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THE COST OF WATER SUPPLY AND
WATER UTILITY MANAGEMENT

Volume II

by

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FOREWORD

The Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and welfare of the American people. Noxious air, foul water, and spoiled land are tragic testimonies to the deterioration of our natural environment. The complexity of that environment and the interplay among its components require a concentrated and integrated attack on the problem.

Research and development is that first step in problem solution, and it involves defining the problem, measuring its impact, and searching for solutions. The Municipal Environmental Research Laboratory develops new and improved technology and systems (1) to prevent, treat, and manage wastewater, solid and hazardous waste, and pollutant discharges from municipal and community sources, (2) to preserve and treat public drinking water supplies, and (3) to minimize the adverse economic, social, health, and aesthetic effects of pollution. This publication is a product of that research and is a most vital communications link between the researcher and user community.

The Safe Drinking Water Act of 1974 establishes primary, health-related standards and secondary, aesthetic-related but nonenforceable guidelines for drinking water supplies. These standards will bring about fundamental changes in the way water is handled before it is delivered to the consumer. Many of these changes will have an economic impact on the affected water utilities. This report provides detailed information on the current costs of water supply for 12 selected water utilities. In addition to providing information on the individual supplies, data are aggregated to provide projections of the relative impact of various strategies that might be undertaken to satisfy the Act's requirements. These data and associated analyses are presented in two volumes. Volume I is a summary of selected data from the study together with its analysis. Volume II contains detailed, in-depth information for each utility studied.

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ABSTRACT

A study of 12 selected water utilities was undertaken to determine the economics of water delivery. Data were collected from at least one Class A water utility (revenues greater than \$500,000/year) in each of the U. S. Environmental Protection Agency's 10 regions. Volume I provides summary information and in-depth analyses of five of the utilities studied. All the utilities are analyzed in aggregate, and factors affecting the cost of water supply are examined. Also provided is an evaluation of the hypothetical impact of the Safe Drinking Water Act in 1980.

Volume II contains the basic data from each of the 12 utilities studied. Services of each utility were divided into three functional areas common to all water supply delivery systems--acquisition, treatment or purification, and distribution. These areas provided a common basis for collecting and comparing data. Costs were categorized either as operating or as capital expenditures.

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CONTENTS

Foreword	iii
Abstract	iv
Figures	vi
Tables	x
Abbreviations and Definitions	xvi
Metric Conversion Table	xvi
Acknowledgements	xvii
1. Executive Summary	1
2. Introduction	5
3. Conclusions	8
4. Overview and Aggregate Data Analysis	9
5. Cincinnati Water Works	15
6. Kansas City, Missouri, Water Department	42
7. Dallas Water Utility	66
8. San Diego Water Utility	91
9. New Haven Water Company	113
10. Fairfax County Water Authority	136
11. Phoenix Water Department	157
12. Kenton County Water District	177
13. Orlando Water Utility	199
14. Elizabethtown Water Company	220
15. Pueblo Water System	244
16. Seattle Water Department	266

FIGURES

<u>Number</u>		<u>Page</u>
1	Location of Water Utilities Studied	6
2	Average Annual Revenue-Producing Water for All 12 Utilities . . .	10
3	Cincinnati Water Works Service Area	17
4	Major Facilities in Cincinnati Water Works Service Area	18
5	Cincinnati Water Works Organizational Chart	19
6	Cincinnati Water Works Supply Division	21
7	Schematic Diagram of Treatment Plant Costs (\$/mil gal) in the Cincinnati Water Works System	23
8	Cincinnati Water Works Water Flow, 1964 to 1973: Treated Water Versus RPW	25
9	Location of 10 Major Users Within the Cincinnati Water Works Service Area	40
10	Kansas City Water Supply Service Area	44
11	Kansas City Water Department Organizational Structure	45
12	Kansas City Water Department Treatment Plant Schematic	47
13	Kansas City Water Flow: Treated Water Versus RPW	50
14	Kansas City Water Department Facilities	57
15	Kansas City Water Department Allocation of Capital and Operating Expenses to Water System Components	58
16	Locations of 10 Major Users Within the Kansas City Service Area .	65
17	Dallas Water Utility Water Supply Service Area	68
18	Dallas Water Utility Organizational Structure	69
19	Plan of a Dallas Water Treatment Plant	73
20	Dallas Water Utility Water Flow: Treated Water Versus RPW . . .	76
21	Dallas Water Utility Treatment Plants and Pump Stations	83
22	Dallas Water Utility Allocation of Capital and Operating Expenses to Water System Components	84
23	Dallas Water Utility Cost Zones and Location of Major Users . . .	89
24	San Diego Water Utility Reservoir System and Service Area	93

FIGURES (continued)

<u>Number</u>		<u>Page</u>
25	San Diego Water Utility Organizational Chart	94
26	Flow Diagram of the Alvarado Filtration Plant	97
27	San Diego Water Utility Water Flow: Treated Water Versus RPW . .	99
28	San Diego Water Utility Facilities	106
29	San Diego Water Utility Capital and Operating Costs Allocated to Water System Components	107
30	San Diego Water Utility Major Users and Cost Zones	111
31	New Haven Water Company Service Area	115
32	New Haven Water Company Organizational Chart	116
33	New Haven Water Company Treatment Facility Locations	118
34	New Haven Water Company Water Flow: Treated Water Versus RPW . .	121
35	New Haven Water Company Location of Facilities and General Direction of Water Flow in the Retail Service Areas	128
36	New Haven Water Company Allocation of Capital and Operating Expenses to Water System Components	129
37	Fairfax County Water Authority Location Map and Service Areas . .	138
38	Fairfax County Water Authority Organizational Chart	140
39	Fairfax County Water Authority Schematic Diagram of Treatment Facilities	142
40	Fairfax County Water Authority Water Flow: Treated Water Versus RPW	144
41	Fairfax County Water Authority Principal Supply and Transmission Facilities, 1967	152
42	Fairfax County Water Authority Allocation of Capital and Operating Expenses to Water System Components	153
43	Phoenix Water Department Retail Service Area	159
44	Phoenix Water Department Organizational Chart	160
45	Squaw Peak Treatment Plant Flow Diagram	162
46	Phoenix Water Department Water Flow: Treated Water Versus RPW .	165
47	Simplified Phoenix Waterworks Schematic, 1975	171
48	Phoenix Water Department Major Users	175
49	Kenton County Water District Retail Service Area	179
50	Kenton County Water District Organizational Chart	180
51	Schematic Diagram of the Water Treatment Plant and Distribution System for Kenton County Water District No. 1	182

FIGURES (continued)

<u>Number</u>		<u>Page</u>
52	Kenton County Water District Water Flow: Treated Water Versus RPW	185
53	Kenton County Water District Facilities	192
54	Kenton County Water District Allocation of Capital and Operating Costs to Water System Components	193
55	Kenton County Water District Major Users	197
56	Orlando Water Utility Source Water Map	201
57	Orlando Water Utility Organization Chart	202
58	Orlando Water Utility Flow Diagram	204
59	Orlando Water Utility Water Flow: Treated Water Versus RPW . . .	207
60	Orlando Water Utility Flow Map	214
61	Orlando Water Utility Allocation of Capital and Operating Expenses to Water System Components	215
62	Orlando Water Utility Major Users	218
63	Elizabethtown Water Company Service Area Map	223
64	Elizabethtown Water Company Organizational Chart	224
65	Elizabethtown Water Company, Raritan-Millstone Plant	226
66	Elizabethtown Water Company Water Flow: Treated Water Versus RPW	229
67	Elizabethtown Water Company System Map, July, 1974	236
68	Elizabethtown Water Company Allocation of Capital and Operating Costs to System Components	237
69	Elizabethtown Water Company Meter Rates	240
70	Location of 10 Major Users Within the Elizabethtown Water Company Service Area	243
71	Pueblo Water System Retail Service Area	246
72	Pueblo Water Utility Organizational Chart	247
73	Pueblo Water Utility Water Treatment Facilities	249
74	Pueblo Water Utility Water Flow: Treated Water Versus RPW . . .	252
75	Pueblo Water Utility System Facilities	259
76	Pueblo Water Utility Allocation of Capital and Operating Expenses to Water System Components	261
77	Seattle Water Department Service Area	268
78	Seattle Water Department Organizational Chart	270
79	Seattle Water Department Location of System Treatment Facilities	272

FIGURES (continued)

<u>Number</u>		<u>Page</u>
80	Seattle Water Department Water Flow: Treated Water Versus RPW .	274
81	Seattle Water Department Distribution Area	281
82	Seattle Water Utility Allocation of Capital and Operating Expenses to System Components	283
83	Locations of Seattle Water Department Major Users	289

TABLES

<u>Number</u>		<u>Page</u>
1	Cost Analysis Summary for Latest Year of Record (1974)	3
2	Expected Increase in Costs for 1980	4
3	Average Operating Costs for Major Operating Cost Categories	11
4	Average Unit Costs for Major Operating Cost Categories	11
5	Average Operating Cost Categories as Percent of Total Operating Cost	12
6	Average Operating and Capital Costs	12
7	Operating and Capital Expense Ratios	13
8	Manpower Costs	14
9	Cincinnati Water Works, Basic Facts	16
10	Cincinnati Water Works Storage Facilities	24
11	Cincinnati Water Works Annual Operating Costs	26
12	Cincinnati Water Works Unit Operating Costs	28
13	Cincinnati Water Works Operating Cost Categories as Percent of Total Operating Cost	29
14	Cincinnati Water Works Capital and Operating Costs	30
15	Cincinnati Water Works Capital Versus Operating Expense Ratios	30
16	Cincinnati Water Works Labor Cost Analysis	31
17	Cincinnati Water Works Historical and Reproduction Costs of Plant-in-Service	33
18	Transmission Costs Between Service Areas	34
19	Cincinnati Water Works Cost, Consumption, and Revenue by Area (1973)	35
20	Cincinnati Water Works Water Cost for 10 Major Users	36
21	Cincinnati Water Works Meter Rates (April 1, 1969)	37
22	Cincinnati Water Works Monthly and Quarterly Commodity Charges	38
23	Actual Price Versus Cost Comparisons for Ten Major Users in Cincinnati Water Works Service Area	41
24	Kansas City, Missouri, Water Department, Basic Facts	43

TABLES (continued)

<u>Number</u>		<u>Page</u>
25	Kansas City Water Department Systems Storage	49
26	Kansas City Water Department Annual Operating Costs	51
27	Kansas City Water Department Unit Operating Costs	52
28	Kansas City Water Department Operating Cost Categories as Percent of Total Operating Cost	53
29	Kansas City Water Department Labor Cost Analysis	54
30	Kansas City Water Department Capital and Operating Costs	54
31	Kansas City Water Department Capital Versus Operating Expenses Ratios	55
32	Kansas City Water Department Cost, Consumption, and Revenue, by Zone	59
33	Kansas City Water Department Meter Rates	61
34	Kansas City Water Department Commodity Charges	62
35	Kansas City Water Department Charge Analysis	63
36	Kansas City Water Department Water Costs for 10 Major Users	64
37	Dallas Water Utility, Basic Facts (1974)	67
38	Dallas Water Utility Storage Facilities	74
39	Dallas Water Utility Annual Operating Costs	77
40	Dallas Water Utility Unit Operating Costs	78
41	Dallas Water Utility Operating Cost Categories as Percent of Total Operating Costs	79
42	Dallas Water Utility Labor Cost Analysis	80
43	Dallas Water Utility Operating and Capital Costs	80
44	Dallas Water Utility Capital Versus Operating Expense Ratios	81
45	Dallas Water Utility Costs, Consumption, and Revenue, by Zone	85
46	Typical Monthly Rates for the Dallas Water Utility	86
47	Dallas Water Utility Costs for 10 Major Users	87
48	Dallas Water Utility's Costs and Revenues for Major Users	90
49	San Diego Water Utility, Basic Facts (1974)	92
50	San Diego Water Utility Storage Facilities	98
51	San Diego Water Utility Annual Operating Costs	100
52	San Diego Water Utility Operating Costs	101
53	San Diego Water Utility Operating Cost Categories as a Percent of Total Operating Cost	102

TABLES (continued)

<u>Number</u>		<u>Page</u>
54	San Diego Water Utility Labor Cost Analysis	103
55	San Diego Water Utility Capital and Operating Costs	103
56	San Diego Water Utility Capital Versus Operating Expense Ratios .	105
57	Cost Elements for San Diego Service Zones	108
58	Typical Monthly Rates for San Diego Water Utilities	109
59	San Diego Water Utility Water Costs for 6 Major Users	110
60	Costs and Revenues for the San Diego Water Utility's 6 Major Users	112
61	New Haven Water Company, Basic Facts	114
62	New Haven Water Company Distribution Reservoir and Standpipes . .	120
63	New Haven Water Company Annual Operating Costs	122
64	New Haven Water Company Operating Costs	123
65	New Haven Water Company Operating Costs Categories as Percent of Total Operating Cost	124
66	New Haven Water Company Labor Cost Analysis	125
67	New Haven Water Company Capital and Operating Costs	125
68	New Haven Water Company Capital Versus Operating Expense Ratios .	126
69	New Haven Water Company Quarterly Rate Schedule	131
70	New Haven Water Company Quarterly Rate Schedule	131
71	New Haven Water Company Season Rate Schedule	132
72	New Haven Water Company Season Rate Schedule	132
73	New Haven Water Company Quarterly Rate Charge Analysis	133
74	RPW for New Haven Water Company's Ten Major Users	134
75	Fairfax County Water Authority, Basic Facts (1974)	137
76	Fairfax County Water Authority Storage Facilities	143
77	Fairfax County Water Authority Annual Operating Costs	145
78	Fairfax County Water Authority Unit Operating Costs	146
79	Fairfax County Water Authority Operating Cost Categories as Percent of Total Operating Cost	147
80	Fairfax County Water Authority Labor Cost Analysis	149
81	Fairfax County Water Authority Capital and Operating Costs . . .	149
82	Fairfax County Water Authority Capital Versus Operating Expense Ratios	150

TABLES (continued)

<u>Number</u>		<u>Page</u>
83	Fairfax County Water Authority Cost Elements by Zones	154
84	Fairfax County Water Authority Meter Rates	155
85	Fairfax County Water Authority Charge Analysis	155
86	Fairfax County Water Authority Water Costs for 10 Major Users . .	156
87	Phoenix Water Department, Basic Facts (1974)	158
88	Phoenix System Storage Facilities	164
89	Phoenix Water Department Annual Operating Costs	166
90	Phoenix Water Department Unit Operating Costs	167
91	Phoenix Water Department Operating Cost Categories as Percent of Total Cost	167
92	Phoenix Water Department Labor Cost Analysis	168
93	Phoenix Water Department Capital and Operating Cost	168
94	Phoenix Water Department Capital Versus Operating Expense Ratios	169
95	Phoenix Water Department Meter Rates Effective January 1, 1974 .	172
96	Phoenix Water Department Unit Rates (Effective January 1, 1974) .	173
97	Phoenix Water Department Water Costs for 10 Major Users	174
98	Kenton County Water District, Basic Facts (1974)	178
99	Kenton County Water District Storage Facilities	184
100	Kenton County Water District Annual Operating Costs	186
101	Kenton County Water District Unit Operating Cost	187
102	Kenton County Water District Operating Cost Categories as Percent of Total Operating Cost	188
103	Kenton County Water District Labor Cost Analysis	189
104	Kenton County Water District Capital and Operating Costs	189
105	Kenton County Water District Capital Versus Operating Expense Ratios	190
106	Kenton County Water District Cost Elements by Zones	194
107	Kenton County Water District No. 1 Quarterly Rates	195
108	Kenton County Water District 10 Major Users	196
109	Orlando Water Utility, Basic Facts (1974)	200
110	Orlando Water Utility Elevated Water Storage	206
111	Orlando Water Utility Ground Storage Reservoirs	206
112	Orlando Water Utility Annual Operating Costs	208

TABLES (continued)

<u>Number</u>		<u>Page</u>
113	Orlando Water Utility Unit Operating Costs	209
114	Orlando Water Utility Operating Cost Categories as Percent of Total Operating Cost	210
115	Orlando Water Utility Labor Cost Analysis	211
116	Orlando Water Utility Capital and Operating Costs	211
117	Orlando Water Utility Capital Versus Operating Expense Ratios . .	212
118	Orlando Water Utility Water Rates	216
119	Orlando Water Utility RPW of 10 Major Users	217
120	Elizabethtown Water Company, Basic Facts (1974)	221
121	Elizabethtown Water Company Number of Meters by Meter Size . . .	222
122	Elizabethtown Water Company Storage Facilities	228
123	Elizabethtown Water Company Annual Operating Costs	230
124	Elizabethtown Water Company Unit Operating Costs	231
125	Elizabethtown Water Company Operating Cost Categories as Percent of Total Operating Cost	232
126	Elizabethtown Water Company Labor Cost Analysis	233
127	Elizabethtown Water Company Capital and Operating Costs	233
128	Elizabethtown Water Company Capital Versus Operating Expense Ratios	234
129	Elizabethtown Service Area Cost, Consumption and Revenue by Zone	239
130	Elizabethtown Water Company Water Costs for 10 Major Users . . .	241
131	Pueblo Water Utility, Basic Facts (1974)	245
132	Pueblo Water Utility Storage Facilities	251
133	Pueblo Water Utility Annual Operating Costs	253
134	Pueblo Water Utility Unit Operating Costs	254
135	Pueblo Water Utility Operating Costs as Percent of Total	255
136	Pueblo Water Utility Labor Cost Analysis	257
137	Pueblo Water Utility Capital and Operating Costs	257
138	Pueblo Water Utility Capital Versus Operating Expense Ratios . .	258
139	Pueblo Water Utility Water Rates, March 1974	262
140	Pueblo Water Utility Minimum Monthly Charge by Meter Size	262
141	Rates for Multiple Dwelling Units, Inside City	263
142	Pueblo Water Utility Water Costs for 10 Major Users (1974) . . .	264
143	Seattle Water Department, Basic Facts (1974)	267

TABLES (continued)

<u>Number</u>		<u>Page</u>
144	Seattle Water Department Storage Facilities	273
145	Seattle Water Department Annual Operating Costs	275
146	Seattle Water Department Unit Operating Costs	276
147	Seattle Water Department Operating Cost Categories as Percent of Total Operating Cost	277
148	Seattle Water Department Labor Cost Analysis	278
149	Seattle Water Department Capital and Operating Costs	280
150	Seattle Water Department Capital Versus Operating Expense Ratios	280
151	Seattle Water Utility Cost Elements by Source	284
152	Seattle Water Department Minimum Charge by Meter Size Inside City Limits	285
153	Seattle Water Department Minimum Charge by Meter Size Outside City Limits	286
154	Seattle Water Rates for All Meter Sizes	287
155	Seattle Water Department Water Costs for 10 Major Users	288

ABBREVIATIONS AND DEFINITIONS

cost	-- expense of water production
CPI	-- Consumer price index
Maximum day/ maximum hour	-- maximum day flow for the year in MGD/maximum hour flow for the year in MGD
Mil gal	-- million gallons
MGD	-- million gallons per day
Price	-- amount charged user
Retail service area	-- area in which water is retailed by the utility
Revenue-producing water (RPW)	-- the water measured as metered consumption and paid for by wholesale and retail customers within the service area
Treated water	-- the amount of water treated through the water department's treatment plant
SMSA	-- standard metropolitan statistical area
Source water	-- raw water from ground or surface supply

METRIC CONVERSION TABLE

<u>English Units</u>	<u>Metric Equivalents</u>
1 foot	0.305 meters
1 mile	1.61 kilometers
1 sq mi	2.5~ sq kilometers
1 mil gal	3.79 thou cu meters
1 \$/mil gal	0.26 \$/thou cu meters

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SECTION I

EXECUTIVE SUMMARY

A two-year study of 12 selected water utilities was undertaken to determine the economics of water delivery. Data were collected from at least one class A water utility (revenues greater than \$500,000/year) in each of U. S. Environmental Protection Agency's (EPA) 10 regions. The finished water from all utilities selected meets the 1962 Public Health Service Drinking Water Standards, Volume I of this report provides in-depth analyses for five of the 12 utilities studied: Cincinnati, Ohio; Kansas City, Missouri; Fairfax County Water Authority in Fairfax, Virginia; Dallas, Texas; and the Elizabethtown Water Company in Elizabeth, New Jersey. Aggregate analysis of data from all the utilities is also provided in Volume I, along with an evaluation of factors affecting the cost of water supply and a consideration of the impact of technologies that might be used to satisfy requirements of the Safe Drinking Water Act.

Volume II contains the basic data from each of the 12 utilities studied. They represent many institutional arrangements, physically different water supply systems, and different conditions faced by water utilities across the United States. For example, Cincinnati and Kansas City are single-source utilities distributing water to far-flung distribution areas. Others, such as the Dallas Water Utility and the Fairfax County Water Authority, are in rapidly growing areas with capital costs distributed over a fast growing, revenue-producing base that keeps water costs low. Two investor-owned utilities, Elizabethtown Water Company and New Haven Water Company, were included in the sample to demonstrate problems associated with investor-owned utilities. The San Diego and Phoenix utilities operate in water-short areas. Pueblo and Kenton County were the smallest utilities studied. Seattle has made extensive investments in controlled source protection, and Orlando uses groundwater from a deep aquifer.

Data were collected for 10 years in five operating cost categories and two capital cost categories. The operating cost categories are support services, acquisition, treatment, power and pumping, and transmission and distribution. Capital costs were divided into interest and depreciation. Each operating cost category was examined as to total expenditures, unit costs, and percent of total cost. Revenue-producing water was used for all unit cost calculations because it represents the basis on which utilities obtain their operating revenues. The impact of operating expenditures, increasing labor costs, and increasing labor productivity on total water production costs were examined.

A systems evaluation was made for each utility in which the service area was divided into its components. Schematic diagrams of the system components have been developed for each of the utilities studied. For some utilities, these diagrams are very detailed, and for others, because of the complexity of the system, the diagram is somewhat superficial. By using the systems diagram and the previous cost categorizations, it was possible to evaluate the costs associated with delivering water to various subsections of the distribution system and to make some estimates as to how the costs of water vary throughout the distribution area.

Individual and comparative analyses reveal certain trends. Labor cost is a significant part of the annual operating costs for all utilities and has nearly doubled in some cases over the period of analysis. More and more dollars are being shifted into support service activities. Examination of water delivery costs shows that they increase with the distance from the treatment plant; thus there are definite limits to the efficient size of water utility service areas.

Mathematical models have been developed that relate labor cost (\$/man-hour), productivity (man-hours/million gallons (mil gal)), and production (revenue-producing water) to annual operating costs. Another model has been developed for annual capital costs incorporating revenue-producing water and depreciation.

Extrapolations have been made with historical data for future water costs. Estimates for meeting the Safe Drinking Water Act's organic standards have been superimposed on these costs. Between 1974 and 1980, it is estimated that the price of water will have increased by 36% as a result of normal inflation and increased demands. For those few utilities required, under the Safe Drinking Water Act, to install the most expensive control technology (granular activated carbon), costs will increase an additional 24% above the expected 1980 level.

Total costs for each of the 12 utilities during the latest year of data collection are shown in Table 1. Taxes for the investor-owned utilities are reported separately. This analysis provides a mechanism for comparing utilities.

We hope these data will provide useful information on water supply costs from various utility systems and an example of the means by which data can be collected from water supplies to provide comparative information. With the advent of the Safe Drinking Water Act, regulatory agencies, utility managers, and the public should be able to isolate and understand various cost impacts on utilities of inflation and expansion demand versus regulatory impacts. The approach suggested here will allow the utility manager to pinpoint areas where costs are spiraling out of control and allow him to take corrective action. Table 2 summarizes some of the expected cost increases resulting from inflation and demand, as well as the effects of add-on technologies.

TABLE 1. COST ANALYSIS SUMMARY FOR LATEST YEAR OF RECORD (1974)

Utility	Revenue-producing water (mil gal)	Cost categories (\$/mil gal)					Total
		Support services	Acquisition	Treatment	Distribution	Interest	
Kansas City	26,855	\$ 145	\$ 15	\$ 82	\$ 138	\$ 50	\$ 430
Dallas	63,030	83	25	52	120	58	338
San Diego	47,192	96	277	28	106	7	514
New Haven	17,714	113	29	15	106	117	560"
Fairfax Co.	19,232	88	35	56	134	209	522
Phoenix	63,661	91	17	47	112	53	320
Kenton Co.	2,259	82	12	103	124	73	394
Orlando	12,522	110	42	22	135	85	394
Elizabeth	38,256	89	67	33	144	113	492+
Pueblo	6,793	99	38	84	232	164	617
Seattle	45,967	109	37	13	77	27	263
Cincinnati	38,104	85	17	36	139	18	295

* Includes \$179 taxes.

+ Includes \$76 taxes.

TABLE 2. EXPECTED INCREASE IN COSTS FOR 1980

Item	cost in 1975	Expected cost in 1980	1980 costs with add-on technologies		
			GAC - contractors	GAC - media replacement	Chlorine dioxide
Treatment operating cost (\$/yr in millions)	1.10	1.50	2.97	4.17	2.17
† Treatment capital cost (\$/yr in millions)	0.48	0.60	3.34	1.33	0.73
Total operating cost (\$/yr in millions)	8.85	12.40	13.07	15.07	13.07
Total capital cost (\$/yr in millions)	3.80	4.95	7.69	5.68	5.08
Total production cost (\$/yr in millions)	12.75	17.35	21.56	20.75	18.25
Total unit cost (\$/mil gal)	412.00	480.00	596.47	574.06	504.90

SECTION 2

INTRODUCTION

The Safe Drinking Water Act of 1974 will bring about fundamental changes in the way drinking water is handled before it is delivered to consumers. The Act establishes primary health-related standards and secondary or aesthetic-related but nonenforceable guidelines for drinking water supplies. Throughout the Act, emphasis is placed on the need to consider the economics of water delivery.

In response to this need, a 2-year study of selected water utilities was undertaken in which data were collected from at least one Class A water utility (revenues greater than \$500,000/year) in each of the U. S. Environmental Protection Agency's 10 regions. Figure 1 shows the location of the utilities studied. Twelve utilities were selected for investigation--one in regions I, II, III, V, VI, VII, VIII, and X and two in regions IV and IX. The study, which ran from 1974 through 1976, was conducted in two phases with a special study in Cincinnati, Ohio. Data were collected so that costs could be easily compared among utilities.

Each utility's services were divided into the functional areas of acquisition, treatment or purification, and distribution. These functional areas or subsystems are common to all water supply delivery systems and can therefore provide a common basis for data collection. Another category common to all water utilities is the management or administrative function which completes the framework of the institution for insuring an adequate supply of safe drinking water. This institution is most commonly called a water supply utility.

Costs were categorized as either operating or capital expenditures. Operating costs have been assigned to the following functional areas: acquisition, treatment, power and pumping, transmission and distribution (including storage), and support services. The first four functional areas are related to the physical delivery of water, and the fifth, support services, is related to the overall integrative responsibility of utility management. Operating costs include operating labor, maintenance, and materials. For example, if the utility has a treatment division, laboratory personnel costs are included in the treatment cost category, but management costs for the division are included in the support services category. Support services include, therefore, all of the administrative and customer services that are required to manage the water utility and collect revenues but that are not directly related to the physical process of delivering water.

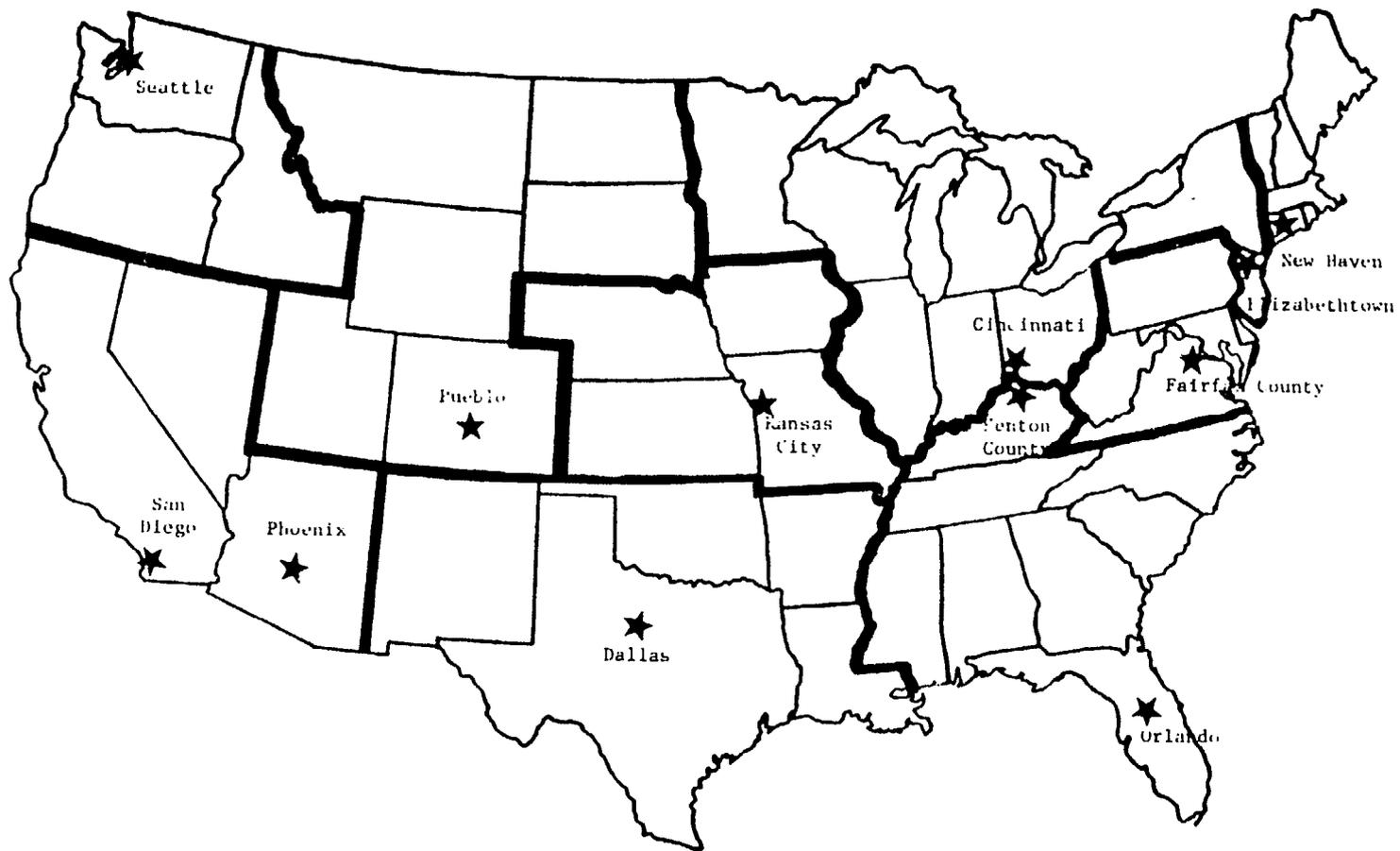


Figure 1. Location of water utilities studied.

Capital costs are assumed as depreciation and interest for the plant-in-service. Depreciation is based on the historic cost of the facility divided by its useful life, and not on the costs required to reproduce the facility. Lower costs will therefore be associated with older utilities. Most of the utilities analyzed constructed the major portion of their facilities in the 1930's and 40's. Interest costs are the dollars the utilities must pay for their bonds or other money raising mechanisms.

Revenues were not considered in this report. All of the data reported are strictly related to the cost of water supply and do not include some of the broader aspects of elasticity of demand and optimal pricing policies of water supply. All costs reported are based on revenue-producing water (RPW) pumped by the utilities for a 10-year period from 1965 through 1974.

The report has been prepared in two volumes. Volume I contains summary information and an analysis of the factors that affect the cost of water supply, and Volume II contains the basic data from each of the selected utilities.

SECTION 3

CONCLUSIONS

Data from the 12 utilities studied here are representative of many utilities in the United States. Distributed across the country, the 12 utilities studied reflect differences in wage rates and costs for various items throughout the United States. The cost of water supply has been continually increasing as a result of increased capital and labor costs, labor wage rates, costs of chemicals and other supplies, and increased demand for water. However, a decrease in the number of man-hours required to supply 1 million gallons (mil gal) of water has moderated these cost increases. In many cases, when the unit cost of water is modified by the Consumer Price Index (CPI), costs have actually decreased with time.

Equations developed in Volume 1 show that when water conservation measures are adopted, increasing wage rates and other inflationary effects will increase the cost of water in accordance with other cost increases in the economy. Such increases are inevitable and should be anticipated.

The methodology used for collecting these data can be applied to water utilities not included in this study. Such an application would provide for a comparative and standardized analysis of water supply costs for all utilities. This effort is intended as a model for other related data collection efforts.

SECTION 4

OVERVIEW AND AGGREGATE DATA ANALYSIS

Revenue-producing water from all 12 utilities increased by approximately 50% over the 10-year period studied (1965-74) (Figure 2).

Average costs for the five major operating cost categories all showed substantial increases over time (Table 3). Support services increased from an average of slightly over \$1 million/year to more than \$3 million/year, or by nearly 200%. The other categories increased by slightly more than 100%, with the exception of transmission and distribution, which increased by approximately 73%.

Unit costs had considerably smaller increases or remained stable during the 10-year period (Table 4). Support services unit cost increased nearly 63%, transmission and distribution stayed nearly the same, and total expenditures increased by less than 50%.

The five operating cost categories varied as a percent of total operating cost (Table 5). Support services increased from 26% to slightly over 31%, and treatment, power and pumping, and transmission and distribution decreased as percents of total operating cost.

Average operating and capital costs for all 12 utilities more than doubled during the 10-year period (Table 6). Operating expenditures increased by 127%, and capital expenditures increased by 78%. Unit costs increased by only 25%.

Average operating and capital expenditures ratios for the 12 utilities studied are shown in Table 7. Operating expenses increased as a percent of total cost from 64.5% in the first year of analysis to nearly 70% by the last year, whereas capital cost dropped from 35.5% in the first year of analysis to just over 30% in the last year.

The impact of labor and operating costs for water supply are shown in Table 8. Labor costs accounted for 42% of the utilities' operating costs in the first year of analysis and 42% in the last year. The average cost/man-hour increased 82%, but the ratio of man-hours/mil gal of RPW decreased by 16%. Table 8 shows a steady decrease in capital/labor cost ratio. Although economies of scale were in effect with respect to the number of man-hours used to produce water, this cost reduction was nullified by wage increases. Labor is therefore a very important factor in what is typically presumed to be a capital intensive industry.

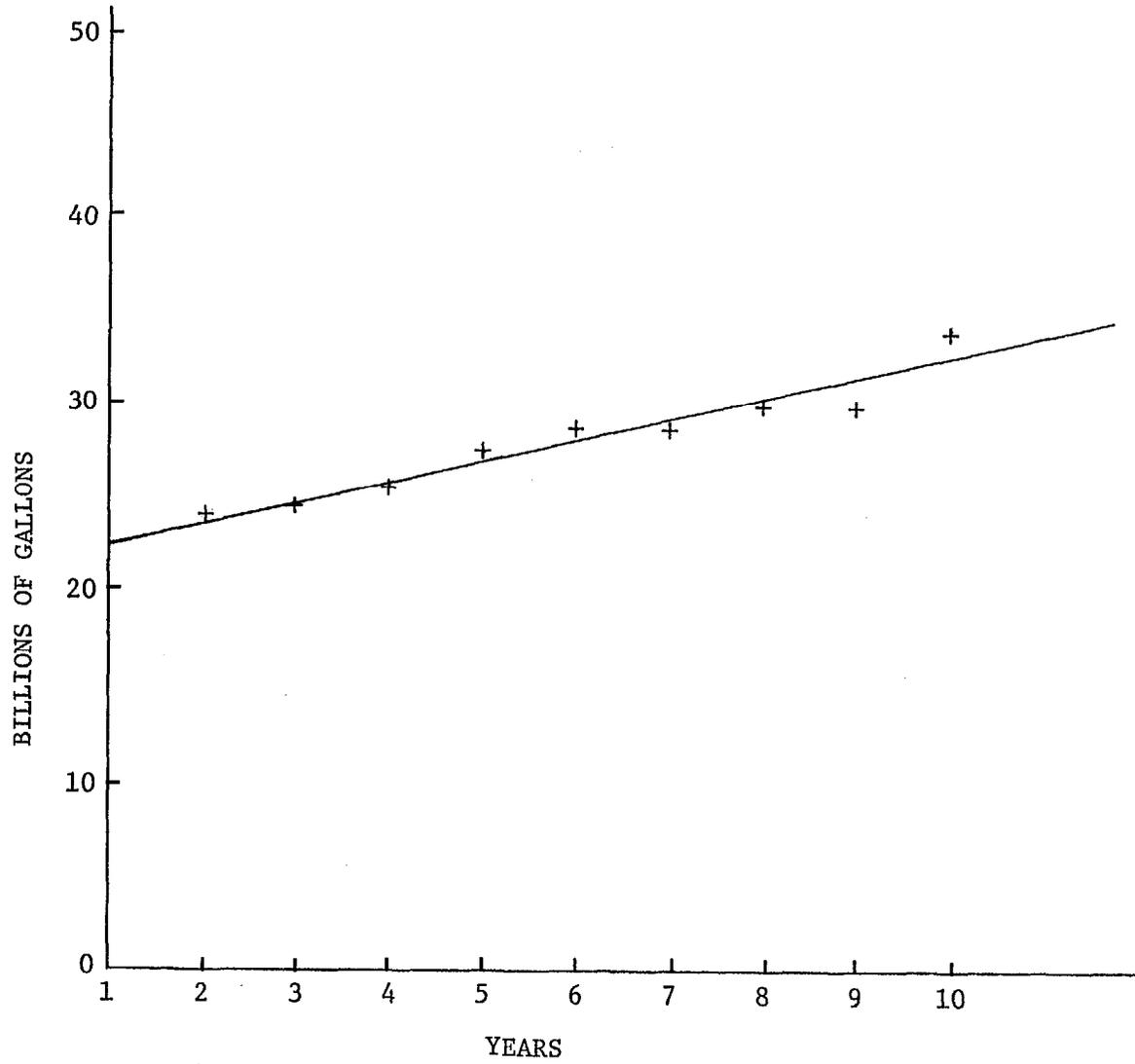


Figure 2. Average annual revenue-producing water for all 12 utilities.