of the expert panel consultation will also be submitted to MTAC. All participants will receive a copy of the final consultation report via E-mail, and the option of receiving a copy of the final research report.

Consultation Instructions

A brief background of the situation leading up to the development and use of benchmark indicators appears below, followed by a list of statements and questions.

Using the "reply" function of your E-mail software, please respond as you see fit. Add, modify, or change the statements, or provide whatever information that you feel is relevant. It is not necessary to comment on every statement. Type your comments directly onto this E-mail.

We will begin to collect and summarize responses 7 days after sending the initial E-mail. Participants will receive a draft report via E-mail one week later, and will be given the opportunity to provide additional follow-up responses.

Background

Surveys and research reports have repeatedly cited the economies of scale inherent in traditional water treatment technologies, and the inverse relationship between water system size and the number of non-compliance incidents. A variety of factors have combined to leave many small systems without adequate financial resources to respond to changing socioeconomic, regulatory, and technical demands.

The 1996 Safe Drinking Water Act Amendments attempt to specifically address the need to improve small community water system performance, and have charged state regulatory agencies with the responsibility of making judgments about the technical, managerial, and financial capacity of water systems, a task that has not traditionally been a part of the drinking water program.

While efforts on all three capacity dimensions are necessary, some observers have suggested that improved financial performance is the key to break the cycle of failure experienced by many small water systems. Previous efforts to improve water system financial performance have included subsidies, training programs and self-assessment checklists.

More recent efforts have followed the lead of credit rating services such as Moody's, in seeking to establish ranges of "benchmark" indicators that can alert regulatory officials and water system managers to impending problems, and direct them to appropriate courses of action to avert failure. Benchmark indicators can be developed by collecting and comparing water utility data from a large sample of water systems.

Questions and Statements

"Small" water systems have been identified in several different ways by agencies and researchers. What measure(s) of size should be used to identify those community water systems that are most typical of the problems attributed to small systems? (e.g., pumpage, number of connections, number of customers, size of total assets, etc.).

The smallest community water systems are often excluded from studies because of problems with data collection and accuracy. How important is it to include these systems in efforts to develop benchmark measures for small water systems? Should special efforts be made to ensure their inclusion?

Small water systems are very different in terms of size, organization, type and quality of source water, age, customer characteristics, etc. Can a single set of benchmark indicators be used by all systems, or should separate sets of benchmarks (or ranges in benchmark values) be developed for different categories of water systems? What categories might be most important in grouping systems for a benchmarking analysis?

Benchmarking practitioners recommend that benchmarks be linked to a business's "critical success factors." What are the most critical factors to the success of small water systems? What is causing the most trouble for small water systems?

"Performance" benchmarking requires the selection of a set of observable/measurable indicators that water system managers can easily access or compute. It also requires that these indicators are logically (and statistically) related to measures of performance. What is the best measure(s) of the performance of small community water systems?

"Process" benchmarking seeks to improve internal programs and processes by learning how the "best" organizations conduct similar activities. Would small systems benefit from efforts to organize a network that would help small water system managers to identify the best practices of other water systems?

Do you believe that there is a "felt need" for benchmarking tools for financial analysis? Are small water system managers already engaged in an informal use of benchmarking? In your interactions with small system managers, what measures are they likely to use to describe the performance of their water systems?

Which member of a small water system organization is most likely to be the best person to contact regarding information that can be used in the development of benchmarks (e.g., manager, operator, consultant, mayor, etc.)? Who are the most likely users of benchmarking tools?

What do you think is the potential value of systematic benchmarking for the small water system community?

Please add any additional comments, or suggest questions or issues that you would like to see addressed in a survey of small water systems.

If you know of researchers, government officials, or non-governmental organizations that might wish to be included in this consultation, please type in their names and/or E-mail addresses below, or simply forward this E-mail message to them.

Do you wish to receive a copy of the final report of the "Benchmark Investigation of Small Water System Economics"? (please check below)

Yes ____ No ____Paper ____ or PDF ____.
If paper, please type your mailing address below:

References

List of Documents Reviewed for This Consultation

Some of the documents that were reviewed in the preparation of this consultation appear below. Please add your own suggestions of other relevant publications.

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PHASE 1 RESPONSES FROM PANELISTS

The exact wording of the questions and statements sent to the panelist appears in Appendix B-1 (above). The responses of panelist are presented below, under brief headings that identify each group of questions and statements. Responses have been edited slightly to maintain confidentiality and correct spelling. Panelists were assigned a respondent number, which is shown in parenthesis at the beginning of each response.

Part 1. Comments on: BACKGROUND

(#8) There has probably been too much emphasis on the use of financial benchmarks as indicators of trouble. It might be more productive to consider turning the focus around the other way – documenting the financial profile of successful/sustainable small systems of different types to provide benchmarks of financial health as targets to strive for. Moreover, the objective should not be to focus on financial health or ill health per se, but rather to use financial benchmarks as indicators of sustainability – what does it take to know that you are sustainable?

(#9) Finances are the most important leg of the three-legged capacity tool. Actually, this approach really is not that new.
(*editorial not: for example see*: Janice A Beecher, G. Richard Dreese, and James R. Landers. 1992. *Viability Policies and Assessment Methods for Small Water Utilities*, The National Regulatory Research Institute, Columbus, OH; and, G. Richard Dreese and Janice A. Beecher. 1993. “Developing Models for Assessing the Financial Health of Small and Medium-Sized Water Utilities,” *Journal of the American Water Works Association*, Vol. 85, No. 6: 54–60)

Part 2. Comments on: DEFINING SMALL WATER SYSTEMS

What measure(s) of size should be used to identify those community water systems that are most typical of the problems attributed to small systems?

(#1) Pumpage & number of customers

(#2) Any of these will do. You need to be a little careful with number of connections or customers because there are a few systems that serve only industrial parks or complexes that have very few customers but produce large quantities of water and have substantial revenue and assets.

(#3) Small water systems are considered to serve <3300 population; more recently, we've seen some use 10,000. Small in Kansas is <500 connections that comprise approximately 90 percent of all systems

(#4) Pumpage and number of connections.

(#5) Number of connections has always made the most sense to me for small water systems.

(*#6*) Probably number of users or number of connections.

(#7) Pumpage and number of connections are relatively good indicators. Size of total assets can be very misleading, especially when most small systems don't have a clue as to the value of their system. Number of customers (assuming you mean connections x number of people per household, etc.) is also misleading to some extent and difficult for small systems to ascertain. Otherwise (active) connections and customers are the same.

(#8) I think the number of connections is the most important variable because it relates directly to cash flow which I believe to be the most important indicator. As I recall the story, the EPA started using the 3,300 person cut-off for two reasons: 1) it was a proxy for 1,000 connections (implying 3.3 persons/hh - higher than today's average) and 2) the EPA community water supply survey indicated that below 1,000 service connections the average system had a staff of less than one full-time equivalent. This staffing cut-off is an interesting "structural" boundary to consider. There may be big differences in the efficacy of operations and maintenance (and financial management) above and below this threshold.

(#9) Pumpage is the best indicator, because it captures economies of scale; connections (with a cutoff of about 1,000) is also a reasonable proxy.

(#10) Number of connections and pumpage

Part 3. Comments on: INCLUSION OF VERY SMALL WATER SYSTEMS

How important is it to include these (smallest) systems in efforts to develop benchmark measures for small water systems?

(#1) Important for them to see how other larger systems operate.

(#2) It's important to try to get information about the very small systems (e.g., mobile home parks). However, from the data and studies that I have reviewed, it is safe to conclude that the very small systems are no better (and may be worse) than the smallest systems you can get data for. So, by excluding the very small systems, your results will be conservative (that is, they will make the industry look better than it is).

(#3)Very important to include - or at least an agency or organization which can appraise their needs and interests.

(#4) Yes they should be included, small systems are different and need their own benchmarks. It will take a special effort to collect the data

(#5) I think the only way to get input from most small systems will be to go in person to interview them, a very expensive proposition I wouldn't recommend. The best source of information will be the technical assistance providers who deal with them on a regular basis, such as the Rural Community Assistance Program (RCAP), National Rural Water Association (NRWA), and possibly the National Environmental Training Center for Small Communities (NETC).

(#6) There are more small systems, in number, than large systems. Probably should be included.

(#7) It is extremely important that the very small systems be included. This is where you commonly find minimal capacity to meet SDWA requirements and have the greatest need for infrastructure development. Special efforts should be made to include these systems, though this will be the most difficult group of water systems to gain credible/reliable information. This effort may require other partners established within the targeted states that regularly provides service to these size systems.

(#8) I recall one student of this problem who wrote a paper on "the particle physics theory of small water systems." In this theory, it is argued that below 200 connections, all bets are off and even experienced technical assistance field hands cannot tell what's going to happen next in a water system in this super small size range. I think there is truth in this. It reinforces another saying I've heard – that these should not be thought of as small water systems but as "small clusters of homes." Our data shows that cash flow is still the most important concept in these systems and it is possible to get income statement data even in this micro size range. (forget the balance sheet, however.) This is an extremely important category for study. Of the 50,000 odd small systems that EPA counts nationwide

40,000 or so serve fewer than 500 connections. Some simple benchmarks relating to revenue and expense relationships could provide them with simple easy to follow operating guidance.

(#9) Yes – with some random sampling. This could be done in conjunction with assessments for non-transient non-community systems, which face many of the same problems.

(#10) It is important. I suggest you use the limit of 500 customers for the smallest group.

Part 4. Comments on: CATEGORICAL GROUPING OF WATER SYSTEMS

What categories might be most important in grouping systems for a benchmarking analysis?

(#1) Water sources (Wells or Surface) (Treated or Purchased). Growth of system. Storage capacity. Age and type of distribution lines.

(#2) The biggest fundamental difference I have found is between systems that use surface water, those that use groundwater, and those that purchase water from another system. Each of the three categories of water source has different cost and asset characteristics. Other than that, I think that you can capture the differences (for example, different mix of residential/commercial/industrial customers) in the benchmarks.

(#3) Perhaps financial analysis can be common. Size of system, date of construction, debt load per tap, water source/type, etc. All impact financial position.

(#4) I see small systems being somewhat similar and one set of benchmarks being adequate.

(#5) You must use a range of benchmark values, as the size and complexity of "small" systems has such a large range. Surface water vs. Ground water systems, treatment method, number of connections

(#6) One set of characteristics will not likely fit all. The grouping we use is to separate systems that are not combined with other utility systems such as sewer. Water systems that are combined with other utilities have unique financial and operational characteristics. We then separate the systems into two groups. One group is those systems that produce/treat their own water. The second group is those systems that purchase treated water and function primarily as a distribution system only. In small systems the trend is toward buying treated water from a central source

(#7) A separate set of benchmarking may be appropriate, depending upon how the indicators are identified and structured. If there is to be a breakout, I would suggest the following:

25–500 persons
501–3,300 persons
3,301–10,000 persons
10,001–500,000 persons
500,000 and above persons

(#8) These variables are important to sort out. Refer to the PA benchmarks study to review the various hypotheses that were tested (all of them, I believe). Once you have the data (and QA it – no small task), it is a simple matter to run the stats to test them all. I would recommend looking at all of them. It is, of course, essential to keep the different ownership categories separate throughout due to different accounting conventions.
(*editorial note, see:* John E Cromwell III, Scott J. Rubin, Frederick A. Marrocco, and Mark E. Levan.. "Business planning for small system capacity development," *Journal of the American Water Works Association* 89, no. 1(January 1997): 47–57; and, John E. III Cromwell and Scott J. Rubin. *Development of Benchmark Measures for Viability Assessment*. Bethseda, MD: Prepared for the Pennsylvania Department of Environmental Protection. Apogee Research, Inc. 1995)

(#9) Some simple benchmarks could be developed (already have been!) That will be highly correlated. Some are generic across types of systems. Some type-specific measures could be used. Avoid looking at rates or prices; they are almost meaningless.

(#10) I would suggest the use of benchmark ranges. A set of criteria to judge the financial and planning health of small utilities was developed by Integrated Utilities Group, Inc. It provides a set of criteria to use to determine if (outside) assistance is desirable for financial planning and utilizes a numerical scoring mechanism.
(*editorial note, see:* C. (Kees) W. Corssmit. *Fiscal Health Scoreboard for Water and Wastewater Utilities*. Based on a Publication in "The Newsletter of the Special District of Colorado." Prepared by Integrated Utilities Group, Inc., Denver, Colorado. 1996).

Part 5. Comments on: WHAT TO BENCHMARK

What are the most critical factors to the success of small water systems?

(#1) Management and Water Treatment

(#2) They key factors are the system's financial performance (net revenues, positive cash flow, return on investment, etc.), the quality of its management, and the quality of its technical performance. A system that is deficient in at least one of these areas will have problems. A system that is deficient in two or more is probably in serious trouble

(#3) Effective management and strong governance positions. Generally, there are fewer and fewer "sparkplugs" in small communities, those who possess or are willing to exert leadership roles. What is causing the most trouble for small systems? I think it is being told that they considered to be a problem when in reality they are not. Too many regulators seem to not be able to accept that when a small system is performing its function which is to provide quality and quantity of water system, then they need to allow that system and its neighbors to be left alone.

(#4) Trained operators, proper replacement/maintenance and system financial performance are most critical. Trouble is caused by; low salaries resulting in poor operation/maintenance, lack of political fortitude charge appropriate user fees.

(#5) Most critical factors are pricing the water at a cost sufficient to allow for proper operation, maintenance, and expansion. I believe that small systems continually underprice water and are unable to operate effectively. Giving these systems tools to help get a grip on these issues is critical. If there is an adopted standard for operational dollar needs, the burden would be lifted from the operator/manager somewhat .... kind of a scapegoat. This is a big problem!

(#6) 1. Poor or inadequate accounting systems. Many systems use cash accounting. 2. Failure to segregate water system funds from other funds. Doesn't allow accumulation of reserves to make major capital improvements if funds are co-mingled with operational funds of other accounts that tend to get spent. 3. Water Rates. Not understanding how to price the product.

(#7) Most Critical Factors: 1) Financial stability; 2) System reliability (operations); 3) Consistent production of water meeting MCLs; and 4) Certified operator. Causing the greatest problems: 1) Compliance issues e.g., (testing/monitoring/reporting); 2) Lack of financial resources; 3) Lack of certified operator(s); and 4) Operational problems.

(#8) Cash flow is a well-established indicator. Cost based pricing is the key input to long-term sustainability. The ownership and management must provide clear accountability. My own bias is toward economic regulation as a means to ensure capacity, because it is comprehensive.

(#10) Lack of management skills; lack of financial resources.

Part 6. Comments on: PERFORMANCE MEASURES

What is the best measure(s) of the performance of small community water systems?

(#1) 1.Water Production cost/1000 gallon. 2. Retail water sale cost /1000 gallon. 3. Water loss for system.

(#2) See the benchmarking work done in Pennsylvania.
(*editorial note, see:* "Evaluating Business Plans for Small Public Drinking Water Systems Manual" at: *http://www.dep.state.pa.us/dep/subject/advcoun/techctr/evalbpmanualfinal3.doc.*)

(#3) First, are the customers happy? Is there water in the system? Are the rates affordable? Is service a top priority with management/governance or do problems go unattended? Water loss ratios below 15 percent, prudent fiscal management, etc. All contribute to a system's viability. Financial statements will tell the story. We strive for systems to have a debt service coverage ratio of 1.25.

(#4) Water quality, loss of service events, cash flow performance, investment in short and long-term asset replacement.

(#5) Compare cost of water to the final quality of the delivered product (quality measured in NTU, taste and odor, trihalomethanes). Any monitoring violations or customer complaints should also be considered.

(#6) Operational performance—meeting or keeping water quality standards, maintaining service. Financial Performance—cost of doing business factors—funding accounts including reserves for capital improvements.

(#7) 1) MCL Violations/Reporting/Monitoring Violations, Administrative Orders, etc.; 2) Turnover rates of operators and/or extended time(s) without certified operators; 3) biannual/updated Capital Improvement Plan; 4) replacement reserve account (benchmark @ 10 percent of annual gross revenue); 5) "special" requirements on water operating permit; and 6)age of system components.

(#8) Cash Flow. These are too numerous too list here. But there are several key operational indicators. For very small systems, though benchmarking is difficult. Ratios like "employees per whatever" don't really apply.

(#10) See the criteria used in the *Fiscal Score Card* referred to above.

Part 7. Comments on: PROCESS BENCHMARKING

Would small systems benefit from efforts to organize a network that would help small water system managers to identify the best practices of other water systems?

(#1) State Rural Water Associations are already in existence for this purpose. Many small systems are not using their services.

(#2) Yes.

(#3) Not really – it is not generally the business of one system to worry about a neighboring system's problems or operations.

(#4) yes, I believe MN rural water association. Is already filling this role in MN.

(#5) Sure, it may help operators develop and continue better operational guidelines through a spirit of competition. Publication of operational parameters would also help justify system expenses to customers

(#6) Already networks in place. Round Table and Illinois Rural Water Association. Also, water system operator's meetings and conferences.

(#7)This is a toughie. The problem is that most, at this size, will not access the information or seek assistance. Reasons include: 1) the fear factor – "if things are wrong and somebody finds out, I could lose my job," 2) lack of resources and time to stay current; and 3) the delivery mechanisms for such an endeavor need to almost be a one-on-one type approach.

(#8) most of the benchmarking literature is not relevant to the financial benchmarking that your research is intended to perform.

(#9) To an extent this would be helpful and it already occurs. But even best practices cannot overcome lacking economies of scale. I lean more toward restructuring and "out of the box" ideas (such as technology changes), which are not captured by this sort of benchmarking

(#10) Sure.

Part 8. Comments on: BENCHMARK NEEDS AND CURRENT PRACTICE

Do you believe that there is a "felt need" for benchmarking tools for financial analysis? What measures are they likely to use to describe the performance of their water systems?

(#1) (1.) Cost (Retail and Bulk or Wholesale); (2.)Water loss; and (3.) Operating cost comparison (repairs, insurance, electrical, chemical, engineer etc.).

(#2) I don't know enough to answer this.

(#3) The need for financial benchmarking is appreciated by industry organizations and associations, state and federal agencies (if they care). System managers see quality of service and financial position as primary measures of performance.

(#4) Yes, there is a need for bench marking tools for financial analysis. I do not believe most small system managers are using bench marking. My opinion is that most small system managers would describe their system performance by meeting SDWA standards and water is in the pipe nearly all the time.

(#5) I've seen a large range in financial responsibility of system management. Most on the poor end. The measures I would suggest are listed above.

(#6) Probably not "felt" as strong as it ought to. Most operators are more aware of operational issues and yes, they do some informal benchmarking

(#7) Yes, there is the felt need for such tools. Most small systems do not have full-time personnel and financing issues are left up to others, i.e., city clerk, city council/water board. Little input is given by/received from water system personnel. Most are not qualified to conduct a financial analysis; they are not trained in this area. Capital Improvement Planning is the exception, not the rule. (Most don't even do rate studies or have a meter "change-out" program...simple activities). Small system water personnel are also not adept at communicating their needs with the policy/decision-makers; they do not have the experience or expertise to develop the information or materials they need to accomplish this. Also, many times politics determines whether rate increases/purchases/improvements are furthered. Water system personnel aren't elected; council members are. Per discussions with small system operators/managers, they utilize measures such as:

1) meeting budget(s)
2) keeping expenses down
3) keeping rate increases to a minimum
4) some relative cash flow

(#8) Lack of violations and low rates

(#9) This is old news. Good small system managers already do benchmarking, seek improvement. Some actually are pretty sophisticated.

(#10) Many managers will already use very informal benchmarking tools. Annual and monthly financial reports are often used.

Part 9. Comments on: INFORMATION CONTACTS/BENCHMARK USERS

Who are the best sources of information about small systems? Who are the most likely users of benchmarking tools?

(#1) The manager is most likely to have the information you need.

(#2) Manager/administrator/bookkeeper. Users of benchmarking? State and federal agencies, rating agencies, investors.

(#3) The operator and the city clerk would have the needed information. The most likely users would be city council, regulators and finance people.

(#4) I think your best contact would be technical assistance providers, as they have dealt with these communities as a whole. In most cases, the system operator/manager is the best contact otherwise

(#5) Operators, Mayors, Treasurers, Boards, IEPA, Lenders.

(#6) Most small systems are "one person operations" (the operator). These individuals are the ones closest to the action and can provide the most input with regards to information on operations. Most small systems use consultants/engineers only in times of need and usually don't have a engineering firm that is on retainers. Those systems that have some form of a manager would be useful as they probably have more capacity to understand the critical benchmarking needs. City clerks/office managers can provide some useful information as they are the ones usually in charge of overseeing the financial activities of small municipal water systems or private water systems.

(#7) Owner/Manager

(#8) The one and only guy who runs the system part time.

(#9) The manager. Any of those listed plus Directors of Special Districts.

Part 10. Comments on: POTENTIAL VALUE

What do you think is the potential value of systematic benchmarking for the small water system community?

(#1) Comparative analysis of one small system to another of similar kind.

(#2) I think it's an important piece of the puzzle, but not “the answer.”

(#3) Would allow for there to be a yardstick, if properly used, could be of assistance to all systems. Having such information would allow funding agencies to better understand overall needs, those who provide technical assistance could better target their efforts. Lastly, the individual systems should be able to see where they are spending more than necessary by industry standards.

(#4) To provide a touch of reality and information on what is needed for a water system to be sustained over the life of the community.

(#5) Helps establish a standard for proper operation of small water systems (good news). Justifies increased expense on system (bad news). Educates the system operator and the public

(#6) Possibly.

(#7) With regards to long-term viability and increasing the capacity of water system personnel, the value is great. The greatest fear is employing a benchmarking system that is too complicated, obtrusive or overly structured with little flexibility. From our experiences with the development of the State's Capacity Development Plan, small systems fear the Primacy Agencies will be too stringent in their application and the water system(s) will get caught up in a non-flexible system. The big question is. "Will the utilization of benchmarking apparatus's be used to determine viability or provide guidance?" If the answer is guidance, the success of such an endeavor will be more likely.

(#8) Take a look at the percentiles and CDF graphs in the PA benchmark study (*editorial note, see citations in Part 6, #2 above)*. That is the kind of output that lends itself to easy use by small systems. When you are having trouble and the percentiles are saying that you are consistently on the 10th percentile of 3, 4, or 5 key financial indicators, it tells you right where the trouble is. And it is something you can show to your board to help convince them you have to make changes to fix things. And, nobody has to tell you whether you are viable or non-viable or otherwise label you. The percentile comparison against your peers tells you all you have to know. This is especially critical because most states have no authority to intervene in financial management of these systems. So, a good thing that states can do is provide this type of impartial comparative information to allow people to make their own comparisons and draw their own conclusions. It is a market-oriented intervention. It is workable even under a Republican governor.

(#9) Very limited, to be perfectly honest. We know how to solve this problem – it is a matter of political will, not more surveying or benchmarking.

(#10) Could be quite high- there is very little available right now.

Part 11. ADDITIONAL COMMENTS

(#1) Computer mapping of rural systems needed to determine location, size of lines and capacity of system.

(#2) Generally, don't create a survey which begins with the cliché "As you know, small systems are a problem!" or any such connotation. If you want to help small systems, then help them – don't condemn them as some within the regulatory and bureaucratic community are constantly doing. Want to find some real problems? Have 50 samples run on bottled water – Kansas did that and found 15 percent of the sample contain contaminants which had they been detected in public water systems, would have caused EPA to shut them down.

(#3) Do small systems see themselves as being viable without continued subsidies from either the state or federal government.

(#4) Think that this is a very worthwhile project ... please keep me informed.

(#5) The development of a financial benchmarking initiative is definitely needed, no question. If for no other reason than to provide some level of guidance to small systems that wish to earnestly attempt to: 1) determine if they are financially fit; 2) identify financial problems/issues within their water utility; 3) identify approaches to make/take corrective actions; and 4) communicate more effectively with decision/policymakers.

(#8) Before you survey systems survey the states in the region to thoroughly understand their existing financial reporting requirements. These will exist in different agencies of state government. You may find one for investor owned systems, one for municipals, and another one for authorities/districts. They may be good (Wisconsin) or not so good, but they exist. They may not go all the way down the size gradient, but every little bit helps. I would see what's out there and see what you can learn from it before launching the survey effort. In addition, the existing state reporting mechanisms are your only shot at getting balance sheet data. In your broadcast survey, I would encourage you to focus only on the income statement. You will not get good balance sheet data except where it is already a required reporting item by states. Including balance sheet data will hurt your response rate and add bias towards getting responses from only well managed systems. Data quality is enough of a problem with just the income statement. One trailing thought, Peter Shanaghan of EPA headquarters has some pie charts showing the change in ownership mix as you progress through system size categories form 10,000 to 3300 to 1,000 to 500 to 100. The changes in ownership mix are quite drastic as you cut across this gradient.

(#9) This is deja vu all over again. I can see some incremental value in this but haven't we been here before? Is there much more to be said? Repackaging and dissemination, I guess, which keeps all of us going. I believe they are doing something similar in Texas – indicators of good performing systems (TNRCC).

(#10) The cost of clean water is very significant for small utilities. I have addressed this in several papers published over the last ten to twelve years. I am beginning to see these predictions coming true more often. User charge impacts of the Clean Water Act can be in the twenty to fifty dollars per month incremental impact range per household.

Part 12. SUGGESTED ADDITIONAL REFERENCES

(#1) I have reviewed most of these documents/articles in the past and find them to be, for the most part, relevant. One additional resource you may want to review is: USEPA. Office of Ground Water & Drinking Water. Partnership *for Safe Water Voluntary Treatment Plant Performance Improvement Program Self-Assessment Procedures*. October, 1995.

(#8) See: "Linking Full Cost Recovery and Sustainability," Cromwell and Jordan, in Providing Safe Drinking Water in Small Systems: Technology, Operations, and Economics, Lewis Publishers, 1999

(#10) Fiscal Health Scoreboard for Water and Wastewater Utilities, Integrated Utilities Group Inc.

B-2: EXPERT PANEL CONSULTATION PHASE 2 PROTOCOL AND RESPONSES

CONSULTATION PROTOCOL

Dear Colleague:

A short time ago we sent you an E-mail message asking for your feedback on several questions regarding the development and use of benchmark measures for small community water systems.

You will find a summary of the responses that we received below. Based on these responses, we developed a number of questions for possible inclusion in a survey of small water systems in 10 Midwestern states. A working list of survey questions follows the response summary.

We would appreciate it if you could review the E-mail message below. We invite you to comment on the summary of responses, as well as the working list of survey questions. Add, delete, modify, or criticize these as you see fit. Let us know what you think. Participation in the first round of this consultation is not a requirement for providing comments at this time.

Please submit your responses by using the "reply" function of your E-mail program and typing directly into this message. All respondents will receive a copy of the final draft of this panel consultation via E-mail (in MS Word format) during the first week of October.

Thank you for taking the time to consider our requests. Please contact us at any time if you have comments or suggestions regarding this research endeavor.

Sincerely

Dr. Roger Beck
Associate Professor
Agribusiness Economics
SIUC

Dr. Ben Dziegielewski
Associate Professor
Geography
SIUC

Sponsored by the Midwest Technology Assistance Center http://mtac.sws.uiuc.edu
Conducted by Southern Illinois University Carbondale, Department of Agribusiness Economics and Department of Geography

Summary of First Round Responses

Defining Small Water Systems

What measure(s) of size should be used to identify those community water systems that are most typical of the problems attributed to small systems?

The number of connections, population served and pumpage were all suggested as appropriate measures. Suggested values for these measures were: 1,000 connections and 3,300 customers. No range was suggested for pumpage.

It was noted that: some agencies use less than 10,000 customers as a measure of small systems; the great majority of systems serve less than 500 customers; and the number of connections is an inappropriate measure when small systems have a few large customers, or serve only industrial parks/complexes.

Inclusion of Very Small Water Systems

How important is it to include these (smallest) systems in efforts to develop benchmark measures for small water systems?

All of the respondents stated that it was very important to include even the smallest community water systems (CWS) in the study, in spite of the recognized difficulties with data collection. It was stated that these systems may be more likely to have minimal capacity, the greatest need for infrastructure improvement, and there are just so many of them.

Several respondents suggested working with partner organizations such as NRWA and RCAP as a way of improving data collection or getting some sense of the needs and interests of these systems. Others commented that a careful sample of smallest systems would be adequate.

Categorical Grouping of Water Systems

What categories might be most important in grouping systems for a benchmarking analysis?

Several critical distinctions between small water systems were suggested:

- water source (ground/surface/purchased)
- "size"
- system growth
- storage capacity
- date of construction / age and type of distribution lines
- treatment method
- combined (water and sewer) systems vs. water supply only
- debt load per tap

Responses were divided as the to need to develop separate benchmark ranges. Some respondents suggested that several simple benchmarks would be applicable across all categories; other suggested that these differences could be sorted out statistically once the data is obtained.

What to Benchmark

What are the most critical factors to the success of small water systems?

Many factors were suggested:

- management quality - effective management and strong governance
- technical performance (i.e., water treatment)
- financial performance
- lack of "sparkplug" leadership in small communities
- unnecessary regulatory mandates
- trained/certified operators
- low salaries
- operation/maintenance/replacement
- pricing/inappropriate user fees/water rates/cost-based pricing
- political fortitude
- inadequate accounting systems (i.e., cash accounting)
- co-mingled accounting systems (not separate from other municipal or utility budgets)
- testing/monitoring/reporting
- system reliability

Some specific indicators were suggested:

- net revenues
- return on investment
- regulatory compliance
- cash flow/ cash flow/ cash flow

Performance Measures

What is the best measure(s) of the performance of small community water systems?

Many performance measures were suggested:

- water production cost/1000 gallon
- retail water sale cost/1000 gallon
- water loss ratio (below 15 percent)
- affordable rates
- customer satisfaction/complaints
- debt service coverage below 1.25
- water quality (measured in NTU, taste and odor, trihalomethanes)
- loss of service events
- investments in asset replacement fund
- replacement reserve account (benchmark @ 10 percent of annual gross revenue)
- MCL /reporting/monitoring violations
- age of system components
- biannual/updated Capital Improvement Plan
- cash flow/ cash flow/ cash flow

Process Benchmarking

Would small systems benefit from efforts to organize a network that would help small water system managers to identify the best practices of other water systems?

Most respondents commented that "process benchmarking" is already done through the efforts of state Rural Water Associations. Several obstacles to this type of information exchange were mentioned: many very small systems do not participate in RWA programs; the fear factor – "if things are wrong and somebody finds out, I could lose my job;" small systems lack the resources and time to stay current; such programs would require an expensive one-on-one approach.

Benchmarking Needs and Current Practice

Do you believe that there is a "felt need" for benchmarking tools for financial analysis? What measures are they likely to use to describe the performance of their water systems?

Respondents were split as to whether or not small system managers were already using self-assessment measures. Examples of currently used performance measures included:

- cost (retail/bulk/wholesale)
- water loss
- operating cost comparison (repairs, insurance, electrical, chemical, engineer etc.)
- lack of violations/meeting SDWA standards
- "low" water rates; keeping rate increases to a minimum
- meeting budgets
- keeping expenses down
- cash flow

Most respondents replied that there was a recognized need for better financial management tools. Some suggested that small systems are better at handling operational issues and do not have the staffing and resources to perform even the most basic self-analysis, such as rate studies or capital improvement planning. Other comments pointed out that self-assessment, and the development of financial tools, may be hampered by poor communications between system personnel and policy and decision-makers. In particular, the honest evaluation of rate increases is hampered by the political process involved in raising rates in publicly operated systems.

Information Contacts / Benchmark Users

Who are the best sources of information about small systems? Who are the most likely users of benchmarking tools?

Suggested best sources of information at small systems are:

- manager/administrator
- operator
- engineer
- bookkeeper
- city clerk
- technical assistance providers
- mayors
- treasurer
- the one and only guy who runs the system part-time
- owner/manager

Suggested "most likely" benchmark users:

- financial sources
- water organization boards
- industry organizations and associations
- state and federal agencies
- rating agencies
- investors
- lenders
- city council
- regulators

Potential Value

What do you think is the potential value of systematic benchmarking for the small water system community?

Comments ranged from "great" to "very limited" and "not 'the answer'."

The following phrases were used in responses to this question:

- comparative analysis; a yardstick
- determine if systems are financially fit
- allow funding agencies to better understand overall needs
- target technical assistance
- provide a touch of reality
- information on what is needed for a water system to be sustained over the life of a community
- establishes a standard for proper operation of small water systems
- objective measures that operator/managers can use to support the need for sustainable water rates
- educates the system operator and the public
- identify financial problems/issues; has potential to tell you right where the trouble is
- identify approaches to make/take corrective actions
- allow managers to make their own comparisons and draw their own conclusions
- a market-oriented intervention
- communicate more effectively with decision/policymakers

Implementation of benchmarking tools could be impeded by systems managers' fear that:

- they will be too complicated, obtrusive or overly structured with little flexibility
- will be used to determine viability rather than to provide guidance
- will be employed by primacy agencies, who will be too stringent in their application

Additional Comments

These comments noted that:

- the overall high quality of small water systems is misrepresented by the use of generalizations about the "small system problem"
- "ownership" (public/private) plays a critical role in small system financial performance
- state financial reporting agencies could serve as a major source of financial data for small systems and should be used in the study

- small water system mangers should be surveyed to see if they believe they can remain viable without outside subsidies
- GIS/computer mapping can play a significant role in the improved management of small systems
- benchmarking research can only make minor contribution to improved system performance

Suggested References

Three additional documents were suggested for review:

- *Partnership for Safe Water – Voluntary Treatment Plant Performance Improvement Program Self-Assessment Procedures.* USEPA. Office of GroundWater and Drinking Water. October, 1995.
- "Linking Full Cost Recovery and Sustainability," John Cromwell and Jeffery Jordan, In: *Providing Safe Drinking Water in Small Systems: Technology, Operations, and Economics, Lewis Publishers*, 1999.
- *Fiscal Health Scoreboard for Water and Wastewater Utilities,* Integrated Utilities Group Inc.

Part 3. Working List of Mail Survey Questionnaire Items

The survey questions that appear below were developed from the above responses. They are presented in draft format and those actually used in the survey will be reviewed for clarity and order of presentation. Note that information collected in the survey will be supplemented with data obtained from state regulatory and financial agencies.

Surveys will be sent to a sample of systems that serve less than 1,000 connections. The sample will be stratified by size (>200 connections, <200 connections), ownership type (public / private) and major source of supply (surface, ground, purchased).

Contact person(s): (Name(s), position(s) within the organization, training)

1) Regarding your supply system, what is your:
   a.) current number of active connections?
   b.) approximate current population served?
   c.) pumpage (finished water: average/day, max day)?
   d.) current water supply sources (surface water, groundwater, purchased water and estimated percent from each source)?
   e.) distribution system storage capacity?
   f.) estimated age of system components (source/plant/distribution mains)?
   g.) most recent estimate of distribution system water loss?
   h.) types of treatment processes?

2) What type of water supply service do you provide (estimated pecent of: residential, commercial/industrial, wholesale)?

3) How is your water system organized? (private company, city department, county agency, regional authority, other)?

4) Who provides oversight of the water system management and operation? (elected board, appointed official, etc)?

4a.) Is your system required to file routine financial reports with any state agency, funding agency, or lender?

4b.) Are these reports available to the public?

5) What other information is collected routinely for use in the internal management of your system?

6) Do you keep a record of:

a.) drinking water violations?

b.) customer complaints?

c.) boil water orders?

d.) loss of service events?

7.) Do you, or another person, prepare an annual financial report for your system?

8.) Do you prepare an annual budget?

9.) How is your system funded (operating revenues, taxes, combination)?

10.) What is the basis of your accounting system? (cash or accrual)

11.) Is the financial management of your systems completely independent from other municipal operations, or other utility operations (i.e. wastewater)?

12.) Do you have a reserve fund that is used for replacement/expansion costs?

13.) Can you provide us with a current rate schedule? A history of rate changes?

14.) What type of funding mechanisms have you used to finance major infrastructure improvements and purchases? Can you provide us with a brief summary of your utility's grant and loan history?

15.) Who do you contact when you need technical, financial, or managerial assistance (NRWA, AWWA, RCAP, USDA Rural Development state regulatory agency, National Drinking Water Clearinghouse, other)?

16.) Is your utility a member of a water-related non-governmental organization? (state/national Rural Water Association, AWWA, other)?

17.) Have you recently performed an assessment of the affordability of your water rates? What was the basis of your assessment?

18.) Are you aware of any self–assessment programs for small water utilities in your state? Have you participated in any such program?

PHASE 2 RESPONSES FROM PANELISTS

The exact wording of the questions and statements sent to the panelist appears in above. The responses of panelist to Phase 2 of the Consultation are presented below, under brief headings that identify each group of questions and statements. As in the Phase 1 discussion, panelists were assigned a respondent number, which is shown in parenthesis at the beginning of each response.

Comments on: DEFINING SMALL WATER SYSTEMS

What measure(s) of size should be used to identify those community water systems that are most typical of the problems attributed to small systems?

(#11) Suggest that the population served based classification system used by USEPA be retained as it is generally understood by PWSs: small = 25 to 3300; medium = 3301 to 10,000; large = > 10 k.

(#12) We delineate systems by persons served: <500 = very small; 501-3300 = small; 3301-10,000 = medium; >10,000 = large. Measures for systems that are most typical of problems in small systems are (1) populations less than 500, and (2) operational control - whether they have a certified operator

(#13) I am familiar with the 10,000 figure. I think it is a good breakpoint with regard to a utility's ability to retain expertise in house. Systems that are dominated by commercial or industrial water use probably should be classified separately regardless of whether the system is small. You might want to consider a domestic use ratio as a test. Arguably if more than 50 percent of the consumption is non-domestic many benchmarks may not work well.

Comments on: INCLUSION OF VERY SMALL WATER SYSTEMS

How important is it to include these (smallest) systems in efforts to develop benchmark measures for small water systems?

(#11) Need to consider that small system operators tend to leave their position for a better paying job on a fairly frequent basis

(#12) It's vitally important to include the smallest systems in developing benchmarks. The greatest percentage of systems, in our state and nationally, are classified as small systems. Yes, special efforts should be made to ensure their inclusion.

(#14) I would agree that it is important to include the smallest facilities since in our state, the largest number of facilities in non compliance is these facilities.

Comments on: CATEGORICAL GROUPING OF WATER SYSTEMS

What categories might be most important in grouping systems for a benchmarking analysis?

(#11) The above categories all have a place in evaluation of a water system depending on the problem being analyzed - technical, financial or managerial.

(#12) Separate sets of benchmarks should be developed for the various system types. Broad categories for system types are: Ancillary (homeowner's associations, prisons, mobile home parks); Municipality; Privately-owned system (private company which operates a supply)

(#13) Consider adding ownership as a category-public vs. private.

(#14) - compliance status

Comments on: WHAT TO BENCHMARK

What are the most critical factors to the success of small water systems?

(11) See above.

(12) Critical success factors include certified operator, adequate funds, system design, expansion of private (unregulated) to public system, lack of adherence to construction standards. Areas which create the most trouble for small systems include lack of technical knowledge, lack of management, lack of certified operator, lack of adequate funds, lack of understanding of serious potential ramifications of their actions.

(#13) Some of these work only if the utility is operated with rate payers- I think the indicators that work regardless of whether rates are charged are most valuable and can include systems serving industries and institutions better- look at expenditure per gallon produced, look at regulatory compliance.

Comments on: PERFORMANCE MEASURES

What is the best measure(s) of the performance of small community water systems?

(#11) See above.

(#12) The best measure of performance is compliance with the SDWA. Five categories included: critical problem (acute MCL); serious problem (non-acute MCL); minor problem (occasional monitoring violations); potential problem (no problem now, but one foreseen); and no problems (current and future compliance with SDWA). If a problem is identified, then classified, the willingness of the supply to work in correcting the problem is the next critical factor.

Comments on: PROCESS BENCHMARKING

*Would small systems benefit from efforts to organize a network that would help small water system managers to identify the best practices of other water systems***?**

(#11) Use of State RWAs could be effective if they have the funding to add staff for this type of work. However, small system employee retention could be a major factor.

(#12) No, networking would not be beneficial. The circuit rider and peer review process has had minimal positive impact in the past. Small systems want to be told what needs to be done, how to do it, etc. Their water activities are often not their primary job, and both the time and funds are usually not available to have them get "best practices" from other supplies

Comments on: BENCHMARK NEEDS AND CURRENT PRACTICE

Do you believe that there is a "felt need" for benchmarking tools for financial analysis? What measures are they likely to use to describe the performance of their water systems?

(#11) State primacy agencies will have to use some of this information to implement the Capacity Regulations regardless of where it is developed

(#12) Yes, there is a need for benchmarking tools for financial analysis. No, small system managers aren't usually involved in the financial end very much - usually the city clerks in a small town have this responsibility. The measures they are likely to use in describing the performance of their system include whether they are in compliance with state regulations and complaints from customers on: (1) esthetic water quality parameters like iron, (2) service interruption, and (3) cost of water.

(#14) Most of our small systems do not have a clue what their system costs are, except for the utility bill. Most do not have an understanding of what their future needs might be until system problems are encountered. It very important to assist the small facilities with some kind of future planning tools. *("Other comments pointed out that self-assessment, and the development of financial tools, may be hampered by poor communications between system personnel and policy and decision makers.")* - In most small systems, there won't be any difference in those personnel. *("In particular, the honest evaluation of rate increases is hampered by the political process involved in raising rates in publicly operated systems")* - generally with good education this isn't that much of a problem

Comments on: INFORMATION CONTACTS / BENCHMARK USERS

Who are the best sources of information about small systems? Who are the most likely users of benchmarking tools?

(#11) These sources may have the information, but are they will to share this information because of confidentiality or business considerations.

(#12) For the financial and managerial benchmarks, the mayor/council chair for finances and budgets in muni supplies; the chair of non-muni supplies such as homeowners association; the owner of ancillary or private supplies. For the technical benchmarks, the operator would be the most likely person. The most likely users of benchmarking tools are the state and federal regulators, and the economic developers of the communities

Comments on: POTENTIAL VALUE

What do you think is the potential value of systematic benchmarking for the small water system community?

(#11) Pilot work is needed to be able to judge the value of the analysis and the responsiveness of a PWS to implement the recommended changes. Also need to determine why changes were not implemented and make adjustments or provide alternatives if possible.

(#12) From a regulator's perspective, consistency in regulating the public water supplies

(#14) If the small system will use these resources, it can potentially keep them out of trouble in the future. But, getting this information to the small system and its periodic use will be the greatest problem.

ADDITIONAL COMMENTS

(#12) Differentiate into the three types of small systems, based on why they provide water: municipal, ancillary, and privately-owned (where they provide water, and are a for-profit entity). Non-transient non-community systems are also required to participate in capacity development, per the 1996 SDWA. Will they be addressed? Also, in our state, we're including transient non-community systems in the "new" systems strategy. The TNCs actually take the most time from a compliance/enforcement standpoint. The non-municipal (ancillary) small communities have special needs that are different than small communities.

(#14) If the research results in an easy but informative self-assessment tool, it will be worth the time invested.

Comments on: SUGGESTED REFERENCES

(#11) These may be too complex for the small system operator/official and simplified versions will be needed.

Comments on: WORKING LIST OF MAIL SURVEY QUESTIONNAIRE ITEMS

(only questions that were commented on appear below)

1) Regarding your supply system, what is your:

a.) current number of active connections?
b.) approximate current population served?
c.) pumpage (finished water: average/day, max day)?
d.) current water supply sources (surface water, groundwater, purchased water and estimated percent from each source)?
e.) distribution system storage capacity?
f.) estimated age of system components (source/plant/distribution mains)?
g.) most recent estimate of distribution system water loss?
h.) types of treatment processes?

i.) max\min pressure in the distribution system

6.) Do you keep a record of:

a.) drinking water violations?
b.) customer complaints?
c.) boil water orders?
d.) loss of service events?

(#11) Add water main breaks & locations and equipment failure.

15.) Who do you contact when you need technical, financial, or managerial assistance?

(#11) USEPA OGWDW web site and Safe Drinking Water Hotline

General Comments:

(#13) These questions look like a good start.

APPENDIX C:
FOCUS GROUP REPORTS

INTRODUCTION

Appendix C contains the documentation from each of the three focus groups that were conducted during this study. In each of the following summary reports the setting and participants in the group are first described. Next some of the key issues that were raised in the session are listed and described. The questions used in each session were slightly different, and the discussion of issues reflects these differences. Where appropriate, lists of the measures that water systems use in the management of their systems are included.

Each report includes a large section that consists of the direct quotations of group participants. These comments not only highlight some of the key issues raised in each session, but reflect the tone of the discussions. In many respects, these statements represent the most valuable information contained in each report. Finally, each report includes a set of observations and conclusions that were made by the research team based on our interpretation of the interactions and comments made during each session.

C-1: Focus Group #1 - Small Water System Managers

SETTING

Focus Group #1 was held in conjunction with an annual small water system conference sponsored by one of the state sections of the American Water Works Association. The project team was scheduled in the final time slot of the two-day program to give a presentation about the new Technical Assistance Centers and the role of financial benchmarking in the management of small water systems. A 90-minute focus group meeting was scheduled to begin immediately following the conference presentation. Unfortunately, the conference schedule became delayed, the presentation had to be cancelled, and the focus group shortened by 15 minutes. MTAC information sheets, and copies of the Fall 1999 issue of the National Drinking Water Clearinghouse publication *On Tap* (which contained an article about the Technical Assistance Centers and financial measures) were distributed.

PARTICIPANTS

Conference organizers provided a list of registered participants and their communities. The names were matched to a 1998 copy of the SDWIS data files in order to identify participants who were managing “small” water systems. The phone numbers of the participants were then obtained from either the AWWA Membership Directory, or by phone calls to the community's city hall. Eighteen water system managers who were registered to attend the conference were identified.

Prospective participants were contacted by phone several days before the focus group. They were informed of the purpose of the focus group, and the exact starting and ending times of the meeting. They were also notified that the focus groups discussion would be tape-recorded and were assured of the anonymity of their participation. Finally, they were offered a $50 compensation for their participation, and invited to supper at the conference site following the meeting. Eleven of the managers contacted gave their preliminary agreement to participate in the session.

Nine of the system managers stayed for the session. Some of the characteristics of the water systems of the members of the group are displayed in the table below.

Size and source of systems managed by participants of FG#1
(source: 1998 SDWIS files)

Participant	*Population Served*	*Number Connections*	*Primary Source*
A	1,980	870	GW
B	2,006	891	PW
C	6,735	2,930	GW
D	3,902	1,740	SW
E	2,194	915	GW
F	421	n.a.	GW
G	3,450	n.a	SW
H	1,181	n.a	GW
I	2,503	n.a	PW
GW = groundwater, SW = surface water, PW = purchased water, n.a = not available in SDWIS data file			

All of the participants managed municipal water systems. Six of the nine participants operated water systems that were in the population range of less than 3,300 customers (USEPA's classification for a small water system). Two of the other systems were within 600 customers of this size category. Seven of the nine managers were also responsible for other utilities in their communities.

It should be noted that the participants in this focus group may represent a "best practices" group of water managers. Their voluntary participation in the small system conference and the focus group, and membership in AWWA and other organizations, all suggest that they are the most active members of their peer group. Following the focus group session, three of the nine participants remained for supper. The research team members joined them at a single table and the discussion continued. Some of the statements included in the analysis below were taken for this latter discussion.

FOCUS GROUP #1 ANALYSIS

The following section summarizes the comments that were made by focus group members into four categories: (1) an "inventory of indicators" used by managers to describe their water systems, (2) system needs and problems, (3) issues discussed during the focus group meeting, (4) a sample of representative comments made during the session. This is followed by a summary of conclusions, recommendations, and observations from this focus group session.

SUMMARY OF RESPONSES TO THE QUESTIONS

Description of water systems and communities

Participants suggested a large number of indicator measures that they use to describe and monitor their systems. The "inventory" table below lists those that were mentioned during the focus group session. The "inventory" lists the indicators (as broadly defined and identified by the project team) that focus group members had used during the discussion. If some standard, or benchmark, of the indicator was also presented, then this was also reported in the second column of the table.

Inventory of Indicators and Measures

Indicator mentioned	*Measure or Benchmark (when provided)*
Ability to get loans	Rates sufficient to cover loan pay off
Adequate capacity	Drought event horizon – "x-year event" Frequency of issuing water restrictions
Affordability	Number of customers on Social Security Employment in service area Age of customers in service area
Age of water plant	
Annual Municipal Budget	
Class of plant	
Closed ("looped") water system	Ability to shut off individual city blocks
Cost of new facilities	
Cost of O&M	
Cost per customer per month	$12 – example of inadequate monthly rate
Customer satisfaction	
Elevated towers	
Fire protection	Number of fire hydrants
Fire protection flow	
Interest rates from loans	Revolving loan fund in Illinois = 2.5%
Monitoring cost	$/year
Number of water line breaks per month	
Number of wells	
Ownership type	
Peak demand	
Percent of water line replacement	
Population growth; population increase	
Population served	
Production (gallons/minute or million gallons/day)	
Rates structure	
Reliability	Number of water sources Number and volume of storage facilities Interconnections
Size of storage capacity (gallons)	
System efficiency	No break; No boil orders: no low pressure events.
Treatment plant capacity	"must be able to meet growth"
Treatment processes	
Undersized mains	
Volume of infiltration (sewer)	
Water budget deficit	
Water line pressure	"Average 60 psi throughout the whole system"
Water mains and lines - age	
Water mains and lines – type of material	
Water quality – hardness	
Water rates	sufficient to cover debt and system improvements
Water rates	Per cost of treatment

Water system needs and problems

The second question that was presented to the participants asked them to identify the "needs and problems" that they would address if they had access to a substantial source of grant funding. The following list is a summary of the concerns mentioned during the discussion. This list also includes the needs that focus group members wrote on 3X5 cue cards but that were not discussed during the session

- Can't keep up with growth in peak demand
- 105 year old water lines – upgrade and replace water and sewer lines
- Difficulty in raising matching funds for RDA loans
- Loss of capacity of surface water supplies (from siltation)
- Need to replace / extend sewers
- Watershed management to maintain and improve water quality
- Need to replace cast iron water mains
- Need to replace shut-off valves
- Cost and difficulty of replacing water mains that are located under 8 inch thick concrete sidewalks
- Water quality – hard water
- Inadequate water rates
- Unwillingness of customers to pay more
- Watershed management to improve source water quality
- Inability to get grant funds for the proper size of mains – will only fund smaller mains
- New elected officials unable to understand water system problems/operation
- Meter replacement program – install new meters with "leak detection" read outs
- High soil acidity weakens old water mains
- Scale build up in water lines
- Lack of knowledge of local elected officials
- Poor communication between elected officials and utility managers
- Hard to find replacement parts for old water mains
- Replacement of lead service lines
- Add more computer monitoring and automation
- Replace existing lime softening plant
- Drill new wells
- Purchase property for a new facility
- Upgrade existing wastewater treatment plant
- Install second water tower in county

Issues

A list of the issues that were discussed during the focus group is given below. Italics are used to indicate the emphasis that was used by the participants as they discussed the issue. The issues are divided into two categories, and are followed by quotations from statements made during the session that are relevant to the study. These statements have been edited slightly to maintain the anonymity of the focus group members.

Issues raised related to financial management

Water systems must be able to measure and demonstrate "growth potential" in order to be competitive for grant funds.

Some state funding agencies are not able to provide funding for water mains above a certain size. This impacts the ability of a community to obtain lower fire insurance rates. It is likely that the cost of the reduced insurance would easily compensate for the cost of the larger water mains.

Adequate water rates are critical to system management because: (1) appropriate rates must be demonstrated in order to secure Federal grant and loan funds; (2) rates should be kept "progressive", that is, closely follow changes in the cost of operations; (3) water use must be directly linked to costs, "people should pay for the water that they use"; (4) can be supported with the least political trouble if rate adjustments are tied to annual financial audit *by a municipal ordinance*.

The cost of monitoring is increasing rapidly because of an increasing number of regulated contaminants, at an increasingly higher level of precision (elevated from: ppm, to ppb, to ppt). One participant stated that monitoring costs for his water system has increased from $800/year to $11,000/year. The monitoring and treating of the large number of regulated contaminants was thought to be far in excess of what is necessary to maintain adequate public health.

The management of water systems is largely invisible and greatly under-appreciated by the user community. Users must be *educated* to understand that *water systems must operate as a business*.

Small systems that are urged or required to take over failing water systems will endanger their own financial situation if they do not also receive additional outside funds from other sources.

It is difficult for water systems managers to get local communities to discuss the construction of shared water facilities, even when this is clearly in their mutual self-interest.

The smallest water systems are often unable to meet the requirements for grant funding, but can access funding by teaming up with larger nearby water districts.

USDA's *Water 2000 Program* is having a negative impact on rural communities. It negates one of the critical incentives that people have to live in rural communities – access to centralized water supply and wastewater treatment. It also promotes rural sprawl, forcing poor counties to increase their expenditure on other services (such as roads, ambulance and fire protection), while creating thinly spread water systems that will be much more difficult and expensive to maintain in the future.

Issues that provoked the most enthusiastic response from participants

The practice of cross-subsidization of services in small municipalities is widespread. Revenues from water supply are rarely used only for the management of the water utility.

Managers of small water systems must keep the cost of water services affordable. This is difficult in the low-income service areas served by most small water systems.

Systems that are very poorly managed are those most likely to attract assistance funding ("mercy grants") from state and federal programs. This provides a perverse incentive for systems to delay rate hikes, maintenance, and infrastructure upgrades.

There are considerable trade-offs between new/improved infrastructure costs and increasing O&M costs. For most (especially older) systems, upgrading is invariably the better economic choice.

Municipal officials do pay attention to what is happening in other communities and make demands upon system managers based upon these comparisons. Water managers also make comparisons to other systems, as was demonstrated by the lively discussion that followed the mention of an annual water rate survey that is circulated in the region.

EXCERPTS FROM THE SESSION DIALOGUE

"A lot of people griped (when the new system manager reviewed and increased rates as his first action), but when they came up to me I told them 'Your telling me that you shouldn't have to pay for what you use', that's all we're doing. Slowly their mind changed. People are (now) very happy with the way the system is run; we have no line breaks, no boil orders, and no water pressure problems. The inconvenience (to customers) has declined big time. They come in to pay their bill and they say 'well it's a little bit higher, but we're glad we don't have to worry about a boil order all the time."

"How do you look at your revenue and expenditures?" We go by a lot of different things; the bills that we receive from our water provider, the reports from our auditors, the ratio of cost per (1,000 gallons) treating water."

"We don't want to keep increasing the fees that we charge everyone so we keep looking at what we can do to lower our expenditures; to quit repairing stuff and replace it with the best you can buy so it will last for a very long time."

"When we look at the regional water rate report, (described above) we're always right in the 50% range."

"Our water and sewer department carries (financially) the police and fire departments a lot of the time."

"It makes a lot of difference if you keep your rates progressive. We all experience inflation, and if you don't have your rates progress along with the cost of operations, you're just asking for trouble."

"The mindset is still 'you're just a water/sewer guy'. Now it's so technical, this job is something that is very important. I try to tell people, you're not paying for the water and sewer, you're paying for the convenience of turning the tap on, and not having the out-house out there."

"Congress thought that it wouldn't hurt anybody to pay an extra $200-$300 per year to make sure that they had safe water, but a lot of towns didn't even have that for a total (yearly) water bill."

"They (regulatory agencies) don't provide the money to help meet the regulations. That's the problem."

"If you're in non-compliance it is pretty easy to figure out what you have to do first, once you're in compliance then everyone has their own particular wish list."

"It is complicated and there really is no single answer. They have to have a new treatment plant to be able to pump better water, but before they can do that they may need better wells. To be able to do that they have to have more money, so they may need to consolidate or something like that, so they get all that done and they still have a bad distribution system, so they have to replace all that. There's no easy answer, *and the government's answer is to just do it*."

"You can, by state statute, assess fees to fire protection districts and fire departments to pay for fire hydrants. Well, with our fire department we'd have to lend them the money."

CONCLUSIONS AND OBSERVATIONS

There was conflicting evidence presented during the focus group as to whether or not managers are currently engaged in some form of benchmarking, and whether or not they see this as a useful technique for the long term management of their water systems.

It does appear that managers are using a large number of indicators to monitor the performance of their systems, as demonstrated by the "inventory" table. As would be expected in a group composed of system managers, more than two-thirds of these are focused on the physical aspects of water system performance. However, the small system problems and needs described by the participants virtually all require a direct financial commitment from the utility. So while monitoring finances may not be the first order of business for this group, they recognized the importance of having sound finances to meet system performance objective. Virtually all of the participants thought that their water rates were inadequate to meet the cost of needed system improvements, and found it difficult to motivate local rate-making bodies to develop rates that would meet these needs.

Although participants initially did not see themselves as using comparisons with neighboring systems – several examples of casual comparisons between systems did come up during the session. One of the most enthusiastic discussions occurred when one participant brought up a regional rate study that had been developed locally and circulated around the region. This survey offered a convenient opportunity for comparison, and this is exactly how it had been used by several of the managers who participated in the focus group. This suggests that water system managers would make use of benchmarking tools to assist in the management of their systems once they became available.

C-2: Focus Group #2 - State and Federal Regulatory Officials

SETTING

The second focus group was held during a regional meeting of state and federal drinking water officials. The focus group was held as the last session on the second day of a three day meeting. The meeting took place in a large conference room in the regional EPA office. The meeting began with a PowerPoint introduction of the benchmark study. This presentation provoked much discussion, and many of the comments reported in this summary were made during this introduction. The session lasted approximately one hour.

PARTICIPANTS

The focus group session appeared as an item on the meeting agenda, and all of the more than 20 meeting participants were invited to participate. Ten of the meeting participants stayed for the focus group session; two left before the session ended. Focus group participants included representatives from five states in the MTAC service region, and included state drinking water directors from three states. Several members from the regional office also participated, including the regional director and capacity development coordinator.

SUMMARY OF RESPONSES

The analysis of Focus Group #2 consists of a summary of the responses to the focus group questions, grouped by topical areas, a sampling of the direct comments of focus group participants, and a series of conclusions and observations.

The Small System Problem

Small *community* water systems *are not* the biggest problem for regulatory agencies. Based on the violations record, *non-community* systems are a much bigger problem.

Municipal water systems are much easier to regulate. They have an institutional structure that is accountable to both water customers regulators.

Many small systems, especially the worst, have *no good management options* for long-term financial sustainability. None of the commonly proposed solutions – restructuring, grants, training, etc. – are going to improve their situation. No one has come up with a way to address the problems of these systems.

Consolidation *does not* solve all problems (as sometimes suggested by federal agency documents). Restructuring is not the answer because other systems are only interested in buying/taking over *viable* water systems.

Small systems are looking at a big shock when the arsenic rule kicks in.

The role of "politics" in rate making is greatly understated. This is the number one reason that rates are inadequate.

There is *no financial planning* going on at small water systems and there is no clear incentive for municipalities to move toward better financial management.

Funding assistance to small systems has not worked. USDA provides funds to a water system and 20 years later they are back in the same situation.

Poor communities do not equal poorly managed water systems. Many systems in very poor areas are well managed and operating in the black.

Size does matter. Systems serving less than 500 people are much more likely to have problems. There are economies of scale and small systems are going to have a harder time paying for their water system.

Small communities always operate on a shoestring. All municipal funds end up in a general pool that gets used for the most pressing community needs. Funds are rarely ever set aside for capital improvements.

Many of the worst-off systems are still trying to get over the bad management of the past system administrations.

Methods for improving small water systems finances

The State of Mississippi is requiring training for water system board members. This may be one of the best ways to bring improved management to small systems.

The circuit rider model has been an excellent method of improving small systems operations, and could be extended to help with financial management.

There are many well-run small water systems that have a "litany of problem solving" techniques. These system should be identified and a series of case studies drawn up that can provide guidance.

The best way to improve small systems is to create a peer-to-peer program to send the good operators/managers to help the poorer operations.

Role of benchmarking in financial improvement

There was no clear indication given by participants that they were familiar with benchmarking or supported efforts to introduce benchmarking as a technique to improve small water system management.

The attitude that small systems can be persuaded to operate as a business was viewed as faulty. Many small systems lack the basic incentives and skills to operate like a business. Benchmarking will not help to change this situation.

Several stated that having benchmarks available might be helpful.

Funding assistance to small systems

There were many comments made about the role of funding assistance, especially grant programs, for small systems. These were seen a way to keep small systems afloat that did nothing to improve system management or address the root causes of system problems.

EXCERPTS FROM THE SESSION DIALOGUE

"Everything that gets done (in terms of regulation to community systems) is going to hit the others (the non-community systems) a log factor heavier."

"If you've got a municipal accountable structure in place, you can go in with your public meetings and public feedback. That affects those public officials. With all of your public meetings and public feedback the public will force compliance."

"Private companies won't buy the bad systems; they'll only buy the viable ones."

"I think that the biggest problem that you're going to have in getting these system to operate as a business is to adopt the proper attitude about how a utility operates as a business"

"We've dealt with these utilities for years; they operate on a crisis basis. They don't fix anything until they have a crisis; once they have a crisis they can find money. If there is no crisis, then there is no money available. The old Farmer's Home had originally funded these systems and now 20 years later they're funding them again.

"I can remember telling Farmers Home that they ought to insist that these systems put in meters. Twenty years later they have no one to test them, and so they're still flat rating their customers."

"The money goes into a general pool because the city has no other ways to finance city operations so the money goes to fund the crisis. If they need snow plowing, it goes to snowplowing; if they need a new garbage truck it goes to buy a garbage truck. So the money in a small system is never segregated to pay for capital improvements. They are always operating on a shoestring."

"I have the example of a city that had no money to build a new water tower. They had an old wooden water tower that burned down, and that's how they got the money to buy a new one."

"So when you're looking at infrastructure, it cost a city of 500 people the same that it costs a city of 100,000 to put up a new water tower; it costs a quarter of a million bucks. Where are they gonna get a quarter of a million bucks?"

"That's the problem getting these systems to act as a financial entity - its the fact that for the last 30 years you had people who bled the system dry."

"One thing about small systems, the well-run systems really stand out…If you have a strong personality with good sense in charge, you will have a well-run system."

"We (government agencies) are always dealing with the operators, we have never had anyone to talk to about financial matters."

CONCLUSIONS AND OBSERVATIONS

Because of their emphasis on compliance management regulatory agencies have much more experience in operational interactions with systems. They are only now beginning to pay attention to financial management because of the capacity development provisions of the 1996 SDWA Amendments. While participants thought that benchmarking might indeed be able to play a role in improving small water system management, none of the participants saw a pressing need for benchmarking at this time.

Comments made by the group suggest that they thought that other programs for improving water systems financial performance might be at least as successful as benchmarking.

C-3: Focus Group #3 - Technical Assistance Providers

SETTING

The third focus group was held during a regional in-service training of technical assistance personnel. The focus group was held after the last session on the second day of a three-day meeting. The meeting was held in a large meeting room of a community center. The project team described the Midwest Technology Assistance Center and the benchmark study during a lunch-time PowerPoint presentation on the day of the focus group meeting. The session lasted approximately one hour and 15 minutes.

PARTICIPANTS

The project team sent a letter describing the project and purpose of the focus group component to the in-service coordinators. They, in turn contacted staff members in their organization and arranged for their participation in the focus group. Nine staff members and an invited financial training consultant stayed to participate in the focus group session. The group included a representative from the national office, 3 state directors, the regional water and wastewater program coordinator, a regional director, and three field staff service providers.

SUMMARY OF RESPONSES

The analysis of Focus Group #3 consist of a review of the indicators and measures that were suggested by the participants, comments on the availability of data at small systems, and a review of some of the issues mentioned during the session and some of the comments made by participants.

Inventory of Indicators and Measures

Warning signs

- can't pay for water
- "significant non-compliers"
- number of operators - 3 licensed operators for very small system is too many
- general condition of facilities
- rust in the water
- condition of the water tower
- lack of population growth – stagnant population
- unmetered system
- only 4 hours of storage capacity in water tower

Measures that water systems use over time

- rates - as compared to neighboring systems
- regular revenues - cash flows
- 1.2 operating ratio
- user fees sufficient to cover entire expenses
- breakeven point – operating ratio equal to one
- amount in reserve fund
- current ratio
- years of experience of operator and board
- longevity of the operator or certification – NOT guaranteed as good measures; could have a very bad one for a long time - just because an operator is certified doesn't guarantee that they are good
- does the system have/use a budget
- frequency of rate increases – should be reviewed at least once every 3 years
- water loss
- age of water system
- water quality
- does the system have a wellhead protection program

Data availability

Most small system do not have records (balance sheets, budgets, etc.) unless Rural Development or another funding source requires them to file quarterly reports, or state agencies require reports or annual audits. Some states also require that funds collected for water systems be used only for water costs. Even if a system has a budget "on paper" they often don't really know what the numbers mean. Every system needs someone on the board who really understands the budget.

Problems of small water systems

Participants described many financial and other problems of small systems:

- Most systems don't have access to financial expertise.
- Many municipalities do not maintain separate books for their water systems. They do whatever they want to move funds around to meet the immediate needs of the community.
- Mobile home parks just want to take as much money as they can from their operations
- Service in unincorporated areas with poor water quality.
- Private water systems (especially MHPs) with low-income residents can't afford to maintain systems, and are not eligible for grants or loan funds.
- When the one guy who know how to run the system retires there is no one to take over.
- Communities themselves are in financial trouble, thus so are their water systems.
- Systems have water rates are inadequate to cover all costs.

EXCERPTS FROM THE SESSION DIALOGUE

“The types of systems that are referred to us are those that Rural Development looks at their quarterly report and finds that there are negative figures.”

“We look at their budget development. These are rudimentary; many times user fees are insufficient to cover the entire expense that is listed in the budget. We look at the USDA reports that they have done, because they're required to do that; we look at audits; these are required for the first two years. Our state PUC regulates water systems and requires (financial) reporting. Those documents all together give you a pretty good picture of the financial situation.”

“What we almost always find out is that there's a need to produce more income or reduce operating costs. We’re just trying to get them to a breakeven point - an operating ratio of one.”

"They don’t separate out any of the other costs of their business. They don't develop little cost or revenue centers around the different types of services that they provide … it’s all lumped into: ‘These are our revenues and these are our expenses’. And why would they want to? Most of them just keep records for taxes.”

"Many times I think that when the owner of the park is threatened with closure the idea of separating the utility structure from the mobile home park management is acceptable.”

"Each situation has its own little quirks or uniqueness’ to it, but what you also brought out - and I don't know how you measure this - is that local commitment and involvement that support the operation of a water system.”

“Rural development looked at it they said that they weren't going to invest in that old plant. But when you looked at that 50 year old plant, it was just beautiful; because they had an operator who took great pride in keeping it that way."

"In your work with communities can't you get a sense of what’s going to be successful or not by whether they send you stuff (reports, correspondence, etc.) or not? Whether they do what you ask them to do - or does that matter?"

“I don't think that they don't want to give it to you - they just don't know where it is - or they just don't understand what you're asking for.”

“I do think that the (benchmark) numbers are certainly valuable, but I was just also wondering if there are variables that are not easy to quantify, but they might be just as important. It just seems like these small systems are really dependent one person - it is just the nature of their size."

"It is hard to fire a bad operator."

"The small system may have an operator but does the operator have the resources that they need to run it properly."

"We found that many of the systems that are in financial trouble may not have done a rate review in a long time. I am finding some systems that have not raised their rates since 1978. If you've not raised your rates in 20 years you're digging yourself in a lot deeper … of course the longer that you let it go, the more adverse reaction that you get from citizens because you have to do a 300% rate increase."

"It is almost a matter of pride; (they think) the longer that they are able to hold out and not increase the rates the better they're doing, when in reality its the opposite."

"Usually there's the operator who manages the systems - and then the clerk or business manager does the books and pays the bills. I don't think that anybody's got the responsibility (to push for a rate increase)."

"First of all you want to look at the age of the system, and then the difference between water pumped and water billed. We had one where there was a 40% water loss. Well it turns out that the system was installed in 1892 – and modified a few times. The last time was in 1968. They really needed a new distribution system."

"Some of these small communities are facing rural sprawl. There are $200,000 or $300,000 homes being built right outside of town that could be hooked up, but that are going on wells. Their utilities have this attitude that: 'we're not going to expand our utilities to serve these damn people', when in fact if they looked at the cost-benefit ratio it would be real important to do it."

"A utility without growth is going to die. All your costs are fixed; 90% are fixed."

"I don't know how this information (benchmarks) would benefit us (tech assistance providers) unless we are involved in capacity development plans" and "we haven't been going in and assessing capacity."

"As the EPA, the fed and the states, push to look at more long-term viability assessments of these systems, if you don't have benchmarks or have a way to compare them, then I don't know (if) it can be done. I can see some benefit of doing an assessment on system X, and being able to compare it to some benchmarks."

Benchmarks won't be useful "unless there's some carrot-stick approach. Let's say grant money is contingent on an operating ratio 1.2." (I think) that's what they're trying to do with the (SRLF) drinking water money.

"The only thing that we have to compare now is user rates."

“Do you think that communities are going to look at other communities CCR reports?” ..“If they’re provided to them. The operators would, and the leaders of the communities would.”

"Let them not only compare - but think of it as an opportunity to fix the problem, (even if) that involves purchasing water from a neighbor instead of pumping bad water … if the CCR reports have been keeping good (records), the utilities can sit down and say: ‘your tests last year were great, why were ours so bad?’”.

“What I am seeing - at least in USDA funded communities - it seems like that there's somehow a magic number of users below which there aren't going to be an economy of numbers. I think that there have been some loans that were made to communities where the number of businesses was so small that they didn't merit this kind of a solution. So I think that there's a correlation there.”

“The fact that USDA loans can be amortized over 40 years can tend to throw a monkey-wrench into the scheme of things too. There are some communities that have to replace parts of their system in 20 years (while they are still paying for them). This can affect cash flow.”

“It is impractical to enforce anything (state capacity development plans) based on benchmarks.”

CONCLUSIONS AND OBSERVATIONS

Participants at this session were skeptical to the use of metric benchmarks and cited many obstacles to the implementation of this form of benchmarking, including: the unavailability of data, lack of familiarity by community leaders,

Members of this group have extensive experience in assisting small systems with the process of collecting local data to document community and water system conditions as a prerequisite to grant and loan programs. They expressed much support for the value of these programs as a training ground for the improved financial management of small systems.

This group also suggested that the traditional application of financial ratios may be an unnecessarily complicated approach to assessing small systems. Several simple observations of community conditions, management behavior, and physical assets may be all that is required. This is reflected in some of the “decision-tree” techniques recommended in this organization’s publications on financial management.

APPENDIX D:
COMMUNITY WATER SYSTEM SITE VISIT REPORT

INRODUCTION

Appendix D contains the documentation for the site visit component as well as a summary of the information that was volunteered by water system managers during telephone conversations to the research office during the survey component of the project.

Appendix D-1 contains a list of the issues that were discussed during the site visit component of the study. The comments of system managers were organized into two sets of themes: (1) those that were relevant to the study at hand, and (2) those issues that were not directly relevant to the current study. This is followed by a selection of the direct quotes made by focus group participants and recorded on a notepad during the visit.

During the implementation of the survey component, the research office received a very large number of telephone calls (more than 40) regarding the questionnaire, the project and the sponsor. The feedback from nearly 24 of the callers was written down during the conversations. As was done with the focus group component, these comments were summarized into themes and are reported the Appendix D-2, which serves as an Addendum to this appendix. Also included in the addendum are numerous quotations from small (and large) system managers that were collected during these phone conversations.

Finally, Appendix D-3 contains sample copies of three of the documents that were used during the site visit component. Exhibit 1 is the interview form used during meeting with system managers. Exhibit 2 is a confirmation letter that was sent to those individuals who agreed to participate in the site visit interviews. Finally, Exhibit 3 is a letter assuring the site visit participants of the confidentiality of their comments as required by the Southern Illinois University Human Subjects Committee.

D-1: SITE VISIT SUMMARIES

SUMMARY OF COMMENTS FROM THE SITE VISITS

The comments made by site visit participants were recorded and organized into themes. These have been grouped below into those that are directly related to the goals of the site visit component, and those themes on other topics related to the management of small water systems. This is followed by a representative sample of quotations made by participants.

Themes directly relating to the goals of the site visit component

Water system reports and records

Participants described many different types of financial reports that they routinely prepare. They also suggested numerous types of measures and techniques that they use to monitor their water systems.

Water system reports

- Annual budget
- Annual community audit
- Annual treasurers report
- Daily "municipal" deposits"
- Daily water production report
- Daily water quality testing report
- Monthly contracted services report
- Monthly delinquent accounts report
- Monthly financial report and funds balance
- Monthly ledger of accounts
- Monthly Mobile Home Park financial report (from accountant)
- Monthly summary of the amount of water billed vs. purchased
- Quarterly water budget
- Revenue Bond payment schedule
- Rural Development quarterly and annual reports and audit
- State loan reporting forms
- State regulatory agency reporting form (operations only)
- Vehicle operation cost report
- Year-to-date budget reports and balance sheet required for GMAC commercial mortgages

Monitoring measures

- # of customers
- Age of water lines
- Average charge
- Average cost per user
- Cash flow – "the most important"
- Cost of water testing
- Current consumption
- Income of the customers
- O&M costs
- Return on investment (private MHP)
- Size of reserve fund
- Total usage
- Well size and depth (as measures of quantity and quality)

Knowledge and interest in benchmarking

None of the participants were aware of benchmarking as a technique to improve the management of their water systems. Once described, several thought that it would be helpful for small water systems.

Water Rates

Rates are often the most visible sign of what is happening at a water system and rate-related issues were discussed during every visit.

- Most participants commented on the inadequacy of their water rates. Several purchased-water systems failed to even pass along price increases from their water providers, or sold water to wholesale customers than less than it cost them.
- System operators know that their rates are inadequate but are unable to convince rate-making bodies to increase rates.
- Rates are not linked to actual water system costs
- Politicians are anxious to keep rates low

Contract Operations

Most participants stated that their systems contract out some part of water system operations and management. All of the participating rural water districts (RWD) were completely managed by engineering/management firms, or contracted out all of their operations. One participant commented that most RWDs have no political constituency or experience in management, and are therefore a "natural" for remote management.

Although contracted services provide opportunities for systems to tap economies of scale and reduce costs, some participants related "nightmare" experiences of shoddy or incomplete work, and expensive lawsuits.

Several participants noted that the cost of contracted services varied greatly by provider, and that a comparative list of these costs might help managers determine when they should go shopping for other service providers.

Suggestions for sharing benchmark study findings with system managers
Participants suggested several venues for distributing the results of the Benchmark Investigation to the managers of community water systems, including:

- American Water Works Association publications
- State Rural Water Association "Fax-alert" system
- State Municipal Associations (focus on municipal officials, not just water officials)
- State Mayors Association
- "Preview Magazine"
- "Municipal Magazine"

It was also noted that licensed operators need to renew their licenses every two years and need to attend training sessions to keep up their license. Too few of these training sessions include any information about financial management.

Likely responses to water system survey
Many participants stated that they almost always throw mail surveys in the trash. Surveys having two pages or less, or that do not require a lot of work, are more likely to be completed.

It was noted that water systems, which are operated in conjunction with other services, would find it difficult to allocate the costs of buildings, vehicles, labor and equipment for a single service. It was also suggested that completion of the survey could require the participation of several individuals (i.e., operator, village clerk, accountant, board member). It was recommended that a message appear on the survey, requesting recipients to pass the survey on to the proper person(s).

Themes based on other issues discussed by participants

Small water system challenges
All of the participants spent some time describing past, present, or impending problems of their water systems. These comments are organized by category below. Several systems had problems in multiple categories.

Physical Problems

- a lot of illegal water lines
- confusion about size and location of pipes
- many valves buried under streets
- whole systems need to be shut down during any repair because valve system is inadequate or impossible to locate
- system does not have any way to tell when water tower is full – dump a lot of purchased water on the ground when tank overflows

Impact of previous management

- water system had been allowed to run down.
- the people who installed the system left no drawings – can't find valves
- need to locate and map water lines and valves – this information was not recorded by previous managers who kept it in their heads
- previous system administration did not keep ANY records

Water management boards

- village officials are not trained or competent to deal with water issues
- water boards and village boards may be an "obstacle" to effective management
- board members may have vested interest in low rates (own rental property)
- board would not approve increase in rates to keep pace with increases from provider (purchase water system)
- rates set by board for wholesale customer is less than it cost to buy water
- rates set by board for customers outside village are less than inside village

Legal problems and uncertainties and needs

- uncertain of water system standing on many legal matters (how state laws influence their ability to turn off customers, disputes with other providers over water lines and service territories, etc.)
- need help with finding and interpreting state ordinances, and preparing local ordinances.
- have spent lots of money suing contractors who have done inadequate work
- don't know why they have to be regulated – have only 10 units (MHP)

Water system needs

Participants discussed some of the technical, managerial, and financial needs of their water systems.

- need help to create maps of current water system configuration
- "Need outside technical help just to get help"
- one of the most needed tools for small system management is a set of "procurement procedures" to help small systems know how to buy items; how to write contracts with engineering firms and other contractors
- there should be more input from the public
- new "HAA MCL requirements are a problem – even if there were effective treatment protocols, couldn't get a loan soon enough to have new treatment train on-line soon enough to meet requirements
- need legal advice to deal with contractors
- need legal advice to deal with state laws and ordinances
- need way to isolate/find bad water meters
- need help buying, installing and using telemetry equipment
- would like to know how to deal with delinquent accounts
- want to find out if they need to adjust rates - when and how much to increase rates
- community needs training support for operator
- community can buy water from regional provider but needs help in deciding how and when to make this move – what are cost and benefits – need "objective" advice

Experiences in working with engineering firms

Several of the participants cited problems with the engineering firms that they work with.

- engineers won't listen to municipal officials
- feel that engineering firm is not responsive to the community's needs – TELL the community what it MUST do – do not ask what the community wants or needs – no spirit of negotiation – not treated like customers
- don't supervise their contractors, resulting in poor quality work and future problems
- engineering firm not able to get sub-contractors to complete work
- engineering firm won't finish project even though some of their money is being withheld.
- community will not want to apply for USDA grant because this would require involvement of an engineering firm – stated that firm would make project bigger than necessary so as to increase their profits – community would end up having to pay more
- always interested in finding other engineering firms – few in area
- never received "as built" drawings from engineering firm - system clerk has had to keep track of every customer on a 911 map – the engineering firm has called him to ask for locations
- engineering firm failed to provide meter locations for all customers
- engineering firm got people to sign up to have meters installed so that project would go forward – then people never connected to the meters – just have them sitting there so as to raise the value of their property – there is no way to force these people to connect now
- USDA should monitor engineering firm behavior and penalize engineering firms that do not complete contracts in a timely fashion or cause inordinate numbers of problems for small communities

Experiences with state agencies, technical assistance providers, and funding agencies

Many participants commented on their interactions with government agencies and technical assistance providers. The comments were universally positive with state Rural Water Association representative receiving considerable praise for their efforts to assist and support small community systems.

System management practices

Participants suggested many practices that they use of could be used to improve small water systems.

Cost reducing strategies

- Saved thousands of dollars a year from switching from state water lab to private lab.
- Saved $16,000 on a single project by using the office fax machine to solicit of dollars annually by using a fax machine
- New computer software has helped the system to better isolate costs and problems with system (such as unaccounted for water, and inadequate billing of wholesale customers)

Methods of full-cost pricing identified by participants

- Rates that include fire district differential
- Rates that include an out-of-town differential
- Multiple-CDs used to collect interest on water system reserves – different maturity dates facilitate liquidity of funds
- Proactively increasing water rates to pay for impending repairs to water tower
- RWD water rates are more costly than town – reflects higher distribution costs
- Need to raise annual dues (homeowner's association) to prepare for water line replacement
- Have accumulated savings to replace water lines which are now 30 years old
- As the system was being planned the useful life of each component was estimated, amortized, and the replacement cost built into the fee structure (homeowners association)

Quotes from Water System Managers

Small communities and water systems

"The operation of the water systems is different from other municipal utilities. People are accustomed to inexpensive water. Also, the water system is the only service that is completely in the control of the village, so there is no entity outside of the community to blame for increases in rates (as in the case of natural gas). … The community has many important issues that it has to regularly deal with, and of these, the water system is probably one of the least critical. As long as the system is working, it is difficult to pay very much attention to it."

"The two biggest problems for small water districts are: (1)to find a secretary who will do things right and not quit, and (2) how to get systems to raise rates; especially those with low cash flows."

"The water system brings in more than 3 times more money than the Village gets from all other sources. The Village Board cannot understand why this money should not be used for other community needs."

"The water board is appointed by the county board. They are very ignorant about financial management and will not even review the monthly financial reports."

Inherited problems

"When I took over the financial management of the water system, I found that we were paying insurance for equipment that was gone."

"The system had been previously operated without meters, with flat rate charges that didn't even pay the bill for the water we purchased. The community had to come up with money from the general fund every month to pay the water bill, and the system was $65,000 in debt. Revenues have increase by 50% since metering, but we (mayor and system manager) have had to spend a considerable amount of time 'educating' the customers and the Village Board. Enforcement of billing has made customers much more responsible for their water use and pay bills on time."

"We were able to recover $12,000 in back charges through better management. We are still making up for past mistakes. We have no reserve fund right now, but are working to develop one."

Technical assistance

"The money that we spend for our rural water association membership is the best money we spend."

"Need outside technical help just to get help"

D-2: ADDENDUM: Telephone Comments

PURPOSE

Representatives of more than 40 water systems contacted the project team after receiving the "reminder" postcard that was mailed one week after the initial survey questionnaire. There were several different reason for the calls: to report that they had not received a survey; to report that they were regional water systems without retail customers; to ask questions about the survey or the project; to refuse to take part in the project.

All callers were reminded of the purpose of the project and encouraged to comment spontaneously on the financial and operational management of their water systems. They were informed that any comments that they made would be included in the final report, and not directly attributed to them or their water system. These comments were recorded in the telephone log. The comments from 24 water systems were substantial enough to be included in this section of the report.

The people who provided comments during telephone discussion included: water superintendents, regional water managers, mayors, operators, board members, engineers, mobile home park owners and managers. The type of water systems that are managed by the participants included:

Regional Providers – 4
Municipal – 7
Not-for-Profit Organizations– 4
Home-Owners Association – 5
Mobile Home Park – 3
Apartment Complexes - 1

These have been organized into themes and appear below. These are followed by a sample of quotations that were noted during the telephone discussions.

Summary of comments from site visits and telephone contacts

Monitoring measures and benchmarks

Benchmarks

- System has no debt
- Water towers inspection every three years
- Monthly water bill is 10% of gross revenue (private MHP)
- Time to replace water lines – 30 years old
- High quality water source

Monitoring Measures

- # of customers
- # of employees
- Age of water lines
- Monthly consumer cost
- Annual charge for services (homeowner association)
- Average cost per user
- Cash flow – "the most important"
- Cheapest lot rent in the state
- Cost of water testing
- Cost of contract operator
- Current consumption
- Debt service ratio – "is critical"
- Income of the customers
- Leak detection by watching for "green areas"
- Leak detection by watching master meters and electric consumption
- O&M costs
- Production cost ($/gal)
- Service area size (sq. mi.)
- Size of reserve fund ($)
- Total usage
- Well size and depth (as measures of quantity and quality)

Small water system challenges

All of the participants spent some time describing the past, present, or impending problems of their water systems. These comments are organized by category below. It is important to note that some systems had problems in multiple categories.

Physical Problems

- a lot of illegal water lines
- confusion about size and location of pipes
- many valves buried under streets
- whole systems need to be shut down during any repair because valve system is inadequate or impossible to locate
- well is only 120 ft. deep
- hard, rusty water
- system needs to be prepared for huge peaks in use because of weekend use at second homes and heavy vacation traffic
- problems with other municipal components (sewer system) may rob revenues from water systems

Impact of previous management

- water system had been allowed to run down.
- the people who installed the system left no drawings – can't find valves
- need to locate and map water lines and valves – this information was not recorded by previous managers who kept it in their heads

- no one had done anything for about 15 years - it took 4 years to get the system back into shape
- previous system administration did not keep ANY records
- system had 5 chief operators in a single year
- people who ran the system before took good care of it - - left plenty of money in the reserves

Legal problems and uncertainties and needs

- don't know why they have to be regulated – have only 10 units (MHP)
- home-owner association water rates in one state are controlled by Public Service Commission – the system needs to have capital expenditures to raise rates

Socioeconomic characteristics of service area

- people are poor, median household income ($17,000)
- mostly old retired and disabled people on fixed incomes
- village can't even afford to develop park on donated land
- we're not a professional water system
- 130 homes but only about 30 year-round residences
- the guy who works for the association keeps having trouble passing the operator exam, but he knows more about the system than anyone
- difficult to manage park since husband has died
- everyone in town is old - no one to run the system – no one has been keeping records

Experiences with state agencies, technical assistance providers, and funding agencies

Many comments were made by managers about their interaction with technical assistance groups, state regulatory agencies, and financial assistance programs.

State regulatory officials

- state water officials are great – always respond to inquiries
- state regulatory staff not too bad – just doing their job
- have had very good experience with the state regulatory agency people – are always very helpful – quick to respond to water quality problems with assistance
- state regulatory agency causes
- fined water system $280 for submitting late samples, even though it was the state lab that delayed the samples so long as to miss deadline

State role in water testing

- Private MHPs do not pay for water testing; state sends them test bottles to fill up and return. Once a year the state comes out to each system and conducts a separate test themselves.
- State agency provide bottles that we just send in to the regional office; if the water is OK we don't hear from them for a few weeks; if there are problems they let us know the next day
- Need to buy "jugs" from the state. These are tested by a nearby (large) water system. All of the bottles for monthly water monitoring cost about $15/year.

Financial Assistance

- Right now the state does not provide funds for small systems
- State Revolving Loan Fund is too difficult to use – "Would like to use 2.8% drinking water SRLF but we are instead using 5% money from local banks because there is too much paper work for the SLRF."
- "Rural Development really the ones that help small systems manage their finances."

Experiences with restructuring

Many of the participants described experiences with some type of restructuring, most often switching to purchased water systems, or participation in some other form of regional water management. These comments are noteworthy because of the emphasis that has been given to restructuring as method of overcoming some of the inherent diseconomies of small water system operations. Many participants saw switching from own-source to purchased-water as a good strategy. By maintaining control of distribution systems they remain eligible for low-interest loans, and do not surrender any of the land use controls that are often a stated objection of small communities to regional strategies. A few participants expressed objections to certain types of regional providers.

Purchasing water from regional provider

- The cost to produce water from old surface water supply, with a plant that won't be able to meet future regulations, is \$3-\$4/1,000 gallons. Can buy treated water from a regional supplier for \$3/1,000 gallon
- Much easier for a small town to maintain a purchase water system
- It is too expensive for small communities to operate their own (treatment) systems - regional providers are able to afford most advanced systems
- Very happy with purchased water from a private for-profit utility – do expect rate increases – wish that other nearby systems would also hook-up as a way to reduce cost for all
- For larger systems operating their own supply is better; smaller may not be able to carry the debt burden.
- No chance to hook up to a regional system – and no interest in doing so.

Regional water management

- Regional system does everything but own the systems – billing, repairs, monitoring. Because systems maintain their independence, they can still apply for grants/loans to improve distribution system. This is often been the cheapest alternative for communities that would have spent a fortune replacing worn-out facilities, and allows small systems to take advantage of economies of scale. Region encourages systems to build a reserve fund to cover the cost of replacing future (distribution) infrastructure.
- Were contacted by private utility – wanted to manage system – would have cost consumers about an additional \$9/month
- Two regional water systems in the area – bitter opposition to becoming a part of the regional cooperative system. Water from the co-op system is so expensive that it is cheaper to upgrade existing plant, so no one is supportive. However, very positive

response to proposals to join regional system run by county, which will allow them to keep existing facilities.

- Regional system can afford to hire its own controller, accountants and auditors
- Community systems have not opposed joining the regional supply. Region has plenty of water available and local communities can maintain control of their expansion and ability to annex additional territories. No fear of lack of supply. Regional water is considerably cheaper than what communities could produce on their own; have ten-year contracts that are always renegotiable. Region can require systems to improve infrastructure before providing service (i.e., would not supply one town until they replaced their water tower)
- In spite of being a large regional water provider, still operate simple budgets (in a spreadsheet) – these could serve as a model for small community water systems
- Regional system has just doubled their capacity – still high growth rate in the region
- Private water provider would be willing to buy community water system
- Regional system does manage some financial activities of some small systems

Satellite management

- Satellite management program was not contentious because it remotely managed systems are mostly of old private water systems that nearby municipal utilities refused to take over.
- Satellite system has taken over many small private systems and trailer parks
- Regional satellite water system has struggled with regulations; have to go through the same amount of work for 50 customers or 50,000; CCRs are a nightmare. Satellite management has some built-in inefficiencies, must serve a 500 square mile county.

System management practices

Participants suggested many practices that they use to improve management of their systems.

Financial

- The mayor, a businessman, stated that the town and water systems need to be run like a business
- Must target efforts at preventative maintenance and system upgrades
- Water system should function on a pay-as-you-go plan and be kept debt-free
- Water systems should be bonded in order to access financing
- Much easier for a small town to maintain a "purchased-water" system
- Women are better water managers - - keep records on everything
- All money not spent goes into savings – have a variety of maturity dates on CDs so that money is available if needed
- Multiple-CDs used to collect interest on water system reserves – different maturity dates facilitate liquidity of funds

Technical

- Keep a close watch on electric bill; an unusually high bill was used to identify a leaky uptake pipe in the well.
- Have arranged access to redundant water supplies to use in emergencies

Management

- System will soon need a licensed operator will and probably need to pay about $500/month. Current unlicensed operator paid $200/month.
- Mobile Home Park is owned by a national firm with more than 100 other parks. The management is centralized and facilities kept in excellent shape.

Methods of full-cost pricing identified by participants

- Rates that include fire district differential
- Rates that include an out-of-town differential
- Proactively increasing water rates to pay for impending repairs to water tower
- RWD water rates are more costly than town – reflects higher distribution costs
- Need to raise annual dues (homeowner's association) to prepare for water line replacement
- Have accumulated savings to replace water lines which are now 30 years old
- As the system was being planned the useful life of each component was estimated, amortized, and the replacement cost built into the fee structure (homeowners association)

Not-for-profit systems

Comments from not-for-profits that operate water systems:

- only keep the minimum documents to satisfy state reporting requirements
- traditionally operated under a program of fixing/paying for things as they break – there is some "new thinking" that they should plan ahead – start saving money for future problems

Home Owner Association Systems

Participation in home owner association meetings varies greatly, and is likely to be one of the key components in effective management of the systems in these communities. One HOA commented that they sponsor and annual picnic to keep residents interested and involved in decision making. Another, can't even get enough residents together to elect new board members, but refuse to incorporate into a nearby community that is willing to take over services to the community.

Quotes from Water System Managers

System performance measures

"We primarily keep track of our debt service ratio – a private company would cringe at the amount of debt that we carry (regional water provider)"

"I don't look at the gallons (that the mobile home park is using) unless they are running out on the ground."

"Our water is so pure that is unbelievable"

Inherited problems

"It took about 4 years after I took over the system to get the water system into shape. No one had done anything for about 15 years. We have just completed major renovations to the system and everything now is in good shape. There have been no violations in the last 2 years. Even though I got the water operator of the year award from the State Rural Water Association, I am not well-liked in the community because I spent so much money on the water system, and this resulted in significantly higher water rates."

"We had a water break this year and no body had a map of the system. It was very expensive and difficult to repair because no one knew where the pipes were or even what size they were. We tore up much more street than necessary, and then didn't even have the right pipes available for repair at 2 AM. The system is older, it has no valves so we cannot shut down parts of systems for repair."

Regional systems – purchased water systems

"Probably an issue of size, where bigger having you own supply is probably better; but smaller may not be able to carry the debt burden to develop new sources."

"It is so much easier to operate our system since we switched to buying treated water. I breathe a sigh of relief every time I think about how we didn't have to upgrade our treatment facility."

Regional providers are "Mad at small systems because we don't pay a lot of money for water. The nearby town would love to have us hook up to their water system and pay a lot of money to buy their water."

Problems with regulation

"The CCR confuses people; it has frightened some older people."

"I don't know who makes these rules – they probably have never been out in the country to see what these systems are like."

"I really think the CCR reporting 'sucks'. I went to school one whole day to learn how to do it. The guy who runs the nearby system had to do the report 4 times before he got it right. People do not understand the report."

Can't understand why the restaurant across the street – that can serve 500 people at a single banquet doesn't need to face the same testing requirements as her little apartment complex – there is a potential for much greater harm from this "non-community system"

Technical assistance
"The state drinking water staff and our state rural water association have both been extremely helpful to our water system."

The *Midwest Assistance Program* is highlighted as being very helpful, particularly through its excellent regional workshop: "If we had any trouble that's who I would call first."

Final Word
"If you're going to supply safe water it costs money."

APPENDIX D-3:
Site visit documents

Exhibit 1. - Site Visit Interview Questions

Introductory
Thank you for taking the time to talk to me
Introductions - Explain confidentiality statement
Main goal: find out what type of information that you have available and how you use it,
Do you have any questions for us before we begin?

Background Info

Please describe your water systems for us.(WHAT TERMS ARE USED TO DESCRIBE?)

Probe:
- size – pop/connections/gpd/number of employees/miles of line
- source
- ownership type
- management system – whose in charge – how are decisions made
- age – of various components
- outside consultants/contractors/etc

Who is responsible for the financial decisions made about your system? How are financial decisions made.

Are the finances of the water system managed separately from those of the sewer system? From the village budget? Is there occasional or frequent transfers of funds between any municipal operations (cross-subsidies)?

Reporting / Availability of records and information

Are you required to prepare any financial or operation reports:
- for external agencies and government units?
- Banks/lending agencies?

Do you prepare any regular operational or financial reporting documents for your own use? For use in discussions with the Village Board?
(CAN WE SEE THESE? GET COPIES)

Who do you call when you need help on financial or technical issues related to the operation of your system?

Benchmarking Practices

What are some of the measures or indicators that you pay attention to in order to assess how well things are going with the operation and management of the system? (For example, line loss, delinquent billing accounts, etc. How do you know when it is time for a rate increase?)

Do you keep track or record any of these measures? Compare them over time?

Do you, or the members of the Village Board, compare the operation and management of your water system to those in other communities?

What are the measures that are used in these comparisons?

Which systems do you compare yours to? Why?

Would you use a set of comparative data if it were available to you?
(SHOW EXAMPLES – Cromwell/C'dale price study)

Have you ever used any form of "self-assessment tool" that was provided by the IEPA, RCAP, IRWA, or any other organization? (SHOW EXAMPLES)

What are some of the changes that you expect your system to have to deal with in the next few years? (WHAT ARE THE SIGNS? INDICATORS OF CHANGE?)

What are some of the ways that you plan for future changes for your system
Do you have a capital development plan or other planning document?

Survey Response

Would you be willing to participate in a mail survey that asked for information about your water system?

What would be some of the reasons that would encourage or discourage your participation in a mail survey?

- length of survey
- time required to fill out
- purpose of the survey
- other

Would you be willing to mail copies of financial documents in response to a survey request?

Connectivity – Information Dissemination

Does your utility belong to the state or national RWA? AWWA? Do you receive journals or magazines from any water related organization?

How did you find out about the services of the Rural Community Assistance Program?

Have you worked with Rural Development on loan packages?

Do you have an internet connection?
Do you use email as part of your operation
Do you visit the web sites of regulatory agencies or tech assistance providers

What would be the best way for us to make sure that you were able to see the results of this research project?

Exhibit 2. - Letter of Introduction for site visits

Mayor XXXX
City Hall
XXXX IL.

Month XX, 2000

Dear Mayor XXXXX:

Thank you for taking the time to talk with me on the phone and agreeing to meet with us on Friday.

The purpose of the research project sponsored by the *Midwest Technology Assistance Center*, to develop a set of "benchmark measures" that water system managers and decision-makers can use to assess the current status of their systems, and the ability of their system to cope with changing demographics and regulations. I have enclosed a short article from the Fall '99 issue of *Water Sense* that describes two financial ratios that are commonly used by the financial community to assess water system performance. I have also enclosed a page from a manual developed by the State of Pennsylvania to assist the small water system in that state. This page presents the percentile range of values of various indicators, collected from a large sample of municipal water systems in the state, and includes "Warning Flags", or the values that indicate when a system is in serious trouble. Both of these are examples of the type of measures that we have been asked to develop in this research project.

The purpose of our visit to XXXX will be to meet with you and XXXXX (system operator) and discuss the kinds of operating and financial information that you routinely collect and have available. This will help us to understand the pool of information that can potentially be requested from system managers with a mail survey and be used in the development of benchmark indicators. It would be helpful to us if you could bring along copies of any of the financial statements, or other types of reports that you and the Village Board use during your discussions about the community's water system. We would also like to learn about any of the indicators that you use in the management of the XXXX system, and would be interested in any comments that you might want to share regarding the management of small community water systems. I do not anticipate that our discussions will take about one hour.

I have enclosed a fact sheet about our sponsor, the *Midwest Technology Assistance Center*, to give you some idea of the kind of activities that they have initiated. I have also enclosed a copy of a one-page statement that we are required to provide to all research participants by the Southern Illinois University Human Subjects Committee.

I will give you a call on Thursday morning to confirm our visit. We look forward to meeting you and learning more about the community of XXXX and its water system.

Thanks again.

Sincerely,

Tom Bik
618-453-1118
tombik@siu.edu

Exhibit 3. - Human Subjects Responsibilities Acknowledgement

Benchmark Investigation of Small Public Water Systems Economics
Midwest Technology Assistance Center
Southern Illinois University Carbondale

The site visit to your community is a part of the *Benchmark Investigation of Small Public Water Systems*, a research project sponsored by the Midwest Technology Assistance Center (MTAC), and conducted by researchers from the Geography Department and Agribusiness Economics Department of Southern Illinois University Carbondale.

The information collected during this site visit will help us to understand the kinds of financial and operating data that are routinely collected by the managers of small community water systems. We will use this knowledge to assist us in the development of a mail survey that will be sent to about 1,000 small community water systems in 10 Midwestern states. The results of this survey will be summarized and analyzed in order to develop a set of measures that can be used by water system managers to assess the performance of their water systems. A summary of the results of this research project will be published in *Water Sense*, a free publication distributed by the National Drinking Water Clearinghouse, and on the MTAC web site (*www.mtac.uiuc.edu*).

Information collected during this site visit will be presented in our research reports only in a summary format, and the names of the participants and their water systems will not be used or released in any form. There is no penalty for failure to participate in this site visit and you may terminate the site visit at any time. Termination of the site visit will have no effect on your relationship, or the relationship of your water system, with the Midwest Technology Assistance Center, or any other agency or organization.

This project has been reviewed and approved by the Southern Illinois University Human Subjects Committee. Questions concerning your rights as a participant in this research may be addressed to the Committee Chairperson, Office of Research and Development Administration, Southern Illinois University, Carbondale, IL 62901-4709; Phone: (618) 453-4533. Although no confidential information will be requested during this site visit, all the information that is collected will be carefully handled to ensure that the confidentiality of all participants is maintained.

If you have questions or comments regarding this research project at any time, you can contact Tom Bik at:

Benchmark Investigation of Small Public Water System Economics
Faner Hall 4427
Carbondale, IL 62901-4514
phone: 618-453-1118
fax: 618-453-2671
smallsys@siu.edu

Sponsored by the Midwest Technology Assistance Center
http://mtac.sws.uiuc.edu
Conducted by Southern Illinois University Carbondale
Department of Agribusiness Economics and Department of Geography

Thank you for your invaluable assistance in this investigation.

Roger Beck
Tom Bik
Ben Dziegielewski

APPENDIX E.
SUMMARY OF SURVEY RESPONSES

Part 1. Management Needs and Practices

Q-1 Which of the following decisions are you likely to make in the next 5 years? Please check all that apply. Then, rank the choices that you made *(1, 2, 3, etc…. with 1 being the most important)*.

- ❒ ____ INCREASE WATER RATES
- ❒ ____ CHANGE RATE STRUCTURE
- ❒ ____ EXPAND WATER SERVICE S TO NEW AREAS
- ❒ ____ INSTALL NEW TREATMENT TECHNOLOGIES
- ❒ ____ CONSTRUCT NEW WATER SOURCES (WELLS OR RESERVOIR)
- ❒ ____ LOCATE SOURCES OF FUNDING ASSISTANCE
- ❒ ____ SWITCH FROM SELF-SUPPLIED TO PURCHASED WATER
- ❒ ____ SELL WHOLESALE WATER TO OTHER WATER SYSTEMS
- ❒ ____ ACQUIRE ANOTHER WATER SYSTEM
- ❒ ____ TRANSFER OWNERSHIP OF THE SYSTEM TO ANOTHER PROVIDER
- ❒ ____ OTHER *(please specify)* ____________________
- ❒ ____ OTHER *(please specify)* ____________________
- ❒ ____ OTHER *(please specify)* ____________________

Response Rate	N	%
No answer	15	4
Responded to one or more categories	335	96
Total surveys returned	350	

Impending decisions	N	%	Ranked as #1	Ranked as #2	Ranked as #3 +
Increase rates	221	66	155	34	42
Expand services	129	39	32	30	27
Locate funding	123	37	30	25	34
Install new tech.	86	26	19	15	25
Change rate structure	85	26	10	24	22
Construct sources	79	24	22	17	16
Switch to purchased	32	10	11	4	11
Sell wholesale	29	9	2	4	14
Transfer ownership	18	5	6	3	6
Acquire system	14	4	1	1	7
Other	41	12			

Forty-one respondents wrote in one or more other types of impending decisions at their water systems. A representative sample of these comments appears below.

- No changes planned at present
- Install meters; install new type of meter
- Replace existing mains; increase main size
- Acquire grant money
- Build newer tower; re-coat elevated storage; repaint vs. replace water tower
- Upgrade existing systems
- Interconnect with city's system; obtain water from regional system
- Explore second source
- Hopefully a municipal system will be made available.

Q-2 Do you prepare any of the following financial summaries or reports for your water supply system?

- ❒ INCOME STATEMENT
- ❒ ANNUAL BUDGET
- ❒ ANNUAL FINANCIAL AUDIT
- ❒ REPORTS TO LENDING AGENCIES
- ❒ USER CHARGE ANALYSIS
- ❒ BALANCE SHEET
- ❒ YEAR-TO-DATE WORKSHEETS
- ❒ MONTHLY FINANCIAL REPORT
- ❒ CAPITAL IMPROVEMENT PLAN
- ❒ TMF CAPACITY ANALYSIS
- ❒ OTHER *(specify)* ____________________
- ❒ OTHER *(specify)* ____________________
- ❒ DO NOT PREPARE **SEPARATE REPORTS** FOR WATER SYSTEM
- ❒ DO NOT PREPARE **ANY** REGULAR REPORTS FOR WATER SYSTEM

Response Rate	N	%
No answer	8	2
Responded to one or more categories	342	98
Total surveys returned	350	

Reporting	N	%
At least one or more reports	285	83
No reports for water system	57	17
No separate reports	35	
No regular reports	38	
Both	19	

Type of financial reports	N	%
Annual budget	187	55
Monthly financial report	142	41
Income	124	36
Annual financial audit	98	29
Balance sheet	93	27
Capital improvement plan	55	16
Reports to lending agencies	47	14
User charge analysis	38	11
TMF capacity analysis	11	3
Year to date worksheets	90	26

Twenty-nine respondents wrote in one or more other types of other financial reports.

- System prepares monthly board reports
- Federal and state regulatory monitoring requirements
- Accountants make out PSC report
- Auditor prepares quarterlys, year end audit
- Quarterly and annual financial reports
- CCRs
- Monthly and annual water usage reports
- Review CD printouts

Q-3 Do you use any "rules of thumb", "financial ratios", or other indicators to monitor the financial performance of your water system?

❒ NO

❒ YES, PLEASE DESCRIBE THE INDICATORS THAT YOU USE, AND/OR CHECK THE BOXES OF THE FINANCIAL INDICATORS DESCRIBED BELOW

5) ____________________

2) ____________________

3) ____________________

4) ____________________

5) ____________________

❒ NET REVENUES = Total Revenues minus Total Expenses

❒ OPERATING RATIO = Total Annual Operating Revenues divided by Annual Expenses (excluding depreciation, interest, or other debt service)

❒ DEBT SERVICE COVERAGE RATIO = Annual Gross Revenue minus Operating and Maintenance Expenses divided by Annual Principal and Interest Charges

Response Rate	N	%
No answer	11	3
Responded to one or more categories	339	97
Total surveys returned	350	

Indicator Usage	N	%
Do not use indicators	214	63
Use Indicators	121	37
Use "standard" indicators		
Net revenues	98	81
Operating ratio	29	24
Debt service coverage ratio	20	17

Eighteen respondents wrote in one or more financial indicators that they use in managing their systems:

- Water system audited annually
- Water audits
- Watch electric use
- Maintain $100,000 balance
- Rates set by state to cover cost of new improvements
- Income vs. expenditures
- PSC report yearly
- Previous years usage and billing
- O & M & depreciation vs. sales & interest earnings
- Monthly budget analysis
- Financial report each month
- Operating expenses divided by gallons sold
- Analyze past and present performance to project the next year budget
- Actual expenses vs. budget
- Repair cost averages
- Financial ratios
- Testing costs
- O&M / hours / cost year to year vs. annual inflation

Q-4 Do you have any informal cooperative arrangements with other water providers?

- ❒ NO
- ❒ YES, PLEASE CHECK THE TYPE OF INFORMAL COOPERATION
  - ❒ SHARE EQUIPMENT
  - ❒ SHARE PERSONNEL
  - ❒ EMERGENCY INTERCONNECTIONS
  - ❒ BULK PURCHASES OF SUPPLIES, CHEMICALS, ETC.
  - ❒ OTHER *(please specify)* ____________________________

Response Rate	N	%
No answer	9	3
Responded to one or more categories	341	97
Total surveys returned	350	

Cooperative arrangements	N	%
Have cooperative arrangements	73	28
Share equipment	30	41
Share personnel	23	32
Emergency interconnections	26	36
Bulk purchases	10	14

The other choices written in by respondents included:

- Purchase water
- Wholesale supplier to supply water to customers inside city limits
- Contingency planning
- Two cities and three townships own a water plant together.

- Working on a emergency interconnection
- Water supplied by a rural water cooperative
- Contract out O&M
- Share materials
- Purchase water
- The city provides the water, the village takes care of water lines and purchase meters from town.

Q-5 Have you ever received any advice or assistance regarding the financial management of your water system?

❒ NO
❒ YES, PLEASE LIST THE PROFESSIONALS OR ORGANIZATION WHO PROVDED THE ASSISTANCE

4) ______________________________

2) ______________________________

3) ______________________________

4) ______________________________

Response Rate	N	%
No answer	11	3
Responded to one or more categories	339	97
Total surveys returned	350	

Assistance	N	%
Received advice or assistance	98	30
Did not received advice or assistance	240	71

Type of assistance provider:	N	%
Professional consultants	62	45
Rural water associations	19	14
State agency	16	12
Rural development/FMHA	15	11
Local government	12	9
Rural community assistance program	2	1
Banks	3	2
Other	8	6

Ninety-five respondents wrote in one or more types (maximum of three choices) of financial advis ors that have provided them with assistance in managing their water systems. These have been summarized into the categories listed in the table above. The “Professional consultant” category includes professional auditors, accountants, attorneys, and engineering firms; “Local government” includes local and regional planning agencies, sanitary commissions, or municipalities; “State” includes state regulatory agencies and public utility commissions; “Rural water associations” and “Rural Community Assistance Program” include mentions of any of these organizations; “Banks” includes listing of a particular bank.

Write-in responses that were unique or mentioned too infrequently to categorize were placed in the “other” category and included:

- League of Minnesota Cities
- Informal advice and/or assistance from accounting professionals within our private development
- Financial advisors

- Community development block grant program
- League of Nebraska municipalities
- Lending agencies
- Small water systems
- EPA

Part 2. Water System Characteristics

Q-6 What year did your water system first begin operation?

WATER SYSTEM BEGAN OPERATIONS IN 19 ______ ______

Response Rate	N	%
No answer	58	17
Responded to question	292	83
Total surveys returned	350	

Year of operation began	N	%
Pre 1900	9	3.1
1900-1925	34	11.6
1926-1950	57	19.5
1951-1975	128	43.8
1975-1985	31	10.6
1985-1995	24	8.2
1999+	8	2.7
"Unknown"	1	0.3

Q-7 Which of the following best describes the type of ownership of your water system?

- ❒ PUBLIC – CITY OR VILLAGE
- ❒ OTHER PUBLIC *(please specify)* ____
- ❒ PRIVATE – INVESTOR OWNED
- ❒ PRIVATE – HOMEOWNERS ASSOCIATION
- ❒ PRIVATE – MOBILE HOME PARK
- ❒ OTHER PRIVATE *(please specify)* ____

Response Rate	N	%
No answer	6	2
Responded to one or more categories	344	98
Total surveys returned	350	

Ownership type	N	%
Public	193	55
Other public	43	12
Private – investor owned	15	4
Private – homeowners association	36	10
Private – mobile home park	28	8
Other private	24	7

Forty-three respondents chose other public, which included:

- Townships
- Water authorities
- Public water supply districts
- Rural water districts
- County/county nursing homes
- Co-ops
- Water and sanitary districts
- Public – not-for-profit
- Municipal districts
- Correctional facilities

Twenty-four respondents chose other private, which included:

- Private – not-for-profit
- Apartment complexes
- Mobile home parks
- Co-ops
- Campgrounds
- Retirement homes

Q-8 What water source(s) are used by your system?

❒ GROUNDWATER ONLY

❒ SURFACE WATER ONLY

❒ PURCHASED TREATED WATER ONLY

❒ PURCHASED RAW WATER ONLY

❒ MULTIPLE SOURCES *(estimate % from each source below)*

% GROUNDWATER ________ % SURFACE WATER ________ % PURCHASED ________

Response Rate	N	%
No answer	5	2
Responded to one or more categories	345	98
Total surveys returned	350	

Type of water sources(s)	N	%
Groundwater only	197	57
Surface water only	56	16
Purchased treated water only	80	23
Purchased raw water only	1	0.2
Multiple sources	14	4

Q-9 What is the estimated number of people who are served by your water system?

PERSONS SERVED ___________________________________

Response Rate	N	%
No answer	20	6
Responded to question	330	94
Total surveys returned	350	

Distribution of System Service Population			
Population range	Frequency	Cumulative % All respondents	Cumulative % <3,301 (%)
0-200	99	30	32
201-500	64	50	53
501-1,000	69	71	76
1,001-3,300	74	93	100
3,301-5,000	15	98	
5,001-10,000	2	99	
>10,000	5	100	

Summary statistics	N	Min	Max	Mean	Sd
Systems <3,301	306	20	3,300	734	764
All Respondents	328	20	30,000	1,275	3,075

Q-10 What was the annual average daily number of gallons going into your water delivery system, including wholesale deliveries?

AVERAGE GALLONS / DAY ____

Response Rate	N	%
No answer	76	22
Responded to question	274	78
Total surveys returned	350	

Average daily pumpage	All respondents	Systems < 3,301
N	272	243
Mean	167,062	114,710
Standard deviation	323,731	178,445
Minimum	1,027	1,027
Maximum	2,700,000	1,600,000

Frequency distribution and cumulative percent (%)				
Daily pumpage	All respondents (N=272)		System < 3,301 (N=243)	
Average Gallons/Day	*N*	*Cumulative (%)*	*N*	*Cumulative %*
25,000 or less	75	28	74	30
25,001-50,000	42	43	38	46
50,001-100,000	52	62	50	67
100,001-500,000	86	94	74	97
500,001-1mgd	10	97	5	99
1mgd-2mgd	5	99	2	100
> 2mgd	2	100		

Q-11 What was the largest number of gallons per day (maximum day) that went into your water system during the last 12-month period for which you have records?

PEAK GALLONS / DAY ____

Response Rate	N	%
No answer	103	29
Responded to question	247	71
Total surveys returned	350	

Summary statistics		
Max day	**All respondent**	**Systems less than 3,301**
N	245	217
Mean	309,194	203,822
SD	587,140	267,245
Minimum	1,900	1,900
Maximum	5,300,000	2,010,000

Distribution and cumulative percent (%)				
Max day	**All respondents (N=245)**		**Systems less than 3,301 (N=217)**	
Peak gallons/day	***N***	*Cumulative %*	*N*	*Cumulative(%*
25,000 or less	46	19	45	21
25,001-50,000	23	28	21	30
50,001-100,000	39	44	36	47
100,001-500,000	100	85	95	91
50,001-1mgd	23	94	16	98
1mgd-2mgd	8	98	3	99
>2mgd	6	100	1	100

Q-12 What is the maximum number of gallons per day that your system can produce, or if your water system purchases water, what is the maximum withdrawal per day allowed by your current contract?

MAXIMUM SYSTEM CAPACITY IN GALLONS / DAY ______________________________

Response Rate	N	%
No answer	122	35
Responded to question	228	65
Total surveys returned	350	

Summary statistics		
System capacity	**All respondents**	**Systems less than 3,301**
N	226	213
Mean	712,582	655,688
Standard deviation	1,362,953	1,496,606
Minimum	5,000	5,000
Maximum	14,000,000	14,000,000

Frequency distribution and cumulative percent (%)				
Max day	**All respondents**		**Systems less than 3, 301**	
Peak gallons/day	***N***	***Cumulative %***	***N***	***Cumulative %***
25,000 or less	11	5	10	5
25,001-50,000	19	13	18	14
50,001-100,000	28	26	27	27
100,001-500,000	96	68	94	74
50,001-1mgd	31	82	24	86
1mgd-2mgd	27	94	20	96
>2mgd	14	100	8	100

Q-13 How many miles or feet of water pipe are there in your water system?

________ MILES ***OR*** ______________________________ FEET WATER PIPE

Response Rate	N	%
No answer	74	21
Responded to question	276	79
Total surveys returned	350	

Reported length of water pipe	Feet	Miles
N	67	210
Mean	18,500	54
Median	8,100	10
Min	90	1
Max	127,495	1,100
Note: One system reported length in both feet and miles.		

Q-14 How many connections does your water system serve in each of the following customer types?

________________ **TOTAL CONNECTIONS**

______________ RESIDENTIAL CONNECTIONS

______________ COMMERCIAL CONNECTIONS

______________ INDUSTRIAL CONNECTIONS

_______________ WHOLESALE CONNECTIONS

______________ OTHER *(please specify)* ____________________________________

Response Rate	N	%
No answer	27	8
Responded to question	323	92
Total surveys returned	350	

Total connections	N	Median # of connections
No response or no connections	4	247
Provided number of connections	319	

Residential connections	N	Median # of connections
No response or no connections	36	245
Provided number of connections	287	

Commercial connections	N	Median # of connections
No response or no connections	36	18
Provided number of connections	211	

Industrial connections	N	Median # of connections
No response or no connections	265	3
Provided number of connections	58	

Wholesale connections	N	Median # of connections
No response or no connections	285	2
Provided number of connections	38	

Nine respondents included connections in the "other" category:

- Agricultural
- Church campground
- Churches
- Irrigation - agriculture
- Municipal unpaid
- Pasture/stockwater/feedlot
- Rental property
- Rural water meters

Q-15 What percent of your customers are served by metered connections?

❒ NOT ALL CONNECTIONS ARE METERED

% METERED _______________

❒ ALL CONNECTIONS ARE METERED

❒ INDIVIDUAL CONNECTIONS ARE NOT METERED

Response Rate	N	%
No answer	12	3
Responded to question	338	97
Total surveys returned	350	

Metered connections	N	%
100% metered	222	67
0% metered	81	24
Not all connections are metered	33	9
Greater than or equal to 99% metered	17	
Between 85 and 98% metered	14	
10% or less	4	

Q-16 How many paid employees participate in operation and management of your water supply system?

- ❒ ONE PART-TIME PERSON (*one person less than 35 hrs/wk*)
- ❒ ONE FULL-TIME PERSON (*one person about 35 hrs/wk*)
- ❒ ONE FULL TIME; ONE PART TIME
- ❒ TWO FULL TIME
- ❒ OTHER *(please specify number of employees)* ____________________________________

Response Rate	N	%
No answer	15	4
Responded to question	335	96
Total surveys returned	350	

Number of paid employees	Number of water systems	Cumulative %
0	34	10.1
0.5	78	33.4
1.0	49	48.1
1.5	49	62.7
2.0	60	80.6
2.5	12	84.2
3.0	17	89.3
3.5	3	90.1
4.0	11	93.4
4.5	4	94.6
5.0	9	97.3
6.0	2	97.9
7.0	2	98.5
8.0	1	98.8
9.0	2	99.4
11.0	1	99.7
12.0	1	100.0

Of those water systems reporting no paid employees, 5 reported all volunteer labor, and 3 reported contracting out all labor.

Q-17 How many boil water orders have been issued by your water system in the last fiscal year or 12 month period for which you have records?

BOIL WATER ORDERS ISSUED IN LAST 12 MONTHS ___________________

Response Rate	N	%
No answer	17	5
Responded to question	333	95
Total surveys returned	350	

Number of boil water orders in last 12 months	Number of water systems
No boil water orders	253
One or more boil water orders	80
1	30
2	24
3	8
4	6
5	1
6	3
7	2
9	1
10	1
12	1
15	2
55	1

Q-18 Do you share personnel or equipment with other services in the operation and maintenance of your water system?

- ❐ NO
- ❐ YES, WHAT TYPE OF SERVICE: *(check all that apply)*
  - ❐ WASTEWATER
  - ❐ NATURAL GAS
  - ❐ OTHER WATER SYSTEM
  - ❐ OTHER *(specify)*__________________

Response Rate	N	%
No answer	13	4
Responded to question	337	96
Total surveys returned	350	

Share personnel or equipment	N	%
Yes	109	32
No	228	68

Type of shared personnel or equipment	N	%
Wastewater	86	79
Natural gas	7	6
Other water system	14	13
Other	41	38
Note: Numbers do not sum to total because several systems operate more than one other service.		

Forty-three respondents wrote in one or more other types of shared personnel or equipment with other services in the operation and maintenance of their water system:

- Street department
- Electric
- Administration
- Fire department
- Utility construction
- Parks
- Town government
- Maintenance
- Alley
- Service department
- Cemetery
- Home owners association

Q-19 Which of the following treatment processes are used by your water system? *(please check the boxes of all processes used by your system, or write in treatment processes not listed in the space provided)*

❒ **NO TREATMENT (purchase treated water, or do not treat water)**

PRE-DISINFECTION

❒ Chlorine ❒ Chlorine Dioxide ❒ Chlorinamines
❒ $KMNO_4$ ❒ Ozone ❒ Lime/Soda Ash Softening
❒ Recarbonation with CO_2

IRON AND MANGANESES REMOVAL

❒ Green Sand Filtration ❒ Aeration Filtration ❒ Chemical Oxidation Filtration

FLOCCULATION/COAGULATION

❒ Aluminum Salt ❒ Clays ❒ Iron Salts
❒ Polymers ❒ pH Adjustments ❒ Activated Silica
❒ Other Flocculation/Coagulation

FILTRATION

❒ Slow Sand ❒ Rapid Sand ❒ Reverse Osmosis
❒ Pressure Filtration ❒ Dual/Multi-Media ❒ Diatomaceous Earth
❒ Other Filtration

ORGANICS REMOVAL

❒ Ion Exchange ❒ PAC Addition ❒ GAC Adsorption Post Contactors
❒ Air Stripping ❒ GAC Adsorption Filter Adsorbers

POST-DISINFECTION

❒ Chlorine/Hypochlorination ❒ Chlorinamines
❒ Chlorine Dioxide ❒ Floridation

CORROSION CONTROL

❒ pH Adjustments ❒ Corrosion Inhibitors
❒ Alkalinity Adjustments ❒ Corrosion Control Combinations

OTHER TREATMENTS NOT ELSEWHERE CLASSIFIED

❒ OTHER *(specify)* ______________________________

❒ OTHER *(specify)* ______________________________

Response Rate	N	%
No answer	20	6
Responded to question	330	94
Total surveys returned	350	

Treat water	N	%
Yes	194	58
No	136	42

Pre-disinfection	N	%
Yes	148	77
No	46	23

Pre-disinfection processes	N	% of systems that treat
Chlorine	130	67
KMNO4	30	15
Recarbonation with CO2	5	3
Chlorine Dioxide	7	4
Ozone	0	0
Chlorinamines	3	2
Lime/Soda Ash Softening	13	7

Iron & manganese removal	N	%
Yes	50	26
No	144	74

Iron & manganese removal processes	N	% of systems that treat
Green sand filtration	16	8
Aeration filtration	29	15
Chemical oxidation filtration	10	5

Flocculation/coagulation	N	%
Yes	65	34
No	129	66

Flocculation/coagulation processes	N	% of systems that treat
Aluminum salt	42	22
Polymers	37	19
Other F/C	12	6
Clays	3	2
pH adjustments	17	9
Iron salts	3	2
Activated silica	0	0

Filtration	N	%
Yes	83	48
No	101	52

Filtration processes	N	% of systems that treat
Slow sand	23	12
Pressure filtration	12	6
Other filtration	6	3
Rapid sand	30	15
Dual/multi-media	25	13
Reverse osmosis	1	1
Diatomaceaous earth	0	0

Organics removal	N	%
Yes	24	12
No	170	88

Organics removal processes	N	% of systems that treat
Ion exchange	4	2
Air stripping	4	2
PAC addition	13	7
GAC Adsorption filter adsorbers	5	3
GAC Adsorption filter post contactors	1	1

Post-disinfection	N	%
Yes	109	56
No	85	44

Post-disinfection processes	N	% of systems that treat
Chlorine/hypochlorination	86	44
Chlorine dioxide	2	1
Chlorinamines	9	5
Floridation	46	24

Corrosion control	N	%
Yes	70	36
No	124	64

Corrosion control processes	N	% of systems that treat
pH adjustments	48	25
Alkalinity adjustments	16	8
Corrosion inhibitors	21	11
Combinations	5	3

Other treatments	N	%
Yes	27	14
No	167	86

Twenty-seven respondents wrote in other treatment processes including:

- Chlorinate well and distribution system annually
- Manganese treatment
- Molluscide
- Phosphate
- Po4
- Poly phosphate
- Poly phosphates TPC 682
- Single water softening w/ iron control
- Softners
- Solid contact clarifier
- Supplemental cl2 @ boosters in summer
- Upflane clarifin
- Water conditioned by water softener (salt)

Q-20 Does your water system own any water towers or other storage facilities?

❒ YES, *(please enter the number of facilities below)*
NUMBER OF STORAGE FACILITIES ___________________

❒ NO

Response Rate	N	%
No answer	17	5
Responded to question	333	95
Total surveys returned	350	

Own water towers or other storage facilities	N	%
Yes	267	80
No	66	20
At least one	168	
2	63	
3	22	
4	6	
5 or more	7	

Of the total systems that answered "yes" to the question, eight systems reported having some type of water tower or other storage facility, but did not indicate the number of storage facilities.

Q-21 How many people and connections did your system serve 5 years ago?

___________________ PEOPLE SERVED 5 YEARS AGO

___________________ ACTIVE CONNECTIONS 5 YEARS AGO

Response Rate	N	%
No answer	52	15
Responded to question	298	85
Total surveys returned	350	

Reported change in population served in last five years			
Type of Change	*N*	*Average Percent Change*	*Median Percent Change*
Increasing	155	+53.5	+17.6
Unchanged	87	0	0
Decreasing	22	-9.2	-8.2
Total valid responses	264		

Reported change in total service connections in last five years			
Type of Change	*N*	*Average Percent Change*	*Median Percent Change*
Increasing	157	+25.4	+10.2
Unchanged	68	0	0
Decreasing	25	-5.2	-3.6
Total valid responses	250		

Q-22 How many people and connections do you expect to serve 5 years from now?

____________________ PEOPLE WILL BE SERVED 5 YEARS FROM NOW

____________________ CONNECTIONS WILL BE SERVED 5 YEARS FROM NOW

Response Rate	N	%
No answer	58	17
Responded to question	292	83
Total surveys returned	350	

Expected change in future population served during next five years			
Type of Change	*N*	*Average Percent Change*	*Median Percent Change*
Increasing	144	+18.1	+12.7
Unchanged	74	0	0
Decreasing	22	-13.1	-7.7
Total valid responses	240		

Expected change in future service connections during next five years			
Type of Change	*N*	*Average Percent Change*	*Median Percent Change*
Increasing	170	+18.0	+8.8
Unchanged	56	0	0
Decreasing	22	-6.4	-4.5
Total valid responses	248		

Q21 and Q22 COMBINED

Ten year change in population served			
Type of Change	*N*	*Average Percent Change*	*Median Percent Change*
Increasing	170	+46.5	+25.0
Unchanged	66	0	0
Decreasing	15	-12.8	-7.4
Total valid responses	251		

Ten year change in service connections			
Type of Change	*N*	*Average Percent Change*	*Median Percent Change*
Increasing	164	+41.7	+19.9
Unchanged	60	0	0
Decreasing	20	-10.4	-7.2
Total valid responses	244		

Q-23 Does your business or water system bill customers directly for water?

❒ NO, PLEASE GO TO QUESTION 24
❒ YES, PLEASE GO TO QUESTION 25

Response Rate	N	%
No answer	16	5
Responded to question	334	95
Total surveys returned	350	

Bill directly for water	N	%
Yes	272	81
No	61	19

Q-24 What is your best estimate of the percent of annual total revenues that you used to pay for the cost of operating your system ?

_________% PERCENT OF ANNUAL REVENUES USED TO PAY FOR WATER SYSTEM COSTS

Response Rate	N	%
No answer	291	83
Responded to question	59	7
Total surveys returned	350	

Annual total revenues	N
100%	10
1%	5
Between 2 and 25%	15
Between 30 and 50%	7
Between 56 and 85%	14
Between 90 and 98%	8

Fifty-nine water systems estimated the percent of total annual revenue from 1-100%. Twenty-three of these respondents had answered YES to question #23, but did not skip question #24.

Q-25 How frequently are your customers billed?

- ❒ MONTHLY
- ❒ BI-MONTHLY
- ❒ QUARTERLY
- ❒ ANNUALLY
- ❒ OTHER *(please specify)* ______________________________

Response Rate	**N**	**%**
No answer	43	12
Responded to question	307	88
Total surveys returned	350	

Customers frequently billed	**N**	**%**
Monthly	215	62
Bi-monthly	11	3
Quarterly	56	16
Annually	7	2
Other	16	5
Subtotals do not sum to respondent total, because some systems reported more than one billing frequency.		

Of the sixteen respondents that selected other:

- 4 include water with other fees/rent
- 3 wrote “N/A”
- 3 bill semi-annually
- 7 supply water at no charge
- 1 use self-billing
- 1 uses monthly for annual and quarterly for residential
- 1 bills 3 times a year

Q-26 Please MAKE A COPY OF YOUR LATEST RATE SCHEDULE AND RETURN IT WITH THIS QUESTIONNAIRE ***OR*** use the space below to describe your rate structure *(including customer type, fixed charges, meter charges, minimum allowances & volume charges, etc.)*.

____
____
____
____
____
____
____

Response Rate	**N**	**%**
No answer	40	11
Responded to question	310	89
Total surveys returned	350	

Residential Rate Schedule	Min	Max	Mean	SD
Minimum Monthly Charge ($)	0	$55.00	11.51	7.73
Charge for 6,000 gallons/month	$4.67	$61.00	25.76	12.75

- Forty-eight wrote in a response, but either did not include rate, include water service in other charges, or do not have residential customers.
- Three measures were calculated based on rates for residential customers, normalized to reflect monthly values: monthly minimum allowance, monthly minimum charge, monthly residential water charge for 6,000 gallons of water use.
- Minimum quantities provided with the monthly minimum charge ranged from 0 to 8,000 gallons, with 1,000 gallons being most common (N=81), a flat monthly charge was used by 35 systems.

Q-27 What were the years and percentage of increase of your last TWO water rate increases?

YEAR OF LAST INCREASE 19 ___ ___ % OF RATE INCREASE _______________

YEAR OF PREVIOUS INCREASE 19 ___ ___ % OF RATE INCREASE _______________

❐ NO RATE INCREASE IN THE PAST 5 YEARS

Response Rate	N	%
No answer	60	17
Responded to question	290	83
Total surveys returned	350	

- 51% or 147 respondents reported no increase in last year
- 49% or 143 respondents reported last rate increases
- 30% or 86 respondents reported two rate increases

Distribution of year of last rate increase		
Year of last rate increase	*Frequency (N=121)*	*Cumulative %*
2000	17	14
1999	37	44
1998	21	61
1997	24	81
1989-1996	23	100

Distribution of reported percent of last rate increase		
Percent of increase (%)	*Frequency (N=121)*	*Cumulative percent (%)*
0-10	48	40
11-25	35	69
26-50	25	95
51-75	7	95
76-90	1	96
> 90	5	100

Q-28 Do you have any programs to encourage your customers to conserve water?

❒ NO

❒ YES, PLEASE CHECK THE PROGRAM TYPE OR DESCRIBE BELOW.

- ❒ CONSERVATION BROCHURES IN WATER BILLS
- ❒ FREE WATER CONSERVATION AUDITS FOR CUSTOMERS
- ❒ CONSERVATION KIT DISTRIBUTION PROGRAM
- ❒ SCHOOL EDUCATION PROGRAM
- ❒ OTHER *(specify)* ____________________
- ❒ OTHER *(specify)* ____________________
- ❒ OTHER *(specify)* ____________________

Response Rate	N	%
No answer	9	3
Responded to question	341	97
Total surveys returned	350	

Conservation program	N	%
Yes	58	17
No	291	83

Type of program	N	%
Conservation brochures in water bills	22	38
School education program	6	10
Conservation kit program	5	7
Free water conservation audits	4	7
Other	39	67
Note: Numbers do not sum to total because some systems operate more than one program.		

Thirty-nine respondents wrote in one or more other types of programs that they use to encourage their customers to conserve water:

- Public info provided through city newsletters, consumer confidence reports, billing statements, brochures, public notices, board meetings, bulletins, posted conservation plans, and signs.
- Verbal instructions given regarding irrigation practices, lawn watering restrictions, and the operation of sprinkling systems, and washing machines.
- Mandatory conservation plan when needed, especially in times of drought and other water emergencies.
- Rate structures/cost of water increases with excessive use.
- Operator inspections
- Conservation appliances such as water conservation showerheads, and toilet leak kits are made available.
- Installing meters and charging for actual usage.
- Ordinances/voluntary/mandatory

Q-29 What were the annual water sales revenues and deliveries in the customer categories listed below for the last financial reporting period? *(If your system does not bill for water, please enter your best estimate the annual deliveries from your system.)*

(*If zero, enter "0")*

	ANNUAL WATER SALES REVENUE	ANNUAL DELIVERIES (in GAL)
TOTAL SALES AND DELIVERIES	$________________	________________________ GAL
RESIDENTIAL CUSTOMERS	$________________	________________________ GAL
COMMERCIAL CUSTOMERS	$________________	________________________ GAL
INDUSTRIAL CUSTOMERS	$________________	________________________ GAL
WHOLESALE CUSTOMERS	$________________	________________________ GAL
LOCAL GOVERNMENT USE	$________________	________________________ GAL
UNACCOUNTED FOR *(water lost to leakage or otherwise not accounted for)*		________________________ GAL
OTHER (specify)		
_________________________	$________________	________________________ GAL
_________________________	$________________	________________________ GAL

Response Rate	N	%
No answer	82	23
Responded to one or more categories	268	77
Total surveys returned	350	

Total Revenues and Deliveries	N	Min	Max	Mean	Sd
Total Revenue ($)	214	$258	$3,202,350	$173,856	$364,138
Total Deliveries (gal)	171	4,600	998,010,000	65,549,023	144,759,345
Residential Revenue ($)	120	$70	$2,965,800	$127,804.59	$294,313
Residential Deliveries (gal)	98	450	500,280,000	36,499,521	75,286,103
Commercial Revenues ($)	73	$130	$431,423	$28,084	$60,811
Commercial Deliveries (gal)	55	2,282	136,382,736	10,707,538	24,031,206
Industrial Revenue ($)	30	$29	$260,083	$28,924	$55,057
Industrial Deliveries (gal)	27	59	440,281,000	25,218,261	84,635,419
Wholesale Revenue ($)	24	$30	$3,193,000	$249,717	$722,919
Wholesale Deliveries (gal)	21	22.00	994,090,000	150,536,340	299,259,686
Local Gov. Revenue ($)	17	$178	$18,168	$5,167	$5,149
Local Gov. Deliveries (gal)	21	34	12,460,000	2,938,450	3,849,698
Unaccounted For Water	62	246	53,719,750	8,041,883	11,770,479

Other revenues, deliveries, and responses	35
Un-metered or free metered	10
Fire use	9
Bulk sales	9
Flushing/malfunctions/maintenance activities	4
Miscellaneous deliveries or sales revenue	3
Not applicable	2

Q-30 What were the contributions to your water systems from other revenue sources? (*If zero, enter "0"*)

NEW CONNECTION FEES $___________________

OTHER SERVICE CHARGES $___________________

INTEREST EARNINGS $___________________

OTHER REVENUES NOT REPORTED ELSEWHERE *(specify)*

____ $____________________

Response Rate	N	%
No answer	69	20
Responded to one or more categories	281	80
Total surveys returned	350	

Contributions from other revenue sources	N	Median Value ($)
Connection Fee	122	3,000
Service Charges	88	1,192
Interest	123	3,000
Other	66	

Sixty-six of the respondents wrote in one or more other sources of revenue.

- Ad valorem taxes
- Farm income
- Fire protection fees; hydrant rentals
- Mobile home tax
- Property tax
- Reimbursement for work
- Sale of filters
- Space rentals
- Special assessment
- Taxes (3 mill)
- Tower antenna
- Transfers from general fund
- Water availability charges
- Water testing fees

Q-31 Do you use any outside contractors to assist in the operation of your system?

- ❒ NO
- ❒ YES, PLEASE ESTIMATE YOUR ANNUAL COST FOR EACH SERVICE *(If zero, enter "0")*
- ❒ ENGINEERING ANALYSIS $______________ per year
- ❒ ACCOUNTING/AUDITING $______________ per year
- ❒ OUTSIDE ANALYTICAL TESTING & REPORTING $______________ per year
- ❒ BILLING $______________ per year
- ❒ CONTRACT SYSTEM REPAIRS $______________ per year
- ❒ LEGAL SERVICES $______________ per year
- ❒ OTHER (specify)___________________________ $______________ per year

Response Rate	N	%
No answer	8	2
Responded to one or more categories	342	98
Total surveys returned	350	

Use outside contractors	N	%
Yes	250	73
No	92	27

Type of outside contractor	Number of systems that contracted service	Median annual cost ($)	Number of systems that reported cost
Engineering	114	3,000	68
Accounting/auditing	121	1,450	91
Testing/reporting	151	1,054	130
Billing	42	2,100	21
System repairs	138	3,062	107
Legal services	90	1,579	62
Other	38	--	--

Thirty-eight respondents checked the "other" box. Thirty-four specified another type of service, including:

- Bookkeeper/manager
- Cathodic protection
- Combined contracting categories from single provider
- Computer maintenance
- Licensed operator
- Line location
- R-O-L maintenance
- Technical supervision
- Treatment plant operations
- Unspecified service from PWD

Q-32 Please estimate the operating expenses for your water system in the last fiscal year or 12 month period in the categories listed below: (*If zero, enter "0").*

1) SALARIES, WAGES AND BENEFITS $ ____________
2) ADMINISTRATION (office utilities, rent, supplies, postage, phone) $ ____________
3) OPERATING UTILITIES (electricity, gas, oil, etc.) $ ____________
4) INSURANCE $ ____________
5) PURCHASED WATER EXPENSE $ ____________
6) CHEMICALS $ ____________
7) OTHER OPERATING SUPPLIES (tools, pipes, parts, etc.) $ ____________
8) CONTRACT SERVICES (from question Q-31) $ ____________
9) TAXES (excluding payroll taxes) $ ____________
10) DEPRECIATION $ ____________
11) OTHER *(specify)* ____________ $ ____________
12) OTHER *(specify)* ____________ $ ____________

Response Rate	N	%
No answer	61	21
Responded to one or more categories	289	79
Total surveys returned	350	

Wages	N	Median wages	N	$
No answer	28	*All respondents*	232	19,579
Reported zero expense	29	*<3,301 pop.*	216	16,710
Reported expenses	232			

Administration	N	Median admin.	N	$
No answer	66	*All respondents*	198	2,000
Reported zero expense	25	*<3,301 pop.*	183	1,864
Reported expenses	198			

Utilities	N	Median utilities	N	$
No answer	52	*All respondents*	222	4,492
Reported zero expense	15	*<3,301 pop.*	206	4,264
Reported expenses	222			

Insurance	N	Median insurance	N	$
No answer	75	*All respondents*	185	2,394
Reported zero expense	29	*<3,301 pop.*	170	2,000
Reported expenses	185			

Purchased water	N	Median purchased	N	$
No answer	120	*All respondents*	77	27,000
Reported zero expense	92	*<3,301 pop.*	69	23,172
Reported expenses	77			

Chemicals	**N**	**Median chemicals**	**N**	**$**
No answer	96	*All respondents*	149	2,922
Reported zero expense	44	*<3,301 pop.*	133	2,377
Reported expenses	149			

Supplies	**N**	**Median supplies**	**N**	**$**
No answer	86	*All respondents*	179	5,357
Reported zero expense	24	*<3,301 pop.*	168	5,000
Reported expenses	179			

Contract services	**N**	**Median services**	**N**	**$**
No answer	97	*All respondents*	157	4,413
Reported zero expense	35	*<3,301 pop.*	146	3,776
Reported expenses	157			

Taxes	**N**	**Median taxes**	**N**	**$**
No answer	150	*All respondents*	77	1,325
Reported zero expense	62	*<3,301 pop.*	73	1.325
Reported expenses	77			

Depreciation	**N**	**Median depreciation**	**N**	**$**
No answer	162	*All respondents*	77	31,702
Reported zero expense	50	*<3,301 pop.*	66	26,090
Reported depreciation	77			

One-hundred and nine respondents reported expenses in one or more “other” categories, including:

- Base purchase water contract fees
- Capital outlays/expenditures
- Combined categories
- contributions to regional water authority
- Deposit refunds
- Dues
- Equipment maintenance; rental
- License fees
- Repair and maintenance
- Training and education expenses
- Travel
- vehicle expenses; leasing fees
- water tower painting and repair

Q-33 Please estimate the amount of debt service expenditures for your water system in the last fiscal year or 12 month period: (*If zero, enter "0"*)

1) INTEREST PAYMENTS $ ___________________

2) PRINCIPAL PAYMENTS $ ___________________

3) OTHER DEBT SERVICE EXPENDITURES

(specify) __________________________________ $ ___________________

Response Rate	N	%
No answer	77	22
Responded to one or more categories	273	78
Total surveys returned	350	

Interest Payments	N	Median ($)
Made interest payment	102	16,775
$0 – no payment	139	
No answer	32	

Principal Payments	N	Median ($)
Made principal payments	95	17,056
$0 – no payment	111	
No answer	67	

Other debt services	N
Made other payments	102
$0 – no payment	100
No answer	32

Eighteen respondents reported some type of other payment:

- Total and combined interest and principle payments
- Unspecified payments
- Capital outlays

Q-34 What was the total amount of outstanding debt owed by your water system at the end of your last financial reporting period? (*If zero, enter "0"*)

OUTSTANDING AMOUNT OF LONG TERM DEBT $___________________

Response Rate	N	%
No answer	78	22
Responded to question	272	78
Total surveys returned	350	

Outstanding debt	N	Median debt	N	$
Reported zero debt	159	*All respondents*	113	289,642
Reported amount of debt	113	*<3,301 pop.*	98	210,000

Q-35 Do you have any type of reserve fund for your water system?

❒ NO

❒ YES, PLEASE INDICATE THE PURPOSE OF THIS FUND

- ❒ DEBT SERVICE RESERVE
- ❒ PLANNED EQUIPMENT REPAIR AND REPLACEMENT
- ❒ EMERGENCY REPAIRS
- ❒ SYSTEM EXPANSION AND IMPROVEMENT
- ❒ REVENUE STABILITY
- ❒ OTHER ____________________

Response Rate	N	%
No answer	24	7
Responded to question	326	93
Total surveys returned	350	

Reserve fund	N	%
Yes	221	68
No	105	32

Purpose of reserve fund	N	%
Debt service reserve	79	36
Emergency repairs	97	44
Equipment repair and replacement	96	43
System expansion	48	22
Revenue stability	25	11
Other	28	13

Twenty-eight respondents wrote in one or more type of reserve fund:

- CDs
- Excess of annual income/excess funds
- Painting of tower/new well pump
- Supplemented O&M budgets
- Escrow fund and other funds required by Department of Environmental Quality.
- Currently operating in red.
- Depreciation reserve
- Bond revenue for payments
- Water extension replacements
- Village general fund
- Surplus and depreciation
- Line credit-local bank
- Repairs for water break
- Savings account
- Reserve account required by rural development

Q-36 What was your water system's annual contribution to your reserve fund during your last financial reporting period? (*If zero, enter "0")*

ANNUAL CONTRIBUTION TO RESERVE FUND $__________________

Response Rate	N	%
No answer	83	24
Responded to question	267	76
Total surveys returned	350	

Annual reserve contribution	**N**	**Median annual contribution**	**N**	**$**
Reported zero	153	*All respondents*	113	8,400
Reported "all excess funds"	1	*<3,301 pop.*	100	7,200
Reported amount of contribution	113			

Q-37 What is the total amount that you have accumulated in your reserve fund? (*If zero, enter "0")*

ACCUMULATED RESERVE FUND $__________________

Response Rate	N	%
No answer	86	25
Responded to question	264	75
Total surveys returned	350	

Accumulated reserve	N	Median reserve	N	$
Reported zero reserve	94	*All respondents*	161	30,000
Reported amount of reserve	161	*<3,301 pop.*	145	28,500
Wrote in response	9			

Nine respondents wrote in comments including:

- "N/A"
- "System operating in red"
- "Don't know"

Q-38 Has there been a recent assessment of the value of the physical assets *(property, plant, equipment, lines. etc)* of your water system, or can you estimate the value?

❒ NO
❒ YES, ESTIMATED VALUE OF PHYSICAL ASSETS $________________________

Response Rate	N	%
No answer	50	14%
Responded to question	300	86%
Total surveys returned	350	

Can estimate value of system	**N**
No	230
Yes	70
Reported value of system	64

Median annual contribution	**N**	**$**
All respondents	64	866,208
<3,301 pop.	53	650,000

Q-39 What sources of capital financing *(revenue bonds, state or federal grants and/or loans, etc.)* have you used in the past 10 years to pay for infrastructure needs, major repairs, and water system expansion?

NAME OF AGENCY/LENDER ____

TYPE OF FINANCING ❐ GRANT ❐ LOAN

YEAR OF AWARD ____________________

AMOUNT $__________________________

PURPOSE ____

Response Rate	**N**	**%**
No answer	124	35
Responded to question	226	65
Total surveys returned	350	

Type of response	**N**
Responded "None"	80
Responded "N/A"	20
Reported one or more sources of external financing	127
Reported 2 or more	44
Reported 3 or more	5

Source of financing	**N**	**%**
Rural Development/USDA/FmHA	44	24
State funding programs	37	21
Banks/commercial lenders	35	19
Bonds	17	9
Combination of sources	11	6
CDBG	7	4
Other federal source	7	4
Other sources	7	4
Local/regional	5	3
Did not report source	10	6

Type of financing	**N**	**%**
Loans only	78	43
Grants only	48	27
Combination grants loans	28	16
Not specified (includes bonds)	26	14

Amount of financing reported – all respondents	Grants	Loans	Combination grants/loans
N	42	70	17
Min ($)	8,800	10,000	22,500
Max ($)	1,637,000	3,920,00	7,000,000
Mean ($)	321,600	515,000	1,917,000
Median ($)	250,000	255,000	894,000
Note: Not all respondents reported values for financing obtained.			

Purpose of financing	N	%
Construction/expansion of water works	48	32
Extension/installation of water lines	39	26
Construction of elevated storage	24	16
Drilling of new wells	16	11
Other	25	16
Note: Not all respondents reported the purpose of financing.		

Twenty-five respondents reported purposes that did not fit into the four categories in the above table. These purposes included:

- New reservoirs
- New subdivision
- Project start-up
- Purchase of utility
- Refunding and improvements
- Repairs
- Storm drainage improvement
- Update equipment

Survey Participants

Please check the boxes that best describe ALL of the people who participated in filling out this questionnaire:

❒ OWNER ❒ OPERATOR ❒ MUNICIPAL/SYSTEM CLERK
❒ ACCOUNTANT ❒ ENGINNER ❒ BOARD MEMBER/ELECTED OFFICIAL
❒ OTHER *(specify)* ______________________________

Response Rate	N	%
No answer	24	7
Responded to one or more categories	326	93
Total surveys returned	350	

Number of participants per survey	N
Single participant	205
Two participants	105
Three or more	16

Type of Participant	# of times listed as participant
Operator	155
Municipal/system clerk	127
Board member/elected official	52
Owner	34
Accountant	19
Engineer	4
Other	76

Seventy-six respondents checked the “other” box and wrote in the following participant descriptions:

- Apartment manager
- Bookkeeper
- City administrater
- City superintendent
- City water and sewer worker
- Condo association officer
- Contracted service employee
- Director, physical facilities
- Financial secretary
- General manager
- Local resident, water commission chairperson
- Maintenance supervisor
- Management company
- Manager
- Manager/agent
- Mayor
- Office assistant
- Office manager and water system manager
- Operator/manager
- President, chairman and manager
- Project manager
- Property manager
- Property manager/maintenance tech.
- Public works director
- Secretary
- Superintendent of public works
- Superintendent of treatment plant
- Supervisor
- Supervisor water & wastewater
- System administrator
- System manager
- System president
- System superintendent
- Treasurer
- Village administrator
- Village clerk-treasurer
- Village treasurer
- Water operator / maintenance man
- Water superintendent
- Water system manager
- Water tester
- Water trustee

Additional Comments:

One hundred and ninety-three participants included some comments or additional information on the back page of the questionnaire. Seventy-three of these are included below. Some of the comments were edited to protect the confidentiality of the participants.

I personally feel the small water systems have little voice in required testing like the lead and copper.

I am sorry for not responding earlier, but the person who kept the records on the water system passed away over a year ago. I have no information or data on the water system.

Our city is in the process of having the regional water association take over the water and sewer systems. Our sewer system was put in 1993 and water in 1975 for which we have purchased over our water from a town which is 5 miles away. They have their own well. The regional water association is about 2 miles away, and on all 4 sides of our city, which we can hook on.

Our citizens are unhappy about the amount of chlorine we are directed to put in our systems, as we can smell it in our homes and creates a bad rust problem.

EPA of Illinois are after us all the time and we see other bigger municipalities being allowed to do the same things that we are being allowed to do the same things that we are cited for.

Would love to hear about any low interest loans available to private systems.

We are a water district with a lot of small lines in need of improvement. We are trying to get grant money for bigger lines and replacing 2 inch lines.

We are a not for profit corporation- consisting of 49 houses in our association. We have no lots left to be built upon, nor do we expect to annex in any more property for housing, thus will not enlarge our association, nor add anymore residents to our water supply. We charge dues in the amount of $32.50/month. Of this amount, $5.00/month is set aside for a new well system when and if it is needed. We add $2.00 administration fee for late pay (2nd month and 3rd month). 4th month- if needed- we add $20.00/month and contact our attorney, which has never happened in the 10 years I have been treasurer

I feel there should be more grant money and less loan money to water companies, we appreciate every thing that FHA and DCCA *(state assistance organization*) have done for us. With all the expense and upkeep for the water company it should be 100% grant money especially in rural areas like our county. We have a lot of rock to contend with, and some of the houses are far apart. The need for good drinking water is great in our area. We have a lot of iron, lime, and hard water, and a lot of the people buy drinking water in town and take their clothes to the Laundromat.

I apologize for not completing the form, but the system didn't want to divulge financial information in 1990. Four board members applied for a $100,000 loan for a new well, tank, and building. It was a personal loan using their homes as security

Our system didn't want to complete the survey. I answered the ones that I could.

I find this very difficult to fill out, as we do not have a water system. Our sub-division purchases the water from another city through one master meter. We have no control over the chlorine or any other checking of water. We do have a water sample tested every month. Homes have meters- they are read every 3 months. Customers are billed every 3 months- although city bills us every month. City just doubled our water rates to pay for new osmosis plant in city. Hope this report is okay- we will be voting to go into city, or not, in the future.

The customers of our water system are billed by another village. Three years ago the village stopped reading our meters and began billing us by dividing the total usage by 32 then sending each user the same bill. We as users feel this is unfair, however, we have no leverage. We receive all our water from this village; we are at their mercy.

Our municipality is considering the need of additional water supply sources and financing to implement this protest, due to the constructions and quality of our current water supplier.

Too many personal questions regarding operations

We need new infrastructure. We are a for-profit organization, are there any free grants/loans you are aware of that may help us.

Many loan programs require a metered system. Our annual water service fee has proven so much easier that we are most reluctant to consider meters. We know each year exactly what our income will be and can estimate expenses very closely having many years of past expenses to go by. With the annual fee, our income comes in all at once and we can then be drawing interest throughout the year with just enough to pay

Our water is totally purchased - we operate only a distribution system. Water is tested daily for chlorine. Water tested monthly for coliform bacteria - 2 samples.

We are a population of 200 and get all of the water from another city. We have nothing to do with the treatment of water.

This is a small rural supply in a 50 home subdivision built around a man made-spring feed lake. It was started forty years ago and was not under EPA regulations at that time. I was born 9-14-22, and would like to get rid of the responsibility of running the system. I have a Class C license. The nearest municipal supply is five miles away

This is a volunteer organization; 16 street reps. 3 officers; receive free water for services; have monthly meetings.

System needs funding. We do not have a rate schedule.

We are contemplating public water system hook-up. We have had initial surveys and are evaluating ways to fund the new system. We will have to replace all water lines and will need to apply for grants to be able to fund the project.

We are a small mobile home park that supplies water for tenants.

The EPA ordered me to have VOC's and SOC's tested 4 times last year under threat of $25,000 fine due to a mistake made by the state. Cost to me was $6000.

Unable to get financial information

I turned this over to our auditor. I am unable to help as I have had 5 bypasses and a pacemaker.

Our city does not have its own water system. We purchase water from the another city.

We just had a change of who was taking care of billing and collection and income and expenses. Not much record keeping was done before I started in April 2000. What I could, I filled in the best.

Not interested in participating

We are a system that has been very stable since it was started in the 60's. We have very good soft water and most of our repair costs are replacing valves in our city, as may have gone bad in last 5 years.

There needs to be more opportunities in the West for water system operators to become certified.

We are proud of our water system. We produce good water, but because of all the regulations coming in the future, we are in danger of losing our plant and having to purchase water somewhere else.

Please see that we are a small water system operated and reported by volunteers with technical assistance from the Rural Water Association and outside contractors plus evaluations by Department of Environmental Quality. I did this survey to the best of my ability and resources.

Need more grant money for infrastructure repairs and treat plant improvements to meet new federally mandated parameters. The EPA keeps tightening up the regulations and it is very difficult to come up the financing. We are a small system. We serve approximately 500 people year around.

My budget is more complex than what is presented here. I wrote it myself that way to elucidate budget tracking. Our water system is extremely atypical and should not be used in your survey for any statistical analysis.

Our water supply corporation is not a small system nor does its raw water operations fit the scope of the survey. Our average day is in excess of 50 million gallons/day with peaks over 100 million gallons/day, serving 30 cities in 6 counties.

A difficult questionnaire to answer based on how our structure is set up

System is currently operating in the red.

The state wants our system revised (per EPA) to add meters. Sampling taps in well house, chlorination taps & for system to flow from well through the pressure tank. This requires new lines from the wells to the well house, new lines to pressure tank & inlet fitting on pressure tank to permit flow through. I estimate about $10,000; if new tank required, about $25,000. A complete waste of money at this time - just so some bureaucrat can say our system is current to the latest requirements. Metering underground water - give me a break

We use the national average. Why we are cynical of government!

I am very interested to know how many small operations there are comparable to mine. I hope to learn from your report a simple way to calculate my expenses on water supply. I would appreciate information on qualified engineering analysis.

We are significantly concerned about various pending EPA regulations, and its potential cost. Our area has one of the highest levels of arsenic. We are in compliance with state regulations. In a year we are looking at a filtration system which may result in a financial burden on our small community.

Our city replaced its cast iron water lines with pv lines in 1991- that year we also built a new pump house and put in chlorination equipment.

We are looking at funding a new well and iron removal plant (ours is about 33 years old) and need water main extensions. Wastewater system needs funding for lagoon, main replacement and extensions.

We are a member of the Rural Water Association. We do consult with them if we have any operational problems.

Need to update water mains of trancite pipe and fire hydrant and values - 2 mile of brancite and 2 miles of plastic have no way to disinfect water lines now.

We buy our water from another city water department. Return water is dumped into city sewers. Prices we charge our customers are based on the rates the city charges us.

System will go out of water processing business in 2001 and purchase water from another wholesale water commission.

This system is a wholesale water supplier that sells to 16 rural water districts and small communities. Wholesale customers range in size from 100 persons to 6000 persons. The financial information given is for the wholesaler and does not reflect the financial situation of any of our wholesale customers.

We no longer have well water. We are now on city water!

We are temporarily without a village clerk. The figures given should be close. The only ones I used were for water only.

I am new in the position of city clerk. I hope I have found and given you the information needed.

We serve 34 homes with 1 well, 110,000 gallons tank, 3 pressure tanks and pumps. We are saving to install new water lines and expect to pay for these out of the savings. The portion of our fees used for roadwork is minimal. Three years ago we sealed and chatted the roads for approximately $500, this should last for at least 5-10 years.

Private companies can not obtain financing -this needs to change

This is a state-owned water supply to be used for inmates and staff only for the use of operation of state prison only.

We were forced to find other water sources, as our nitrates were too high. We purchase water now from another rural water association. Our customers are not satisfied with the taste of the water and the cost is very high. We have had problems with methane as we receive the water clorinated. We would prefer our groundwater, but will probably never be able to change over because of our loan and all the tests being required.

System has been upgraded completely in last 20 years. Mains, fire hydrants, wells, buildings, and controls.

We are a small village. Our water and sewer systems are all paid for. We have no debt. We operate on a general fund. We have a few customers who are out of town. They pay $2.00 per month extra on water and sewer. One of our village's borad members takes care of the water system and is paid for his extra cost.

I believe our water system is not the best. It seems it costs a lot as most of our people are old and I can’t believe our use of water is as much as the rural water board says it is. However, they checked the meter flow last fall when we had a leak and said it was OK. Some believe we should have another shut off value of some kind.

We are a small mobile home park. We do all sampling required. No test has come back in violation. Supply 34 people, 2 wells drilled by a beverage. Way too much paper work for such small business.

Our water system needs updating - water mains consist of galvanized lines - some in poor condition which frequently causes leaks. We had a survey to identify all relevant data concerning the village's current health and environmental status, identify current or potential problems, provide cost estimates to eliminate any identified problems and to prioritize activities needed. The Midwest Assistance Program is currently conducting an income survey. Nebraska Rural Water Association has completed a water rate survey study. Initial plans include seeking financial aid to address all or some of the needs identified.

Sorry to disappoint you, but we have switched to city water. I would not have been able to complete your survey in any case, as I don't have the information.

People in general will need to change their attitudes that water is free. We will need to pay for the new regulations somehow, rates, loans, and grants. Small towns and water systems will have trouble hiring the quality of employees needed to keep their system in compliance.

We presently installed a new treatment plant, 6,500 feet of lines, new 500,000 storage tank, and meters. We have not started using metered rates as of yet.

I would like to see changes in distribution of licenses for small systems that are on rural water. We do not treat water. All we need is tech supervision. They need to raise the limit to 2,000 population instead of 1,000 population on technical supervision. This is very unfair, all I do is fix water breaks, flush hydrants, maintenance on system. This needs to be changed, we have a lot of people leaving because they got their license and moved to bigger and better paying jobs. I am hoping to retire from here but if they don't change this, I will be letting go. This is very unfair. EPA should think of the small guys.

Our village clerk resigned. No financial records available. Sorry about the delay. No clerk, no mail!

Due to the geographical areas served by the rural community's water systems we are constantly being asked to extend our services just a little further. We can't afford to extend our lines to all areas and need funding assistance to upgrade our existing systems.

The clowns at EPA are testing things totally unnecessary. Well water should be tested for bacteria and the rest is imagination. Copper is worst, and the rest are about as bad. Good luck - the EPA is out of control in Ohio. I have units in Pennsylvania. Altogether different, much more reasonable there.

EPA testing and consumer confidence reports are getting out of hand. These costs keep rising year after year. Last estimate for outservices for consumer confidence report was $500. This year's testing will cost over $2,600 if the requirement for testing, reporting, and operators need to be licensed. We will split system into 4-5 homes and be rid of this over-reaction by EPA on small system operations.

Water supply is a private well whose output is processed through a leased RO system. 50 condos are supplied with a total of 4000 to 5000 gallons of treated water per day. There are no paid employees. Total cost of the RO Processing System is approximately $33,000 per year. EPA/Department of Natural Resources (DNR) testing requests and oversight costs are excessive.

I will not fill out this questionnaire. I have enough government telling me what to do- to the point I am not interested.

Most of these questions do not pertain to us. We have a private well that is maintained by us. Water is included in the monthly rent.

Due to the fact that we are in an agricultural (rural) area our nitrate level exceeds maximum contaminant level. We are helpless victims of misguided farming techniques - with no apparent solutions available. We realize that we are not alone. Our nitrate levels have been on the rise for years - as are all the levels of everyone here in our county. Our aquifers have been permanently contaminated. Who is responsible? What can, or will be done? We only have questions. Normally in America nothing is done until a problem rises to the conscious level. Maybe you can help. Best of luck with your study!

We are a 50 bed AFC home serving persons with various disabilities. We are in a rural area with out access to city water. We have our own wells and septic lagoon system. We are part of a larger non-profit corporation that provides all types of mental health services across the state. This facility was recently acquired from the county and was previously the last working "poor farm" in our state. Parts of this facility have been in service since 1900, but most is part of the newer construction dated 1976. Basically - we acquired a dilapidated water system in an area with the hardest, mineralized nasty water you can find. We are struggling to bring the system up to current standards and put in treatments to make the water more palatable and lower maintenance costs.

I. INTRODUCTION

PURPOSE

The purpose of this report is to summarize the findings of the *Benchmark Investigation of Small Public Water System Economics*, a study to investigate the role of financial benchmarking in small communities. Specifically, the scope of work for this study included:

- A review of the literature and resources on economic benchmarking for small water systems
- A survey of a representative sample of small community public water systems in the Midwest and the analysis of survey data to assess the causal relationship between system size, age, usage patterns and treatment processes and system outcomes including, reliability, cost, and compliance.
- A series of focus group sessions involving different segments of the small public water system community to assess the potential value of systematic benchmarking
- Preparation of a Technology Brief based upon the information collected during the study that would provide potential benchmarking tools for use by small system managers and consultants.

BACKGROUND

The "small system problem" has been a frequent topic of discussion and debate among water resources professionals, researchers and regulatory agencies. It has long been recognized that these systems face several particular economic disadvantages, especially in their inability to capture economies of scale in treatment, and because they often also face diseconomies of distribution because of their low-density service areas. The passage of the Safe Drinking Water Act in 1974 added a regulatory burden to these economic disadvantages, and many small systems have struggled to overcome the complications of aging infrastructure, low-income customers, polluted water sources, and difficulties in retaining trained staff members in order to remain in regulatory compliance.

Numerous governmental and not-for-profit initiatives have been implemented to help small systems to remain viable in this changing financial and regulatory environment. Technical assistance programs from non-governmental organizations, funding assistance from state and federal agencies, promotion of regional approaches to water delivery systems, and operator training programs are some of the efforts that have targeted different components of the small system framework.

However, in the discussions leading up to the drafting of 1996 Amendments, one recurring theme began to emerge, based largely on the experience in several states. This was the need to gain a better understanding of technical, financial, and managerial capacity of community water systems, so that scare resources could be focused on those systems that were most likely to benefit from assistance. These efforts gained formal regulatory status in the 1996 Amendments, which required primacy agencies to develop methods to evaluate the technical, financial, and managerial "capacity" of the water systems in their states.

As states have begun to design programs to assess water systems capacity, financial management has emerged as the key element in the development of sustainable water systems. Without effective financial management, the resources are not available to replace aging infrastructure, purchase new technology, or retain qualified managers and operators. Increasingly, the phrase "water systems must operate like a business" has begun to appear in the literature of technical assistance organizations and regulatory agencies. This business approach helps water systems managers to understand and account for all current and future costs, and to build these costs into the prices that are paid by consumers for their water service. The business approach also allows "water-system-businesses" to take advantage of the array of analytical and continuous improvement techniques that have been developed by the business community.

Benchmarking is one such technique. Benchmarking is a process that facilitates business improvement through the measurement of key operational indicators, and the comparison of these indicators to those of recognized business leaders. Benchmarking has been proposed as an especially useful guide for the managers of small water systems, especially because many of these systems are geographically or institutionally isolated from their colleagues, or are managed by decision-makers (such as city councils) that have little practical experience in water systems. These decision-makers may inadvertently emphasize actions, such as keeping rates artificially low, which actually are harmful to their water systems in the long term.

As their name implies, benchmarks can provide a reference point that decision-makers can use to guide the management of their systems. This perspective can encourage systems to re-evaluate many of the traditional approaches that may have long since become ineffective, and allow them to explore new approaches to the management and configuration of their systems that may prove more beneficial to consumers and communities.

ORGANIZATION OF THE REPORT

This report is organized into seven chapters. Chapter II provides a brief summary of the "small system problem", some of the actions that have been taken to address it, and a discussion of benchmarking and its emerging role in management of drinking water supplies. Chapter III describes the purpose and methods used in each of the five components of the study. The results and findings of the non-survey components of the study are presented in Chapter IV. Chapter V presents a question-by-question review of the responses of the 350 participants in a mail survey of water systems in the Midwest. The consolidation and analysis of the data from the mail survey and development of benchmark measures are described in Chapter VI. Chapter VII summarizes the findings of all of the research components and recommends future actions based on the results of this study. Finally, the five appendices contain an annotated bibliography and the supporting documents that were developed during the course of this research study.

II. REVIEW OF PREVIOUS STUDIES

INTRODUCTION

This brief review is intended to provide the background from which to understand the necessity and direction of research efforts to develop performance assessment tools for small drinking water systems. An annotated bibliography and topical listing of relevant publications is also included in this report (Appendix A). The annotated bibliography contains individual reviews of publications related to the evolution of the problems of small water systems, the economics of small community water systems, performance assessment and benchmarking methodologies, and assessment tools for small systems.

A discussion of the method used to develop the annotated bibliography and topical listing of relevant publications is included in Chapter III.

The following section describes some of the conditions that have led to addition of capacity assessment provisions to Safe Drinking Water regulations and the application of benchmarking approaches to small water systems. This is followed by brief case studies of the individual applications that have been developed and used to assess small system financial capacity.

APPLYING BUSINESS MODELS TO SMALL SYSTEM MANAGEMENT

Numerous research articles, government reports, and congressional testimony have outlined problems and challenges of small community water systems. (Clark, 1987; Cromwell, et al. 1992; NRC, 1996; Shanaghan, 1994; USEPA 1999, 1995, 1993). Several themes can be identified which have led to the application of benchmarking as a tool for the financial management of small water systems.

- National drinking water quality regulatory requirements have significant cost impacts on the operation and management of water systems.
- Small water systems are at a considerable economic disadvantage in water treatment and distribution, and system management because of the economies of size in treatment and management, and diseconomies of size in distribution in areas with low population density.
- The historical under-pricing of water and average-cost pricing approach in the United States has resulted in consumer resistance price increases, and has left many water systems ill-prepared and ill-funded to deal with the difficult management realities of declining water quality, diminishing availability of new water sources, changing demographics, and more stringent regulations. Many smaller systems are thus less able to meet drinking water regulations.

The two tables below illustrate these observations. Table 1 shows that the cost of upgrading small water systems is more than three times higher in per household terms than the comparable cost for large systems. The estimated cost of $3,300 per household is high enough to threaten the financial sustainability of many small systems.

Table II-1. Estimated 20-Year Need and Cost per Household

System Size (pop)	***Total Need (billion $)***	***Cost per household ($)***
Large (50,000 +)	$58.5	$970
Medium	$41.4	$1,200
Small (<3,300)	$37.2	$3,300
Source: USEPA (1997), pp.8 and 16		

One of the major deficiencies of small systems is manifested in the number of reported violation as shown in Table 2. The frequency of reported violations for maximum contaminant levels (MCLs) is orders of magnitude higher in small systems than in medium and large systems. Monitoring and reporting violations (M&R) also demonstrate the same pattern. And while MCL violations are often considered to be the more serious of the two, a study of small systems in Pennsylvania found that it was the number of M&R violations that were statistically correlated with independent field ratings of poor water system capability. (Cromwell & Rubin, 1995)

Table II-2. Percent of Systems with Violations
and Violations per 1,000 People Served:1998

Size Category	***% of systems w/MCl***	***MCL per 1,000***	***% of systems w/M&R***	***M&R per 1,000***
<501	7.5	0.807	21.1	5.924
501-3,300	1.4	0.072	13.1	0.303
3,301-10,000	6.3	0.014	11.5	0.090
10,000+	6.2	0.002	11.3	0.293
All Systems	--	0.025	--	0.162
Source: USEPA (1999), pp.6-1 and 6-2				

State and federal regulatory agencies have pursued numerous legislative, funding, and technical assistance initiatives intended to improve the performance of small systems. In the early 1990s several states began to experiment with programs to assess the viability of small water systems. These programs were intended to address several objectives:

- To better characterize the problems so that other instruments of state policy beyond the domain of public health regulation can be brought to bear upon it;
- To identify "troubled" systems in need of some sort of help or some sort of fix to avert failure;
- To prevent other systems from slipping into "troubled" status;
- To require greater assurance of viability as a condition for approval of the formation of new systems. (Cromwell & Rubin, 1995)

Early viability assessment programs borrowed heavily from business and banking models. One of the key requirements of these models is that water systems must be operated as businesses that are able to account for the full cost of providing services, and operated independently of subsidies to or from other units of government. The premise of this approach is that that only by using this type of “strict economic evaluation" will managers have the correct information needed to plan for the long-term future of the system. (Beecher, et al. 1992; Cromwell & Rubin, 1995; Jordan, et al., 1997)

These early programs laid the groundwork for many of the capacity development provisions of the 1996 Safe Drinking Water Act Amendments and led to the popularization of the dictum that “water systems must be operated as a business” that has become a fundamental approach of many technical assistance programs. Financial management has since been recognized as the key to planning and management of small water systems: "without funding, water systems cannot afford to hire good managers, but without good managers, water systems will have trouble developing a plan to increase revenues” (NRC, 1997, p.7)

CASE STUDIES OF PERFORMANCE ASSESSMENT AND BENCHMARKING

The main goal of performance assessment and benchmarking approaches is to "identify the key factors that separate good small systems from those that are having problems" and find ways to use this information to improve water service” (Rubin, 1995). In the past few years, several authors and researchers have explored different methods to provide this type of evaluation.

The following sections provide the key details of four empirically based systems of financial performance evaluation for small water systems (a more complete summary of each appears in the annotated bibliography). In each of these studies, researchers set out to create a simple framework from which to identify and select the variables critical to successful financial management. These variables were then anchored to some comparative data from other water systems, and appropriate levels of performance were determined. In several of the studies, the authors also tested the discriminating power of their approach to identify those systems that were in need of assistance.

The Small Utility Ranking Formula or *SMURF* was developed for the Pennsylvania’s Public Utility Commission (Rubin and O’Neal, 1994). The goal of the authors was to develop a simple approach to identify water systems that were likely to be having difficulties. Twenty different indicator variables were selected, based on the criteria that they were easily obtained, and had been demonstrated to have a relationship to system performance. The variables included a mix of operating characteristics, expert based judgements, and financial ratios.

A 5-point scoring system was developed for each of the variables based upon the national water industry averages and the personal experience of the authors. The variables were grouped into four main categories: size, rates, management, and finance, with 25 possible points for each category and a total possible score of 100 points.

The authors then applied their index to a sample of more than 100 small water systems in Pennsylvania. They found that the scoring system was able to distinguish between systems that were performing well and those, which were not. They were also able to develop an index that categorized systems by problem areas, and thus to suggest possible actions for improvement.

Dreese and Beecher (1993) based their water system distress classification models on business failure prediction literature. Although, many of these models were data intensive and mathematically complex, they set out to borrow the essential findings of these studies to develop a simple, direct approach that could be quickly applied by regulators and system managers. Previous distress models had identified critical characteristics of business performance that could easily be measured using common financial ratios:

1) leverage
2) liquidity
3) profitability/income
4) historical earnings/profit trend

Dreese and Beecher were able to identify 10 different easily calculated financial ratios that measured these four general categories of financial performance. They selected seven of these that had a negative relationship to business failure. By summing these ratios an overall distress score, which varied inversely with the water system's financial performance was obtained.

In order to set up a classification index for the distress score, the authors collected financial information from a national water industry. They first ranked the water utilities by their return on equity and then calculated distress scores for the 15 highest and 15 lowest systems. These scores were then fit to a normal curve and 1.5 standard deviations (82%) was selected as the normal range of values for the distress scores. They then developed a four-category classification system (good/excellent, weak/marginal, distressed, bankrupt) that separated weak and distressed systems from the excellent systems.

Jordan, Carlson and Wilson (1997) borrowed a water-based analogy from the financial literature to express the four components that they argued are critical to financial health: the size of liquid assets *(the reservoir)*, cash flow *(inflow into reservoir)*, debt (*measure of the potential drain*), and expenditures (*draining of liquid assets*). The likelihood of the business failure of the water system is then described in terms of these factors.

Using data from balance sheets and income statements, the authors were able to create 96 different non-redundant financial ratios that described these four financial measures of system performance. Factor analysis was used to reduce this number to one variable that best expressed the measure in each category. The resulting four measures were:

- current assets/current liabilities – as the measure of the size of the reservoir (current ratio)
- net income + depreciation / principal & interest – as the measure of the inflow (cash flow ratio)
- total debt/total equity – as the measure of the potential drain on the system (debt to equity ratio)
- gross revenue / operating and maintenance charges: - as the measure of outflows (operating ratio)

Based on other studies the authors selected a fifth financial ratio, return on assets (net income/net assets) as the best over all measure of business performance. Using data from more than 400 water utilities in Georgia they tested the effectiveness of their four performance measures by regressing them against return on assets. They found that all four variables had a significant effect on return on assets.

The authors set the recommended levels of these measures based upon industry experience and logical inference. The level of return on assets must at least match what it would cost to cover the expense of borrowed funds for capital improvements, currently between 6 and 10 percent. Inflows into the system need to be kept high enough for the water system to pay all of its current bills and still have enough in reserve to service interest and principal payments. The authors concur with the 1.5 ratio that is recommend by investment services. The measure of the potential drain on the system is a measure of the number of dollars in assets that are based on borrowed funds, so this ratio needs to be at a minimum of 1.0. The authors suggest that a 2.0 or 3.0 level is more indicative of a healthy system. The authors cite previous research to set the minimum level of the current ratio, or measure of the size of the reservoir, at 1.6. They recommend 2.0 as a healthy level. The level of system expenditures, or outflows, must be at least 1.0 for a system to be self-supporting. Below this level, expenses exceed revenues. Systems with any debt at all must have an operating ratio greater than 1.0, and the level recommend by investment services is 1.5.

The approach developed by Cromwell and Rubin (1995) is perhaps the broadest investigation to date. Their study began with a search for indicators of performance that went beyond the financial indicators and included variables describing the physical, demographic and financial characteristics of small water systems in Pennsylvania. Using a variety of data sources the authors developed a data set for more than 240 small systems in 3 ownership categories.

In order to establish which of these variables were truly indicative of system performance the authors developed a “field assessment tool” that ranked water systems on 16 different criteria related to the long-term future performance. State drinking water officials used the assessment tool to rank the performance of a substantial number of the water systems in the database.

By statistically testing the variables included in the data set against the field rankings of the State officials, the authors were able to select a set of "indicators" that were linked to externally generated judgements of performance. The recommended level of performance or "benchmark ranges" were determined using a statistical process comparing the field ranking scores.

Separate benchmarks were derived for each of the three ownership types because of the differences in "tax laws, financing methods, bond covenants, and accounting practices." The authors proposed 24 benchmarks that could be used to identify those water systems that were the most likely to fall into difficulty. The authors also developed percentile rankings or "indicator profiles" for the 47 continuous variables used in the study. They caution that while these benchmarks and profiles can point to problem areas in system performance, the final judgement on a water systems long-term viability must include a "healthy dose" of subjective judgement.

SUMMARY

Although the challenges to drinking water systems often put the greatest burden on those small systems with the fewest resources, new tools are also evolving to provide assistance to these systems. Each of the approaches described above has made some small contribution to an increased understanding of tools for the evaluation of financial capacity.

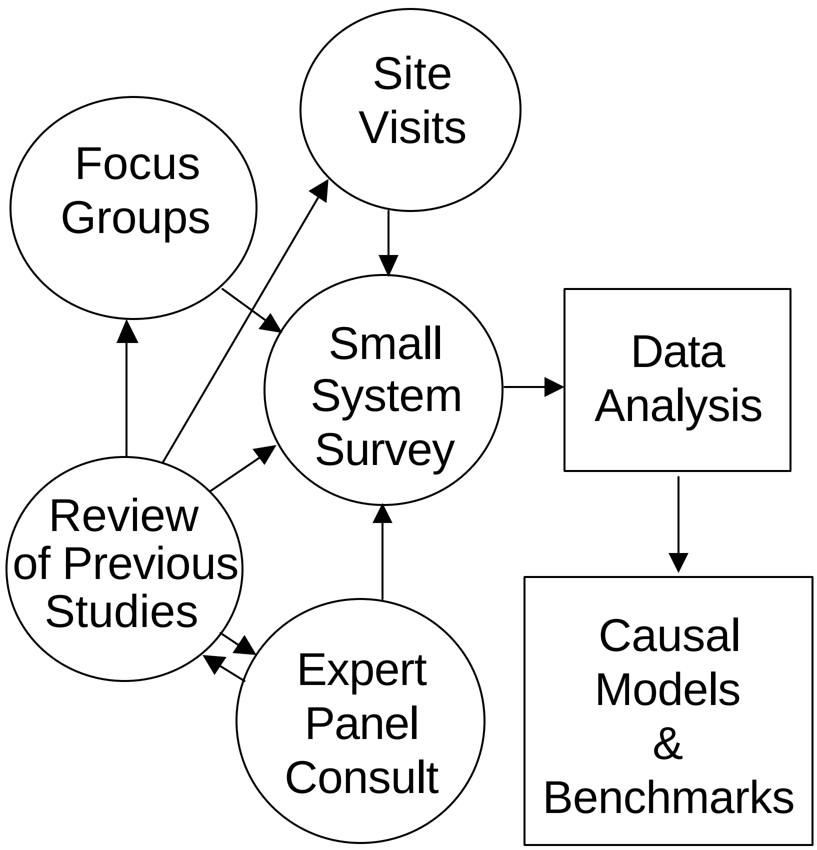
It is interesting to note that each of the approaches described above were developed prior to the passage of the 1996 Safe Drinking Water Act Amendments. The capacity development provisions in that legislation should provide an impetus for the development of numerous other approaches for the evaluation of financial capacity, and a host of new tools to assist small water system managers.

III. STUDY APPROACH

PURPOSE

This chapter describes the research approach used in this study, which consisted of five interacting components. Each of the first four study components were designed to produce findings that would supplement the other components, as well as contribute to information necessary for the development of a community water systems survey. Figure III-1 below represents the intended plan of work for the project.

Figure III-1. Study Approach



This approach to the study reflects the basic theme of soliciting the participation of as many members of the small drinking water community as possible, using a variety of interactive approaches. A search of the published literature, structured E-mail solicitations, on-site visits and interviews, interactions with technical assistance providers, focus groups, telephone interactions, and a mail survey were all used in the completion of this study. The following sections briefly describe the research methods used in completing the five study components.

PRELIMINARY INVESTIGATIONS

Three of the five components were required by the Request for Proposals: a review of the literature, a series of focus groups, and a survey of small water systems in the Midwest. Two additional components were added in the research proposal. The first was a structured interaction with professionals who had experience in working with small water systems, or who had a record of research in the study of drinking water issues. The advice of these professionals was used to provide direction for later stages of the study. The second additional component was a series of site visits to small community drinking water systems. The interviews with the managers of small systems were intended to provide some understanding of the record keeping practices and the need for performance assessment at small systems.

Although each of the components was intended to provide insight into the potential application of performance assessment approaches for small drinking water systems, the survey component was the most important. It was the tool that would be used to collect the data needed to produce the indicator measures and benchmarks that were required as one of the final products of the investigation. The non-survey components, while providing valuable information on their own, were all intended to collect information that could be used to increase the effectiveness of the mail survey, and in that sense were "preliminary" or "groundwork" steps in the study.

REVIEW OF LITERATURE

Purpose

The literature resources component of the study served to:

1) identify individual and organizational participants for the Expert Panel Consultation component of the project
2) collect evidence of the unique economic and operational characteristics of small drinking water systems that may contribute to difficulties in the financial management of these systems
3) provide direction for the development of statistical models to explore the causal factors driving costs, compliance, and reliability
4) review the history, rationale, and methodology of performance assessment and benchmarking
5) review past benchmarking applications in the water industry, and in particular for small water systems and to organize a collection of the indicators and benchmarks that have been recommended by previous studies and publications

The literature resources component of the study consists of an annotated bibliography and a topical listing of publications related to financial benchmarking and small water system management.

Search Methodology

An initial review of literature was conducted using the ILLINET Online System of Libraries, and several electronic indexes (Water Resources Abstracts, Social Science Index, Business Periodicals, Agricola). A secondary compilation of references was obtained from the bibliographies of publications obtained during the initial collection of documents. An Internet search was also conducted using available search engines, including reviews of the web sites of government agencies and non-governmental organizations that work with small community water systems. Participants of the Expert Panel Consultation component of this project suggested other relevant documents, and a bibliographic search was requested from the National Drinking Water Clearinghouse.

Selection of Publications for Inclusion

Publications were selected from the following topical areas:

- the "small system problem"
- the economics of small community water systems
- national statistical surveys of community water systems
- approaches to small system self-assessment
- benchmarking techniques and measures and empirical benchmarking studies
- empirical studies exploring the causal relationships between system performance and benchmarking measures

The type of publications reviewed included books, research reports and technical studies, government publications, self-instruction manuals, Internet documents, software, and pamphlets.

A few of the publications included are slightly redundant in that the authors use the same basic approach or data in several publications. However, these publications are included, because in all instances, the authors provide additional insights or information in each publication. Some sources may also be more easily accessible than others for those wishing to review complete copies of the annotated documents.

Annotation Format

The variety of types of publications included in the bibliography required a flexible approach in the preparation of annotations. Wherever possible, each annotation includes a bibliographical caption, states the purpose of the investigation or publication, describes the data used, causal relationships, key findings, and any conclusions or recommendations regarding benchmarks for small public water systems. The length of the annotations varies from a single paragraph to a few pages.

Also, because of the overall purpose of the study was to develop and test indicators of financial performance, when such measures are used or recommended in a publication, these are described in the annotation, most often in the form of a list or table.

The publications in the annotated bibliography are listed in alphabetical order. A topical categorization and more comprehensive list of publications is included in the *Topical Listing of Relevant Publications* section that follows the *Annotated Bibliography*. Both documents are found in Appendix A.

EXPERT PANEL CONSULTATION

Purpose

The purpose of the expert panel consultation was to solicit opinions on the important premises and requirements of financial benchmarking for small water supply systems. Comments and suggestions collected during the consultation were intended to provide guidance for other project components, in particular to collect input on the design and implementation of the survey component. A secondary purpose of the consultation was to alert key members of the small water system community in the region to the project so as to open avenues of communication and support for the later stages of the project.

Selection of the Expert Panel

Panelists were selected from the following groups that are involved in some way in the financial management of small community water systems:

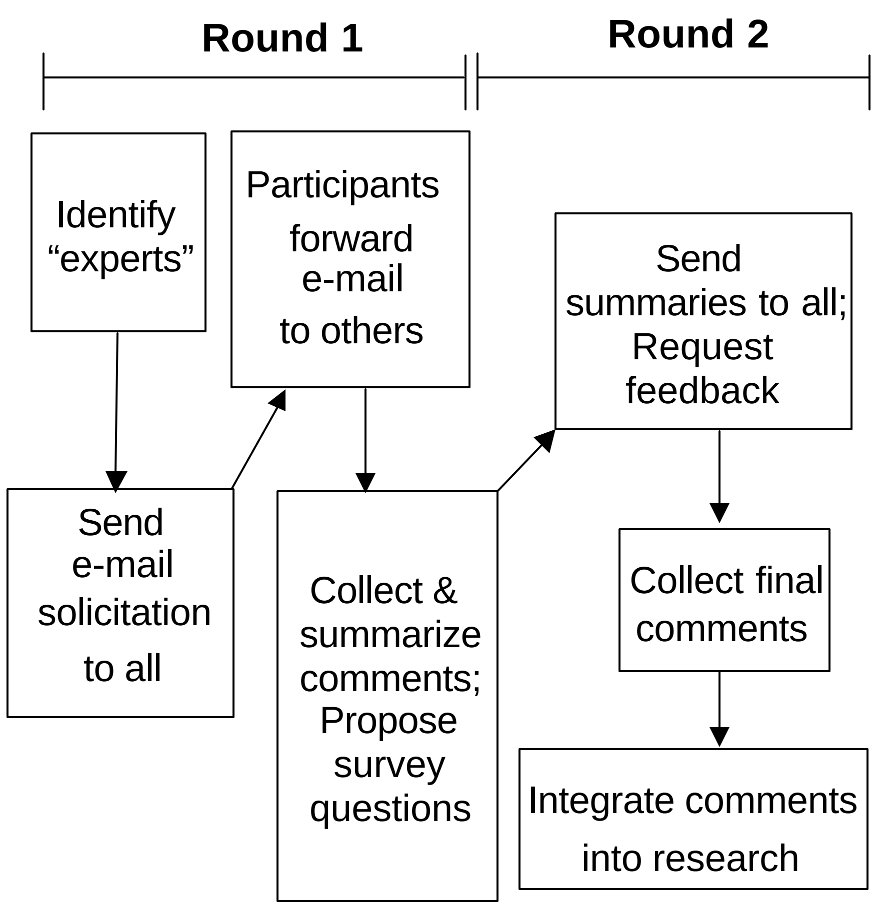
- Authors of research articles about benchmarking and small water system economics
- State drinking water regulatory offices
- State and national offices of the National Rural Water Association
- Rural Water Education and Research Foundation
- State and national offices of the American Water Works Association
- State offices of the Rural Development Administration/Rural Utilities Services
- Regional offices of the Rural Community Assistance Program
- Offices of the regional Technical Assistance and Environmental Finance Centers
- USEPA national and regional offices
- Financial consultants

Panelists and organizations were identified during the review of the literature. The consultation was conducted using E-mail in order to facilitate the participation of panelists. E-mail addresses for potential panelists were obtained from the web sites of national and state organizations.

The Consultation Process

The consultation method can best be described as a modified Delphi approach. It consisted of two rounds of E-mail messages. In the first round, panelists were sent a short background description of the problems of small water systems, and the proposed use of financial benchmarking as a strategy to address these problems. A series of questions and statements about the development and use of benchmarking, and a list of pertinent documents and publications followed the background section.

Figure III-2. Expert Panel Consultation Process



Panelists were asked to respond/react to the questions and statements in any way they saw fit. The E-mail message requested that panelist submit their replies within one week (responses were actually collected for nearly two weeks). The responses from the panelists were next summarized, and a working list of survey questions, based upon the summaries, was developed.

In the second round of the consultation, panelists were sent the summary of the first round responses along with the working list of survey questions. They were once again asked to respond as they saw fit. The responses of the second round were combined with those of the first round, and a series of recommendations for further research was developed based upon this information.

A summary of the results and recommendations of the Consultation are found in Chapter IV. The complete record of correspondence of the Expert Panel Consultation appears in Appendix B.

FOCUS GROUP MEETINGS

Background: Focus Group Research

Focus group research is a qualitative technique that collects information about the diversity of experiences, situations, and responses of individuals.

Focus groups typically involve an informal discussion, among a selected group of individuals, in a non-threatening environment. The discussion is directed by a moderator, and guided by a pre-selected series of questions, on topics of interest to the focus group sponsor. Researchers act as the link between the participants and the sponsor. The data that are derived from the focus group is the "conversation" that takes place during the group meeting.

Focus groups are usually too small to be statistically representative of the universe of possible responses, but provide an opportunity to obtain an in-depth perspective of the topics under investigation. Focus groups are therefore often used as a preliminary step to further research efforts, or to guide the implementation of programmatic interventions.

Purpose

As part of the benchmark study, the Midwest Technology Assistance Center (MTAC) required that the research team "convene focus groups involving different segments of the small public water systems community in the Midwest to assess the potential value of systematic benchmarking." The focus groups also attempted to establish the familiarity of those involved in the management of small water systems with benchmark measures and techniques, and to identify some of the performance indicators are already in use. Finally, the focus groups provided an opportunity to listen to the members of the small system community on a variety of related issues regarding the needs and management of small water systems.

The Focus Group Plan

The project team identified three potential constituencies that play a role in the financial management of small community systems: water system managers, staff members of technical assistance organizations, and state and federal drinking water officials. Each of these groups are potential users of financial assessment tools or benchmarking guidelines.

In order to facilitate the participation of focus group members with the least inconvenience, each focus group was "piggy-backed" onto a scheduled conference or meeting. The goal was to have 8 to 12 participants at each of the 3 focus groups.

Prior to the beginning of each focus group session, one member of the project team gave a brief presentation on the Technology Assistance Centers and the role of benchmarking in the water industry. This presentation was intended to inform conference attendees about these topics, as well as to serve as an introduction to benchmarking for the focus group participants.

At the beginning of each session participants were provided with a one-page summary of the goals of the benchmark study and a sheet assuring them of the confidentiality of the comments that they provided during the focus group session. These documents were reviewed and approved by the Southern Illinois University Human Subjects Committee.

Although a slightly different format was used for the questions in each focus group, their substance can be summarized by two main questions:

> (1) What are the measures that you currently use to assess the financial performance of small water systems?
>
> (2) What do you think of the potential of financial benchmarking as a tool to assess the performance of small water systems?

The responses of the focus group participants were documented, summarized, and grouped into themes. The conclusions and recommendations are based on an analysis of these themes and are presented in the Chapter IV. Further details and selected comments from participants in each of the focus group sessions are included in the Appendix C.

SITE VISIT COMPONENT

Purpose

The site visit component of the project was intended to collect information from small community water system staff members that could be used in the design and implementation of the mail survey component. Several types of information were targeted:

1) Availability of financial records and record-keeping practices
2) Measures used to assess financial health of system (current "benchmarks")
3) Receptivity to survey questionnaires and suggestions for ways to increase the participation of small systems in the survey component
4) Suggestions for ways to distribute the final results of the project to system managers

Also, during the implementation of the mail survey, more than 40 of the survey participants contacted the project team by telephone. The comments made during these telephone discussions were entered in a telephone log. Because of the similarity of these comments to those made during the site visits, and the value of this feedback from small system managers, they are included in this report as an Addendum to Appendix D.

Methodology

The plan of work for the project called for a series of site visits to water systems in Illinois and several of the surrounding states. The project team planned to contact state Rural Water Associations (RWA) and Rural Community Assistance Programs (RCAP), and where possible, conduct interviews during scheduled visits from these technical assistance providers. The purpose of the proposed team approach was to reduce the inconvenience of the visits to the water system managers, and take advantage of the established rapport of technical assistance field staff to improve the likelihood of an effective interview. This approach was also intended to provide an opportunity for the research team to listen to the ideas and opinions of field staff about financial benchmarking for small water systems.

In preparation for the site visits a tentative lists of questions, a letter of introduction, and a statement assuring confidentiality, as required by the Southern Illinois University Human Subjects Committee, were prepared. Copies of these documents are included in Appendix D.

Implementation of the Site Visits

State rural water association offices and rural community assistance program offices were contacted in three states to attempt to schedule joint site visits. Unfortunately, scheduling turned out to be more difficult than anticipated, and after repeated efforts, site visits were only arranged with one technical assistance provider.

Initial telephone contacts with the systems were made by either the project researcher or the technical assistance provider. During the calls, a request was made to meet with someone who could discuss the finances of the water system, and dates and times for the visit were arranged. Follow-up letters were sent to confirm the visit and to clarify the purpose of the project. Site visits were made to eight water systems in one state, including four municipalities, three rural water districts, and one mobile home park. Interviews lasted between 30 minutes and 2 hours. The people interviewed included accountants, board members, engineering consultants, mayors, operators, and utility superintendents. Discussion of the findings of the site visits appear in the Chapter IV.

MAIL SURVEY OF SMALL COMMUNITY WATER SYSTEMS

Purpose

One of the required components of the benchmark study was a survey of small water systems in the Midwest. The intent of the survey was to collect data that can be used to "assess the causal relationships between system size, age, usage patterns, and treatment processes, and system outcomes, including reliability, cost, and compliance." These data were also to be "translated into potential benchmarking tools for use by small system managers and consultants."

Survey Development

The research design set out a plan to collect feedback from different constituencies of the small water system community as to the type of measures that could potentially serve as benchmarks and the type of information that could reasonably be expected to be collected using a mail questionnaire. The initial selection of information to be collected during the survey component was dictated by the Request for Proposal (RFP). It required that that the survey be used to collect information on:

- ownership
- water source
- treatment
- system flow and usage patterns
- rate structure
- debt service costs

- operating revenue base
- operating and maintenance costs
- other associated information

The literature review identified several variables that were used by previous benchmark studies of small water systems, and an effort was made to include questions that would permit a comparison with these studies. The expert panel consultation asked panelists to both criticize a sampling of "draft questions" and to suggest questions of their own. Both the content and implementation of the survey were discussed during focus group sessions and in site visits to small water systems. Finally, USEPA's most recent survey of community water systems was reviewed, with the intention of providing comparison to some of the financial data collected during this national effort.

Sample Design and Selection

Data Sources

The data source used in the development of the sample frame was the Safe Drinking Water Information System (SDWIS). The SDWIS database is a revised version of the Federal Reporting Data System that was developed under the 1974 Safe Drinking Water regulations to monitor the activities of all public drinking water systems in the United States. Data are submitted quarterly by the states to SDWIS. The particular data set used for this research project was obtained through Freedom of Information Requests from the offices of USEPA Regions 5 and 7.

The following data elements were obtained for all of the (formally defined) Community Water Systems in the 10 states included in USEPA Regions 5 and 7:

System Name
SDWIS ID
Ownership category
Service Population
Number of connections
Number of SDWA violations for the last 3 years
Contact information (Name, address)

System identification data were taken from the July 1999 edition of the SDWIS report. The three years of violations include all violations for the three years preceding that date. The SDWA violation data were reduced to two violation categories. Four types of maximum contaminant level violations (single sample, average, acute/TCR, monthly/TCR) were combined and summarized as "MCL" violations. Eight types of monitoring violations (regular, check/repeat/confirmation, routine major and minor TCR, repeat major and minor TCR, routine/repeat SWTR-unfilt, and routine/repeat SWTR-filter) were combined and summarized as "Monitoring" violations.

Development of the Sampling Frame

Information was obtained for the more than 10,000 community water systems in the 10-state region. A preliminary data screening revealed some duplicate listings. Once these were removed, the number of available systems was 11,614. Further review of the data revealed that some of the contact information fields were missing for several of the states. This information was later obtained from state regulatory officials.

Four criteria were used to select the systems that would be included in the sampling frame. The first selection criterion was that systems be "community" water systems, based upon the scope of the project as defined in the RFP, and the proposal submitted to MTAC. The USEPA defines community water systems as those that "have at least 15 connections used year-round by residents or regularly serve at least 25 residents year-round" (Drinking Water Infrastructure Needs Survey, 1997, p.1). It was assumed that the all of the 11,614 systems provided by USEPA were community systems, as specified in the FOIA requests sent to USEPA.

The second selection criterion was system size. The impact of the economies of size is one of the factors driving research into the financial performance of small water systems. "Small" water systems had been identified as those that serve 1,000 connections, or having a service population of 3,300, during the Expert Panel Consultation phase of this study. A review of the data revealed a high correlation between these two measures, although some systems with large service populations had few connections, and several systems reported a larger number of connections than population served. The service population of 3,300 or less was chosen as the definition of "small system" used in this study. All systems with larger service populations were removed from the frame. An additional size category field was also added to each record based on the eight service population size categories used in USEPA's 1995 Community Water System Survey. These categories were used during the sample selection process to assess whether the sample was representative of the frame.

Water system ownership type was the third criterion. Discrimination by ownership type is necessary because its influence on managerial motivations, system cost structure, and accessibility to subsidized financing and technical assistance. The original data set contained six different categories of ownership (federal, state, Native American, local, private, and mixed public-private). The majority of the systems have either local or private ownership and this matched the "public – private" ownership criteria that had been included in the project RFP and reviewers comments on the project proposal. Therefore, systems having any other type of management were discarded. In addition, the ownership field was blank for a small number of water systems in several states. These systems were discarded from the sample.

The type of water source was the fourth criterion. The source of water used by a water system has a significant effect on the management and associated costs of operating a water system. Three types of sources are considered in this study: surface water, groundwater, and purchased water. The USEPA data set lists five different categories of water source: surface, ground, ground water under the influence of surface water, surface water purchased, ground water purchased, and ground water under the influence of surface water purchased. These were reduced to three categories. Surface and groundwater systems were used as listed. The three "purchased" categories were combined into one, under the assumption that most purchased water is already treated (to verify this, the "source water question" in the questionnaire did request specification of treated/untreated). Systems with ground water under the influence of surface water were reclassified as surface water, since these systems must meet all of the requirements of surface water systems.

Finally, at the study sponsor's request, the Illinois EPA was contacted to obtain a list of 19 water systems that had been contacted in the Fall of 1999 as part of a USEPA sponsored "Needs Survey". In order to reduce the burden on these systems that might come from "over-surveying" these systems were removed from the sample frame.

The final sample frame consisted of 9,468 community water systems. Four size categories, two ownership categories and 3 source categories, were used in an initial disaggregation of the data into 24 categories.

Sample Selection

The original project proposal stated that survey questionnaires would be sent to1,000 water systems in the 10-state region. However, during the earlier phases of the project, substantial anecdotal evidence pointed to exceptionally low survey response rates from small water systems. The USEPA's 1997 survey effort (*Community Water Survey. Volume II: Detailed Survey Result Tables and Methodology Report*, *Jan. 1997*) revealed that even with a substantial 2-stage survey effort, including advance phone calls to water systems, EPA's contractors were able to achieve only an average 50% response rate for systems in the 4 smallest EPA population size categories (systems serving less than 3,300 people). MTAC's own *1999 Small Water System Needs Survey* was only able to achieve a 20% response rate. Consequently, the sample size for the initial survey mailing was doubled (to 2,000) in an effort to secure an adequate number of responses for the analysis.

The sampling frame was created as described above. A review of the distribution of systems in the sample frame revealed that it was skewed towards 6 of the 24 population size/ownership type/source water categories. The remaining 18 categories each contained less than 4% of the total frame, and 11 of these contained less than 1%. The number of systems per category ranged from 4 to 2,003. Half of the categories contained 100 or fewer systems.

This uneven distribution of systems across the different categories, and the very low numbers of total systems in some categories, made it likely that some of the water system categories (particularly surface water systems) would not have enough responses to permit a statistical analysis of these systems using a random sample. Therefore, an "allocated" sampling approach described below was used to select the sample of water systems that would be sent the mail questionnaire.

Based on the evidence from the *USEPA National Survey*, and other surveys of small water systems, it was assumed that a 25% response rate would be a reasonable estimate of the response rate from small water systems using a three-mailing approach (survey/postcard/survey). The following "allocation procedure" was thus used to select the sample:

1) All categories that would yield a sample size of less than 30, at the 25% sampling rate, were included at 100% of their size in the sample frame. This procedure resulted in 541 systems being included in the sample.
2) Next, because the total number of surface water systems in the sample frame is quite small (264 or 2.8%), all of the surface water systems that were not already included in the sample (from #1 above) were included at 100%. This added another 138 systems to the sample (N = 639)
3) Next, 120 systems from each of the remaining 10 categories were included. This number would yield a respondent size of 30 for each category, based on a 25% response rate. This raised the total number in the sample to 1,879. These were distributed evenly to the 5 categories in the less than 500 population served groups. This decision was based on evidence from the *1997 National Survey* that smaller systems are less likely to respond.

A review of the final distribution of systems revealed that the sample resulted in a disproportionate representation of several of the states in the study area. One final adjustment was made to the sample to ensure that each state had a minimum of 120 systems in the sample. To do this systems in similar categories were shifted from states that had a larger representation to those having less than 120. Care was taken to maintain the categorical integrity of the sample.

Finally, the sample data set was reviewed. It was noted that several addresses and persons were represented multiple times in the sample (denoting the management of multiple systems by single firms or individuals). To avoid an undue burden on respondents, any address or person that was represented more than once was sent only a single questionnaire. To replace these duplicates, substitute systems, with matching characteristics, were randomly selected from the sampling frame.

The final sample size by category is displayed in Table III-1, along with the category sizes from the sampling frame, and the sampling rate (the number of systems in the frame divided by the number in the sample multiplied by 100) of each segment of the sample.

Table III-1

Sampling Frame By Service Population Size Category, and Primary Water Source, and Allocation of Systems to Sample

Population Size Category	Ownership Type	Primary Source	Frame N	Frame %	Allocated Sample N	Allocated Sample %	Sampling Rate %
100 or less	L	G	208	2.20	141	7.05	68
100 or less	L	P	100	1.06	93	4.65	93
100 or less	L	S	13	0.14	12	0.6	92
100 or less	P	G	2003	21.16	162	8.1	8
100 or less	P	P	49	0.52	38	1.9	78
100 or less	P	S	6	0.06	6	0.3	100
101 - 500	L	G	1506	15.91	171	8.55	11
101 - 500	L	P	479	5.06	141	7.05	29
101 - 500	L	S	40	0.42	40	2	100
101 - 500	P	G	1371	14.48	146	7.3	11
101 - 500	P	P	71	0.75	56	2.8	79
101 - 500	P	S	6	0.06	6	0.3	100
501 - 1,000	L	G	1040	10.98	134	6.7	13
501 - 1,000	L	P	275	2.90	119	5.95	43
501 - 1,000	L	S	50	0.53	50	2.5	100
501 - 1,000	P	G	193	2.04	113	5.65	59
501 - 1,000	P	P	37	0.39	26	1.3	70
501 - 1,000	P	S	7	0.07	7	0.35	100
1,001 - 3,300	L	G	1350	14.26	146	7.3	11
1,001 - 3,300	L	P	364	3.84	116	5.8	32
1,001 - 3,300	L	S	138	1.46	138	6.9	100
1,001 - 3,300	P	G	120	1.27	106	5.3	88
1,001 - 3,300	P	P	38	0.40	29	1.45	76
1,001 - 3,300	P	S	4	0.04	4	0.2	100
Total Systems			**9468**	**100**	**2000**	**100**	

Ownership Type	Frame N	Frame %	Sample N	Sample %	Diff from Frame %
L	5563	58.8%	1301	65.1%	6.29
P	3905	41.2%	699	35.0%	-6.29

Ownership Codes
L = local/publicly owned system
P = private ownership

Primary Source	Frame N	Frame %	Sample N	Sample %	Diff from Frame %
G	7791	82.3%	1119	56.0%	-26.34
P	1413	14.9%	618	30.9%	15.98
S	264	2.8%	263	13.2%	10.36

Source Codes
G = ground water
S = Surface water
P = purchased water

Pop Size Category	Frame N	Frame %	Sample N	Sample %	Diff from Frame %
100 or less	2379	25.1%	452	22.6%	-2.53
101 - 500	3466	36.6%	560	28.0%	-8.61
501 - 1,000	1609	17.0%	448	22.4%	5.41
1,001 - 3,300	2014	21.3%	540	27.0%	5.73

Survey Implementation

A draft version of the survey questionnaire was prepared and sent to a sample of small water systems, technical assistance providers, and state agencies for review. Minor modifications were made to the questionnaire based upon the comments that were received back from this pretest, and final copies of the questionnaire, return envelopes, and reminder postcards were prepared.

The initial mailing of 2,000 questionnaires took place on May 30, 2000. The follow-up postcard was mailed one week later. A sample of the survey was sent to the state drinking water agency in each state with a letter asking state agencies to refer all questions regarding the questionnaire to the benchmark study team and asking agency staff to encourage systems to participate. In at least one state (Illinois) the state director did ask regional staff members to encourage systems to participate.

A second mailing of 1,000 questionnaires was sent 24 days after the initial mailing. The systems receiving a second questionnaire were selected randomly from the sub-sample of systems that had not yet returned questionnaires or had not had their original questionnaires returned because of bad addresses. A second round of questionnaires was not sent to the entire set of non-respondents because the original study proposal only budgeted for a mailing of 1,000 questionnaires in each round.

The largest number of questionnaire returns occurred 14 days after the initial mailing. The closing date for receiving questionnaires to be included in the study was August 3, 2000. Five surveys were received after that date but were not included in the analysis.

Survey Response

A total of 350 surveys were returned, including some that were only partially completed. There were 107 questionnaires returned by the post office as undeliverable, 12 questionnaire were returned blank; two questionnaires were returned unanswered because the system owner was deceased; 6 questionnaires were returned unanswered because ownership of the systems had been transferred, and one was returned from a system that refused to participate in the study.

Following the initial mailing numerous phone calls were received from questionnaire recipients. Five of the systems who received questionnaires called to say that they were regional water providers that had been mistakenly identified as small systems and could not participate in the study. Four other recipients called to say that they did not wish to participate in the study. The survey response rate, after excluding surveys returned with bad addresses, blank questionnaires, refusals, etc. (n=137) was approximately 18 percent.

Table III-2.

Comparison of Sampling Frame, Sample, and Survey Respondents By Population Size Category, Ownership Type, and Primary Water Source

Population Size Category	Ownership Type	Primary Source	Frame N	Frame %	Sample N	Sample %	Survey Respondents N	Survey Respondents %
100 or less	L	G	208	2.20	141	7.05	19	5.43
100 or less	L	P	100	1.06	93	4.65	10	2.86
100 or less	L	S	13	0.14	12	0.60	0	0.00
100 or less	P	G	2003	21.16	162	8.10	32	9.14
100 or less	P	P	49	0.52	38	1.90	5	1.43
100 or less	P	S	6	0.06	6	0.30	1	0.29
101 - 500	L	G	1506	15.91	171	8.55	37	10.60
101 - 500	L	P	479	5.06	141	7.05	28	8.00
101 - 500	L	S	40	0.42	40	2.00	10	2.86
101 - 500	P	G	1371	14.48	146	7.30	21	6.00
101 - 500	P	P	71	0.75	56	2.80	10	2.86
101 - 500	P	S	6	0.06	6	0.30	1	0.29
501 - 1,000	L	G	1040	10.98	134	6.70	33	9.43
501 - 1,000	L	P	275	2.90	119	5.95	18	5.14
501 - 1,000	L	S	50	0.53	50	2.50	10	2.86
501 - 1,000	P	G	193	2.04	113	5.65	11	3.14
501 - 1,000	P	P	37	0.39	26	1.30	1	0.29
501 - 1,000	P	S	7	0.07	7	0.35	0	0.00
1,001 - 3,300	L	G	1350	14.26	146	7.30	29	8.29
1,001 - 3,300	L	P	364	3.84	116	5.80	10	2.86
1,001 - 3,300	L	S	138	1.46	138	6.90	25	7.14
1,001 - 3,300	P	G	120	1.27	106	5.30	12	3.43
1,001 - 3,300	P	P	38	0.40	29	1.45	4	1.14
1,001 - 3,300	P	S	4	0.04	4	0.20	2	0.57
Total Systems			**9468**	**100**	**2000**	**100**	**329**	**94.05**

Ownership Codes

L = local/publicly owned system (respondents that checked "Public" or "Other Public" on questionnaire)

P = private ownership (respondents that checked "Private - Investor Owned, Homeowners Assn., Mobile Home Park, or Other" Private on questionnaire)

Source Codes

G = ground water

S = surface water

P = purchased water

Notes:

The 1,001 - 3,300 group of respondents includes four (4) systems that reported service populations between 3,301 and 3,500.

Nineteen (19) responding systems reported service populations of greater than 3,500 and were not included in the table above.

Two (2) public systems (one each in the 101-500 & 501-1,000 categories) did not report their water source and were not included in the table above.

The sampling procedure used in the study was intended to insure an a statistically adequate sample for each of the different combination size, ownership and population categories of small water systems and was not intended to be representative of the population of small water systems in the Midwest. Table III-2 displays the distribution of water systems in the sampling frame, the sample, and the group of systems that responded to the mail survey. The effect of the over-sampling procedures used is evident in the comparison of the distribution of systems in the sampling frame and the sample of systems that received questionnaires.

The response rates for each category of water system were compared to the average response rate to assess whether or not there was any systematic non-response bias to the survey. On the whole, response rates were slightly lower for surface water systems, although this really reflects the balance between greater than average response rates in some individual size and ownership categories, and less than average in others. Two of the surface water categories had no respondents. Groundwater and surface water systems responded at approximately the average rate. Private systems were slightly less likely to respond than average.

Quality Assurance and Control

All returned completed and partially completed survey forms were given a new identification numbers and were reviewed for internal consistency of responses. In cases where "implausible" answers were reported, they were checked against other questions in the survey, or where available against information in the Safe Drinking Water Information System. These values were then either adjusted or assigned a missing value code.

The information from the edited questionnaires was entered into an MS Access database. A second step in the quality assurance process was based on the analysis of the distribution of values of for individual questions and relationships between reported numeric values (such as persons/connection or $/unit volume). The extreme high and low values for individual variables were checked against the original surveys and corrected where appropriate of assigned a missing value.

Analysis of Survey Data

The final survey data set consisted of 350 observations. More than 150 data fields, representing reported information and calculated variables were included in the final data set for each observation. The data set was loaded into two statistical packages (JMP IN and S-PLUS). The analysis used descriptive statistics, comparisons of group tests (t-tests, Chi-Squared, F-tests), as well as multivariate regression procedures, including logit regression.

IV. RESULTS OF GROUNDWORK CONSULTATIONS

PURPOSE

The purpose of this chapter is to summarize and report on the findings of the Expert Panel Consultation, the Focus Group Meetings, and the Community Water System Site Visits. The results of the Community Water System Survey are reported in Chapter V.

EXPERT PANEL CONSULTATION RESULTS

Consultation Respondents

The survey was initially sent to 65 individuals. Of these four were returned because of inadequate E-mail addresses. Two of these E-mail addresses were corrected and resent. The other two were deleted from the mailing list. Eight people were either referred to the research team by respondents and were sent copies of the E-mail survey, or had been sent copies of the survey by those in the initial mailing. The total number of possible respondents was 73.

Twelve surveys were returned from the first round. Of these two contained no comments, but requested a copy of the final report. Ten surveys contained comments, and these were used to develop the summaries and questions for the second mailing. All 73 panelists received copies of the second round E-mail message. Additional second-round comments were received from four panelists.

Summary and Recommendations

The Panel made several key recommendations on how to proceed with the Benchmark Investigation:

What constitutes a small system? Definition of the target population

Respondents recommended that small and very small systems, including systems serving homeowners associations and mobile home parks, be included in the study. Service population and number of connections were the most frequently cited measures of size. Comments on the sampling frame, suggest that two approaches could be used: a proportional stratified random sample of water supply systems serving 25 to 500 customers, and 501 to 3,300 customers; or a proportional stratified random sample of systems serving from 15 to 200 connections, and 201 to 1,000 connections. Respondents also suggested the inclusion of systems up to a service population of 10,000. Several respondents commented on the many likely problems of using a mail survey as the primary data collection tool for benchmarking information from small water, and recommended that secondary data from State agencies be used instead.

Categorizing systems for benchmarking

Several suggestions were made on the appropriate categorical grouping of the small water systems for the purpose of developing benchmarks. The most frequently mentioned dimensions included source of water (groundwater, surface water, purchased water), system ownership (public, private), and system size. It was also suggested that statistical tests of significance be used to identify and retain the categories for which separate benchmarking measures would be most appropriate.

Characteristics of successful systems

Panelists identified several characteristics of successful water systems. Adequate cash flow, effective management, and consistent production and delivery of water meeting maximum contaminant levels were seen as sure indicators of a successful system. Factors associated with troubled systems were: lack of a certified operator, poor or co-mingled accounting system, under-priced water, inability to generate reserves for capital improvements, and noncompliance with water quality standards.

Indicators of water system "performance"

The candidate benchmark measures or "best indicators of performance" suggested by the panelists included:

- unit cost of water production
- retail price of water
- debt service coverage ratio,
- availability and size of the reserve fund
- system water loss ratio
- age of system components
- frequency of loss of service events
- number of customer complaints
- quality of finished water.

Benchmarking Needs and Users

The majority of panelists believed that there is a need for benchmarking tools by small system managers. The availability of useful benchmarks would allow system managers to communicate the need for improving the quality of service and financial position to community decision-makers. Rather than being used as a viability test, the most useful role of benchmarking may be to provide a system with information regarding its relative position with respect to its peers. Also, while panelists voiced a real need for the development of benchmark measures for system managers, the "most likely users" of the measures were overwhelmingly identified as regulatory officials, rating services, and water boards and councils.

FOCUS GROUP COMPONENT RESULTS

Participant Experiences and Perceptions

A short summary of the experiences and perceptions of the focus group participants appears below. These are listed as a series of "findings" (in italics), followed by a brief explanation.

The small system problem is well recognized: While participants in each groups provided numerous examples of well run systems, even in economically disadvantaged areas, they also identified many of the problems of small systems. All of the groups agreed that the smallest systems were likely to have the biggest problems. The general opinion expressed was that the seriousness of many of these problems was beyond the scope of benchmarking to improve, thus earning the technique less than a complete endorsement by focus group participants. There was general agreement among regulatory officials that non-community water systems generally posed a much greater problem in large part because of the lack of an "accountability structure".

There are numerous disincentives to effective financial management: Benchmarking requires that systems adopt a more business-like management approach. Focus group participants cited numerous reasons why small system financial management may not conform to a business model. These included:

1. Political and other incentives to keep rates low
2. Water sales revenues are used to subsidize other community needs
3. Water supply is often the only income generating activity in a community, especially if it lacks commercial establishments
4. Systems that are managed the worst are most likely to get preferential treatment for grants or low-interest loans
5. Some loan programs provide a "continuous" subsidy for poorly managed systems
6. Few training programs are available for financial management
7. The individuals responsible for making financial decisions may have the least training in water system operation or financial management

Familiarity with benchmarking as a tool for financial analysis is limited, and financial information is largely unavailable: Although each of the groups presented numerous indicators that they use to identify and measure water system performance, none of the participants appeared to have had more than incidental experience with financial benchmarking. Participants in all of the groups also commented on the lack of record keeping as one of the characteristics of those systems most in need of improved financial management.

Water rates dominate discussion of financial management: Water rates were a topic of considerable discussion in each of the groups. Although water rates should reflect the unique physical, technical, and organizational attributes of each water systems, water rates continues to be a dominant standard or indicator for comparing water system performance. Customers and local municipal officials often resist water rate increases, even when rates have not kept pace with increasing costs. Small system managers bear the burden of educating public officials and customers. Many of the participants, especially in the session of system managers, described the persistent inadequacy of water rates and revenues to meet system needs.

Interest in financial management is still new: The regulatory emphasis on meeting monitoring and reporting standards may have overwhelmed interest in bringing about good financial control. Few systems of standardized collection of financial information have been introduced.

"Key individuals" are the driving force in the successful management of small water systems: Participants in each of the three groups noted that effective small water system management was almost inevitably the product of one, or a few individuals, who have taken the initiative to do whatever it takes to get the system in shape and keep it running. These individuals generally volunteer large amounts of their personal time to the management and promotion of their water systems and communities. These individuals very often follow in the footsteps of individuals or groups that have allowed their system to fall into disrepair over a long period of time.

Role of loan programs in improving small system performance: There was disagreement as to whether or not subsidized loan and grant programs improve water system performance and financial management skills. One group argued that the availability of these funds simply allowed water systems to continue with poor management practices, because they are continually being "rescued" from financial ruin. The opposing opinion was that the reporting requirements mandated by subsidized programs often encourages fiscal discipline for the first time, and provides "training" in proper record keeping and financial management.

Participant Suggestions

Participants volunteered several suggestions for using financial benchmarking and other techniques to improve small systems. These are summarized below.

Non-community water systems: Benchmarks developed for mobile home parks, home owners associations, and very small systems may be applicable to the management of non-community water systems.

"Qualitative" indicators may be as important as accounting data: "Accounting metrics" do not tell the whole story of water systems performance. Other easily observed signals (such as condition of the water tower of treatment plant, or the level of participation at board meetings) may just as effectively measure the overall condition of a water system.

"Process/Practices" benchmarks may be equally valuable to small systems: Participants in each of the sessions suggested that a list of exemplary practices used by small systems to improve management would be a useful tool for system managers.

Focus groups are an effective technique to explore small water system issues: Several participants in the system manager session suggested that the focus group technique was an effective forum for the exchange of information. Participants had a wealth of information drawn from years of experience dealing with the day-to-day problems of their systems, but had never been provided with the opportunity to share these experiences in a structured setting. Most of the managers at the meeting expressed the opinion that regulatory officials and consulting engineers frequently ignore their input, and that this is the source of many subsequent problems. Focus group sessions were suggested as one way to overcome this situation and improve water system management.

Summary and Recommendations

Several conclusions and recommendations can be made regarding the potential use of systematic benchmarking for small water systems based on the comments and experiences shared during the focus group sessions.

In general, efforts to implement financial benchmarking may be premature for the majority of small and very small water systems. Thus the development of programs that focus on developing standardized record keeping procedures may be a necessary precursor to widespread adoption of benchmarking practices. These could include: incentives to establish standardized forms of record keeping, training for managers to improve business attitudes, programs to promote greater awareness of benchmarking concepts and techniques, projects to support data collection and analysis.

Other on-going efforts such as the development of new technologies, incentives to restructure systems to capture economies of size and scope, educational programs for water management boards, and loan and grant programs to overcome capital constraints are considered to be more important. However, these programs may offer opportunities to serve as a venue for training system managers to collect data and use data for performance assessment.

Different forms of financial performance assessment will need to be implemented to meet the capacity development requirements of the 1996 Safe Drinking Water Act Amendments. Regulators are likely to look to metric benchmarking to assist in this process. Each of the constituencies participating in the focus group sessions do have a need for benchmarking tools, and thought that they would find them useful if properly developed and implemented.

SITE VISIT COMPONENT RESULTS

Findings

The comments from individual site visits were reviewed and organized into major issues or themes. These themes were divided into two groups: those that directly relate to objectives of the benchmark investigation, and those that, while not directly related to the goals of the project, contribute to a better understanding of the situation faced by the managers of small community water systems. The themes related to the project were summarized into a set of observations related to financial benchmarking and the subsequent components of the benchmark project. These observations appear below. The complete set of themes and a sample of representative quotations from water system managers appear in the Appendix D-1. Also, during the implementation of the mail survey many of the survey participants contacted the study team to inquire about the survey or to comment on the study or the management of small water systems. These comments were summarized and appear as an Addendum to Appendix D.

Observations from Interviews with Small System Managers

Problems of small water systems

- System managers are well aware of the economic disadvantages of small water system operations.
- One recurring story which was related was that the current manager "inherited" or "came forward to take over" a system that had been allowed to fall into debt and disrepair. One of the key components of a successful system is likely to be the active involvement of an individual or group of individuals who are dedicated to improving their water system and community.
- Water rates and thus revenues are generally inadequate. Few rate making bodies are proactive in making timely adjustments of rates to meet system needs.
- Participants thoroughly support the notion that small systems need to "operate like a business".

Record keeping

- The types of record keeping techniques observed during site visits ranged from complex to almost non-existent.
- Participants were more likely to provide information about the physical condition of their system than of its financial condition.
- Responsibility for financial operations and decisions seem to be shared by several people at most systems. Water system financial information appeared to be maintained by city or system clerks and office managers. Unfortunately, none of these staff members were interviewed during the site visits.
- Information on water system revenues were readily available at most systems. Itemized tracking of expenses and assets appeared to be difficult, primarily because of commingled employee responsibilities and accounts.
- Almost all participants used contract providers for some services.

Benchmarking Awareness/Familiarity – current uses

- There appeared to be little familiarity with benchmarking concepts, per se. There was some evidence that systems are aware of what is happening at neighboring systems. Some participants track and compare their own progress over time ("internal benchmarking").
- The measure that was most often mentioned for comparing water system performance was water rates.
- In general, participants were not responsive to questions about financial management measures and techniques.
- Although few of the participants were familiar with benchmarking as a management improvement technique, most expressed an interest in learning about comparative measures and other business tools to help them better manage their finances.

Benchmarking needs and uses

- Many participants expressed interest in learning about the *practices* used by the managers of other systems, rather than specific indicator measures.
- One expressed need was for indicator measures that could be used to assess the long-term adequacy of water rates and revenues, that could be used to demonstrate the need for rate increases to water customers and rate-making bodies.

Benchmarking users

- Even at small water systems, there are likely to be several members of the "water management team". Water system and municipal clerks play a significant role in the management of small water systems. Their role should be recognized in financial training programs, and future benchmarking research efforts. In some systems the operators also play an important role in financial decisions. Financial information could be included in the training programs that some states require for them to maintain their certification. Finally, elected officials often are assigned, or have assumed, leadership roles in the management of their community's water system. These individuals were anxious to receive more information and would likely be receptive to financial training programs sponsored by state or federal agencies.

Dissemination of benchmark information

- A few of the interview participants receive publications and participate in programs sponsored by the National Rural Water Association, the American Water Works Association, or organizations for municipal officials that include information on water system management. Others stated that they have participated in programs sponsored by their state drinking water agencies. None of the systems interviewed currently receive information from the National Drinking Water Clearinghouse or currently use the Internet as a source of information. One system receives alerts via fax machine from their state rural water association.

Response to surveys

- Most water system managers find it difficult to take the time to deal with survey questionnaires. Brief surveys are more likely to be completed and returned. Survey instructions need to acknowledge that several different individuals may need to cooperate to complete the survey.

V. SUMMARY OF SURVEY RESULTS

PURPOSE

One of the required components of the benchmark study was a survey of small water systems in the Midwest. The stated purpose of the survey was to collect data that could be used to "assess the causal relationships between system size, age, usage patterns, and treatment processes, and system outcomes, including reliability, cost, and compliance," and to "translate the results into potential benchmarking tools for use by small system managers and consultants."

The purpose of this chapter is to summarize the responses of survey participants to each question of the survey. This summary represents the initial step in data analysis.

The following sections contain the characterization of survey responses, and correspond to the main parts of the original survey questionnaire. These include: (1) management needs and practices, (2) water system characteristics, (3) financial characteristics, and (4) additional comments and suggestions. Detailed summary tables for each survey question are included in Appendix E. This chapter also contains a description of the external variables used in the study, and a discussion of several financial variables, which were calculated, based upon information provided by survey respondents.

For many of the survey questions, this summary also includes an analysis of the differences in response by system size, water source, and ownership type. Each of these categories represents unique characteristics that influence the economic situation faced by water system managers. Where appropriate, tables include simple comparative statistical tests. Because the response rate differed by question, each table also reports the number of observations in each category.

System size categories were based upon the service population that respondents reported on the survey questionnaire. Population estimates were added for nine non-reporting systems using information from USEPA data files. Water systems were divided into five size categories, consistent with those used by the USEPA. It should be noted that even though one of the criteria used to select systems for inclusion in the sample frame was a service population size of less than 3,301 (as reported in the USEPA Safe Drinking Water database), 23 systems with larger service populations received and responded to the questionnaire. An additional size category is included in many of the summary tables for those systems serving greater than 3,500 customers. The slightly higher customer size category was chosen to include four systems that were slightly above the target population. This small broadening of the size category was to accommodate what was considered to be a reasonable increase in system's customer base between the date of the USEPA's data collection and the actual mailing of the survey questionnaires nearly a year later.

Three categories of water source were used, based upon responses to the questionnaire: ground water, surface water, and purchased water. Systems that reported multiple water sources were grouped under the category for which they were required to provide the highest level of treatment.

Six different ownership categories were included on the questionnaire and are reported in this summary. These categories expand on the usual public/private comparisons. They allow a separate review of the information provided by two categories of ancillary systems, homeowner associations and mobile home parks, as well as systems that are likely to serve populations with unique management requirements, such as thinly dispersed populations that appear to be represented by the "other" public category, or the retirement facilities included in the "other" private category.

The tabulated results presented in this chapter should be interpreted with some caution because of two factors. The first is non-response bias. Although no systematic bias was found, the non-response analysis did not include other relevant factors, such as the number of SDWA violations, or measures of current financial or operating condition. Thus it is possible, even likely, (as participants in the Expert Panel Consultation cautioned) that responding systems were those that have better record keeping and management practices. The second factor is how representative the sample is of the entire population of small public water systems in the 10-state study area. The sampling procedure used in this study was designed to achieve a statistically adequate sample size in each of a number of size, source, and ownership categories, through the over-sampling of some groups. Thus, the average results from the total sample of 350 systems do not directly apply to the entire population of systems. Instead, only the results obtained for individual categories or types of systems can be extrapolated to the same categories of systems in the population. A set of appropriate weights would need to be applied to the survey results in order to extrapolate them to the entire population of small public water supply systems in the Midwest.

MANAGEMENT NEEDS AND PRACTICES

Important Management Decisions

Survey participants were asked in Question 1 to identify and rank the important decisions they will need to make during the next five years. Ten different management decisions were listed on the questionnaire and space was provided for participants to write in other responses. Table V-1 shows the frequency of selection of the ten different management decisions.

Table V-1. Ranking of Expected Management Decisions

Rank	***Management Decision***	***Percent of Systems***
1	Increase water rates	66
2	Expand water services to new areas	39
3	Locate sources of funding assistance	37
4	Install new treatment technologies	26
5	Change rate structure	26
6	Construct new water sources (wells or reservoirs)	24
7	Other decisions	12
8	Switch from self-supplied to purchased water	10
9	Sell wholesale water to other water systems	9
10	Transfer ownership of the system to another provider	5
11	Acquire another water system	4
Total number of responding systems = 335		

The need to "increase water rates" was identified by 221 out of 350 total survey respondents (66 percent). This decision was also ranked the highest, with 155 respondents ranking it as #1. A decision to change water rates, a closely related issue, was indicated by 85 respondents (26 percent). Taken together these two decisions outdistance all other management concerns.

The next most frequently mentioned decisions (by nearly 40 percent of respondents to both) included "expanding water services to new areas" (129 respondents) and locating sources of funding assistance (123 respondents). Also, approximately one fourth of the respondents selected the installation of new treatment technologies (86 respondents) and construction of new water sources.

These survey responses suggest that the financial decisions faced by small public water supply systems prevail over technological issues. Further examination by size category, ownership type, and water source reveal those areas where differences exist between water system types (Tables V-2, V-3, & V-4). Chi-square tests of independence were performed to determine whether the observed differences were statistically significant from expected differences. When the computed Chi-square was greater than the critical Chi-square at the 0.05 level of probability, an asterisk was used to denote that the two variables are not independent.

Although decisions related to water rates dominates all categories, a higher than average number of larger systems reported this decision. A higher than average proportion of systems serving more than 500 were concerned with decisions related to the expansion of service lines and finding sources of funding assistance.

Table V-2. Important Management Decisions by Population Size Category

Population Served / Management Decision	***Expected %***	***< 101***	***101-500***	***501-1,000***	***1,001-3,301***	***>3,500***
Percent of category responses						
Increase rates *	*66*	52	65	72	71	88
Expand services *	*39*	11	29	44	60	82
Locate funding *	*37*	18	27	42	55	71
Install new technology*	*26*	18	17	20	38	71
Change rate structure *	*26*	21	33	16	24	41
Construct sources *	*24*	9	18	28	39	29
Switch to purchased water	*10*	12	8	12	10	0
Sell wholesale water *	*9*	0	3	6	16	53
Transfer ownership	*5*	6	8	3	4	6
Acquire system	*4*	0	6	6	4	6
Number of observations	--	*66*	*102*	*69*	*83*	*17*
* c^2 *- significant at the 0.05 level.*						

A higher than average number of systems serving more than 1,000 persons indicated future decisions about installing new treatment technologies. The proportion of systems in the <101 and 501-1000 categories that were more interested in switching to purchased was greater than expected, but this difference was not statistically significant. Concern over the transfer of ownership or acquisition of another systems does not appear to differ by system size category.

With respect to system ownership (Table V-3), significant statistical differences in the responses are found in the need to increase water rates, expand services, and locate funding. A greater than expected percent of municipal systems are concerned about increasing rates and revising rate structures than other systems. "Other" public and "other" private systems reported a greater than expected need to expand services. Finally, the need to locate funding was indicated more frequently than expected by municipal systems.

Table V-3. Important Management Decisions by Ownership Type

Ownership/ Management Decision	***Expected %***	***Muni-cipal***	***Other Public***	***Private***	***Home Owner Assoc.***	***Mobile Home Parks***	***Other Private***
Percent of category responses							
Increase rates *	*67*	79	57	60	60	26	50
Expand services *	*39*	38	67	33	20	13	50
Install new tech	*26*	27	19	20	31	26	18
Construct sources	*24*	26	24	27	14	17	27
Change rate structure *	*25*	31	19	7	23	17	9
Locate funding *	*38*	46	36	20	20	9	36
Switch to purchase *+	*10*	8	5	20	6	30	9
Sell wholesale *+	*9*	9	17	7	9	0	0
Acquire system	*4*	4	5	7	6	9	0
Transfer ownership *+	*5*	3	2	20	17	4	6
No. of observations	--	*193*	*42*	*15*	*35*	*23*	*22*

* χ^2 *- significant at the 0.05 level.*
+ Note: 20% of cells have expected count of less than 5, χ^2 *tests may be questionable.*

The distribution of responses concerning pending decisions grouped by source of water supply is shown in Table V-4. Significant differences in answers about the priority decisions were found for decisions about funding, installation of new technology, construction of water supply sources and sale of wholesale water. For example, a higher than average proportion of surface water systems indicated the need to expand services, locate funding, install new technology, and sell water wholesale.

Table V-4. Important Management Decisions by Source of Supply

Supply Source/ Management Decision	***Expected %***	***Ground Water***	***Surface Water***	***Purchased Water***
Percent of category responses				
Increase rates	*66*	62	75	71
Expand services	*39*	34	51	41
Locate funding *	*37*	32	66	29
Install new technology *	*26*	25	57	5
Change rate structure	*26*	24	26	29
Construct sources *	*24*	33	21	6
Switch to purchased water	*12*	10	21	- -
Sell wholesale water *	*10*	6	26	1
Transfer ownership +	*9*	5	3	7
Acquire system +	*5*	4	2	6
Number of observations	--	*189*	*61*	*85*

* χ^2*- significant at the 0.05 level.*
+Note: 20% of cells have expected count of less than 5, χ^2 *tests may be questionable.*

Managers of surface water systems indicated the need to find sources of funding and install new treatment technology about twice as frequently as expected (i.e., compared to the average frequency for all systems). A higher than average proportion of groundwater systems were reported decisions about the construction of new water source.

In summary, the frequency and distribution of answers to the question about the important pending decisions clearly indicate concerns over the need to generate sufficient revenue by raising or revising water rates. The frequency and ranking of several other decisions depend on system size, ownership and supply source of the responding systems.

Availability of Financial Reports

Question 2 asked system managers about the type of reports that they use at their systems. Approximately 83 percent of the respondents prepare some type of a financial report for their systems. There was no response to this question on eight questionnaires and 57 respondents indicated that no separate financial reports are prepared for their water systems. The most frequently checked types of financial reports included: annual budget (55 percent of respondents), monthly financial reports (41 percent), and income statements (36 percent). These results indicate that the majority of systems that responded to the survey prepare one or more types of reports to help them in financial management, and have some information available that could potentially be used in benchmarking.

The use of financial reports was similar across all system sizes and types of supply sources. Significant differences in the distribution of answers were found among different types of system ownership. These are shown in Table V-5.

Table V-5. Use of Financial Reports

Ownership/ Financial Report	***Expected %***	***Muni-cipal***	***Other Public***	***Private***	***Home Owner Assoc.***	***Mobile Home Parks***	***Other Private***
Percent of Responses							
Annual budget *	*55*	65	70	40	39	0	38
Monthly financial report*	*41*	48	61	13	33	0	33
Income statements *	*36*	37	48	47	33	0	42
Annual financial audit *	*29*	35	26	13	33	0	21
Balance sheet *	*27*	25	42	33	33	0	38
Capital improvement plan	*16*	19	29	7	14	0	0
Reports to lenders *+	*14*	14	30	13	3	0	8
User charge analysis	*11*	13	19	7	6	0	8
TMF capacity analysis	*3*	2	12	0	3	4	4
Year to date worksheets *	*26*	26	49	20	19	0	33
No Separate Report *+	*16*	13	2	33	25	42	8
No Reports *+	*17*	12	9	20	19	54	25
Number of observations	--	*191*	*42*	*15*	*36*	*26*	*24*

* c^2 *- significant at the 0.05 level.*

+Note: 20% of cells have expected count of less than 5, c^2 *tests may be questionable.*

Annual budget and monthly budget were the most frequently mentioned types of reports. More than 40 percent of publicly owned systems (both municipal and other) use these. “Other” public and private systems reported a higher than expected use of income statements. “Other” public systems also reported more frequent use of balance sheets, capital improvement plans, reports to lending agencies, user charge analysis and year-to-date worksheets. The use of financial reports was lowest among mobile home parks. A greater than average number of mobile home parks, private systems and homeowner association indicated that they do not use any reports or do not generate separate reports for their water supply system.

Use of Financial Indicators

Survey participants were asked whether they use any "rules of thumb," "financial ratios" or other indicators to help them monitor the financial performance of their system. Two of the most common measures recommended for monitoring system financial performance, operating ratio and debt coverage ratio, were provided as possible answers, along with what was included as a minimum business assessment measure, net revenues. Only 121 of the 339 respondents (37 percent) indicated that they use one or more measures. Approximately two thirds of the respondents did not check or name any indicator measures of financial performance.

Monitoring net revenue was reported as the most frequently financial indicator (98 out of 121 respondents). The operating ratio (total annual operating revenues divided by annual expenses, excluding depreciation, interest, and debt service) was reported only by 29 respondents, and the debt service ratio (annual gross revenue minus operating and maintenance expenses divided by annual principal and interest charges) was reported by 20 respondents.

In addition to these three indicators, the respondents listed 18 other ways that they monitor the financial performance of their systems, including: annual audits, comparing budget to actual expenses, and minimum cash balance. A complete list of responses can be found under Question 3 in Appendix E.

Table V-6 shows the survey results on the use of indicators, which are categorized by system size and ownership category. The type of water source used by the system appeared to be independent of the use of financial indicators.

Table V-6. Percent of Systems Reporting the Use of Indicators
by System Size and Ownership

Grouping variable	***No. of Obs.***	***Use Indicators***	***Use Net Revenue***	***Use Operating Ratio***	***Use Debt Coverage***
All systems (expected %)	--	*35.7*	*28.9*	*8.6*	*5.9*
Percent of Responses					
System size:					
< 101	*67*	20.9	16.4	2.9	1.49
101-500	*106*	36.8	31.1	6.6	2.8
501-1,000	*69*	39.1	34.8	10.1	8.7
1,001-3,500	*80*	41.2	32.5	10.0	6.2
>3,500	*17*	70.6	58.8	35.3	29.4
c^2 value	--	*16.8*	*13.6*	*13.8*	*15.5*
Probability	--	*<.01*	*<.01*	*<.01*	*<.01*
Ownership category:					
Municipal	*192*	42.7	38.0	6.2	4.7
Other public	*41*	48.8	41.5	26.8	21.9
Private	*15*	20.0	13.3	0.0	0.0
Homeowners assn.	*36*	27.8	16.7	11.1	2.78
Mobile home parks	*27*	0.0	0.0	0.0	0.0
Other private	*22*	36.4	22.7	13.6	4.6
c^2 value	--	*33.4*	*33.5*	*21.5*	*18.2*
Probability	--	*<.01*	*<.01*	*<.01+*	*<.01+*
+Note: 20% of cells have expected count of less than 5, c^2 tests may be questionable.					

According to the distribution of responses by system size, a higher than average proportion of large systems reported using some type of financial indicator. Systems serving more than 3,500 persons reported the use of indicators twice as frequently as the average for all systems. Public systems (both municipal and "other") also reported the use of indicators more often than systems in other ownership categories.

"Other" public systems stand out in Table V-6, as the most frequent users of all three indicators. Systems serving less than 100 persons and private systems are among categories with the lowest reported use of financial indicators. None of the mobile home park managers who responded to the survey reported using any financial indicators.

Cooperative Arrangements

Cooperative arrangements between water systems provide an opportunity to capture economies of scale in some functions, and provide an opportunity for system managers to exchange comparative information with neighboring water systems. Only 73 respondents (28 percent) reported having any informal arrangement with other water providers (Question 4).

The three leading types of arrangements included sharing of equipment (30 responses), emergency interconnections (26 responses), and sharing personnel (23 responses). Ten respondents reported arrangements for bulk purchases of supplies, chemicals and other materials. These results suggest that potentially beneficial cooperation among neighboring systems is limited.

Table V-7. Informal Cooperative Arrangements
by Size, Source and Ownership.

Grouping variable	***Number of Observations***	***System with Cooperative Agreements (%)***
All systems (expected %)	*341*	*21.4*
System pop. size:		
< 101	*67*	10.4
101-500	*106*	16.9
501-1,000	*71*	19.7
1,001-3,500	*80*	32.5
>3,500	*17*	52.9
$c^2 = 20.40; p<.01$		
Source type:		
Ground	*194*	15.5
Surface	*59*	39.0
Purchased	*87*	24.1
$c^2 = 14.09; p<.01$		
Ownership category:		
Municipal	*192*	21.4
Other public	*42*	37.2
Private	*15*	13.3
Homeowners assn.	*32*	19.4
Mobile home park	*21*	3.7
Other private	*20*	30.4
$c^2 = 14.30; p=0.0138$		

Table V-7 shows the percent of cooperative agreements among different sizes and types of systems. A higher than expected proportion of agreements is found among systems serving more than 1,000 persons, systems with a surface water source, as well as "other" public and "other" private systems. Very small systems, groundwater systems and private systems reported relatively low frequencies of cooperative arrangements.

Assistance in Financial Management

Thirty percent of the respondents reported receiving some advice or assistance regarding the financial management of their systems. The most frequently mentioned form of assistance (62 respondents) was that received from professional consultants, including auditors, accountants, attorneys, and engineering firms. Other sources of assistance, which were indicated by 12 to 19 percent of respondents, included rural water associations, state agencies, rural development agencies and local governments. No statistical differences in responses to this question (Question 5) were found between systems of different size, source or ownership type.

These results confirm that small systems generally do not receive financial advice. Additionally, they suggest that efforts to implement performance assessment programs might benefit from enlisting the help of those professional consultants who provide advice to small water system managers.

WATER SYSTEM CHARACTERISTICS

Age of Water Systems

Approximately 83 percent of the respondents reported the year when their water system began operation (Question 6). Nine systems began operation before 1900, and 91 systems were put into operation between 1900 and 1950. Nearly 44 percent of the respondents (129 systems) began operation between 1950 and 1975. This distribution of system age indicates that more than one half of the systems are 25 or more years old, and that the largest segment of systems participating in the survey may just now be reaching the limits of the design life of some of the components of their system.

In terms of system size, the lowest mean age (31.4 years) is found for systems serving less than 100 persons, and the highest is in the 1,001-3,500 category (Table V-8). The F-ratio of 4.44 indicates that the differences in mean age among the five size categories are statistically different at the probability level of less than 0.01.

The mean age of systems also differed among systems based on their supply source and ownership type. The mean age of surface water systems of 52.7 years, suggests that they are significantly older than groundwater (45.3 years) and purchased water systems (36 years). On average, municipal systems that participated in the survey are much older than those in the other ownership categories.

Table V-8. Mean System Age
by Size, Source and Ownership

Grouping variable	***Number of observations***	***Mean Age (years)***
All systems (expected)	*291*	*44.3*
System pop. size:		
< 101	*54*	31.4
101-500	*86*	44.3
501-1,000	*62*	45.3
1,001-3,500	*74*	52.8
>3,500	*15*	44.1
F-ratio = 4.44; p<.01		
Source type:		
Ground	*166*	45.3
Surface	*51*	52.7
Purchased	*73*	36.0
F-ratio = 5.37; p<.01		
Ownership category:		
Municipal	*158*	58.4
Other public	*42*	24.1
Private	*15*	26.5
Homeowners assn.	*32*	30.5
Mobile home park	*21*	32.1
Other private	*20*	25.4
F-ratio = 22.71; p<.01		

System Ownership

Nearly 68 percent of the systems responding to Question 7 of the survey were publicly owned, with the majority owned by a city or village. Thirty percent of the systems were privately owned, and no ownership information was included on six surveys. The complete distribution of system ownership can be found in Appendix E, as well as in many of the tables in this chapter.

Sources of Water Supply

Nearly 99 percent of respondents identified the source of their water supply in Question 8. Fifty-six percent reported using groundwater, 16 percent surface water, 24 percent purchased water, and four percent have multiple water sources. The multiple source systems were placed in the category for which they were required by the SDWA to provide the highest level of treatment. A comparison of systems by their source of supply, system size, and ownership type appears in Table V-9.

Table V-9. Type of Water Source by System Size
and Ownership Type

Grouping variable	*Number of Observations*	*Ground Water*	*Surface Water*	*Purchased Water*
All systems (expected)	*348*	*56*	*18*	*26*
Percent of reporting systems				
System pop. size:				
< 101	*67*	76	1	22
101-500	*107*	54	10	36
501-1,000	*73*	60	14	26
1,001-3,500	*82*	50	33	17
>3,500	*19*	21	63	16
c^2 *= 61.223; p<.01*				
Ownership category:				
Municipal	*198*	54	24	22
Other public	*43*	33	16	51
Private	*15*	67	20	13
Homeowners assn.	*36*	75	3	22
Mobile home park	*27*	93	0	7
Other private	*24*	58	8	33
c^2 *= 51.742; p<.01* *Note: 20% of cells have expected count of less than 5,* c^2 *tests may be questionable.*				

The comparison of system ownership and supply source in Table V-9 shows that all four types of private systems tend to use groundwater. Surface water systems are more likely to be found among municipal and "other" public systems. Purchased water is more likely to serve as a source for both "other" public and "other" private systems. The use of surface water as a source was higher than expected in the two largest population served size categories; groundwater was much higher than expected in the smallest. The 101-500 population served size category included a higher than expected number of purchased water systems.

Population Served

Population served was one of the criteria used to select the water systems to be included in the sample frame. Systems were included in the sample frame that reported having 3,300 customers or less in the Safe Drinking Water Information System files for the 10 states included in the study area. Question 9 on the questionnaire asked systems to report the number of persons that they serve. Twenty-three water systems that returned completed survey questionnaires reported service populations that exceeded the target population of 3,300 persons. These systems have been left in the analysis for the purpose of comparison. Four size categories, consistent with those used by USEPA, were used to group the systems. The largest size category was expanded slightly to include systems up to a size of 3,500 people. This was done to include four additional systems in the "small system" category, under the assumption that it was reasonable to include systems that had experienced a slight increase in service population during the one year time period between when the SDWIS data was collected and when the survey questionnaire was mailed. A fifth size category was included for those systems that exceed the "small system" size category. The reported population served of the 19 systems included in this category ranged in size from 3,700 to 30,000.

Table V-10. Size of Water Systems (Population Served) by Ownership Type

Ownership Type	***Expected %***	***Muni-cipal***	***Other Public***	***Private***	***Home-Owner Assoc.***	***Mobile Home Parks***	***Other Private***
			Percent of reporting systems				
System pop. size:							
< 101	*19*	11	12	47	39	44	25
101-500	*31*	32	23	7	33	33	38
501-1,000	*21*	27	19	13	11	19	4
1,001-3,500	*23*	25	33	27	17	4	29
>3,500	*5*	5	14	7	0	0	4
No. of observations	*350*	*198*	*43*	*15*	*36*	*27*	*24*
c^2 = 62.29; $p<.01$							

Table V-10 shows the breakdown of system sizes by ownership type. The distribution of water systems serving less than 3,500 people was evenly divided across size categories. The 198 municipal systems closely approximated the distribution of all systems in the sample. The less-than-100 persons category has a higher than expected percentage of private systems, homeowner associations and mobile home parks. This distribution reflects the tendency for small systems to be privately operated.

Water Production

Table V-11 below shows the reported average-daily and maximum-day production, and estimated capacity for the water systems responding to the survey, for systems that serve populations of less than 3,500. The mean daily production for these systems was 123,511 gallons per day as compared to the mean value of 167,062 gallons per day for all responding systems.

Table V-11. Production/Capacity in Gallons per Day (gpd) and Gallons per Connection (gpc) for Systems Reporting Population Served of Less than 3,500

Production/Capacity (gallons/day)	***# of Obs.***	***Min. (gpd)***	***Max. (gpd)***	***Mean (gpd)***	***Median (gpd)***	***Median (gpc)***
Average daily production	261	1,027	1,720,000	123,511	60,000	214
Maximum daily delivery	234	1,900	4,212,000	230,365	117,700	358
Maximum system capacity	213	5,000	14,000,000	614,400	259,000	794

Responding systems reported a wide range of water production values. Nearly half of the systems produced less than 50,000 gallons per day, while a few systems produced many times this amount to service large agricultural and industrial customers. Although some systems were operating either at or near their maximum capacity, most of the small systems reported large surpluses in capacity. While nearly 80 percent of systems were able to report their average daily use, only 65 percent reported the maximum capacity of their systems.

The breakdown of daily production values for systems by size, source and ownership is shown on Table V-12. As would be expected, average daily production is proportional to system size. The median average production for surface water systems is more than twice that for groundwater systems. With respect to ownership type, homeowner associations and mobile home parks had the two lowest values. The median average production per total number of connections is also reported for each category. Per connection average day production is fairly uniform across all categories, but is higher for systems serving more than 3,500 persons and lower for systems that purchase their water, mobile home parks, and "other" private systems.

Table V-12. Median Average Daily Water Production in Gallons per Day and per Connection by System Size, Source and Ownership

Grouping variable	***# of Obs.***	***Median av. day prod. (gpd)***	***# of Obs.***	***Median av. day prod. (gpc)***
All systems (expected)	*278*	*65,772*	*264*	*220*
System pop. size:				
< 101	*41*	5,500	*39*	192
101-500	*77*	26,500	*71*	192
501-1,000	*65*	74,000	*62*	212
1,001-3,500	*78*	200,000	*75*	249
>3,500	*17*	440,000	*17*	396
Source type:				
Ground	*154*	55,822	*146*	230
Surface	*56*	161,000	*54*	249
Purchased	*68*	40,000	*64*	175
Ownership category:				
Municipal	*170*	77,500	*161*	224
Other public	*38*	153,000	*38*	235
Private	*11*	55,000	*11*	227
Homeowners assn.	*25*	30,000	*24*	223
Mobile home park	*16*	7,700	*14*	134
Other private	*17*	65,000	*15*	184

Length of Transmission and Distribution System

The distance that systems must convey water to serve their customers significantly impacts the cost and difficulty of system management. Question 13 on the survey asked participants to report the length of the water pipe in their system. More than 75 percent of systems reported the length of their transmission and distributions systems in miles, with a median length of 10 miles. For those systems reporting the length in feet, the median was 8,100 feet. The reported lengths in feet were converted into miles and are compared by system size, source and ownership in Table V-13.

Table V-13. Median Miles and Miles per 100 Connections of Transmission and Distribution System by System Size, Source and Ownership

Grouping variable	***# of Obs.***	***Median miles***	***# of Obs.***	***Median miles/100 conn***
All systems (expected)	*276*	*7.8*	*259*	*3.0*
System pop. size:				
< 101	*44*	1.1	*38*	3.4
101-500	*88*	5.0	*82*	3.9
501-1,000	*53*	6.1	*52*	1.8
1,001-3,500	*74*	19.5	*71*	2.6
>3,500	*17*	67.0	*16*	12.2
Source type:				
Ground	*156*	5.0	*144*	2.3
Surface	*52*	20.0	*50*	3.2
Purchased	*68*	8.5	*65*	5.1
Ownership category:				
Municipal	*154*	8.0	*144*	2.6
Other public	*39*	48.0	*39*	14.0
Private	*12*	18.0	*12*	6.1
Homeowners assn.	*34*	2.0	*31*	2.5
Mobile home park	*17*	1.0	*14*	1.1
Other private	*19*	10.0	*18*	11.9

Transmission and distribution pipe length increases with population served, with a median length of about one mile for the smallest size category. Surface water systems have significantly larger transmission and distribution systems than the other source types. The lengths per 100 connections for the “other” categories of both private and public system types are more than twice as large as the next largest ownership type. It is likely that these are made up of water districts and private regional water providers that serve low-density rural areas.

Number of Connections

Question 14 asked respondents about the number and type of connections served by their systems. More than 90 percent of participants responded to the question. Nearly all reported at least their total number of connections, with the mean value being 383 connections per system. Many of the participating systems reported having only residential customers, however, more than 65 percent also reported commercial connections, 18 percent reported some industrial connections, and 12 percent have wholesale water that serve other communities. The total number of reported connections increases with population size category, and there is a larger number of connections for surface water systems, and the "other" categories of both public and private systems.

The analysis of calculated variables that include the number of connections in the denominator is complicated by the inclusion of several large systems that reported only a few wholesale connections, as well as some very small water systems that reported only a few connections. The interpretation of any "per connection" values in this chapter must therefore be treated with caution. When means and median measures were unduly influenced by these "outlier" systems, they were not included in the analysis, and this is noted at the bottom of the summary tables.

Table V-14. Mean and Median Total Connections by Size, Source and Ownership

Grouping variable	***# of Obs.***	***Mean # of Total Connections***	***Median # of Total Connections***
All systems (expected)	*324*	*383*	*244*
System pop. size:			
< 101	*58*	34	30
101-500	*100*	151	125
501-1,000	*69*	348	325
1,001-3,500	*79*	774	700
>3,500	*18*	1,223	1,082
F-ratio = 53.0869; p<.01			
Source type:			
Ground	181	310	214
Surface	58	708	528
Purchased	83	318	150
F-ratio = 13.8440; p<.01			
Ownership category:			
Municipal	*184*	405	294
Other public	*42*	520	418
Private	*15*	227	49
Homeowners assn.	*33*	186	59
Mobile home park	*23*	134	76
Other private	21	691	224
F-ratio = 4.27; p=0.0009			

Metered Connections

Only a small number of systems did not answer Question 15, which requested information about metered connections. Approximately one-quarter of all respondents do not use water meters in their systems. Several of the respondents even called into question the necessity of having metering for small systems in additional comments written on the questionnaire. Approximately 70 percent of the respondents operate a system with 99 percent or more of their connections metered.

Table V-15 shows the percent of system that have 95 percent or more of their connections metered (332 respondents) broken down by system size, supply source and system ownership. The percent of metered systems increases with system size, and there is significantly less use of meters by groundwater systems than surface and purchased water systems. A higher proportion of municipal and public systems use meters than any of the categories of private systems.

Table V-15. Percent of Systems with 95 Percent or more Connections Metered by Size, Source and Ownership

Grouping variable	***Number of observations***	***Percent of systems***
All systems (expected)	*326*	*75*
System pop. size:		
< 101	*63*	40
101-500	*99*	75
501-1,000	*70*	81
1,001-3,500	*81*	94
>3,500	*18*	100
$c^2 = 7.12; p<.01$		
Source type:		
Ground	*185*	59
Surface	*60*	95
Purchased	*84*	96
$c^2 = 67.735; p<.01$		
Ownership category:		
Municipal	*195*	85
Other public	*42*	90
Private	*15*	60
Homeowners assn.	*32*	47
Mobile home park	*20*	25
Other private	*22*	64
$c^2 = 62.29$; p<.01		

Number of Paid Employees

All but 18 respondents provided information about the number of paid employees needed to operate their system. Nearly 50 percent reported one or less paid employees, and 32 systems reported zero paid employees. This suggests that many of the smallest systems use at least some unpaid volunteer help. Further evidence of the importance of volunteer help in the operation of small systems can be found in the comments written on some of the questionnaires, and from observations made during the site visit and focus group components of this study.

The number of paid employees increases with system size, and surface water systems employ significantly more staff members than ground or purchase water systems. Public water system categories have more employees than private systems.

Table V-16. Mean and Median Number of Paid Employees
by Size, Source and Ownership

Grouping variable	***Number of Obs.***	***Mean # of employees***	***Median # of employees***
All systems (expected)	*332*	*1.6*	*1.5*
System pop. size:			
< 101	*60*	0.6	0.5
101-500	*102*	1.0	1.0
501-1,000	*70*	1.5	1.5
1,001-3,500	*81*	2.6	2.0
>3,500	*19*	4.8	4.0
F-ratio = 56.75; p<.01			
Source type:			
Ground	*186*	1.3	1.0
Surface	*61*	3.2	2.5
Purchased	*83*	1.3	1.0
F-ratio = 38.57; p<.01			
Ownership category:			
Municipal	*193*	1.7	1.5
Other public	*43*	2.6	2.0
Private	*15*	1.4	1.0
Homeowners assn.	*32*	1.0	0.5
Mobile home park	*23*	0.7	0.5
Other private	*21*	1.4	1.0
F-ratio = 5.87; p<.01			

Boil Water Orders

The number of boil water orders has been used in previous studies as a measure of water systems reliability, indicating the service interruptions and degree of inconvenience to customers. Only 80 (24 percent) of the 333 systems responding to Question 17 reported one or more boil water order in the last 12 months. Of these, 63 percent had more than one boil water order, and 12 systems reported 5 or more. One system reported 55 boil water orders, 40 more than the system with the next highest number. The low incidence of boil water orders reported (76 percent of systems reported no boil water orders) would appear to contradict the often-reported unreliability of small water supply systems.

On average, both the number and percent of systems with boil water orders increases with system size. Surface water systems had a significantly larger number of boil water orders, but there was little difference in boil water orders by ownership type, with the exception of the 15 private systems, which reported zero boil water orders (Table V-17).

Table V-17. Mean Number and Percent of Boil Water Orders in the Past 12 Months by Size, Source and Ownership

Grouping variable	***# of Obs.***	***Mean Number of Boil Water Orders***	***Percent of Systems with Boil Water Orders***
All systems (expected)	*333*	*0.84*	*24.0*
System pop. size:			
< 101	*63*	0.06	6.4
101-500	*102*	0.49	24.5
501-1,000	*69*	0.87	28.9
1,001-3,500	*80*	1.00	28.8
>3,500	*19*	4.5	42.1
		F-ratio = 6.57; p = < .01	*c^2 =18.88; p = < .01*
Source type:			
Ground	*190*	0.40	17.9
Surface	*60*	1.98	31.7
Purchased	*82*	1.02	32.9
		F-ratio = 4.83; p < .01	*c^2 =9.29; p < .01*
Ownership category:			
Municipal	*192*	0.64	22.4
Other public	*41*	0.68	29.3
Private	*15*	0.00	0.0
Homeowners assn.	*33*	0.78	27.3
Mobile home park	*24*	0.83	25.0
Other private	*23*	3.50	35.8
		F-ratio = 2.96; p = 0.0125	*c^2 =10.64; p = 0.059*

Shared Personnel/Equipment

Approximately 30 percent of the systems that responded to Question 18 share either personnel or equipment with another locally managed service. Nearly 80 percent of these systems share resources with a wastewater operation. The ability to share equipment and personnel is significantly higher than expected in systems serving more than 1,000 persons, systems relying on surface water, and municipal systems (Table V-18).

Table V-18. Percent of System that Share Equipment and/or Personnel with Other Systems by Size, Source and Ownership

Grouping variable	***Number of observations***	***% that share***
All systems (expected)	*337*	*32*
System pop. size:		
< 101	*64*	5
101-500	*103*	26
501-1,000	*71*	34
1,001-3,500	*80*	58
>3,500	*19*	47
$c^2 = 55.29$; $p < .01$		
Source type:		
Ground	*190*	29
Surface	*61*	46
Purchased	*84*	31
$c^2 = 5.94$; $p = 0.0514$		
Ownership category:		
Municipal	*194*	46
Other public	*43*	23
Private	*15*	0
Homeowners assn.	*33*	12
Mobile home park	*24*	8
Other private	*23*	13
$c^2 = 49.77$; $p < .01$		

Water Treatment Processes

Nearly 95 percent of respondents provided information on the treatment processes used by their water systems. More than 40 percent of systems reported that they do not treat their water. When those systems which purchase treated water are removed from this total, 17 percent of self-supplied system participating in the survey reported using no treatment process at all.

Sixty percent of respondents do provide some treatment of their water. Pre-disinfection was the process reported most often (77 percent), followed by post-disinfection (56 percent) and filtration (48 percent). Slow sand filtration, a process that has been suggested as a cost-effective alternative for small water systems is being used by 12 percent of systems reporting treatment processes.

Table V-19 indicates that, as would be expected because of the more frequent use of surface water supplies by larger systems, both of these categories have the largest number of unit treatment processes.

Table V-19. Mean Number of Total Treatment Processes
by Size, Source and Ownership

Grouping variable	***Number of observations***	***Number of processes***	
		Mean	***Median***
All systems (expected)	*325*	*2.3*	*1*
System pop. size:			
< 101	*62*	0.6	0
101-500	*101*	1.6	1
501-1,000	*68*	1.8	1
1,001-3,500	*80*	4.0	3
>3,500	*19*	5.8	7
F-ratio = 27.0408 ; p< .01			
Source type:			
Ground	*186*	1.8	1
Surface	*60*	7.0	7
Purchased	*83*	0.07	0
F-ratio = 241.3285; p< .01			
Ownership category:			
Municipal	*188*	2.9	1
Other public	*43*	2.0	0
Private	*15*	1.7	1
Homeowners assn.	*33*	1.8	1
Mobile home park	*24*	0.5	0
Other private	*22*	1.3	0
F-ratio = 3.8700 ; p< .01			

Ninety-eight different combinations of processes, or "treatment trains", were used by the 193 systems that provide treatment. The most frequently used type of treatment was the single process of pre-disinfection with chlorine (36 systems). Table V-20 displays the treatment combinations that were reported by two or more systems. Eighty other different treatment combinations were reported by survey respondents. Details on these combinations appear in Appendix E.

Table V-20. Treatment Process Combinations Used by Two of More Systems

# of processes	*# of systems*	*Treatment processes and combinations*
1	36	PD-chlorination
1	7	PSD-chlorine/hypochlorination
1	5	PSD-fluoridation
1	2	PD–chlorine dioxide
2	6	PD-chlorination PSD-fluoridation
2	4	PSD-chlorine/hypochlorination, fluoridation
2	3	PD-chlorination CC-corrosion inhibitors
2	2	PD-chlorination FC-polymers
2	2	PD-chlorination OR-ion exchange
2	2	IM-aeration filtration PSD-chlorine/hypochlorination
2	2	PD-chlorination CC-CC-phosphates
2	2	PD-chlorination PSD-chlorine/hypochlorination
3	3	PD-chlorination IM-aeration filtration F-pressure filtration
3	2	IM-aeration filtration F-pressure filtration PSD-chlorine/hypochlorination
3	2	PD-chlorination PSD-fluoridation CC-corrosion inhibitors
3	2	PD-chlorination PSD-fluoridation CC-phosphates
5	2	PD-chlorination IM-aeration filtration F-pressure filtration PSD-chlorine/hypochlorination, fluoridation
5	2	PD-chlorination FC-aluminum salt, polymers F-rapid sand PSD-chlorine/hypochlorination CC-pH adjustments
PD - pre-disinfection; IM - iron and manganese removal; FC-flocculation/coagulation; F - filtration; OR - organic removal; PSD - post-disinfection; CC -corrosion control		

Water Storage Facilities

The expense of constructing, operating and maintaining the water storage facilities that are used to store finished water and to maintain adequate water system pressure can be significant for small water systems. As pointed out by participants in the project focus group component, the local water tower is one of the most visible signs of the financial condition of both the water system and the community. Approximately 20 percent of the systems that responded to Question 20 reported that they do not have any water storage facilities. Surface water systems tended to have two or more water storage facilities, as compared to one for groundwater or purchase water systems. On average, the "other" categories of both private and public systems reported more storage facilities than other ownership types.

Table V-21. Mean Number of Storage Facilities
by Size, Source and Ownership

Grouping variable	***Number of observations***	***Mean # of storage facilities***
All systems (expected)	*332*	*1.3*
System pop. size:		
< 101	*66*	0.5
101-500	*103*	0.9
501-1,000	*69*	1.3
1,001-3,500	*78*	2.0
>3,500	*16*	3.8
F-ratio = 23.8062; p< .01		
Source type:		
Ground	*188*	1.2
Surface	*60*	2.3
Purchased	*82*	1.0
F-ratio = 14.1731; p< .01		
Ownership category:		
Municipal	*190*	1.3
Other public	*42*	1.8
Private	*15*	1.3
Homeowners assn.	*33*	1.1
Mobile home park	*24*	0.6
Other private	*22*	2.2
F-ratio =3.2870; p< .01		

Estimated Change in Service Population and Connections

In Question 21, survey participants were asked to estimate the service population and number of connections that their system had five years ago. In Question 22, they were asked to predict what these same two measures might be in five years. Using the responses to both questions, the percent of change in both population and connections over the 10-year period were calculated. Tables VI-22 and 23 report the percent of systems that expect a decrease, no change, or increase, in population served and number of connections. Although there are some slight differences in the responses reported in the two tables, the general picture presented by survey participants is one of anticipated water system growth. Only in the smallest size category did the percent of systems anticipating growth (in either population served or number of connections) fail to reach 50 percent. A greater than average proportion of larger systems forecast population and connection increases, as compared to the "other" public and private ownership categories. Mobile home parks were least likely to expected increases in population or connections least frequently. There was no significant difference in expected growth by type of water source.

Table V-22. Predicted Direction of Change in Population Served
by Size, Source and Ownership

	# of	*Percent of Systems Reporting/Expecting*		
Grouping variable	***Obs.***	***Decrease***	***No change***	***Increase***
All systems (expected %)	*254*	*7*	*26*	*67*
System pop. size:				
< 101	*49*	6.1	46.9	46.9
101-500	*79*	11.4	30.4	58.2
501-1,000	*58*	5.2	20.7	74.1
1,001-3,500	*58*	5.2	12.1	82.8
>3,500	*10*	0.0	0.0	100
c^2 = 30.464; $p< .01$				
Source type:				
Ground	*148*	8.8	29.7	61.5
Surface	*43*	4.6	20.9	74.4
Purchased	*61*	4.9	21.3	73.8
c^2=4.1611; p=0.3295				
Ownership category:				
Municipal	*139*	10.8	21.6	67.6
Other public	*34*	0.0	11.7	88.2
Private	*11*	0.0	18.2	81.8
Homeowners assn.	*29*	10.3	41.4	48.3
Mobile home park	*21*	0.0	71.4	28.6
Other private	*17*	0.0	17.7	82.4
c^2 =43.736; $p< .01$				

The mean and median percent of observed change reported by systems (the change between estimated past and current population served) was also calculated (see Appendix E). One hundred and fifty-five systems (59 percent of respondents) reported an increase in population, with a median percent increase of 17.6 percent. Eighty-seven systems reported no change, and a median decline in population served of -8.2 percent was reported by 22 systems. The corresponding changes for the number of connections were +10.2 percent and –3.6 percent.

In terms of anticipated change during the next five years, 144 systems expect to grow by an average of 18.1 percent (median 12.7 percent). The average for the 22 systems anticipating a decrease was 13.1 percent (median -7.7 percent). Similar but slightly smaller percents were derived for the estimated change in the number of connections.

Table V-23. Predicted Direction of Change in Number of Service Connections by Size, Source and Ownership

Grouping variable	***# of Obs.***	***Percent of Systems Reporting/Expecting***		
		Decrease	***No change***	***Increase***
All systems (expected %)	*247*	*9*	*24*	*67*
System pop. size:				
< 101	*46*	10.9	50.0	39.1
101-500	*70*	11.4	27.1	61.4
501-1,000	*54*	7.4	20.3	72.2
1,001-3,500	*66*	6.1	7.6	86.4
>3,500	*11*	9.1	18.2	72.7
c^2 = 32.467; p< .01				
Source type:				
Ground	*138*	10.1	26.8	63.0
Surface	*49*	10.2	18.4	71.4
Purchased	*58*	5.2	24.1	70.7
c^2 = 3.081; p=0.5443				
Ownership category:				
Municipal	*137*	11.7	21.9	66.4
Other public	*34*	2.9	2.9	94.1
Private	*10*	10.0	30.0	60.0
Homeowners assn.	*29*	3.5	37.9	58.6
Mobile home park	*19*	5.3	78.9	15.8
Other private	*14*	14.3	0.0	85.7
c^2 =54.081; p< .01				

WATER SYSTEM FINANCIAL CHARACTERISTICS

Water Billing

Questions 23 and 24 asked survey participants if they billed customers directly for water services, and if not, to provide an estimate of the total percent of their annual revenues that are used to pay for the cost of operating their water system. Approximately 17 percent of the 334 systems that responded that they did not bill customers directly. Fifty-nine systems estimated the percent of their revenues used in the operation of their systems, reporting a range of values from one to 100 percent.

Water Billing Frequency

Eighty-five percent of survey participants regularly bill their customers for water. The majority of these (75 percent) use a monthly billing system, and another 20 percent use a quarterly billing system. Other billing types reported are summarized in Appendix E.

Water Rates

Survey participants were asked in Question 25 to describe their customer charges for water service, or to provide a copy of their water rate schedule. Forty-one systems did not respond to this question. Another 46 systems wrote in some response but either do not charge for water, or do not have retail customers. Respondents described many different arrangements for monthly, quarterly, semi-annual and annual charges. In order to have a basis for comparison, three measures were derived from the information provided by respondents to describe the charges paid by customers: minimum monthly charge, minimum monthly quantity, and the total bill for 6,000 gallons of water per month for residential customers.

The charge for 6,000 gallons/month ranged from less than $5/month to more than $60/month, with an average of approximately $26/month. Although rate structures were not coded beyond the three derived measures, it was observed that none of the respondents used a multi-part, increasing block structure (other than those systems with a lower unit price in their minimum volume allowance), and that 35 systems used flat rate charges.

Table V-24. Mean Water Charge at 6,000 Gallons per Month by Size, Source and Ownership

Grouping variable	***Number of Obs.***	***Mean Water Charge at 6K gal/month ($)***	***Median Water Charge at 6K gal/month ($)***
All systems (expected)	*263*	*$25.80*	*$25.00*
System pop. size:			
< 101	*34*	$21.95	$18.88
101-500	*81*	27.24	26.30
501-1,000	*63*	24.73	22.02
1,001-3,500	*72*	25.73	25.64
>3,500	*13*	32.51	31.05
F-ratio = 2.09; p = 0.0830			
Source type:			
Ground	*138*	19.71	17.28
Surface	*51*	31.50	31.50
Purchased	*72*	33.50	32.50
F-ratio = 45.42; p < .01			
Ownership category:			
Municipal	*177*	23.37	21.83
Other public	*32*	34.22	31.52
Private	*10*	26.56	27.16
Homeowners assn.	*24*	25.02	26.10
Mobile home park	*2*	34.83	34.83
Other private	*14*	33.54	35.85
F-ratio = 5.97; p < .01			

The charge for 6,000 gallons generally increased with system size, with the exception of systems between 101 and 500. On average, groundwater customers pay considerably less for

6,000 gallons of water per month than do surface or purchased water system customers. The "other" category of public and private water systems charged more for their water, and the two mobile home parks that reported water rates on the questionnaire charged the highest average price for 6,000 gallons of water.

Water Rates Increases

More than 82 percent of systems reported the time period since their last rate increase in Question 27. More than 50 percent of these reported that they have not had any rate increase in the past 5 years. One hundred and forty three systems reported rate increases, with 86 systems reporting two rate increases. Only slightly more than one-third of the respondents have had one or more rates increases in the past 3 years.

A total of 121 systems indicated the percent of their last rate increase. Approximately 40 percent of these systems increased rates by less than 10 percent. Another 29 percent reported increases in the range from 11 to 25 percent. Increases in the range from 26 to 50 percent were reported by 26 percent of respondents. Only 13 responses indicated rate increases greater than 50 percent.

Table V-25. Percent of Systems Without a Rate Increase in the Past Five Years By Size, Source and Ownership

Grouping variable	***Number of Observations***	***Percent without a rate increase in 5 years (%)***
All systems (expected %)	*290*	*51*
System pop. size:		
< 101	*53*	74
101-500	*82*	51
501-1,000	*64*	42
1,001-3,500	*76*	46
>3,500	*15*	27
$c^2 = 17.708; p< .01$		
Source type:		
Ground	*161*	53
Surface	*53*	32
Purchased	*74*	58
$c^2 = 9.409; p< .01$		
Ownership category:		
Municipal	*172*	44
Other public	*37*	60
Private	*12*	50
Homeowners assn.	*31*	45
Mobile home park	*14*	93
Other private	*19*	68
$c^2 = 19.285 ; p< .01$		

Table V-25 shows the percent of systems that have not had a rate increase in the last five years by size, source and ownership. A higher than expected percent of systems without a rate increase were found among systems serving 100 people or less, purchased water systems, mobile home parks, and "other" public and private systems.

Activities to Encourage Conservation

Only 17 percent (58 systems) of participants who responded to Question 28 indicated that they have activities to encourage their customers to conserve water. The most common type of conservation activity reported was mailing conservation brochures along with water bills. Thirty-nine respondents reported using activities other than those listed in the survey questionnaire. These are listed in Appendix E.

Table V-26. Percent of Systems with Conservation Activities
by Size, Source and Ownership

Grouping variable	***Number of observations***	***Percent using customer conservation activities (%)***
All systems (expected)	*243*	*17*
System pop. size:		
< 101	*65*	20
101-500	*103*	11
501-1,000	*73*	23
1,001-3,500	*83*	18
>3,500	*17*	12
c^2 = 5.979; p = 0.2007		
Source type:		
Ground	*194*	20
Surface	*61*	20
Purchased	*84*	8
c^2 = 6.488; p= 0.0390		
Ownership category:		
Municipal	*194*	15
Other public	*42*	12
Private	*15*	0
Homeowners assn.	*35*	26
Mobile home park	*26*	31
Other private	*23*	22
c^2 = 12.001; p= 0.0348 *Note: 20% of cells have expected values <5. c^2 may be questionable.*		

As shown in Table V-26, systems with population served of 100 persons or less, and between 500-1,000 persons reported higher than average use of water conservation activities. Also, higher than average incidence of conservation activity was reported by homeowners associations, mobile home parks, and "other" private systems.

Annual Revenues and Deliveries

Information on annual revenues from water sales was provided by 268 systems (77 percent of all respondents) in Question 29. Not all respondents provided revenues for all customer categories. Two hundred and fourteen (214) respondents reported total revenues, and 120 respondents reported their residential revenues. Revenues from other customer classes were reported by a smaller number of respondents: 73 for commercial, 30 for industrial, 24 for wholesale deliveries and 17 for local government. The median value of total annual water sales revenue for the survey respondents was $75,054. The median annual volume of water deliveries was 23 million gallons.

In addition to water sales revenues, survey participants were asked to provide estimates of revenues from sources such as new connection fees, service charges, and interest earnings. A total of 281 respondents (80 percent) provided data on one or more categories of other revenues. The median value for revenues from new connection fees was $3,000 per year. The median reported value for other service charges was $1,192 per year, and the median of systems that reported non-zero annual interest earnings was $3,000 (n=123). Sixty-six respondents also reported other sources of revenue (see Appendix E).

Table V-27. Median Reported Total Annual Water Deliveries and Total Deliveries per Connection per Day by Size, Source and Ownership

Grouping variable	***#. of Obs.***	***Median total annual deliveries (gal)***	***# of Obs.***	***Median total deliveries per connection/day (gal/conn/day)***
All systems	*163*	*23,000,000*	*153*	*191*
System pop. size:				
< 101	*18*	2,746,228	*18*	186
101-500	*50*	7,732,575	*48*	171
501-1,000	*33*	21,058,745	*33*	193
1,001-3,500	*49*	63,000,000	*47*	216
>3,500	*13*	187,522,200	*12*	317
Source type:				
Ground	*81*	22,387,000	*79*	210
Surface	*33*	62,049,531	*31*	216
Purchased	*48*	14,638,656	*47*	175
Ownership category:				
Municipal	*95*	25,732,800	*91*	186
Other public	*27*	61,642,300	*27*	212
Private	*5*	4,739,000	*5*	221
Homeowners assn.	*15*	12,896,590	*15*	200
Mobile home park	*3*	5,428,000	*3*	346
Other private	*16*	19,776,585	*15*	203
Note: 16 water systems having less than 16 connection were excluded from the per connection analysis.				

Table V-27 shows that median annual deliveries per connection generally increased with system service population size (with the exception of the 100 and less category) and were higher in surface water systems and mobile home parks.

Table V-28. Median Reported Total Annual Water Revenues and Total Annual Revenues per Connection by Size, Source and Ownership

Grouping variable	***#. of Obs.***	***Median total annual revenues ($/yr)***	***# of Obs.***	***Median total annual revenues per connection ($/conn/yr)***
All systems	*214*	*75,054*	*199*	*261*
System pop. size:				
< 101	28	6,150	*26*	189
101-500	62	33,723	*59*	240
501-1,000	47	76,000	*46*	224
1,001-3,500	61	222,800	*59*	299
>3,500	16	442,974	*15*	511
Source type:				
Ground	117	48,831	*112*	188
Surface	43	204,499	*41*	370
Purchased	52	77,658	*50*	340
Ownership category:				
Municipal	140	66,989	*133*	235
Other public	27	241,155	*27*	451
Private	9	133,000	*9*	344
Homeowners assn.	20	22,401	*19*	200
Mobile home park	1	5,700	*1*	133
Other private	15	103,000	*14*	244
Note: 16 water systems having less than 16 connection were excluded from the per connection analysis.				

The total annual revenues are compared in Table VI-28. The median value of total annual revenues per connection was $261. Systems serving more than 1,000 persons and surface and purchased water systems reported higher revenues than the median value. The highest revenues of $451 per connection was reported by the "other" public systems.

Use of Outside Contractors

Nearly three-fourths of all respondents (n=250) to Question 31 reported they use outside contractors to assist in the operation of their system. One hundred and fifty-one respondents (151) contract out their water testing and reporting. System repairs, accounting and engineering analysis are among the other top purposes for which the outside contractors are used. Table V-29 shows that the percent of systems using contract services is similar across size, source, and ownership characteristics, with only the smallest systems and private system categories having less than 60 percent that use some type of contract service.

Not all of the respondents who indicated that they use various types of contract assistance also reported the annual cost of these services. Table V-30 summarizes the annual cost of different services that were reported by those respondents that did included this information.

Table V-29. Percent of Systems Using Contract Services
by Size, Source, and Ownership

Grouping variable	***Number of observations***	***Percent using contract services (%)***
All systems (expected %)	*342*	*73*
System pop. size:		
< 101	*68*	56
101-500	*102*	72
501-1,000	*72*	75
1,001-3,500	*83*	86
>3,500	*17*	82
c^2 *= 17.753; p< .01*		
Source type:		
Ground	*195*	72
Surface	*61*	74
Purchased	*84*	76
c^2 *= 0.597; p= 0.7420*		
Ownership category:		
Municipal	*195*	71
Other public	*41*	88
Private	*15*	53
Homeowners assn.	*35*	83
Mobile home park	*27*	67
Other private	*24*	71
c^2 *= 10.736; p= 0.0569*		

Table V-30. Mean and Median Annual Cost of
Selected Contract Services

Contract Category	***N***	***Mean ($)***	***Median ($)***
Engineering analysis	*68*	6,327	3,000
Accounting/Auditing	*91*	2,914	1,450
Analytical testing/reporting	*130*	2,488	1,054
Billing	*21*	3,541	2,100
Contract system repairs	*107*	7,006	3,062
Legal services	*62*	3,939	1,579

System Operating Expenses

Nearly 79 percent of the respondents provided some data on the ten categories of operating expenses. The median values of the reported expenses of all the survey participants and the those systems serving 3,500 or less are shown in Table V-31. The largest category of expenses for most water systems was the salaries and wages that they pay to their employees. The largest cost category for nearly 90 percent of the purchased water systems that reported expense information (n=48) was the cost of purchasing water. Depreciation was a significant expense category for those systems that that reported it, however, the median value of depreciation expenses per connection was zero for the two smallest size categories (Table V-32). Operating expenses per connection increased with system size for most categories.

Table V-31. Reported Operating Expenses by Category

	Annual Median Operating Expense ($)			
	All Systems		***System serving <3,500***	
Expense Category	***N***	***$/year***	***N***	***$/year***
Salaries, wages and benefits	*231*	19,257	*215*	16,670
Administration	*197*	2,000	*182*	1,854
Utilities	*221*	4,489	*205*	4,000
Insurance	*184*	2,231	*169*	2,000
Purchased water expense	*78*	25,974	*70*	22,147
Chemicals	*148*	2,811	*136*	2,279
Other operating supplies	*178*	5,328	*166*	5,000
Contract services	*157*	4,413	*146*	3,796
Taxes	*77*	1,325	*73*	1,309
Depreciation	*76*	30,818	*64*	23,610

Table V-32. Median Operating Expense in Dollars per Connection per Year
by System Size Category

System Size	***All systems***	***< 101***	***101-500***	***501-1,000***	***1,001-3,500***	***>3,500***
Expense Category	***$ per connection per year*** *(number of observations)*					
Salaries/Benefits	54.1 *(233)*	14.0 *(40)*	41.7 *(69)*	55.8 *(56)*	*84.0 (65)*	124.2 *(15)*
Administration	6.0 *(199)*	4.3 *(32)*	5.0 *(59)*	5.3 *(51)*	9.3 *(54)*	37.0 *(14)*
Utilities	16.2 *(212)*	19.1 (36)	14.1 *(58)*	14.3 *(55)*	20.7 *(58)*	42.5 *(15)*
Insurance	5.7 *(184)*	2.0 *(30)*	6.6 (50)	3.8 *(49)*	6.7 *(57)*	26.9 *(14)*
Water Purchases	112.6 *(73)*	134.5 *(9)*	130.1 *(27)*	110.3 *(14)*	87.8 *(17)*	117.6 *(8)*
Chemicals	5.7 *(168)*	0.4 *(28)*	6.3 (5*1*)	4.4 (44)	12.7 *(45)*	170.0 *(11)*
Supplies	14.3 *(183)*	8.3 *(27)*	11.9 *(48)*	12.6 *(48)*	21.5 *(55)*	49.2 *(12)*
Contract Services	12.8 *(173)*	21.2 *(30)*	1.01 *(46)*	2.9 *(30)*	3.7 *(32)*	0.0 *(8)*
Taxes	0.95 *(122)*	0.0 *(22)*	2.3 *(22)*	4.0 *(18)*	3.1 *(24)*	0.6 *(4)*
Depreciation	19.3 *(76)*	0.0 *(15)*	0.0 *(11)*	20.1 *(26)*	59.5 *(38)*	457.7 *(12)*

Debt Service Expenditures and Outstanding Debt

Questions 33 and 34 asked participants about their debt service payments and total amount of accumulated debt. A total of 260 respondents provided data on one or more categories of debt service expenditures. The median value of the interest payments, for the 139 respondents who had non-zero payments, was $16,775 per year; the median value of principal payments was $17,056.

The total amount of outstanding long-term debt was reported by 273 respondents. Nearly 59 percent of these respondents (159) reported zero debt. For the remaining 41 percent, the median value of reported debt was $289,642, and $210,000 for systems with population served of less than 3,500 persons.

Table V-33. Median Annual Debt Service and Debt Service per Connection by Size, Source and Ownership

Grouping variable	***# of obs.***	***Median annual debt service ($)***	***# of obs.***	***Median annual debt service/connection ($/conn)***
All systems	*260*	0	*236*	0
System pop. size:				
< 101	*52*	0	*44*	0
101-500	*76*	0	*71*	0
501-1,000	*51*	0	*51*	0
1,001-3,500	*65*	43,612	*64*	66
>3,500	*16*	173,000	*15*	266
Source type:				
Ground	*149*	0	*139*	0
Surface	*61*	33,406	*42*	71
Purchased	*89*	0	*62*	0
Ownership category:				
Municipal	*199*	3,756	*133*	19
Other public	*37*	35,903	*36*	63
Private	*14*	0	*14*	0
Homeowners assn.	*30*	0	*28*	0
Mobile home park	*15*	0	*12*	0
Other private	*22*	0	*19*	0

Note: 16 water systems having less than 16 connection were excluded from the per connection analysis.

The median amount of reported annual debt service per connection was zero for all system types except for the two largest size categories, surface water, and municipal and "other" public systems. The median amount of total debt is also zero for the same categories of systems. Median annual debt service per connection for the 107 systems reporting a non-zero amount of debt service was $83 per connection. Median total debt for the 103 non-zero systems was $670 per connection.

Table V-34. Median Total Outstanding Debt and Total Debt per Connection by Size, Source and Ownership

Grouping variable	***# of obs.***	***Median outstanding debt ($)***	***# of obs.***	***Median outstanding debt per connection ($/conn)***
All systems	*273*	*$0*	*244*	*$0*
System pop. size:				
< 101	*54*	0	*47*	0
101-500	*84*	0	*78*	0
501-1,000	*59*	0	*57*	0
1,001-3,500	*60*	199,840	*58*	306
>3,500	*16*	1,924,323	*15*	4,550
Source type:				
Ground	*159*	0	*148*	0
Surface	*44*	222,000	*41*	551
Purchased	*68*	0	*64*	0
Ownership category:				
Municipal	*147*	5,000	*138*	55
Other public	*35*	492,527	*34*	591
Private	*13*	0	*13*	0
Homeowners assn.	*35*	0	*32*	0
Mobile home park	*19*	0	*16*	0
Other private	*21*	0	*19*	0

Note: 16 water systems having less than 16 connection were excluded from the per connection analysis.

Water System Reserve Fund

Approximately 68 percent of the respondents reported that they maintain a reserve fund for their system in Question 34. Emergency repairs, planned equipment repairs and replacement, and debt service reserve were among the most frequently indicated purposes of the reserve fund. Table V-35 indicates that a higher than expected percentage of systems with a reserve fund was found among systems serving more than 1,000 persons, and surface and purchased water systems. "Other" public, homeowners associations, and "other" private systems also had a higher than expected percentage of systems with a reserve fund. A complete list of the stated uses of system reserve funds is reported in Appendix E.

Table V-35. Percent of Systems with Reserve Fund
by Size, Source and Ownership

Grouping variable	***# of obs.***	***Percent of systems with reserve fund (%)***
All systems (expected)	*328*	*68*
System pop. size:		
< 101	*67*	55
101-500	*100*	66
501-1,000	*65*	65
1,001-3,500	*80*	78
>3,500	*16*	100
$c^2 = 21.151; p < .01$		
Source type:		
Ground	*186*	62
Surface	*58*	78
Purchased	*82*	74
$c^2 = 7.366; p = 0.0251$		
Ownership category:		
Municipal	*183*	69
Other public	*41*	90
Private	*15*	53
Homeowners assn.	*36*	78
Mobile home park	*25*	12
Other private	*23*	74
$c^2 = 49.174; p < .01$		

Annual Contributions to Reserve Fund

Two hundred and twenty-two systems (66 percent) reported that they made no contribution to a reserve fund during the last financial reporting period. A total of 114 systems reported making some contribution (one system did not specify the amount). The median value of the reported contribution was $8,400 among all system sizes and $7,200 among the 100 systems with population served of 3,300 persons or less.

Table V-36. Mean Annual Contribution to Reserve Fund
by Size, Source and Ownership
of those Systems Making a Contribution

Grouping variable	*# of obs.*	*Median contribution to reserve fund ($)*	*# of obs.*	*Median contribution per connection ($/conn)*
All systems	*113*	*$8,400*	*103*	*$28*
System pop. size:				
< 101	*14*	1,000	*14*	29
101-500	*28*	3,000	*26*	21
501-1,000	*23*	12,132	*22*	46
1,001-3,500	*36*	19,000	*35*	22
>3,500	*12*	42,285	*11*	37
Source type:				
Ground	*54*	9,250	*50*	29
Surface	*22*	27,576	*17*	28
Purchased	*36*	7,450	*35*	34
Ownership category:				
Municipal	*57*	5,000	*53*	18
Other public	*25*	25,152	*22*	67
Private	*3*	20,000	*3*	162
Homeowners assn.	*12*	7,640	*11*	60
Mobile home park	*1*	2,000	*0*	--
Other private	*13*	8,000	*12*	15

Note: Analysis only includes systems reporting a non-zero annual contribution to their reserve fund. Also, 16 water systems having less than 16 connection were excluded from the per connection analysis.

The median annual contribution to a reserve fund per connection was greatest in the 501-1,000 and greater than 3,500 population served category, for purchased water systems, and "other" public, "other" public and homeowners association systems. The highest level of median contribution per connection was reported by private systems, but this value is based on responses from only three systems.

Accumulated Reserve Fund

The median value of the accumulated reserve fund, for the 161 systems that reported having a fund, was $30,000. For systems serving 3,500 or less persons (n=146) the median value of the fund of $27,500.

Table V-37. Median Accumulated Reserve Fund and Reserve Fund per Connection by Size, Source and Ownership, for those Systems with a Fund

Grouping variable	***# of obs.***	***Median accumulated reserve fund ($)***	***# of obs.***	***Mean accumulated reserve fund per connection ($/conn)***
All systems	*161*	*$30,000*	*147*	*$155*
System pop. size:				
< 101	*26*	9,098	*25*	277
101-500	*45*	12,000	*42*	115
501-1,000	*34*	51,476	*33*	130
1,001-3,500	*41*	75,000	*39*	109
>3,500	*15*	250,000	*14*	305
Source type:				
Ground	*88*	31,574	*83*	167
Surface	*29*	63,000	*27*	177
Purchased	*42*	20,000	*41*	119
Ownership category:				
Municipal	*88*	30,000	*83*	111
Other public	*29*	75,000	*29*	309
Private	*7*	20,000	*7*	286
Homeowners assn.	*20*	23,838	*19*	326
Mobile home park	*1*	2,000	*0*	--
Other private	*13*	75,000	*12*	128

Note: Analysis only includes systems reporting a non-zero accumulated reserve fund. Also, 16 water systems having less than 16 connection were excluded from the per connection analysis.

The median value of the reserve fund was proportional to system size, and was larger for surface water systems, and “other” public and “other” private systems. The accumulated reserve fund per connection is largest for both the smallest and largest size service population categories, for surface water systems, and for homeowners association system. Municipal systems reported the smallest amount of reserve funds per connection by ownership type.

Assessment of Physical Assets

Only 68 systems reported conducting a recent assessment of the value of physical assets of their systems. The median reported value of physical assets was $743,452, and the median value per connection was $1,477. The general unavailability of assessments of the value of water system physical assets makes it difficult to make any statements about the estimates of the value of physical assets per connection by size, source and ownership categories.

Table V-38. Median Value of Physical Assets and Assets per Connection by Size, Source and Ownership

Grouping variable	***# of obs.***	***Median value of physical assets ($)***	***# of obs.***	***Median value of physical assets per connection ($/conn)***
All systems	*68*	*$743,452*	*60*	*$1,477*
System pop. size:				
< 101	*7*	100,000	*7*	5,000
101-500	*14*	211,500	*13*	870
501-1,000	*13*	476,320	*13*	1,082
1,001-3,500	*23*	2,600,000	*22*	2,774
>3,500	*11*	4,800,000	*11*	18,620
Source type:				
Ground	*37*	781,112	*36*	1,948
Surface	*13*	2,024,906	*12*	13,268
Purchased	*17*	423,571	*17*	1,163
Ownership category:				
Municipal	*31*	706,904	*30*	1,477
Other public	*15*	4,000,000	*15*	4,331
Private	*2*	1,437,036	*1*	1,781
Homeowners assn.	*6*	200,000	*6*	910
Mobile home park	*2*	20,000	*2*	373
Other private	*12*	1,560,098	*11*	2,426
Note: 16 water systems having less than 16 connection were excluded from the per connection analysis				

Sources of Capital Financing

Approximately one-third of the survey participants (n=125) did not answer Question 39, which requested information about sources of external funding. Seventy-nine respondents stated that they did not use external funds; 19 other systems reported that this question was not applicable to them. One hundred and twenty-seven participants reported on their use of external sources of funds to finance their infrastructure needs, major repairs or water system expansion. Table V-39 shows the distribution of external funding sources of the most recent funds secured by respondents.

Table V-39. Distribution of Reported Funding Sources

Type of Financing	***# of Obs.***	***Percent of respondents***
All Sources	*225*	*100*
Grants and loans	25	11
Grants	26	12
Loans	61	27
Bonds	15	7
None	79	35
Not applicable	19	8

The three leading sources of financing were USDA's Rural Development program, state funding programs, and commercial banks. Grants accounted for more than 25 percent of all forms of financing. The median amount of financing (for both grants and loans) was approximately $250,000. An analysis of the use of external funding revealed no significant differences by system size, water source, and ownership type.

SURVEY PARTICIPANTS AND ADDITIONAL COMMENTS

System operators and municipal clerks accounted for the majority of respondents, participating on nearly 50 and 40 percent of the surveys respectively. The division of responsibilities at small water systems is reflected in the observation that 121 surveys (37 percent of respondents) were completed by two or more persons.

One hundred and ninety-three surveys had additional comments written in the space provided on the final page of the questionnaire. While many of these comments were additions or clarifications to survey questions, more than 70 comments contained information regarding various aspects of small water system management. These comments were edited (to preserve confidentiality) and are included in Appendix E.

EXTERNAL VARIABLES

Two externally collected variables, the number and type of Safe Drinking Water Act (SDWA) violations, were added to the data collected using the survey questionnaire. These are described in the following section. No other externally collected data were used in the analysis of survey data. While the authors readily admit the importance of affordability, or the ability to pay, in the analysis of small water system performance, the effort to obtain this information was deterred by the inherent difficulties of collecting income data based on water system boundaries, and the age of the available census income data.

M&R and MCL Violations

All community water supply systems must comply with the requirements of the Safe Drinking Water Act. These requirements take three forms: maximum contaminant levels (MCL is the maximum level of a specific contaminant that is permitted in finished drinking water), treatment techniques (specific methods that water treatment facilities must use for the removal of regulated contaminants), and monitoring and reporting requirements (regular schedules of water quality tests and reports that must be prepared and submitted to regulatory agencies). Compliance with these requirements are monitored by state primacy agencies and reported quarterly to the USEPA.

The two measures that are most often used to assess community water systems compliance with the SDWA are the number of monitoring and reporting (M&R) and maximum contaminant level (MCL) violations. Three years (July, 1996 to July, 1999) of violations data were obtained from the USEPA during the original Freedom of Information Act request, which was used to obtain system characteristic data on the universe of systems in the Midwest.

The SDWA violation data was reduced to two violation categories. Four types of maximum contaminant level violations (single sample, average, acute/TCR, monthly/TCR) were combined and summarized as "MCL" violations. Eight types of monitoring violations (regular, check/repeat/confirmation, routine major and minor TCR, repeat major and minor TCR, routine/repeat SWTR-unfiltered, and routine/repeat SWTR-filter) were combined and summarized as "Monitoring and Reporting " (M&R) violations. A third "total violations" category was also created that consisted of the sum of both MCL and monitoring violations.

There were 396 total monitoring violations for the 350 systems that returned questionnaires. However, one system had 192 violations across the three-year period, more than 10 times more than the system with the next largest number of violations (19).

The great majority of systems responding to the survey had no monitoring and reporting (252 systems or 72 percent), or MCL violations (288 systems or 82 percent). Approximately 90 percent of all responding systems had one violation or less of either type. More than 60 percent of respondents (213 systems) had no violations of either type, and more than 80 percent had one violation or less (283 systems).

Table V-40 describes the breakdown of M&R and MCL violations by system size, source and ownership. With respect to system size, the percentage of systems with violations generally decreases (slightly) with increasing system size. The highest percentage of systems with M&R violations (31 percent) is in the 101-500 size category. The next highest rate of 28 percent in found in the size category 100 persons or less. The MCL violations are also slightly higher than expected in these two size categories (Table V-40).

Table V-40. Percent of Systems with One or More SDWA Violations by Violation Type, System Size, Water Source and Ownership.

Grouping variable	***No. of Obs.***	***M&R (%)***	***MCL (%)***	***Total (%)***
All systems	*350*	*28*	*17*	*39*
System size:				
< 101	67	28	19	40
101-500	108	31	19	43
501-1,000	74	22	15	34
1,001-3,500	82	30	18	42
>3,500	19	21	5	26
Source type:				
Ground	198	30	22	44
Surface	61	26	12	33
Purchased	89	24	11	33
Ownership category:				
Municipal	199	27	20	42
Other public	43	26	9	33
Private	15	20	0	20
Homeowners assn.	36	33	22	44
Mobile home park	27	41	22	48
Other private	24	29	12	33

Surface and purchased water systems had a lower than average percent of systems with violations in both M&R and MCL categories. Finally, with respect to system ownership, homeowner associations and mobile home parks had a higher than average percent of systems with both types of violations. Municipal systems had higher than average percent of systems with MCL violations.

CALCULATED VARIABLES

Using the information provided by survey respondents, several calculated variables were added to the survey data in order to provide additional measures of water system performance and to generate normalized variables that could be assessed for their potential to serve as benchmark indicators. These are summarized in the following sections and broken down by system size categories.

Calculated Variables for Revenues and Expenses

Information provided on the questionnaire was used to create several variables to describe annual water system revenues. The revenue earned from the sales of water was requested as part of Question 29 in the survey. The revenue earned from activities other than sales (connection fees, penalties, interest earnings, etc.) was requested in Question 30, and were summed to create a non-sales revenue variable. The sum of the sales and non-sales values represents the gross revenue for each water system.

Table V-40. Mean and Median Gross Revenue and Gross Revenue per Connection by System Size Category

System size	***# of obs.***	***Mean Gross Revenue ($)***	***Median Gross Revenue ($)***	***# of obs.***	***Median gross revenue per connection ($/conn)***
All systems	*229*	*$202,327*	*$88,270*	*191*	*$290*
System size:					
< 101	*26*	8,688	5,522	*25*	194
101-500	*62*	51,893	38,773	*59*	256
501-1,000	*41*	106,363	99,576	*41*	284
1,001-3,500	*59*	295,806	239,000	*57*	325
>3,500	*16*	1,001,117	472,754	*15*	647

Table V-40 shows the increasing revenues with increasing systems size. Gross revenues per connection are considerably smaller than the median for the smallest size category, and more than double the median for the greater than 3,500 category.

Several variables to summarize expense categories were also created. The information reported in Question 32 was summed to create a variable describing water system operating expenses. Those expenses reported in Question 33 were summed to create a variable describing funds used to pay debt service expenses. Any capital expenses that were recorded in these questions were not included in either expense category. Table V-41 shows that expenses also increase with systems size, and that per connection operating expenses do not reach the median for the entire sample until the system size reaches 1,000 persons served.

Table V-41. Mean and Median Operating Expense and Operating Expense per Connection by System Size Category

System size	***# of obs.***	***Mean operating expense***	***Median operating expense***	***# of obs.***	***Median operating expense per connection ($/conn)***
All systems	*276*	*$120,165*	*$46,565*	*253*	*$195*
System size:					
< 101	51	5,985	3,820	*48*	110
101-500	80	33,574	22,215	*75*	177
501-1,000	59	67,647	56,542	*58*	181
1,001-3,500	70	218,017	196,634	*67*	245
>3,500	16	682,631	470,780	*15*	421

An estimate of the total expenses for the participating water systems was obtained by summing the operating and debt service expenses. Table V- 42 shows the distribution of total expenses by systems size category.

Table V-42. Mean and Median Total Expense and Total Expense Per Connection by System Size Category

System size	*# of obs.*	*Mean Total Expense ($)*	*Median Total Expense ($)*	*# of obs.*	*Median Total Expense per connection ($/conn)*
All systems	*277*	*$161,910*	*$50,400*	*254*	*$231*
System size:					
< 101	*51*	6,902	4,237	*48*	157
101-500	*81*	39,344	23,400	*76*	185
501-1,000	*59*	78,593	70,200	*58*	198
1,001-3,500	*70*	284,725	250,965	*67*	329
>3,500	*16*	1,046,413	725,652	*15*	623

Net water system revenue was calculated as the difference between gross revenue and total expense. Table V-43 shows the net revenue by size category. Since nearly one-third of reporting systems reported a negative net revenue for the reporting year, a separate row is included for those systems with positive and negative net revenues.

Table V-43. Mean and Median Net Revenue and Net Revenue Per Connection by System Size Category

System size	*# of obs.*	*Mean net revenue ($)*	*Median net revenue ($)*	*# of obs.*	*Median net revenue per connection ($/conn)*
All systems	*196*	*$7,880*	*$6,246*	*183*	*$196*
With net rev>0	*136*	43,628	16,084	*127*	76
With net rev<=0	*60*	-73,149	-20,210	*56*	-63
All systems					
System size:					
< 101	*26*	1,670	2,064	*25*	41
101-500	*57*	9,249	5,731	*54*	38
501-1,000	*41*	17,941	11,186	*41*	34
1,001-3,500	*56*	17,194	15,259	*54*	23
>3,500	*16*	-45,296	8,038	*15*	24

SUMMARY

The detailed question-by-question analysis revealed some important relationships between systems characteristics and their performance. These are analyzed in further detail in the next chapter.

VI. ANALYSIS OF BENCHMARKING DATA

PURPOSE

This chapter describes the analysis of the survey data which is aimed at the development of benchmarking variables and indicators. A number of system characteristics were examined in terms of their distribution among survey participants and their interrelationships. The main purpose of this analysis was to determine how the sampled small water systems performed in terms of a number of selected operational, economic and financial criteria.

The analysis of three specific areas of water system performance was required by the guidelines of this project: cost, compliance, and reliability. Statistical models were developed in an attempt to identify those variables that could explain performance in these three areas. The methods of analysis used are described in the following section. The subsequent section presents the results of the analysis of four different groups of indicators. The last part of the chapter summarizes the selected indicators for a top-performing group of small water systems.

METHODS OF ANALYSIS

Statistical Methods

The multivariate analysis of the survey data was undertaken in order to determine the relationship between the selected performance indicators and other system characteristics. These relationships were used to explain the reasons for the variability in performance among the systems and to use this information to identify the links between performance and benchmarking variables.

Logistical Regression

In several instances, binary indicator variables were created to designate systems with and without a given condition. For example, systems that reported one or more boil water orders were assigned a value of 1 on the binary variable while the systems without boil water orders were assigned a value of zero. The binary variables can be used as dependent variables in a multivariate analysis (i.e., with two or more independent variables, either binary or continuous) with the help of a logistic function. This function can be used to model the probability that a system with given characteristics will issue boil water orders. This probability is specified as:

$$\Pr.(E) = \frac{e^{bX}}{1+e^{bX}} = \frac{1}{1+e^{-bX}} = \frac{1}{1+e^{-Z}}$$

where:

Pr. (E) = probability of event E taking place (e.g. issuing boil water order)
e = the base of natural logarithm

The exponent can be substituted by symbol Z, where Z is in this application would be a linear function of several system characteristics that are hypothesized to affect the probability of the event. If Z is a binary variable that takes the values of 0 and 1 (e.g., 0 = no boil orders, 1 = one or more boil orders), and Z = $\boldsymbol{b}$X is a multiple regression equation that estimates Z based on the data such as,

$$Z = \boldsymbol{b}X = a + b_1 X_1 + b_2 X_2 + b_3 X_3$$

then the Pr.(E) denotes the probability that a particular observation Z has an actual value of 1, given its estimated value $\boldsymbol{b}$X.

Several variables were analyzed using logit regression procedure, which estimates a liner equation for Z. The coefficients and their error values can be interpreted to indicate if a postulated variable has a significant effect on the probability of experiencing boil orders, monitoring and reporting (M&R) violations or maximum contaminant level (MCL) violations.

Linear Regression

In cases where the dependent variables are continuous, a standard multivariate linear regression procedure was used. The regression models were constructed using the following three sets of explanatory variables:

$$Y = a + b_i S_i + c_j T_j + d_k X_k$$

where:

S_i = one or more variables representing system size
T_j = one or more variables for system type
X_k = other explanatory variables

All multivariate analyses were performed using S-Plus statistical software package.

Benchmarking Analysis

The purpose of the benchmarking analysis was to determine whether the data that had been collected using the mail survey of small water systems could be used to develop a set of benchmark indicators for the comparison of management and financial performance among small community water supply systems.

Benchmarking Measures and Values

Benchmarking is a method used by businesses to measure their performance relative to the performance of other businesses. Benchmarking can also be used to assess the performance of water supply systems, in terms of costs, revenues, and technical performance data. For example, a unit cost benchmark should allow the water system manager to determine whether the cost of water production and delivery (or any other cost category) by his/her system is reasonable, that is, whether it falls within the range of costs found in similar systems.

Benchmarking measures are ratios that express technical, economic and financial data in ways that allow a meaningful comparison between different water supply systems. Benchmarking measures can also serve to "normalize" the data with respect to the size of the system. However, other characteristics of the system (such as type of water supply source or system ownership) may also be important and may require that separate benchmarks be developed for systems sharing the same characteristic.

A benchmark value, in the context of this study, represents an expected value that is normalized, primarily with respect to the size of the system (or the magnitude of its water supply operations). This value would represent various normalized ratios or quantities such as:

1. Unit use of water per person served (e.g., gallons per capita per day)
2. Percent unaccounted water use
3. Unit O&M cost per 1,000 gallons of water delivered to the distribution system
4. Unit O&M cost per service connection per year
5. Unit O&M cost per person served per year
6. Financial operating ratio
7. Debt coverage ratio
8. Gross revenue per 1,000 gallons of deliveries
9. Gross revenue per connection per year
10. Net revenue per 1000 gallons of water deliveries
11. Net revenue per connection per year
12. Average price paid per 1,000 gallons of water used

Other similar normalized variables can be used to characterize the operations of small water supply systems and make it possible to provide for a meaningful comparison with peer systems.

Benchmarking Assumptions

The review and development of benchmarking measures for the small public water supply systems covered by this study is based on the following assumptions:

1. The value of any technical, financial or economic benchmark in a sample of water systems that are similar (i.e., belong to the same category) varies not only because of the differences in efficiency of system's management but also because the systems within a category may differ by size, ownership, treatment processes and other characteristics that affect the value of the benchmark but are external and cannot be easily changed by system managers. A meaningful comparison of benchmark values can be performed only if "corrections" are made for the factors other than efficiency or effectiveness of system operations.

2. The first step in the selection of benchmarking values is to determine if all systems within the sample meet certain minimum performance criteria and if there are significant differences in the benchmark values among systems that belong to different categories (i.e., with respect to size, ownership, treatment and other).

3. Selection of a benchmark value is necessarily related to one or more assumptions about its expected value. While several practical methods can be used to decide on which value in the distribution is to be chosen, the simplest approach is to select a value that represents:

   (1) a minimum acceptable value
   (2) median value, which indicated that 50 percent of comparable peer systems were able to exceed the value (or, where appropriate, to stay below the median value)
   (3) a 10, 20, or 30 percentile value below which 10, 20, or 30 percent of sample systems are found (assuming the lower benchmark value is better)
   (4) a 70, 80, or 90 percentile value above which 30, 20, or 10 percent of sample systems are found (assuming the higher benchmark value is better)

4. When preparing sample distributions of any benchmarking variable, the highest and lowest values were examined to determine whether they should be excluded because of some unique characteristics of the systems for which they were derived. The inclusion of the extreme values is mitigated by the use of medians and percentiles, however, they may introduce some bias in the selected values from the distribution.

5. The statistical models should allow a separation of major influencing characteristics within the sample thus permitting more meaningful predictions of median or percentile values within a category of water supply systems.

The selection of appropriate variables and their related benchmark values is a primary focus of previous studies of small water supply systems. The above approach is intended to be "judgement-free." That is, it simply provides information on the distribution of a benchmarking variables that were demonstrated to be significantly related to cost, compliance and reliability measures, and allows system managers to see where their system fits into the distribution of values collected from a sample of similar water systems.

ANALYSIS OF PERFORMANCE INDICATORS

Incidence of Boil Water Orders

The number of boil water orders issued by each responding system during the previous 12 months was used as an indicator of system reliability. Boil water orders were reported by 80 systems while 253 systems reported that they did not issue any boil orders during the previous year. A binary variable distinguishing between the systems with and without boil water orders was created and it was statistically analyzed for associations with other system characteristics.

The binary variable indicating whether or not a system reported one or more boil water orders during the preceding 12 months was analyzed using logit regression. The logistic equation with three significant independent variables is presented in Table VI-1.

Table VI-1. Logit Regression for Incidence of Boil Water Orders

Variable	*Coefficient*	*t value*
Intercept	-0.2484	-0.48
Number of total connections	0.0004	2.63
Municipal ownership	-0.9015	-2.43
Operating ratio	-0.6041	-2.07
Null Deviance: 202.43 on 183 degrees of freedom Residual Deviance: 182.83 on 180 degrees of freedom		

The results of the logit regression indicate that the probability of instituting boil water orders increases with the number of service connections, holding all other variables constant. Lower probability of boil water orders is associated with the public systems. The results in Table VI-1 indicate that the probability of a boil water order in a public (municipal) system with 1,000 connections and an operating ratio of 1.0 would be 0.2050 (or 20.5 percent), with a z-value of –1.354. A system with 100 connections and the same operating ratio would have a probability of issuing a boil water order of 0.153, or 15.3 percent (z = -1.714).

An important result is that the probability of boil orders decreases with increasing operating ratio, when other variables are held constant. The relationship indicates that an increase in operating ratio from 1.0 to 1.5 would lower the probability from 0.205 to 0.160.

Additional results of the logit regressions are shown in Table VI-2. The equation shown on this table includes several variables that are not statistically significant at the 0.05 level but have t-statistics higher than 1.0, which means that the magnitude of the estimated coefficient of the variable is greater than the associated error but the ratio is not high enough to indicate the standard level of statistical significance. Also, the coefficients of the "public systems" and "operating ratio" differ substantially from those in Table VI-1 because they correspond to a smaller data set (86 degrees of freedom versus 183 in Table VI-1), because of the missing values in the extended set of independent variables. This suggests that systems that have a financial buffer between operating costs and revenues are more likely to avoid boil water orders. Financially healthy systems translate into physically healthy systems.

Table VI-2. Extended Logit Regression for Incidence of Boil Water Orders

Variable	***Coefficient***	***t value***
Intercept	-0.7567	-1.26
Number of total connections	0.0011	2.59
Operating ratio	-0.5509	-1.81
Purchased water source	0.7949	1.92
Municipal ownership	-0.9201	-2.04
Received grant in past 10 years	1.2278	2.96
Null Deviance: 202.97 on 184 degrees of freedom Residual Deviance: 171.35 on 179 degrees of freedom		

The extended regression equation shows that the probability of boil orders also increases for systems that purchase their water, and systems that have received a grant in the past ten years. This finding is consistent with the previous table; systems that purchase water are those for whom the financial indicator operating ratio is not providing the operating buffer needed.

Additional multivariate regression analysis was conducted on the subset of data including the 80 systems that reported one or more boil water orders. Table VI-3 shows the results of two linear regressions, which used the reported number of boil water orders as the dependent variable.

Table VI-3. Linear Regression of the Reported Number of Boil Water Orders

Variable	***Coefficient***	***t value***
Model #1		
Intercept	0.7992	1.58
Population served	0.0005	2.35
Length of pipes, miles	0.0367	7.00
R-squared = 0.751 Residual standard error = 3.62 on 62 degrees of freedom F-statistic = 93.66 on 2 and 62 degrees of freedom		
Model #2		
Intercept	2.5763	1.59
Population served	0.0015	4.13
Length of pipes, miles	0.0187	2.37
Net revenue per connection, $/year	0.0090	3.71
Operating ratio	-1.8090	-1.76
R-squared = 0.840 Residual standard error = 3.96 on 32 degrees of freedom F-statistic = 41.96 on 4 and 32 degrees of freedom.		

The results in Table VI-3 indicate that the number of boil water orders in the data for the 80 systems reporting was strongly correlated with system size and increased with population served and the total length of pipes. Additionally, two variables introduced in Model #2 were net revenue per connection and operating ratio. The results indicate that the number of boil water orders increases with net revenue per connection and decreases with operating ratio. This implies more stringent cost monitoring on the part of systems that are less likely to have boil water orders.

Monitoring and Reporting Violations

A binary variable was constructed to distinguish between systems with and without monitoring violations. This variable was used in a logistic regression to identify those system characteristics and other variables that significantly increase or decrease the probability of having one or more monitoring violation. The results of the logistic regression are shown in Table VI-4.

Table VI-4. Extended Logit Regression for Incidence of M&R Violations

Variable	***Coefficient***	***t value***
Intercept	0.3366	0.61
Number of total connections	-0.0005	-1.38
Issued boil water order in last year	0.9018	2.71
Monthly water bill at 6,000 gallons	-0.0255	-2.10
Private water system	-1.1774	-1.15
Percent of residential connections	-0.0073	-1.39
Null Deviance: 299.45 on 243 degrees of freedom Residual Deviance: 248.42 on 238 degrees of freedom		

According to the estimated relationship, the probability of M&R violations is smaller in private water systems, systems with a larger total number of connections served, and it decreases with the increasing monthly water bill and percent of residential connections. The probability is higher for systems having a boil water order in the past year. However, some of the estimated coefficients have low statistical significance and have to be interpreted with caution.

A linear regression analysis was performed on the number of M&R violations for systems that reported one or more of such violations (98 systems). One system that reported 192 violations over the 3 year period of record was not included in the analysis. The results of the regression are shown in Table VI-5.

TableVI-5. Linear Regression of the Number of Monitoring Violations

Variable	*Coefficient*	*t value*	*Pr(>|t|)*
Intercept	1.8862741	2.04	0.0446
Have reserve fund	0.5748272	1.73	0.0867
Transfer ownership of system	-0.636522	-1.22	0.2256
Switch to purchased water	-1.720394	-3.93	0.0002
Mobile home park	0.9086762	1.85	0.0682
Private	1.6312988	2.01	0.0473
R^2 0.203287	Adj R^2 0.155292		
Root Mean Square Error 2.572818	Mean of Response 2.067416		
Observations 89			

Mobile home parks and private systems had more M&R violations than other types of systems. Also, systems with a reserve fund had had more violations although the estimated coefficient is only marginally significant. Also, a significantly smaller number of M&R violations was found among systems that indicated on the survey that they need to switch to purchased water. The relatively low R-square suggests that this particular set of variables is explaining only about 16 percent of the variation in the dependent variables.

Maximum Contaminant Level (MCL) Violations

A binary variable was constructed to distinguish between systems with and without monitoring violations. This variable was used in a logistic regression to identify those system characteristics and other variables that significantly increase or decrease the probability of having one or more monitoring violation. The results of the logistic regression are shown in Table VI-6.

Table VI-6. Extended Logit Regression for Incidence of MCL Violations

Variable	*Coefficient*	*t value*
Intercept	-1.3353	-2.19
Number of total connections	-0.0008	-1.45
Issued boil water order in last year	0.5689	1.40
Monthly charge at 6,000 gallons	-0.0356	-2.29
Municipal ownership	0.8518	1.63
Null deviance: 222.40 on 247 degrees of freedom		
Residual deviance: 211.09 on 243 degrees of freedom		

The results indicate that the probability of having MCL violations increases for municipally owned systems and if the system issued a boil water order in the past year. It decreases as monthly charge for water and the total number of connections increase. The monthly charge is the only significant variable in Table VI-6 at the 0.05 level of probability. This finding suggests that as the monthly charge increases, the probability of MCL violations decreases.

A linear regression analysis was performed on the number of MCL violations for systems that reported one or more of such violations (61 systems). The results of the regression are shown in Table VI-7. The estimated regression coefficients indicate that the number of total MCL violations over the three-year period was inversely related to total water deliveries indicating that smaller systems had more violations than larger systems. The number of violations also increased with the number of paid employees. Two additional variables indicate that the survey respondents who indicated a need to increase rates or transfer ownership of their system were likely to have a smaller number of total violations.

TableVI-7. Linear Regression of the Number of Monitoring Violations

Variable	***Coefficient***	***t value***	***Pr(>|t|)***
Intercept	3.030113	5.65	<.0001
Increase rates	-0.454331	-1.61	0.1239
Transfer ownership	-1.008313	-2.26	0.0359
Number of paid employees	0.299121	2.05	0.0547
Total Deliveries	-1.46e-8	-1.82	0.0853
RSquare	0.442784		
RSquare Adj	0.325475		
Root Mean Square Error	1.14826		
Mean of Response	2.291667		
Observations	24		

ANALYSIS OF FINANCIAL AND OPERATIONAL BENCHMARKS

Financial and Operational Ratios

A number of operational and financial ratios were calculated based upon the information provided by the survey respondents. Table VI-8 lists 19 different ratios and shows the mean and median values for all reporting systems in the survey. One of the significant drawbacks of using survey data was that a large number of systems failed to report information in one or more of the survey categories. This led to the uneven distribution of observations of the independent variables that hindered many of the attempts at providing a multivariate analysis of the data.

Table VI-8. Means and Medians Values for Calculated Ratios

Ratio	# of Obs.	Mean	Median
Gross revenue per 1,000 gallons delivered ($)	*140*	4.92	4.37
Net revenue per 1,000 gallons delivered ($)	*135*	0.60	0.46
Total expense per 1,000 gallons delivered ($)	*155*	2.97	3.46
Operating expense per 1,000 gallons delivered ($)	*155*	2.55	2.84
Gross revenue per person served ($)	*140*	4.92	4.34
Net revenue per person served ($)	*193*	19.97	15.16
Total expense per person served ($)	*274*	125.72	98.97
Operating expense per person served ($)	*273*	105.46	79.31
Gross revenue per total connections ($)	*190*	324	287
Total expense per total connections ($)	*254*	292	230
Net revenue per total connections ($)	*182*	39	37
Operating expense per total connections ($)	*253*	240	195
Operating ratio	*196*	1.6	1.4
Debt service coverage ratio	*45*	1.8	1.4
Population served per residential connections	*282*	3.1	2.5
Gallons per person per day	*161*	120	84.5
Max daily pumpage / Average daily pumpage	*244*	1.96	1.6
System capacity / Max daily pumpage	*208*	2.9	1.8
Unaccounted-for water/Total deliveries * 100 (%)	*55*	14.2	12

Note: 16 systems with less than 16 connections were excluded from calculations of ratios where the number of total connections was in the denominator. 10 systems reporting zero unaccounted-for water were not included in the calculation of unaccounted for percentages.

The ratios, unit values and other estimates shown on Table VI-8 may be considered preliminary benchmarks for small water systems. Most suitable for this purpose are median values since they indicate that 50 percent of the reporting systems had values that were below the median value and 50 percent had values that were above the reported median. Depending on whether the lower or higher values of the indicator are considered more desirable, a more appropriate benchmark would be either the 25- or the 75-percentile value to facilitate a comparison with the "best" peer systems.

Table VI-8 does not show the distribution of the benchmarking indicators in the sample of the responding systems. Such distributions are examined in the following sections. Also, all ratios were examined, using either cross-tabulations or a multivariate linear regression procedure, for their statistically significant correlations with system characteristics and other variables. This was done in order to determine if the benchmark values depended on system size, source type, and system ownership characteristics, as well as other characteristics.

Percent of Unaccounted-For Water

The loss of water that has been either treated or purchased by a water system is a common performance measure that is used to evaluate water systems. Water loss has both financial and managerial implications. The survey questionnaire asked respondents to estimate the amount of water lost by their systems. Seventy-one respondents provided a value for the amount of unaccounted-for water. Four answered that they had 0 (zero) water lost and were not included in the analysis.

Percent of unaccounted-for water was calculated by dividing the reported amount of unaccounted-for water in gallons per year by the reported amount of total water deliveries and multiplying that fraction by 100. Unfortunately, few systems reported both total deliveries and unaccounted-for water, so only 58 valid observations for this variable were obtained. Table VI-9 shows the summary statistics for the percent-unaccounted water among the 54 (non-zero) respondents. The median value of unaccounted water is 12.0 percent.

Table VI-9. Descriptive Statistics for Unaccounted Water

Statistic	***Mean percent of unaccounted water (%)***
Number of observations	*54*
Mean	14.0
Median	12.0
Minimum	0.1
Maximum	54.6
Percentiles	
10%	0.6
25%	3.3
75%	19.6
90%	34.7

The average percent of unaccounted for water is compared by system size, source and ownership in Table VI-10. The average percent of unaccounted-for water for the 54 reporting systems was 14.4 percent.

Based on the data reported in the survey an appropriate benchmark value for unaccounted-for water would be 12 percent of total production (or the amount of water delivered to the distribution system). The American Water Works Association recommends a value of 15 percent for all water supply systems, which would fall close to the 67 percentile of the data in this study. A 1995 survey of 2,000 community water systems by USEPA (1997) found a mean value of unaccounted water of 14 percent for systems serving 501-3,300 persons, and 9 percent for systems serving fewer than 500 persons.

Table VI-10. Percent of Reported Unaccounted-for Water
by Size, Source and Ownership

Grouping variable	*Number of observations*	*Mean percent of unaccounted for water (%)*
All systems	*54*	*14.4*
System size:		
< 101	6	13.8
101-500	15	14.1
501-1,000	8	19.5
1,001-3,500	20	13.3
>3,500	5	12.7
Source type:		
Ground	21	14.7
Surface	14	14.9
Purchased	19	13.8
Ownership category:		
Municipal	33	16.1
Other public	15	11.4
Private	2	4.7
Homeowners assn.	2	7.6
Mobile home park	0	--
Other private	2	25.9
Note: Analysis does not include 4 systems reporting zero unaccounted-for water.		

The lower value of 12 percent is achievable by small systems with fewer miles of the distribution system and fewer valves, connection meters and other controls. It should be noted, that this benchmark value is appropriate for systems that are 100 percent metered, thus allowing the system manager to compare total annual delivery to the total annual water sales (i.e., the sum of all metered annual consumption by retail and wholesale customers).

Unit Costs (Total Expenses)

Unit costs per 1,000 gallons, per connection, and per person served were calculated for annual total expense, which included both operating expenses and non-operating expenses. Table VI-11 shows the descriptive characteristics and percentiles for three unit cost values.

Table VI-11. Annual Total Expense Per 1, 000 Gallons Delivered,
Per Connection, and Per Population Served

Statistic	***Total expense per 1,000 gallons ($/gal)***	***Total expense per connection ($/conn)***	***Total expense per population served ($/person)***
Number of obs.	*155*	*254*	*274*
Mean	4.13	293	126
Median	3.47	230	99
Min	0.21	1	0.40
Max	18.78	3,213	755
Percentiles			
10%	1.06	55	24
25%	2.03	133	53
75%	5.17	357	162
90%	8.33	550	237
Note: 16 systems with less than 16 connections were not included in the per connection analysis because of the influence of large wholesale water systems with few connections which are included in the data.			

The total expenses for 1,000 gallons of water delivered to the distribution system ranged from $0.21 to $18.78 for 155 reporting systems. This is a large range that is centered on a median value of $3.47 with 50 percent of systems falling into the range between $2.03 and $5.17 per 1,000 gallons. Similarly, 50 percent of system had total annual expenses per service connection between $133 and $357, and total annual expense per person served in the range from $53 to $162. All three total expense ratios have large variability that has to be examined before considering these as suitable for benchmarking. For comparison, USEPA (1997) found the median value of total expenses per capita of $81 for systems serving 101-500 persons and $88 for systems serving 1,000-3,300 persons, which were considerably lower than the median value reported by participants in this study.

A linear regression of the total expenses per 1,000 gallons (Table VI-12) indicates that systems using purchased water tended to have higher total expenses by $2.23 per 1,000 gallons than surface water and groundwater systems. This interpretation is possible because the systems source variables are binary. Two additional binary variables in the equation indicate that the systems that received grants and systems that took out loans during the last ten years also had higher expenses per 1,000 gallons (by $1.70 and $0.87 per 1,000 gallons, respectively). An inverse relationship was found between the unit total expense and the two continuous variables: operating ratio and average daily per capita use.

TableVI-12. Linear Regression of the Annual Total Expense per 1000 Gallons

Variable	***Coefficient***	***t value***	***Pr(>|t|)***
Intercept	4.7994	8.63	0.0000
Purchased treated water	2.3274	5.50	0.0000
Operating ratio	-0.8773	-2.98	0.0035
Gallons per person per day	-0.0046	-3.20	0.0017
Received grant in past 10 years	1.6952	3.53	0.0006
Received loan in past 10 years	0.8667	1.98	0.0494
Residual standard error: 2.235 on 126 degrees of freedom Multiple R-squared: 0.3819 F-statistic: 15.57 on 5 and 126 degrees of freedom; p<0.0001			

Because of the significance of the source type variable (i.e., purchased water) in Table VI-12, the total operating expenses per 1,000 gallons were compared by supply source (Table VI-13). The results show large differences between the systems with different sources with groundwater having the lowest and purchased water the highest median total expenses per 1000 gallons of delivered water. The difference between medians is $0.93 between groundwater and surface water, and $1.73 between purchased water and surface water systems.

TableVI-13. Distribution of Annual Total Expense
per 1000 Gallons by Source Water Type

Statistic	***Ground***	***Surface***	***Purchased***
Number of observations	*75*	*33*	*46*
Mean	3.12	4.05	5.78
Median	2.45	4.38	5.31
Minimum	0.21	0.66	0.60
Maximum	18.78	9.42	14.42
Percentiles			
10%	0.70	1.74	2.33
25%	1.39	2.74	3.23
75%	3.78	4.38	7.84
90%	5.65	6.06	9.84

The results in Table VI-13 indicate that at the minimum a separate benchmark values for total expenses per 1,000 gallons should be used for surface and groundwater and purchased water systems. For example if the median value is used for comparisons among systems, then instead of $3.47 per 1,000 gallons per year for all systems, the three separate benchmarks would be $2.45 for groundwater systems, $4.38 for surface water systems and $5.31 for purchased water systems. Additional adjustments would have to be made to account for differences in the mean miles of the distribution system and mean population served within each supply source category.

For comparison, USEPA's Community Water System Survey (1997) found the median value of total expenses to be $2.34 per 1,000 gallons for systems serving 501-1,000 persons, and $2.04 for systems serving 1,001-3,300 persons. For systems serving 1,001-3,300 persons, the unit costs were $1.72 for groundwater systems, $2.32 for surface water systems and $3.60 for purchased water systems.

Unit Cost (Operating Expenses)

The annual operating expenses per unit are shown in Table VI-14. They indicate somewhat narrower ranges than in case of total expenses.

Table VI-14. Annual Operating Expense Per 1,000 Gallons Delivered, Per Connection, and Per Population Served

Statistic	***Operating expense per 1,000 gallons ($/gal)***	***Operating expense connection ($/conn)***	***Operating expense per person ($/person)***
Number of obs.	*156*	*253*	*273*
Mean	3.54	240	106
Median	2.85	55	79
Min	0.01	1	0.40
Max	20.89	2,663	685
Percentiles			
10%	0.99	55	24
25%	1.74	109	48
75%	4.53	284	134
90%	6.36	447	685

The percentile values indicate that for 50 percent of the reporting systems, the annual operating expense fell between $1.74 and $4.53 per 1,000 gallons. The corresponding range for operating expenses per service connection was between $109 and $284 and for the operating expense per person served between $48 and $134. The corresponding ratio of the 75- to 25-percentile values are 2.6, 2,6 and 2.8, indicating that the standardization of the operating expenses by the volume of water delivered and by service connection may be slightly better for benchmarking than population served.

The linear regression of the annual operating expenses per 1,000 gallons is shown in Table V-15. The purchased water supply source is found to be a significant predictor of this unit cost. The other three variables include: operating ratio, per capita use, and systems that have received grants.

TableVI-15. Linear Regression of the Annual Operating Expense Per 1,000 Gallons

Variable	***Coefficient***	***t value***	***Pr(>|t|)***
Intercept	4.8216	11.0729	0.0000
Purchase treated water	1.9711	5.8978	0.0000
Operating ratio	-1.1637	-5.0029	0.0000
Gallons per person per day	-0.0034	-2.9851	0.0034
Received grant in past 10 years	1.1105	2.977	0.0035
Residual standard error: 1.766 on 127 degrees of freedom Multiple R-squared: 0.4187 F-statistic: 22.87 on 4 and 127 degrees of freedom; p<0.0001			

The operating expenses for purchased water systems were approximately $1.97/gallon higher than in other systems. Table VI-16 shows the breakdown of unit operating expenses by supply source.

TableVI-16. Distribution of Annual Operating Expense
per 1,000 Gallon by Source Water Type

Statistic	***Ground***	***Surface***	***Purchased***
Number of observations	*75*	*33*	*46*
Mean	2.62	3.32	4.81
Median	2.08	3.38	4.68
Minimum	0.21	0.66	0.60
Maximum	18.78	7.80	12.90
Percentiles			
10%	0.62	1.19	1.96
25%	1.28	1.97	2.84
75%	2.99	4.19	6.22
90%	4.53	5.75	7.48

Table VI-16 indicates that the operating expenses per 1,000 gallons were the lowest in groundwater systems and highest in purchased water systems. Approximately 50 percent of groundwater systems fell within $1.28 to $2.99 per 1,000 gallons (based on the 25th and 75th percentile values). Corresponding ranges for surface water systems were $1.97 to $4.19 per thousand gallons, and for purchased water, $2.84 to $6.22 per thousand gallons.

Unit Revenues (Gross Revenue)

Several unit cost and production indicators were calculated. These examine the relationship between gross and net revenues and the number of gallons delivered, and the number of persons and connections served.

Table VI-17 shows the descriptive statistics for three unit measures of gross revenue: gross annual revenue (in dollars) per 1,000 gallons of system deliveries, per service connection and per person served.

Table VI-17. Gross Revenue per 1, 000 Gallons Delivered, Per Connection, and per Person Served

Statistic	***Gross revenue per 1,000 gallons ($/gal)***	***Gross revenue per connection ($/conn)***	***Gross revenue per person served ($/person)***
No. of obs.	*140*	*191*	*201*
Mean	4.80	325	151
Median	4.26	290	125
Min	0.47	8	2
Max	13.24	1,348	794
Percentiles			
10%	1.31	126	51
25%	2.78	172	81
75%	6.48	419	173
90%	8.66	562	274
Note: 16 systems with less than 16 connections were not included in the per connection analysis because of the influence of large wholesale water systems with few connections which are included in the data.			

The median values in Table VI-17 indicate that one half of the reporting systems had the annual gross revenue less than $4.26 per 1,000 gallons of water delivered, less than $290 per service connection and less than $125 per person served. The corresponding 75 percentile values are $6.48/1,000 gallons, $419/connection and $173/person. While these values indicated how much revenue is being raised on average, they do not provide an indication if these amounts are sufficient to cover costs. The USEPA (1997) showed median values of total revenues per 1,000 gallons sold ranging from $2.25 to $3.08. The corresponding per capita values ranged from $79 to $97.

The regression of the unit revenue in Table VI-18 shows the dependence of gross revenue per 1,000 gallons on groundwater and purchased water supply source, deliveries in gallons per person per day, the operating ratio, use of grant funds, and population served.

TableVI-18. Linear Regression of the Annual Gross Revenues Per 1.000 Gallons

Variable	***Coefficient***	***t value***	***Pr(>|t|)***
Intercept	4.3498	6.5412	0.0000
Purchase treated water	1.7025	2.9773	0.0035
Operating ratio	0.6762	2.2782	0.0244
Gallons per person per day	-0.0058	-4.0173	0.0001
Received grant in last 10 years	1.2464	2.6222	0.0098
Groundwater source	-1.1679	-2.1864	0.0306
Population served	-0.001	-1.6777	0.0959
Residual standard error: 2.247 on 125 degrees of freedom Multiple R-squared: 0.3796 F-statistic: 12.75 on 6 and 125 degrees of freedom; p<0.0001			

The breakdown of unit gross revenue by water source is shown in Table VI-19.

TableVI-19. Distribution of Gross Revenues
Per 1,000 Gallons by Source Water Type

Statistic	***Ground***	***Surface***	***Purchased***
Number of observations	*65*	*31*	*43*
Mean	3.78	4.60	6.81
Median	3.20	4.59	6.58
Minimum	0.61	0.47	0.86
Maximum	18.80	9.55	13.24
Percentiles			
10%	1.03	1.08	2.95
25%	1.91	3.82	4.20
75%	4.50	5.75	9.09
90%	7.70	6.70	10.97

In comparison to Table VI-17, the gross revenues for surface water systems are close to the average for all systems (i.e., $4.81). Groundwater systems have lower than average revenues while purchased water systems have higher than average revenues per 1,000 gallons.

Unit Revenues (Net)

Table VI-20 compares sample statistics for systems with reported positive net revenue. The sample means are $1.54 per 1,000 gallons, $105 per service connection, and $50 per person served. The median values are significantly lower indicating a right-tail skew of the distribution of the sample.

Table VI-20. Annual Net Revenue per 1, 000 Gallons Delivered, per Connection, and per Person Served

Statistic	***Net Revenue Per 1,000 Gallons ($)***	***Net Revenue Per Connection ($)***	***Net Revenue per Person Served ($)***
No. of observ.	*106*	*141*	*152*
Mean	1.54	105	50
Median	0.97	76	32
Min	0.01	1	0
Max	18.79	540	540
Percentiles			
10%	0.06	15	5
25%	0.34	32	14
75%	1.86	156	59
90%	3.56	228	107

Note: These statistics were estimated using only those water systems having positive net revenues. Also, 16 systems with less than 16 connections were not included in the per connection analysis because of the influence of large wholesale water systems with few connections which are included in the data.

A regression analysis found no significant relationship between systems size, source, and ownership characteristics and annual net revenues per 1,000 gallons. Table VI-21 indicates that the only factors that were found that influenced annual net revenues were whether the system had a loan in the past 10 years, and the estimated rate of growth (as measured by the ratio of anticipated future service population to the number of persons served five years previously).

TableVI-21. Linear Regression of the Annual Net Revenues per 1,000 Gallons

Variable	***Coefficient***	***t value***	***Pr(>|t|)***
Intercept	1.7791	5.54	<.0001
Loan in past 10 years	-1.0485	-3.07	0.0027
Forecast change persons served	-0.6157	-3.28	0.0014

Residual standard error: 1.631 on 102 degrees of freedom
Multiple R-squared: 0.1777
F-statistic: 11.02 on 2 and 102 degrees of freedom; $p<0.0001$

Systems that had loans were likely to have lower annual net revenues per 1,000 gallons, as were those which anticipated higher forecast growth rates.

Operating Ratio

Numerous types of operating ratios are typically used to assess the relationship between revenues and expenditures. The operating ratio used here was calculated by dividing gross revenues by the systems operating expenses. Where reported, depreciation was left in the denominator. An operating ratio of 1.0 indicates that the enterprise is just collecting enough revenues to cover the basic costs of operation. A ratio of 1.2 has been recommended as evidence of a system in reasonable financial health. Table VI-22 shows the distribution statistics for the operating ratio for all participating systems, as well as for only those with positive net revenues.

Table VI-22. Operating Ratio

Statistic	***All systems***	***Systems with positive net revenue***
Number of observations	*196*	*136*
Mean	1.61	1.87
Median	1.44	1.65
Min	0.05	1.00
Max	9.18	9.18
Percentiles		
10%	0.81	1.11
25%	1.08	1.32
75%	1.89	2.06
90%	2.47	2.67

Of the 350 systems in that responded to the survey, 154 did not provide enough information to compute an operating ratio. Of the 196 with adequate financial information, 136 systems had positive net revenue.

The regression equation in Table VI-23 indicates that the values of the operating ratio depends on total non-sales revenues, the number of wholesale connections, and per capita use. Surface water systems have, on average, an operating ratio that is 0.2 lower than in other systems.

TableVI-23. Linear Regression of the Operating Ratio

Variable	***Coefficient***	***t value***	***Pr(>|t|)***
Intercept	1.4576	17.5061	0.0000
Gallons per person per day	0.0006	1.6063	0.1107
Non-sales revenues	0.0000	2.1451	0.0339
Number of wholesale connections	0.0097	3.7759	0.0002
Surface water	-0.1994	-1.4746	0.1428
Residual standard error: 0.6282 on 126 degrees of freedom Multiple R-squared: 0.1551 F-statistic: 5.785 on 4 and 126 degrees of freedom; p=0.0026			

Debt Service Coverage Ratio

Not only must water systems earn enough revenues to cover the day-to-day costs of system operations, but they must also be able to pay off any debts that have been accumulated by the system in a timely fashion. Many measures have been developed to evaluate the ability of a business to cover its debt requirements. The measure used here, debt service coverage ratio, is calculated by dividing the net available revenue (gross revenue minus operating and maintenance expenses, but not including depreciation) by annual interest and principle charges. A ratio of 1.0 would indicate that a water system has just earned adequate revenues to cover its debt payments. Table VI-24 shows statistics for the debt service coverage ratio for 46 responding systems.

Table VI-24. Debt Service Coverage Ratio

Statistic	***Debt coverage ratio***
Number of observations	*46*
Mean	1.8
Median	1.4
Min	-5.8
Max	17.4
Percentiles	
10%	-0.9
25%	0.7
75%	2.5
90%	3.5

These systems provided sufficient financial information to calculate this ratio. Thirteen of the 46 systems had debt service coverage ratio of less than 1.0, and the median value of the ratio was 1.4. Also, respectively, 25 percent and 10 percent of systems have a ratio greater than 2.5 and 3.5.

The regression analysis in Table VI-25 suggests that there is a positive relationship between debt service coverage and groundwater as a water source and the net revenue per person served.

TableVI-25. Linear Regression of the Debt Service Coverage Ratio

Variable	***Coefficient***	***t value***	***Pr(>|t|)***
Intercept	0.8108	1.3662	0.1795
Groundwater source	2.3595	2.6655	0.0110
Net revenue per person served	0.0289	4.0495	0.0002
Residual standard error: 2.837 on 40 degrees of freedom Multiple R-squared: 0.3332 F-statistic: 9.995 on 2 and 40 degrees of freedom; p=0.0003			

ANALYSIS OF SYSTEM CAPACITY RATIOS

Maximum-Day to Average-Day Pumpage

The system peaking factors for the surveyed systems are shown in Table VI-26. The median value of the peaking factor was 1.6 and declined from 1.8 for very small systems to 1.4 for systems serving more than 3,500 persons, thus showing a dependence of the peaking ratio (maximum-day to average-day deliveries) on system size.

Table V-26. Mean and Median Peaking Factor
by System Size

System size	***#. of Obs.***	***Ratio of max day to average day***	
		Mean	***Median***
All systems	*244*	1.96	1.6
System size:			
< 101	32	2.4	1.8
101-500	*67*	2.1	1.6
501-1,000	*57*	1.9	1.7
1,001-3,500	*72*	1.7	1.5
>3,500	*16*	1.7	1.4

The regression equation in Table VI-27 indicates that peaking ratio is significantly higher for groundwater systems than for purchased and surface water systems, and lower for systems with larger transmission and distribution systems. No significant relationship of population served or other size variables was found.

Table VI-27. Linear Regression of the Peaking Factor

Variable	***Coefficient***	***t value***	***Pr(>|t|)***
Intercept	1.7474	13.7369	0.0000
Groundwater source	0.3619	2.2572	0.0250
Miles of trans. & distribution	-0.0010	-1.7006	0.0905
Residual standard error: 1.151 on 211 degrees of freedom Multiple R-squared: 0.04 F-statistic: 4.396 on 2 and 211 degrees of freedom; p=0.01347			

System Capacity Ratios

The survey results indicate that the majority of systems have the excess capacity to meet their maximum-day demands (Table VI-28). The regression results in Table VI-29 show that more system capacity is associated with younger systems and municipal systems. However, the coefficient for municipal ownership is of marginal statistical significance, and has to be interpreted with caution.

Table VI-28. Mean and Median Ratio for Maximum Capacity to Maximum Day Pumpage by System Size

System size	***No. of Obs.***	***Ratio of max capacity to max day***	
		Mean	***Median***
All systems	*206*	*2.95*	*1.8*
System size:			
< 101	*18*	4.0	2.8
101-500	*52*	3.4	2.4
501-1,000	*48*	2.1	1.7
1,001-3,500	*71*	2.2	1.5
>3,500	*14*	3.5	1.5
Note: 5 systems with ratios over 15 were not included in the calculations for the smallest size category.			

Table VI-29. Regression of System Capacity to Maximum Day Ratio

Variable	***Coefficient***	***t value***	***Pr(>|t|)***
Intercept	17.0110	1.6256	0.1058
Age of system	-0.4742	-2.1386	0.0338
Municipal ownership	23.6733	1.7768	0.0773
Residual standard error: 72.87 on 182 degrees of freedom Multiple R-squared: 0.027 F-statistic: 2.519on 2 and 182 degrees of freedom; p=0.08332			

ANALYSIS OF OPERATING COST STRUCTURE

In order to understand the structure of costs for small water systems, the percentage breakdown of different water system expenses for the systems participating in the study was prepared. The percent of total operating expenses for each category was calculated. However, because participating systems did not all have expenses in every category, the number of observation changes for every cell in the tables below (the number of observations appear in Italics in parenthesis). Also, the median values in the tables below do include zero values when they where reported by systems.

The median values of percentages of total expenses indicates that salaries and benefits for employees represent the largest category of operating cost, which for 231 reporting systems represented approximately one-third of total operating expenses. The cost of

Table VI-30. Median Values of Percent of Total Operating Expense Categories by System Size

System Size	***All systems***	***< 101***	***101-500***	***501-1,000***	***1,001-3,500***	***>3,500***
Expense Category	Percent of total expenses (*number of observations)*					
Salaries/Benefits	32.5 *(231)*	31.3 *(27)*	36.9 *(66)*	26.4 *(56)*	36.8 *(66)*	30.2 *(16)*
Administration	3.5 *(197)*	4.0 *(23)*	2.9 *(56)*	3.4 *(47)*`	4.2 *(56)*	3.3 *(15)*
Utilities	9.7 *(221)*	22.2 (*35*)	9.91 (*58*)	9.26 (*53*)	7.8 (*59*)	9.6 *(16)*
Insurance	2.8 *(184)*	4.3 *(19)*	3.5 (*47*)	2.6 (*44*)	2.6 (*59*)	2.3 *(15)*
Water Purchases	43.6 (*78*)	75.1 (*9*)	55.3 (*28*)	44.6 (*14*)	25.1 (*19*)	13.4 (*8*)
Chemicals	5.1 (*148*)	4.9 (*16*)	7.2 (*41*)	3.7 (*35*)	5.1 (*44*)	6.8 (*12*)
Supplies	8.3 (*178*)	24.6 (*18*)	9.2 (*45*)	7.3 (*45*)	8.0 (*58*)	6.5 (*12*)
Contract Services	9.2 (*157*)	21.9 (*22*)	9.6 (*39*)	8.7 (*39*)	7.4 (*46*)	6.0 (*11*)
Taxes	3.1 (*77*)	2.5 (*9*)	2.3 (*22*)	4.0 (*18*)	3.1 (*24*)	0.6 (*4*)
Depreciation	23.3 (*76*)	21.7 (*4*)	22.3 (*11*)	23.4 (*17*)	23.3 (*32*)	25.9 (*12*)

Water purchases is the second largest category for all systems, however, this result applies to purchased water systems and is a minimal category for systems that primarily use surface and groundwater sources.

Table VI-31. Median Values of Percent of Total Operating Expenses Categories by Water Source.

System Size	***All systems***	***Ground Water***	***Surface Water***	***Purchased Water***
Expense Category	Percent of total expenses (*number of observations)*			
Salaries/Benefits	32.5 (*231*)	34.2 (*123*)	42.1 (*50*)	20.0 (*56*)
Administration	3.5 (*197*)	4.1 (*105*)	3.0 (*41*)	2.3 (*50*)
Utilities	9.7 (*221*)	13.4 (*133*)	7.6 (*45*)	2.8 (*41*)
Insurance	2.8 (*184*)	3.1 (*99*)	3.2 (*44*)	2.2 (*41*)
Water Purchases	43.6 (*78*)	8.2 (*8*)	9.4 (*12*)	52.6 (*57*)
Chemicals	5.1 (*148*)	4.2 (*89*)	9.9 (*45*)	2.4 (*13*)
Supplies	8.3 (*178*)	11.4 (*100*)	7.3 (*42*)	5.0 (*36*)
Contract Services	9.2 (*157*)	11.8 (*88*)	5.3 (*30*)	9.5 (*38*)
Taxes	3.1 (*77*)	3.1 (*44*)	3.2 (*16*)	1.7 (*17*)
Depreciation	23.3 (*76*)	23.9 (*40*)	23.4 (*17*)	23.3 (*19*)
Note: Twenty (20) ground & surface water systems also reported purchase water expenses and are included in this analysis.				

Another large cost category is depreciation, and was in the range of 20-25 percent of total expenses for those systems reporting depreciation expenses. Utilities, supplies, and contract services represent the next three largest expense categories, representing slightly less than 10 percent for most groups of systems (Tables VI-30 and VI-31).

Table VI-32. Median Percent of Total Operating Expenses Categories by Ownership.

System Size	***All systems***	***Muni-cipal***	***Other public***	***Private***	***Home owners***	***MHP***	***Other private***
Expense Category	Percent of total expenses (*number of observations)*						
Salaries/Benefits	32.5 (*231*)	37.2 (*156*)	23.4 (*30*)	27.0 (*10*)	38.9 (*10*)	23.0 (6)	24.0(*17*)
Administration	3.5 (*197*)	3.3 (*121*)	3.0 (*28*)	5.4 (*9*)	4.3 (*18*)	8.7 (5)	4.5 (*15*)
Utilities	9.7 (*221*)	9.6 (*136*)	7.7 (*29*)	15.2 (*10*)	20.7 (*19*)	28.8 (10)	5.5 (*15*)
Insurance	2.8 (*184*)	2.9 (*111*)	2.3 (*28*)	2.8 (*9*)	4.7 (*16*)	3.2 (3)	2.5 (*16*)
Water Purchases	43.6 (*78*)	52.4 (*37*)	30.2 (*22*)	49.1 (*4*)	72.8 (*3*)	-- (0)	41.6 (*11*)
Chemicals	5.1 (*148*)	6.3 (*99*)	1.5 (*18*)	4.4 (*6*)	4.4 (*10*)	5.9 (5)	9.9 (*9*)
Supplies	8.3 (*178*)	9.0 (*118*)	7.3 (*23*)	8.9 (*5*)	11.0 (*13*)	15.9 (8)	2.9 (*11*)
Contract Services	9.2 (*157*)	7.3 (*93*)	7.8 (*23*)	15.5 (*5*)	27.2 (*15*)	54.6 (8)	12.1 (*12*)
Taxes	3.1 (*77*)	3.2 (*43*)	1.3 (*10*)	7.7 (*4*)	3.0 (*11*)	8.9 (2)	1.6 (*7*)
Depreciation	23.3 (*76*)	21.8 (*35*)	26.9 (*18*)	19.0 (*6*)	24.9 (*7*)	1.6 (7)	31.5 (*8*)

AVERAGE PRICE OF WATER

The average price of water was calculated from the theoretical monthly bill for a residential consumer at the consumption level of 6,000 gallons. The average price per 1,000 gallons ranged from $0.78 to $10.17 per 1,000 gallons. Table 33 shows the differences in average price per 1,000 gallons between different systems.

Table VI-33. Descriptive Statistics for Average Price of 1,000 gallons per Month

	Number of	***$ per 1,000 gal month***	
Grouping variable	***observations***	***Mean***	***Median***
All systems	*263*	*4.30*	*4.17*
System size:			
< 101	34	3.66	3.14
101-500	81	4.54	4.38
501-1,000	63	4.12	3.67
1,001-3,500	72	4.29	4.27
>3,500	13	5.42	5.18
Source type:			
Ground	138	3.28	2.88
Surface	51	5.25	5.25
Purchased	72	5.58	5.42
Ownership category:			
Municipal	177	3.89	3.64
Other public	32	5.70	5.25
Private	10	4.43	4.53
Homeowners assn.	24	4.17	4.35
Mobile home park	2	5.80	5.80
Other private	14	5.59	5.98

Table VI-34. Linear Regression of Average Price of Water

Variable	*Coefficient*	*t-Statistic*	*Probability*
Intercept	6.5991	19.0410	0.0000
Groundwater systems	-2.2342	-9.2948	0.0000
Public ownership	-1.2782	-3.9322	0.0001
Received grant in last 10 years	0.8784	2.7130	0.0073
Max Day (1,000 gallons)	-0.0006	-2.2420	0.0261
Residual standard error: 1.678 on 194 degrees of freedom Multiple R-squared: 0.3586 F-statistic: 27.12 on 4 and 194 degrees of freedom; p=0.0000 Note: "Public" ownership includes both municipal and other public systems.			

The three binary variables in Table 34 indicate that on average systems using groundwater charged $2.23 less per 1,000 gallons than surface and purchased water systems. Publicly owned systems charged $1.28/1,000 less than private and ancillary systems. Also, systems that received grants charged $0.88/1,000 gallons more. The price was also negatively related to maximum day deliveries, which in this case is a measure of system size. The price was lowered by $0.60 for each million gallons of maximum-day deliveries. The equation of Table 34 explained 36 percent in the variance among the 194 reporting systems.

Additional variables add explanatory power to the multiple regression equation, however, because of the missing values, the number of observations on which the model is estimated is smaller. Table 35 shows a regression model with eight explanatory variables, which is estimated for 118 systems with available data.

Table VI-35. Extended Regression Model for Average Price of Water

Variable	*Coefficient*	*t-Statistic*	*Probability*
Intercept	5.0287	11.8181	0.0000
Groundwater system	-1.16636	-5.4162	0.0000
Max Day (1,000 gallons)	-0.0012	-3.5623	0.0005
Age (years)	-0.0144	-2.7906	0.0062
Loan in past 10 years	0.9543	2.7430	0.0071
Capacity to av. day ratio	0.0285	2.7172	0.0076
Growth in connections ratio	0.7108	2.9618	0.0037
Number of storage tanks	0.3435	2.5639	0.0117
Residual standard error: 1.641 on 110 degrees of freedom Multiple R-squared: 0.4209 F-statistic: 11.42 on 7 and 110 degrees of freedom; p<0.0001			

The results in Table 35 indicate that the average price of water was also higher for systems with a recent history of growth in the number of connections and groundwater systems. The price also increased with the ratio of system capacity to average day production and the number of storage tanks in the systems, and whether the system had a loan in the past 10 years. The average price decreased with maximum-day pumpage and system age.

As would be expected, a highly significant relationship was found between price and system's cost, estimated for 139 systems based on available data, was:

$$\text{Average Price} = \underset{(9.90)}{2.457} + \underset{(9.96)}{0.499}\ (\text{Total Expenditure/1000 gallons})$$

This relationship explained 42 percent of variation in average price among the systems. It indicates that per each dollar in total annual expenditure per 1,000 gallons of water produced approximately $0.50 was added to the average price of water.

For 139 reporting systems the median price charged was 23 percent higher than the unit cost (total expenses). This margin of net revenues varied slightly by system size and ownership categories (Table VI-36).

Table VI-36. Total Expense per 1,000 gallons and Price per 1,000 Gallon

Grouping variable	***Number of observations***	***Total Expense $ per 1,000 gal***		***Average Price $ per 1,000 gal***	
		Mean	***Median***	***Mean***	***Median***
All systems	*139*	*4.14*	*3.53*	*4.52*	*4.33*
System size:					
< 101	*14*	3.35	2.95	4.75	4.39
101-500	*41*	4.34	3.90	4.72	4.67
501-1,000	*31*	3.63	2.92	3.96	3.28
1,001-3,500	*44*	4.42	4.23	4.42	4.29
>3,500	*9*	4.76	4.41	5.68	5.62
Source type:					
Ground	*64*	2.87	2.43	3.35	2.94
Surface	*29*	4.20	4.38	4.98	5.20
Purchased	*45*	5.83	5.46	5.89	6.08
Ownership category:					
Municipal	*87*	3.79	3.33	4.08	3.83
Other public	*25*	5.03	4.28	5.44	5.18
Private	*4*	3.40	3.72	4.56	4.55
Homeowners assn.	*11*	3.35	2.83	4.33	4.20
Mobile home park	--	--	--	--	--
Other private	*10*	5.79	4.90	6.02	6.24

THE SELECTION OF BEST PERFORMING SYSTEMS

In order to establish a reference set of "best water" systems, a set of the criteria were prepared that were generally agreed upon as necessary for an effective system, based on the comments that were collected from local decision makers, system operators, regulators and researchers during this study. These were organized into a set of "gold system" criteria.

Table VI-37 below describes the progressive "filtering" that was performed on the sample of water systems that participated in the survey. Thirty systems were identified using the following criteria for inclusion:

1) Small systems: those respondents serving less than 3,500.
2) Systems that were in regulatory compliance over last 3 years: no maximum contaminant level or monitoring and reporting violations in the past three years.
3) Systems that met the study's highest reliability criteria: no boil water orders in the past year.
4) Systems that had a positive cash flow: net revenue greater than zero, or if negative net revenues, reserve fund is greater than three times annual total expenditures.
5) Self-supporting systems: have not had to rely on grant funds in the past 10 years.
6) Systems that were able to respond to a minimum number of questions that are key to characterizing operating and financial characteristics including:
   - Estimated population served
   - Estimated average daily pumpage
   - Water rates
   - Revenues and expenses
   - Total Deliveries
7) Systems with "unaccounted-for" water of 20 percent or less, if reported.

Table VI-37. Best Performing System Criteria

#	*Progressively exclusive criteria*	*Number of Systems*
	All systems in sample	350
1	Systems serving less than 3,500 persons	331
2	No maximum contaminant level violation	271
	No monitoring and reporting violations	199
3	No boil water orders in the last year	151
4	Net revenues >0, unless reserve fund > 3 years of total expenditures	57
5	No Grants	51
6	Minimum reporting on survey	
	Estimated population served	51
	Estimated average daily pumpage	45
	Water Rates	44
	Revenues and expenses	44
	Total Deliveries	34
7	Unaccounted-for use less than 20 percent	30

Some of the key characteristics of the best performing systems appear in Table VI-38. The data for individual systems show that the top 30 systems, with only a few exceptions, had less than 1 employee per 100 connections. The median monthly water bill for 6,000 gallons was $12.50, but ranged from $9.90 to $543.60. Net revenue per 1,000 gallons of deliveries ranged from $0.30 to $7.93.

The operating ratio ranged from 1.02 to 3.73, with a median value of 1.77. The debt service coverage ratio (available for only six of the thirty systems ranged from 1.75 to 3.73 with a median value of 2.69.

The purpose of Table VI-38 is to determine how individual systems measured on several indicators. For example, the first system in the table has a service population of 300, has an operating ratio of 2.86, as well as one of the lowest operating expenses per 1,000 gallons, has no debt and net revenues per 1,000 gallons that is nearly twice the median value for all systems.

For benchmarking purposes, the first four columns capture the systems characteristics which can be used by individual systems to find a close match for their systems. For example, a public groundwater system serving approximately 1,000 persons can be matched to systems number 6 and number 7. The operating ratio for the first system is 1.1, and 2.33 for the second system. The largest differences between these two matching systems is the monthly water and net revenue.

The distribution of systems participating in the survey that met the best performing system criteria appears in Table VI-39 below. The table also shows the percentage of participating systems in each category that met these criteria, and the mean values of several operational and financial indicators. Table VI-39 groups the systems from Table VI-38 by system size, source, and ownership type. The median values in the table can be used as benchmarks for each type of system.

Table VI-38. Key Characteristics of Systems Meeting the Best Performing System Criteria

	#	Owner-ship type	Pop served	Total conn.	% Non-residential conn.	Employees per 100 Conn.	Price for 6,000 gal/month	Net Revenue per 1,000 gal	Operating ratio	Debt service coverage ratio	Total expense per 1,000 gal	Operating expense per 1,000 gal	Gallons Per Person per day	Miles of T&D per 100 conn.
GROUNDWATER	1	1	300	135	11.9	0.37	$16.67	$1.84	2.86	.	$0.99	$0.99	110	5.9
	2	1	487	224	10.3	0.45	23.20	1.15	1.8	.	1.42	1.42	90	1.8
	3	1	550	245	3.7	0.61	11.00	3.49	1.79	.	4.40	4.40	78	.
	4	1	700	344	14.5	0.15	12.44	1.27	1.75	3.61	3.46	2.71	82	1.8
	5	1	761	280	10.7	0.71	13.76	0.23	1.66	.	3.78	2.42	71	1.6
	6	1	1000	474	15.8	0.53	13.50	0.18	1.1	.	1.69	1.69	112	1.5
	7	1	1089	409	12.2	0.49	38.40	0.73	2.33	.	3.14	1.66	63	.
	8	1	2600	947	19.1	0.21	16.00	0.85	1.81	2.73	2.40	1.79	76	.
	9	2	21	21	9.5	7.14	26.00	2.19	1.47	.	4.63	4.63	211	2.2
	10	2	170	167	2.4	1.2	30.00	1.17	1.42	.	2.83	2.83	185	12.0
	11	3	1250	603	14.4	0.5	9.89	0.12	2.04	.	0.50	0.30	1291	3.0
	12	4	98	36	0	0	46.50	1.25	1.9	.	1.39	1.39	140	2.8
	13	4	400	140	0	0.71	15.00	0.5	1.47	.	1.06	1.06	121	7.1
SURFACE	14	1	500	285	14	0.53	18.50	0.03	1.19	.	4.38	3.71	82	2.1
	15	1	520	244	7.4	0.41	24.00	0.63	1.18	.	3.53	3.53	68	0.8
	16	1	610	275	0.7	0.73	19.70	0.14	1.04	.	3.73	3.73	55	6.6
	17	1	701	289	12.5	0.69	23.75	1.13	2.18	2.12	2.82	1.81	133	.
	18	1	1500	626	0.6	0.64	53.55	2.08	1.87	3.73	4.68	3.61	228	58.1
	19	1	2225	918	10.1	0.16	10.50	0.31	1.47	.	0.66	0.66	168	1.3
	20	1	3100	1383	33.3	0.29	32.46	1.48	3.92	1.75	3.17	1.19	108	2.6
	21	3	20	20	0	2.5	45.00	4.85	2.03	.	4.70	4.70	181	30.0
PURCHASED	22	1	115	39	0	1.28	25.00	0.07	1.02	.	3.00	3.00	91	5.1
	23	1	300	123	4.07	0	29.4.0	0.45	1.08	.	5.81	5.81	53	4.1
	24	1	378	378	6.6	0.4	38.85	7.93	3.12	.	3.73	3.73	187	4.0
	25	1	400	120	0.8	0.83	48.00	3.76	1.89	.	4.24	4.24	34	10.0
	26	2	675	228	1.8	0.44	44.02	2.25	1.44	.	5.13	5.13	65	11.0
	27	3	69	41	0	9.76	20.10	0.82	1.78	2.64	2.73	1.99	188	85.4
	28	4	130	42	2.38	2.38	33.00	0.46	1.08	.	5.79	5.79	72	4.8
	29	6	430	430	0	0.12	26.30	2.49	4.4	.	0.73	0.73	204	1.9
	30	6	2000	380	0	0.26	36.50	0.47	1.07	.	7.00	7.00	33	72.4
Mean			*770*	*328*	*7.30*	*1.15*	*26.70*	*1.48*	*1.84*	*2.76*	*3.25*	*2.92*	*153*	*13.1*
Std.Dev			*785*	*311*	*7.77*	*2.09*	*12.50*	*1.70*	*0.82*	*0.79*	*1.68*	*1.75*	*222*	*22.8*
Median			*510*	*260*	*5.34*	*0.51*	*24.50*	*0.99*	*1.77*	*2.69*	*3.32*	*2.77*	*100*	*4.0*
Max.			*3,100*	*1,383*	*33.33*	*9.76*	*53.60*	*7.93*	*4.40*	*3.73*	*7.00*	*7.00*	*1,291*	*85.4*
Min.			*20*	*20*	*0.00*	*0.00*	*9.90*	*0.30*	*1.02*	*1.75*	*0.50*	*0.30*	*33*	*0.8*

Ownership types: 1=municipal; 2=other public; 3=private; 4=homeowners association; 6=other private. No mobile home parks met all the best performing system criteria.

Table VI-39. Percent of Systems Meeting the Best Performing System Criteria, and Median Values of Indicators by Size, Source and Ownership Type

Grouping variable	***#. of obs.***	***Percent of systems (%)***	***Median gallons per person per day***	***Median 6K/month price ($)***	***Median Net revenue per 1,000 gal ($)***	***Median Operating Ratio***	***Median Total expense per 1,000 gal ($)***	***Median Operating expense per 1,000 gal ($)***
All systems	*30*	*9%*	*100*	*$24.50*	*$1.48*	*1.77*	*$3.32*	*$2.77*
System size:								
< 101	4	6	184	35.50	1.72	1.8	3.68	3.31
101-500	11	10	91	26.30	1.15	1.5	3.00	3.00
501-1,000	8	10	74	16.73	0.88	1.5	3.63	3.12
1,001-3,500	7	8	108	32.46	0.73	1.9	3.14	1.66
Source type:								
Ground	13	10	110	16.00	1.15	1.8	2.40	1.69
Surface	8	13	121	23.88	0.88	1.7	3.63	3.57
Purchased	9	10	72	33.00	0.82	1.4	4.24	4.24
Ownership category:								
Municipal	19	10	82	23.20	0.85	1.8	3.46	2.71
Other public	3	7	185	30.00	2.2	1.4	4.63	4.63
Private	3	20	188	20.10	0.82	2.0	2.73	1.99
Homeowners assn.	3	8	121	33.00	0.50	1.5	1.39	1.39
Mobile home park	0	0	--	--	--	--	-	--
Other private	2	8	119	31.40	1.48	2.7	3.87	3.87

VII. CONCLUSIONS

This study represent one of the earliest, if not the first, attempt to collect financial and operating data from small water systems for the purpose of developing benchmarks. The results of the study, while far from definitive, do provide insights into the management of small systems in the Midwest, and can provide guidance for similar, future studies.

The principal outcome of this study is a large information base that describes the operational, economic and financial characteristics of small public water supply systems in ten states of the Midwest. This body of information was collected through consultations with experts, site visits, and focus group meetings and through a 40-question mail survey of 350 small systems. This chapter provides a summary of key findings of the study, especially those that pertain directly to the objectives of the project. Several recommendations for further research are also given. The key findings and recommendations are derived from the results of all of the research components. More information about each finding, as well as information on other findings can be found in the previous chapters of this report, primarily in Chapters 4, 5 and 6. Detailed documentation of research results is included in the appendices.

KEY FINDINGS

The major findings of the study pertain to the challenges small systems face in order to achieve long-term financial integrity while meeting all state and federal performance guidelines. The findings that emerged from this study are summarized below.

1. The adoption and use of benchmarking procedures is not a top priority for the managers of small public water supplies systems. The practice of using indicator measures to assess financial performance also appears to be rare. The majority of water system managers focus on the uninterrupted operation of their systems and tend to take a technical view of the system performance, even though they are well aware of the difficulties in securing sufficient financial resources to cover the cost of operation and upgrading of their physical plant. The survey revealed that only one-third of system managers use some type of financial assessment indicator. The majority of respondents used only net revenues, an assessment that would be expected of every business enterprise. Less than 10 percent of managers calculated operating ratios or debt service coverage ratios to monitor their financial condition.

2. The assessment of the Expert Panel Consultation members as to the difficulties of using a survey to collect data to develop benchmarks was confirmed. Few systems responded to the survey (less than 20 percent). Of those systems that did respond to the survey, many did not respond to questions that requested financial information about their systems that could be used in the development of benchmarks.

3. The topic of water rates dominated every component of the study. System managers, technical assistance staff, and regulatory officials all commented on the problem of establishing full-cost pricing and the inability of many systems to raise adequate revenues. Survey respondents rated increasing rates and developing new rate structures as their most important future task. The survey data also indicate that the prices and tariff structure vary substantially among systems and are correlated with some performance indicators. In spite of the difficulty of developing a comparable price between these many different pricing structures, and the fact that water prices should vary by the unique cost characteristics of each system, water rates appeared to be the primary comparative indicator used by managers and water system decision-makers.

4. The availability of financial records and related data that are needed to calculate financial indicators (other than price of water) appears to be limited. Only four out of 10 systems prepare monthly financial reports and only slightly more than one half of the managers indicated that they have annual budgets. Because of the expert consensus that only systems with good data are likely to respond to the financial surveys, and the non-response rate of close to eighty percent, the actual proportion of systems with inadequate financial records is likely to be substantially higher.

5. Efforts to conduct financial performance or "capacity" assessment of small drinking water system are also likely to be hampered by a lack of technical support on financial matters to small systems. Only 30 percent of survey respondents had used the services of any technical advisors, and comments from the focus groups and interviews with system managers suggest that even the most basic financial record keeping and planning is lacking in many small systems. A surprisingly small number of systems who responded to the survey appear to be taking advantage of the services provided by the National Rural Water Association state affiliates, the Rural Community Assistance Program regional affiliates, or state offices of the USDA's Rural Development program. However, those respondents who did use these programs praised them highly.

6. The analysis of system reliability found the relationship between operating ratio and systems reliability as measured by the number of boil water orders. This ties into the observation by most systems that one of their greatest needs is to take actions to improve their rates and rate structure. However, a detailed statistical analysis of the variability in the operating ratios revealed that adequate levels of the ratio were linked both to higher prices for water and lower unit costs of system operations. One way to interpret these results is that the majority of small systems are well aware of their need to improve their revenue sufficiency and their financial position.

RECOMMENTATIONS

The outcomes and experience of this project lend support to the following recommendations for future investigations of small public water supply system and for formulating appropriate assistance programs.

1. The development of benchmarks for the community of small water systems requires detailed financial and operating data for a representative sample of small systems. The mail survey approach used in this study and the financial data that were reported may not be representative for the entire population of small systems. Other sources of data need to be examined in order to improve and expand the benchmarks suggested in this study. The potential of using existing national databases to develop benchmarks should be explored. Other existing information, such as the files used to monitor repayment of Rural Developments loans could also prove useful to future benchmarking studies.

2. While the experience-based financial benchmarks devised from the investment service community are applicable as general "rules of thumb" for small water systems, more meaningful benchmarks can be derived only through the analysis of small system financial data. By using a large sample, such analysis could help identify those systems that can serve as models for different categories of small systems.