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METHODS FOR ASSESSING THE VIABILITY OF SMALL WATER SYSTEMS:

A Review of Current Techniques and Approaches

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CHAPTER 1.
INTRODUCTION AND OVERVIEW

1.1 Introduction

This manual has been developed to assist States in understanding and applying presently available water system viability assessment methodologies. EPA hopes that the information presented here will stimulate State creativity and lead to development of additional, alternative viability assessment methodologies appropriate to the circumstances of specific States. Small systems and technical assistance providers should also find this document useful as a tool for water system self assessment.

1.2 What Is Viability?

At its simplest, the term ***viability*** can be defined as follows:

Viability is the ability to
- *consistently provide*
- *quality service*
- *at an affordable cost.*

An alternative definition is:

Viability is the
- *technical*
- *financial, and*
- *managerial capability*

to consistently comply with current and prospective performance requirements.

While there is no universally accepted definition of viability, all definitions are fairly similar and cover the same major points. Every one of these points has considerable significance.

Technical, financial, and managerial capabilities of small water systems are often limited by the flow of revenues and the strength of the institutional arrangements. Weakness in any of these three areas can affect the reliability of water service. Over the long-run, inadequate cost recovery will lead to deterioration of system components. The lack of a dedicated flow of revenues sufficient to sustain the system raises a question as to the long-term reliability of water service.

The ability to consistently comply with current and prospective performance requirements incorporates the fact that performance requirements may change as our knowledge of technology and health effects advances. The emerging concern regarding Cryptosporidium is an example. Thus a system must be capable of adjusting to change and meeting new challenges as they emerge. In terms of all the above components of viability, the correct context is forward-looking, towards the future rather than the past.

1.3 Why Address Small System Viability?

Why new words and new initiatives to address small system viability? It could be said that history has finally caught up with us, or stated otherwise, that we are at a turning point -- a crossroads -- in the history of the small system segment of the water supply industry. For some time, historical forces have been creating and enlarging a gap between the performance demands placed on small systems and the institutional capabilities of small systems.

Figures 1.1 and 1.2 illustrate some key institutional characteristics of the small system universe. "Small systems" have typically been considered to be those serving fewer than 3,300 persons. As shown in Figure 1.1, 87 percent of the community water systems in the country classify as "small systems" by this definition. Moreover, the largest two slices of the pie chart in Figure 1.1 illustrate the fact that 62 percent of all community water systems serve fewer than 500 persons. There is a natural tendency to think of small water systems as being small towns or small utilities. As these data make clear, however, most small systems are actually small clusters of homes.

Other significant characteristics relating to the ownership profile of small systems are displayed in the pie chart in Figure 1.2. As shown here, about 55 percent of small water systems are mobile home parks, home owner's associations, or small private water companies (shown as investor owned, but actually mom & pop small companies for the most part). These private ownership forms are highly concentrated in the very smallest systems, those serving fewer than 500 persons. Of the systems serving fewer than 500 persons, 80 to 90 percent are in one of these three private ownserhip categories. While roughly 40 percent of all systems serving fewer than 3,300 persons are publicly owned by small towns, districts, or authorities, these systems are concentrated near the large end of the small system spectrum.

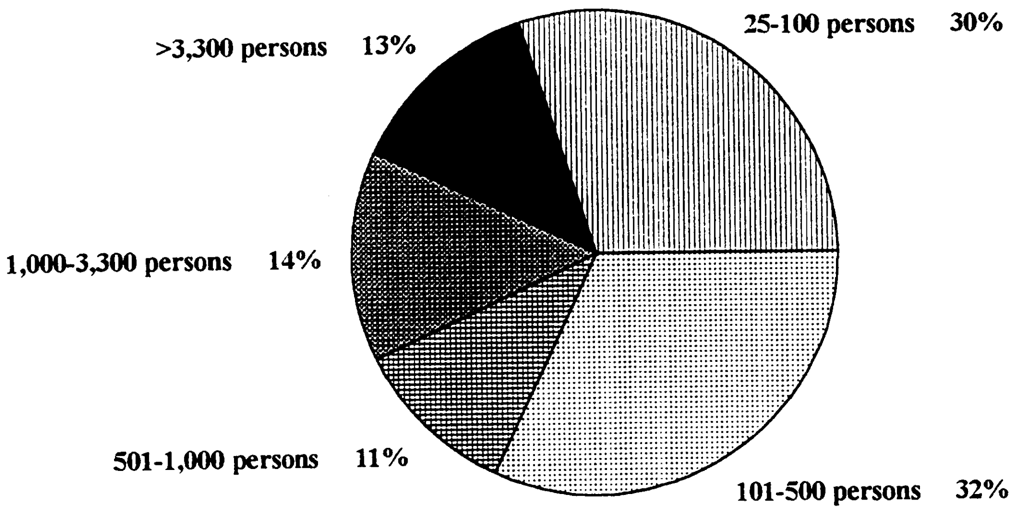
There are many stories behind such statistics, the recurring theme is one of institutional weakness. This is illustrated by two predominant stereotypes: the case of rural economic decline and the case of suburban sprawl.

Water supply infrastructure in many rural communities was initially sized and put in place during the earlier part of the twentieth century at a time when the economics and demographics of these communitites supported larger populations. With technological advances in agriculture, and with various changes affecting natural resource and mining industries, many rural communities are now less prosperous economically and home to much smaller populations. In addition to the smaller customer base, advances in public health protection have increased the expense of providing potable water.

FIGURE 1.1

NUMBER OF SYSTEMS BY SIZE

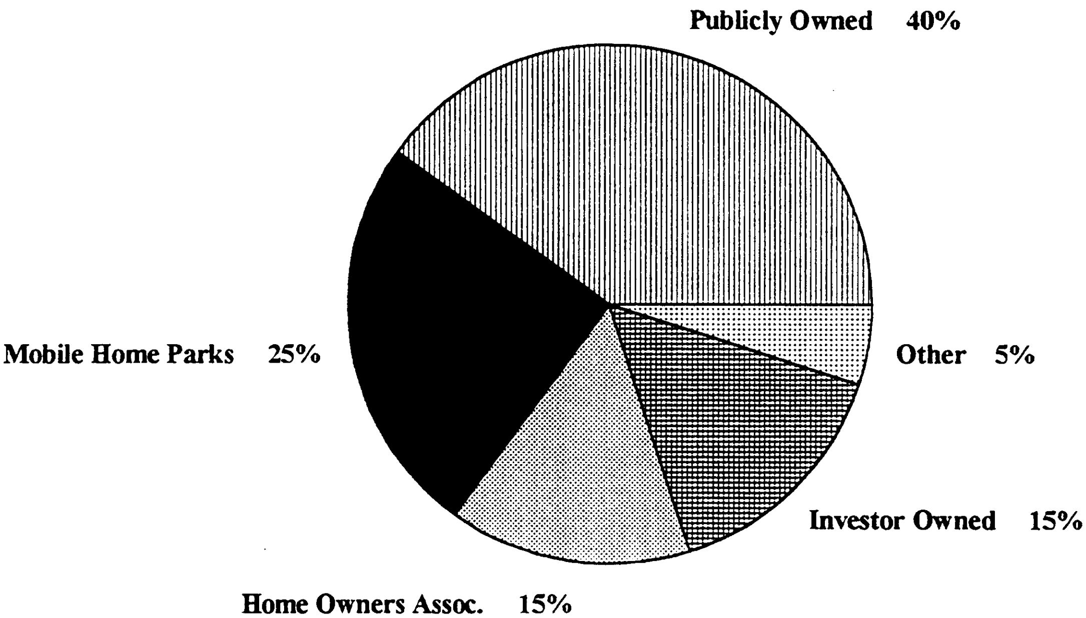
(based on size of population served)



Total number of community water systems = 58,000.

Figure 1.2

OWNERSHIP OF SMALL CWSs



Approximately 52,000 CWSs are small (seve <3,300 persons).

Over the latter half of the twentieth century, the process of suburbanization has been one of the dominant demographic and economic trends in the nation. It has resulted in the creation of thousands of small water systems, initially built by land developers and then turned over to cooperative homeowners associations. Because the developer's interest often extends no further than the sale of the last lot, the provision for prudent financial and technical management of these water systems within a sustainable institutional framework has often been completely lacking.

Among the many thousands of small systems, there are many other stories which may not adhere exactly to these two stereotypes, but still share the same types of institutional weaknesses and the same results in terms of performance problems. **Because water supply was not historically an expensive service to provide, institutions devised for service delivery were not conceived with very strong management and financial capabilities. The gap between performance expectations and capabilities is likely to grow wider and cannot be ignored. The systemic deficiencies in water service delivery mechanisms of small communities are an accident of history and must be viewed in a much broader context than that of the SDWA program. The institutional changes required to address the performance gap in service delivery raise much broader issues of public infrastructure policy and the respective roles of state and local government.**

Thus, there is a need for a new way of thinking about small systems. The new focus on the underlying service delivery mechanism has been captured in the word "viability." State primacy agencies originally recognized the need and offered the term "viability" in requesting assistance from EPA in the development of "viability screening tools" that could be applied to: 1) evaluate the sustainability of new developer-built small water systems; and 2) determine whether existing small systems were capable of sustaining themselves.

1.4 State Programs To Address Viability

At the most general level, a state viability program consists of a coordinated collection of initiatives by state government to address concerns regarding the reliability of water supply service delivery mechanisms in small communities. The issue of viability is rooted in state and local institutions that are, in turn, rooted in state law and in the unique regulatory and intergovernmental culture of each state.

Viability is a much broader issue than SDWA compliance and affects the full range of organizations and individuals involved in state and local policy towards public infrastructure as well as public policy in other areas such as social policy, economic development, and rural poverty. While there are similarities in the nature of the problem across the country, it is very clear that the development of solutions will require approaches tailored to the unique circumstances of each state.

The ultimate objective of a state viability program is to help local institutions to become fully capable and reliable service delivery mechanisms. In order to be effective, state viability programs will have to carry out a sequence of two steps: 1) assessing the viability of water systems, and 2) acting to enhance the viability of water systems. These two steps are very broadly conceived. This breadth of interpretation is consistent with the fact that viability touches on a broad range of issues regarding the role, responsibility, and authority of state government. This being the case, the approach to be taken will have to evolve uniquely in each state. The pace of development will vary. The form in which different states undertake to assess viability and act to address viability concerns will vary.

A comprehensive state viability program could have the following four programmatic elements:

- a mechanism for ***new system viability screening*** to deter formation of potentially non-viable systems;

- a mechanism for ***viability assessment of existing systems*** to assist systems and state regulators in identifying and anticipating the needs of the future;

- ***effective coordination*** within and between agencies of state and local government to enhance the viability of troubled systems through restructuring or other means.

- a ***safety net*** mechanism to rescue and restructure water systems which have clearly failed and where economic and social issues unrelated to water supply make it impossible to restore adequate service without substantial government assistance.

To be fully effective, these types of mechanisms may require new types of explicit authority for the agencies of state government involved in their implementation. However, there is still a very wide range of interpretation and approaches that can be taken to putting these elements in place. Also, the type and amount of authority needed could be very different from one state to another. Many states may have more existing authority to initiate these efforts than previously realized.

This report provides a review of methods for viability assessment and therefore bears primarily on the first two elements of a viability program. Viability assessment can be an effective means of educating all of the stakeholders regarding the need for institutional changes at both the state and local level. In addition, viability assessment can provide the understanding necessary to build consensus on the most appropriate public policy approaches to implementing the other viability program elements (i.e., inter-agency coordination and safety net mechanisms).

1.5 The Role Of Viability Assessment

Viability assessment can be undertaken at two levels. One approach is to assess the viability of individual water systems. Another approach is to perform viability assessment at the "aggregate" level, viewing all the systems in the state to obtain an overall profile.

- The results of ***system-level analysis*** can go right to work for small systems and state regulators, helping them to clearly identify and understand existing and potential small system problems and to appropriately target financial and technical assistance.

- The results of ***aggregate-level analysis*** can be used to help educate state legislators and other agencies of state government regarding the needs for broad state initiatives (e.g., a safety net) in this area of public infrastructure.

In many states, these two types of viability assessments can be initiated without any additional legal authority.

1.6 Five Examples Of Viability Assessment Methodology

This manual presents summary descriptions of five different examples of viability assessment methodologies that have been developed by states and others. The intent is not to provide a detailed "cookbook" to viability assessment, but rather to describe each of these examples in sufficient detail that other states can gain enough understanding of the *approach* to be able to apply it in their own circumstances.

The five methodologies covered include one system-level method for new system viability screening, two methods for system-level assessment of existing systems, and two methods for aggregate-level assessment of existing systems.

1.7 New System Viability Screening

The new system viability screening tool described in Section 2 is a viability planning software called PAWATER that was developed as part of joint State-EPA viability research in Pennsylvania.[1] This user-friendly device has also been used by a few other states for new system screening.

The idea behind PAWATER is to encourage developers and local officials responsible for development to consider the full costs of running a proper water system before commiting to build one. PAWATER requires the user to complete a structured set of input specifications to provide a sufficient basis to estimate the costs of all necessary facilities, operation, and management. The cost curves used in the costing step can be edited by the user to suit individual circumstances. There is also a treatment module that allows the user to "what-if" the cost impact of different SDWA compliance requirements. This feature can be made more directly relevant in states where source water quality testing is required as part of the permitting process.

Based on these input assumptions, the PAWATER model computes the total capital requirement and total annual revenue requirement of the proposed system under different assumptions regarding ownership (private water company, municipally owned, or homeowners association). The program provides a summary of the capital cost and annual cost per dwelling unit that is meaningful to a developer.

1.8 System-Level Viability Assessment of Existing Systems

In the models that have been developed, system-level viability assessment of existing systems has been conceived as a two-step process:

- Step 1 -- Figure out where the system is, presently, -- in terms of the condition of the infrastructure and the quality of service -- and where it's going in the future.

- Step 2 -- Develop a comprehensive business management and financial plan to take the system where it needs to go.

Most of the information needed in the first step is engineering and performance data of the type developed in the course of sanitary surveys, comprehensive performance evaluations, and vulnerability assessments. The development of the grass-roots level of financial information implied in the second step is an effective means of educating the owners, managers, and customers of small systems to the realities of the future cost environment.

The methodologies described in sections 3 and 4 of this manual represent approaches to the two steps in the process of assessing existing system viability.

Section 3 presents a summary of "A Dozen Questions To Assess Small System Viability," the product of an effort by the American Water Works Association's Guidance Committee to Small Water Systems.[2] A structured series of questions is provided as a diagnostic guide to assist small system owners, managers, and customers in performing a self-assessment of the extent of potential future liabilities stemming from either existing infrastructure deficiencies or anticipated SDWA compliance requirements. The diagnostic procedure is the first step towards development of a comprehensive plan for the water system.

Section 4 presents a summary of the Washington State Financial Viability Planning Manual.[3] Washington State has a program of comprehensive water supply planning already in place that performs the comprehensive diagnostic analysis. The next step after identifying all current and future needs is development of a financial plan to meet those needs. This second step in viability assessment is the focus of the Financial Viability Planning Manual. Similar to the approach used in the PAWATER model, the manual provides a procedure to define the total capital investment requirements and total annual revenue requirement of the system, projected six years into the future. The ability to meet these and other needs must be demonstrated in order to pass specific tests of viability envisioned in the Washington State program.

1.9 Aggregate-Level Viability Assessment of Existing Systems

Aggregate-level viability assessment can be used to characterize, or profile the condition of all small systems within a state, taken as a group. Such assessment methodologies use operating and financial data to develop a profile evaluation of the current status of the small system segment of the water supply industry within a state. This is contingent, therefore, upon the existence of data with which to characterize the current performance and financial condition of small water systems. Institution of an annual reporting process intended to collect operating and financial data from small water systems would be needed to support this approach where such reporting processes are not already in place. Such reporting is performed in a number of states by investor-owned utilities, municipal uilities, and water districts.

In general, aggregate viability assessment consists of analyzing the data on various operating and financial parameters from the entire population, or from a large sampling, of the small water systems within a state. This aggregate perspective provides a sense of the range of variability between systems, as well as a general indication of the correlates of viability. Such broad perceptions can then be validated against the state's first hand knowledge of the systems. From this type of analysis of the aggregate profile, states can identify those water systems that appear to be the ones that could profit the most from available forms of technical and financial assistance to enhance viability. Another product of such aggregate profiling is it provides a picture that can be presented to state policy makers to document the extent to which more serious problems exist in systems that are, by all indicators and comparisons, in truly serious trouble.

The methodologies presented in Sections 5 and 6 of this manual offer two examples of aggregate-level viability assessment. These examples should be viewed as illustrations rather than as fully developed models. It is possible to devise an array of different approaches to performing such assessment. In one state, for example, there is an effort underway to merge the two methods described here into one.[4]

Section 5 describes a methodology developed by staff of the Pennsylvania Consumer Advocate's Office using data submitted by private water companies in annual reports to the Public Utility Commission.[5] The intent of this methodology was to develop a relatively simple, but quantitative assessment approach. The resulting index of viability, the Small Utility Ranking Formula, is based on 20 indicators; five each in areas of size, rates, management , and finance. The index results in an overall score on a scale of 0 to 100. While not based on formal use of quantitative analytical techniques, the SMURF ranking formula has a lot of intuitive appeal and represents the degree of flexibility that is available for analysts to exploit in assessing viability in a manner that makes sense to those using the information.

Section 6 describes a more formal quantitative methodology for aggregate viability assessment utilizing a combination of statistical techniques and predictive models used in financial failure analysis in the banking industry.[6] The application of these techniques was made possible through the use of a data base of annual report information supplied by private water companies to public utility commissions. Although this method utilizes sophisticated analytical techniques, the intuition in the approach is very simple. As described in Section 6, the approach can be useful as a source of ideas for specific indicators of financial distress.

REFERENCES:

1. PAWATER: Financial Planning Model for New Small Water Systems, developed for the Pennsylvania Department of Environmental Resources by Gannett Fleming, Inc. and Wade Miller Associates, Inc., July 1992.

2. Cromwell, Albani and Schmidt, *A Dozen Questions to Assess Small System Viability*, Annual Conference of the American Water Works Association, San Antonio, TX, June 1993.

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4. Wade Miller Associates, Inc., *State Initiatives to Address Non-Viable Water Systems in Pennsylvania* (1991).

5. Rubin, *et al.*, "A Quantitative Assessment of the Viability of Small Water Systems in Pennsylvania," *Proceedings of the Eighth NARUC Biennial Regulatory Information Conference* (1992), Vol. IV, pp. 79-97.

6. Dreese, *et al.*, "Developing Models for Assessing the Financial Health of Small and Medium-Sized Water Utilities," *Journal American Water Works Association* (June 1993), pp. 54-60.

CHAPTER 2.
PAWATER: A FINANCIAL PLANNING MODEL FOR NEW, SMALL COMMUNITY WATER SYSTEMS[1]

2.1 Overview of the PAWATER Approach to Viability Assessment

The PAWATER Financial Planning Model is a microcomputer-based software application for estimating the total costs of design, construction, finance, and operation of proposed new, small community water systems. The model is intended as a preliminary screening tool to be used by communities, private developers, and state and local regulators to assess financial viability of new water systems prior to beginning system development.

PAWATER was developed with three primary objectives in mind:

- to encourage communities to consider the full capital, operating, and financing costs of providing water, and to evaluate the impact of these costs on residents;
- to promote an evaluation of alternative operating structures such that planners select the water system option best suited to community needs; and
- to provide regulators with a tool that can be incorporated in the system permitting process so that all system developers are required to complete comparable long-range financial plans that make clear the full costs of quality water provision. Combined with statutory provisions that enable regulators to tie system approval to acceptable financial planning results, PAWATER can assist regulators to prevent the development of non-viable water systems by identifying potential problems prior to construction.

The PAWATER model incorporates fundamental financial planning concepts with a database of cost estimates and operating parameters in a "user-friendly" software package that requires no sophisticated financial expertise. It is assumed that the user of the PAWATER software has an understanding of water system requirements and local conditions, and that, prior to using the software, the developer has completed a series of detailed worksheets provided in the PAWATER package. Ideally, a water system developer's engineer will have completed intermediate-level investigations of system requirements, will help complete the worksheets, and may assist in exploring alternative scenarios using the PAWATER software. The software may be used by the developer to explore system options, or by the regulator and the developer together to assess the viability of a proposed system as part of the permitting process.

The PAWATER software prompts the system planner to enter data on water usage, source, treatment, storage, and distribution requirements for the proposed system, as well as information on anticipated interest rates, inflation, and financing structure. Although the user has the capability to modify most information in the model, PAWATER calculates default values for a range of key variables. For instance, cost estimates of major construction and operating items, such as pipes and chemicals, are generated from water system cost tables based on user responses to questions of system size, operating environment, and treatment needs. These cost tables can be modified to reflect local economic conditions.

PAWATER uses information provided by the user and supplied by the system to calculate the expected annual capital, operating, and financing costs of the system, and the fees required per household to cover these costs over a five-year period. The program analyzes costs and fees required for three alternative ownership structures: a homeowners association, an investor-owned utility, and a municipally-owned utility. In addition, the cost of interconnecting with an existing system can be estimated. PAWATER produces a four-page summary report of total capital costs, total annual operation and maintenance costs, and a pro-forma cash flow analysis for each of the three ownership scenarios. A detailed 17-page report also can be produced that details the user-provided assumptions and the PAWATER cost calculations of major system components.

The results can be used to assess the practicality of a proposed system based on the burden to the community and its residents of financing the full cost of construction, operation, and financing. The information used to generate the cost scenarios can then be manipulated by system planners and regulators to explore the effects on costs of different interest rates, customer growth rates, system configurations, ownership structures, and other changes in assumptions and critical water system variables. In addition, the software allows the user to change treatment requirements so as to explore the cost impacts of future Safe Drinking Water Act (SDWA) regulations. Figure 2.1 depicts the major steps in the PAWATER financial planning approach.

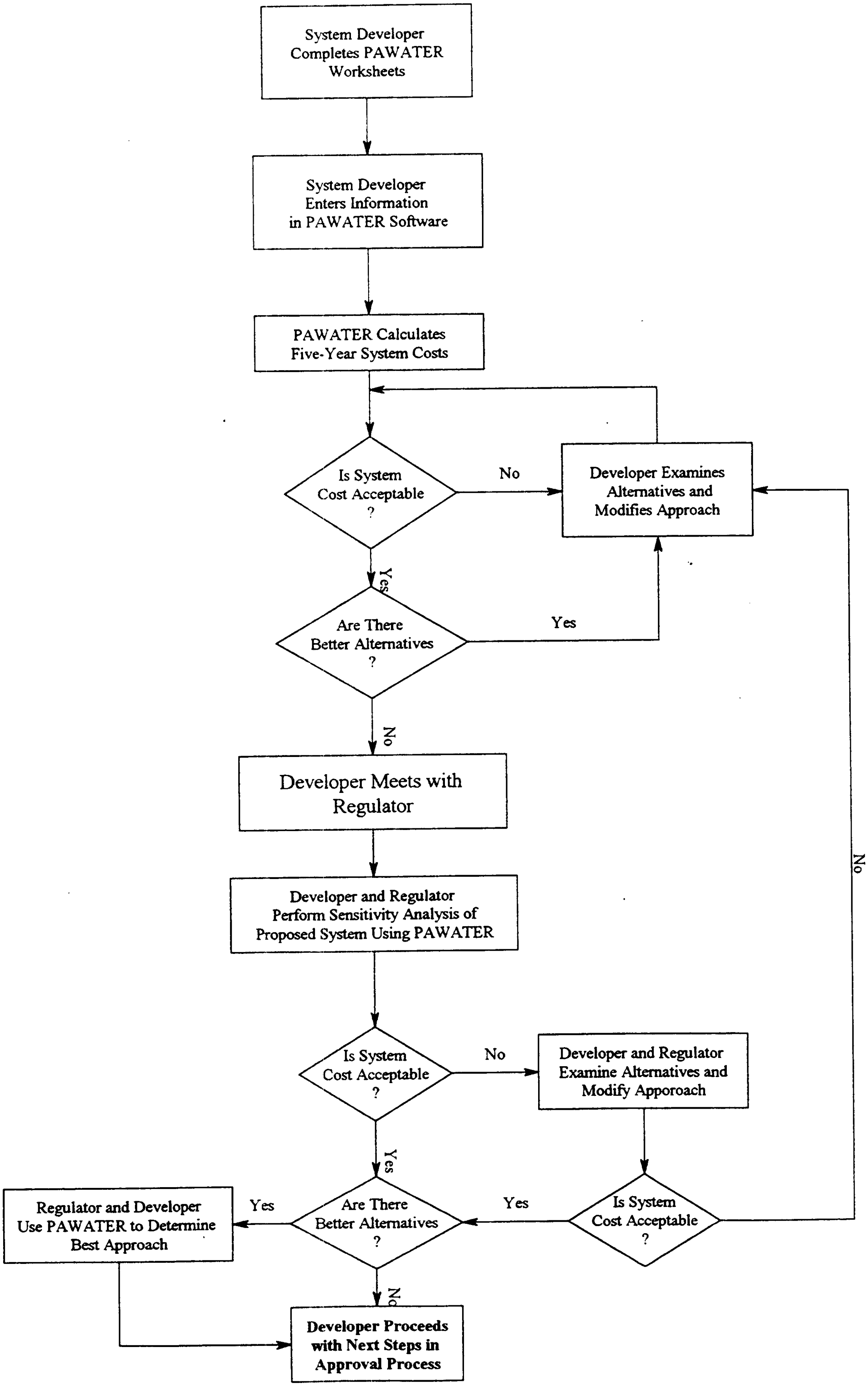
2.2 Purpose and Objectives of the PAWATER Model

Financial Planning and Viability Assessment for New Water Systems

PAWATER is a financial planning tool for new water system developers and regulators. It provides a systematic and comprehensive methodology for estimating the full costs of quality water provision based on assumptions about system requirements and financing structure, and details of the local economy, the geologic and water source environment, and proposed system design. PAWATER is a tool for individual system analysis that provides information for the assessment of *potential viability* of a proposed system based on assumptions and design data, rather than an assessment of *actual viability* for an existing system.

PAWATER does not address the question of system viability directly. It simply reports the full costs of water provision as well as the annual per residence charges and other revenue sources needed to cover these costs over time. This information can be used by regulators in conjunction with information on per capita incomes in the service region and water system

Figure 2.1
Major Steps in the PAWATER Financial Planning Methodology



charges in surrounding areas to assess the ability and willingness of customers to pay these charges and fees. This information alone, however, is not sufficient to prevent the development of non-viable systems. Regulators must also have the statutory ability to tie system approval to the results of PAWATER or similar financial planning studies. In this way, regulators can identify systems which appear to be excessively expensive, and therefore potentially non-viable, prior to system construction. Ideally, regulators need sufficient authority to be able to insist on convincing evidence of viability as a condition of system approval.

This proactive approach to viability assessment has two principal benefits. First, by requiring developers to conduct a PAWATER or similar financial planning analysis as part of the permitting process for system approval, regulators encourage developers to think through the full costs of water service provision during system planning. These costs are often not made explicit by developers who may have no incentive to minimize operating costs or to plan for O&M cost recovery in cases where their responsibility for system operations ends once a housing development is complete and housing units are sold. In many cases, homeowners associations or localities are burdened with unanticipated operating and maintenance costs for water systems once the system developer has moved on. By tying system approval to full-cost financial planning, regulators encourage developers to explore alternatives that can lead to less costly service delivery, like interconnections with surrounding systems. As a result, developers may eliminate non-viable approaches from consideration prior to regulatory involvement.

Second, since the PAWATER tool allows users to save and modify assumptions like the rate of inflation, growth in demand, and financing structure, as well as system design variables such as pumping and treatment requirements, the regulator and the developer can work together to explore potential system viability based on developer's assumptions as well as other likely financial and operating scenarios. Notably, the effect of future SDWA regulations can be explored by analyzing the cost impacts of additional treatment technology requirements. This exploration of alternatives can illustrate the sensitivity of system viability to potential increases in costs and might further suggest modifications to system design to promote more efficient operation. In instances where viability appears questionable over the range of likely scenarios, the developer and regulator can then evaluate the effects on system costs of other system options.

Users of the PAWATER Software and PAWATER Results

As described more completely in Section IV, PAWATER requires that the user have knowledge of water system requirements as well as economic and construction conditions at the site in order to complete the planning analysis. Although the program is not intended for the development of detailed, site-specific cost estimates, the planning information requested by the model still demands a thorough understanding of water system design parameters in general, and an intermediate-level familiarity with site specific requirements. It is expected that the developer will have performed an initial design assessment and will work with a water system engineer to complete PAWATER worksheets prior to using the software.

The PAWATER analysis can be conducted by the system developer independently and then replicated together with state or local regulators to calculate the full costs of a proposed system design. The developer may want to explore a number of alternatives prior to submitting a proposed design for approval, and the regulator may want to assist the developer to investigate still other alternatives or to critically examine the impacts of changes in inflation or other assumptions. It is expected that both the developer and the regulator may want to examine a number of design and operating structures in order to identify the most suitable and cost-efficient system, and that a range of realistic assumptions will be tested to analyze the cost impacts of likely future scenarios.

PAWATER results can be used by developers, potential water system customers, governments, and regulators to evaluate the full costs and associated fees and subsidies required to meet the financial obligations of the proposed water system. These costs and fees can be compared with national and regional averages and can be assessed with respect to customer household incomes and residents' willingness to pay to make a determination of the likely financial viability of the proposed system. In instances where the costs appear to be excessive, the developer can use PAWATER to reevaluate plans and explore alternative water provision options.

If the proposed system design seems reasonable, the PAWATER information can be used as the basis for more detailed engineering studies prior to system development. Regulators can file the results of the PAWATER analysis with other system approval documents to provide background information in the event of future system viability problems. In addition, the information can be used by local governments and homeowners associations to inform potential home buyers of the expected costs of water provision in the area. This information may help justify needed rate increases and may improve system financial viability by providing customers with information needed to budget household expenses.

2.3 PAWATER Technical Approach: Financial Planning and Full Cost Recovery

The general financial planning approach used by the PAWATER software is straightforward. The methodology used is commonly applied during planning for any capital-intensive, long-lived investment for public service provision. It requires an estimation of the *full-costs* of water provision during the life of the system and a determination of the revenue sources, such as user fees, supplemental charges, and subsidies required to recover these costs.

Costs of Water System Provision

Financial planning for full cost recovery is based on the premise that the costs of service provision include more than just the annual costs of labor, supplies, equipment, and other routine expenses needed to operate a facility once it is operational. The capital outlays needed for the initial design and construction of water system assets, such as payments for pumps, pipes, treatment facilities, and engineering services, and the funds needed to expand and upgrade the system over time are often the largest financial burdens associated with water provision. Sources of funds for these capital costs must be accounted for by system developers. Typically, capital costs for construction are financed, in part, through the issuance of debt on public markets. The annual interest payments on these loans represent another cost of the system. In addition, in cases where developers invest private funds in water system development, they expect to see a financial return on that investment in the form of profits. The fee that private water providers charge to ensure a reasonable profit represents an additional cost of water service provision. The total of these capital, operating, and financing costs over the life of the water system assets represents the full costs of the system.

Water System Revenue Sources, Subsidies, and Forfeited Revenues

Since quality water provision has value, water system owners, both public and private, typically charge users directly or indirectly for some or all of the costs of providing the service. Direct charges include monthly fees to each residence, perhaps based on the amount of water used, and one-time connection fees for residences that are added to the system. Indirect charges may include additions to the purchase price of a home or commercial property, or special property tax surcharges used to pay water system costs.

Full-cost recovery implies that the residents who benefit from water provision will pay the full costs for the service through some combination of user-fees, taxes, and special charges. Often, however, a system is built to service a number of housing units that are sold and inhabited over a period of years. In many cases, it is considered unfair to charge the early purchasers of residences for the full-cost of service provision during this "build-up period" when these costs are based on a operating a system intended to serve a larger population. To avoid this situation, private developer or government subsidies may be required to reduce costs to users before all residences in the service area are purchased and/or connected to the system. These subsidies are used to lower user fees below full-cost recovery levels for customers who connect to the water system in early years of development and are set such that customers only pay the portion of system costs that they would pay under the fully-developed operating environment. Public utility commissions often require that private owner/operators implement these equitable user fee charges during system customer base development. Under private ownership, these subisidies are considered a required cost of business and are referred to as "forfeited revenues" in the PAWATER model.

Matching Costs with Revenues: Promoting Rational Decision-Making and Accountability

A financial plan for full-cost recovery makes explicit the expected costs of providing service over a given planning horizon (typically five to twenty years), as well as the revenues and subsidies that will be used to cover these costs. It provides sufficient information for developers, community residents, local government officials, citizens, and regulators to assess the practicality of the proposed approach and to evaluate the expected financial impacts of the system on community residents and other taxpayers. In this way, financial plans promote rational decision-making on the part of developers and local governments, reduce uncertainties over future resource needs, and foster accountability among those responsible for water system decisions.

Unfortunately, the financial planning process is often ignored or implemented incompletely by system developers and governments, potentially resulting in system costs that can not be recovered through user fees. In cases where realistic full-cost financial plans are not prepared, system quality often deteriorates, and customers must pay excessive fees or taxpayers must provide unexpected subsidies to keep systems operational. PAWATER is one financial planning approach to limit these non-viable system outcomes. As described below, the PAWATER software automates many fundamental financial planning tasks, incorporates historical information on water system costs, and allows system developers to easily explore the costs of alternative system designs.

2.4 PAWATER Methods and Data Requirements

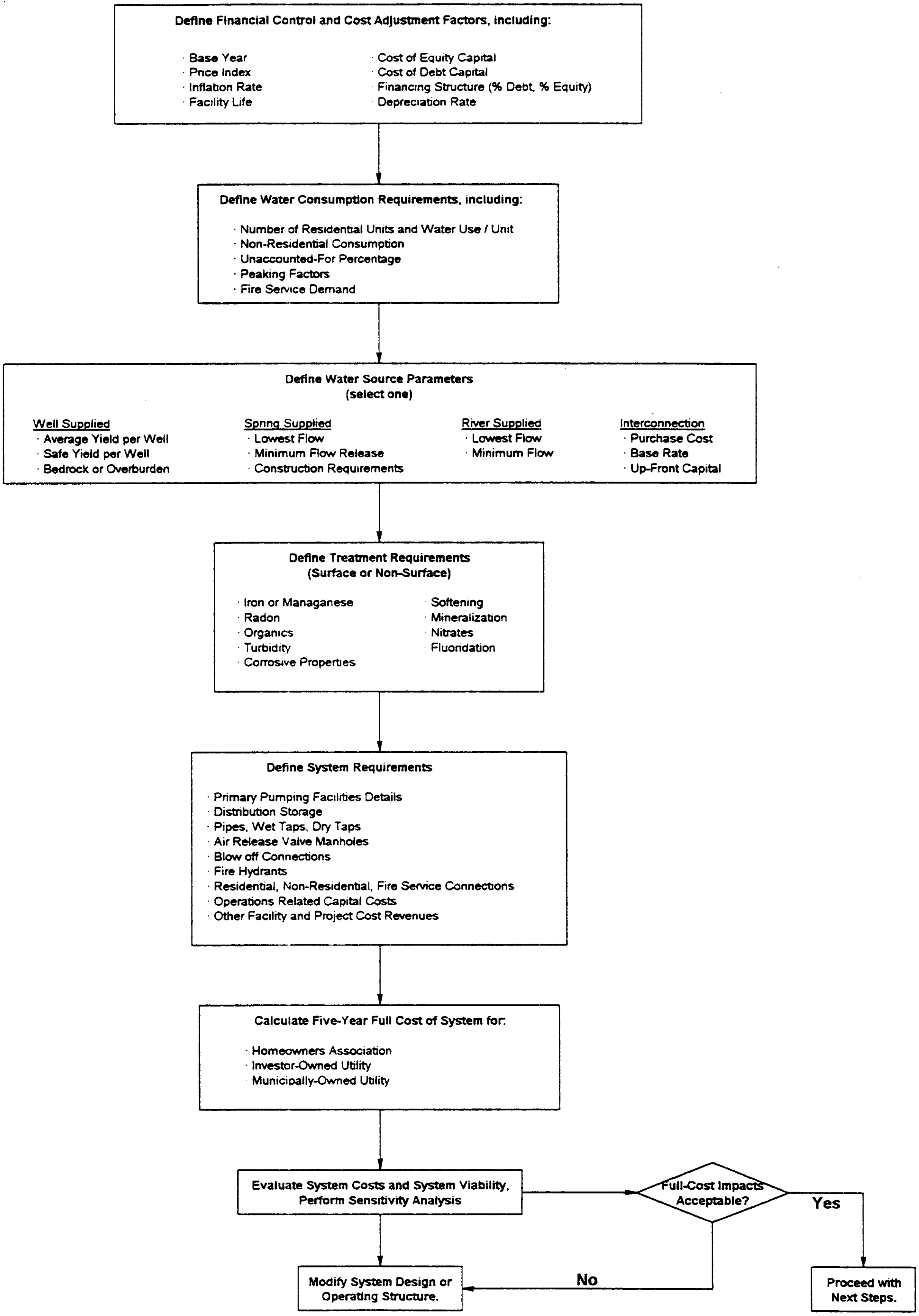
PAWATER provides an efficient and consistent method of estimating system costs and associated revenue requirements for a few common system ownership/operating structures. The PAWATER viability screening process requires the prospective water system developer (or engineer) to complete a seven-page Data Collection Worksheet describing relevant system parameters and economic and financial assumptions. The developer, alone or in conjunction with the regulator, then enters this information into the PAWATER program, which uses this data and an internal cost database to calculate system costs. Users can then examine the PAWATER output to assess system financial impacts, can adjust input parameters to explore system sensitivity to alternative assumptions, and can make a determination on proposed system viability. The primary steps in the PAWATER methodology are illustrated in detail in figure 2.2.

The PAWATER Data Entry Program and User-Defined System Requirements

The PAWATER data entry program consists of multiple screens that prompt the user to enter data and make decisions regarding design parameters and physical characteristics of the proposed system. The program follows a logical system planning path, which begins with the entry of general economic data, such as interest rates and construction conditions, followed by detail on water consumption and demand levels, and information on physical system design. PAWATER customizes its data input requests based on previous information provided by the user. For example, a user's choice of a water source (e.g. wellfield supply) will define what additional information on system design will be required (i.e., if wellfields are specified, no information on spring-supplied or surface water-supplied systems will be requested). Throughout the data entry process, PAWATER checks the reasonableness and consistency of user input, provides recommended default values, and presents immediate output of interim calculations.

PAWATER initially prompts the user to supply a number of financial control parameters and general utility criteria that will affect cost calculations throughout the PAWATER analysis.

Figure 2.2
PAWATER Data Entry and Analysis Steps



These variables include construction, electricity, and general cost levels and inflation rates for the study period, percent debt financing and interest rate on debt, percent equity financing and rate of return on equity, expected facility life, and depreciation rate for the facility. The system also prompts the user for five *General Utility Criteria* variables that are used to adjust construction costs for pipes and other facilities based on nature of the workforce (in-house, contract, or union) and geographic conditions (type of terrain, percentage rocks, etc.).

Once these general variables are defined, PAWATER requests more detailed information on water system requirements. Water system demand requirements are calculated from information provided by the user on numbers of residential units, commercial consumption, unaccounted-for water, "peaking factors", and fire service requirements. PAWATER provides a number of methods for calculating residential, commercial, and peak demand and uses the results of user input and internal calculations to determine system costs. The PAWATER approach to estimating system costs based on user-input demand and treatment requirement parameters are discussed in more detail below.

PAWATER Cost Estimates

The PAWATER software includes a database of cost estimates for all system capital and O&M components drawn from historical data on water supply facilities. The database includes cost tables for system components based on facilities of various size and design. As the user provides information on physical system requirements, the PAWATER software matches user inputs with appropriate default costs, adjusted for inflation and operating environment factors entered by the user. In all cases, these system-provided cost estimates can be modified by the user to reflect unique individual operating conditions. Cost categories covered in the PAWATER analysis include:

Capital Costs

Capital costs are estimated by one of several methods linked to the program's cost database. Methods used include fixed cost per item, and unit costs tied to item size or capacity. Capacity requirements are linked to projected demands, based on such user-provided data such as numbers of residences, commercial "equivalent dwelling units (EDUs)" served, and applicable "peaking factors". For example, costs for installed water mains, fire hydrants, and meters are estimated using a fixed cost per unit multiplied by units required for system demands. Costs for water treatment facilities are based on user-defined treatment requirements, which allow PAWATER to select needed water treatment technologies (e.g. package-type gravity filtration, or reverse osmosis plants). Once treatment requirements and water demands are defined, PAWATER uses a construction cost versus capacity (maximum daily demand) relationship tabulated in the cost database to derive expected construction costs for treatment. PAWATER tables also contain information on construction cost versus storage capacity and are used to estimate the cost of storage facilities, such as elevated tanks, clearwells, and standpipes, from user-supplied data on fire and other emergency needs. Construction costs for pumping facilities are estimated based on a complex set of user-supplied data and PAWATER database relationships for pump stations, pressure relief valves, and telemetry control requirements. The user also can enter the costs of up to three additional capital components not included in the PAWATER database.

O&M Costs

Operation and Maintenance (O&M) cost estimates represent anticipated annual costs for comprehensive system operation consistent with industry standards. O&M cost estimates are included for water supply, treatment, transmission, and distribution. All energy costs, customer costs, and general administrative costs are also included. Customer costs include meter reading, billing and collection, and miscellaneous customer service expenses. O&M cost estimates are drawn from PAWATER's cost tables, using historical relationships between system O&M costs and numbers of EDUs served.

2.5 Results

PAWATER reports system costs and a projected cash flow analysis for the first five years of water system operations under three water utility ownership structures: a homeowners association, an investor-owned utility, and a municipally-owned utility.

For all three ownership options, capital costs for the water source, treatment facilities, pumping facilities, storage structures, operations capital, and other facilities are financed assuming that these facilities are constructed in the base year. The remaining capital expenditures, which include mains, taps, hydrants, meters and meter pits, manholes, and blowoffs are assumed to be constructed in proportion to the EDUs served annually. All annual operating expenses are also computed in proportion to the total EDUs served in each year. PAWATER then presents the annual charges per EDU, additional costs per residence, and subsidies or forfeited returns required by system owners under each ownership structure. These calculations are unique to each ownership option and are discussed in detail below.

Homeowners Association

For systems owned by a homeowners associations and for mobile home parks, it is assumed that the capital costs for system construction will be included in the purchase price of the units served by the water system. PAWATER calculates the contribution to water system capital costs required per EDU by dividing the total capital cost of the system by the number of EDUs expected once the system is fully developed. This methodology implies that developers must sell all of the planned units in a development in order to recoup water system capital costs, and that early purchasers will not be required to pay the capital cost share of unsold units. Since this capital cost contribution is hidden in the purchase price of the unit, it is not included as a financial outlay for the water system and is reported separately on the PAWATER report.

PAWATER then calculates the annual charge per EDU for the homeowners association owned system by dividing the gross revenue required once the system is fully developed by the total number of EDU's. Gross revenue requirements include the O&M costs calculated from user-supplied information and PAWATER cost tables as well as contributions to a fund for capital renewal and replacement. The annual renewal and replacement fund contributions are assumed to be equal to the loss in value of the system's cumulative capital assets each year (calculated from the user-defined depreciation rate times the cumulative capital cost of the system). PAWATER assumes that this annual charge per EDU, calculated to cover costs once all EDUs are connected to the system, will be the annual charge per EDU in the early years of system operation as well. In cases where this annual charge results in system revenues insufficient to cover gross revenue requirements prior to full system development, PAWATER calculates the annual subsidy required each year. The present value of all subsidies required throughout the study period is presented in the PAWATER report.

Investor-Owned Utility

For systems owned and operated by the private sector, PAWATER assumes that the construction cost of the facility is recovered from users in water rates charged over the life of the system. In addition, the private entity will charge users a price that allows the firm to earn sufficient returns to pay off debt used to finance the facility and compensate equity investors for their financial investment. PAWATER uses user-supplied information on the debt-equity mix used to finance the facility, interest rate on debt, and required return on equity to calculate the overall return required on the depreciated value of the system each year. In estimating system costs and project cash flows, PAWATER must also account for income and other taxes paid by the private owner/operator.

PAWATER calculates the total capital and operating costs incurred in each of the first five years of system operations. The report also includes the yearly depreciation expense incurred on capital assets. PAWATER then calculates private sector taxes and the return required on the fully-developed system based on user-supplied information on tax rates, debt-equity mix, and the cost of debt and equity. Once the costs, taxes, and returns are determined, PAWATER calculates the revenue required for the fully-developed system and establishes the annual charge per EDU. This annual charge is assumed to remain constant in the early years of system operations and PAWATER calculates the return available to the private investors in these years by subtracting total O&M costs, depreciation, and taxes from revenues generated by the annual EDU charge. PAWATER then calculates the required return in these years (based on the weighted return on debt and equity for cumulative system assets) and presents any shortfall between actual and required return as a "return forfeited" by the private investor. The present value of these forfeited returns, or private sector subsidies, is also presented in the PAWATER report.

Municipally-Owned Utility

For municipally-owned utilities, PAWATER assume that construction costs of the water system will be recovered through a one-time tapping fee and annual water fees charged throughout the life of the facility. All construction costs not recouped through tapping fees are assumed to be financed through a bond issue, with interest payments recovered through user charges. PAWATER assumes a $3000 tapping fee, but this default value can be changed by the user.

PAWATER estimates the capital and operating costs required under the first five years of system operations. As with the Homeowners Association option, PAWATER also assumes that contributions to a replacement reserve are funded annually at a level equal to annual depreciation of accumulated capital assets. PAWATER also calculates the annual debt service required each year based on the total amount of debt required for the system (total capital costs minus total tapping fee revenue), the cumulative capital costs expended, and the interest rate and maturity of debt information supplied by the user.

Once yearly costs have been determined, PAWATER calculates the gross revenue required to cover these costs once the system is fully developed. PAWATER divides gross revenue by total EDUs served to establish an annual charge per EDU. As with the other two options, PAWATER assumes this user charge for the fully developed system will apply to users in earlier years of system development as well. It is assumed that the municipality will provide a subsidy to meet any additional revenue needs of the system. The PAWATER report details the annual subsidy required as well as the present value of total system subsidies throughout the study period.

2.6 Summary and Extensions

PAWATER provides an easy-to-use tool for developers and regulators to assess the full costs of providing water service for proposed community water systems. The PAWATER approach minimizes the complexity of the financial planning process by both automating the planning steps and providing ready access to a database of historical information on design, construction, and operating costs. PAWATER also provides for a great deal of flexibility in analyzing numerous ownership/operating structures, alternative economic assumptions, and what-if scenarios regarding the impacts of future SDWA regulations on system costs and viability.

Nevertheless, users may want to adapt and build on the tools provided in the PAWATER package. Some modifications can be made from within the PAWATER software. For instance, the cost database can be updated to reflect recent changes in prices of materials or regional cost variations. Other changes may require more substantive efforts. For instance, system owners or regulators may wish to develop financial plans for more than a five-year period, or may wish to analyze the impacts of other ownership structures not included in the PAWATER reports. Although the financial planning methodology used by PAWATER is straight-forward and can be implemented with any spreadsheet program, the inclusion of historical cost data and automation of the cost estimating process can involve some substantial development time.

In addition, PAWATER is just one piece of the viability assessment process. PAWATER can be most effectively used as part of a broader policy and regulatory framework for viability assessment. Such a framework would need to be defined so as to meet the needs of individual states and regions but will likely include statutory provisions to tie system approval to the results of a PAWATER or similar system financial plan. In addition, some states may wish to explore mechanisms to ensure that developers build the system they have defined in their proposal. Policy tools, such as financial guarantee requirements, might be used to encourage developers to implement the system as approved.

REFERENCES:

1. PAWATER: Financial Planning Model for New Small Water Systems, developed for the Pennsylvania Department of Environmental Resources by Gannett Fleming, Inc. and Wade Miller Associates, Inc., July 1992.

CHAPTER 3.
A DOZEN QUESTIONS DIAGNOSTIC TO ASSESS SMALL SYSTEM VIABILITY[1]

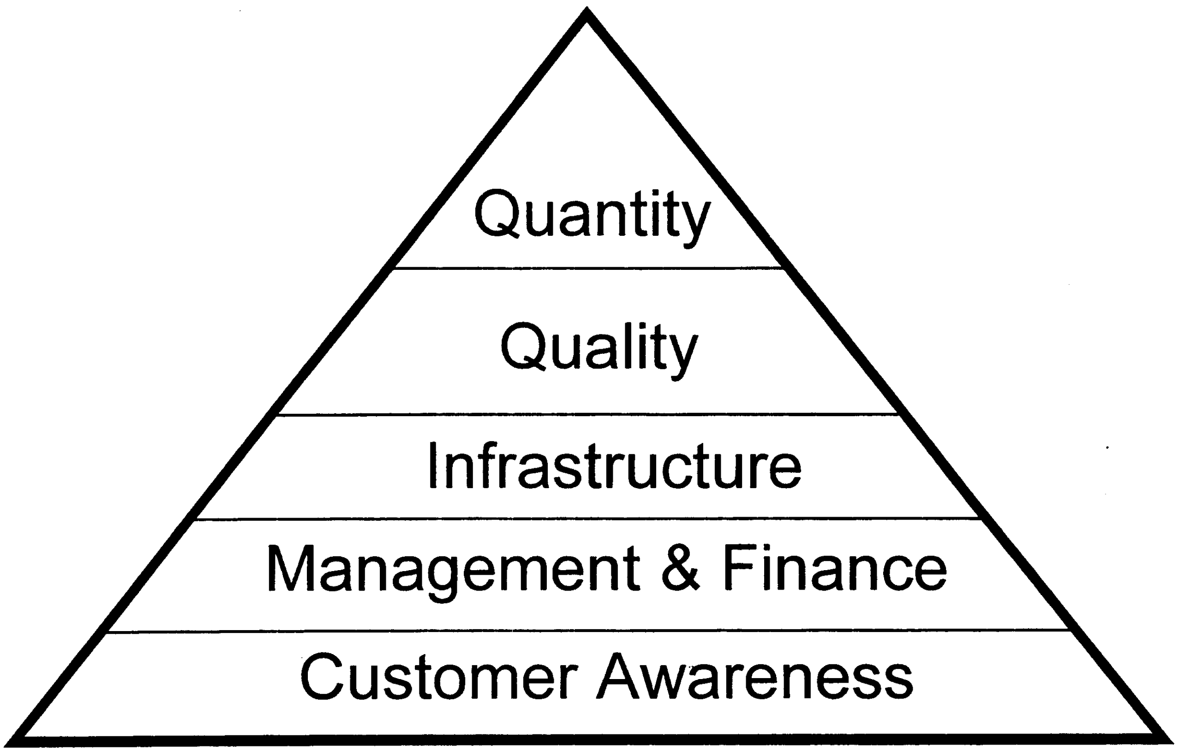
3.1 Overview of the Dozen Questions Approach

The "Dozen Questions" approach to assessing small system viability was produced for the *AWWA Guidance Committee to Small Systems*. It provides a diagnostic procedure for probing an existing drinking water system's ability to meet current and future operating and financial requirements. The objective of the method is to promote comprehensive strategic planning among small system owners, managers, customers, and regulators so that near- and long-term operating and financial challenges are understood and effective cost-efficient responses can be planned.

The method simply consists of a series of detailed questions that cover the critical parameters defining small system viability. The twelve categories of questions form a five-tiered "diagnostic pyramid" as depicted in Figure 3.1. The five tiers of the pyramid are traversed sequentially, beginning with questions on water system capacity and demand, continuing through questions on water quality and infrastructure conditions, to arrive at questions of management capabilities and financial stability. Finally, questions on customer awareness assess the degree to which customers understand the operating and financial challenges faced by small water system providers. The implication of this pyramid structure is that the problems and challenges identified in upper tiers will require a broader, sturdier underpinning of management and financial support to ensure system viability in the future. At its foundation, customer understanding of what is required to operate and maintain a water system is integral to assuring cooperation for new capital investment and higher water rates, and, therefore, system viability.

The focus of the dozen questions method is on encouraging small system owners to ask themselves the necessary questions to uncover system risks and liabilities and to confront the costs of meeting these challenges. The method deliberately raises questions without providing too much structure for exploring solutions. Its intent is to provide insight into existing and potential problems such that owners are stimulated to take logical next steps to address system limitations revealed in the diagnostic process. In addition, the procedure focusses on collecting and organizing information so that owners, managers, governments, and customers can evaluate the extent to which the water system is meeting, and will continue to meet, its financial and regulatory obligations. This information provides a basis for action and can improve understanding and cooperation among key stakeholder groups.

Figure 3.1
The Dozen Questions "Diagnostic Pyramid"



3.2 Purpose and Objectives of the Dozen Questions Approach

The dozen questions methodology is intended to alert small system owners, managers, and customers of the challenges they must meet and the decisions they must make in order to remain viable throughout the next decade as new, more stringent Safe Drinking Water Act (SDWA) regulations are introduced. The method has three basic objectives:

- to encourage a "big picture" evaluation of existing system demands and future system requirements implied by Safe Drinking Water Act (SDWA) regulations (to be phased in over the next ten years) so as to promote efficient operational and investment decisions over the long-term;

- to combine knowledge of water demand and quality issues with an equally comprehensive understanding of the full costs of meeting these operating requirements; and

- to encourage systematic collection and dissemination of information on these critical water systems issues so as to promote dialogue and cooperative planning among owners, managers, regulators, and customers.

The approach does not result in a definitive determination of system viability. Instead, the goal is to encourage key stakeholders associated with small systems to ask themselves a series of questions that will lead them to recognize the risks of being unprepared and to discover their *most viable* options for the future. In this way, systems all along the "viability spectrum" will benefit from the dozen questions diagnostic. Systems that have the technical, managerial, and financial capability to meet all customer demands and regulatory requirements without major modifications to operations will be able to use the diagnostic to prepare detailed operating and financial plans in order to communicate their stability to customers, regulators, and credit providers. Owners of systems that appear viable today, but that may face serious challenges as new SDWA regulations are imposed, can identify major required changes to current operations needed to meet requirements for the foreseeable future. These systems can institute one-time cost-effective modifications or seek outside assistance, rather than make a series of incremental expenditures that may be costly in the long-run. Finally, systems that are not currently meeting obligations or that will be unable to meet future customer demands and regulatory requirements can begin seeking assistance before problems become severe. In these cases, restructuring alternatives or other options can be evaluated and implemented with a full understanding of area needs and system costs.

3.3 Dozen Questions Technical Approach: A Forward-Looking Assessment of Operating Requirements and Full Costs

The "dozen questions" diagnostic actually consists of many more than twelve questions. These questions, which can be divided into twelve general categories, cover both current conditions and future requirements and contingencies. Many require specific, detailed information about the chemical, geological, financial, and physical characteristics of the water supply, treatment, and distribution system. Others require a more open-ended assessment of future conditions and an ability to predict the ways in which demographic, agricultural, and industrial changes to the region surrounding the system will impact water provision operations and costs. It is likely that system owners, managers, and engineers will need to participate in the diagnostic process so that technical, operational, managerial, financial, and strategic concerns can be addressed.

The questions systematically probe system quantity, quality, infrastructure conditions, managerial competence, financial stability, and customer awareness, in that order. This progression leads the system "diagnosticians" to fully explore the technical challenges faced by system owners and managers in order to meet current and future customer demands as well as satisfy existing and soon to be introduced SDWA regulations. Once these challenges are identified, the diagnostician must then critically evaluate the managerial and financial capabilities of the system to achieve these objectives. Finally, the extent to which water system customers are aware of the technical challenges and financial requirements for providing water is assessed, to evaluate the potential for customer support for needed rate increases in the future.

The twelve categories of questions, grouped by the five tiers of the diagnostic pyramid, are summarized in figure 3.2. Additional detail on the nature of the questions in each category is provided in section 3.4.

3.4 Dozen Questions Diagnostic Methods and Data Requirements

The questions that comprise the twelve diagnostic categories require assessments of existing water quantity and quality parameters, operational and engineering detail on water source, storage, distribution, and treatment, capital and operating financial requirements, and managerial and personnel capacity. In addition, questions probe likely changes in many of these critical factors and therefore require estimates of future needs and costs. For many questions, the implications of some answers are briefly explored. In order to complete the diagnostic, it is likely that a number of technical studies, water quality monitoring, and financial plans will need to be prepared so that accurate answers and reliable projections can be made. A description of the twelve questions categories and types of questions included in the diagnostic is summarized below.

Figure 3.2 Twelve Categories of Questions in the Dozen Questions Diagnostic

Quantity

1. Is the water source safe, adequate, and reliable?

Quality

2. Is microbiological contamination a current or a potential future problem?
3. Are disinfection by-products likely to be a problem under new SDWA regulations?
4. Are corrosion by-products an existing or potential future problem?
5. Are natural geologic contaminants an existing or potential future problem?
6. Are agricultural chemicals an existing or potential future problem?
7. Are industrial/commercial chemical contamination an existing or potential future problem?

Infrastructure

8. Is water system infrastructure, including pumping, storage, and distribution systems, in good condition?

Management and Finance

9. Can existing and future operator requirements be met?
10. Are management systems and controls adequate to meet existing and future requirements?
11. Has the system completed comprehensive financial plans and is the system capable of meeting all existing and future financial obligations?

Customer Awareness

12. Do water system customers understand the challenges and costs of providing high-quality water on demand?

1. Is the Water Source Safe, Adequate, and Reliable

Small systems differ in their ability to maintain an adequate quantity of supply on a reliable basis to meet existing and future water needs. The twenty-six questions in this section of the diagnostic focus on adequacy of existing supplies to meet existing demand (e.g. *What are average and peak daily requirements?*, and *Have shortages been experienced?*) and existing or new supplies to meet future demand (e.g. *Does the system have a demand forecast?*, *Are the long-term plans of commercial customers known?*, *What alternative water sources are available, and what are their characteristics and costs?*, and *How much influence does the system have over activities taking place in the watershed or well head area that may be potential sources of contamination?*).

2. Is Microbiological Contamination a Current or Potential Future Problem

Recent major outbreaks of waterborne disease have emphasized the need for strong discipline in protecting water supplies from microbiological contamination. This discipline requires vigilant efforts in source protection, treatment, storage, and distribution. Also, new SDWA regulations will increase the treatment requirements for protection from microbial contamination in both surface waters and groundwater. The thirty-one questions in this section explore microbiological considerations for both surface water and groundwater, as well as in water distribution systems. Questions include:

> *For Surface Water Systems: Will you have to filter?, Is your record free of any waterborne disease outbreaks or "boil water" notices from the state? Has the state or your own engineer performed a "sanitary survey" or "performance evaluation" of your plant recently with satisfactory results?*
>
> *For Ground Water Systems: Are you sure it's really ground water? Does your water become cloudy or turbid and undergo changes in temperature in the period after storm events? Do you regularly inspect and maintain your chlorine dosing equipment? Can you detect a chlorine residual at taps throughout the distribution system?*
>
> *For Distribution Systems: Are you just delivering water or are you growing anything else in there? Have you encountered compliance problems with the Coliform Standard? Do you regularly receive complaints regarding the taste and odor of chlorine?*

3. Are Disinfection By-Products an Existing or Potential Future Problem

Although the public health benefits of disinfection are universally accepted, recently there have been questions raised about the potential health effects of various chemical by-products formed by popular disinfectants such as chlorine. As a result, new SDWA regulations will require small water systems to begin controlling for disinfection by-products in the latter part of the 1990s, with further controls possible during the first decade of the next century. This diagnostic section explores the likelihood that small water systems will need to address the issue of disinfection by-products in the future. Questions include: *Do surface water systems have raw water with Total Organic Compound (TOC) levels > 4 mgl? (TOC > 0.7 mg/l for ground water systems) and/or bromide levels > 40 ug/l (bromide > 60 ug/l for ground water systems) Do surface water systems have a filtration process that includes both chemical coagulation and settling prior to filtration?*

4. Are Corrosion By-Products an Existing or Potential Future Problem?

Lead and copper occur in trace amounts in tap water, in part as by products of corrosion from pipe materials and plumbing fixtures. Recent SDWA regulations, known as "the Lead Rule" govern monitoring and control requirements for small systems to address corrosion by-product issues. The three questions in this section of the diagnostic are designed as a guide to assessing water system liabilities in this area. These questions are: *Has your first draw monitoring produced results for lead above the 15 ug/l level? Does your treated water have a pH less than 8 and an alkalinity less than 50 mg/l? Do you have lead service lines, goosenecks, or service connections in you distribution system?*

5. Are Natural Geologic Contaminants an Existing or Potential Future Problem?

A number of naturally occurring inorganic chemicals present contamination problems in ground and surface waters as a result of gradual weathering of soils and geologic materials and as a result of other releases from these sources during mining and processing operations. This section of the diagnostic explores the extent to which radon, radium and uranium, arsenic, and sulfate represent existing or potential contamination sources that may require treatment under future SDWA regulations.

6. Are Agricultural Chemicals an Existing or Potential Future Problem?

Agricultural chemicals such as nitrate (from fertilizer), pesticides, and herbicides can contaminate water sources. Removal of these chemicals can be expensive, although only a small percentage of water systems are expected to have levels of contamination that exceed the standards for these contaminants. This section of the diagnostic begins to assess a water system's potential compliance challenges as regulations governing agricultural contaminants are phased in over the next decade. Questions are primarily general assessments such as: *Do you know your local geology and geography?, Within your watershed area or your "zone of contribution," are there any facilities engaged in the production, storage, or handling of agricultural chemicals such as manufacturing plants, warehouses, or farm supply stores?*

7. Is Industrial/Commercial Contamination an Existing or Potential Future Problem

Organic and inorganic contaminants often associated with hazardous waste sites or other industrial/commercial disposal areas represent potential threats to water quality that will be regulated under various phases of the SDWA implemented throughout the coming decade. Although most wells and surface intakes are not expected to exhibit this sort of contamination at above regulated levels, the questions in this section of the diagnostic begin to assess potential liabilities in this area. The principal question in this section is: *Have you had any water samples with VOCs?*

8. Is Water System Infrastructure in Good Condition?

The questions in this section of the diagnostic provide an evaluation of the condition of water system infrastructure, including pumping, storage, and distribution. Questions include:

> *Pumping: Do you hire a qualified pump contractor to perform an inspection of all pumping equipment, identify potential problems, and perform maintenance on an annual basis? Does the system have sufficient gravity-flow distribution storage to provide safe*

and adequate service for up to 24 hours without power? Is an existing standby/emergency power equipment, controls, and switches tested or exercised routinely under load conditions for at least 30 minutes at a time?

Storage: Is there only one storage tank? Is there a contingency plan for storage if the tank collapses? Is there a high and low water level electrode signal to control the pumps? Do all interior piping, fittings, and accessories conform to the minimum plumbing requirements of the National Plumbing Code?

Distribution: Does the operator routinely flush, test, and maintain the hydrants in the system? Is unaccounted-for water in the system monitored and analyzed each month? Is there a program to gradually replace sub-standard sized mains?

9. Can Existing and Future Operating Requirements Be Met?

For many small systems, the combination of a backlog of deferred infrastructure rehabilitation needs and new SDWA performance requirements imply that operational demands are rising at unprecedented levels. This section of the diagnostic explores whether existing and future operational needs can be met. Questions include: *Has your water system experienced recent episodes of: violations of any SDWA standards including contaminant levels, monitoring and reporting requirements, shutdowns or outages, or customer complaints? Is the present quality of staff adequate to do the job? Based on the answers to previous questions regarding the extent of your potential water quantity, water quality, and infrastructure liabilities, what is the forecast for operational requirements and how does this match up against your current level of operational capability?*

10. Are Management Systems and Control Adequate to Meet Existing and Future Requirements?

The management systems needed to oversee the water system grow more complex as the quantity, quality, and infrastructure needs increase. This section of the diagnostic highlights the general types of management systems required. The thirty-six questions include: *Is there a clear plan of organization and control among the people responsible for management and operation of the system? Do you have explicit rules and standards for system modifications? Do you have a deliberately organized regulatory compliance program? Is there a contingency plan for making interconnections to neighboring systems and how do you know they will work when needed? Do you have adequate legal counsel, insurance, engineering advice, technical/operations assistance, rate case preparation, and financial advice?*

11. Has the System Completed Comprehensive Financial Plans and Is the System Capable of Meeting All Existing and Future Financial Obligations?

The answers to all of the previous questions in the diagnostic typically result in higher levels of both capital and operating costs. The dozen questions diagnostic addresses the small system's ability to meet these costs by asking questions that assess the financial planning process as well as pricing, budgeting, and accounting systems. The questions that make up this generic financial viability test are illustrated in figure 3.3.

Figure 3.3 Dozen Questions Diagnostic: Financial Viability Assessment

Does your water system presently operate on a break-even basis, or does it generate surpluses or losses? Is your water system an independent financial entity? Are there any other sources of revenue besides the water rate? Does the water system keep all the water revenues, or are they also used for other purposes? If your system is not an independent financial entity, what would it take to convert it to such independent status, wherein the water rate is the sole source of revenue and water expenses are the sole use of water revenues, resulting in pay-as-you-go break-even cash flows?

Do you have a budget? Does your budget process provide for annual depreciation of existing plant, the annual cost of servicing your debts, and the annual cost of operations and maintenance? Do you use the budgeting process to determine your annual revenue requirement via either the cash needs approach or the utility approach, as described in the AWWA Revenue Requirements Manual (M35)? Do you provide for a reserve fund for capital replacement? Do you use a cost-of service method to develop rates sufficient to meet your revenue requirements, as described in the AWWA Water Rates Manual (M1)? Do you regularly review your rates?

Do you have a capital budget, or capital improvement plan that projects future capital investment needs some distance (at least five years) into the future? How are forecasts made? How are they translated into construction projects? How are projects scheduled and approved? Does your planning process take account of all the potential capital needs suggested by all of the preceding questions in this paper? Does your long-term planning incorporate analysis of alternative strategies that might offer cost savings to customers, such as consolidation with other nearby systems or sharing of operations and management expenses with other nearby systems?

Do you employ standardized accounting and tracking systems? What accounting conventions and standards do you follow? How do you track budget performance? How do you track tax liabilities and assure compliance? How is billing and collection handled? Where are the records to substantiate depreciation of fixed assets? How are financial management record-keeping systems organized? Who's in charge of the cash drawer? What controls are exercised over expenditures? How do you keep from exceeding your budget? What are the purchasing procedures? What are your procedures for selection of outside contractors and suppliers?

12. Do Water System Customers Understand the Challenges and Costs of Providing High-Quality Water on Demand?

Customer awareness is a critical factor in the long-term viability of small water systems. When customers fully appreciate all of what it takes to operate and maintain a water system, they are more likely to support rate increases needed to meet new treatment standards or to fund adequate infrastructure maintenance. In addition, when customers are provided information about system needs and challenges, they can understand and assist in evaluations of alternative strategies for providing water service, conceivably at lower cost. Since customers will bear part of the burden of a small system's failure to meet SDWA compliance liabilities through a reduction in property values, they have a strong incentive to see that the system can successfully achieve its objectives, or that alternatives are identified before there are severe problems. These incentives can be used to build support for a viability planning process that takes account of all the issues identified in the diagnostic. In addition, in cases where small systems appear well suited to meet existing and future challenges, public awareness of this fact can help system owners secure low-cost capital or attract neighboring communities who may wish to purchase excess water. The penultimate questions in the dozen questions diagnostic is therefore: *How much of all this is known and understood by customers; and how would this change their attitudes about the future?*

3.5 Results

In may respects, the dozen questions diagnostic is an interactive process. It is expected that as questions are posed, and information is gathered to respond, many problems will be identified and solutions designed before the diagnostician moves on to subsequent questions. The process is unstructured, however, and, as designed, there is no standardized "product" produced as a result. Nevertheless, it is expected that the operating and financial plans prepared as part of the diagnostic process will be available to those within and outside the system who have a direct stake in water system operations. In addition, the diagnostic should not be considered a one-time test of long-term viability. Conditions change, often rapidly, and the answers to the diagnostic questions may be quite different in a year. Therefore, the results of the diagnostic should not be considered static, the questions lend themselves to periodic reassessment as condintions, needs, and regulations change.

3.6 Summary and Extensions

The dozen questions diagnostic provides a free-form question-and-answer approach to viability assessment. It does not produce a discrete "viable/non-viable" determination for small systems, but instead encourages system owners and other interested stakeholders to ask the questions necessary to uncover potential problems and reach their own conclusions regarding the ability of the system to meet current and future operating and financial obligations. The answers generated during the course of the diagnsotic are intended to encourage small system stakeholders to take action, in some cases to resolve operating problems before they become severe, in other cases to seek assistance or evaluate restructuring options if problems appear overwhelming.

The diagnostic can be expanded or streamlined to meet priority needs of systems in a particular state or region. It can be incorporated into a broader program for viability assessment that includes more formal procedures for information reporting or a regulatory framework that ties operating permit approval to the results of some or all of the results of the diagnostic questions. Since one of its primary objective is to encourage small system owners to being answering questions and taking action prior to regulatory involvement, states may wish to consider the diagnostic as an informal initial step in the viability assessment process.

REFERENCES

1. Cromwell, Albani and Schmidt, *A Dozen Questions to Assess Small System Viability*, Annual Conference of the American Water Works Association, San Antonio, TX, June 1993.

CHAPTER 4.
WASHINGTON STATE FINANCIAL VIABILITY PLANNING MANUAL[1]

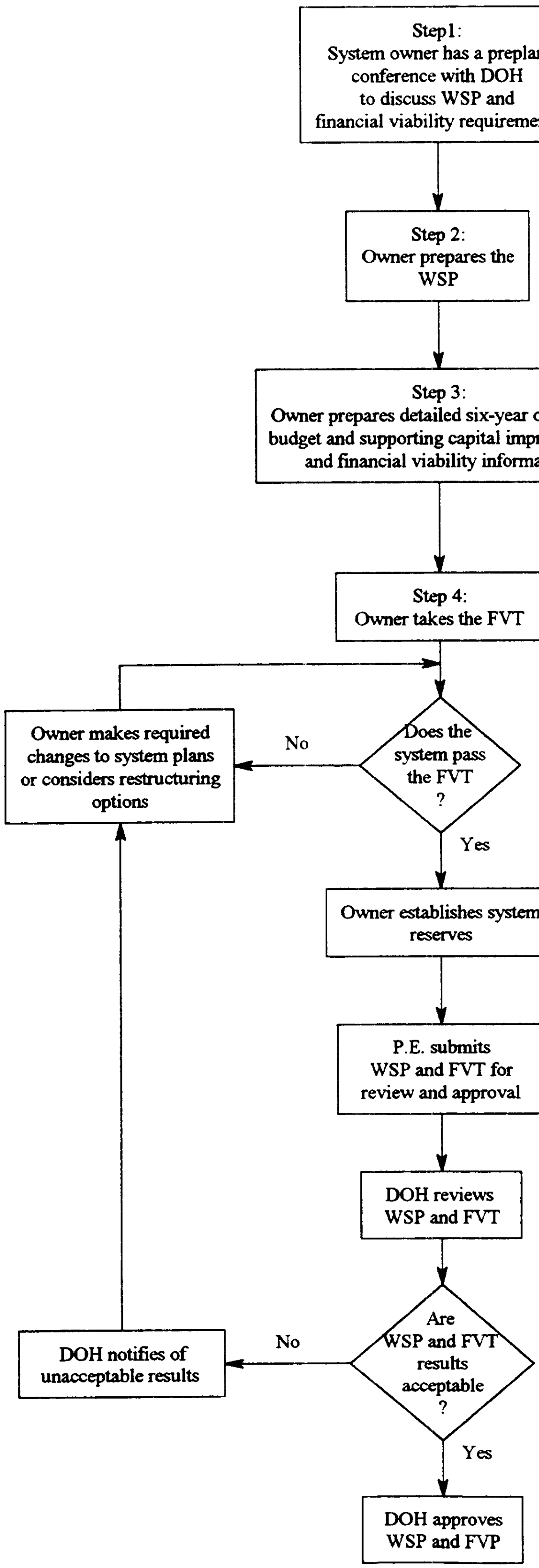
4.1 Overview of the Washington State Water Systems Planning and Financial Viability Program

Washington State has implemented a comprehensive package of programs and regulations to promote viability of new and existing community drinking water systems and to provide information to the public on the operating and financial health of these systems. The programs, aimed at non-investor owned systems serving less than 1000 residences, incorporate comprehensive water system planning steps with a multi-stage "financial viability test". In addition, the state has established a number of regulatory provisions that allow the Washington State Department of Health (DOH) to tie permit approval to successful completion, certification, and submission of system planning documents and the financial viability screening test. Major steps in the Washington State program are illustrated in Figure 4.1. The steps required to prepare for and take the financial viability test are described in the **Washington State Small Water Utilities Financial Viability Manual** and are summarized in this section.

The Washington State DOH requires that water systems regulated by the department complete and submit a comprehensive planning document known as the Water System Plan (WSP). The WSP provides a detailed description of the existing system, presents twenty-year Capital Improvement Planning (CIP) information for system expansion and improvements, and details historical sources of revenues and anticipated future sources of financing for capital and non-capital expenses. Water system owners also must complete the Financial Viability Program (FVP), which requires facilities to prepare a detailed six-year budget of revenues and expenses and pass a financial viability test (FVT). The FVT consists of four basic financial calculations aimed at assessing the internal financial stability of the water system as well as determining the affordability of water system customer charges. In the event that systems do not pass the FVT, Washington State has the statutory authority to deny construction or operating permits or begin receivership action. New regulations governing the FVT program will take effect in 1995. If a facility fails to pass FVT's affordability test, Washington State authorities can encourage owners to investigate restructuring options and can promote public disclosure of the rates required to operate the system in the future.

The Washington State approach combines forward-looking requirements for system planning with an easy to apply mechanism for identifying water systems likely to have financial viability problems. It incorporates this planning and screening methodology with regulatory mechanisms in order to promote compliance, identify and restructure non-viable systems, and improve information dissemination to the public.

Figure 4.1
Major Steps in the Washington State
Viability Assessment Program



4.2 Purpose and Objectives of the Washington State Financial Viability Program

Promoting Financial Viability and Improving Information Disclosure

The Washington State Financial Viability Program (FVP) is a central part of DOH's broader policy for water systems planning and regulation. It is aimed at assisting new or existing small community drinking water systems to plan for and demonstrate financial viability. The primary objectives of the FVP are to:

- Highlight the importance of maintaining a financially sound water utility;
- Provide managers of small water utilities (under 1000 connections) with an easy to use framework for preparing a budget used to measure rate impacts of projected water system needs and to assess system financial viability; and
- Establish a consistent mechanism for regulators to assess financial viability and to collect information on a water system's compliance with DOH viability criteria. In conjunction with Washington's regulatory framework, this information can be used to restrict operations of systems deemed to be non-viable.

In addition, the program is a vehicle for improving public disclosure of water system financial information for existing or potential water system customers. The tools of the Washington State program also can be used in situations where restructuring is being considered to determine the cost and viability impacts of alternative water service provision options.

Users of WSP and FVT Results

Utility owners can use WSP and FVT results to evaluate the current and future financial and operating health of community water systems. This information can be used by owners to adjust capital investment plans and other planning assumptions so as to ensure compliance with current and impending water regulations or to improve the efficiency and affordability of the system. The comprehensive planning data prepared by the owner can also be used to justify future rate increases needed to finance investments intended to meet new water quality regulations. Regulators can use the information provided by owners to ensure that water quality standards will be met and to evaluate the financial soundness of the utility and the cost of service. Since the regulator has the statutory authority to tie system approval to the results of the planning documents and the FVT, the regulator can identify potentially non-viable systems and can work with system owners to improve financial stability through restructuring. In addition, water system customers and surrounding residents can evaluate future operating plans of the water utility and can use information on current and estimated future rates to plan household expenses.

Since information collected for the FVP is available to owners, regulators, and customers, the Washington State approach promotes cooperative dialogue among important stakeholders. Owners are encouraged to explore alternative service provisions options prior to regulatory involvement, customers are provided with information so that they can understand the need for rate increases, and regulators have a consistent set of data from which to pursue policy objectives equitably among water systems in the region.

4.3 The Financial Viability Program Technical Approach: Full-Cost Financial Planning Combined with Tests of Financial Stability and Affordability

The FVP is based on the following definition of financial viability:

> *Financial viability is the ability to obtain sufficient funds to develop, construct, operate, maintain, and manage a public water system in full compliance with federal, state, and local requirements.*

This definition implies that in order to be considered viable, water systems must have sufficient financial stability to meet their current and future financial obligations even when revenues fall below expectations or when emergencies occur. Therefore, the Washington State FVP requires owners to prepare budgets detailing the full costs of water supply provision as well as the revenues expected to be available to meet these costs over a six-year planning horizon. In addition, owners must demonstrate that the system has established and funded contingency reserves sufficient to meet unforseen operating and emergency needs.

Full cost estimates include routine operating, general, and administrative expenses as well as capital outlays needed to maintain existing facilities, expand capacity, and/or upgrade treatment technologies to meet six-year customer demands and regulatory requirements. Expenses also include the cost of repaying new or existing loans used to finance system construction. In addition, expenses may include contributions to establish or enlarge contingency reserves. Revenue sources include monthly fees collected from water customers, one-time charges for connection, penalties for late payment, and interest earned on water system investing activity expected over the planning period.

Contingency reserves are financial accounts created by the utility that hold funds designated for a specific purpose. These reserve funds may include reserves used to pay operating costs in the event of revenue shortfalls (*operating reserves*), or funds used for replacement and repair of critical system components in the event of an emergency (*emergency reserves*). Some systems also may wish to fund a reserve for the long-term replacement of capital assets in order to spread the burden of financing capital replacement over the life of the system (*replacement reserves*).

The FVT component of the Washington State FVP requires owners to use the revenue and expense budgets and reserve fund information to address the following four financial viability questions:

1. Do projected revenues exceed projected expenses?

2. Are operating reserves sufficient to cover operating needs in the event of a revenue shortfall?

3. Are capital reserves sufficient to finance repairs and keep the system operational in the event of an emergency? and

4. Can customers afford to pay system rates?

The first three questions probe the internal financial stability of the water utility. They assess the water utility's ability to meet routine operating expenses with anticipated system revenues (question 1), and the ability of the utility to meet obligations under adverse conditions (questions 2 and 3). The fourth question assesses whether customers will be able to pay the rates projected in the utility's budget. The affordability question has an important impact on financial viability since high rates may result in a higher percentage of uncollectible bills or a lower than anticipated demand for services. These factors will result in lower than expected utility revenues and, therefore, decreased financial stability.

The Washington State FVT uses the results of a simple financial calculation to answer each of the four viability questions. Although no set of four calculations can fully determine a utility's financial viability, the test questions used in the FVT are aimed at identifying systems that do not meet minimum criteria expected of a viable system. Section 4.4 provides detail on the budget information required for the FVP and the FVT calculations used to answer the four viability questions.

4.4 Washington State Financial Viability Program Methods and Data Requirements

The Washington State Financial Viability Program builds on information contained in the Water System Plan (WSP), a comprehensive twenty-year planning document supplied by system owners to the Washington State DOH. Figure 4.2 summarizes the information contained in the WSP. Using information from the WSP, owners then prepare a detailed six-year budget of revenue sources and expenses. Owners must also prepare detailed information on system contingency reserves, annual system charges per residence, and median household income in the service area. The budget, contingency reserve, annual charges, and income information will be used as input to the FVT.

Figure 4.2
Content of Washington State Water System Plans (WSPs)

The outline below summarizes the key elements addressed in WSPs. Information must be supplied for a twenty-year planning period and the plan must be approved in writing by a certified professional water systems engineer.

1. Description of the System

   Maps and descriptions of the service area, existing facilities, and pressure zones, information on system owners and managers, policies, history, and agreements with surrounding facilities.

2. Basic Planning Data

   Existing and future projections of population served and number of service connections, historical and future projections of water usage by customer class and per connection (including average and peak flows, fire service requirements, and unaccounted for water), and planned water conservation programs and their impact on water demand.

3. System Analysis (Adequacy of Facilities and Activities)

   Identification of water system minimum design criteria and evaluation of existing systems (capacity, remaining life expectancy, instantaneous demand), information on source requirements, treatment, storage, distribution, and fire flow, water quality analysis (history of monitoring, required changes under SDWA and WSDOH drinking water regulations), and summary of deficiencies identified in the evaluation of existing systems related to growth, replacement, existing and proposed requirements.

4. Improvement Program

   Identification of capital and non-capital improvements for a twenty-year period, with a six-year implementation program.

5. Financial Program

   Itemized three year summary of system revenues and expenses, detail on past system improvement finance (surcharges, debt, reserves);

6. Relationship with Other Plans

   Compatibility with adjacent system and regional plans, county response and compatibility with land use plans; and consistency with previous water system plans.

7. Operation and Maintenance Program

   Description of personnel and personnel responsibilities for water system operations, description of water quality sampling procedures and responses to samples that exceed state standards, and identification of most vulnerable system facilities and description of cross connection control program.

Operating Budget

Revenue Sources

The first category in the operating budget is revenues. Major revenue categories include:

Water Rates All money received for supplying water service. Information from the WSP on the forecasted number of service connections and projected water sales combined with current rate structures and assumptions on rate increases are used to calculate total utility revenue from rates. This information is also used to calculate annual charges per service connection.

Fees and Services All other miscellaneous fees and charges for service provided other than for water service. This includes bad check fees, reconnect fees, and meter testing fees. These revenues are estimated for the six-year planning horizon by using a historical growth rate, if available, or assuming revenues for these categories will increase at the anticipated rate of inflation.

Other Revenues All other revenues not included in the two categories above. Expected interest income on invested funds is reported here.

Expenses

The second major sub-section of the operating budget is the identification of utility expenses. Expenses include all those activities or purchases that incur cost for the utility during the same periods as revenues. Expenses can be estimated in various ways. One method bases the projections on historical experience and assumes past growth trends will continue in the future. In other cases, it is known that expenses will increase at a different rate than in the past and this information can be included in budget projections. The two principal expense categories are Operation and Maintenance (O&M) expenses and General and Administrative (G&A) expenses.

O&M Expenses O&M expenses include all expenses incurred by the utility that are directly related to the production and delivery of water to the customer. They include salaries and benefits of employees directly involved in water provisions activities, electric power, telephone, and other utility costs, chemical used in the treatment of water, and parts, supplies, and repairs needed for the routine production and delivery of water. In addition, all water monitoring and outside analysis costs incurred by the utility are considered O&M expenses. Recent changes to SDWA regulations imply that owners should estimate these costs carefully, using information from the WSP on new treatment and monitoring requirements.

G&A Expenses These expenses are not directly related to water production and delivery. They are considered system overhead. All expenses related to the administration of the utility are included here. Major G&A categories include salaries and benefits for officers, directors, secretarial, and meter-reading employees, insurance policies, legal, accounting, and other professional staff, contracted engineering services, and administrative office supplies.

Other Expense Categories

In addition to O&M and G&A expenses, the FVP requires owners to report other major expense items in their operating budget. These include depreciation expenses, taxes, and annual debt payments (interest and principal). The FVP also requires a full accounting of anticipated capital improvement program expenditures and loans sources over the coming six-year period. This information is taken directly from the CIP and includes information on capital outlays for: new capital improvement facilities, renewals or replacements to existing facilities, and facilities built to conform to SDWA regulations.

Contingency Reserves

In addition to the operating budget, owners must also submit information on operating cash reserves, emergency reserves, and replacement reserves. For each reserve account, the owner must supply information on annual installments and running balances. This information will be compared against the minimum required balance in the FVT for the operating cash reserve and the emergency reserve. A replacement reserve is not required to pass the FVT, but is recommended. A replacement reserve will spread the economic burden of future capital costs over a longer period and will lessen future rate shocks to the customers of the system.

The Financial Viability Test

Once information on system revenues and expenses and contingency reserves are prepared, the owner can take the FVT. Figure 4.3 details the four calculations that make up the FVT. Test 1 is straight-forward, no utility can remain viable if revenues are not meeting operating expenses. Tests 2 and 3 imply that viable systems must have established and funded operating reserves and emergency reserves to cover contingencies at levels acceptable to Washington State. Test 4 is based on national averages that suggest that water rates begin to be unaffordable when they exceed 1.5% of the median household income of residents served.

Figure 4.3
Washington State Financial Viability Test

TEST 1:	Are Revenues − Expense ≥ 0
TEST 2:	Is the Operating Cash Reserve ≥ ⅛ × (Annual O&M Expenses + G&A Expenses)
TEST 3:	Is the Emergency Reserve ≥ The Cost of the Most Vulnerable System Component
TEST 4:	Are Annual User Rates ≤ 1.5% of Customer Median Household Income

4.5 Results

Based on the results of the FVT, the owner can adjust plans in the WSP and the operating budget to improve the financial stability of the system, change annual contributions to contingency funds to achieve FVT target levels, or modify rates to generate additional revenues. If the FVT is completed to the satisfaction of the owner, the owner then establishes the operating, emergency, and voluntary replacement reserve accounts as specified in the WSP and FVT. The completed WSP and FVT are then reviewed, certified, and submitted to DOH by a registered professional engineer. DOH then reviews the WSP and the FVT and informs the owner in a WSP review letter whether the system met DOH requirements for approval. DOH may raise questions about the owner's plans that require amendments to the WSP. In this case, the owner must modify the WSP, retake the FVT, and resubmit the WSP and the results of the FVT for approval.

Financial Viability Test - Pass/Fail Consequences

It is assumed that a water system has direct control over the outcome of the first three components of the FVT and can take appropriate planning action (e.g. system redesign or rate increases) to meet FVT requirements. The fourth test, however, is used as a measure of affordability only. While it is expected that the owner will critically examine water system designs to develop the most cost-efficient system, it is understood that it might not always be in the power of the water system to assure a rate that is less than the FVT value.

By passing the first three parts of the FVT, a water system demonstrates sufficient financial viability to suggest it can be managed and operated successfully even under adverse conditions. Successful completion of the first three components of the FVT will facilitate the water system remaining in compliance with DOH requirements and may also assist the system in securing funds from commercial lending and financial assistance institutions.

Conversely, failure to pass any of the first three tests will prevent approval of the utility's FVP and WSP. As specified in a number of State of Washington regulations, this may lead to denial of construction permits or a DOH determination that the water system is inadequate. An inadequacy determination by DOH could then result in denial of building permits, denial of home mortgages by lending institutions, or receivership action by DOH. Alternatively, DOH may work with the system to identify and implement an acceptable institutional restructuring option. Alternatives include merging with an adjacent system, formation of a water district, or contracting for management and/or O&M with an outside agency. The regulator and the owner can use the tools of the FVP to explore the financial impacts of alternative ownership/operating structures.

Passing the fourth component of the FVT demonstrates that water system rates are within the national average range and, therefore, assumed to be affordable for system users. Conversely, if rates exceed the FVT parameter, owners must recognize that users may have difficulty paying water system charges. In addition, the owner may have difficulty obtaining loans or financial assistance for the system. DOH will encourage the owner to investigate restructuring options and require the owner to provide public disclosure of the projected rates and findings of restructuring option studies.

In all cases, the results of the FVP provide the utility, DOH, and current or prospective customers with a detailed assessment of six-year financial and operating health of the water system. If the system passes all components of the FVT, the owner has a documented statement of financial health that will facilitate system approval and will expedite attempts to secure loans or financial assistance for needed capital upgrades or expansions. If the system fails parts of the FVT, the information collected as part of the FVP process will assist owners and regulators to evaluate alternative system designs and restructuring options. In cases where internal financial stability is unacceptable, DOH has the statutory authority to prevent system operations and encourage the owner to explore restructuring options. In instances where system affordability is in question, the owner can be encouraged to explore alternative options before experiencing financial distress.

4.6 Summary and Extensions

The Washington State FVP approach combines a detailed information-gathering phase with a simple set of viability screening calculations. This approach is implemented within a broader regulatory context that gives the regulator the ability to make system approval decisions based on the results of the screening process. In addition, the program recognizes the importance of information dissemination and provides for public distribution of the information submitted. These general attributes of a viability assessment approach for existing systems have wide applicability to the viability question. They are also easily modified or expanded to meet the needs of individual states or communities. It is likely that states may want to add additional viability criteria or modify the details of the FVT to stress other important aspects of financial health. Likewise, the WSP and operating budget details may be simplified or otherwise altered to conform with local requirements. The regulatory mechanism can also be adapted to conform with existing statutes or to strengthen compliance through alternative means. This approach may also be combine with aggregate assessment methods in order to target existing facilities that may be especially prone to viability problems.

REFERENCES

1. State of Washington, Department of Health, Division of Drinking Water, *Small Water Utilities Financial Viability Manual*, August 1994 draft.

CHAPTER 5.
SMALL UTILITY RANKING FORMULA (SMURF)[1]

5.1 Overview of the SMURF Method of Viability Assessment

The Small Utility Ranking Formula (SMURF) is a relatively simple, quantitative method to assess the viability of a group of small water systems. SMURF can screen a large number of water systems quickly while still accounting for the multi-faceted nature of the "small water system problem." The SMURF analysis results in a profile that illustrates and quantifies the problems facing small water systems and provides some indication of possible solutions. The profile can be used to support efforts to remove state barriers to, and provide incentives for, obtaining new regulatory authorities to address the small water system problem and implementing program changes. The results can also help identify the factors that are most important to viability and show how individual water systems rank against sample averages.

The general approach used by SMURF involves: identifying suitable indicators based on their perceived relationship to viability; assigning points for different values of the indicators; and aggregating the points for individual indicators into one viability score for each water system. By examining the resulting distribution of viability scores, groups of systems can be identified based on common characteristics such as capability to borrow, size, and level of management expertise.

The SMURF viability score comprises 20 indicators of system size, rates, management, and finances. Data inputs are obtained from annual reports and company tariffs and rate review information on file with state Public Utility Commissions. For states without access to such data, SMURF illustrates the type of data that could be included in new reporting requirements and the way that data can be used to profile small water system viability.

If SMURF indicators and scores are appropriate to an individual users' needs, a simple, spreadsheet-based software program is available that stores the raw data and automatically computes viability scores. If SMURF indicators and scores are deemed inappropriate, the approach is easily modified to incorporate: indicators and scores reflecting different views on factors affecting small water system viability; and/or alternative indicators for which data are available. Users can also define their own classification scheme that may or may not involve viability determinations.

5.2 Purpose and Objectives of the SMURF Method

The purpose of SMURF is to screen a *large* number of existing systems using a *simple* and *quantitative* approach that still addresses the *multi-faceted* nature of the "small system viability problem."

Methods to assess viability at an aggregate level necessarily focus on a subset of the variables that are examined during detailed assessments of individual water systems. Nonetheless, viability is a function of financial, technical and managerial capabilities that cannot be measured by just one or two variables. SMURF balances the need to limit the number of variables examined during aggregate level assessments with the need to explore enough variables to accurately assess viability. Four different aspects of viability are examined: system size, rates, management, and finance. SMURF incorporates five indicators of each. Each system receives a score in each of the four areas, as well as an overall viability score.

Although SMURF addresses many aspects of the viability problem, SMURF remains simple. Where data are available, SMURF viability scores can be generated very quickly for a large number of systems. Where data are unavailable, SMURF illustrates the variables that could be incorporated into new reporting requirements -- a first step in developing a full viability program -- and the types of analysis that could be performed with the variables.

The result of applying SMURF is a profile illustrating and quantifying the spectrum of small water systems (from viable to "basket cases"), as well as some indication of where the problems lie (size, rates, management and/or finance). Such a profile can help place the "small water system problem" on the state policy agenda by providing educational support for efforts to:

- remove state barriers to and provide incentives for small water system viability;
- obtain new regulatory authorities to address the "small water system problem;" and
- implement new programs, such as "safety net" programs for basket cases.

SMURF may also assist in identifying the indicators that are most reliable in determining the viability of water systems. SMURF's aggregate assessment can potentially show which indicators vary most over a sample of water systems. Sample averages can be calculated from the SMURF results to form the basis for comparing and ranking individual systems.

5.3 Technical Approach

Several principles and assumptions underlie SMURF and other aggregate-level assessment methods.

- Despite the diversity of small water systems, a fairly small number of variables (in SMURF's case, 20) provides sufficient information to portray the viability of small water systems *at an aggregate level*.

- Although relationships between viability and individual variables have not been formally validated, reasonable indicators of viability can be selected based on limited evidence or common sense.

- Viability indicators are a relatively objective means to measure small water system viability.

- The indicators, even though measured using historical data, reveal the extent to which small water systems can reliably meet performance requirements on a long-term basis.

SMURF's 20 indicators were chosen for two reasons. First, the indicators were able to be quantified from information on file with the Pennsylvania Public Utilities Commission. Information sources included annual reports, company tariffs and rate case data. For states without such data, SMURF indicators suggest what variables could be required under a reporting requirement to support a viability assessment program. Second, the indicators measure one of four important factors related to the ability of a water system to operate: size, rates, management, and finance.

The rationale behind each of the four factors is as follows.

Size: The raw size is believed to be an important determinant of a system's ability to respond to system emergencies, hire professional personnel, and spread the costs of improvements among customers without causing large rate increases. Size indicators include: number of customers, gallons delivered, and revenues.

Rates: Rates set at levels sufficient to recover the long-term costs of delivering water services are essential to ensure viability. Without adequate cost recovery, systems will not be able to finance ongoing maintenance, expansions or restructuring, upgrades to comply with SDWA requirements and other planned investments. Rates indicators include: level of current rates, types of rates used, and frequency of rate reviews.

Management: Poor management is frequently the underlying cause of financial or technical performance problems. Simple factors are used as indicators of whether "the system is being operated as one would expect a public utility to operate." The quality of management is measured with indicators such as: frequency of rate review cases, quality of annual reports, and average age of plant.

Finance: In viability assessment, the finance variables are designed as much to measure the ability of systems to finance their activities as they are designed to measure the systems' ability to generate a profit to their owners. Therefore, a company with small profits but no debt might score better than a highly indebted system with greater profits. The variables should measure water systems' access to all three major sources of funds to finance investments: retained earnings; equity issues; and debt (loans or bonds). Financial indicators include: cash flow, shareholders' equity, and equity as a percent of total capital.

Overall viability of a system is the combined status in the areas of size, rates, management and finance. One score -- the SMURF viability index -- measures a system's rating in all four areas. Individual indicators and the calculations for the viability scores are described in detail below.

5.4 Methods and Data

Straight forward, spreadsheet-based software is available to aid analysts in using SMURF. The SMURF software prompts the user to enter the variables shown below. The SMURF software uses the data inputs to calculate 20 indicators and assign a ranking from 1 to 5 for each indicator.[2] More points are assigned when indicators suggest greater viability. A single viability score is then calculated by simply adding up the points assigned to each of the 20 indicators.

Figure 5.1
SMURF Data Inputs

Name of Utility
Number of Customers:
- Total Number of Customers
- Number of Residential Customers

Gross Utility Plant In Service ($)
Depreciation Reserve ($)
Capitalization:
- Shareholders' Equity ($)
- Total Debt ($)
- Other (preferred stock, CAC, CIAC) ($)

Gross Operating Revenue ($)
Depreciation Expense ($)
Net Income ($)
Millions of Gallons Delivered
Rate Type (Fixed/Fixture/Metered)
Rate Charges
Is a Stand-By Fee Charged for Vacant Lots? (Yes or No)
Has the PUC Examined the Rates in Last 5 Years? (Yes or No)
Quality of Annual Report on a Scale of 1 (poor) to 5 (good)
Number of Rate Cases in Last 10 Years
Number of Years Since Last Rate Case (rounded to nearest year)
Number of Utilities with Same Owner

Size Variables

Number of Customers. Other things being equal, systems with fewer customers have fewer resources with which to maintain viability. A customer count of 1,000 is roughly equivalent to EPA's small system cut-off point (serving a population of 3,300). Therefore, systems with 1,000 customers or more are scored 5. Systems with fewer than 200 customers are scored 0. This is a somewhat arbitrary lower bound, reflecting opinions that with fewer than 200 customers a system could likely not afford to hire a professional operator, deal with emergencies or finance system improvements. Between 200 and 1,000 customers, one additional point is scored for each additional 200 customers or part thereof.

Gross Utility Plant In Service. Data from the National Association of Water Companies indicate that investor-owned utilities with annual revenues above $1 million have invested approximately $1,600 per customer. A good sized system (serving 1,000 customers or more) would, therefore, have gross plant investment of $1 million or more. Five points are assigned to such systems. Systems with a gross plant investment of less than $100,000 are likely to be very small systems or larger systems which are undercapitalized. These systems are assigned a score of 0. Between these extremes, one score is assigned for each additional $225,000 of plant investment or fraction thereof.

Gross Utility Operating Revenues. A good size system would generate $375,000 or more in annual revenue. This corresponds to an average of $375 or more in revenue per customer. While this is high for residential customers, a viable system is likely to have a base of commercial customers and, therefore, higher average revenues. Total revenues less than $75,000 indicate that a system has very low rates, a small number of customers, or both. Since such systems are less likely to be viable, they are assigned a score of 0. An additional point is awarded for each additional $75,000 in revenue or fraction thereof.

Millions of Gallons Delivered. A score of 5 is given to systems that deliver more than 70 million gallons of water. This is based on an average of 1,000 residential customers using on average 15,000 gallons per quarter, as well as a 20% allowance for lost or unaccounted for water. Below 10 million gallons per year, systems were scored 0. Systems that do not report gallons sold or delivered are also scored zero since this indicates a lack of adequate knowledge about system operations or possibly an absence of metering. Between 10 million gallons and 70 million gallons, an additional 1 point is scored for each 15 million gallons or fraction thereof.

Percent Non-Residential Customers. A diverse customer base generally provides a more stable revenue base and higher average revenue per customer. As the number of customers declines, the percentage of non-residential customers should increase. Therefore, twenty percent was selected as a good ratio of non-residential to total customers. No points are assigned to companies with no non-residential customers. Between 0% and 20%, one point is awarded for each 5% or fraction thereof.

Figure 5.2 Summary of Size Variables	
SMURF Variable	**Score Awarded**
Number of Customers	0 if < 200 1 if 200 to 400 2 if 400 to 600 3 if 600 to 800 4 if 800 to 1,000 5 if ≥ 1,000
Gross Utility Plant in Service	0 if < $100,000 1 if $100,000 to $325,000 2 if $325,000 to $550,000 3 if $550,000 to $775,000 4 if $775,000 to $1,000,000 5 if ≥ $1,000,000
Gross Utility Operating Revenues	0 if < $75,000 1 if $75,000 to $150,000 2 if $150,000 to $225,000 3 if $225,000 to $300,000 4 if $300,000 to $375,000 5 if ≥ $375,000
Millions of Gallons Delivered	0 if < 10 1 if 10 to 25 2 if 25 to 40 3 if 40 to 55 4 if 55 to 70 5 if ≥ 70
Percent Non-Residential Customers	0 if 0% 1 if > 0% to 5% 2 if 5% to 10% 3 if 10% to 15% 4 if 15% to 20% 5 if ≥ 20%

Rates Variables

Typical Annual Residential Rate. Rates that are too low can jeopardize a system's viability. However, rates that are too high sometimes indicate that the system is: close to collapsing (spreading costs over fewer customers); poorly managed (e.g., not refinancing high-cost debt); and/or more likely to be by-passed by the drilling of private wells. The "typical" annual residential rate is used to indicate rate levels, where typical annual resident is defined as:

- a resident consuming 15,000 gallons per quarter (for systems with metered rates); or
- a resident with a kitchen sink, outside spigot/hose, first bathtub, first water closet, extra water closet, first sink, extra sink, and automatic clothes washer (for systems with rates based on fixtures).

Systems with rate levels between $300 and $450 per year for a typical residential customer receive 5 points. Systems with rates below $100 or above $650 receive no points. In between, each $50 or part thereof away from the 5-point range results in one less point being awarded.

Type of Rate. Three types of water rates are common: flat rates; fixture rates; and metered rates. Flat rates do not necessarily reflect the cost of the services provided to individual customers. Therefore, systems with flat rates are awarded no points. Metered rates are preferred since they provide accurate price signals base on the quantity of water consumed by individual customers. Systems with metered rates receive 5 points. Two points are given to systems with fixture rates.

Presence of Stand-By Charges for Vacant Lots. The Pennsylvania State PUC allows systems serving vacation home developments to charge a stand-by fee for as-yet undeveloped lots. This allows the systems to recover the fixed costs of having installed a water system to serve future developments. In practice, many lot owners do not pay the charge. Only when they are ready to build, do owners pay the arrearage. Since it cannot terminate service to a vacant lot, systems have little power to enforce payment. Therefore, the presence of stand-by charges can result in cash flow problems. It could also indicate an inadequately sized system -- either too large because the expected number of homes were not built, or too small because building takes place more rapidly than anticipated. Therefore, 5 points are awarded to systems without stand-by charges and 0 points for systems with stand-by charges.

Minimum Bill as Percent of Typical Annual Rate. Stable revenue streams are more conducive to system viability.[3] Therefore, a system receives 5 points if the minimum bill is at least 60% of the typical annual residential bill (defined above). At the other extreme, a system receives 0 points if the minimum bill is less than 20% of the typical bill. One extra point is awarded for every 10% increment or part thereof.[4]

PUC Examination in Past 5 Years. Public utility commissions usually examine a system's quality of service, financial management and other operating features during a rate case review. Such reviews can encourage restructuring to increase viability. Therefore, 5 points are awarded if the system has gone through a detailed rate review within the past 5 years and 0 if it has not. A detailed rate review is defined as one where the PUC suspends the proposed rate increase for a full investigation. If the rate increase is granted without an investigation, the system receives 0 points.

Figure 5.3 Summary of Rates Variables

SMURF Variable	Score Awarded
Typical Annual Residential Rate	0 if < \$100 or ≥ \$650 1 if \$100 to \$150 or \$600 to \$650 2 if \$150 to \$200 or \$550 to \$600 3 if \$200 to \$250 or \$500 to \$550 4 if \$250 to \$300 or \$450 to \$500 5 if ≥ \$300 and < \$450
Type of Rate	0 if FLAT 2 if FIXTURE 5 if METER
Stand-By Charge for Vacant Lots	0 if YES 5 if NO
Minimum Bill as % of Typical Annual Rate	0 if < 20% 1 if 20% to 30% 2 if 30% to 40% 3 if 40% to 50% 4 if 50% to 60% 5 if ≥ 60%
PUC Examination in Past 5 Years	0 if NO 5 if YES

Management Variables

Quality of Annual Report. A "better" annual report is an indicator that a system is well managed. Criteria distinguishing annual reports include: whether all entries are made in the proper location; whether the arithmetic is correct; and whether all appropriate information is provided. Reports are graded with 5 points given to systems with good reports and 1 point given to systems with poor reports. Since the grading is somewhat subjective, it is important that only a small number of people perform the grading and that explicit grading criteria are established.

Number of Rate Cases in Past 10 Years. The number of rate cases in the previous decade is an indicator of system managers' attentiveness to finances. The SMURF developers expect most well managed systems to have requested a rate increase every two years. Some evidence suggests that water consumption falls with a large rate increase. Therefore, regular, moderate rate increases can contribute to system viability. One point is awarded for each rate case in the last 10 years, up to a maximum of 5 points.

Years Since Rates Changed. The number of years since the last rate change also reveals how closely managers are watching system finances. If rates are less than 2 years old, 5 points are awarded. One point is subtracted for each additional 2 years or fraction thereof since the last rate change.

Average Age of a Plant. Newer plants are likely to be more viable than older plants. The developers of SMURF, however, did not have access to direct data on the age of the plant. Therefore, plant age was approximated with the depreciation reserve expressed as a percent of gross plant in service. Five points are given if the reserve is less than 10% of the gross plant in service. For each additional 10% one point less is given. No points are given to systems if the depreciation reserve is 50% or more of the gross plant in service.

Number of Affiliated Companies. This variable measures the likely expertise of the utility's management. Specifically, it is assumed that a system affiliated with several other systems is more likely to have professional management, sound financial practices, etc. One point is given for every two affiliated companies to a maximum of 5 points for more than 8 affiliated systems.

Figure 5.4 Summary of Management Variables	
SMURF Variable	**Score Awarded**
Quality of Annual Report	Subjective Rating Between 1 (if POOR) and 5 (if GOOD)
Number of Rate Review Cases in Past 10 Years	0 if 0 1 if 1 2 if 2 3 if 3 4 if 4 5 if ≥ 5
Years Since Rates Changed	0 if ≥ 10 1 if 8 to 10 2 if 6 to 8 3 if 4 to 6 4 if 2 to 4 5 if < 2
Depreciation Reserve as % of Gross Plant (Average Age of a Plant)	0 if ≥ 50% 1 if 40% to 50% 2 if 30% to 40% 3 if 20% to 30% 4 if 10% to 20% 5 if < 10%
Number of Affiliated Companies	0 if 0 1 if 1 or 2 2 if 3 or 4 3 if 5 or 6 4 if 7 or 8 5 if > 8

Finance Variables

Net Operating Income. Net operating income, defined as revenues less expenses, measures the profitability of a system. Other things being equal, higher profits improve access to capital from all three financing sources (retained earnings, equity and debt). One point is awarded for the first $10,000 of net operating income. An additional point is given for each additional $15,000 or part thereof, to a maximum of 5 points.

Shareholders' Equity. Shareholders' equity represents the owners' interest in the utility, as defined by retained earnings plus paid-in capital. The variable measures the internal financial resources of the water system. One point is scored for each $100,000 (or part thereof) of shareholders' equity, to a maximum of 5 points.

Equity Ratio. The equity ratio measures equity as a percent of total capital (equity plus debt). The equity ratio describes the capitalization structure of a water system or, more specifically, the degree to which the water system is capitalized through equity. The higher the ratio, the less indebted is the water system. Systems with equity ratios greater than 40% receive 5 points. For each drop of 10 percentage points, the system receives 1 less point.

Net Cash Flow. Net cash flow is defined as net income plus depreciation. Cash flow represents the funds generated annually and available to meet the water system's financial commitments. Points are awarded for net cash flow in the same manner as points for net operating income: 1 point for the first $10,000 and an additional point for each additional $15,000, to a maximum of 5 points.

Debt as a Percent of Net Plant Investment. This ratio is calculated as:

$$\frac{\text{Debt}}{\text{Gross Plant - Depreciation Reserve}}$$

As the ratio increases, the system's ability to finance new investments declines. Higher ratios indicate that the system has greater debt obligations relative to the remaining revenue-producing life of the system assets. No points are awarded if the ratio is 70% or more. For each drop of 10 percentage points (or part thereof), an additional point is awarded, to a maximum of 5 points.

Figure 5.5 Summary of Finance Variables

SMURF Variable	Score Awarded
Net Operating Income = Revenues - Expenses	0 if < $10,000 1 if $10,000 to $25,000 2 if $25,000 to $40,000 3 if $40,000 to $55,000 4 if $55,000 to $70,000 5 if ≥ $70,000
Shareholders' Equity = Retained Earnings + Paid-In Cash	1 if $0 to $100,000 2 if $100,000 to $200,000 3 if $200,000 to $300,000 4 if $300,000 to $400,000 5 if ≥ $400,000
Equity Ratio $= \frac{\text{Equity}}{\text{Equity + Debt}}$	0 if ≤ 0% 1 if 0% to 10% 2 if 10% to 20% 3 if 20% to 30% 4 if 30% to 40% 5 if ≥ 40%
Net Cash Flow = Net Income + Depreciation	0 if < $10,000 1 if $10,000 to $25,000 2 if $25,000 to $40,000 3 if $40,000 to $55,000 4 if $55,000 to $70,000 5 if ≥ $70,000
Debt as % of Net Plant $= \frac{\text{Debt}}{\text{Gross Plant - Depreciation Reserve}}$	0 if ≥ 70% 1 if 60% to 70% 2 if 50% to 60% 3 if 40% to 50% 4 if 30% to 40% 5 if < 30%

It is important to remember that the above indicators and scoring were derived from data available in Pennsylvania. There are several reasons why analysts may wish to deviate from the SMURF indicators and scoring.

- Some indicators may not be suitable for some states. In Pennsylvania, stand-by charges are allowed and, based on a perceived relationship to viability, are incorporated into the SMURF viability index. Other states may not allow stand-by charges, thereby making the variable meaningless.

- As mentioned above, the indicators were selected, in part, because they could be measured from data on-file with the Pennsylvania State PUC. States that lack individual data can simply use a smaller set of indicators or define alternative variables. In these cases, the SMURF software cannot be used. However, these and similar financial ratio calculations are straight forward and can be easily performed in any spreadsheet software program.

- Some analysts may disagree with the hypothesized relationships between the indicators and viability. In addition, analysts may believe that the indicators are not the best measures of system viability.

The general approach adopted by SMURF is, however, flexible enough to accommodate different indicators and rankings. The general approach involves: identifying appropriate and available indicators of small water system viability; attaching ranking scores to ranges of each indicator so that the rankings reflect the relationships of the indicators to viability; computing a viability score for each small water system.

Regardless of whether or not the specific SMURF indicators and rankings are used, the results should be verified. For example, if detailed assessments are available for a small number of small water systems, the conclusions of the detailed assessments should be compared to the SMURF results. If the SMURF results are found to misrepresent the viability of the systems, indicators and/or rankings should be adjusted to reduce the errors.

5.5 Results

As described above, for each small water system examined, SMURF produces a total viability score out of 100, as well as a score out of 25 for each of the four indicator groups: size; rates; management; and finance.

The SMURF results can be used to:

- identify groups of small water systems with similar characteristics;

- identify the extent to which certain problems -- such as poor management -- are present in a sample of small water systems;

- develop a profile illustrating the diverse problems and opportunities facing small water systems; and

- begin to identify the need for programs and restructuring to promote viability.

There is no fixed way to analyze the results from SMURF. Instead, the analysis involves examining the distribution of system scores and developing a classification system that suits the results and the needs of the users. In some instances, for example, viability determinations based on SMURF scores may be desirable. In other cases, viability determinations may not be appropriate.

To illustrate the results analysis, consider the classification scheme that emerged from the 139 privately-owned small water systems in Pennsylvania. Six distinct groups of systems were identified from the results. The descriptions and score ranges for each group are listed below.

Group 1 - Viable Systems: small water systems that have the financial and managerial capability to provide reliable water service on a long-term basis.

Group 2 - Well-Managed, Too Small, Capacity to Borrow: small water systems with strong management (as indicated by their management and rates indicators) and sufficient financial strength to raise expansion capital. However, their small size indicates that growth, perhaps through acquiring other nearby small systems, may improve their viability and the viability of neighboring systems.

Group 3 - Well-Managed, Too Small, Little Capacity to Borrow: small water systems that would fit into group 2 if their financial situation provided them greater access to financing sources. Specifically, low equity ratios and debt/net plant ratios reveal that a lack of borrowing capacity to facilitate expansion. These companies are not yet good candidates for growth but, through regional support programs, could raise additional revenue by providing management and operational support to other water systems.

Group 4 - Fair Size, Poor Management: small water systems that are large enough to qualify as viable but for lack of management expertise (revealed by low scores in the management and rates indicator groups). If systems in this group fail to improve management, they could be taken over by a water system in Group 1 or Group 2. Alternatively, a Group 3 company could be enlisted to help improve management.

Group 5 - Non-Viable Systems: small water systems characterized by low or mediocre scores in all four indicator groups. This category, however, contains a broad spectrum of systems. Some may require immediate attention, while others' needs may be less acute. Participation in shared management programs or acquisition by other systems may make some of these water systems viable, others may require active management and/or financial assistance.

Group 6 - Basket Cases: small water systems that, due to very low total scores, are likely to be unable to meet current regulatory requirements, provide adequate service or otherwise meet current obligations.

Figure 5.6 SMURF Index Categories		
	System Categories	**Index Ranges**
1.	*Viable*	Total Score ≥ 65
2.	*Well-Managed, Too Small, Capacity to Borrow*	31 < Total Score < 65 Management + Rates > 31 Size ≤ 8 Equity Ratio + Debt > 6
3.	*Well-Managed, Too Small, Little Capacity to Borrow*	31 < Total Score < 65 Management + Rates > 31 Size ≤ 8 Equity Ratio + Debt < 6
4.	*Fair Size, Poor Management*	31 < Total Score < 65 Size > 8 Management + Rates < 27
5.	*Non-Viable Systems*	31 < Total Score < 65 Do Not Meet Criteria for 2, 3 or 4
6.	*Basket Cases*	Total Score ≤ 31

The general approach taken by SMURF in developing the classification scheme is flexible. Different classification schemes can be defined depending on the results obtained and the users' needs. Caution should be exercised when developing classification schemes based on a small number of indicators. Systems can be ranked using the total viability scores, scores for indicator groups, or scores for individual indicators. However, errors are more likely if the classification schemes rely on fewer indicators.

5.6 Summary and Extensions

SMURF illustrates an approach used by aggregate-level viability assessment methods. Aggregate-level assessments derive conclusions from a necessarily small number of indicators. Given that the relationships of specific indicators with viability have not been formally validated, anecdotal evidence and common sense remain the basic tools for selecting viability indicators. SMURF shows the type of rationale that can be used to identify and rank viability indicators for system-level viability assessment as well as other aggregate-level assessment methods. The details of the SMURF rationale can be transplanted to other states as is or, more likely, amended to suit other data constraints, state characteristics and perspectives on viability.

SMURF also shows one approach to analyzing the viability scores that result from aggregate-level assessments. In this approach, a classification scheme is allowed to emerge from the distribution of viability scores for a sample of small water systems. The classification scheme for any particular application of the approach will vary with the sample and the needs of individual analysts.

Regardless of the specific indicators, scoring and classification scheme developed, SMURF produces the basic product of all aggregate-level assessment methods: a profile of the "small water system problem" that quantifies and describes the diversity of small systems along the viability spectrum. The value of such a profile lies in its use as an educational tool to help place the small water systems on the agenda of state legislators. SMURF does not prescribe changes, either at the state program level or at the system level. But it can offer *preliminary* indications of what viability problems might be present. Regulators and owners can use this information to identify possible solutions.

SMURF also illustrates some of the drawbacks and dangers to aggregate-level viability assessment. First, SMURF includes a fairly small number of indicators for assessing such a complex and multi-faceted issue as small system viability. Therefore, the method may not always result in correct classifications of individual systems. Second, the heavy reliance of aggregate-level viability assessment on the data available is clear from SMURF. Data for the SMURF model were available for about half of Pennsylvania's 260 small water systems. Choices of viability indicators are currently limited by data that are readily available. For some states, SMURF and other aggregate-level assessment methods can suggest data that could be included in new or expanded reporting requirements. Third, SMURF provides only a snapshot of small water systems based on current data. While useful for mobilizing support to address the "small water system problem," interpreting the SMURF results must consider that viability refers to the ability to meet long-term performance requirements.

REFERENCES AND ENDNOTES

1. Scott J. Rubin *et al.*, "A Quantitative Assessment of Viability of Small Water Systems in Pennsylvania," *Proceedings of the Eighth NARUC Biennial Regulatory Information Conference* (1992), Vol. IV, pp. 79-97

2. There are some inconsistencies between the ranking ranges contained in the software and those contained in the report describing SMURF. For the purposes of this manual, the ranking ranges from the report are used.

3. Rubin and O'Neal point out that, even though stable revenues may enhance viability, other goals such as water conservation may be better served by less stable rates.

4. This variable is obviously related to the rate type variable described above. A flat rate will receive a total of 5 points (0 points for being a flat rate and 5 points for being very stable). A metered rate will receive total points between 5 and 10 (5 for being metered and between 0 and 5 for stability).

CHAPTER 6.
FINANCIAL DISTRESS ASSESSMENT MODELS[1]

6.1 Overview

Financial Distress Assessment Models (FDAMs) are a method for assessing the financial health of small water systems based on the simplest and most common financial analysis technique -- analysis of financial performance ratios. Just as private investors use financial ratios to make investment decisions, utility regulators can use financial ratios to help identify water systems that are financially distressed. Although financial capability is not equivalent to small water system viability, it is an essential component of viability.

The mechanics of using FDAMs are straight forward and flexible. Financial ratios measuring liquidity, leverage and other financial characteristics are used to calculate a "Distress Score" for each system. By defining a classification scheme, the Distress Score can identify systems that are financially strong, weak or marginal, or distressed. Depending on the user's needs and data constraints, the FDAM can be modified to accommodate: a wide variety of financial ratios; alternative definitions of the Distress Score; and state-specific system classification schemes.

Financial Distress Assessment Models are most suitable for aggregate assessments of privately-owned water systems. Given the small number of variables employed, the models provide an overview assessment of financial health. Systems classified as "distressed" deserve immediate and detailed analysis beyond what the models can provide to determine the root causes of the distress and corrective actions. FDAMs cannot be applied where financial reporting is not practiced. However, FDAMs illustrate the data that could be built into new reporting requirements, a possible first step towards a comprehensive state viability program. Such reporting is practiced in some states, extending even to small systems and the availability of such data has proved extremely valuable in educating legislatures and others involved in water supply issues.

6.2 Purpose & Objectives

Financial Distress Assessment Models are a method of measuring the financial capability of small water systems. The method was developed for three potential uses:

- as an early warning system to identify potentially bankrupt or financially distressed water systems;

- as a screening device to measure the financial capability of systems seeking certification; and

- as a viability test to help evaluate the impacts of possible structural changes among existing systems.

By focusing on financial capability, however, FDAMs do not consider all aspects of small water system viability. A viable water system is one which is self-sustaining and has the commitment and financial, managerial and technical capability to reliably meet performance requirements on a long-term basis. Financial capability is only one aspect of small water system viability, albeit one that is necessary.

Given the small number of financial ratios used as inputs (seven in the model described below), FDAMs can quickly assess the financial capability of a large sample of small water systems. The small number of ratios also means that the financial capabilities of individual systems may not always be correctly identified. Therefore, FDAMs are a method for aggregate-level assessments. They do not provide prescriptions for improving financial capability. Further research is needed to determine corrective actions at either the system or policy level.

FDAMs generate profiles of groups of small water systems. Profiles can quantify the financial capability of the systems, identify the variations among the sample and show the extent to which "basket cases" exist. For example, FDAMs can quantify the number of small water systems that:

- are financially capable of meeting current and future service demands, including compliance with SDWA;
- have sufficient financial capabilities to meet current service demands but could face difficulties in meeting future demands;
- do not have the financial capabilities to meet current demands but could if they were restructured; and
- are financially incapable of meeting current demands and have little hope of turnaround.

Policy analysts can use such profiles to help educate state legislators about the "small water system problem" and generate support for initiatives to promote small water system viability. Profiles can also provide average financial performance of small water systems which can be useful as benchmarks for comparing individual systems.

In addition to providing profiles, FDAMs can help identify some of the factors that should be examined during system-level assessments. System variables that are most strongly correlated with viability can emerge from an analysis of the models' results. Caution must be exercised when using FDAMs for this purpose since the situations of individual systems are often unique.

A key constraint to applying FDAMs is data availability. The financial data used as inputs to FDAMs are generally not available for publicly-owned systems. Ratios for privately-owned systems are also frequently not available. Therefore, the current applicability of FDAMs may be limited in many areas. However, FDAMs show the types of variables that useful for aggregate-level viability assessment and how the variables can be analyzed. Where data are not available, these variables could be incorporated into expanded reporting requirements, a possible first step in developing a comprehensive viability program for small water systems.

6.3 Technical Approach

The basic concepts used in bank failure models are the foundation of FDAMs for small water systems. Although non-viable water systems do not necessarily declare bankruptcy or fail in the same way that banks do, financial ratios can identify systems that are in financial distress and may not be able to deliver the water services needed by their customers.

Four important components of financial health are included in the FDAM described below: liquidity; leverage; profitability; and efficiency. Each component is defined and illustrated with relevant financial ratios.

Liquidity: the ability to meet short-term financial obligations. A system with low liquidity may be unable to make required payments to creditors. A system with high liquidity will have more cash available than required to meet obligations in the near future. Liquidity ratios generally compare cash and assets that can be quickly converted to cash to short-term or "current" liabilities. Examples of liquidity ratios include:

- current assets/current liabilities (where "current assets" are cash, marketable securities, accounts receivable and inventories); and

- quick assets/current liabilities (where "quick assets" are cash, marketable securities and accounts receivable).

Higher values of these ratios indicate better liquidity and, in general, stronger financial health.

An alternative measure of liquidity is fixed assets/total assets, where fixed assets are assets that can*not* be quickly converted to cash. This ratio is inversely related to liquidity. Higher fixed assets/total assets implies less liquidity.

Leverage: the extent to which system investments are financed with owners' funds (equity) as opposed to loans (debt). The more the system is financed with debt, the higher is the system's leverage. Since debt-holders must be paid a constant amount regardless of the performance of the system, highly leveraged systems are more financially risky than systems funded with relatively more equity. The following examples illustrate leverage ratios:

- book common equity/total assets: if the value of equity is high relative to the assets of the system, the system is less financially risky;

- total debt/total assets: lower debt relative to assets means that a system can more easily meet obligations to debt-holders from the revenue-producing capability of its assets; and

- market value equity/book value debt: high equity relative to debt implies that a system can meet obligations to debt-holders even when performance is not strong.

Efficiency: the ability of the system to generate revenues from inputs. For example, sales/total assets reflects the system's ability to generate revenues from its assets. Higher sales per dollar of assets implies greater efficiency. Alternatively, operating revenues/operating expenses measures the efficiency with which non-capital inputs are used. Higher revenues per dollar of labor, chemicals, energy, etc. indicate greater efficiency.

Profitability: the degree to which revenues exceed costs. The most direct approach to measuring profitability is expressing profits (earnings or income) as a percentage of other financial variables, as in net income/sales and net income/shareholders' equity. A related ratio is cash flow over sales, where cash flow is equal to net income plus depreciation. Alternatively, profitability ratios could compare revenues and costs using ratios such as operating revenues/operating expenses. Higher revenues relative to expenses indicate higher profits.

Measures of profit trends are related to profitability ratios in that they measure profitability over a number of years. Successive years of profit are generally reflected in retained earnings. Therefore, profit trends are measured by ratios such as retained earnings/common stock equity.

There are numerous financial ratios that could be used to measure these four components of financial health. Over 100 financial ratios have been incorporated into business bankruptcy and bank failure models. The accuracy and predictive power of these models depends on which financial ratios are included. The choice of variables will also determine the accuracy and predictive power of FDAMs for small water systems.

Extensive research has attempted to identify the most reliable indicators of bank failures and business bankruptcies. This research has reached consensus on several points.

- *Models should include financial ratios that describe various components of financial performance.*

  Models should include ratios measuring all four components (liquidity, leverage, profitability and efficiency). Looking at one or two components in isolation does not provide a comprehensive snapshot of financial health and may result in a misdiagnosis of financial health. In the context of FDAMs for small water systems, models that examine all the components of financial health are less likely to identify a healthy system as distressed or a distressed system as healthy.

- *Ratios describing the same component of financial health are substitutable.*

  The predictive power of ratios describing the same components (liquidity, leverage, etc.) are similar. One indicator of liquidity, for example, is generally as highly correlated with business failure as other indicators of liquidity. This implies that there is much flexibility in choosing the financial ratios to include in an FDAM for small water systems. Lack of data on a specific indicator does *not* prevent use of this assessment methodology. Rather, the model can be built around the financial data that are available.

- *Only a small number of ratios are needed to assess financial health.*

  It is possible to generate accurate results using only a small number of financial ratios. One researcher, for example, achieved 87 percent accuracy in predicting business bankruptcy using only one variable -- cash flow to total debt. A reason for this finding is that many financial ratios are calculated from the same variables taken from financial statements.

The literature also indicates that there are risks in determining financial health with a small set of financial ratios. First, bank regulators have not adopted ratio-based bank failure models because such models lack a high degree of accuracy in predicting bank failure more the one year in advance of the failure. This is of concern with viability assessment since viability relates to long-term performance. Second, when bank failures do occur, they are usually the result of poor management. Financial performance ratios in isolation do not necessarily reflect the management capabilities of a small water system. Comparing small water systems on the basis of their financial ratios neglects other factors that determine viability.

6.4 Methods and Data

Financial Distress Assessment Models involve four basic steps:

(i) select and calculate the financial performance ratios;

(ii) calculate a Distress Score for each system;

(iii) develop a scheme that classifies systems according to their Distress Score; and

(iv) verify the accuracy of the classification scheme.

Since the calculations and subsequent data manipulations are quite simple, spreadsheets are suitable for compiling the data.

Step 1 Select and Calculate the Financial Ratios

Over 100 financial ratios have been used to help predict business failures. Yet, as described above, only a small number of ratios are needed to build an assessment model that can generate accurate results. The key rule in selecting ratios for inclusion in the model is to cover the various components of financial health: liquidity; leverage; profitability; and efficiency. Data availability may play a significant role in selecting ratios, particularly if the model is applied to publicly-owned data.

Ideally, data for systems with known financial health will be available to guide the selection of financial ratios. If the financial health of a sample of firms is known, there are diagnostic exercises that can help verify the selection of ratios. For example, the developers of the FDAM method had access to data on 30 small systems already divided into strong and weak systems. The ratios were calculated, along with averages for each of the two groups of systems. Based on these figures, two simple tests are possible.

(i) The sample averages are consistent with *a priori* expectations regarding the relationship of the ratios to financial distress. The first seven ratios should be lower for distressed systems and, in fact, they are. The last three ratios should be higher for distressed systems. This holds for two of the three ratios.

(ii) The magnitudes of the averages are considerably different for the two groups of systems. For example, cash flow/sales for the strong firms is nearly three times larger than the weak systems. The size of these differences suggest that the ratios are useful in classifying systems according to financial health.

Figure 6.1 Testing the Selection of Financial Ratios

Financial Ratio	Expected Relationship to Financial Distress	Average for Strong Systems (1)	Average for Weak Systems (2)	(1)/(2)
Cash Flow/Sales	-	0.258	0.095	2.71
Current Assets/Current Liabilities	-	1.702	1.157	1.47
Book Common Equity/Total Assets	-	0.294	0.226	1.30
Retained Earnings/Common Equity	-	0.500	0.318	1.57
Sales/Total Assets	-	0.275	0.236	1.17
Operating Revenues/Operating Expenses	-	1.321	1.121	1.18
Net Income/Sales	-	0.175	-0.029	-6.03
Total Debt/Total Assets	+	0.699	0.754	0.93
Net Fixed Assets/Total Assets	+	0.823	0.734	1.12
Current Liabilities/Total Debt	+	0.100	0.181	0.55

Step 2 Calculate the Distress Score

Once the financial ratios are selected and compiled, a Distress Score is calculated for each system. This one statistic then becomes the basis for classifying the financial health of a system.

If all the financial ratios are inversely related to financial distress, calculating the Distress Score can be as simple as adding up the financial ratios. The table below illustrates this approach. All seven financial ratios selected are inversely related to financial distress. As each ratio increases in value, the likelihood of financial distress is reduced. When the ratios are summed, a system with a higher Distress Score is deemed more financially healthy than a system with a lower Distress Score.

Figure 6.2 Distress Classification Model with Illustrative Data

	Viable System		Distressed System	
Profitability				
Net Income + Depreciation / Annual Operating Revenues	$3.3 + 1.3 / 22.9	=0.200	$.240 + 1.6 / 14.3	=0.129
Liquidity				
Current Assets / Current Liabilities	5.8 / 3.7	=1.570	3.1 / 5.1	=0.607
Leverage				
Common Stock Equity / Total Assets	16.9 / 51.8	=0.326	11.1 / 65.3	=0.170
Profit Trend				
Retained Earnings / Common Stock Equity	11.1 / 16.9	=0.657	5.0 / 11.1	=0.450
Growth and Efficiency				
Annual Operating Revenues / Total Assets	22.9 / 51.8	=0.442	14.3 / 65.3	=0.219
Efficiency and Profitability				
Annual Operating Revenues / Annual Operating Expenses	22.9 / 18.7	=1.220	14.3 / 12.0	=1.190
Profitability				
Net Income / Annual Operating Expenses	3.3 / 22.9	=0.144	.240 / 14.3	=0.017
Distress Score (sum of the ratios)		**=4.56**		**=2.78**

Note: Dollar values are in millions.

Simply summing ratios to determine the Distress Score is not appropriate if the ratios selected for inclusion in the Distress Score are not all related to financial distress in the same way. Ratios that are positively related to financial distress (higher ratios mean increased chance of financial distress) must be adjusted.

If desired, more complicated approaches can be used to calculate the Distress Score. For example, prior to adding, each ratio can be weighted according to its relative importance in determining financial distress.

Step 3 Develop the Classification Scheme

Distress Scores can be used to rank systems according to their financial health. However, ranking does not reveal which systems are in financial trouble and which are stable. To interpret individual Distress Scores, a classification scheme is needed.

There is no one classification scheme that must or should be used. In fact, the appropriate classification schemes will differ depending on:

- the number of financial ratios included in the Distress Score;
- the relationship of the financial ratios to financial health; and, perhaps,
- state-specific factors that determine how high financial ratios must be to ensure system viability.

Classification schemes may vary in the number of categories of systems, the ranges of Distress Scores corresponding to each category and the names of the categories. For example, some users may wish to use the terms "viable" and "non-viable" in the category names. Other users may decide it is inappropriate to make viability determinations using a methodology that focuses on only one aspect of viability, namely financial capability.

A three-tier classification scheme was defined for Distress Scores encompassing the seven ratios shown above:

If the Distress Score is:	The system is classified as:
4.0 or more	Good to Excellent
3.0 to 3.99	Weak to Marginal
3.0 or less	Distressed

In addition, a separate category was created for "bankrupt" water systems, defined as systems with liabilities exceeding assets. This definition, derived from the private sector, was assumed to apply to water systems.

The scheme was derived from a sample of 15 small water systems that were known to be financially weak and 15 small water systems that were known to be financially strong. The averages and standard deviations of the Distress Scores were calculated for each of the two groups of systems (strong and weak). For the fifteen strong systems, the average was 4.50 with a standard deviation of 0.99. For the fifteen weak systems, the average was 3.10. It was assumed that the Distress Scores for the systems were distributed along a normal curve with an average of 4.5 and a standard deviation of 1.5. Systems with Distress Scores below 3.0, a figure close to the average Distress Score for the weak systems, were considered distressed.

Assuming a particular probability distribution is a somewhat limited approach to defining the classification scheme. Nonetheless, it may be preferred to a purely subjective approach. Users' of FDAMs can define their own classification schemes using whatever approach their needs and data constraints.

Step 4 Verify the Model Results

After the Distress Scores have been calculated and systems have been classified, the model results should be verified, This involves checking a subset of the systems to ensure that the model has classified them correctly. There are many approaches that could be used for the verification, including the following:

- if the financial health of a sample of systems is known (systems other than those used to develop the classification scheme), compare the model's classification to the existing classification;
- ask independent analysts familiar with individual systems to verify the classification; and
- send results to system mangers for feedback.

Verification could reveal that healthy systems are classified as distressed or that distressed systems are classified as healthy. The model user will have to decide whether to accept errors or to adjust the model to reduce the number of errors. Three types of adjustments to the model may be necessary.

- *Adjustments to the Ratios*

Incorrect classification may result from one or more of the financial ratios included in the Distress Score. For example, verifying the seven-ratio Distress Score described above revealed that the model gave high ratings to two weak systems. Detailed analysis of these systems revealed that both had unusually high liquidity ratios due to high levels of accounts receivable. The accounts receivable in fact reflected uncollectible accounts remaining on the books. Adjustments could have been made either to the values of the ratio for these individual systems or to the selection of liquidity ratios.

- *Adjustments to the Definition of the Distress Score*

The verifications could reveal that some financial ratios are more powerful indicators of financial health than others. In this case, weighting the more powerful indicators more heavily may improve the accuracy of the model.

- *Adjustments to the Classification Scheme*

Consistently classifying healthy systems as distressed would suggest that the range of Distress Scores defining heathy systems should be lowered. Conversely, frequent classification of distressed systems as healthy would suggest that the range of Distress Scores defining distressed systems should be raised.

6.5 Results

For each small water system, FDAMs produce spreadsheets or databases containing underlying financial data, calculated financial ratios and a Distress Score. The output can show the distribution of systems across the different classifications of financial health. However, a more elaborate picture of "the small system problem" can be derived from the model's results. Depending on the data collected, the results could answer questions such as:

- are small water systems serving particular areas (urban vs. suburban vs. rural) more likely to be in financial distress?
- are small systems serving less than 500 customers more likely to be in financial distress than small systems serving larger markets?
- is the financial health of small systems improving or declining over time?
- how closely related to the general economic climate is the financial health of small systems?

Answering such questions can help illustrate for state policy makers the need for new initiatives to help restructure small water systems.

Two caveats are relevant when interpreting the results of FDAMs.

- Caution must be exercised when interpreting the Distress Scores of individual systems. Given the diversity of small water systems, a model based on a fairly small number of financial ratios is bound to produce some classification errors. Some systems that are distressed may escape being classified as distressed, while other healthy systems may be classified as distressed. The tests and model verification procedures described above will likely not eliminate all inaccuracies.

- The model does not prescribe solutions for restructuring distressed or marginal systems. Restructuring systems to increase viability is a complex task that must consider many more factors than those included in FDAMs.

Taken together these two caveats imply that the model is best viewed as an aggregate assessment model that provides a first screening of small water systems. If classified as distressed or marginal, individual water systems are worthy of further research to verify the classification and identify corrective actions.

6.6 Summary and Extensions

Financial Distress Assessment Models (FDAMs) measure one aspect of small water system viability, namely financial capability. When data are available, FDAMs provide a quick method for screening the financial capabilities of a large sample of small water systems. FDAMs are easily modified to include different selections of financial ratios, methods of calculating Distress Scores and classification schemes. They are straight forward to use and data can be stored and manipulated in basic spreadsheets.

Results provide an aggregate profile of the financial state of small water systems that can be used to educate policy makers, quantify the "small water system problem" and identify potentially weak systems for further attention. There are, however, limitations to what FDAMs can provide. They do not prescribe solutions for the "small water system problem" either at the system or policy level. The results are based on data which may have only limited power to measure long-term financial capabilities. Finally, financial capability is only one aspect of system viability. Managerial and technical capabilities are not always revealed in current financial ratios.

For many states, data availability will constrain their ability to apply FDAMs. In these cases, FDAMs illustrate the information that added to reporting requirements to facilitate viability assessments.

REFERENCES

1. Dreese, *et al.*, "Developing Models for Assessing the Financial Health of Small and Medium-Sized Water Utilities," *Journal of the American Water Works Association* (June 1993), pp. 54-60.