Analysis of a Uniform, Comprehensive Cost Analysis Method for Virginia Municipal Water and Wastewater Systems

by

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(ABSTRACT)

Municipal water and wastewater systems in Virginia are faced with substantial capital needs for the expansion, replacement, and improvement of existing facilities, and the construction of new facilities. To compound this problem, the financial environment surrounding these utilities is changing from one in which grant financing is being replaced by debt financing, and the overall availability of federal and state aid is declining. The literature on utility management emphasizes the use of a "user-pays" approach that makes use of a comprehensive method of cost analysis.

This thesis tests the hypothesis that a uniform, comprehensive cost analysis method can be developed to effectively meet the cost analysis needs of municipal water and wastewater systems in Virginia. This is accomplished in a four step process: development and distribution of a questionnaire to all municipal water and wastewater systems in Virginia; analysis of the survey results; description and analysis of the Government Finance Officers Association's comprehensive cost analysis workbook for water and wastewater utilities; and evaluation of this workbook in several Virginia communities.

The results of this work show that a comprehensive cost analysis method can be developed which will effectively meet the cost analysis needs of water and wastewater operations in Virginia. However, such a method does have its shortcomings, and further research is recommended.

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INTRODUCTION AND RESEARCH DESIGN

Overview

Within the past five years, there has been substantial discussion about the growing infrastructure needs which face states and municipalities. This has been especially true for municipal water and wastewater systems. For these systems, there exists not only a need to construct new systems components, but also the parallel need of upgrading and expanding existing facilities. The average cost of a new wastewater treatment plant today may well exceed the resources of many localities. For example, a community of 10,000 residents can expect to pay over $3 million for a 1 mgd (million gallon per day) secondary wastewater treatment facility, while a community of 1 million residents can expect to pay over $96 million for a 100 mgd treatment plant (Werntz and Pryor, 1986). The requirements that these numbers represent place a significant burden on towns or cities that provide wastewater service.

The literature in the field of water and wastewater management emphasizes a "user-pays" approach and the use of comprehensive, uniform cost analysis methods which can aid localities in linking their costs to their revenue base. It is believed that such methods will help localities select the most appropriate financial options available for the expansion, improvement, or replacement of their their water and wastewater facilities, both now and into the future. An example of such a method is being developed by the Government Finance Research Center, in association with the Center for Urban and Regional Studies at Virginia Tech. This comprehensive method is in the form of a workbook which contains a number of worksheets or modules that guide the user through the different components of cost analysis, such as estimating capital needs, financing those capital needs, determining annual cost of service, setting user charges, and measuring performance.

This comprehensive method is the focus of this research. This thesis will accomplish four objectives: (1) investigate the financial environment of public water and wastewater operations in Virginia; (2)

examine the perceived cost analysis needs of these systems; (3) evaluate the Government Finance Officers Association workbook approach against criteria for comprehensive cost analysis provided by the literature and the perceptions of potential users; and (4) test the effectiveness and usefulness of the workbook through a survey and interviews of potential users.

Water and Wastewater Needs Across Virginia

Similar to other states, Virginia is faced with substantial infrastructure costs for its public water and wastewater systems. A 1985 survey by the Virginia Department of Health (VDH) concluded that for water supply systems, $1.9 billion will be needed in upgrades and new construction through the year 2000. The State Water Control Board estimates the capital needs for wastewater systems at $2.1 billion through the year 2000. According to the Virginia General Assembly's Joint Subcommittee Studying Water Supply and Wastewater Treatment in Virginia, the funding of water systems within the State will be much more difficult than that of wastewater systems. For wastewater systems, the Joint Subcommittee projects an average annual need over the next five years for publicly owned facilities of $140 million, while the maximum annual public assistance funds available is estimated to be $123 million. These amounts assume the 1987 level of federal and state support of water and wastewater facilities will be available through the year 2000. This leaves an estimated minimum annual shortfall of $17 million or 12% of need. While the average annual need for publicly owned water systems is smaller than that of the public wastewater systems ($126.7 million), the maximum annual public assistance funds available is estimated to be significantly less than that of public wastewater systems- $30.42 million. This leaves a minimum annual shortfall of $96.28 million, or 76% of need (Joint Subcomm., 1987). Table 1 presents a summary of these findings.

Table 1. Summary of Virginia Annualized Water and Wastewater Needs (in millions/year)

	Water	*Wastewater*	*Total*
Average Annual Need Through 2000	$126.7	$140.0	$226.7
Max. Federal and State Funds	30.4	123.0	153.4
Min. Annual Shortfall	96.3	17.0	113.3
Shortfall as Percent of Need	76%	12%	42%

Source: Joint Subcomm., 1987; in Randolph, **Water and Sewer Service in Virginia**, VPI&SU.

It is evident from these figures that increased attention needs to be given to the financial support of Virginia's public water systems if they are to continue operating into the future.

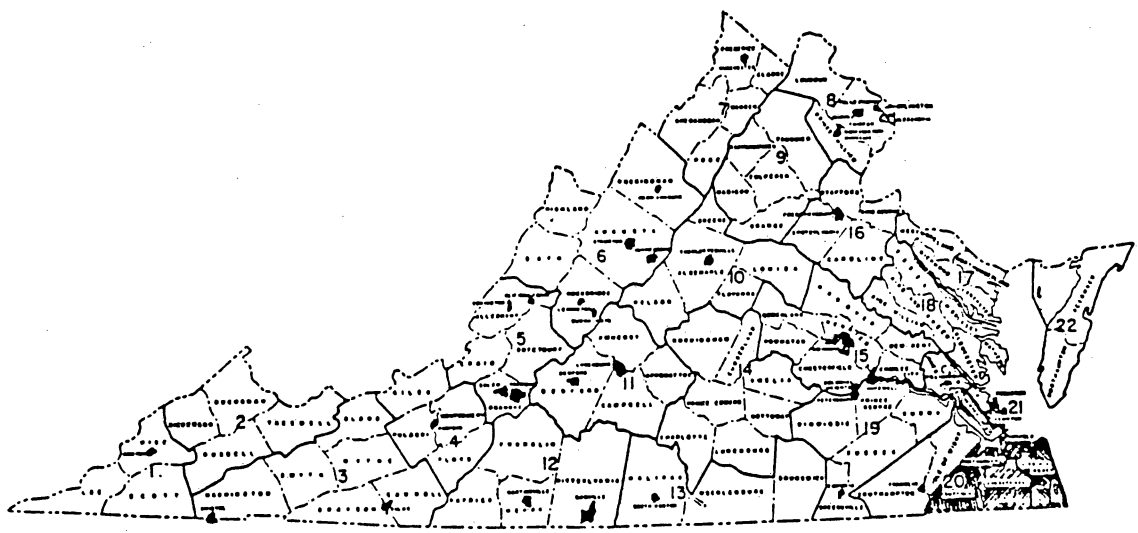
To illustrate these pressing financial needs of Virginia public water systems, the following table (Table 2) breaks down need (defined as demand for capital) by Planning Districts into existing dollar needs and estimated year 2000 dollar needs (no such comprehensive information exists for public wastewater systems in the State). These daty are analyzed as per capita need based on 1985 population projections developed for each Planning District by the Tayloe Murphy Institute (Martin and Sheatsley, 1986). Figure 1 displays a map of Virginia divided by planning districts to help visualize the areas of particular need.

Table 2. Infrastructure Needs of Public Water Systems in Virginia by Planning District (in thousands)

Planning District	*Existing Needs*	*Per Capita*	*Year 2000 Needs*	*Per Capita*
1- Lenowisco	$13.08	$128	$43.69	$425
2- Cumberland Plateau	13.38	96	22.92	164
3- Mt. Rogers	14.57	80	17.27	95
4- New River Valley	14.32	100	10.06	70
5- Fifth	18.81	74	105.09	413
6- Central Shenandoah	28.87	137	54.76	260
7- Lord Fairfax	9.54	70	24.06	176
8- N. Virginia	79.63	64	157.57	127
9- Rappahannock/Rapidan	4.24	43	1.72	17
10- Thomas Jefferson	12.25	81	7.16	47
11- Central Virginia	7.35	37	33.32	166
12- W. Piedmont	9.66	40	22.72	94
13- Southside	16.52	199	17.16	206
14- Piedmont	2.39	28	8.35	99
15- Richmond Regional	64.64	96	350.81	522
16- Radco	5.90	44	22.92	169
17- N. Neck	.79	19	3.26	77
18- Middle Peninsula	15.36	233	2.89	42
19- Crater	6.92	43	11.06	69
20- S.E. Virginia	236.06	250	161.49	171
21- Peninsula	48.86	132	190.55	516
22- Accomack/Northampton	1.12	25	8.03	176

Source: Virginia Dept. of Health, Div. of Water Programs; Martin and Sheatsley, 1986.

Figure 1. Virginia Planning Districts



The areas of the state with the greatest existing capital needs as measured on a per capita basis are the more rural areas (Planning Districts #1, 4, 6, 13), and the rapidly growing Tidewater region of the state (Planning District #18, 20, 21). In terms of year 2000 capital needs, the areas of the state with the highest per capita need are the rural areas (Planning Districts 1, 5, 6, 13), the Tidewater region (Planning District #21), and Richmond and its surrounding counties (Planning District #15). In addition, it is mostly these areas that are experiencing the largest increase in per capita dollar needs between now and the year 2000. It is evident from these figures that many parts of Virginia- rural, urban, and rapidly growing areas- are all in need of greater assistance. It is these areas of priority need that will need to be addressed in consideration of both current and future funding allocations within the state.

In addition to these areas, there are the more subtle needs of the State's rural sections that do not provide community water and wastewater service to their residents. In rural Virginia, almost three-quarters of households do not receive community water service, and more than three-quarters of the households do not receive community wastewater service (Randolph, 1987). Should the State or its local communities decide to provide community water and wastewater service to these rural areas, whether for protection of public health, protection of water quality, meeting expanding growth, or at the request of local residents, the cost of doing so will have to be met. Also to be considered are smaller communities systems facing constrained water supply and wastewater treatment capacities.

Past Financing Trends

There have been a number of traditional funding sources available to municipal water and wastewater systems in Virginia. These sources include local, state, and federal governments.

Local Sources

There exists a variety of local financial options used by communities. One such option has been General Obligation (GO) bonds, which are backed by the full faith and credit of the issuer (locality). These bonds are used to finance long term capital costs, and are generally considered secure because of the backing of the issuer as well as their simplicity and cost of insurance. Revenue bonds represent another option for long term capital financing. These bonds are the most frequently used option for long term debt, and are backed by the revenue generating capacity of the facility (WPCF, 1984). Other popular sources of revenue fall under the title of "pay-as-you-go". These are concerned with short-term financing based on year-to-year determinations of need and appropriations. Pay-as-you-go financing may come from user charges contributed to a reserve or sinking fund, monies re-directed from the general fund of the municipal budget to water and wastewater operations, and various types of property or ad valorem taxes. Other financing mechanisms include substitute sources of long-term debt capital, and short-term capital sources (e.g.- interim financing and bond anticipation notes) which are later retired by issuing conventional long term debt instruments (Boland, 1985).

Federal Sources

Since 1972 the federal government has provided local governments with monies for their wastewater treatment plants through the Construction Grants program of the Federal Water Pollution Control Act of 1972 (FWPCA) (FWPCA). These funds have been targeted at meeting pollution compliance standards. There is no comparable funding for water systems. Since that time, the FWPCA has provided for the distribution of nearly $50 billion in municipal wastewater treatment grants. Initially, the grants paid 75% of the cost of an approved project in a qualifying locality. The 1977

Amendments (renamed the Clean Water Act- CWA) extended the deadline from 1977 when wastewater treatment plants had to meet effluent and discharge guidelines set by the law. These amendments also enabled the Environmental Protection Agency (EPA) to delegate operational responsibility for the Construction Grants program to certain qualified states, and provided funds to these states to support these new administrative activities. The 1981 Amendments signified a turning point in the federal role in funding wastewater treatment plants. Beginning in 1984, the federal share of individual construction grants was reduced from 75 percent to 55 percent (Lewis, 1986). Also in 1984, the EPA adopted the National Municipal Policy. This policy established wastewater compliance standards and schedules for the purpose of improving municipal compliance rates to protect the nation's water quality. The establishment of this policy "basically reaffirms that municipalities must comply with the statutory deadlines of the Clean Water Act, whether or not they receive federal funds" (Grandstaff, 1985). Extensions beyond the established deadlines of the Act are allowed only if 'extraordinary' circumstances preclude compliance. If this is the case, the state agency, the locality, and the EPA will develop a schedule of compliance to demonstrate how the locality plans to meet the compliance requirements (Dombrowski, 1984).

The recently approved extension of the CWA (The Water Quality Act of 1987) is completing the process begun with the 1981 Amendments. The 1987 Amendments authorize $18 billion through 1994 for the phase-out of the federal program and conversion to state revolving loan funds. Under these changes, full grants of $2.4 billion have been authorized for the 1987 and 1988 fiscal years. In 1989 and 1990, the same amount is to be split: $1.2 billion for construction grants, $1.2 billion for state revolving funds (no direct construction grants). Contributions to these funds will then be $1.8 billion in 1992, $1.2 billion in 1993, $600 million in 1994, and nothing thereafter. The money will be allocated primarily on the basis of the existing formula of the old law and the most recent Needs Survey by the EPA (Gray, 1986). In Virginia, the projected share of construction grants/loans authorizations is $25 million for grants and $25 million for grants or loans (of which $11 million may go to loans at the states discretion) in 1987. In 1988, $12 million is for grants, and $37 million

is for grants or loans (of which $31 million may go to loans). From 1989 to 1990, no money will be allotted for grants only, while $25 million will go for grants or loans, and $25 million will go to loans only ($46 million of this total may go to loans). After 1990, all funds are to go to loans. (Joint Subcomm., 1987).

Under the new revolving loan program, states may use monies for a variety of purposes: loans, loan guarantees, and payments to reduce interest on loans and loan guarantees; bond interest subsidies and bond guarantees to municipalities, and interstate and intermunicipal and regional agencies; insurance for obligations; and as security for revenue bonds used to finance construction. Localities receiving these funds must establish a dedicated source of revenue for repayment (Gray, 1986). Revolving Loan Funds...

> begin with an appropriation of "seed" money to the fund, loans are made available for specific purposes such as municipal treatment plant construction. The loan repayment, including interest, go directly back into the fund to be used for other loans, thus continually recycling a limited money supply. Depending on interest rates charged on the loans, the fund can maintain and even increase its purchasing power (Werntz and Pryor, 1986).

Despite these large expenditures -fourteen years of federal grants totalling some $53 billion (1984 $'s)- only one-half of the treatment facilities originally thought necessary to obtain clean water throughout the U.S. have been built (Bodde, 1985). From 1971 to 1981, a total of $1.165 billion was spent on the design, construction, expansion, and upgrading of municipal wastewater treatment plants in Virginia. The federal government paid 75% of these costs under the 1972 FWPCA. The federal grants peaked at $251.8 million in 1976, and have since fallen to $50 million in 1984 (Hickman, 1984). This marked decline, coupled with repayment of funding under the new revolving loan program, will force communities to reassess their financing schemes.

Other federal funding sources for water and wastewater operations have come from the Farmers Home Administration (grants and loans through its Rural Water and Waste Disposal Systems program); the Economic Development Administration (grants); the U.S. Department of Housing

and Community Development (Community Development grants for planning and construction); and the Appalachian Regional Commission (grants for construction) (Joint Subcomm., 1987).

State Established Revolving Loan Funds

Due to the change in the federal law, the role of states in financing may by necessity expand. As of 1986, 16 states have developed operational revolving loan programs capitalized at the state level, while another 19 states are either studying alternative financing programs or have proposed legislation for them (Jenson, 1986). Anticipating the changes in the federal program, Virginia established its Water Facilities Revolving Loan Fund in 1986. The General Assembly appropriated $20 million for the first two years of the Fund, and authorized the State to accept any federal money appropriated for state revolving loan funds. Under the law, the Fund is separate, permanent, and perpetual, dedicated solely to improvements of publically owned *wastewater treatment* facilities. Money from the fund will be loaned to local governments at current market rates (or below market rates for "needy" communities), all principal and interest will be repaid into the Fund, and money will the be reloaned for additional projects. The Virginia State Water Control Board will administer the policy aspects of the Fund, while the Virginia Resources Authority will serve as the financial manager of the Fund (State Water Control Board, 1987). To qualify for consideration under this program, communities will be judged against the following criteria:

1. **Project type.** Highest priority will go to projects designed to meet new water quality standards, reduce toxic discharges, and reduce nutrient discharges. Other projects such as expanding capacity, extending service areas, and refinancing existing facilities will not be considered

2. **Environmental concerns.** Priority will go to those projects directly responsible for water quality problems in high priority water bodies. Also considered is the applicants enforcement and compliance history, and place in line under the EPA Construction Grants program
3. **Fiscal stress.** Financial need based on a number of economic indicators
4. **Readiness to proceed.** Those at the highest state of readiness will be considered top priority (State Water Control Board, 1987).

It is expected that this fund will be helpful in relieving the potential financial stress caused by a reduction in federal funds. If the state's appropriation of $10 million per year, for the period 1986 to 1990, is added to a federal appropriation of $50 million per year for the same time period, "...the resulting $300 million loaned at 8% interest will meet Virginia's wastewater treatment needs by 2009" (Joint Subcomm., 1987).

Unlike wastewater funding, little attention has been given to the financing of water operations by either state or federal governments in the past. As a result, local government units have had to bear a majority of water treatment and distribution costs. However, this situation is changing for Virginia localities. The Virginia Resources Authority was established in 1984 to fund water and wastewater projects, and provided $15.5 million in loans for water systems in 1986. A law establishing a new revolving loan fund for water systems was enacted by the 1987 General Assembly, providing $10 million the first year, and the same amount thereafter, to be administered by the State Department of Health (Joint Subcomm., 1987). This $10 million per year, however, does not approach the expected annual need of $123 million through the year 2000.

State Sources

Other state funding has also emphasized wastewater treatment operations, while provision of a "...safe and adequate potable water supply has typically been the responsibility of the locality" (Joint Subcomm., 1987). State financing has come through the following Virginia agencies: the State Water Control Board (loans and grants); Department of Housing and Community Development (grants); the Virginia Resources Authority (loans and grants); and the Health Department (grants). One other source that has been fully supported by state appropriations is the Virginia Water Project, which provides grants and loans to low-income rural communities and their residents (Joint Subcomm., 1987). Table 3 provides a summary of various funding sources.

Table 3. Federal and State Assistance for Water and Wastewater (in millions)

	FY 1982-1986		FY 1987*	
Agency	*Water*	*Sewer*	*Water*	*Sewer*
EPA	0.0	208.6	0.0	50.0
FmHA grants & loans	27.5	30.7	7.1	7.9
HUD- large cities	7.5	7.5	1.5	1.5
CDBG- small cities	28.8	30.9	4.9	5.4
Appalachian Reg Comm	4.1	3.3	0.3	0.2
Res Shoreline Prot Prog	0.0	0.4	0.0	0.2
Va Resources Auth (from FY 1986)	15.5	48.1	14.2	44.9
Va Water Project	0.7	0.3	0.5	0.2
Va Dept Health- flouridation	0.4	0.0	0.1	0.0
SWCB- Ches Bay	0.0	2.3	0.0	1.6
SWCB- Spec Prog	0.0	3.3	0.0	0.0
SWCB- Revolving Loan	-.-	-.-	0.0	10.2
TOTAL	89.3	337.8	30.4	123.0

*- estimated figures.

Source: Joint Subcomm., 1987; Randolph, 1987.

For the period 1982-1986, 84 percent of the total available funding came from federal sources, and 79 percent went to wastewater operations. The estimated 1987 funding levels are also presented. The largest increases in funding have come from the Virginia Resources Authority, and the Virginia

Water Facilities Revolving Loan fund. However, comparison of these figures with the projected capital needs of Virginia's municipal water and wastewater systems reveals that the current levels of state and federal funding will not be enough to cover projected costs.

The Need for a Comprehensive Cost Analysis Approach

Given this information on financing and capital needs, many localities may be questioning their ability to continue or expand service of their wastewater treatment facilities with their existing financial resources. Michael Pagano and Richard Moore, in **Cities and Fiscal Choices**, argue that public budgeting is an incremental, and often possibly disjointed, process. This occurs because of the multiplicity of actors involved in the budget process, their varied demands, and limited funding sources (Pagano and Moore, 1985). "Most cities keep such scanty records of spending, employment, and service levels, that they must find it difficult to monitor themselves... cities are rarely able to inform their citizens how their tax dollars are being spent" (Menchik, 1982). Keith Mueller, in **The Journal of Urban Affairs**, argues that local decision making tends to develop momentum over time and can become resistant to change. This customary mode of decision making is described by the concept of incrementalism: "left undisturbed... we can expect local decision makers to pursue, incrementally, policies consistent with the predominant momentum built up over time. If incremental politics prevails, we can expect little movement toward change" (Mueller, 1984). This type of policy mode could prove detrimental in this changing financial environment that calls for new, innovative funding strategies for water and wastewater operations.

As a reaction to incremental decision making, a number of experts in the fields of municipal finance and public works have looked to greater use of comprehensive planning, analysis. and decision

making. Jerome Gilbert, in **Water Engineering and Management**, has developed a comprehensive approach that cites four important areas which need to be addressed:

1. an effective preventative maintenance program.
2. a capital program of replacement and improvement as part of the future planning process and annual budget.
3. an equitable water rate structure- sufficient to pay for annual costs, including debt service, of a comprehensive rehabilitation program.
4. a system of charges that places the burden of financing facility expansion on those customers causing the need (Gilbert, 1985).

Roger Kemp, in **Public Works**, concurs by stating that "project capital planning... helps educate the public and elected officials on their governments long term capital needs. It also sets forth financing requirements beyond the normal annual budget cycle". Others agree that a comprehensive, uniform, cost analysis method (hereafter referred to as a comprehensive method) is not only appropriate, but necessary, for the efficient, responsible operation of public services (Boland, 1985; Kory and Rosenberg, 1982; and Rider, 1982).

It is evident that the future of municipal water and wastewater facility financing will involve decreased dependence on federal monies. In their place, localities will need to rely more on local and state sources of debt financing, which need to be repaid. This means that localities will need to be prepared to assume greater financial responsibility for their water and wastewater operations. Thus, localities will be forced to address questions which previously garnered little attention.

These questions include: what are the short- and long-term capital needs; what is the best way to finance these needs; what rate schedule will reflect operating costs as well as present and future financing costs; what is the effect of different means of financing on user charges and local debt? This

last question is particularly important as localities who choose to finance their system operations through increased borrowing will face the limits of state imposed debt ceilings. A comprehensive method of cost analysis aims to allow localities to address these questions in a systematic, accurate fashion which recognizes the relationships between operation and maintenance, capital needs, financing options, and user charges. It is expected that comprehensive cost analysis will also help assure the long-term financial stability of water and wastewater operations.

An important financing tool in this changing financial environment will be State revolving loan funds. However, the available research on revolving loan funds makes no mention of the use of a comprehensive, uniform cost analysis planning method in their implementation (i.e.- what kind of method is needed? how will it work? what will it address?). However, the evidence presented above suggests that a comprehensive method would be helpful to a locality that might chose to make use of available revolving loan funds as well as other sources of repayment financing.

Research Design

Research Objective

This research will investigate the use of a comprehensive method to organize and analyze water and wastewater cost and user charge information in the changing financial environment faced by Virginia localities. The objective is to analyze the potential for, and the usefulness of, such a comprehensive cost analysis method for municipal water and wastewater operations. The basic hypothesis of this work is that **a comprehensive, uniform cost analysis method can be developed to**

effectively meet the cost analysis needs of municipal water and wastewater systems in the State of Virginia. This research will approach the hypothesis by investigating the need for a comprehensive cost analysis method among Virginia water and wastewater operators; and by evaluating the effectiveness and usefulness of a developed comprehensive method in meeting the financial management needs of these systems.

Methodology

The methodology used to test this hypothesis is divided into the following four stages: **Development and implementation of a survey** of municipal water and wastewater systems in Virginia to gather data and to investigate the need for a comprehensive cost analysis method. **Analysis of the survey** results on the perceptions of need for a comprehensive method by Virginia localities, i.e.- do they believe that they could find a comprehensive cost analysis method for managing their water and wastewater operations useful? In addition to these perceptions, an important aspect of this need is the determination of how these localities are performing cost analysis. Knowledge of this aspect is necessary as one can not recommend a course of action unless present actions are known. **Analysis of a workbook developed as a comprehensive method** for cost analysis by Virginia localities. The workbook will be analyzed in terms of a set of criteria developed from the literature as well as the survey analysis. **Evaluation of this comprehensive method** for effectiveness using field level interviews. These four pieces of information combined should provide an accurate picture of the need for, and effectiveness of, a comprehensive cost analysis method by Virginia municipal water and wastewater operators.

Survey of Water and Wastewater Operations in Virginia

In order to ascertain the financial and cost analysis needs of Virginia municipal water and wastewater systems, and to assure the development of a valid, reliable comprehensive method to address these needs, a mailed survey was developed and distributed to all municipal water wastewater systems in the State. The purpose of the survey was to gather system operation and financial information, to determine local financial record keeping methods and how local utilities currently do cost analysis, as well as to investigate the need for a uniform, comprehensive cost analysis planning method for financial planning. The questionnaires (attached as Appendix A) first ask for background information on the system (system components, size, age, number of people served, etc.) The substantive sections of the questionnaires cover user charges, system efficiency, capital needs of the system, system financing, and staffing and record-keeping. Within each of these sections there are questions about what practices the localities are currently using and how they are using them; the perceived need for a uniform, comprehensive cost analysis method within areas; and the perceived usefulness of worksheets designed for cost analysis for each section.

Analysis of Survey Results

The survey responses provide information on the current operation of municipal water and wastewater systems in Virginia, operators' perceptions of the usefulness of a comprehensive cost analysis method in their system operations, as well as the current cost analysis method being used. For the purpose of analysis, the survey questions are grouped into the following subject areas: capital and finances; user charges; information availability; need for a uniform, comprehensive cost analysis method; and the current methods of cost analysis being practiced. A discussion of the subject areas and relevant questions will appear in the Survey Analysis Chapter. Based on the re-

sponses given to each of these questions, a picture of how these systems operate, as well as the condition of their facilities, are developed (e.g.- do systems have older facilities that have not been improved recently? do their user charges cover their system costs?). This provides an overview of municipal water and wastewater operations in Virginia from which the balance of this research will follow. In order to complete this analysis, frequencies and percentages for the variety of responses to each question are developed.

Analysis of a Comprehensive Cost Analysis Method

The third stage of this methodology involves a description and analysis of a comprehensive cost analysis workbook designed to meet the financial planning needs of Virginia water and wastewater systems. If such a workbook is going to be useful, it needs to address the shortcomings of current cost analysis practices. To examine the potential usefulness the workbook, this analysis will consist of two steps: whether or not such a workbook addresses a set of criteria established for a useful comprehensive method by the previous survey analysis; and whether or not such a workbook addresses a set of criteria established for a useful comprehensive method by the literature in the field. These criteria are discussed in the Chapter on the Analysis of a Comprehensive Cost Analysis Method.

Evaluation of The Comprehensive Method

This part of the analysis involves the testing of the worksheets for effectiveness. Prior to the distribution of the worksheets to the entire system population, they were pre-tested and evaluated in

five communities that represented a variety of system types: the Town of Blacksburg; the Cities of Radford, Waynesboro, and Staunton; and the Montgomery County Public Service Authority. The following criteria were used to select these communities: willingness to participate; involvement in the survey; and representativeness of the different sizes and government forms (e.g.- one from a medium sized system, a small system, a PSA, etc.). In addition to these communities, the workbook is to be evaluated by the Virginia Department of Housing and Community Development's Office of Local Development Programs, and a consulting firm that assists local governments with services such as cost analysis of their utilities. This will permit the evaluation of the workbook from the perspective of both public and private sector organizations which might make use of this workbook in the services that they provide to communities. For this evaluation, I developed a **Goals Attainment Scale.**

Goal attainment scaling allows an observer to determine if the goals of a program are being attained, and to what extent they were or were not attained. Goal attainment scaling places the expected outcome of a goal in the middle of a range of possible outcomes- "most unfavorable" and "less than expected" on one end, the "expected outcome" in the middle, and "more than expected" and "best anticipated" on the other end (Kiresuk and Lund). Each of these outcomes has a numerical score attached to it so that the overall outcome of the goals may be summed and compared.

Outline of Thesis

This thesis will be organized into five chapters. The first chapter is the introduction. It contains an overview of the thesis, a description of the financial environment that municipal water and wastewater systems operate in, and the research design. The second chapter analyzes the cost analysis needs of Virginia water and wastewater operations. This was accomplished through the

development of a survey of these operations and an analysis of their responses. The third chapter presents a description of a uniform, comprehensive cost analysis method for municipal water and wastewater utilities. This method is then evaluated against a set of criteria developed from the survey analysis and from the literature in the field of cost analysis. In the fourth chapter, this comprehensive method is evaluated for usefulness and effectiveness by water and wastewater operators in five communities representing different system and community types. The last chapter presents a discussion and conclusion of these findings.

COST ANALYSIS NEEDS OF VIRGINIA WATER AND WASTEWATER OPERATIONS

Background

An understanding of the various needs of municipal water and wastewater systems must be determined before a comprehensive cost analysis method can be developed. These include the need for capital improvements and the capacity to pay for them, as well as the need for methods to analyze costs and revenues. In this chapter, these needs will be examined through the analysis of a survey of all municipal water and wastewater operations in Virginia. The responses to this survey address areas such as capital and financial information, user charges, perceived usefulness of a comprehensive cost analysis method, and current methods of cost analysis that are being used. It is these responses that will help to identify the financial environment in which municipal water and wastewater systems in Virginia find themselves. This environment will help to frame the development of a comprehensive cost analysis method, and be the determinant of its eventual success or failure in the field.

Survey Development

The survey of municipal water and wastewater operations in Virginia was accomplished through the use of separate questionnaires for water and wastewater systems (see Appendix A). These questionnaires were mailed to all public water and wastewater systems in the state. The information that was used to develop these questionnaires came through consultation with various government and non-government agencies: Virginia Health Department, State Water Control Board and their regional offices, Virginia Department of Housing and Community Development, State Auditor of

Public Accounts, the Virginia Municipal League, the Virginia Association of Counties, Virginia Water Project, the Virginia Water Resources Research Center; and the Government Finance Research Center. Each of these groups provided initial interviews and/or review and comment. Other information was developed from the literature on cost analysis techniques, accounting, and utility management.

Both questionnaires were mailed to certain communities for the purpose of pre-testing to determine weaknesses or errors within the questionnaires. The pre-testing of the questionnaires involved a range of different municipal or community types: the towns of Blacksburg, Pearisburg, and Christiansburg; the cities of Radford and Virginia Beach; the Montgomery County Public Service Authority; and the Loudon County Sanitation Authority. The responses to these pre-tests were supplemented through personal interviews with those who completed the questionnaires. After revision and clarification, the survey was conducted in the summer of 1986. The questionnaires were distributed to 245 water systems and 258 wastewater systems in Virginia. The distribution covered a broad range of system types: public service authorities, county systems, sanitary districts, cities and towns. A follow-up mailing to non-respondents was used to improve the response rate. Of those distributed, 117 water questionnaires were returned (48 percent response rate), and 109 wastewater questionnaires were returned (42 percent response rate).

Survey Results and Analysis

The following is an analysis of the responses to both the water and wastewater questionnaires. These responses were divided into the following subject areas: user charges, capital and finances,

information availability, usefulness of a comprehensive cost analysis method, current method of cost analysis used, and size of facility. The number of cases (average number of cases where responses varied by question) to questions within each of the subject areas appears in the tables displaying respondent results. The actual questions used to determine the results displayed in this chapter appear in the appendix.

Capital and Finances

A comprehensive cost analysis method requires localities to link their capital costs to revenues or user charges. It is argued that local governments have not given capital financing/budgeting the serious attention it deserves (Chapmen, 1983). Therefore, it is important to determine how localities are currently handling their capital costs and finances. One way to determine this is by knowing how utilities have financed their operations in the past and how they expect to finance these operations in the future. This will not only reveal funding patterns but will also demonstrate perceptions of the future. The results of this analysis appear in Table 4.

Table 4. Financing Sources by System Type as a Percentage of Responses

	Wastewater		Water	
	Past Sources	*Future Sources*	*Past Sources*	*Future Sources*
EPA*	48	21	--	--
HUD CDBG	26	22	17	27
Other HUD	4	3	4	7
FmHA loan	28	--	31	29
FmHA grant	12	24	13	16
VRA loan	--	21	--	25
Rev Bonds	25	34	18	34
GO Bonds	23	22	18	21
CI Fund	23	37	22	32
Rsrv Fund	8	15	6	15
Gen Fund	15	16	14	11
Other	24	20	24	15
CASES	105	94	107	108

* grants for past sources, grants/loans for future sources.

In terms of wastewater systems, the prime source of funding in the past ware EPA grants; other sources included Community Development Block Grants, FmHA loans, revenue bonds, G.O. bonds, and capital improvement funds. This funding pattern is expected to shift from reliance on EPA grants to greater use of capital improvement funds and revenue bonds. This response may indicate that wastewater operators understand the changing financial environment that they will face in the future, as EPA grants are converted to revolving loan funds which require repayment. The EPA funding source is the only source that shows a large decrease in expected use, while FmHA grants, Revenue Bonds, Capital Improvement funds, and reserve funds are expected to see more usage in the future. For water systems, less reliance is expected to be placed in the future on "other" forms of financing, which may be innovative or non-traditional sources, while more reliance is expected to be placed on CDBG grants, Revenue Bonds, Capital Improvement funds, and reserve funds.

Overall, it is evident from these responses that both water and wastewater systems anticipate greater usage of of certain types of grant financing (FmHA, CDBG), which may prove troublesome for these systems as grant financing becomes less available over time. Greater usage is also anticipated for Revenue Bonds, and 'internal' funding sources (Capital Improvement and reserve funds). This may signal a recognition on the part of localities that any sizable or continued increase in funding will need to come from the community or the revenue generating capacity of the facility itself.

Information on the age of systems wastewater/raw water treatment facility and the last improvement on that system provides an indication of the maturity and remaining useful life of these capital facilities. The responses to these questions show the age of current facilities and their last improvement/expansion in terms of the number of years from 1986. For raw water treatment facilities, the median value for the age of the facility is 21.5 years, while the median value for the last expansion/improvement is 6 years. For wastewater treatment facilities, the median value for the age of the facility is 19 years, while the median value for the last expansion/improvement is 3 years.

Although the median age for these facilities is rather mature for capital facilities, the median expansion/improvement indicates a cycle of expansions and improvements that may keep these facilities viable into the future.

A localities ability or desire to perform capital needs assessments can be gauged through knowledge of when a system last determined its capital needs. The responses to this question appear as the number of years from 1986 since the last assessment was completed.

For water systems, the median value was 0 years (which means assessments were carried out in 1986) with a maximum response of 14 years. For wastewater systems, the median response was again 0 years, with a maximum response of 12 years.

These answers indicate that capital assessments are carried out on a regular basis, and that capital needs information is probably up-to-date for most municipal water and wastewater facilities.

User Charges

User charges are an important component of system operations and financing. They not only serve as important revenue sources, but they also can be used to regulate customer demand. However, developing an appropriate set of user charges may be difficult: "if charges are to high, the customer will reduce consumption to below the level at which resources are economically available. But if prices are too low, consumption will be stimulated to the point where water (and wastewater service) can not be supplied in an economically efficient way..." (Woods, 1984). However, over-pricing of water and wastewater services is not very common: "under-pricing of water services is blamed as the cause of deferred... system maintenance and capital improvement" (Shell and Damachi, 1984). In addition to these pricing problems, communities operating water and wastewater services will need to rely on the revenues generated from an accurate rate structure (one in which prices are neither too low nor too high) as federal grant monies end and are instead replaced by revolving loan funds and other forms of loans. User charges will by necessity become one of the primary methods for repayment of these loans. The literature on user charges asserts that charges will have to rise, both to reflect the full range of system costs (recovering capital and operating costs) to meet increasingly stringent standards, as well as to meet the financing trends of the future. It is further argued that localities must understand their water and wastewater rate structures, and communicate the rationale for these rates to the public (Gilbert, 1985; Hanson, 1985; Hickman, 1984; Mercer, 1985; Popkin, 1986; and WPCF, 1984).

The extent to which user charges cover system costs is an important consideration in examining the financial independence of a utility operation. For water systems, the median percentage coverage was 100%, with a mean of 95%. For wastewater systems, the median percentage coverage was also 100%, with a mean of 118% (revenues exceed costs by 18%). These percentages indicate that for the most part, user charges fully cover the costs of operations for water and especially wastewater operations. These numbers may demonstrate localities willingness to cover system costs with user charges into the future.

The date on which a utilities current rate structure took effect, as well as the date of the most previous rate structure, may demonstrate the practices of localities in updating their user charge or rate structures to reflect changing financial and capital conditions. The responses to these questions appear as number of months since August, 1986. Table 5 displays median number of months since the latest, and previous, rate changes.

Table 5. Median Response of Number of Months Since Current and Prior Rate Change

	Wastewater	*Water*
Current	14.0	12.0
CASES	101	105
Previous	58.0	38.5
CASES	86	86

These responses indicate that the current rate structures used by localities reflect conditions of one year (12 months) ago. The value for the previous (or prior to current) rate changes, however, vary by a relatively large amount between water and wastewater systems. While the previous rate changes for water systems tend to be three years old (from 1986), wastewater systems previous rate changes tended to be five years old (from 1986). This may indicate that reliance on accurate rate structures is more important for water systems then it is for wastewater systems. This may be a function of

past funding sources. While wastewater systems utilized federal grants to a large extent to finance their operations (which does not require repayment), water systems depended more upon sources involving some sort of debt financing which requires repayment and the use of accurate revenue data (user charges).

The type of rate structure that a community uses may indicate a number of things, including system sophistication (staffing levels, quality and quantity of data), make-up of customer base, and type of service provided. Table 6 displays the percentage of systems using a given rate structure.

Table 6. Frequency of Rate Structures by System Type

	Wastewater	*Water*
Minimum charge, extra vol. rate	38%	73%
Service charge & vol rate	12	18
Volume rate only	7	6
Flat rate	11	3
Percent of water charge	32	--
CASES	100	114

These results demonstrate a strong reliance on the minimum charge and an extra volume rate structure. Wastewater systems also rely on a percent of water used charge to calculate rates. Since the "minimum charge, extra volume rate" is the most complex structure listed, the use of it by water systems may indicate a relatively high level of system sophistication. For wastewater systems, however, a good deal emphasis is placed on the percent of water used charge, a much simpler rate structure. Information such as this will have to be taken into consideration in the development of any cost analysis method for these operations.

Information Availability

There are a variety of types of information that are necessary, or at least desirable, to effectively operate a water and wastewater utility operation. These range from system data, such as customer counts and useful life of system components, to cost and revenue data, such as operation and maintenance expenditures and cost of system components. The degree to which a community possesses these types of information may be an indicator of their ability to perform system financial analysis: the more information a community has, and the more detailed that information is, the more detailed and accurate and analysis of system operation is likely to be. In order to ascertain the availability of system and cost and revenue data by Virginia water and wastewater systems, a number of questions were posed to water and wastewater utilities which asked them if they possessed certain kinds of information. The results to these questions appear in Table 7 as the percentage of communities having available each source of information.

Table 7. Percent of Communities Possessing Various Types of Information

	Wastewater	*Water*
Year of construction	93%	83%
Useful Life of components	35	33
Customer Counts	86	91
Sewage/water flows	46	74
Maximum daily flows	--	49
Maximum hourly flows	--	22
Number of meters	--	90
Est of infiltration/inflow	68	--
Initial cost of components	82	76
Replacement costs	53	50
Value of fixed assets	70	86
Total O&M	100	94
O&M for treatment	--	58
O&M for collection	68	--
O&M for treatment plant	66	--
O&M for pumping	--	63
O&M for transmission	--	67
Debt service	91	86
Payroll accounts	94	95
Interfund transfers	76	80
AVERAGE # OF CASES	107	105

The responses in Table 7 indicate that water and wastewater systems generally possess a high degree of information availability. The exceptions to this are useful life of system components, maximum daily and hourly flows for water systems, and replacement costs for system components. These latter findings might be expected as these are complex measures to develop and monitor, and are more common among sophisticated water and wastewater operations. In terms of information availability by system type, there is little difference between water and wastewater systems. The exception to this are sewage/water flows. Wastewater systems do not possess flow information as frequently as do water systems.

A Uniform, Comprehensive Cost Analysis Method

It is important to know if localities believe a comprehensive method of cost analysis would be useful. This cost analysis would cover the setting of user charges, determining system efficiency, estimating capital needs, assessing financial capability, and evaluating financial options. Table 8 summarizes the degree to which water and wastewater systems would find useful a comprehensive cost analysis method for each of these utility functions.

Table 8. Perceived Usefulness of Cost Analysis Worksheets by Cost Area

	Wastewater			*Water*		
	Useful	**Not Useful**	**DK**	**Useful**	**Not Useful**	**DK**
User Charges	65%	21%	14%	68%	21%	11%
Efficiency	70	14	16	73	16	11
Capital Needs	77	12	11	82	9	9
Finan Capability	77	12	9	83	9	8
Finan Options	75	17	8	82	9	9
AVER CASES	112			114		

These results indicate a strong perceived usefulness for cost analysis worksheets that address the above stated cost areas. In fact, the response 'useful' exceeded the response 'not useful' for each question by *at least* a factor of 3. It can be concluded from this analysis that the time is right for the introduction of a comprehensive cost analysis method that addresses these areas of concern.

Current Method of Cost Analysis Used

In order to determine how localities are approaching cost analysis in their present day-to-day operations, it would be helpful to know how utility user charges are determined, what information goes into these determinations, whether efficency measures are used, what information is used to determine capital needs, the way in which financing decisions are made for a utility operation, the type of accounting used, and staffing levels employed.

Table 9 displays the various ways in which localities determine their user charges. Responses appear as percentages of systems using each method of user charge determination.

Table 9. Methods of Determining User Charges

	Wastewater	*Water*
Hired Consultant	35%	29%
Formal In-house	32	68
Informal In-house	39	40
Inflation Adjustment	7	7
Other	9	8
CASES	107	113

For water systems, a majority of user charge determinations are made in-house, with the bulk going to formal in-house studies. For wastewater systems, however, user charge determinations are almost evenly divided between informal and formal in-house studies and hired consultants. This indicates a broad reliance on various forms of user charge determination sources for wastewater system, while water systems tend toward internal types of determinations. Based on these responses, it appears that inflation adjustment and "other" forms of user charge determinations do not play a large role in user charge determination by Virginia utilities.

Table 10 displays the types of information used to determine user charges by both water and wastewater systems. Responses appear as percentage of systems using each source of information.

Table 10. Information Used to Determine User Charges

	Wastewater	*Water*
Cost Anal.-APWA/AWWA method	9%	11%
Cost Anal.-other method	56	52
Rates of nearby locality	18	17
Customer Survey	2	3
Governing body mandate	26	30
Other	14	14
CASES	106	111

These responses indicate that by a wide margin over other responses, user charges are determined by cost analysis methods using a method other than that promoted by the AWWA or the APWA.[1] Although these results do not spell out what 'other' cost analysis methods are being used, cost analysis is being used and is the favored method of user charge determination. The second most frequently used source of information comes as a governing body mandate. Little use is made of customer surveys.

The use of efficiency measures helps system operators to gauge system performance. Efficiency measures take a number of forms, such as cost per unit flow, cost per customer, percent of costs covered by charges, accounting ratios, and annual charges in expenditures/revenues. The use of these measures by individual systems may indicate the sophistication of system cost analysis methods.

For water systems, only 23 systems of the 117 total responses (19%) indicated that they make use of efficiency measures in their daily operations. For wastewater systems, only 12 systems of the total

[1] **Water Rates**, American Water Works Association, and **Financing and Charges for Wastewater Systems**, American Public Works Association.

109 responses (11%) indicated that they make use of efficiency measures. These numbers demonstrate either a lack of willingness or ability by both water and wastewater systems to use efficiency measures.

There are a number of sources from which communities may derive information on how to calculate capital needs. Table 11 displays these various sources for both water and wastewater systems. The responses appear as the percentage of localities using a given set of information.

Table 11. Sources of Capital Needs Determinations

	Wastewater	*Water*
Develop Needs List	3%	3%
In-house studies	20	18
Consultant studies	53	53
Other communities	1	1
The State	4	1
Rough Estimate	41	46
Other	1	1
CASES	76	97

*- totals exceed 100% due to multiple choices.

The three major sources of information are consultant studies, rough estimates, and in-house studies, respectively. The rest of the sources play a limited role. These results indicate a split between more formal types of information (in-house and consultant studies) and less formal types of information (rough estimates). Obviously, communities make use of few sources in the calculation of their capital needs.

Much like the previous question, there are various ways in which localities may determine system financing. Table 12 lists the various sources of system financing decisions used by water and wastewater systems. These responses appear as the percent of communities making use of a certain form of decision making.

Table 12. Sources of System Financing Decisions*

	Wastewater	*Water*
In-house analyses	22%	22%
Consultant analyses	34	30
Governing body decision	66	65
Other	7	7
CASES	98	107

*- totals exceed 100% due to multiple choices.

There is obviously a strong reliance placed on local governing body discretion in determining financing sources. Although other sources are used to some degree, financing decisions are retained by those who make other financial decisions affecting the locality. This finding underscores the importance of local governing bodies in judging the types of financial options to be used in a locality.

Financial accounting is an important aspect of overall system operation, as it helps to maintain the fiscal integrity of a systems operation. Table 13 displays the different sources of accounting that localities use to perform their water and wastewater financial accounting.

Table 13. Types of Financial Accounting Used*

	Wastewater	*Water*
Utility accountant	24%	20%
Local govt accountant	51	53
Outside accountant	21	23
Combination	11	12
Other	7	6
CASES	102	113

*- totals exceed 100% due to multiple choices.

Although utility accountants and outside accountants are used, again there is the tendency for utility services to be centralized in the local government. It is interesting, however, to note that most sys-

tems appear to neither have the willingness nor the ability to perform their own accounting services, but must rely upon the local government for these services. This creates a picture of water and wastewater systems that must rely on the local governing bodies of the communities in which they operate for financial services and decisions, as opposed to being independently operated. This finding also may illustrate how a cost, financial accounting, may be shifted to other fund sources.

Each of the previous questions involved some aspect or function of water and wastewater system operation. In order for such systems to continue to operate, they must rely on their staff to carry out their essential functions. The staffing levels, while indicative of the size of the system, may also show an operations commitment to cost analysis. As the number of qualified staff increases, there also may be an increase in sophistication and use of appropriate cost analysis methods. Table 14 lists the results of this question for four service or function areas: rate studies; efficiency evaluations; capital needs assessments; and financial analyses. The results appear as the median number of staff days per year devoted to each service or function.

Table 14. Staffing Levels by Selected Utility Functions (in staff days)

	Wastewater	*Water*
Rate studies	5.0	5.0
Efficiency evaluations	3.3	4.5
Cap needs Assessments	0.0	5.0
Financial analysis	10.0	10.0
AVERAGE # OF CASES	68	65

These results are consistent for both water and wastewater operations with the exception of capital needs assessments for wastewater systems. The value of zero for this function shows that very little staff time is devoted to its completion. Staff time for financial analyses is at least twice as important as (in terms of staff days per year) the other listed functions. However, even the responses for financial analyses are not particularly impressive considering that there are 260 weekdays during the

year. These responses indicate that these functions are not significant aspects of many water and wastewater operations.

Size of Facility

Finally, there is an indication that size of an operation may affect several of the questions given above. It has been argued that smaller-sized systems "receive very little attention, and... management concerns concerns such as record keeping, planning, and maintenance receive short shrift" (Stelstad and Bennett, 1985). In terms of problematic financing and system operation, smaller community systems are expected to suffer the most in the next decade (Hickman, 1984). If this is the case, the capital and financial needs of different size systems will need to be addressed differently, and perhaps analyzed differently, in a comprehensive method. If there is an association between size and each of these previous questions, that association and its strength can be revealed through crosstabulations of size against each of these subject areas. Size is determined from the survey responses, and is defined as the actual flow that passes through the system. It will be divided as follows:

- Losize = (< .2 mgd)
- Medsize1 = (.3 mgd to 1.5 mgd)
- Medsize2 = (1.6 mgd to 10.0 mgd)
- Hisize = (> 10.1 mgd)

Crosstabulation provides a way to determine whether two variables are related (associated) as hypothesized, or, in other words, whether a bivariate relationship exists (Bohrnstedt, Knoke, 1982).

The Chi Square is a test for evaluating the level of statistical significance attained by a bivariate relationship in a crosstabulation (Meier, Brudney, 1981). For this analysis, the Chi Square statistic is used to measure statistical significance. The level of acceptable statistical significance is set at the .05 level (or 5 percent error), which means that there exists a 5 percent chance that results obtained were the product of error. The .05 level of significance is the accepted level for social science research. To measure the strength of the relationship, the Somer's D statistic is used. This is an asymmetric (predicts to the dependent variable based on the independent variable) measure of association for two ordered discrete (ordinal) variables. The values for this statistic range between -1.0 and + 1.0. For those crosstabulations that involve a nominal (unordered discrete) and an ordinal variable, the Lambda statistic is used to measure the strength of the association. The values for this statistic range between 0 and + 1.0. For this analysis, size is considered the independent variable, while each of the previously listed subject areas are considered dependent variables.

For the ordinal dependent variables, the responses are divided into "high" and "low" responses to make the analysis of association statistically useful. To do this, each dependent ordinal variable is divided at the median or middle value, with all responses below that value determined to be "low", and all responses above the median value determined to be "high". For those dependent ordinal variables whose responses are in degrees of usefulness (very useful, somewhat useful, not very useful, not at all useful), the responses were collapsed into "useful" (very useful and somewhat useful) and "not useful" (not very useful and not at all useful). Again, this is done to make the analysis statistically useful. The level of acceptable statistical significance chosen is .05, the standard social science significance level.

Table 15 displays the results of this analysis for water systems, while Table 16 displays the results for wastewater systems. The dependent variables which are presented for both tables *are only those variables (from the entire list of previous questions) that show a statistically significant association.* Strength of association is termed as follows for the Lambda and Somer's D statistic: 0.0 = none;

.01 to .2= weak; .21 to .40= moderate; .41 to 1.0= strong. Direction of the association (positive or negative) is stated for those variables using the Somer's D statistic.

Table 15. Significant Crosstabulation Results of Size of Facility Against the Dependent Variables for Water Systems

Variable	*Significance*	*Strength*	*Direction*
Capital and Finances			
Expect to use FmHA funds	.003	none	
Expect to use VRA loans	.020	none	
Have used FmHA loans	.050	none	
Have used Rev Bonds	.020	none	
User Charges			
Rate structure used*	.006	none	
Cost Analysis Method Used-			
AWWA	.030	none	
Utility accountant used	.007	none	

*- see text for further explanation

It is evident from this table that size plays a factor in effecting only a few of the dependent variables for water facilities. Of those variables listed in Table 15, none show any degree of statistical strength. Although the category type of rate structure used shows statistical significance, it should noted that in the actual crosstabulation table of this variable with size, the number of cells with frequencies of less than five is 56%. This exceeds the acceptable level of 25%, thus making the conclusion of statistical significance for this association less certain.

Table 16. Significant Crosstabulation Results of Size of Facility Against Dependent Variables for Wastewater Systems

Variable	*Significance*	*Strength*	*Direction*
Capital and Finances			
Have used FmHA grants	.030	none	
Have used FmHA loans	.000	weak	
Have used Revenue Bonds	.000	weak	
Have used GO Bonds	.005	none	
Expect to use CDBG grants	.001	none	
Expect to use HUD funds	.030	none	
Expect to use FmHA funds	.007	none	
Expect to use Revenue Bonds	.002	moderate	
Yr of last facility expansion	.007	weak	positive
User Charges			
Rate structure used*	.015	weak	
Cost Analysis Method Used-			
Consultant for user charges	.040	weak	
Utility accountant used	.000	weak	
Local govt accountant used	.000	moderate	
Outside accountant used	.008	none	

*- see text for further explanation

This table shows that size plays a larger role in affecting the dependent variables for wastewater facilities than it does for water facilities. For capital and finances, the use of Revenue Bonds for system financing in the past, the expected use of Revenue Bonds, the past use of FmHA loans, and the year of facility expansion/improvement show associations of statistical significance and strength. The same is true for type of rate used in user charges. The cost analysis method being used, the use of a consultant and the various accounting types also show significant associations of strength. The actual crosstabulation tables of the variable size against the dependent variables appear in Appendix B. The associations displayed in Tables 15 and 16 that demonstrate some degree of strength show the following results:

- *Expect to use Revenue Bonds*- the larger the facility, the more likely it is to expect to use Revenue Bonds to finance facility operations in the past.
- *Have used FmHA loans*- a facility is twice as likely to have used FmHA loans to fund system operations in the past if it is a "losize" facility than any other size facility.
- *Have used Revenue Bonds*- a facility is more likely to have used Revenue Bonds to fund system operations if it belongs to the two larger size facility categories than the two smaller size categories.
- *Year facility expanded/improved*- facilities whose last year of expansion/improvement fell below the median are more likely to be a "losize" facility than any other size, and twice as likely to belong to the two lower sized categories than the two larger size categories.
- *Consultant used for user charge determination*- the larger the size of the facility, the more likely it is to have used a consultant to help determine user charges.
- *Used utility accountant*- the larger the facility, the more likely it is to use a utility accountant.
- *Used local government accountant*- if a facility uses a local government accountant, it is more likely to belong to the two medium size categories than the larger or smaller size category.

As with the water analysis, the category "type of rate structure used" fails to meet the standard of less than 25% of the cells can have frequencies of less than five. Thus, the conclusions about the significance and strength of the association between this variable and size become less certain. The results obtained from the analysis on accounting are not very surprising as it would be expected that that the larger the facility, the more likely it is to have and make use of a utility accountant, while smaller size facilities are more likely to use accountants from their local government. It is rather unexpected that larger size facilities are more likely to use a consultant to determine user charges than smaller size facilities. One might actually believe that smaller size facilities are more likely to use consultants because of their limited staff, information, and knowledge of user charge determination procedures.

What is interesting are the results obtained from the capital and finances section. The larger the facility, the more likely it is to have used Revenue Bonds in the past, and the more likely it is to expect to use Revenue Bonds in the future. This indicates that smaller sized facilities, in comparison to larger systems, have not made as much use of Revenue Bonds, and do not expect to increase use into the future. This may be due to one of two reasons. The first is that Revenue Bonds tend to be more risky than other forms of financing because they rely on the revenue generating capacity of the facility, and smaller systems may not be willing or able to assume such risks. The second is that smaller size systems may not have enough revenue generating capacity (because they serve fewer customers) to back up the issuance of Revenue Bonds. In addition to this, smaller size systems are more likely to use FmHA loans in the past than their larger counterparts. This size difference, however, disappears in terms of the expectation of using FmHA loans in the future. This may either indicate less reliance on the part of smaller systems to use FmHA loans over past usage, or an increase in use of these loans on the part of larger systems. A last point of interest is the last year in which a facility was expanded/improved. Smaller size facilities are more likely to have expanded/improved more recently than larger size facilities. At first glance, this could be explained by saying that smaller size facilities are older and in need of expansion or improvement. However, the previous analysis does not show a significant association between size and the age of a facility. Instead, this may indicate that smaller size systems expansions and improvements are not very large or significant because of their small size, and thus they can afford more frequent improvements or expansions.

Summary

In summary, this analysis has demonstrated that municipal water and wastewater facilities in Virginia have fared rather well in maintaining and operating their systems. The trends developed from this analysis indicate that facilities possess a good improvement/expansion cycle for their systems, carry out capital assessments on a regular basis, employ user charges that are intended to cover system costs, have rate changes that reflect recent information, and have a strong commitment to financial analysis as demonstrated by staffing levels for different utility functions. However, this analysis has yielded some conflicting information on financing and capital needs determinations. While it appears that facilities intend to rely more on "internally" generated sources of funding, such as revenue bonds, Capital Improvement funds, and reserve funds, there is also the expectation that certain types of grant financing (CDBG, FmHA grants) will be used to a greater extent in the future. The move to bonds and set-aside funds indicates that communities are anticipating assuming more responsibility for their water and wastewater system financing, but the increased expected use of certain grant financing may be shortsighted given current funding trends.

In terms of capital needs determinations, a majority of system types (both water and wastewater) use hired consultants to perform this task. However, the second most frequent source of capital needs determination was a 'very rough estimate'. This represents a rather interesting dichotomy, and seems to indicate that the sophistication of system financing analysis varies widely by system.

This analysis has also revealed that water and wastewater systems are not very similar based on their responses given to the questions posed in this chapter. Water systems differ from their wastewater counterparts in financial expectations, time since previous rate change, type of rate structure used, percent coverage of system costs by user charges, number of staff to perform capital needs assessments, and use of efficiency measures. In all of these areas, with the exception of coverage of costs

by user charges (in which the difference was very small), water systems had the most previous rate changes, more sophisticated rate structure, used more formal determinations of user charges, employed more capital needs assessment staff, and had more systems that made use of efficiency measures. These findings may be the result of the history of wastewater systems. In the past, wastewater facilities received EPA Construction Grants to finance and maintain various portions of their facilities. Because this money did not have to be repaid, there may not have been the necessity for strict adherence to formal costing and financing guidelines. Meanwhile, water systems have not had access to such funding or similar funding levels, and thus may have been forced to have been more formal in their costing techniques and more financially responsible to maintain their operations. Another reasoning for this difference may have resulted from the degree of federal and state regulations surrounding wastewater operation. Wastewater operations have had to follow strict guidelines designed for the protection of public health, largely found in the Clean Water Act and its various amendments. Complying with the guidelines established by this law may have required that time and resources, which might otherwise have been devoted to financing and capital needs determination tasks, were directed toward meeting the pollution abatement deadlines of the Clean Water Act. Water systems have not encountered the same degree of attention and regulation under the Safe Drinking Water Act. In addition, water systems tend to possess better quality and greater quantity of customer use information due to metering of water service. Wastewater systems, however, are generally not metered. As a result of this lack of metering, system information for wastewater operations is not as accurate or complete as that of water operations, and may contribute to less rigorous financial analysis. These findings on the differences between water and wastewater systems suggest that any useful and effective comprehensive cost analysis method will need to account for these differences by separating costing procedures by system type. Providing such a separation should improve costing accuracy and usefulness.

The last portion of this analysis, testing the association of each of the previous responses by size of facility, yields some unexpected results. The breakdown of these responses by size suggests that

the size of a given facility is not an important factor in how it performs its various functions, although this is more true for water systems than for wastewater systems. For wastewater systems, size was important factor in financing and accounting. What is most interesting about size, however, are the variables it is not associated with. The way in which a utility determines capital needs and user charges, how often it updates its user charges, and its staffing levels by certain utility functions, do not vary by size of system. It is difficult to determine the reasoning behind this finding, except that it seems to indicate that municipal water and wastewater operations in Virginia are similar, both in their performance and in their decision making, regardless of their size.

Overall, the financial and capital environment in which municipal water and wastewater systems in Virginia operate appears to be from alarming, but there are some needs to be addressed, particularly the use of a comprehensive cost analysis method.

A COMPREHENSIVE, UNIFORM METHOD OF COST ANALYSIS

Introduction

This chapter focuses on the work of Paul Shinn of the Government Finance Officers Association in the development of a comprehensive, uniform cost analysis method for municipal water and wastewater systems in Virginia. This method is intended to aid municipal water and wastewater utilities in improving their financial performance, and is designed to be utilized with existing utility records and the managers understanding of the operations of the system. It is presented in the form of a workbook which is organized into five modules that break down the cost analysis process into its component parts. Each module consists of a series of detailed worksheets that "walk" the user through a given set of steps and summary worksheets that present the results of these steps. The information from one module is often used as input for a latter module. Each of the modules includes subordinate worksheets, summary worksheets, instructions, suggestions for data collection, and sources for further information (Shinn, 1987). The modules are organized as follows:

- Module 1: Estimating Capital Needs
- Module 2: Financing Capital Needs
- Module 3: Determining Annual Cost of Service
- Module 4: Setting User Charges
- Module 5: Measuring Performance

Figure 2 provides a flow diagram of the components of this workbook. Most of the worksheets within these modules are to be filled out separately for water and wastewater systems. Some of the worksheets cover a period of one year, while others cover multiple years. The worksheets are to be completed in reverse alphabetical order based on detail (E, D, C, B, and A) within each module, as they build on the inputs from each other. Line and block numbers are provided in each worksheet for reference and transferring purposes.

WATER AND SEWER COSTING WORKBOOK
Overview of Data Flow

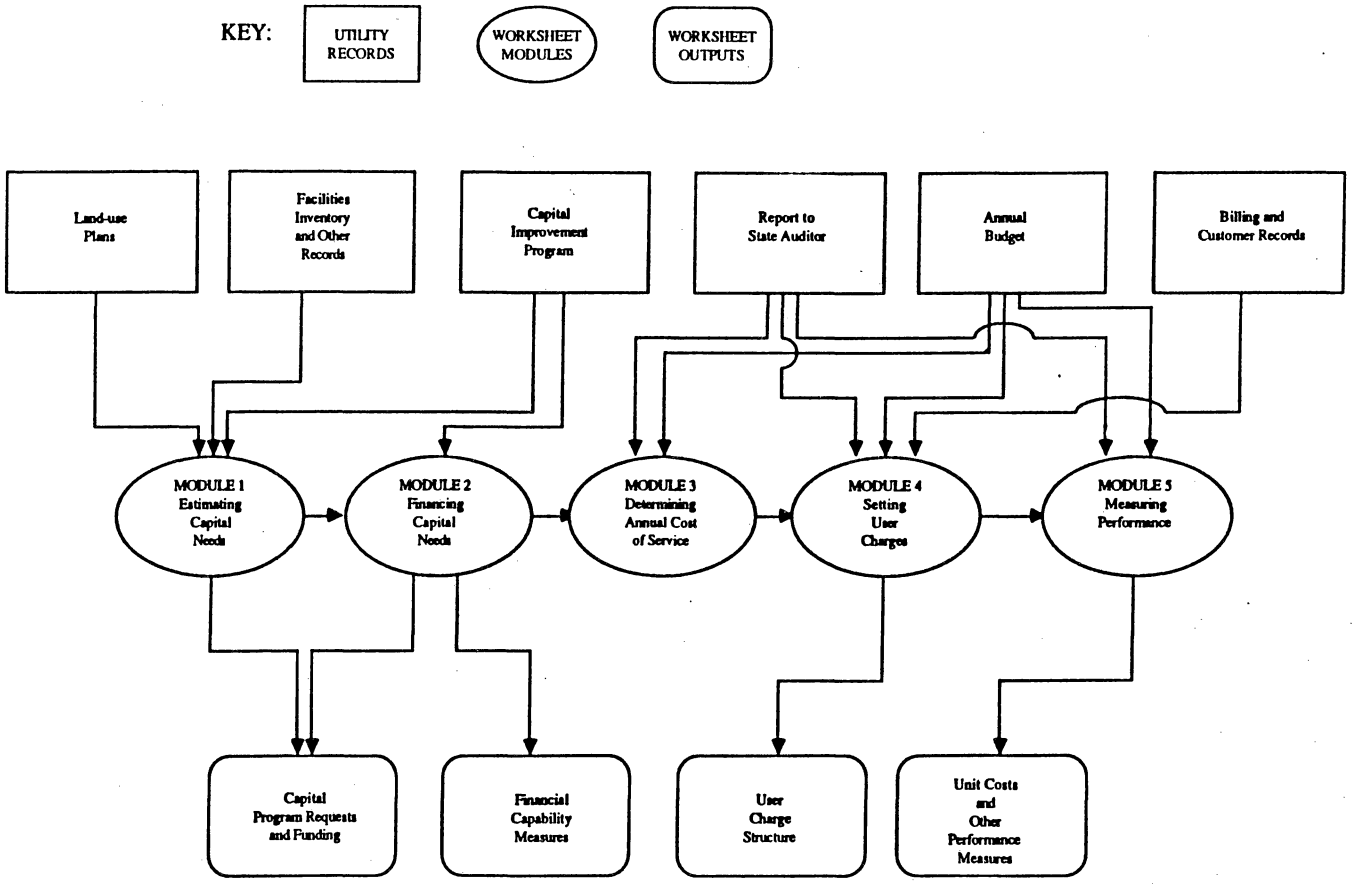


Figure 2. Flow Diagram of Workbook Modules

This chapter is divided into two parts. The first part involves a description of the purpose and content of each of the workbook modules. The second part compares the workbook against two sets of criteria for an effective, useful comprehensive cost analysis method. The first set was developed from the survey analysis chapter which indicate how well the workbook meets the perceived needs of Virginia municipal water and wastewater operators. The second set is developed from the literature on cost analysis. These analyses will be followed by a summary of the results of this chapter. Table 17 presents a summary of the workbook modules and their component worksheets.

Table 17. Summary of Workbook by Modules and Worksheets

Module	*Worksheet*
Module 1: Estmating Capital Needs:	
	1b- Inventory of Projects
	1a- Project Cost Schedule
	1- Summary of Costs of New Projects
Module 2: Financing Capital Needs:	
	2g- Project Financing Analysis
	2f- Project Financing Detail
	2e- Summary of Project Financing
	2d- Capital Fees
	2c- Calculation of Assessments
	2b- Contribution to Reserve Fund
	2a- Calculation of Debt Issue
	2- Impact of Capital Program
Module 3: Determinig Annual Cost of Service:	
	3h- Estimate of Water and Sewer Costs
	3g- Department Overhead Costs
	3f- Allocation of Gov't-Wide Indirect Costs
	3e- Estimate of Depreciation Costs
	3d- Determination & Allocation of Capital Costs
	3c- Determination of Direct Benefits and Costs
	3b- Allocation of Salary Costs
	3a- Allocation of Direct O&M Costs
	3- Summary of Cost of Service
Module 4: Setting User Charges:	
	4e- Determination of Net Revenue Requirements
	4d- Units of Service and Block Rates
	4c- Small Utility Water Rate Structure
	4b- Water Costs by Rate Components
	4a- Water Rate Structure
	4- Test of Rates and Revenues
Module 5: Measuring Performance	

The Workbook

Module 1: Estimating Capital Needs

This module is intended to help localities identify necessary and desirable capital projects. The inputs for this module are knowledge of system operations, the ability to identify necessary projects, their timing, and their cost. This information may be developed from past needs assessments or engineering reports, experiences of other utilities, a Capital Improvements Program, or input from staff and customers. Module 1 is divided into the following worksheet components:

Worksheet 1b- Inventory of Projects

This worksheet breaks down a system into its typical components of service (collection, treatment, administration, etc.). For each project or group of projects, information on total costs (in todays dollars), the percentage breakdown of project costs over the five year planning horizon (with start and finish dates), and annual net operating and maintenance costs which result from the project(s) entered into each line of the worksheet.

Worksheet 1a- Project Cost Schedule

This worksheet converts the cost data developed in worksheet 1b into an estimate of project costs by year after considering the effects of inflation. This conversion is done for each project listed in worksheet 1b.

Worksheet 1- Summary of Costs of New Projects

This worksheet summarizes the results from worksheet 1a. Cost totals are determined from system components instead of by project. Part I of this worksheet summarizes total annual construction costs, while Part II summarizes annual total operating costs.

The output of these worksheets is a five year plan for the capital spending of the system.

Module 2: Financing Capital Needs

This module helps to identify the best combination of financing sources for each project. The inputs for this module are the outputs developed in Module 1, and the user's understanding of potential financing sources to determine the annual cost of the capital program. This module includes a worksheet to evaluate differing financial alternatives for a given project(s) and includes a set of tables listing the impacts of each financial source. This module is broken down as follows:

Worksheet 2g- Project Financing Analysis

This is an optional worksheet to help determine how to finance a given project. It provides a simple method of calculating the impact of financing on ratepayers and taxpayers. These results are not to be used in any of the other worksheets. Once the user has decided how to finance a project, he will enter only the mechanism that he selected in latter worksheets.

Worksheet 2f- Project Financing Detail

This worksheet allows the user to list the financial sources for each project. This provides a total of all financing for each project, and should match the total construction costs for each project in worksheet 1a.

Worksheet 2e- Summary of Project Financing

This worksheet totals the results of all projects from worksheet 2f into a master financing plan for the capital projects that have been planned.

Worksheets 2d through 2a focus on detail of charges and impacts of the chosen financing plan:

Worksheet 2d- Capital Fees

This worksheet is used to determine hook-up fees. This information could help determine whether and to what extent current users are subsidizing future customers.

Worksheet 2c- Calculation of Assessments

This is an optional worksheet to be used if financing of the part of the capital plan is to be done through the use of special assessments. The result is a five year schedule of costs based on annual costs per property owner.

Worksheet 2b- Contribution to Reserve Fund

This worksheet determines the annual contribution that must be made to a reserve fund in order to finance projects from that source. It assumes that reserve fund contributions are made regularly from user charge receipts and deposited into a special fund that will earn interest until construction, and that reserve payments are to be made in equal parts.

Worksheet 2a- Calculation of Debt Issue

This worksheet determines the annual debt service burden due to borrowing construction funds through bonds or revolving loans. It is divided into three sections; one for Revenue Bonds, one for General Obligation Bonds, and one for revolving loans. This is done because interest rates and length of bond term may vary between the different types of borrowing.

Worksheet 2- Impact of Capital Program

This worksheet summarizes the full impact of decisions regarding projects to be constructed and the financing mechanisms to be used. The output of this worksheet is an estimate of the additional costs that result *each year*, both for costs that are borne equally by all users, and for costs to users who will pay assessment or hook-up fees in addition to regular user charges.

This module will be important in estimating future rate trends and in communicating the need for rate increases to local officials and customers.

Module 3: Determining Annual Cost of Service

This module helps to determine the direct operating cost of a system, as well as indirect costs and capital costs. The primary source of information for this module is the systems overall budget. The primary uses of the results of this module are for rate setting and determining overhead costs.

Worksheet 3h- Estimate of Water and Sewer Costs

This worksheet provides an estimate of water and sewer costs when the two are not budgeted or accounted for separately.

Worksheet 3g- Department Overhead Costs

This worksheet will aid in the determination of departmental overhead costs. It assumes that water and wastewater operations are included in a larger public works or community services department. It breaks down costs into their various components (salaries, non-labor costs) and estimates the amount directly allocated to water and wastewater. It then estimates amounts indirectly allocated to water and wastewater based on the percentage of the total public works budget that water and wastewater operations comprise.

Worksheet 3f- Allocation of Gov't-Wide Indirect Costs

This worksheet performs the same function as worksheet 3h for general government overhead. It identifies all overhead costs and allocates the appropriate costs directly to local government departments. It also allows for the allocation of remaining overhead costs to water and wastewater operations. This is similar to Worksheet 3e, except it uses the total budget for the local government as a whole.

Worksheet 3e- Estimate of Depreciation Costs

This worksheet estimates the annual depreciation and the current value of all water or sewer capital assets. This is done by system component, and requires information on the cost, useful life, and purchase date of all capital assets. The results of this work is used in worksheet 3d.

Worksheet 3d- Determination & Allocation of Capital Costs

This worksheet determines capital costs that should be included in the total cost for the purpose of determining rates. It includes the two accepted methods of calculating capital costs, only of which one is to be used. Part I uses the Cash Needs Basis, which recovers only actual cash outlays for capital purposes during the year. Part II uses the Utility Basis, which determines the total investment in the system to date and establishes a reasonable return on that investment.

Worksheet 3c- Determination of Direct Benefits Costs

This worksheet determines employee benefits and related payroll costs as a percentage of salaries.

Worksheet 3b- Allocation of Salary Costs

This worksheets helps to allocate total salaries for both water and sewer systems to the various system components based on timesheets and interviews with employees and supervisors.

Worksheet 3a- Allocation of Direct O&M Costs

This worksheet determines the direct operating and maintenance costs of the water and wastewater utility and assigns them to the appropriate system components.

Worksheet 3- Summary of Cost of Service

This worksheet summarizes the results of the rest of the module's worksheets and determines the annual cost of service, considering all costs, both operating and capital, both direct and indirect.

This module will help the user to insure that the present rate schedule recovers the true cost of providing service to the systems customers.

Module 4: Setting User Charges

This module is the most involved module in this workbook in that it represents a culmination of the information developed in the three previous modules. It is designed to allow its users to develop a specific rate structure based on their cost data and any assumptions that they have made throughout this costing procedure. This module uses the cost data assembled in Module 3 as input, as well as an understanding of the types of customers served by the given system, the patterns of their water use, and a good amount of engineering judgement as to how these patterns affect cost. This discussion will focus on the setting of rate structures for water utilities.

The user is given a choice of four different rate structures. The primary rate structure is the base-extra capacity method recommended by the American Water Works Association for all but a select few water utilities. The three other methods are recommended for "simpler" or smaller utility operations- under 5,000 customers, no industrial or commercial customers with unusual water use patterns, and no extra charge for users outside of the locality. The first of these is the two-block commodity demand method. It is to be used when all customers are metered and there is a variation in the amount of water used by each customer. The second method is a single-block rate structure,

the result of which is a monthly service charge and a cost per 1,000 gallons consumed. This method is to be used if there are customers that use much more water than the average customer. The third method is a rate structure that results in a single-block structure as in the previous method for metered customers, and a flat monthly charge for nonmetered customers. It can also be used to establish a flat rate if there are no metered customers at all. A majority of systems will probably not fit the criteria for this second group of methods, and will use the base-extra capacity method. The result of this method is a rate structure that includes a monthly service charge or minimum charge and three different rates- residential, commercial, and industrial, for volume water usage. The volume rate is usually a declining block rate structure , which means that charges for a given volume will decrease with increased use. This is the most common type of rate structure. This module will allow the user to develop different block rates for inside-the-locality and outside-the-locality uses, as well as a flat rate for wholesale sales.

Worksheet 4e- Determination of Net Revenue Requirements

This worksheet helps determine costs for the system components that identified in earlier modules. For each system component, the user identifies an operating cost, a depreciation cost, and a return on investment for both inside and outside-the-locality customers; each of these will include an allocated share of administrative costs. Finally, it summarizes these results for easy reference to latter worksheets.

Worksheet 4d- Units of Service and Block Rates

Part I and II of this worksheet are for the base-extra capacity method, while Part III is for the small utility methods. This worksheet identifies the customer base and the use characteristics of the those customers. This includes such things as total consumption, peaking factors (maximum hour and maximum day), and size of meter.

Worksheet 4c- Small Utility Water Rate Structure

This worksheet is for those using the smaller utility methods. It contains three separate parts, one for each of the methods. Each user need only fill out the part that matches the type of rate structure they wish to use.

Worksheet 4b- Water Costs by Rate Components

This worksheet determines the total costs (as determined by allocation of component costs in worksheet 4e) and assigns these to the base, maximum hour, and maximum day categories. The result is a base cost in cents per 1,000 gallons, and extra capacity costs in dollars per peak day requirement and dollars per peak hour requirement.

Worksheet 4a- Water Rates Structure

This worksheet uses the results of worksheets 4d and 4b to set rates, which are developed into a monthly service charge, three block rates, a fire protection charge for inside-the-locality users, and a service charge, three block rates, and a wholesale charge for outside-the-locality users.

Worksheet 4- Test of Rates and Revenues

This worksheet uses the rates developed in worksheet 4a, along with information from the users billing records, to estimate the total revenues the new rates will generate to ensure that all costs are recovered.

If the user operates a system designed for using the smaller utility methods, he/she need only fill out Parts I and II of worksheet 4d, one of the three parts of worksheet 4c, and Part IV of worksheet 4. The rest may be disregarded as they are for the base-extra capacity method.

Module 5: Measuring Performance

This module is intended to allow the user to track the financial performance of his system over a period of years. It is designed so that the user can calculate ratios and other indicators of financial strength for prior years and then add new years as they are completed so that trends can be identified. However, this module has yet to be completed at this writing. Its absence is not expected to influence this analysis or an evaluation of this costing workbook as it does not depend on the analysis completed in the previous modules and is therefore considered a minor module.

Analysis of the Workbook Against Selected Criteria

Survey Analysis Criteria

An important function of this workbook is to meet the perceived needs of its potential users; whether these needs are financial, capital, or informational. If it does not meet these needs, utility operators and local government decision makers may be reluctant to make full use of the workbook, thus limiting its overall effectiveness. To gauge how well these needs are addressed in the cost analysis workbook, a set of criteria were developed from the survey analysis in the second chapter. These criteria are those identified as necessary for a useful comprehensive cost analysis method as determined by water and wastewater operators. The following is a list of these criteria, along with a description of how well the comprehensive cost analysis workbook previously described conforms to each criterion.

- *Provides a method to determine long-term, viable financial options*

  The workbook permits the user to understand and develop a variety of options for financing. These include different types and lengths of of borrowing, imposition of special assessments, and use of capital fees and reserves, user fees, hookup fees, and grants. It allows the user to test a variety of assumptions and financing choices to determine which is the most useful or viable combination. However, this can only be done for up to five years on each worksheet. Although the user has the option of projecting well into the long-term (6-10 years) by making copies of the original worksheets, the value and accuracy of such projections may be limited due to the changes in the projection environment.

- *Provides a method to determine capital needs*

  This workbook does not provide such a method. It is expected that each user will possess an understanding of the capital needs of his system. This is a required input to begin this workbook. However, this workbook will be useful to communities in the organization and integration of capital needs into their financial plans.

- *Provides a way to update rate structures to reflect changing conditions*

  This workbook meets this criterion quite effectively. In Module 4, the user can develop a variety of rate structures to address his particular operation based on the assumptions and data developed in each of the earlier modules. As conditions change, they can be reflected in modules 1 through 3 and used as an input for module 4.

- *Provides increased communication between local decision makers and utility operators by requiring the sharing of explicit system information and knowledge*

  The requirement of sharing explicit information and knowledge between these two actors applies to each of the workbook modules with the exception of Module 5. Modules 1 through 4 require the detailed information that must be supplied from a variety of sources. Their outputs- financing, capital needs, user charges, cost of service- will be of interest to all involved. Module 4, however, is mostly a tool for utility operators, as its application elsewhere would be limited.

- *Provides a method by which operation and maintenance costs can be separated out and analyzed*

  Module 1 requires the user to determine the operation and maintenance costs that result form each capital project in need of funding. Module 2 then summarizes this breakdown, and displays its impact under different financing schemes. Module 3 also separates out operation and maintenance costs in determining total cost of service. This is then reflected in the rate develop in Module 4. This will allow the user to understand the impact operation and maintenance costs under varied assumptions, as well as the role it plays in total cost of service.

- *Provides a method to determine user charges*

  Module 4 provides such a method. It allows the user to develop rate structures dependent on the characteristics of his operation. It does this based on the information developed in each of the three previous modules.

- *Provides a method to determine efficiency measures*

Module 5, measuring performance, will address this criterion.

- *Provides a method from which staffing levels and costs can be separated out and analyzed*

  This workbook addresses this criterion in Module 3. In that module, staffing costs, including both salaries and benefits, are segregated by by staff classification (i.e.- director, meter reading, clerical, etc.) and allocated to water and wastewater functions. This includes both direct and indirect (overhead) staffing costs. This allows the user to determine the full, direct cost of each staff member in determining total cost of operation.

Cost Analysis Literature Criteria

A second key function of this workbook is its adaptability to a changing financial environment dominated by increased reliance on local effort, particularly user fees. To evaluate this adaptability, the workbook will be compared to the following set of criteria as developed from the literature in the field (see Boland, 1984, Gilbert, 1985, Kory and Rosenberg, 1982, Shell and Damachi, 1984, and Woods, 1984):

- *Provides a method for determining fees which will cover costs*

  After total cost of operation is developed in Module 3, that information is then used to create a rate structure in Module 4 which will account for system costs.

- *Develops a capital plan that sets out capital needs and their financing*

Module 1 allows the user to identify all of the systems capital needs, and Module 2 determines the various financing options and combinations that are available to the user.

- *Provides the capability for assessing and comparing the effects of various financing mechanisms*

  This is addressed in Module 3- financing capital needs.

- *Develops an equitable system of charges that places the burden of financing facility expansion on the customers causing it*

  The user has the option of doing this in Module 2. In order to place the financing burden of facility expansion on those causing it, the user can develop special assessment fees in addition to normal user charges that will apply apply only to those customers causing the expansion.

- *Develops an effective preventative maintenance program*

  This is not addressed in the workbook as the user must determine capital needs each year based on his understanding of his system. Such a program will need to come from the user.

- *Provides a standard form of infrastructure analysis*

  This is not addressed in the workbook as only those components in need of expansion or repair are analyzed. Such an analysis will depend on the user.

- *Provides a method to assess the present condition of the system*

  This is not addressed in the workbook as the user must determine capital needs each year based on his understanding of his system. Such an assessment will have to come from the user.

- *Provides a method in which one can identify and rank maintenance and reinvestment projects*

  Identification is limited to the users understanding of his system's needs. Modules 1 through 4 will allow the user to rank each program or project based on the data and assumptions used, and choose which best suits his operation.

Table 18 provides a summary of whether this comprehensive cost analysis workbook meets each of the previous criteria, and if it does, which components of the workbook address the criteria.

Table 18. Achievement of Utility Management Criteria by Workbook Module

	Modules					
Survey Analysis Criteria	1	2	3	4	5	none
Determines financial options	x	x	x			
Determines capital needs						x
Increased communication	x	x	x	x		
Updates rate structures				x		
O&M separated and analyzed	x	x	x	x		
Determines user charges				x		
Determines efficiency measures					x	
Staffing separated and analyzed			x			
Literature Criteria						
Fees cover costs				x		
Develops capital plan	x	x	x	x		
Assess and compare fin. mechan.			x			
Equitable system of charges				x		
Develops maintenance program						x
Develops infrastructure analysis						x
Assesses system condition						x
Identify and rank projects	x	x	x	x		

Summary

In summary, this workbook provides an extensive guide to comprehensive cost analysis for municipal water and wastewater systems. It covers in detail the major components of such a method in five distinct, but interrelated components called modules. It provides the user with directions for each module as well as illustrated examples of how to use each of the worksheets that make up the individual modules. The workbook does well in meeting the criteria established by both utility operators through their survey responses and the literature on water and wastewater utility management. Of the fifteen separate criteria, only four could not be met through the use of this cost analysis workbook. The explanation for each of these was the same: the user was required to be familiar enough with his own system to be able to identify its capital or operation needs. The workbook does not presume to be able to develop a capital needs list for utilities or provide guidelines to users as to what capital needs should or should not be considered. However, I do believe that the workbook can be an organizational aid in developing construction schedules and a capital plan. As such, it may prompt the user to complete such schedules and plans. Overall, this workbook appears to be a complete, comprehensive, cost analysis method.

EVALUATION OF THE COMPREHENSIVE WORKBOOK METHOD

Overview

This chapter will focus on evaluating the cost analysis workbook described in the previous chapter. This evaluation of both effectiveness and usefulness was accomplished through review of the the workbook by five communities, one Virginia state agency, and a private consulting firm. The communities were chosen based upon the criteria of willingness to participate, involvement in the survey, and representativeness of different sizes and government forms. The two other participants- the Virginia Department of Housing and Community Development's Office of Local Development Programs, and Anderson and Associates, an engineering consulting firm located in Blacksburg- were chosen for evaluation because they provide assistance to localities in such areas as cost analysis of utility services, and may find this workbook useful in providing this assistance. For evaluation by the community systems, a Goals Attainment Scale was developed. Goals attainment scaling

allows an observer to determine if the goals of a program are being attained, and to what extent they were or were not attained. Each of the possible outcomes of each goal (from most unfavorable to expected to best anticipated) have a numerical score attached to it so that the overall outcome of the goals may be summed and compared. The goals for this workbook (and its individual components) are as follows:

- ADAPTABILITY
- COMPREHENSIVENESS (coverage of cost analysis components and linkages between components)
- COMPREHENSION (understandability)
- UTILITY (intent of use of cost analysis method)
- COMPLEXITY (ease of use)

Table 19 is the Goals Attainment Scale containing these goals. In this table, each goal has an "expected outcome", or what is believed to be the researchers anticipated result for each goal. For this analysis, the "expected outcome" for each goal is as follows:

- **Adaptability-** user has most of the information and resources necessary to complete the worksheets and is confident where and how to obtain the rest.
- **Comprehensiveness-** user believes that worksheets address a majority of their current financial analysis needs.
- **Comprehension-** user can complete the worksheets based upon supplied directions and minimal guidance.
- **Utility-** user anticipates having use for some of the worksheets, but not all of them.
- **Complexity-** although somewhat complex, user believes he can complete worksheets.

Table 19. Goals Attainment Scale

Scale Attainmant Levels	Scale 1: Comprehension	Scale 2: Adaptability	Scale 3: Utility	Scale 4: Complexity	Scale 5: Comprehensiveness
a. Most Unfavorable Outcome Likely (-2)	*User finds entire workbook incomprehensible, even with assistance*	*User has none of the information and resources necessary to complete the worksheets and does not know where to find them*	*User anticipates no use for any of the worksheets*	*User finds worksheets to be too complex to consider use*	*User believes that worksheets do not address any of their current financial analysis needs*
b. Less Than Expected Outcome (-1)	*User is in need of directions and guidance to use workbook*	*User has some of the information and resources necessary to complete the worksheets, but is not sure where or how to obtain the rest*	*User believes that worksheets might be useful, but does not intend on using them*	*User finds worksheets to be too complex after attempting use*	*User believes that worksheets only partially address their current financial analysis needs*
c. Expected Outcome (0)	*User can complete worksheets based upon supplied directions and minimal guidance*	*User has most of the information and resources necessary to complete the worksheets and is confident where and how to obtain the rest*	*User anticipates having use for some of the worksheets, but not all of them*	*Although somewhat complex, user believes he can complete worksheets*	*User believes that worksheets address a majority of their current financial analysis needs*
d. More Than Expected Outcome (+1)	*User can complete worksheets based upon supplied directions and no guidance*	*User has all of the information and resources available necessary to he to complete the worksheets*	*User anticipates making full use of the workbook in the near future*	*User believes he can complete worksheets and considers them to be minimally complex*	*User believes that worksheets address all of their current financial analysis needs*
e. Best Anticipated Outcome (+2)	*User can complete worksheets with minimal use of directions and no guidance*	*User has all of the information and resources available, and these are easy to locate and were previously assembled*	*User will make use of the entire workbook and will incorporate its results into present years operations*	*User believes he can complete worksheets and considers them to be relatively simple*	*User believes that worksheets address all of their current and future financial analysis needs.*

The Utility goal is considered to be twice as important as the other goals. This is because regardless of whether a community finds the workbook understandable, adaptable, simple, and comprehensive, if they do not find it potentially useful, they will make no attempt to use it. Therefore, the goal Utility has been given a weight of 2, while the other four goals have been given a weight of 1. A goals attainment score is calculated based on each communities response. To derive a goals attainment score, the following formula will be used where Wi is the weight assigned to the *i*th goal scale, Xi is the attainment score (-2 to +2) on the *i*th goal scale, and the summations are across all of the goal scale:

$$G.A.S. = 50 + \frac{10\Sigma(w_i x_i)}{(.7\Sigma w_i^2 + .3(\Sigma w_i)^2)^{.5}}$$

If the formula yields a score of 50, then on average, the outcomes are at the "expected level". Any score in excess of 50 indicates an outcome that is "better than anticipated", while any score of less than 50 indicates an outcome that is "less than expected" (Kiresuk and Lund).

A contact within each community, usually the Superintendent of Utilities, Director of Public Works, or Town Manager, was asked to carefully review the workbook and to evaluate it as it pertains to their current systems operation. Each contact was then personally interviewed to assess how well the workbook faired in the attainment of the above stated goals. This was accomplished through observing the contacts response to the worksheets as well as his response to the following list of questions:

- Scale 1: How would you rate the workbook in terms of understandability?
  - -Are the directions well written?
  - -How much assistance do you believe you would need to complete this workbook?

- Scale 2: Did you find that you had the information and resources necessary to complete this workbook?

  -Were they easy to locate?

  -Were they previously assembled?
- Scale 3: What use do you see for this workbook or its parts in your departments operation?
- Scale 4: Did you find this workbook to be too complex?

  -Did you find length to be a problem?
- Scale 5: Would this workbook address your current financial analysis needs?

  -Future needs?

Each of these is presented in a case-study format in which there will be a short description of each community's water and wastewater operation, as determined by the information provided by their original survey response, a presentation of their goals attainment score for each goal and as a total score, and a description of why each community answered as it did as determined by the personal interview.

The evaluation from the point of view of the Department of Housing and Community Development and the private consulting firm were to be approached slightly differently. The contacts within both of these organizations were provided with a short survey to complete which is an adaptation of the previously discussed Goals Attainment Scale. However, responses to to this survey by both of these organizations was not received in time to be included in this evaluation. The completed Goals Attainment Scales for each community are attached as Appendix C.

Community Case Studies

The Town of Blacksburg

Background

The Town of Blacksburg operates both a water and a wastewater system that serves 30,648 people. The Town's water system serves these customers through 4,813 connections, with an actual system flow of approximately 2.5 mgd. This system consists of transmission mains, storage tanks, a distribution system, and service meters, all of which have been rated as being in good condition. The system is supplied treated water by the independent Blacksburg-Christiansburg-VPI Water Authority. Water service is marketed as both retail and wholesale. The wastewater system serves its customers through 4,283 connections, with an actual system flow of 1.9 mgd. This system consists of local collection sewers, trunk sewers, and pumping stations, all of which have been rated as being in good condition. Wastewater treatment and discharge is provided by the independent Blacksburg-Christiansburg-VPI Santitation Authority. Wastewater service is provided only at the retail level. Both water and wastewater service reach 90% of the residents within the Town.

Evaluation of the Goals

The evaluation interview was conducted with Mr. Randy Bartlett, Director of Public Works for the Town. In response to the goals of this program, Mr. Bartlett believed that comprehension was not a problem as the intent of the workbook and the directions were clear and easy to understand. All

of the information and resources necessary to complete the workbook were easily available. In fact, the Town also possesses a cost allocation plan which would be helpful in completing this workbook. However, Mr. Bartlett had no use for any of the modules of the workbook. He believed that this workbook duplicated the Town's five year Capital Improvements Plan. Complexity was not a problem, mostly due to the sample worksheets provided with each module. Length was identified as a major obstacle in to using the workbook. In terms of comprehensiveness, the workbook was not seen as addressing any of the departments current financial analysis needs. This was attributed to the lack of justification for choices within the workbook. These responses translated into the following goals attainment scores:

Comprehension:	+2
Adaptability:	+2
Utility:	-4
Complexity:	+1
Comprehensiveness:	-2
Sum:	-1

Comments

The user was quite negative about the workbook. He believed that if a community had a five year Capital Improvements Plan, as a number do, then they already do a good job at setting rates for their water and wastewater services and thus do not need the assistance of such a workbook. A major criticism of the workbook was that it failed to provide justification for certain choices, such as the type of financing sources used, and determination of capital needs financing. Without such justification, choices can not be defended to other Town officials or to the public. More guidelines

for these types of decisions are necessary. The user also believed that the workbook was nothing more than a way to do math, and that it was not much good otherwise. In summary, the user thought that the intent of the workbook- cost analysis of water and wastewater services- was an impossible task if left solely to the communities to complete. Communities vary too much for the workbook to be uniform in its usage, and any community that would be interested in such an analysis method is looking for an easy way out of calculating costs and determining rates. He believed that there is no easy way out of this, and thus communities should be prepared to spend a good amount of money to get good consulting services for this type of work.

City of Staunton

Background

The City of Staunton operates both a water and a wastewater system. The water system serves approximately 22,000 customers through 8,000 connections, with an actual system flow of 6.0 mgd. The water system consists of a raw water pumping plant, a water treatment plant, and storage tanks that are rated as being in very good condition; transmission mains, a distribution system, and service meters that are judged to be in good condition. The water is marketed both retail and wholesale. The wastewater system serves approximately 21,500 customers through 8,000 connections, with an actual system flow of 3.0 mgd. The wastewater system contains local collection sewers, which are rated as being in fair condition; trunk sewers, pumping stations, and a wastewater treatment plant, all of which are rated as being in good condition. Wastewater service is provided at the retail level only. Both the water and wastewater services reach 90% of the customers within the City.

Evaluation of the Goals

The evaluation interview was conducted with Mr. J. Whitlock, Superintendent of Utility Lines for the City. Mr. Whitlock believed that comprehension was not a problem, as he thought the instructions were very clear and well written, and no assistance would be needed to complete the workbook. All of the information and resources needed to complete the worksheets were available. The City had just completed a five year Capital Improvements Plan, which was viewed as a good source of necessary information. The user did not believe that the workbook would be very useful to his particular situation, although parts of it might be. The workbook was not viewed as being too complex, but length was a problem. The user also believed that the workbook could very well address his systems financial analysis needs, as it was as strong a financial analysis tool as anything else he has seen or used. These responses translated into the following goals attainment score:

Comprehension:	+1
Adaptability:	+2
Utility:	0
Complexity:	+1
Comprehensiveness:	0
Sum:	+4

Comments

This user was quite positive about the potential of the workbook. He believed that the workbook was just as good a financial tool as is the five year Capital Improvements Plan that the City recently completed. In fact, the user claimed that he would have had a lot more use for the workbook if he

had had it one year ago, before the C.I.P. was completed. Some of the worksheets were considered to be useful despite the C.I.P. These include worksheet 1a (project cost schedule), worksheet 1 (summary of costs of new projects), worksheet 2f (project financing detail), worksheet 2 (impact of capital program), worksheet 3h (estimate of water and wastewater costs), worksheet 3e (estimate of depreciation costs), worksheet 3a (allocation of direct operation and maintenance costs), and perhaps some parts of Module 4. On the critical side, the user believed that there was too much duplication of worksheets that were essentially similar (summarized the results of a previous worksheet), although he did not identify them. He also expressed concern about the transferring of numbers required by various worksheets (viewed as excessive and possibly confusing to a potential user). Length was also cited as a problem- the user was originally reluctant to review the workbook because of its length and bulky appearance and expressed concern that other communities might not use it for that reason. Lack of justification for choices, especially for funding choices, was again cited as a problem. In summary, the user hoped to have more use for the workbook in the future.

Montgomery County Public Service Authority

Background

The Montgomery County Public Service Authority (P.S.A.) operates both water and a wastewater systems. The P.S.A. serves many of the rural areas of Montgomery County including Elliston, Shawsville, Maramack, Prices Fork, Plum Creek, Bethel, Riner, and Woodview. The water systems serve approximately 1,500 customers with an actual system flow of .5 mgd. These systems consist of raw water pumping plants and storage tanks that are both rated in good condition; transmission mains, distribution mains, and service meters that are judged to be in fair condition. Water service

is marketed at the retail level. Water service reaches only 20% of the residents within the P.S.A.'s jurisdiction. The wastewater systems serves about 800 customers and have an actual system flow of .18 mgd. The system consists of local collection sewers and trunk sewers rated as being in good condition; pumping stations and treatment plants that are rated as being in very good condition. Wastewater service is also marketed at the retail level. Wastewater service reaches only 10% of the residents within the P.S.A.'s jurisdiction.

Evaluation of the Goals

The evaluation interview was conducted with Mr. Gary Gibson, utilities director for the P.S.A. Mr. Gibson believed that the workbook was self-explanatory and that the directions seemed to be clear, although he thought he would have difficulty completing it. In terms of information and resources necessary to complete the workbook, the utility lacked land use plans, and had little information on facilities inventory and financial data. Most of this data was in a general form, and as such lacked any substantive detail. While the user expressed positive interest about the workbook, he doubted that he would make any use of the worksheets. The user did not believe that the workbook was too complex. Again, length was considered to be a problem in that he believed that the workbook was too long for him to complete in an adequate time period. If used, however, the user believes that this workbook would address a majority of his systems financial analysis needs. These responses were translated into the following goals attainment scores:

Comprehension:	-1
Adaptability:	-1
Utility:	-2
Complexity:	0
Comprehensiveness:	0
Sum:	-4

Comments

This is a very small system with limited data and information. Most of the cost analysis work done for this utility is completed by outside consultants. The user admitted that although revenue data for the system was known, the expense data on the different system that the P.S.A. operates were not very accurate. The P.S.A. is in the middle of a rate study that may reduce some of this inaccuracy, although it is doubtful that it will eliminate it. Overall, the user was impressed with the workbook as he thought it provided a good overview view of system financial information. Although he would like to make use of it, he believed that it was too long and involved for him to complete. He estimated that it would take him several months to complete the workbook. He believed that the workbook would be improved if it were condensed and more general. The use of this workbook would break new ground for the utility.

City of Waynesboro

Background

The City of Waynesboro operates both a water and a wastewater system. The water system serves approximately 16,500 customers through 5,890 connections and has an actual system flow of 3.52 mgd. The system consists of a raw water pumping plant, transmission mains, and storage tanks that are rated as being in good condition; and a distribution system and service meters that are rated as being in fair condition. The system provides mostly retail water service. Water service reaches 90% of the residents within the City. The wastewater system serves approximately 17,000 customers through 5,600 connections, and has an actual system flow of 2.6 mgd. The wastewater system contains local collection sewers and pumping stations that are in good condition; trunk sewers and a treatment plant that are in fair condition. Wastewater service is provided mostly at the retail level. The wastewater system serves 85% of residents within the City.

Evaluation of the Goals

The evaluation interview was conducted with Mr. J. Bowmen, Director of Public Works for the City. Mr. Bowmen believed that the workbook was understandable, and that the directions and the meaning each module were clear and straight-forward. In terms of adaptability, the system had most of the information and resources necessary to complete the worksheets, but the user admitted that they were rather inaccurate and in poor form. The user expressed interest in using the workbook in the future financial analyses, but would not have any use for it currently. If he was to use the workbook, he stated that he was most interested in Modules 3 and 4. The user thought that the

workbook was not too complex, but it would take some time to complete. Length was again cited as a problem. Finally, the user believes that this workbook would address a majority of his systems current financial analysis needs if he were to make use of it. These responses translated into the following goals attainment scores:

Comprehension:	0
Adaptability:	-1
Utility:	+2
Complexity:	0
Comprehensiveness:	0
Sum:	+1

Comments

This is a system that suffers from a number of problems. To begin with, the City's Public Works Department has been trying to make each of its functions self-supporting. One of the steps the City has taken toward this end is the creation of a sinking fund to help support capital needs, especially a required upgrade of the City's wastewater treatment plant within the next five years. However, the local governing body has used up almost all of the money from this fund for other projects. The utility operates under a five year C.I.P., but the department has had little input into its development. Instead, the development of the C.I.P. has been highly politicized, funding only the most popular projects. In fact, the last C.I.P. was developed by a committee of citizens and local political officials. As a result, the department has been unable to fund the capital projects it believes are critical and necessary. The user hopes that the workbook will help change this situation by placing decision making power on capital funding within their authority. Another problem that the user

thinks may be solved by the use of the workbook is the linking of system revenues revenues and expenditures. In the past, revenues have been determined by the local governing body. This has lead to the development of a rate structure that is based on political feasibility rather than real costs. Overall, the user believes that if his system has the proper information in the correct form to make use of this workbook, he would like to make full use it.

City of Radford

Background

The City of Radford operates a water system that serves 13,225 customers. The City no longer operates a wastewater system as of March, 1987. It now pays the Peppers Ferry wastewater system to treat its wastewater. The actual flow of the water system was not provided. The system contains transmission mains that are in good condition; a raw water pumping plant, treatment plant, distribution mains, and service meters that are in fair condition; and storage tanks that are considered to be in poor condition. Water service is marketed at the retail level. There is currently exists what is considered a significant potential for contamination of the City's raw water source (New River) in the form of algae, taste and odor problems. Water service reaches 98% of the residents within the City.

Evaluation of the Goals

The evaluation interview was conducted with Mr. Jettie Montgomery, Superintendent of Water/Wastewater Utilities for the City. Mr. Montgomery believed that the workbook was laid out well, straight-forward, and easy to understand. All of the information and resources necessary to complete the workbook were available. The user expressed a good deal of enthusiasm toward the use of the entire workbook. He believed that it appeared to be an excellent way of organizing and calculating cost information, and converting that information into a valid rate structure. Complexity was not cited as a problem, particularly because of the well presented directions and the example worksheets. Length was not considered to be a problem. In terms of comprehensiveness, this workbook appeared to address a majority of the systems financial analysis needs. These responses translated into the following goals attainment scores:

Comprehension:	0
Adaptability:	+1
Utility:	+2
Complexity:	+1
Comprehensiveness:	0
Sum:	+4

Comments

The user believed that this workbook would be particularly useful in completing future cost analysis, and was quite eager to try to complete the workbook in its entirety. He was currently developing a new rate structure for the City's water users, and admitted that the way he went about it was at best rather simple and limited. Currently, the rate structure is such that residential users

subsidize industrial users (who make up 50% of the total water consumed). The user hopes that the workbook will help him provide justification for alleviating this imbalance. As a result of this work, the user expressed particular interest in Module 4- Determining Rate Schedules. This user was the only one of the five interviewed to believe that the length of the workbook was not a problem. He believed that cost analysis was an involved task, and to expect a workbook on cost analysis to be shorter and less bulky than this workbook was niave. He believed that there is true potential for actual use of this workbook in this community.

Analysis of the Goals Scores

The goals attainment scores can be viewed in two ways: as an average score for each of the goal areas across the communities, and as a score determined from the Goals Attainment Score formula developed earlier which measures the overall level of goals attainment for each community. Table 20 presents the average score for each goal area for all of the communities.

Table 20. Goals Attainment Score by Individual Goal

	Goal				
Community	*Comprehension*	*Adaptability*	*Utility*	*Complexity*	*Comprehen.*
Blacksburg	+2	+2	-4	+1	-2
Staunton	+1	+2	0	+1	0
Waynesboro	0	-1	+2	0	0
Mont Co P.S.A.	-1	-1	-2	0	0
Radford	0	+1	+2	+1	0
TOTAL	+4	+4	-2	+3	-2

These scores indicate the relative attainment for each of the five goals, as compared to each other (the raw numbers can not to be compared to the +2 to -2 scale presented in Table 18). Comprehensiveness and Adaptability receive the highest attainment scores, followed by Complexity. This demonstrates that the workbook, from the point of view of the communities tested, attained these goals in a positive manner. Utility and Comprehensiveness, however, did not fare as well. Both of these received scores of -2, indicating that the workbook did not do a good job in attaining these goals. Comprehensiveness, however, was skewed by the Blacksburg response, as all of the other communities stated that the workbook addressed a majority of their needs. Because of this, this goal will not be considered unattained. The finding for the utility goal is significant, as it is considered the most important of the goals (given a weight of 2). These results suggest that the workbook may be limited in its application, because of modest perceptions of usefulness by communities.

The second part of this analysis- developing Goals Attainment Scores (G.A.S.'s) for each community, involves converting the raw scores for each goal or scale presented in each community case study into a G.A.S. by using the previous formula. Table 21 displays the results of these calculations.

Table 21. Goals Attainment Scores by Community

Blacksburg	48
Staunton	60
Mont. Co. P.S.A.	40
Waynesboro	52
Radford	60

It should be remembered that if the formula yields a score of 50, then on average, the outcomes are at the "expected level". Any score in excess of 50 indicates an outcome that is "better than anticipated", while an outcome of less than 50 indicates that it is "less than expected". Based on the

results presented in this table, the Goals Attainment Scores of both the Town of Blacksburg and the Montgomery Public Service Authority reflect their perceptions regarding the key values of the cost analysis method. Both of these cases received their scores due largely to responses to the utility scale. It is my observation, both from analyzing these systems survey responses and from the interviews with them, that Blacksburg was the most sophisticated operation of the five, and the Montgomery County Public Service Authority was the least sophisticated. Although this sample size is too small (five) to generalize, it suggests that the most sophisticated (possess and make use of cost analysis methods), and the least sophisticated (do not have the information or staff to conduct formal cost analysis) systems may not be as likely to view this workbook as achieving its "expected outcome" as would more "typical" systems (Staunton, Waynesboro, Radford). Lack of achievement of the "expected outcome" is likely to deter the use of the workbook in similar communities.

Summary

In summary, this evaluation has demonstrated that this comprehensive workbook method seems to have value to certain types of users as a method of cost analysis. As derived from the Goals Attainment Scores developed in this analysis, little difficulty was encountered by the test communities in terms of understanding the workbook, adaptability to their current resource and information base, and complexity. However, the workbook did not fare as well in the categories of utility and comprehensiveness. This was a direct result of the responses received from the Town of Blacksburg and the Montgomery County Public Service Authority. It was these responses, particularly that of Blacksburg, that weighted the achievement of these goals to a level that was "less than

expected". A possible explanation for these low ratings may be a result of varying levels of operational sophistication of these two communities. The Town of Blacksburg rated the workbook poorly because it was believed to be a duplication of current efforts, and therefore useless. The Montgomery County P.S.A. rated the workbook poorly because they had little time or resources available to even make an attempt at completing the workbook, and thus viewed it as having very limited usefulness. These communities aside, the workbook fared well in achieving each of the goals. The cities of Radford, Waynesboro, and Staunton gave the workbook generally high achievement scores, and each expressed interest in making use of the workbook in future operations. In terms of operational sophistication, these systems possess the ability to perform simple forms of cost analysis, but would use a more uniform, comprehensive cost analysis method if one were available to their liking. The comprehensive workbook method analyzed here appears to be such a method. It should be noted that although these three systems are all city systems, they vary from each other in their operation characteristics. The City of Radford operates a water system but not a wastewater system, the City of Waynesboro's water and wastewater operation have been dominated by political expediency rather than sensible financial analysis, and the City of Staunton operates the largest system of the three and appears to be the most "average". Because each of these systems is different, the conclusions developed here avoid the assumption that these systems are identical and thus do not yield any meaningful results.

Although these results indicate that this comprehensive workbook method does meet the needs of certain communities, it would have been useful to have responses from the Virginia Department of Housing and Community Development's Office of Local Government Programs, and a private consulting firm. Unfortunately, the comments from these two organizations have not been completed at this time. Based on their earlier interest, however, it appears that the use of the workbook as a consulting tool, both by the private and the public sector, may develop into a viable option.

CONCLUSION

This thesis has attempted to develop an understanding of the environment in which municipal water and wastewater systems in Virginia operate, the problems that are encountered by these systems, and the available solutions to these problems. This understanding was accomplished in a four step process: assessing needs and financial trends; surveying and analyzing the results of utilities' capital, informational, financial, and cost analysis needs; analyzing a comprehensive cost analysis method that is intended to address the cost analysis needs of Virginia utilities; and evaluating this comprehensive cost analysis method. The following is a brief discussion of the conclusions developed from each of these steps:

- The funding environment for water and wastewater systems is changing. No longer will utilities be able to depend as heavily on grant financing as they have done in the past. This is particularly true for wastewater systems as the EPA Construction Grants program is replaced by state operated revolving loan funds. This will require greater financial accountability by utilities.
- Municipal water and wastewater systems in Virginia have fared rather well in maintaining and operating their systems. Their perception of future financing trends, however, may not reflect

current trends, as utilities expect greater use of certain types of grant financing. There is also the perception held by a majority of the systems that a comprehensive cost analysis method to address various utility functions would be very useful. It was also discovered that water and wastewater systems vary in their operation characteristics, with water systems appearing more organized and formal in their operations than their wastewater counterparts. In addition, it was found that the size of a given water/wastewater system does not affect many of the operational characteristics tested here.

- The comprehensive cost analysis workbook developed by the Government Finance Officers Association sets out a detailed method of cost analysis for both water and wastewater systems by breaking down costing into its component parts. This method appears to be an effective and useful method as judged against criteria developed by the survey analysis and the cost analysis literature.
- With two exceptions, the workbook was successfully evaluated by several test communities. It appears that this workbook can be used most successfully by systems that presently perform a simple form of cost analysis and would prefer a more uniform, comprehensive approach.

It is evident from these conclusions that municipal water and wastewater operations in Virginia are facing what might be considered overwhelming capital and financial needs as they enter the 21st Century. Their perception of future funding trends (expectation of using more grants) may only compound this problem over time. The trend that is presently developing is one of increased use of borrowing- in the forms of bonds, revolving loans, FmHA loans, and Virginia Resources Authority loans. To accommodate this trend, utilities will need to develop an understanding of future financing, and develop more accurate, detailed cost analysis procedures to link costs to revenues. This will be particularly necessary as utilities find that they must increase user fees to meet the repayment obligations necessitated by borrowing. The use of a comprehensive cost analysis method will aid localities in justifying rate increases to local decision makers and their constituencies. The desire expressed in the survey for a comprehensive cost analysis method indicates an understanding

of this situation. The G.F.O.A. workbook analyzed and evaluated in this thesis seeks to address this need, and appears to have done so through community based testing. In addition to responding to this need, the G.F.O.A workbook may also serve as an important communication link between facility operators, local government decision makers, and customers as it provides an explicit means of identifying relevent systems and financial data. The survey analysis in the second chapter indicated that a majority of system financial analysis was completed by the local government, not the utility. The use of this workbook by system operators may help improve the communication between these operators and local government decision makers as they will have to combine their efforts and information to achieve meaningful results. Customers will also benefit from this process through the development of accurate rate structures, and the efficient provision of water and wastewater services.

However, several questions and concerns remain unanswered. The number of communities expressing an interest in a comprehensive cost analysis method in the survey was quite large, yet this did not carry over to the evaluation, as two of the five communities tested rejected the use of the G.F.O.A. workbook. It is my belief that speaking in general terms of a comprehensive cost analysis method may sound very appealing to many localities as they are looking for a simple, easy method of analysis that adapts to their particular operation. When it turns out that such a method involves a rather detailed, lengthy procedure, communities may reject its usefulness. Although it should not be expected that such a method will be short and simple, what will come of the communities that still desire a cost analysis method but reject this one when presented to them? This is of particular concern for small, rural utilities, such as the Montgomery County P.S.A. Solutions to this may reside in the work of organizations such as the Department of Housing and Community Development and consulting firms such as Anderson and Associates, which employ this method.

I think it would be a mistake, however, to believe that the use of the G.F.O.A. workbook will solve all of the needs of municipal water and wastewater systems in Virginia. Many systems will continue

to perform simple costs analysis, or none at all. Also, the sheer dollar needs of many of the systems in Virginia is staggering and will not be alleviated any time soon, regardless of the type of cost analysis method used. The future will remain uncertain for many utilities in Virginia as they are forced to borrow more and raise rates to meet repayment obligations. Again, my concern is for the smaller, rural utilities in the state which need to meet stringent pollution control standards, borrow to meet their capital needs, hire consultants to perform cost analysis, and raise rates to repay loans. Their situation is not likely to improve in the near term.

Looking back at the methodology employed in this thesis, there are some limitations that must be addressed and accounted for when reviewing the conclusions made here. The first involves the original survey. Like most surveys, the response that is received is dependent upon the willingness of those surveyed to participate. Even with a good response rate, one is left to assume that the answers provided are correct and accurate. It was this last concern that affected the survey analysis completed in the second chapter. Detailed questions about user charges and actual capital needs in dollars could not be analyzed because user charges were given in varying units of measure, making them incomparable, and capital needs were given by only a few of the respondents. Aside from these problems, the survey analysis proved to be a valuable resource.

A second area of concern was the community evaluation of the workbook. The Goals Attainment Scale which I developed, although useful in measuring the attainment of certain goals, was limited in the accuracy of its measurements. It was difficult to gauge the precise reaction of each community individually as their responses could only be placed in one box in each column on the scale. This may have affected the accuracy of the measures developed from this scale. I tried to counteract this weakness by providing a comment section within each community case study to detail each of their reactions in a non-quantitative fashion. It should also be noted that the Goals Attainment Scale measured how each community *perceived* the workbook in meeting each of goals. The reasoning behind the use of perceptions rather than actual experience was that all of the communities tested

lacked the time to complete the workbook. In addition these concerns is the problem of the selection of the most appropriate user for this workbook within each of the communities. A majority of those interviewed were system operators, and their knowledge of system financial detail may have been limited. It may have been useful to involve other local government decision makers into the evaluation process to obtain their perspective as important actors in the cost analysis process.

A last area of major concern also occurs in the evaluation section, and involves the number of communities tested. Because only five community systems evaluated the workbook, the conclusions developed from that evaluation are limited in their application to the entire Virginia municipal water and wastewater population. Therefore, the results obtained from that evaluation should be considered only suggestive, not representative.

In order to complete this analysis, a number of recommendations need to be proposed to address the concerns and conclusions developed in this thesis. These are as follows:

- To further test the usefulness and effectiveness of the G.F.O.A. workbook, it needs to be reviewed and completed by communities. Only through the actual input of system data can it be determined whether or not the workbook achieves its goals.
- The completion of this workbook by communities should be accomplished not only by system operators, but also by the relevent local government financial analysts and decision makers. This will permit the evaluation of this workbook to reflect the comments of all of the potential users within a community.
- In completing this testing, a larger, more representative (especially the use of a large size system) sample of communities needs to be used. This would help the evaluator to to generalize his/her results to the population of municipal water and wastewater systems in Virginia.
- The suggestion that operational sophistication may affect the perceived usefulness of the workbook needs to be further examined. A clearer understanding of the components of "op-

erational sophistication" and the way in which it effects system financial analysis needs to be determined.

- Finally, to insure maximum use of the G.F.O.A. workbook, the workbook needs to be effectively marketed. One means to do this is through one or a series of workshops. A workshop will allow communities to become familiar with the purpose, content, use, and benefits of employing this workbook into their financial analysis process. Such a workshop should be widely publicized and should include system operators and local government decision makers.

Bibliography

Bodde, David, "Emerging Trends in Infrastructure Financing", American Water Works Association, v. 17, n. 11, November 1985.

Boland, John, "Alternative Solutions", Water Engineering and Management, v. 132, n. 5, May 1985.

Bohrnstedt, George W., and David Knoke, **Statistics for Social Data Analysis**, F.E. Peacock Publishers, Illinois, 1982.

Dombrowsky, Cathy, "Municipalities Face Clean Water Deadline", American City and County, v. 99, n. 3, March 1984.

Chapmen, Ronald, "Capital Financing: Time for a New Look at an Old Idea", American City and County, v. 98, n. 6, June 1983.

Gilbert, Jerome, "Overcoming The Barriers", Water Engineering and Management, v. 132, n. 5, May 1985.

Grandstaff, Jeanne, "Virginia's Municipal Policy Described", Virginia Water, Virginia State Water Control Board, Spring 1985.

Gray, Robert, "Washington News", Water Engineering and Management, v. 133, n. 12, December 1986.

Hanson, Hugh F., "The Question of Rates", American City and County, V. 100, n. 6, June 1985.

Hickman, Richard E., "Infrastructure in Virginia", Virginia Town and City, V. 19, n. 6, June 1984.

Jenson, Lawrence, "The Challenge of a New Generation of Wastewater Treatment", EPA Journal, U.S. EPA, Washington D.C., v. 12, n. 9, November 1986.

Kemp, Roger, "Public Works Productivity: Beyond Cutback to Creativity", Public Works, v. 117, n. 12, December 1986.

Kory, Ross, and Philip Rosenberg, "Costing Municipal Services", Governmental Finance, v. 11, n. 1, March 1982.

Lewis, Jack, "EPA's Construction Grants Program: A History", EPA Journal, U.S. EPA, Washington D.C., v. 12, n. 9, November 1986.

Martin, Julia, and David Sheatsley, "1980-85 Population Projections for Virginia Counties, Cities, and SMA's", Tayloe Murphy Institute, Colgate Darden Graduate School of Business Administration, University of Virginia, July 1986.

Meier, Kenneth J., and Jeffery L. Brudney, **Applied Statistics for Public Administration**, Duxbury Press, Boston, 1981.

Menchik, Mark D., **How Fiscal Restraint Affects Spending and Services in Cities**, Prepared for the Ford Foundation, Santa Monica, California, January 1982.

Mercer, James C., **Managing Urban Government Services**, AMACOM, New York, 1981.

Mueller, Keith J., "Local Government Implementation of Nationally Inspired Programs: A Comparative Analysis", Journal Of Urban Affairs, V. 6, n. 2, Sprig 1984.

Pagano, Michael, and Richard Moore, **Cities and Fiscal Choices: A New Model For Urban Public Investment**, Duke University Press, North Carolina, 1985.

Popkin, Roy, "Some Communities Move Ahead Without EPA Dollars", EPA Journal, U.S. EPA, Washington D.C., v. 12, n. 9, November 1986.

Randolph, John, "Water and Sewer Service in Virginia", VPI&SU, March 1987.

Report of the Joint Subcommittee Studying Water Supply and Wastewater Treatment, Virginia General Assembly, Richmond Virginia, 1987.

Rider, Robert W., "Local Government Planning: Prerequisites of an Effective System", Urban Affairs Quarterly, v. 18, n. 2, December 1982.

Shell, Richard, and Nicholas Damachi, "Improving Water Utility Management", Water Engineering and Management, v. 132, v. 2, February 1984.

Shinn, Paul, **Draft of Cost Analysis Workbook**, Government Finance Research Center, Washington D.C., March 2, 1987.

Stelstad, Merlin J., and Jeffery R. Bennett, "The Big Challenge of Small Water Systems", American City and County, v. 100, n. 2, February 1985.

Virginia Department of Health, "Survey of Water Supply Needs", Division of Water Programs, 1985.

Virginia State Water Control Board, "Virginia Water Facilities Revolving Loan Fund 1986-1987".

Water Pollution Control Federation Task Force on Financing and Charges, **Finances and Charges for Wastewater Systems**, Water Pollution Control Federation, Maryland, 1984.

Werntz, James, and Margherita Pryor, "State Innovations for Paying the Wastewater Bill", EPA Journal, v. 12, n. 9, November 1986.

Woods, Charles, "Water Rates and the Rate Setting Process", American Water Works Journal, v. 76, n. 9, September 1984.

Appendix A. Questionnaires

SEWER SYSTEM SURVEY

Utility _____

Person completing questionnaire _____

Position _____

Telephone number _____

A. BACKROUND INFORMATION:

1. Number of people served by system _____

2. Number of connections _____

3. To the nearest 10%, what percentage of residents within your jurisdiction receive your sewer service? _____%

4. Actual flow of system _____

5. Which of the following sewage system components do you operate?

   a.___ Local collection sewers
   b.___ Trunk sewers
   c.___ Pumping stations
   d.___ Treatment plant

6. How would you rate the *overall condition* of the sewage system facilities you operate?

	Very Good	Good	Fair	Poor	Very Poor	Do not operate
a.___ Local collection sewers	☐	☐	☐	☐	☐	☐
b.___ Trunk sewers	☐	☐	☐	☐	☐	☐
c.___ Pumping stations	☐	☐	☐	☐	☐	☐
d.___ Treatment plant	☐	☐	☐	☐	☐	☐

7. If you operate a wastewater treatment facility,

   a. When was it built? _____
   b. When was the last expansion/improvement _____
   c. What is it's design flow? _____

B. POTENTIAL WORKBOOK APPLICATIONS

USER CHARGES

User charges and rates are paid by customers to cover all or part of the system costs. We would like to know what type of service you provide, the rates you charge and how you set them, and if you feel worksheets would be helpful for analyzing your costs and setting user charges.

8. What type of sewer service do you provide?

   a. Retail service to users
   b.___ Wholesale service to other sewer systems
   c.___ Both retail and wholesale

   -*If Both Retail and Wholesale*, what is the approximate percentage for each:

   a. Retail _____
   b. Wholesale _____

9. What type of rate structure do you use?

   a.___ Minimum volume charge and extra volume rate
   b.___ Service charge and volume rate
   c.___ Volume rate only
   d.___ Flat rate
   e.___ Percentage of water charge (% = _____)
   e.___ Other (specify) _____

   -*If Minimum Volume Charge* is used, what minimum use is covered by the charge? _____

10. To the nearest 10%, what portion of your annual sewer system costs are covered by sewer user charges? _____%

11. What are your current rates/charges for the following: (mark an 'NA' where not applicable to your system)

	Minimum Use or Service charge	Rate/1000 gallons
Wholesale Sewer Rate	_____	_____
Retail Residential Use (6000 gal/mo.)	_____	_____
Retail Commercial Use (50,000 gal/mo.)	_____	_____
Retail Residential Sewer Hookup (4" line)	_____	
Retail Commercial Hookup (6" line)	_____	

12. Who pays for the cost of service line extensions?

a.___ Sewer system pays
b.___ Developer expected to pay
c.___ Mixed policy- depends on size of development
d.___ No set policy
e.___ Do not provide service extensions

13. Do you serve customers outside of your jurisdictional boundaries?

a.___ Yes
b.___ No

-If Yes, Do they pay a higher rate for sewer service?

a.___ Yes
b.___ No

-If Yes, What is the rate (per 1000 gallons)? _____

14. On what date did your current rates take effect? _____

15. On what date did your previous rate change take effect? _____

16. How are your user charges determined?

a.___ Hired consultant
b.___ Formal in-house study
c.___ Informal in-house study
d.___ Inflation adjustment
e.___ Other (specify) _____
f.___ Don't Know

17. What information is used to determine user charges?

a.___ Cost analysis using APWA sewer charges methods
b.___ Cost analysis using other methods
c.___ Rate structure of nearby locality
d.___ Customer survey
e.___ Governing body mandate
f.___ Other (specify) _____
e.___ Don't Know

18. Do you see a need for an accepted method of cost analysis for setting user charges?

a.___Yes
b.___No
c.___Don't know

19. How useful would you find cost analysis worksheets designed for the following:

	Very Useful	Somewhat Useful	Not very Useful	Not at all Useful	Don't Know
Setting User Charges?	☐	☐	☐	☐	☐
Setting Hookup Fees?	☐	☐	☐	☐	☐
Assessing Service Extensions?	☐	☐	☐	☐	☐

SYSTEM EFFICIENCY

Measures of system economic efficiency can be helpful in monitoring the performance of sewer systems. We would like information on your use of efficiency measures and if you feel worksheets would be helpful in computing efficiency measures for your system.

20. What measures do you use to monitor the efficiency of your system?

a.___ Cost per unit flow
b.___ Cost per customer
c.___ Percent of costs covered by charges
d.___ Accounting ratios (e.g.- operating or coverage ratio)
e.___ Annual charges in expenditures/revenues
f.___ Other (specify) _____
g.___ We do not use any efficiency measures

-If an efficiency measure(s) is used, what is the most recent value(s) of your system's efficiency?

_____

21. Do you see a need for an accepted method for computing system economic efficiency to monitor year-to-year changes in your system?

a.___Yes
b.___No
c.___Don't know

22. How useful would you find cost analysis worksheets designed for computing system efficiency?

a.___ Very useful
b.___ Somewhat useful
c.___ Not very useful
d.___ Not at all useful
e.___ Don't Know

CAPITAL NEEDS OF SYSTEM

Several sewer systems throughout the state have significant needs for expansion, rehabilitation, and replacement. We would like information on the needs of your system, how estimates of their costs are derived and if you feel worksheets would be helpful in assessing your capital needs.

23. When did you last assess the current and/or future major capital needs of your system? _____

24. In which of the following areas do you believe your system has major capital needs, *currently (next 5 years)* and *and by the year 2000*?

	Current Needs	Needs by the Year 2000	Don't Know	Do Not Operate
Interceptors/collectors	☐	☐	☐	☐
Inflow/infiltration control	☐	☐	☐	☐
Treatment plant expansion	☐	☐	☐	☐
Treatment plant rehabilitation	☐	☐	☐	☐
Treatment plant replacement	☐	☐	☐	☐
Other (specify) _____	☐	☐	☐	☐

25. For those areas you have marked in Question 24 as having capital needs, how much money do you estimate you *currently need* and *will need by the year 2000* to make these capital improvements? (mark 'DK' if you don't know)

	Current Needs	Year 2000 Needs
Interceptors/collectors	$ _____	$ _____
Inflow/infiltration control	_____	_____
Treatment plant expansion	_____	_____
Treatment plant rehabilitation	_____	_____
Treatment plant replacement	_____	_____
Other (specify) _____	_____	_____

26. What is the basis for the estimates you gave in Question 25 Please mark **next to the $ estimates you gave above**, the letter from the following list corresponding to the source of the estimate (for example, if a $200,000 estimate for plant expansion given above came from "a very rough estimate", you would mark $200,000 (f).)

a. Develop needs list and secure price quotes
b. In-house engineering studies and updates
c. Consultant engineering studies and updates
d. Information from other communities
e. Information from the State
f. Very rough estimate
g. Other (specify) _____
h. Don't Know

27. How do you expect your system will finance these capital needs? (mark more than one if necessary)

a.___ EPA grant or revolving loan fund
b.___ HUD Comm. Dev. Block Grant
c.___ Other HUD Grant
d.___ FmHA grant or loan
e.___ Virginia Resources Authority Loan
f.___ Local revenue bond
g.___ Local general obligation bond
h.___ Capital improvement fund
i.___ Reserve or sinking fund
j.___ General fund
k.___ Other(specify) _____

28. Do you see a need for an accepted method for estimating the costs of capital needs?

a.___Yes
b.___No
c.___Don't know

29. How useful would you find cost analysis worksheets designed for estimating capital needs?

a.___ Very useful
b.___ Somewhat useful
c.___ Not very useful
d.___ Not at all useful
e.___ Don't Know

SYSTEM FINANCING

A range of sources have been used by localities and authorities to finance sewer system capital costs. We would like information on your sources of financing and if you feel worksheets would be helpful in evaluating your financial capability and your financing options.

30. Mark with an 'x' those means you have used to finance your system's capital costs over the past 10 years or so. Give approximate amounts and years if known.

	Approximate Amount(s)	Year(s)
a. ___ EPA grant	$ _____	_____
b. ___ HUD Comm. Dev. Block Grant	_____	_____
c. ___ Other HUD Grant	_____	_____
d. ___ FmHA grant	_____	_____
e. ___ FmHA loan	_____	_____
f. ___ Local revenue bond	_____	_____
g. ___ Local general obligation bond	_____	_____
h. ___ General fund	_____	_____
i. ___ Sinking or reserve fund	_____	_____
j. ___ Capital improvement fund	_____	_____
k.___ Other(Specify)	_____	_____

31. What led you to choose the above means of financing?

a.___In-house financial analyses
b.___Consultant financial analyses
c.___Governing body decision
d.___Other (specify)_____
e.___Don't know

32. How useful would you find cost and financial analysis worksheets designed for the following:

	Very Useful	Somewhat Useful	Not very Useful	Not at all Useful	Don't Know
a. Assessing financial capability?	☐	☐	☐	☐	☐
b. Evaluating financial options?	☐	☐	☐	☐	☐

C. STAFFING & RECORD KEEPING

We would like some information on the work of your staff in cost analysis and accounting, and what type of information and records you have available.

33. Are sewer service accounts kept separately from the General Fund?

a.___ Yes
b.___ No
c.___ Don't know

34. What are the staffing levels (full time equivalents) for the following sewer service functions?

a. Operation and maintenance.....
b. Management.....
c. Finance/Accounting/Bookkeeping....

35. If sewer service and water supply are managed by the same governmental unit, how are their accounts kept?

a.___ As separate enterprise funds
b.___ As a combined water and sewer enterprise fund
c.___ Other (specify)_____
d.___ They are not managed by the same unit

36. Who performs the system's financial accounting?

a.___ the utility has a staff accountant
b.___ local government accounting office
c.___ outside accounting firm
d.___ a combination of the above
e.___ other _____

37. About how much staff time (in staff-days) is devoted each year to the following sewer service functions?

a. Rate studies.....
b. Efficiency evaluations.....
c. Capital needs assessments.....
d. Financial analysis.....

38. To the nearest 10%, approximately what share of sewer rate studies, efficiency evaluations, needs assessments and other management items are handled by outside consultants? _____

39. Do you have records on the following (circle response):

a. *System data*

-Year of construction of system components	y	n	na
-Remaining useful life of system components	y	n	na
-Customer counts by customer class (residential, commercial, industrial)	y	n	na
-Sewage flows by customer class	y	n	na
-Estimate of infiltration and inflow	y	n	na

b. *Cost and Revenue Accounting*

-Initial cost of system components	y	n	na
-Approximate replacement costs of components	y	n	na
-Value of fixed assets - collection system	y	n	na
-Value of fixed assets - treatment plant components	y	n	na
-Depreciation of fixed assets	y	n	na
-Total Operation and Maintenance (O&M) expenditures	y	n	na
-O&M for collection system	y	n	na
-O&M for treatment plant components	y	n	na
-Debt service	y	n	na
-Payroll accounts	y	n	na
-Interfund transfers	y	n	na

WATER SYSTEM SURVEY

Utility _____

Person completing questionnaire _____

Position _____

Telephone number _____

A. BACKROUND INFORMATION:

1. Number of people served by system _____

2. Number of connections _____

3. To the nearest 10 %, what percentage of residents within your jurisdiction receive your water service? _____%

4. Actual flow of system _____

5. Which of the following water system components do you operate? (mark with an 'x' in the space provided)

   a.___ Raw water source (e.g.- river, reservoir or well)
   b.___ Raw water pumping plant
   c.___ Water treatment plant
   d.___ Transmission mains
   e.___ Storage tanks
   f.___ Distribution system
   g.___ Service meters

6. How would you rate the *overall condition* of the water system facilities you operate?

	Very Good	Good	Fair	Poor	Very Poor	Do Not Operate
a. Raw water pumping plant	☐	☐	☐	☐	☐	☐
b. Water treatment plant	☐	☐	☐	☐	☐	☐
c. Transmission mains	☐	☐	☐	☐	☐	☐
d. Storage tanks	☐	☐	☐	☐	☐	☐
e. Distribution system	☐	☐	☐	☐	☐	☐
f. Service meters	☐	☐	☐	☐	☐	☐

7. If you operate a raw water treatment facility,
   a. When was it built? _____
   b. When was the last expansion/improvement? _____
   c. What is it's design flow? _____

If you do not operate a *raw water* source, skip questions 8 and 9 and move to Section B.

8. Have you had problems with the quality of your raw water?

   a.___ Yes
   b.___ No
   c.___ Don't Know

   -*If YES*, what type?

   a.___ Turbidity
   b.___ Dissolved solids
   c.___ Bacterial quality
   d.___ Chemical contamination
   e.___ Other(specify) _____

9. In your opinion, how significant is the potential for contamination of your raw water source?

   a.___ Significant potential
   b.___ Some potential
   c.___ Little potential
   d.___ No opinion

B. POTENTIAL WORKBOOK APPLICATIONS

USER CHARGES

User charges and rates are paid by customers to cover all or part of the system costs. We would like to know what type of service you provide, the rates you charge and how you set them, and if you feel worksheets would be helpful in analyzing your costs and setting user charges.

10. How do you market your water?

    a.___ Retail directly to users
    b.___ Wholesale service to other water systems
    c.___ Both retail and wholesale

    -*If Both Retail and Wholesale*, what is the approximate percentage for each:

    a. Retail _____
    b. Wholesale _____

11. What type of rate structure do you use?

a.___ Minimum volume charge and extra volume rate
b.___ Service charge and volume rate
c.___ Volume rate only
d.___ Flat rate
e.___ Other (specify) _____

-*If a Minimum Volume Charge* is used, what minimum use is covered by the charge? _____

12. To the nearest 10%, what portion of your annual water system expenses are covered by water user charges? _____%

13. What are your current rates/charges for the following: (mark an 'NA' where not applicable to your system)

	Minimum Use or Service charge	Rate/1000 gallons
Wholesale Water Rate	_____	_____
Retail Residential Use (6000 gal/mo.)	_____	_____
Retail Commercial Use (50,000 gal/mo.)	_____	_____
Retail Residential Hookup (5/8" meter)	_____	
Retail Commercial Hookup (2" meter)	_____	

14. Who pays for the cost of service line extensions?

a.___ Water system pays
b.___ Developer expected to pay
c.___ Mixed policy- depends on size of development
d.___ No set policy
e.___ Do not provide service extensions

15. Do you serve customers outside of your jurisdictional boundaries?

a.___ Yes
b.___ No

-If Yes, Do they pay a higher rate for water service?

a.___ Yes
b.___ No

-If Yes, what is this rate (per 1000 gallons)? _____

16. On what date did your current rates take effect? _____

17. On what date did your previous rate change take effect? _____

18. How are your user charges determined?

a.___ Hired consultant
b.___ Formal in-house study
c.___ Informal in-house study
d.___ Inflation adjustment
e.___ Other (specify) _____
f.___ Don't Know

19. What information is used to determine user charges?

a.___ Cost analysis using AWWA water charges methods
b.___ Cost analysis using other methods
c.___ Rate structure of nearby locality
d.___ Customer survey
e.___ Governing body mandate
f.___ Other (specify) _____
e.___ Don't Know

20. Do you see a need for an accepted method of cost analysis for setting user charges?

a.___Yes
b.___No
c.___Don't know

21. How useful would you find cost analysis worksheets designed for the following:

	Very Useful	Somewhat Useful	Not very Useful	Not at all Useful	Don't Know
Setting User Charges?	☐	☐	☐	☐	☐
Setting Hookup Fees?	☐	☐	☐	☐	☐
Assessing Service Extensions?	☐	☐	☐	☐	☐

SYSTEM EFFICIENCY

Measures of system economic efficiency can be helpful in monitoring the performance of water supply systems. We would like information on your use of efficiency measures and if you feel worksheets would be helpful in computing efficiency measures for your system.

22. What measures do you use to monitor the efficiency of your system?

a.___ Cost per unit flow
b.___ Cost per customer
c.___ Percent of costs covered by charges
d.___ Accounting ratios (e.g.- operating or coverage ratios)
e.___ Metered amount delivered as ratio of amount treated
f.___ Annual charges in expenditures/revenues
g.___ Other (specify) _____
h.___ We do not use any efficiency measures

-If an efficiency measure(s) is used, what is the most recent value(s) of your system's efficiency?

_____

23. Do you see a need for an accepted method for computing system economic efficiency to monitor year-to-year changes in your system?

a.___Yes
b.___No
c.___Don't know

24. How useful would you find cost analysis worksheets designed for computing system efficiency?

a.___ Very useful
b.___ Somewhat useful
c.___ Not very useful
d.___ Not at all useful
e.___ Don't Know

CAPITAL NEEDS OF SYSTEM

Several water systems throughout the state have significant needs for expansion, rehabilitation, and replacement. We would like information on the needs of your system, how estimates of their costs are derived and if you feel worksheets would be helpful in assessing your capital needs.

25. When did you last assess the current and/or future major capital needs of your system? _____

26. In which of the following areas do you believe your system has major capital needs, *currently (next 5 years)* and *and by the year 2000*?

	Current Needs	Needs by the Year 2000	Don't Know	Do Not Operate
Source development	☐	☐	☐	☐
Raw water pumping	☐	☐	☐	☐
Treatment plant expansion	☐	☐	☐	☐
Treatment plant rehabilitation	☐	☐	☐	☐
Treatment plant replacement	☐	☐	☐	☐
Storage	☐	☐	☐	☐
Distribution	☐	☐	☐	☐
Other (specify) _____	☐	☐	☐	☐

27. For those areas you have marked in Question 26 as having capital needs, how much money do you estimate you *currently need* and *will need by the year 2000* to make these capital improvements? (mark 'DK' if you don't know)

	Current Needs	Year 2000 Needs
Source development	$_____	$_____
Raw water pumping	_____	_____
Treatment plant expansion	_____	_____
Treatment plant rehabilitation	_____	_____
Treatment plant replacement	_____	_____
Storage	_____	_____
Distribution	_____	_____
Other (specify) _____	_____	_____

28. What is the basis for the estimates you gave in Question 27 Please mark next to the $ estimates you gave above, the letter from the following list corresponding to the source of the estimate (for example, if a $200,000 estimate for plant expansion given above came from "a very rough estimate", you would mark $200,000 (f).)

a. Develop needs list and secure price quotes
b. In-house engineering studies and updates
c. Consultant engineering studies and updates
d. Information from other communities
e. Information from the State
f. Very rough estimate
g. Other (specify) _____
h. Don't Know

29. How do you expect your system will finance these capital needs? (mark more than one if necessary)

a.___ HUD Comm. Dev. Block Grant
b.___ Other HUD Grant
c.___ FmHA grant
d.___ FmHA loan
e.___ Virginia Resources Authority Loan
f.___ Local revenue bond
g.___ Local general obligation bond
h.___ Capital improvement fund
i.___ Reserve or sinking fund
j.___ General fund
k.___ Other(specify) _____

30. Do you see a need for an accepted method for estimating the costs of capital needs?

a.___Yes
b.___No
c.___Don't know

31. How useful would you find cost analysis worksheets designed for estimating capital needs?

a.___ Very useful
b.___ Somewhat useful
c.___ Not very useful
d.___ Not at all useful
e.___ Don't Know

SYSTEM FINANCING

A range of sources have been used by localities and authorities to finance water system capital costs. We would like information on your sources of financing and if you feel worksheets would be helpful in evaluating your financial capability and your financing options.

32. Mark with an 'x' those means you have used to finance your system's capital costs over the past 10 years or so. Give approximate amounts and years if known.

	Approximate Amount(s)	Year(s)
a. ___ HUD Comm. Dev. Block Grant	$_____	_____
b. ___ Other HUD Grant	_____	_____
c. ___ FmHA grant	_____	_____
d. ___ FmHA loan	_____	_____
e. ___ Local revenue bond	_____	_____
f. ___ Local general obligation bond	_____	_____
g. ___ General fund	_____	_____
h. ___ Sinking or reserve fund	_____	_____
i. ___ Capital improvement fund	_____	_____
j. ___ Other(Specify)_____	_____	_____

33. What led you to choose the above means of financing?

a.___In-house financial analyses
b.___Consultant financial analyses
c.___Governing body decision
d.___Other (specify)_____
e.___Don't know

34. How useful would you find cost and financial analysis worksheets designed for the following:

	Very Useful	Somewhat Useful	Not very Useful	Not at all Useful	Don't Know
a. Assessing financial capability?	☐	☐	☐	☐	☐
b. Evaluating financial options?	☐	☐	☐	☐	☐

C. STAFFING & RECORD KEEPING

We would like some information on the work of your staff in cost analysis and accounting, and what type of information and records you have available.

35. Are water service accounts kept separately from the General Fund?

a.___ Yes
b.___ No
c.___ Don't know

36. If water supply and sewer service are managed by the same governmental unit, how are their accounts kept?

a.___ As separate enterprise funds
b.___ As a combined water and sewer enterprise fund
c.___ Other (specify)_____
d.___ They are not managed by the same unit

37. Who performs the system's financial accounting?

a.___ The utility has a staff accountant
b.___ Local government accounting office
c.___ Outside accounting firm
d.___ A combination of the above
e.___ Other _____

38. What are the staffing levels (full time staff equivalents) for the following water service functions?

a. Operation and maintenance.....
b. Management.....
c. Finance/Accounting/Bookkeeping...

39. About how much staff time (in staff-days) is devoted each year to the following water service functions?

a. Rate studies.....
b. Efficiency evaluations.....
c. Capital needs assessments.....
d. Financial analysis.....

40. To the nearest 10%, approximately what share of water rate studies, efficiency evaluations, needs assessments and other management items are handled by outside consultants? _____%

41. Do you have available information on the following (circle response)?: (y = yes, n = no, na = not available)

a. *System data*

-Year of construction of system components	y	n	na
-Remaining useful life of system components	y	n	na
-Customer counts by customer class (residential, commercial, industrial)	y	n	na
-Water Use flows by customer class	y	n	na
-Number of meters by customer class	y	n	na
-Estimates of maximum daily flows by customer class	y	n	na
-Estimates of maximum hourly flows by customer class	y	n	na

b. *Cost and Revenue Accounting*

-Initial cost of system components	y	n	na
-Approximate replacement costs of system components	y	n	na
-Value of fixed assets	y	n	na
-Depreciation of fixed assets	y	n	na
-Total Operation and Maintenance (O&M) expenditures	y	n	na
-O&M for pumping	y	n	na
-O&M for treatment	y	n	na
-O&M for transmission and distribution	y	n	na
-Debt service	y	n	na
-Payroll accounts	y	n	na
-Interfund transfers	y	n	na

Appendix B. Crosstabulation Tables

1.

Expect to use FmHA Funds

FmHA	Losize	Midsize1	Midsize2	Hisize	
Yes	11	15	1	5	32
	39.3%	48.4%	5.0%	18.5%	30.2%
No	17	16	19	22	74
	60.7%	51.6%	95.0%	81.5%	69.8%
Column Totals	28	31	20	27	106
	26.4%	29.2%	18.9%	25.5%	100.0%

Significance- 0.003

Lambda- 0.000

2.

Expect to use Va. Resources Auth. Loans

VRAL	Losize	Midsize1	Midsize2	Hisize	
Yes	5	14	4	4	27
	17.9%	45.2%	20.0%	14.8%	25.5%
No	23	17	16	23	79
	82.1%	54.8%	80.0%	85.2%	74.5%
Column Total	28	31	20	27	106
	26.4%	29.2%	18.9%	25.5%	100.0%

Significance- 0.027

Lambda- 0.000

3.

Have used FmHA Loans

FmHAL	Losize	Midsize1	Midsize2	Hisize	
Yes	12 46.2%	11 36.7%	2 9.5%	8 28.6%	33 31.4%
No	14 53.8%	19 63.3%	19 90.5%	20 71.4%	72 68.6%
Column Total	26 24.8%	30 28.6%	21 20.0%	28 26.7%	105 100.0%

Significance- 0.050

Lambda- 0.000

4.

Have used Revenue Bonds

REVBON	Losize	Midsize1	Midsize2	Hisize	
Yes	2 7.7%	3 10.0%	8 38.1%	7 25.0%	20 19.0%
No	24 92.3%	27 90.0%	13 61.9%	21 75.0%	85 81.0%
Column Total	26 24.8%	30 28.6%	21 20.0%	28 26.7%	105 100.0%

Significance- 0.025

Lambda- 0.000

5.

Type of Rate Structure Used

RATES	Losize	Midsize1	Midsize2	Hisize	
Min Charge, Vol Rate	27 90.0%	27 81.8%	12 60.0%	17 54.8%	83 72.8%
Ser Charge, Vol Rate	2 6.7%	3 9.1%	7 35.0%	9 29.0%	21 18.4%
Volume rate	1 3.3%3.01%	1 0.0%	0 16.1%	5 6.1%	7
Flat Rate	0 0.0%6.11%	2 5.0%	1 0.0%	0 2.6%	3
Column Total	30 26.3%	33 28.9%	20 17.5%	31 27.2%	114 100.0%

Significance- 0.006

Lambda- 0.000

6.

Have used AWWA Cost Analysis Method

AWWA	Losize	Midsize1	Midsize2	Hisize	
Yes	1 3.7%	1 3.0%	4 21.1%	6 21.4%	12 11.2%
No	26 96.3%	32 97.0%	15 78.9%	22 78.6%	95 88.8%
Column Total	27 25.2%	33 30.8%	19 17.8%	28 26.2%	107 100.0%

Significance- 0.036

Lambda- 0.000

7.

Use a Utility Accountant

UTACC	Losize	Midsize1	Midsize2	Hisize	
Yes	2	5	3	12	22
	6.7%	15.6%	14.3%	40.0%	19.5%
No	28	27	18	18	91
	93.3%	84.4%	85.7%	60.0%	80.5%
Column Total	30	32	21	30	118
	25.2%	30.8%	17.8%	26.2%	100.0%

Significance- 0.007

Lambda- 0.000

8.

Have used FmHA Grants

FmHAG	Losize	Midsize1	Midsize2	Hisize	
Yes	10 24.4%	2 8.0%	1 6.3%	0 0.0%	13 12.9%
No	31 75.6%	23 92.0%	15 93.8%	19 100.0%	88 87.1%
Column Total	41 40.6%	25 24.8%	16 15.8%	19 18.8%	101 100.0%

Significance- 0.031

Lambda- 0.000

9.

Have used FmHA Loans

FmHAL	Losize	Midsize1	Midsize2	Hisize	
Yes	22 53.7%	3 12.0%	1 6.3%	4 21.1%	30 29.7%
No	19 46.3%	22 88.0%	15 93.8%	15 78.9%	71 70.3%
Column Total	41 40.6%	25 24.8%	16 15.8%	19 18.8%	101 100.0%

Significance- 0.000

Lambda- 0.100

10.

Have used Revenue Bonds

REVBON	Losize	Midsize1	Midsize2	Hisize	
Yes	5 12.2%	2 8.0%	9 56.3%	11 57.9%	27 26.7%
No	36 87.8%	23 92.0%	7 43.8%	8 42.1%	74 73.3%
Column Total	41 40.6%	25 24.8%	16 15.8%	19 18.8%	101 100.0%

Significance- 0.000

Lambda- 0.185

11.

Have used General Obligation Bonds

GOBON	Losize	Midsize1	Midsize2	Hisize	
Yes	3 7.3%	10 40.0%	4 25.0%	8 42.1%	25 24.8%
No	38 92.7%	15 60.0%	12 75.0%	11 57.9%	76 75.2%
Column Total	41 40.6%	25 24.8%	16 15.8%	19 18.8%	101 100.0%

Significance- 0.004

Lambda- 0.000

12.

Expect to use CDBG Grants

CDBGF	Losize	Midsize1	Midsize2	Hisize	
Yes	15 44.1%	5 21.7%	0 0.0%	1 5.9%	21 23.6%
No	19 55.9%	18 78.3%	15 100.0%	16 94.1%	68 76.4%
Column Total	34 40.6%	23 24.8%	15 15.8%	17 18.8%	89 100.0%

Significance- 0.001

Lambda- 0.000

13.

Expect to use HUD Funds

HUDF	Losize	Midsize1	Midsize2	Hisize	
Yes	0 0.0%	3 13.0%	0 0.0%	0 0.0%	3 3.4%
No	34 100.0%	20 87.0%	15 100.0%	17 100.0%	86 96.6%
Column Total	34 40.6%	23 24.8%	15 15.8%	17 18.8%	89 100.0%

Significance- 0.030

Lambda- 0.000

14.

Expect to use FmHA Funds

FmHAF	Losize	Midsize1	Midsize2	Hisize	
Yes	15 44.1%	5 21.7%	0 0.0%	3 17.6%	23 25.8%
No	19 55.9%	18 78.3%	15 100.0%	14 82.4%	66 74.2%
Column Total	34 40.6%	23 24.8%	15 15.8%	17 18.8%	89 100.0%

Significance- 0.007

Lambda- 0.000

15.

Expect to use Revenue Bonds

REVBONF	Losize	Midsize1	Midsize2	Hisize	
Yes	7 20.6%	7 30.4%	5 33.3%	13 76.5%	32 36.0%
No	27 79.4%	16 69.6%	10 66.7%	4 23.5%	57 64.0%
Column Total	34 40.6%	23 24.8%	15 15.8%	17 18.8%	89 100.0%

Significance- 0.001

Lambda- 0.281

16.

Year of Last Facility Expansion

YEXPAN	Losize	Midsize1	Midsize2	Hisize	
Low	21 47.7%	1 23.1%	6 5.6%	6 28.6%	34 31.2%
High	23 52.3%	20 76.9%	17 94.4%	15 71.4%	75 68.8%
Column Total	44 40.4%	26 23.9%	18 16.5%	21 19.3%	109 100.0%

Significance- 0.007

Somer's D- +0.178

17.

Type of Rate Structure Used

RATES	Losize	Midsize1	Midsize2	Hisize	
Min Charge, Vol Rate	16 41.0%	12 48.0%	6 33.3%	4 22.2%	38 38.0%
Ser Charge, Vol Rate	2 5.1%	1 4.0%	3 16.7%	6 33.3%	12 12.0%
Volume rate	1 2.6%	0 0.0%	4 22.2%	2 11.1%	7 7.0%
Flat Rate	6 15.4%	2 8.0%	2 11.1%	1 5.6%	11 11.0%
% Water	14 35.9%	10 40.0%	3 16.7%	5 27.8%	32 32.0%
Column Total	39 39.0%	25 25.0%	18 18.0%	18 18.0%	100 100.0%

Significance- 0.015

Lambda- 0.032

18.

Consultant used for User Charges

CONSUL	Losize	Midsize1	Midsize2	Hisize	
Yes	16 37.2%	5 20.0%	4 23.5%	12 57.1%	37 34.9%
No	27 62.8%	20 80.0%	13 76.5%	9 42.9%	69 63.1%
Column Total	43 40.6%	25 23.6%	17 16.0%	21 19.8%	106 100.0%

Significance- 0.044

Lambda- 0.081

19.

Utility Accountant Used

UTACC	Losize	Midsize1	Midsize2	Hisize	
Yes	5 12.5%	3 12.5%	5 27.8%	11 57.9%	24 23.8%
No	35 87.5%	21 87.5%	13 72.2%	8 42.1%	77 76.2%
Column Total	40 39.6%	24 23.8%	18 17.8%	19 18.8%	101 100.0%

Significance- 0.000

Lambda- 0.125

20.

Local Gov't Accountant used

LOCACC	Losize	Midsize1	Midsize2	Hisize	
Yes	12 30.0%	20 83.3%	11 61.1%	9 47.4%	52 51.5%
No	28 70.0%	4 16.7%	7 38.9%	10 52.6%	49 48.5%
Column Total	40 39.6%	24 23.8%	18 17.8%	19 18.8%	101 100.0%

Significance- 0.000

Lambda- 0.346

21.

Outside Accountant used

OUTACC	Losize	Midsize1	Midsize2	Hisize	
Yes	15 37.5%	3 12.5%	2 11.1%	1 5.3%	21 20.8%
No	25 62.5%	21 87.5%	16 88.9%	18 94.7%	80 79.2%
Column Total	40 39.6%	24 23.8%	18 17.8%	19 18.8%	101 100.0%

Significance- 0.008

Lambda- 0.000

Appendix C. Goals Attainment Tables

TABLE 18

Scale Attainmant Levels	Scale 1: Comprehension	Scale 2: Adaptability	Scale 3: Utility	Scale 4: Complexity	Scale 5: Comprehensiveness
a.Most Unfavorable Outcome Likely (-2)	*User finds entire workbook incomprehensible, even with assistance*	*User has none of the information and resources necessary to complete the worksheets and does not know where to find them*	*User anticipates no use for any of the worksheets*	*User finds worksheets to be too complex to consider use*	*User believes that worksheets do not address any of their current financial analysis needs*
b.Less Than Expected Outcome (-1)	*User is in need of directions and guidance to use workbook*	*User has some of the information and resources necessary to complete the worksheets, but is not sure where or how to obtain the rest*	*User believes that worksheets might be useful, but does not intend on using them*	*User finds worksheets to be too complex after attempting use*	*User believes that worksheets only partially address their current financial analysis needs*
c.Expected Outcome (0)	*User can complete worksheets based upon supplied directions and minimal guidance*	*User has most of the information and resources necessary to complete the worksheets and is confident where and how to obtain the rest*	*User anticipates having use for some of the worksheets, but not all of them*	*Although somewhat complex, user believes he can complete worksheets*	*User believes that worksheets address a majority of their current financial analysis needs*
d.More Than Expected Outcome (+1)	*User can complete worksheets based upon supplied directions and no guidance*	*User has all of the information and resources available necessary to he to complete the worksheets*	*User anticipates making full use of the workbook in the near future*	*User believes he can complete worksheets and considers them to be minimally complex*	*User believes that worksheets address all of their current financial analysis needs*
e.Best Anticipated Outcome (+2)	*User can complete worksheets with minimal use of directions and no guidance*	*User has all of the information and resources available, and these are easy to locate and were previously assembled*	*User will make use of the entire workbook and will incorporate its results into present years operations*	*User believes he can complete worksheets and considers them to be relatively simple*	*User believes that worksheets address all of their current and future financial analysis needs.*

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