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A FINANCIAL DESCRIPTION AND EVALUATION OF PUBLIC WATER SYSTEMS IN SOUTH CAROLINA

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Introduction

The primary objective of this study is to begin what is expected to be a three phase research project on the financial health and management of public water systems in South Carolina. The specific objectives of this phase are to: (1) search the literature to analyze other work that has been done in this area, (2) identify models and statistical techniques to be used in evaluating the financial health of the water systems and to help predict which systems are in danger of developing financial problems, (3) gather the financial data necessary to analyze the systems, and (4) analyze the data using the techniques identified.

Data

The financial data necessary to analyze water systems in the state were gathered by sending questionnaires to 189 systems that have received Farmers Home Administration (FmHA) loans. Financial information was requested for the years 1980 through 1983. In lieu of completing the questionnaire, most respondents simply supplied financial statements prepared by accountants. From the questionnaires, 68 useable responses were received.

All the requested information was not received from all districts for all years. Below are the years for which data were requested and the number of systems for which full or partial financial statements were received:

	1980	1981	1982	1983
Complete information	34	45	44	44
Partial information	5	2	4	1

As the research progressed, additional data became necessary on the depreciation of fixed assets by the systems and related information. This information was gathered by letter and telephone. In response to this request, 23 useable responses were received.

Methodology

Financial Description of the Water Systems

The financial data gathered were coded and entered into computer data files. A SAS program was written to calculate key financial ratios used to describe and evaluate the current health of the systems surveyed, as well as to identify significant trends over the period studied.

Restatement of Depreciation

In addition, the Means City Cost Index was used to restate depreciation charges of the systems that responded to the second questionnaire. The depreciation was restated in order to estimate a current market value replacement depreciation charge for the systems. This figure could then be compared to actual depreciation on the financial statements to estimate any understatement in annual depreciation charges.

This information was also used to compare assets on the balance sheet (such as Cash, Marketable Securities, and similar assets) available for replacement of fixed assets to judge the ability of the systems to replace existing assets from internal sources as they wear out. Significant undercharges for depreciation and a lack of assets available for replacement of fixed assets could indicate a serious problem as replacement of existing assets becomes necessary.

Identification of Potential Financial Distress

An Altman [1] multivariate discriminant function was used to calculate Z-scores to identify and predict financial distress. No attempt was made to develop a new discriminant function because of the lack of failed and non-failed classifications of water systems to use as a data base. No water systems in the sample had failed.

Aggregate Financial Description of Surveyed Water Systems

Data Problems

Before beginning an in-depth analysis of the consolidated income statements and balance sheets of the South Carolina water systems analyzed in this project, several comments are in order concerning the methods in which the data were collected and the problems which resulted from these techniques. The primary data collection strategy involved the completion of a voluntary survey which requested items of information from income statements and balance sheets.

Although not particularly damaging from the standpoint of the analysis of the overall financial condition of each individual water system (except to the extent that it made year to year and time-trend comparisons more difficult), the large number of missing observations placed a significant downward bias on many of the individual line items reported in the consolidated income statements and balance sheets presented and discussed below. Thus, footnotes or other marks have been added in those instances where the number of missing or obviously erroneous data points were so numerous as to make accurate conclusions from the resulting data difficult or impossible to interpret.

Another problem was the fact that several systems were combined water and sewer systems or water and electric utility systems. The financial data for them did not allow separation into the water system alone. This fact accounts for the rather large Other Revenue items on the consolidated income statement.

Still another problem was the change in the composition of the sample from year to year. Appendix I contains a list of the systems responding to the survey as well as the financial information gathered from each. As can be seen, the systems in the sample change somewhat from year to year. Although this change does cause some distortions in aggregate financial statements and ratios, the problems are noted in the discussion and their effects considered.

A further problem concerned the format of the financial statements themselves. A wide variety of formats and practices were reflected in the statements. While absolute consistency is neither possible nor always desirable, greater consistency would aid internal and external parties substantially. A reliable, homogeneous financial data base and the resulting availability of aggregate comparison information would help system managers and decisionmakers to better assess the health and condition of individual systems. In addition, the availability of aggregate information would aid governmental policymakers in evaluating current conditions, planning for future needs, and anticipating and dealing with problems before they become critical.

Operating Revenues

The income statements of the water systems were aggregated and are presented in Table I. Total operating revenues were categorized as Retail Water Sales, Wholesale Water Sales, and Other Sales. Retail Water Sales account for the majority of

total revenues while the large Other Revenue component is due to the combined systems. Average revenues per district increased from $420,951 in 1980 to $749,959 in 1982, then decreased slightly to $673,455 in 1983. A comparison of the smallest and largest system in terms of Total Operating Revenue is shown below:

Total Operating Revenues

	1980	1981	1982	1983
Smallest Value	$11,172	12,756	11,554	12,960
Largest Value	$3,543,180	5,635,753	6,274,383	6,005,642*
Number of Systems	32	42	44	41

*The decrease from 1982 is due to a change in the composition of the sample rather than an actual decline in operating revenues.

Table 1

Consolidated Water Systems Income Statement
(Mean Dollar Values)

	1980	1981	1982	1983
Operating Revenue				
Retail Water Sales	$263,623	$301,071	$401,284	$383,971
Wholesale Water Sales	4,481	1,911	6,264	37,469
Other Revenue	152,847	311,634	342,411	252,055
Total Revenue	$420,951	$614,616	$749,959	$673,495
Operating Expenses				
Water Purchases	$ 38,185	117,465	52,248	54,078
Salaries and Wages	50,579	68,350	89,698	98,497
Administrative Expenses	9,713	17,731	15,772	17,171
Chemicals	3,998	4,811	6,054	7,668
Other Supplies	10,406	9,881	18,158	23,281
Fuel and Electricity	94,673	108,521	129,082	152,167
Parts and Repairs	23,751	22,094	27,854	28,067
Professional Services	6,701	5,509	8,942	10,688
Depreciation	47,558	74,817	71,059	79,061
Other Expenses	26,409	44,858	168,796	45,540
Total Expenses	$311,973	$470,037	$587,564	$516,218
NET OPERATING INCOME (LOSS)	$108,978	$144,579	$162,395	$157,277
Nonoperating Revenue	$ 16,191	$ 21,027	$ 20,282	$ 12,112
Nonoperating Expenses				
Interest Expenses	$ 50,416	$ 56,002	$ 178,828	$ 60,792
NET INCOME	$ 74,753	$109,604	$ 3,849	$108,597

Operating Expenses

Average operating expenses by major expense category are also contained in Table I. Generally, the trend from 1980 to 1983 was one of increasing expenses. Several additional observations can be made: (1) the large Fuel and Electricity item indicates some combined systems; and (2) the Other Expenses category for 1982 contains a single, unusually large item which influences the average for all systems for that year.

Net Operating Income

Net operating income considers only operating revenues and operating expenses in measuring the results of the system's operations for a fiscal year. This measure does not include revenues unrelated to the normal course of business, nor does it include interest expense. Table 1 indicated that, with the exception of 1982, the trend in net operating income is generally upward.

The ranges for net operating income for each year are:

Net Operating Income

	1980	1981	1982	1983
Largest Value	$509,295	709,388	942,640	1,180,319
Smallest Value	($163,646)	(186,072)	(4,391,589)	(275,754)
Number of Systems	32	41	42	41

Nonoperating Revenues and Expenses

Nonoperating revenues and expenses represent items which are not part of the system's day-to-day operations. For example, interest expense is considered a non-operating expense. This designation is made so that the effects of the system's

financing decisions can be analyzed and evaluated separately from water production and sale. Average nonoperating revenues have ranged from $12,112 in 1983 to $21,027 in 1981 and have exhibited no clear trend. Nonoperating expenses, consisting entirely of interest expense, have generally trended upward, again with the exception of 1982.

Total Net Income

Total net income combines operating and nonoperating revenues and expenses. Thus, it includes normal operations as well as financing costs and any other revenues and expenses. Average net income was substantially positive in 1980, 1981 and 1983 and marginally positive in 1983. The ranges for each year are:

Net Income

	1980	1981	1982	1983
Largest Value	$535,578	659,904	915,355	1,155,569
Smallest Value	($380,497)	(425,043)	(9,466,503)	(400,359)
Number of Systems	32	41	42	41

Comparison of Mean and Median Income Statement Values

In an effort to gain a more accurate picture of the financial condition of the 'typical' South Carolina water system, an income statement based upon the median dollar values of each of the survey line items was also prepared. These values, reproduced in Table 2, present a more meaningful picture of the state of the median system and are less subject to problems of skewness in the presence of outlying and

unrepresentative observations, whether large or small.

The most striking finding from an examination of these data is an apparently high degree of positive skewness in the sizes of surveyed water systems. Indeed, whereas the mean Total Operating Revenue for 1983 was almost $670,000, the median or middle system was less than half this size with a total of about $330,000. This same pattern is apparent in the other income statement items. Note that, while the mean Net Income was positive for the survey period, the median Net Income was negative for all years surveyed. This finding means that more than fifty percent of all systems surveyed reported losses over each of the four years. If this trend continues, the equity base of more than half of the systems will be systematically eroded, causing problems in replacement of assets and other areas as discussed below.

Table 2

Selected Items: Consolidated Water Systems Income Statements

	1980	1981	1982	1983
Total Operating Revenue (Mean Value)	$420,951	$614,616	$749,859	$673,495
Total Operating Revenue (Median Value)	$420,951	$249,976	$344,473	$333,462
Net Income (Loss) (Mean Value)	$ 74,753	$109,604	$ 3,894	$108,597
Net Income (Loss) (Median Value)	($ 17,917)	($15,034)	($19,405)	($28,538)

Analysis of Consolidated Balance Sheets

Table 3 presents a mean dollar value balance sheet of the surveyed water systems. In terms of total assets, total liabilities, capital, and most other items, the means generally increased from 1980 to 1983. These figures exhibit the same pattern as many income statement items; i.e., the trend is upward with the exception of 1982 (which is substantially larger than other years due to the presence of one large system for that year only).

Table 3

Consolidated Water Systems Balance Sheet
(Mean Dollar Values)

	1980	1981	1982	1983
		ASSETS		
Current Assets				
Cash	$ 51,306	$ 70,216	$ 119,577	$ 77,362
Accounts Receivable	26,254	44,266	69,454	76,667
Marketable Securities & Investments	21,309	57,950	87,139	65,118
Reserves	183,516	255,731	286,778	362,371
Other Current Assets	16,894	19,584	19,521	19,660
Total Current Assets	$ 299,279	$ 447,747	$ 582,469	$ 601,178
Long Term Investments				
Net Plant & Equipment	$1,772,500	$1,922,112	$3,443,209	$2,811,898
Land & Real Estate	28,953	250,117	251,723	22,507
Other Long Term Assets	42,567	92,031	91,386	120,056
Total Long Term Assets	1,844,019	2,253,261	3,786,317	2,954,461
TOTAL ASSETS	$2,143,298	$2,701,008	$4,368,786	$3,555,639
		LIABILITIES & CAPITAL		
Current Liabilities				
Accounts Payable	$ 22,660	$ 28,263	$ 43,573	$ 42,373
Notes Payable	16,689	24,583	35,258	34,176
Accrued Expenses	7,456	13,709	21,719	22,872
Other Current Liab.	49,474	54,933	72,021	62,887
Total Current Liab.	$ 96,279	$ 121,487	$ 172,570	$ 162,308
Long Term Liabilities				
Notes Outstanding	$ 341,122	$ 553,728	$ 393,752	$ 405,791
Bonds Outstanding	648,994	517,655	1,590,624	1,109,425
Other Long Term Liab.	265,859	234,606	321,511	255,996
Total Long Term Liab.	$1,255,975	$1,305,989	$2,305,887	$1,771,211
Total Liabilities	$1,352,254	$1,427,476	$2,478,457	$1,933,519
Capital				
Contributed Capital	$ 594,315	$ 834,315	$1,250,848	$1,030,696
Retained Earnings	196,738	439,217	639,482	591,425
Total Capital	$ 791,053	$1,273,532	$1,890,330	$1,622,121
TOTAL LIAB. & CAPITAL	$2,143,298	$2,701,008	$4,368,786	$3,555,639

Table 4 contains median dollar values for the balance sheets. Upon comparison with the mean values in Table 4, it is apparent that in terms of size, the sample is highly positively skewed. For example, the mean value for Total Assets in 1983 is $3,555,639 while the median is only $1,457,569.

Table 4

Consolidated Water Systems Balance Sheet
(Median Dollar Values)

	1980	1981	1982	1983
	ASSETS			
Current Assets				
Total Current Assets	$ 87,480	$ 141,690	$ 208,521	$ 216,242
Long Term Investments				
Total Long Term Assets	964,326	1,216,661	2,075,595	1,262,023
TOTAL ASSETS	$1,059,519*	$1,289,186	$2,487,874	$1,457,567
	LIABILITIES & CAPITAL			
Current Liabilities				
Total Current Liab.	$ 31,356	$ 46,463	$ 57,755	$ 84,998
Long Term Liabilities				
Total Long Term Liab.	$ 600,616	$ 669,168	$1,333,985	$ 699,634
Total Liabilities	$ 678,166	$ 735,020	$1,346,631	$ 787,650
Capital				
Total Capital	$ 262,509	$ 513,233	$ 563,465	$ 529,372
TOTAL LIAB. & CAPITAL	$1,059,519	$1,289,186	$2,487,874	$1,457,567

*Because medians may come from different systems, totals do not add up to the sum of components.

Consolidated Water Systems Ratio Analysis

In order to analyze and assess the financial condition of the surveyed water systems, 57 financial ratios encompassing liquidity, leverage, coverage, expense, fixed asset, operating, and reserve measures were calculated using the mean dollar value income statement and balance sheet presented in Tables 1 and 3. These ratios are presented in Table 5 and will be discussed in turn below.

Liquidity

The current ratio (see Table 5 for ratio formulas) is a rough indication of a firm's ability to service its current obligations. Despite the income statement problems discussed above, the aggregated water systems current ratio increased somewhat from 3.11 in 1980 to 3.70 in 1983, indicating a general improvement in liquidity and suggesting that the management of the water systems placed a premium on the maintenance of liquidity in spite of profitability problems in the period.

The ratios of individual current assets to total assets show accounts receivable to be the item that rose the most relative to total assets, increasing from 1.23 percent to 2.18 percent over the period. The only potential problem apparent here would be a continuing increase in accounts receivable indicating possible problems with collections.

Leverage and Coverage Ratios

The leverage ratios, which are a measure of the level of the use of debt, show that the relative use of debt fell

substantially from 1980 to 1983. In almost every individual item, the leverage ratios either remained stable or decreased, indicating that the water systems in general use less debt to finance each dollar of assets.

This observation is corroborated by the fact that the coverage ratios also generally improved for the time period except for 1982, which was somewhat distorted by the inclusion of a single large district with large interest charges and losses that year.

Table 5

Consolidated Water Systems Financial Ratio Analysis
(Mean Dollar Values)

	1980	1981	1982	1983
Liquidity Ratios				
Current Ratio (Current Assets/Current Liab.)	3.11X	3.69	3.38	3.70
Operating Rev./Accts. Receivable	16.03X	13.46	10.80	8.79
Cash/Total Assets	2.39%	2.60	2.74	2.18
Accts. Receivable/Total Assets	1.23%	1.64	1.59	2.16
Marketable Securities/Total Assets	0.37%	1.15	1.01	0.68
Other Current Assets/Total Assets	0.79%	0.73	0.45	0.55
Total Current Assets/Total Assets	13.96%	16.58	13.33	16.91
Investments/Total Assets	0.63%	1.00	0.98	1.15
Leverage Ratios				
Accounts Payable/Total Assets	1.06%	1.05	1.00	1.19
Notes Payable/Total Assets	0.78%	0.91	0.81	0.96
Accrued Expenses/Total Assets	0.35%	0.51	0.50	0.64
Other Current Liab./Total Assets	2.31%	2.03	1.65	1.77
Total Current Liab./Total Assets	4.49%	4.50	3.95	4.57
Long Term Notes/Total Assets	15.92%	20.50	9.01	11.41
Bonds Payable/Total Assets	30.28%	19.17	36.41	31.20
Other Long Term Liab./Tot. Assets	12.40%	8.69	7.36	7.20
Tot. Long Term Liab./Tot. Assets	56.60%	48.35	52.78	49.81
Total Liabilities/Total Assets	63.09%	52.85	56.73	54.38
Coverage Ratios				
Net Op. Income & Int./Int.	1.25X	1.69	0.65	1.85
Int. Expense/Total Op. Rev.	11.98%	9.40	23.85	9.03
Operating Expense Ratios				
Salaries & Wages/Total Op. Rev.	12.05%	11.47	11.96	14.63
Admin. Expenses/Total Op. Rev.	2.31%	2.98	2.10	2.55
Chemicals/Total Op. Rev.	0.95%	0.81	0.81	1.14
Other Supplies/Total Op. Rev.	2.47%	1.66	2.42	3.46
Fuel & Elec./Total Op. Rev.	22.49%	18.22	17.21	22.59
Parts & Repairs/Total Op. Rev.	5.64%	3.71	3.71	4.17
Prof. Services/Total Op. Rev.	1.59%	0.93	1.19	1.59
Depreciation/Total Op. Rev.	11.30%	8.31	9.48	11.74
Other Expenses/Total Op. Rev.	6.27%	7.53	22.51	6.72
Total Op. Exp./Total Op. Rev.	86.09%	85.13	99.99	85.67

Fixed Asset Ratios

Plant & Equip./Total Assets	82.70%	70.76	78.81	79.08
Land & Real Estate/Total Assets	1.35%	9.26	5.76	0.63
Other Long Term Assets/Tot. Assets	1.99%	3.41	2.09	3.38
Tot. Long Term Assets/Tot. Assets	86.03%	83.42	86.67	83.09

Operating Ratios

Tot. Op. Rev./Fixed Assets	22.80%	26.40	19.80	22.80
Tot. Op. Rev./Total Capital	53.20%	46.80	39.70	41.50
Retail Water Sales/Total Op.Rev.	62.63%	50.54	53.51	57.01
Wholesale Wtr. Sales/Tot. Op. Rev.	1.06%	0.32	0.84	5.56
Water Purchases/Total Op. Rev.	9.07%	19.72	6.97	8.03
Net Operating Inc./Total Op. Rev.	3.03%	6.49	(8.25)	7.66
Total Nonop. Rev./Total Op. Rev.	3.85%	3.53	2.70	1.80

Reserve Ratios

Cap. Replacement Res./Tot. Assets	0.00%	0.00	0.00	0.01
Cap. Repl. Res./Fixed Assets	0.00%	0.00	0.00	0.01
Capital Repl. Res./Total Liab.	0.00%	0.00	0.01	0.01
Debt Replacement Res./Total Liab.	0.01%	0.01	0.01	0.01
Construction Account/Total Assets	0.81%	3.55	0.33	1.76
Debt Repayment Account/Tot. Assets	0.56%	0.64	0.47	0.43
Funded Depreciation/Total Assets	0.08%	0.10	0.34	0.54
Reserve Accounts/Total Assets	7.11%	5.18	5.42	7.46

Capital Ratios

Contributed Capital/Total Assets	27.73%	30.89	28.63	28.99
Retained Earnings/Total Assets	9.18%	16.26	14.38	16.63
Total Capital/Total Assets	36.91%	47.15	43.26	45.62

Expense Ratios

The findings above generally point to a stable, if not improved, financial picture for the surveyed systems, and the expense ratios in Table 5 indicate a similar picture. In all cases the ratios varied relatively little over the period, again with the exception of 1982.

Fixed Asset and Reserve Ratio

The fixed asset ratios presented in Table 5 remained relatively constant over the period even though there were some interperiod variations. However, the variability of these ratios is not the important point; their total relative size is. Total long term assets make up approximately 85 percent of total assets and this has extremely important implications for water system management and policymakers. These assets must be replaced over time at costs almost always substantially above their original cost. If adequate funds are not accumulated over the period the assets are being used, then large amounts of capital must be raised at a single point in time either through internal or external sources.

The need to replace large amounts of fixed assets can be contrasted to the apparent current lack of accumulation of funds for this purpose by the water systems in the survey. The water systems are required by FmHA to put limited funds aside in reserve accounts in accordance with loan requirements. However, this money is not available to replace assets except to the extent that it can be used to retire FmHA loans and thus increase future borrowing capacity. In any event, the total

reserve funds comprised only about 10 percent of assets in 1983. Of this amount, the vast majority (7.46 percent) was held in FmHA required accounts leaving reserves accumulated for construction, replacement, and related uses of 2.73 percent of assets. This point is discussed at length in the following section concerning restatement of depreciation.

Operating Ratios

Operating ratios are designed to highlight a particular phase of operations. Most of these ratios remain relatively constant with three exceptions. The Total Operating Revenue to Total Capital ratio shows a distinct increase reflecting an increase in capital, particularly retained earnings over the period.

Second, retail water sales as a percentage of total sales declined slightly over the period while the percentage of wholesale revenue increased. Both of these trends are attributed to changes in the sample of water systems rather than to changes in the nature of the systems themselves.

Net operating income as a percent of total revenue trended generally upward over the period except for the aberrant year of 1982. This trend reinforces the observation made earlier that most operating expenses as a percent of revenue declined over the period, reflecting success by the systems in controlling these expenses. However, these ratios are based on means and reflect the positive skewness caused by a few large systems in the sample as noted elsewhere. In fact, median operating incomes

were essentially zero in these years as discussed above.

Capital Ratios

Capital as a percent of total assets increased steadily over the period, primarily because of increases in retained earnings. This factor indicates mean income was substantially positive over the period and apparently caused the equity of the average system to increase. Again, however, this observation must be made in light of the above discussion of mean and median income statements, indicating that the median net income over the period was in fact negative and meaning that the equity base of more than half of the systems actually eroded.

Analysis of the Inadequacy of Depreciation Charges

The above analysis of financial statements clearly indicates the inadequacy of depreciation charges, operating and net income, and retained earnings for a large number of water systems in South Carolina. However, the problem still may be understated. Accounting practices require that depreciation charges be calculated and presented in the financial statements based on their original cost. If inflation has caused the replacement cost of the assets to increase since they were acquired, net income and retained earnings will be understated.

Additionally, if depreciation based on historical cost is used as the basis for determining charges to customers, the effect will be to undercharge for water sold. In the long run, water systems may not be able to replace worn out capital assets without substantial grants, debt issues, or extremely large increases in water rates.

Consider the following income statement based on historical costs:

Revenue		$100
Cash Operating Expenses	$85	
Depreciation	10	95
Net Income		$ 5
Add: Depreciation		10
Net Cash Flow		$ 15

Conceptually, of the $15 of net cash flow for this year, approximately $10 would be used to replace assets that wore out during the year and $5 would be used to increase the equity base of the system. However, if inflation has actually caused the replacement cost of capital assets to be, say, $18

instead of $10, a major problem becomes apparent. The income statement restated on a replacement cost basis becomes:

Revenue		$100
Cash Operating Expenses	$85	
Replacement Cost Depreciation	18	103
Real Net Income		($3)
Add: Depreciation		18
Net Cash Flow		$ 15

In real terms, the system is not making enough to replace itself. It generated cash flow in this year of $15, but $18 is needed to replace assets that wore out. Thus, a $3 shortfall will have to be covered from other sources, or in the long run the system will literally consume itself unless it takes drastic corrective action. This action may be in the form of large debt issues to replace assets, large rate increases over a short period of time, or seeking substantial outside grants which may not be available.

Estimation of Replacement Depreciation

To estimate the size of this problem in the surveyed systems, several steps were taken. First, detailed depreciation schedules were obtained from 25 districts. This information provided the original cost, expected useful life, date of acquisition, and depreciation method for 1,009 individual asset items. The items ranged from water lines and filtration plants to vehicles and small equipment.

Second, a methodology was developed to determine the current replacement cost of assets as well as the expected replacement cost when the asset is due for replacement at the end of its useful life. The Means City Cost Index (see

Appendix II) was selected to adjust historical cost to current replacement cost as well as to project future costs. Other cost indexes could also be used, such as the Engineering News-Record Building Construction Index, the Handy Whitman Public Utility Index, or the Consumer Price Index.

Current replacement cost for each asset was estimated by using the change in the Means Index from the asset's acquisition date to the date the depreciation was prepared. By comparing the current replacement cost to the original cost of the asset, the amount of additional depreciation that actually occurred in excess of that charged off on the financial statements can be estimated.

Table 6 contains a comparison of original cost to current replacement cost of the depreciable assets for three selected systems and the total for all 25 districts in the sample. If the Means Index is accepted as a reasonable approximation of cost increases in water system assets, additional depreciation of about $59,000,000 has occurred in the 25 sample systems, above that reflected in their past financial statements. Obviously, since this deficiency is only for 25 systems, total deficiencies for all systems in the state would be proportionately larger.

Table 6

Comparison of Original Cost to Current Replacement Cost of Total Assets

	(1) Historical Cost	(2) Current Replacement Cost	(3) Deficiency (2)-(1)
System 1	$ 2,451,850	$ 4,137,779	$ 1,685,929
System 2	2,197,935	3,331,784	1,133,849
System 3	11,901,071	27,291,156	15,390,085
Total Sample (25 Systems)	$65,549,905	$124,661,101	$59,111,196

Projected Replacement Cost at the End of Asset's Useful Life

Replacement cost was also estimated for the end of each asset's expected useful life. These amounts were calculated assuming that the annual change in the replacement cost of an individual asset over its remaining life would approximately equal the historical annual change in the Means Index. By calculating the replacement cost at the end of the asset's expected life, yearly depreciation charges which reflect both historical and anticipated replacement cost changes can be estimated. The results of these calculations for the three selected districts and for the total sample are shown in Table 7.

Table 7

Estimated Differences in Replacement Costs
and Yearly Depreciation Charges

	Historical Cost	End-of Life Replacement Cost	Current Yearly Depreciation	Yearly Restated Depreciation
System 1	$ 2,451,850	$52,036,336	$ 52,081	$ 888,711
System 2	2,197,535	40,401,390	50,201	822,600
System 3	11,901,071	197,485,083	313,381	4,166,743
Total Sample (25 Systems)	$65,545,905	$914,509,982	$1,697,924	$19,785,605

These findings are dramatic. They demonstrate that, in order to provide for replacement of existing assets over their useful life, provision for depreciation must be increased from about $1,700,000 currently to about $19,800,000. Systems could reflect these real depreciation amounts in rate determinations and set aside corresponding reserves to accumulate the expected replacement cost over the life of the assets. The alternative, which some systems may choose, is to fund at least part of the replacement cost of the assets at the end of their useful life through debt issues, large rate increases, or grants. Which alternative to choose is not an issue in this study, but policymakers and managers should consider the adequacy of rates in light of real depreciation and replacement costs rather than nominal depreciation based on historical costs for accounting purposes.

Effect of Replacement Cost Depreciation on Financial Statements

The effect of restructuring the balance sheet and income statements to reflect replacement cost is also substantial. Net income would be reduced as a result of larger yearly depreciation expenses, and retained earnings and total equity would be reduced to reflect the larger accumulated depreciation. Examples of these effects are shown in Table 8.

Table 8

Effects of Replacement Cost Depreciation on Net Income and Total Capital

	Net Income for Selected Year	Restated Net Income	Total Capital in Selected Year	Restated Capital
System 1	$ 158,217	($ 678,413)	$ 914,429	($ 4,933,183)
System 2	35,964	(736,413)	2,786,748	(1,120,842)
System 3	(1,280,935)	(5,134,257)	5,674,003	(40,081,513)

Financial Implications of Replacement Cost Depreciation

The purpose of using replacement cost depreciation is to first recognize that the replacement of an asset will likely cost substantially more than its historical cost. Secondly, it compels individual systems to charge to current customers at least a portion of this cost over the expected life of assets and accumulate funds to pay for a portion or all of the replacement of the assets at the end of their life.

Under present conditions, few of the systems studied will have the financial resources on hand for replacement. Thus, the systems must rely almost totally on substantial rate increases

or outside funding, such as grants or loans, when assets wear out. This point is reinforced by an extraction of balance sheet information presented earlier. Mean balances of assets theoretically available for asset replacement are presented in Table 9.

Table 9

Liquid Assets Available for Possible Use to Replace Capital Assets as a Percentage of Total Assets

	1980	1981	1982	1983
Liquid Asset				
Cash	2.39%	2.60%	2.74%	2.18%
Marketable Securities and Investments	1.00	2.15	1.99	1.70
Funded Depreciation	0.08	0.10	0.34	0.54

At this point, it is impossible to say with statistical certainty but current indications are that the dollar amounts in Table 7 are representative of systems in the state. If subsequent research confirms this preliminary information, the implications for the financial future of systems are far-reaching. First, the apparent positive mean net incomes discussed in the above section concerning aggregate income statements overstates the current operating condition of water systems in the state. The actual situation is more accurately described by the median statements which show negative net income to be more typical. If this is indeed the case, systems

are currently operating at a real loss and the capital base is in fact eroding over time. This reinforces the above observation that inadequate income is being generated on an aggregate basis to replace assets in the future. In effect, current water customers will be subsidized by future water customers. This is an issue that must be addressed by system managers and those responsible for establishing policy and rates. It is also an extremely important area for further research.

Measurement of Financial Distress

Zeta Analysis Methodology

A review was conducted of literature related to the financial evaluation of both public and private entities. The review was primarily done to identify techniques that can be used to evaluate the current financial condition of organizations and to predict which ones are in danger of becoming financially distressed. The vast majority of the work found dealt with the analysis of private businesses. As a result, its relevance to water districts was initially open to some question. The review is available in its entirety.

However, this literature represents the only careful analysis of financial distress and it seems probable that both public and private concerns likely to have problems will exhibit similar symptoms.

The analysis of financial statements to evaluate the health of prospective borrowers was initially developed at the end of the nineteenth century. During the 1930s, for obvious reasons, attention was turned to the attempt to predict corporate failure. The definition of corporate failure varied from study to study. Some defined failure as the inability to pay interest and principal on debt. Others defined it as having total market value of assets less than the value of liabilities. Still others restricted the term to companies actually in bankruptcy. All of these situations clearly represent some degree of financial distress. Unfortunately, there is no universally accepted theory of corporate failure. As a result, all of the

studies in this area are essentially descriptive studies of financial distress with no development of cause and effect relationships.

Multivariate discriminant analysis was applied to the prediction of financial distress in Altman's now classic article [2]. A sample of 33 paired firms was analyzed by considering 22 accounting variables as predictors of corporate failure. Altman subsequently revised the model for use in situations where market values of equity do not exist. The five-variable discriminant function he developed for these cases was used to evaluate the surveyed water systems. The discriminant function is:

$$Z = .717x_1 + .847x_2 + .3107x_3 + .420x_4 + .998x_5$$

where:

x_1 = working capital/total assets
x_2 = retained earnings/total assets
x_3 = earnings before interest and taxes/total assets
x_4 = book value of net worth/total liabilities
x_5 = sales/total assets

In this model, all variables are measured on the accounting statement prior to bankruptcy. Altman classified firms based on this model as follows. Firms with Z-scores below 1.23 were bankrupt. Those with scores between 1.23 and 2.90 were in a gray area and required further analysis. Those with scores equal to or greater than 2.90 were classified as non-bankrupt. For Altman's data, 97 percent of the firms proved to be correctly classified by this method.

Findings and Analysis

Based upon Altman's model for privately held firms, Z-scores were calculated for all water systems in years for which complete data were available. The Z-scores are contained in Table 10. The systems are listed in random order.

Table 10

Z-Scores for Surveyed Water Systems

System	1980	1981	1982	1983
1	1.53	0.84	0.47	-
2	0.39	0.53	0.39	-
3	0.32	-	-	-
4	0.51	0.43	0.50	0.52
5	-	-	0.50	0.53
6	1.34	1.45	-	-
7	6.85	-	1.40	-
8	1.91	1.92	-	-
9	1.14	1.80	1.71	1.39
10	0.60	0.61	-	-
11	0.27	0.28	0.30	0.39
12	-	0.91	0.94	0.79
13	-	0.57	-	0.51
14	-	-	0.18	0.73
15	-	-	1.25	1.20
16	-	-	1.02	1.24
17	-	-	-	-
18	-	-	0.74	0.89
19	-	-	0.55	0.82
20	5.28	6.00	-	-
21	1.69	1.71	1.90	1.99
22	-	1.48	1.29	-
23	-	-	1.24	-
24	-	1.10	1.12	-
25	0.14	0.04	0.06	0.13
26	-	0.62	0.71	0.72
27	-0.09	-0.06	-	-
28	-	-	-	-0.47
29	0.87	-	0.45	-
30	-	0.87	-	-
31	-	-	-	1.28
32	-	0.56	0.65	0.74
33	-	-	-	0.26
34	-	0.32	0.23	0.24
35	0.54	0.59	0.50	0.63
36	0.07	0.09	-	-
37	0.52	0.59	-	-
38	-	1.03	0.90	1.03
39	-	0.64	0.69	-
40	0.51	0.09	-	-
41	0.28	0.36	0.21	0.31
42	-	-	0.41	0.51
43	0.62	0.58	-	-

A summary of the scores is contained in Table 11. Based on Altman's cut-off scores for financial distress, the vast majority of systems would be in probable financial distress, while most of the rest are in the gray area. Only three scores representing two districts are in the safe range. This evaluation seems unlikely. More likely, the relevant ranges for public utilities such as water systems have cut-off points much lower than those identified by Altman. The low calculated scores for these systems are apparently due to two factors particular to the nature of water systems.

Table 11

Summary of Z-Scores

Z-Scores	1980	1981	1982	1983
Less than 1.23	14	22	21	19
1.23 to 2.90	5	5	6	4
Greater than 2.90	2	1	0	0

First, the systems are capital intensive and have a relatively high level of total assets compared to the typical business on which Altman's model is based. This condition would affect most of the factors in the model since most are based on total assets. For example, the Sales to Total Assets ratio is a major factor in the model, but would be lower in the typical water system than in the typical privately held business.

Secondly, since the systems are not primarily concerned with profit maximization, the levels of earnings before interest

and taxes and retained earnings are lower than in comparable private companies. This also has a depressing effect on the Z-scores.

At present, there is not enough information or a long enough financial history available to make a judgment on this point, but this is a major area for future research. Over time, the systems included in this study as well as others should be followed to see which systems develop financial distress and which systems do not. From this information, a new discriminant function can be developed.

In conducting this research, several points should be noted in defining financial distress for entities such as publicly held water systems. First, the systems do not have stock outstanding and are not publicly traded. Thus, there is no direct reflection of financial problems in such indicators as stock price. Secondly, water systems have some ability to solve financial problems associated with cash flow shortages or the need to cover unforeseen funding needs by rate increases. Alternative water sources for customers may not be available except at high cost and, at least in the short run, the rate increases will result in higher overall revenues.

Thus, financial distress may have to be measured in other ways. The most direct would be such events as severe cash flow shortages resulting in problems paying for current operating costs and debt service. Other evidence of financial distress may be observed more indirectly. For example, long periods of low rate increases followed by large increases could indicate

that a system may not have been charging financially appropriate rates. Eventually, the shortfall in revenue would result in problems covering operating costs, making debt service payments, or funding capital purchases without a large rate increase.

Future research would identify factors directly indicating financial distress and allow those responsible for the management and policy of the systems to identify potential problems before the situation becomes critical. However, the information gathered in this study can provide guidelines for those currently involved in policymaking and operational management of systems. Using the Altman discriminant function above, managers could calculate the Z-score for a particular system. A score below the median (about 0.7) would indicate that the system is in worse financial condition than 50 percent of the systems in the sample and could indicate possible problems.

Summary of Findings and Recommendations

This study was designed to develop and analyze financial information that had not previously been available on public water systems in South Carolina. As with most work involving data gathering, problems were encountered. These problems included nonresponse, improper response, and misinterpretation of requested information by respondents. However, the data gathered contained a substantial amount of information that revealed both positive and, in some cases, negative facts about the current and future financial health of South Carolina water systems included in the survey. By extrapolation, there are also significant implications for systems not included in the study, both in South Carolina and other states.

Summary of Findings

1. Surveyed water systems have been profitable and have had expanding equity bases over the period from 1980 through 1983 when viewed on a mean basis using historical accounting statements.

2. The systems, in terms of a less biased measure of performance, have not been profitable when viewed on a median basis. More than 50 percent of the systems had negative net income in each year of the study period.

3. The liquidity position of the average system improved slightly over the study period.

4. Average debt levels declined steadily over the study period.

5. A lack of uniformity of financial statements exists in the reporting practices of surveyed water systems.

6. Net income and equity levels declined dramatically when depreciation was restated to reflect current and future replacement costs of assets.

7. Surveyed water systems have low reserve assets available for the replacement of assets.

8. Using discriminant analysis to predict possible future financial distress is inconclusive at the present time because of the lack of adequate financial history to identify factors comprising financial distress in water systems, and to develop a discriminant function directly applicable to the systems.

Recommendations

1. Consistent accounting formats and procedures should be used by water systems in order to facilitate analysis by system management and external parties.

2. Managers and policymakers should establish formal and consistent financial self-evaluation and control procedures using techniques described in this study in addition to others that already may be in use.

3. Replacement cost depreciation estimates should be used in the ratemaking process in order to establish rates adequate to replace existing assets.

4. In association with adequate rates, water systems should establish and accumulate replacement reserves on a continuing and consistent basis.

5. Research on the financial health of water systems should continue, particularly in the areas of:

   (a) further development and maintenance of a data base of financial information on state water systems, both private and public;

   (b) yearly calculation of aggregate financial ratios and other measures to be used in the evaluation of aggregate statewide and individual water systems;

   (c) identification of systems that experience financial distress and development of a discriminant function or other technique that will provide a reliable predictor of future problems; and

   (d) estimation of aggregate and individual shortfalls in current rate structures and replacement reserves by comparing historical depreciation to replacement cost depreciation.

FOOTNOTES

[1] Altman, E. I., Corporate Financial Distress. Wiley-Interscience, New York, 1983.

[2] Altman, E. I., "Financial Ratios, Discriminant Analysis, and the Prediction of Corporate Bankruptcy," Journal of Finance (Sept. 1968): 589-609.

APPENDIX I

Financial Statements Obtained from Surveyed Systems

Name of District	Year			
	1980	1981	1982	1983
City of Abbeville	X*	X	X	X
Alcolu W & S of Claredon	X	X	X	X
Town of Allendale			IS**	
Town of Batesburg	X	X		
Beach Island Rural	X	X		
Beaufort-Jasper County			BS***	X
Belton-Honea Path		X	X	X
Bethune Rural Water Co.	X	X	X	X
Town of Blacksburg	X	X	X	X
Blue Ridge Rural	X	X	X	X
Breezy Hill W & S	X	X		
Bucksport Water Sys.	X	X		X
Bull Swamp	X	X		
Casatt Water Co.		X	X	X
City of Cayce		X	X	
Town of Central	X	X	X	X
Town of Chapin	X	X		
Charlotte Thompson WD	IS	X		
Chester Metropolitan District			X	X
Chesterfield County RWD		X	X	
City of Conway			X	X
Dacusville-Cedar Rock	X	X	X	X
Daniel Morgan				X
Edgefield Co. W & S			X	X
Town of Edisto Beach				X
Town of Elko	X	X		
Town of Fort Hill			X	X
Fripp Island			IS	X
Georgetown County			X	X
Rural Water Dist. of Georgetown County		X	X	X
Gilbert Summit RWD	X		X	
Homeland Park W & S	X	X	X	
Town of Jefferson				X
Town of Jonesville	X	X	X	X
Town of Lakeview	X			
Lancaster W & S	X	X	X	
Town of Latta		X	X	X
Town of Leesville	X		X	
Town of Lexington		IS	IS	
Little River W & S Co.	X	X		
Rural Water Co. of Marlboro County	X	X		
Town of McCormick	X	X	X	X
Town of Moncks Corner				X
City of Newberry		IS	X	

Newberry Co. W & S	X	X	X	X
Oswego Rural				X
Town of Pageland			X	X
Piedmont-Inman	X	X		
Rabon Creek	X	IS	X	X
Town of Ridge Spring		X		X
Rocky Creek Water Co.		X	X	X
St. John's Water Co.	IS	X	X	
Saluda Valley-Powdersville	IS	X	X	X
Town of Santee W & S	X	X		
Santuck Hebron		X	X	X
Sardis Rural	X	X	X	X
City of Seneca	IS	X	X	X
Town of Society Hill	BS	X	X	X
Southside Rural WD	X	X	X	X
Starr-Iva W & S	X	X	X	X
Surfside Beach	X	X	X	
Town of Swansea			X	X
Town of Timmonsville			X	X
Trico Water Co.				IS
Valley Public Water	X	X	X	X
Town of Walhalla	X	X	X	X
West Anderson W & S	X	X	X	X
City of Westminster		X	X	X
Number of Complete Statements	34	45	44	44
Balance Sheets Only	1	0	1	1
Income Statements Only	4	2	3	0

*X = both statements available
**IS = income statement only available for that year
***BS = balance sheet only available for that year

APPENDIX II

Means City Cost Index
1940 - 1984

Year	Index*	Year	Index
1940	15.7	1963	47.3
1941	16.8	1964	48.6
1942	18.0	1965	49.7
1943	18.6	1966	51.9
1944	19.3	1967	53.9
1945	20.2	1968	56.9
1946	23.2	1969	61.6
1947	27.6	1970	65.8
1948	30.4	1971	73.5
1949	30.4	1972	79.7
1950	31.4	1973	86.3
1951	34.4	1974	94.7
1952	35.3	1975	102.6
1953	36.2	1976	107.3
1954	36.7	1977	113.3
1955	38.1	1978	122.4
1956	40.4	1979	132.3
1957	42.2	1980	144.0
1958	43.0	1981	160.2
1959	44.2	1982	174.3
1960	45.0	1983	183.5
1961	45.4	1984	188.0
1962	46.2		

*January 1974 = 100.0