

## SECTION 15

### PUEBLO WATER SYSTEM

The Pueblo Water System is a municipal utility providing water to the citizens of Pueblo, Colorado, and to some adjacent areas, including the Memorial Airport. The population of the county in 1974 was just over 127,000. The retail service area, primarily the City of Pueblo, provides water to 108,000 customers. During the past 10 years, the population and the water demand have remained relatively stable. Some system facts are given in Table 131.

#### WATER SUPPLY SERVICE AREA

The Pueblo Water System provides water on a retail basis to all classes of customers within the service area shown in Figure 71. Treated water is primarily supplied to citizens and industry within the city limits and to some outlying areas, including the Pueblo Memorial Airport on the east side of the city. This service area encompasses approximately 56 sq miles.

Growth is anticipated in the future, and it is expected that the service area will expand somewhat to the east, but primarily to the north and southwest. By the year 2,000, the service area will more than double its present size.

#### ORGANIZATION

Because the system supplies water only, it is not intermingled with any other service organization. The system is controlled by five members of the Board of Waterworks, elected by the citizens to serve a 6 year term. This Board is responsible for long-range plans insuring that the water system is operated in the most efficient and economical manner possible.

Five division heads report to an executive director who is responsible for operation of the utility (Figure 72). The Engineering Division is responsible for determining the equipment and facility requirements and construction of the facilities. The Treatment and Pumping Division is primarily responsible for the operation and maintenance of treatment facilities and pumping from the treatment facilities into the system. The Transmission and Distribution Division is responsible for operation and maintenance related to moving the water from the treatment facilities to the customers and for storage within the distribution system. The Finance Division is responsible for maintaining financial records and billing and collecting. The

TABLE 131. PUEBLO WATER UTILITY, BASIC FACTS (1974)

Item	Amount
Population:	
SMSA	N/A
County	127,092
Retail service area (city)	108,028
Area of retail service area (estimated sq miles)	56
Recognized customer classes (number of accounts)	
City resident	27,292
County resident	247
City commercial	1,664
County commercial	21
Flat rate	2
Church and charity	136
Percent metered	100
Purchased water	None
Source water	100% Surface
Pipe in system (estimated miles)	300
Elevation of treatment plants	
North Ft.	4,695
South Ft.	4,695
Elevation of service area (min/max ft)	4600/5050 (1402/1539)
Revenue-producing water (mil gal)	6,845
Treated water (mil gal)	9,854
Maximum day/maximum hour (MGD)	51/82

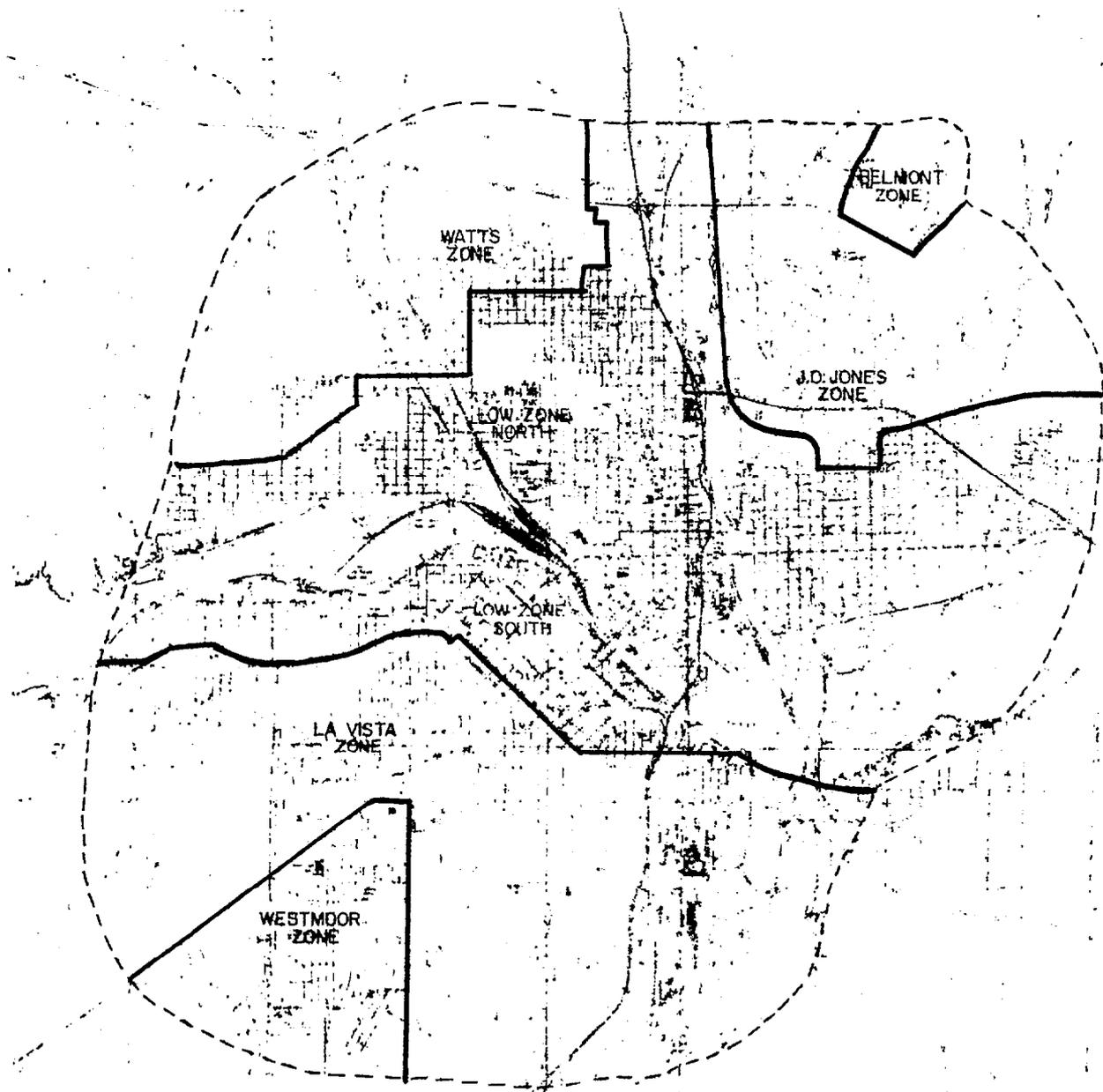


Figure 71. Pueblo Water System retail service area.

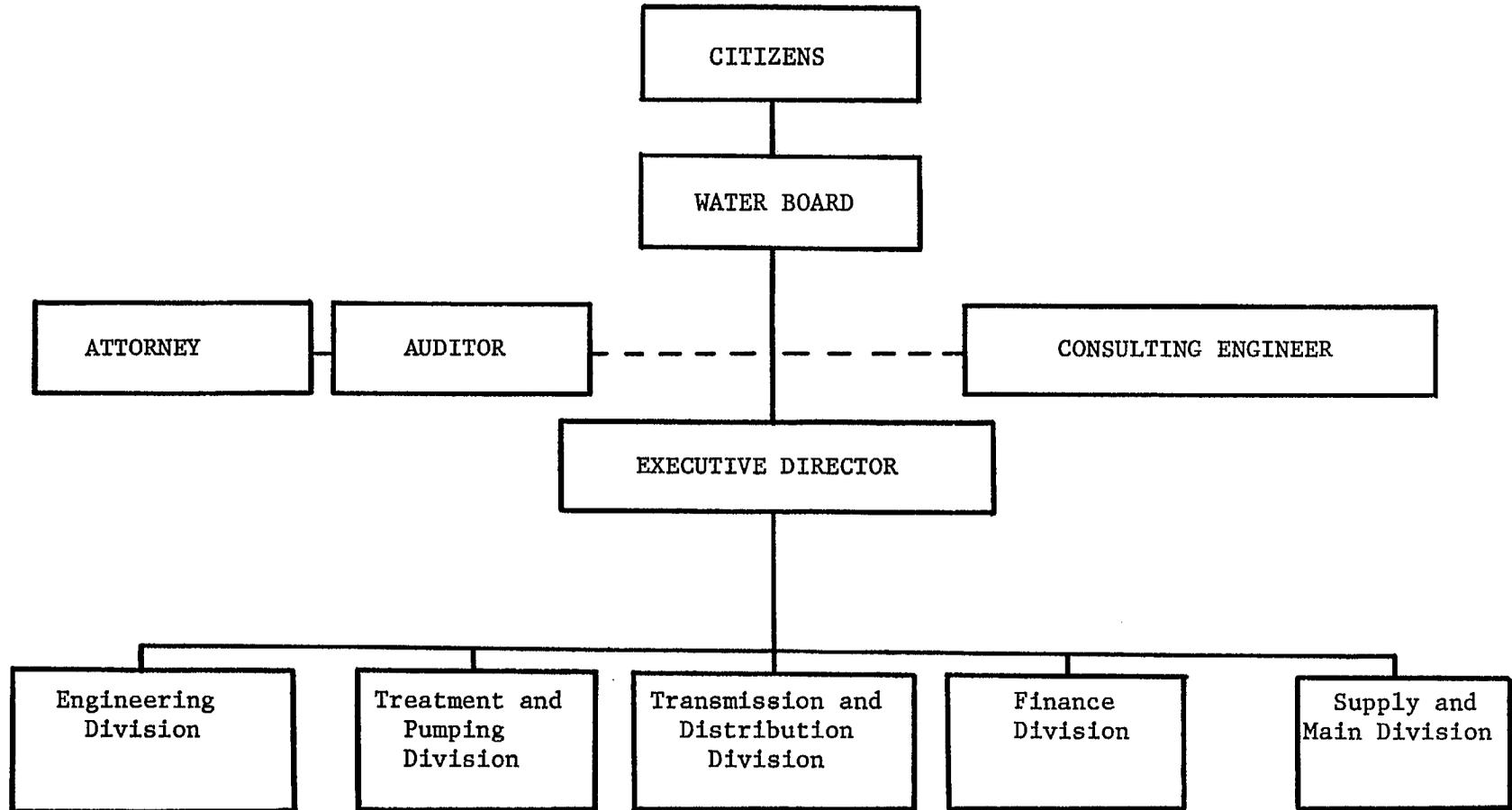


Figure 72. Pueblo Water Utility organizational chart.

Supply and Mains Division is primarily responsible for maintaining the system that supplies raw water to the utility.

#### ACQUISITION

Raw water is taken from the Arkansas River. Because Pueblo is located in an area with a semi-arid climate and at times is subject to water shortage, the system acted to obtain water rights in excess of that normally provided by the Arkansas River.

Pueblo's water supply is composed of three types of rights: (1) non-storable direct flow water from the Arkansas River, (2) storable water diverted from the western slope of the Rocky Mountains into the Arkansas River Basin, and (3) rights to store eastern slope water in Clear Creek reservoir. These watershed areas and storage points are located 140 river miles or more to the west of Pueblo in the Rocky Mountains near Leadville, Colorado.

Pueblo's water rights consist of 34 mil gal of nonstorable water a day from the Arkansas River. To supplement direct flow rights, the Water Board purchased transmountain diversion facilities to transport water from the western slopes of the Rocky Mountains. In 1955, the Board purchased Clear Creek reservoir, which provides 11,232 acre ft of storage space for Pueblo's storable transmountain water. In recent years, the Pueblo Water Board acquired excessive direct flow and transmountain rights for Pueblo's future development. The largest of these is Pueblo's portion of the Twin Lakes diversion system, which alone could support enough water for 50,000 people. From 1967 to 1973, \$23 million was spent for water rights to insure Pueblo's orderly growth and development. The present water supply is capable of supporting 230,000 people plus the water needs of the Comanche Power Station.

#### TREATMENT

Pueblo has two water treatment plants. The Gardner Plant, located on the north side of the Arkansas River, produces 25 MGD, and the McCabe plant, located on the south side of the river directly across from the Gardner plant, produces 15 MGD, providing a total capacity of 40 MGD of treated water. The present treatment process of both plants (Figure 73) removes turbidity and bacteria by sedimentation and flocculation, which depend on gravity aided by chemicals. Each plant uses dry feed machines, mixers, and chlorinators to feed the chemicals in the prescribed amounts into the system.

Water enters each plant through an inlet flume from the Arkansas River to the initial settling basin. Activated carbon is added to the water in the flume and basin to remove any objectionable taste or odor. Heavier particles settle to the bottom, and the water moves slowly to the flash mixers at the beginning of the flocculation tanks. Aluminum sulfate is added and violently flash-mixed by electrically driven blades. This chemical forms jelly-like particles (floc) that attract foreign matter. Slow mixers throughout the tank encourage the formation of floc. As a floc attracts foreign particles, it becomes heavy and sinks to the bottom of the basin. Copper sulfate is added at the end of the flocculation tanks to retard the growth of algae.

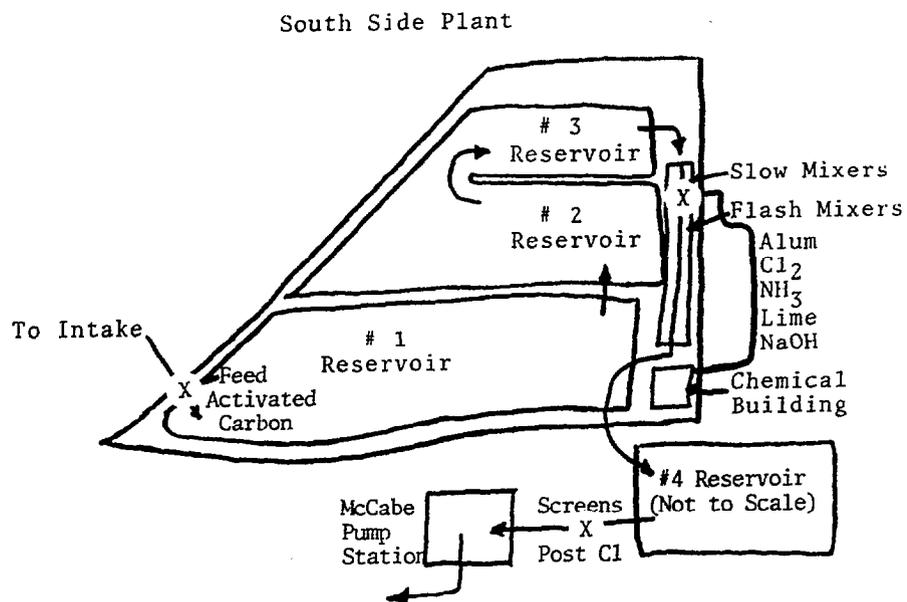
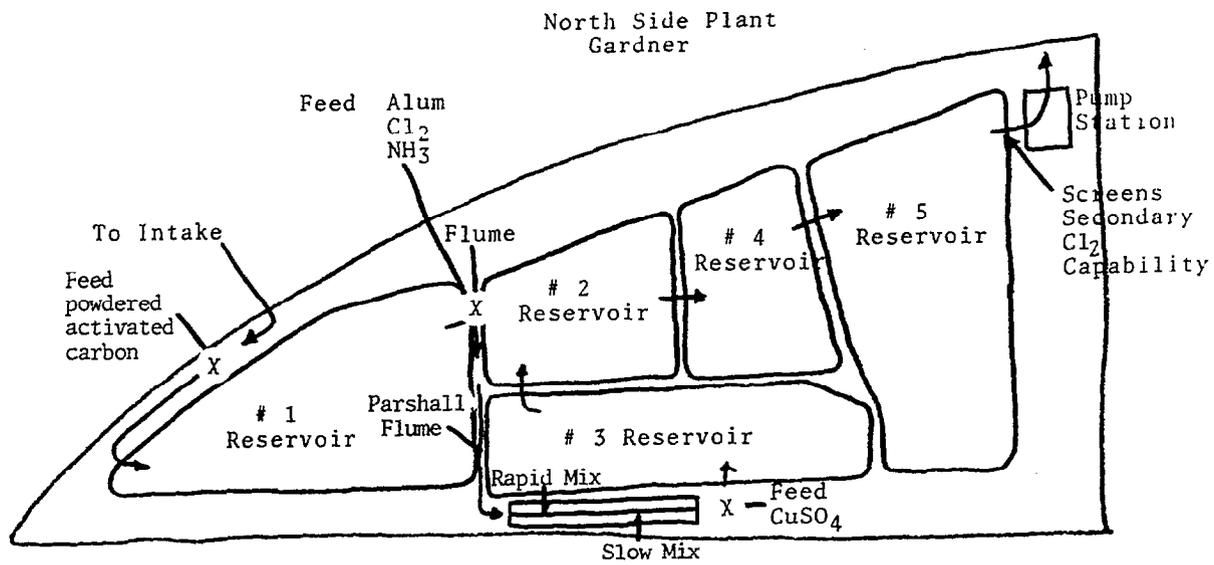


Figure 73. Pueblo Water Utility water treatment facilities.

Chlorine is added to the water to kill any objectionable bacteria, and at the same time, ammonium sulfate is added to combine with the chlorine and form chloramine. These compounds reduce the chlorine taste and enable chlorine to stay in the solution longer.

Filtration, the final step in water treatment, was put into operation during the summer of 1976 at the Northside Treatment Plant. Filtration is especially critical during periods of high water consumption, when the water must be treated rapidly. Chemically treated water will pass through sand filters to guarantee removal of any impurities remaining in the water.

#### TRANSMISSION AND DISTRIBUTION

The transmission and distribution system consists of an estimated 300 miles of underground pipe. The distribution system mains vary in size from 2 to 48 in. in diameter. Most of the pipe is cast iron, but wooden stave, asbestos cement, and steel pipe are also in service. Much of the cast iron pipe is unlined, which has permitted rapid corrosion of the pipe interior. In recent years, cast iron pipes lined with asbestos cement and cement mortar have been used for the smaller mains, and lined steel pipes for the larger mains. The wooden stave pipes are some of the first installed in the system and presently are giving adequate service, although tapping into and repairing the wood pipes have presented some maintenance problems.

Located in Pueblo along the edge of the city are eight clear water reservoir areas with a total storage capacity of over 42 mil gal; these help to balance the water supply and demand. Treated water is pumped into these reservoirs during periods of slack consumption. When the demand for water is heavy, the water flows from the reservoirs into the mains supplementing supplies pumped directly into the system from the treatment plants.

In the nine pumping stations, 28 electric motors from 50 to 700 hp are attached to centrifugal pumps varying in capacity from 1,750 to 10,000 gallons/minute. In addition, at most pumping locations there are large diesel engines ready to take over the water delivery in the event of a general power failure.

A 42-in. pipeline under the Arkansas River links the Gardner and McCabe pumping stations together to allow emergency flexibility. During peak loads, water can be transferred either north or south, as the need arises.

Additional storage is provided by concrete subsurface and ground tanks, steel standpipes, and elevated tanks. A description of the storage capability is given in Table 132.

#### COST ANALYSIS

The demand for water from 1965 through 1974 is shown in Figure 74.

Using the standard cost categories, data were collected and reported as shown in Tables 133, 134, and 135.

TABLE 132. PUEBLO WATER UTILITY STORAGE FACILITIES

Name of facility	Overflow elevation (ft)	Capacity (mil gal)
Watts Reservoir	<b>4903</b>	6
J. O. Jones (4 Tanks)	<b>4919</b>	12
Belmont (2 Tanks)	5008	6
Belmont	<b>5065</b>	1
Watts Elevated	5029	1
Aberdeen	<b>4915</b>	1
Lavista	<b>4987</b>	<b>8</b>
Hellbeck Elevated	4975	2
Westmoor	<b>5150</b>	<b>6</b>
Airport	4650	1

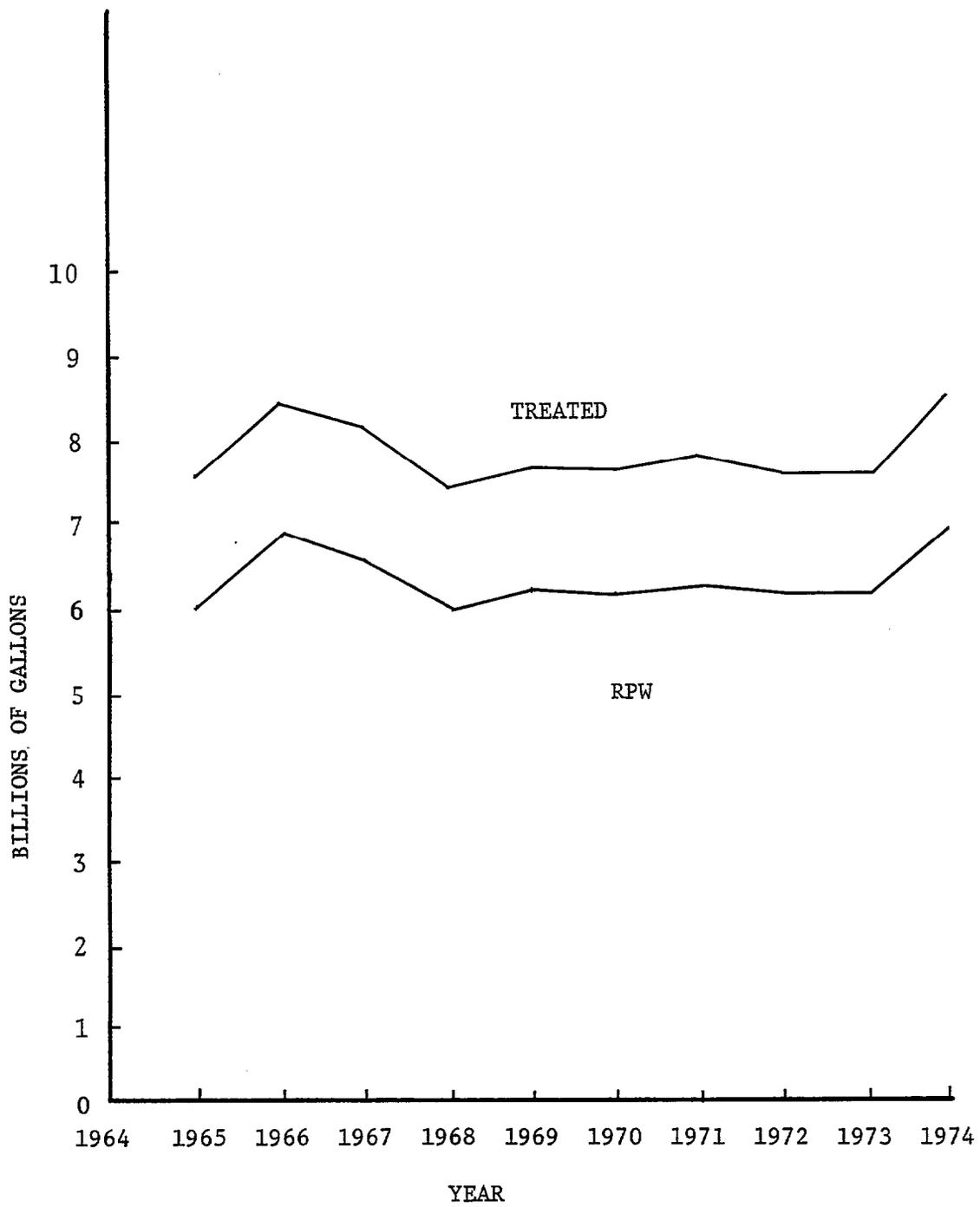


Figure 74. Pueblo Water Utility water flow: treated water versus RPW.

TABLE 133. PUEBLO WATER UTILITY ANNUAL OPERATING COSTS

Category	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Support services:										
Administration	\$146,483	\$170,247	\$141,821	\$170,169	\$149,303	\$176,539	\$155,408	\$166,159	\$204,314	\$189,632
Accounting and collection	163,585	149,739	186,806	175,545	188,538	214,604	248,000	274,611	288,007	322,647
Engineering	---	---	---	38,293	45,118	55,187	58,485	73,767	93,316	92,677
Other	46,119	44,539	45,580	49,194	50,753	43,584	89,554	113,986	85,861	118,124
Total support services	356,187	364,525	374,207	433,201	433,712	490,914	551,447	628,523	671,498	723,080
Acquisition:										
Supervision and labor	15,019	6,471	5,595	22,524	15,663	23,855	18,686	24,403	29,871	42,935
Water development	---	---	---	---	---	---	---	22,367	32,097	36,586
Other	12,881	11,403	5,953	11,894	16,894	11,714	29,135	14,087	25,455	123,326
Total acquisition	27,900	17,874	11,548	34,418	32,557	35,569	47,821	60,857	87,423	202,847
Treatment:										
Supervision and labor	118,852	124,827	119,123	125,429	130,797	146,756	158,494	164,001	188,695	203,810
Chemicals	125,759	142,178	150,652	135,000	136,337	161,413	165,200	168,459	166,166	216,515
Other	38,124	44,972	61,264	70,301	80,920	76,081	92,711	77,532	113,314	107,880
Total treatment	282,735	311,977	331,039	330,730	348,054	384,250	416,405	409,992	468,175	528,205
Power and pumping:										
Supervision and labor	117,268	118,902	128,394	131,292	128,192	116,916	115,947	120,237	120,605	113,657
Power and fuel	163,731	142,672	142,054	144,732	151,443	151,673	150,485	159,748	167,750	205,127
Other	26,877	25,434	39,425	42,154	44,728	35,626	45,221	39,660	45,722	43,303
Total power and pumping	280,876	287,008	309,873	318,178	324,363	304,215	311,653	319,645	334,007	362,087
Transmission and distribution:										
Supervision and labor	183,402	211,780	199,061	156,207	178,359	186,656	200,128	248,516	280,891	322,787
Maintenance	44,025	36,988	18,155	49,754	55,765	54,618	68,035	69,071	89,812	152,204
Other	25,157	24,974	48,527	58,568	77,750	82,687	81,370	94,258	136,938	161,287
Total transmission and distr.	252,584	273,742	265,743	264,529	311,879	323,961	349,533	411,845	507,641	646,278
Total operating cost	1,200,282	1,255,126	1,289,201	1,381,056	1,450,565	1,538,909	1,676,859	1,830,862	2,068,814	2,462,497
Equipment rental credit*	---	---	---	---	52,462	41,002	47,866	49,250	79,840	83,448

\* Must be deducted to produce operating and maintenance costs used in Tables 138 and 139.

TABLE 134. PUEBLO WATER UTILITY UNIT OPERATING COSTS/(\$/mil gal RPW)

Category	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
<b>Support services:</b>										
Administration	\$24.50	\$25.47	\$21.88	\$28.51	\$24.47	\$29.00	\$25.33	\$27.60	\$34.02	\$27.92
Accounting and collection	27.36	22.41	28.82	29.41	30.90	35.41	40.42	45.62	47.95	47.50
Engineering	---	---	---	6.42	7.39	9.06	9.53	12.35	15.54	13.64
Other	7.71	6.66	7.03	8.24	8.32	7.16	14.59	18.93	14.30	17.39
Total support services	59.57	54.55	57.75	72.59	71.08	80.64	89.87	104.41	111.80	106.44
<b>Acquisition:</b>										
Supervision and labor	2.51	0.97	0.86	3.77	2.57	3.92	3.05	4.05	4.97	6.32
Water development	---	---	---	---	---	---	---	3.72	5.34	5.39
Other	2.15	1.71	0.92	1.99	2.78	1.92	4.75	2.34	4.24	18.15
Total acquisition	4.67	2.67	1.78	5.77	5.34	5.84	7.79	10.11	14.56	29.86
<b>Treatment:</b>										
Supervision and labor	19.88	18.68	18.38	21.02	21.44	24.11	25.83	27.24	31.42	30.00
Chemicals	21.03	21.27	23.24	22.62	22.34	26.51	26.92	27.98	27.67	31.87
Other	6.36	6.73	9.45	11.78	13.26	12.50	15.11	12.88	18.87	15.88
Total treatment	47.29	46.68	51.07	55.42	57.04	63.12	67.86	68.10	77.95	77.76
<b>Power and pumping:</b>										
Supervision and labor	19.51	17.79	19.81	22.00	21.01	19.20	18.90	19.97	20.08	16.73
Power and fuel	27.38	21.35	21.92	24.25	24.82	24.91	24.52	26.54	27.93	30.20
Other	4.50	3.81	6.08	7.06	7.33	5.85	7.37	6.59	7.61	6.37
Total pumping	46.98	42.95	47.81	53.31	53.16	49.97	50.79	53.10	55.62	53.30
<b>Transmission and distribution:</b>										
Supervision and labor	30.67	31.69	30.71	26.17	29.23	30.66	32.62	41.28	46.77	48.99
Maintenance	7.36	5.53	2.80	8.34	9.14	8.97	11.09	11.47	14.95	22.41
Other	4.21	3.74	7.49	9.81	12.74	13.58	13.26	15.66	22.80	23.74
Total transmission and distribution	42.45	40.96	41.00	44.32	51.11	53.21	56.96	86.41	84.52	95.14
Total unit operating cost	200.75	187.81	198.89	231.41	237.72	252.78	273.28	304.13	344.46	362.51
Equipment rental credit*	---	---	---	---	8.60	6.73	7.80	8.18	13.29	12.28

\* Must be deducted to produce operating and maintenance costs used in Tables 138 and 139.

TABLE 135. PUEBLO WATER UTILITY OPERATING COSTS AS PERCENT OF TOTAL

Category	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Support services:		1966								
Administration	12.20	13.56	11.00	12.32	10.29	11.47	9.27	9.08	9.88	7.70
Accounting and collection	13.63	11.93	14.49	12.71	13.00	14.01	14.79	15.00	13.92	13.10
Engineering	---	---	---	2.77	3.11	3.58	3.49	4.03	4.51	3.76
Other	3.84	3.55	3.53	3.56	3.50	2.83	5.34	6.22	4.15	4.80
Total support services	29.67	29.05	29.04	31.37	29.90	31.90	32.89	34.33	32.46	29.36
Acquisition:										
Supervision and labor	1.25	0.52	0.43	1.63	1.08	1.55	1.12	1.33	1.44	1.74
Water development	---	---	---	---	---	---	---	1.22	1.55	1.49
Other	1.07	0.91	0.46	0.36	1.17	0.76	1.74	0.77	1.23	5.01
Total acquisition	2.33	1.42	0.89	2.49	2.25	2.31	2.85	3.32	4.23	8.24
Treatment:										
Supervision and labor	9.90	9.95	9.24	9.08	9.02	9.54	9.45	8.96	9.12	8.28
Chemicals	10.48	11.33	11.68	9.77	9.40	10.49	9.85	9.20	8.03	8.79
Other	3.17	3.58	4.75	5.09	5.58	4.95	5.53	4.24	5.48	4.38
Total treatment	23.56	24.85	24.68	23.95	23.99	24.97	24.83	22.39	22.63	21.45
Power and pumping:										
Supervision and labor	9.72	9.47	9.96	9.51	8.84	7.60	6.92	6.57	5.83	4.62
Power and fuel	13.64	11.37	11.02	10.48	10.44	9.85	8.97	8.73	8.11	8.33
Other	2.24	2.03	3.06	3.05	3.08	2.31	2.70	2.17	2.21	1.76
Total pumping	23.40	22.87	24.04	23.04	22.36	19.77	18.59	17.46	16.15	14.70
Transmission and distribution:										
Supervision and labor	15.28	16.87	15.44	11.31	12.30	12.13	11.94	13.57	13.58	13.51
Maintenance	3.67	2.94	1.41	3.60	3.84	3.55	4.06	3.77	4.34	6.18
Other	2.10	1.99	3.77	4.24	5.36	5.37	4.85	5.15	6.62	6.55
Total transmission and distribution	21.05	21.81	20.61	19.15	21.50	21.05	20.84	28.41	24.54	26.24

Table 136 examines labor costs. The cost/man-hour increased 54% over the 10-year period, whereas the total payroll hours required to produce 1 mil gal of RPW remained approximately constant. During that time, there was some fluctuation above and below the manpower requirement in 1965, with most of the fluctuation less than the 1965 requirements. However, in 1974, requirements returned to almost the same value. Thus at least a large portion of the operating cost increased at the same rate as labor cost in a per-man-hour basis.

Table 137 summarizes the operating, depreciation, and interest expenses for the 10-year period of analysis. Table 138 computes capital and operating expense ratios. The operating expenses are those shown as a total of the values in Table 133, the expenses incurred in the normal day-to-day operations of the system. The capital expenses are the total periodic expenditures for major equipment items and facilities plus interest charged on money borrowed for those purposes.

A comparison of the operating and capital expenses as a percent of total shows that in the Pueblo Water System, more expenses are associated with operations than with capital. Over the 10-year period, the trend changed in the direction of capital. In 1965, 65% of the total expended was for operating expense, and 35% was for capital. This ratio changed gradually over the 10 years, with an increased portion of the expenses going toward capital. By 1974, the ratio was 57% for operations and 43% for capital.

The Pueblo Water System's basic equipment, including much of the distribution system and the treatment facilities, is relatively old. During the last 10 years, however, a sizable capital expenditure has been made for water rights and also some for facility improvements. Most of the capital expenditures have been associated with water rights that have little effect on the present operating system but would cause a significant impact on the depreciated capital. These water rights certainly do put the system in a solid position for future operations. A condition such as this, with increasing capital costs compounded with increasing operational costs, causes rapid escalation in total cost for the production of water. This trend can be seen by examining the total cost/mil gal of RPW (Table 137). Examination of the figures for the total 10-year period points up this trend, especially from 1972 through 1974, when the cost of producing water increased rapidly.

#### SYSTEM COSTS

Examination of the costs on a functional basis is only part of the total picture. Because the purpose of the water utility is to deliver water to a customer, it is important to present costs as they relate water delivery to the demand point within the distribution system. The functional categories, both operating and capital, are therefore reaggregated and assigned to physical components in the water delivery system. This section contains such an analysis of the water supply system cost.

Locations of the Pueblo Water System's facilities are shown in Figure 75. Unfortunately, data were not available in the utility's records that would

TABLE 136. PUEBLO WATER UTILITY LABOR COST ANALYSIS

Item	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Total payroll (\$)	653,721	684,597	666,851	670,876	701,103	759,714	821,138	911,971	1,037,755	1,139,840
Total hours on payroll	257,920	257,920	257,920	255,840	260,000	237,120	245,440	260,000	282,880	293,280
Revenue-producing water (mil gal)	5,979	6,683	6,482	5,968	6,102	6,088	6,136	6,020	6,006	6,793
Total payroll/mil gal RPW (\$)	109.34	102.44	102.88	112.41	114.90	124.79	133.82	151.49	172.79	167.80
Total hours/mil gal RPW	43.14	38.59	39.79	42.87	42.61	38.95	40.00	43.19	47.10	43.17
Average cost/man-hour (\$)	2.53	2.65	2.59	2.62	2.70	3.20	3.35	3.51	3.67	3.89

TABLE 137. PUEBLO WATER UTILITY CAPITAL AND OPERATING COSTS

Item	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Operating expense (\$)	1,200,282	1,255,126	1,289,201	1,381,056	1,398,103	1,497,907	1,628,993	1,781,612	1,988,974	2,379,049
Depreciation (\$)	356,407	382,861	463,505	507,538	557,091	568,425	585,038	620,704	657,430	692,620
Interest	277,956	264,575	249,671	235,081	228,919	248,540	270,053	318,430	801,726	1,115,858
Total cost	1,834,645	1,902,562	2,002,377	2,123,675	2,184,113	2,314,872	2,484,084	2,270,746	3,448,130	4,187,527
Total unit cost/(\$/mil gal RPW)	306.85	284.69	308.91	355.84	357.93	380.24	404.84	451.95	574.11	616.45

TABLE 138. PUEBLO WATER UTILITY CAPITAL VERSUS OPERATING EXPENSE RATIOS

Item	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Operating expense (\$)	1,200,282	1,255,126	1,289,201	1,381,056	1,398,103	1,497,907	1,628,993	1,781,612	1,988,974	2,379,049
Capital expense (\$)	634,363	647,436	713,176	742,619	786,010	816,965	855,091	939,134	1,459,156	1,808,478
Total (\$)	1,834,645	1,902,562	2,002,377	2,123,675	2,184,113	2,314,872	2,484,084	2,720,746	3,448,130	4,187,527
Operating expense as % of total	65.42	65.97	64.38	65.03	64.01	64.71	65.57	65.48	57.68	56.81
Capital expense as % of total	34.58	34.03	35.62	34.97	35.99	35.29	34.43	34.52	42.32	43.19

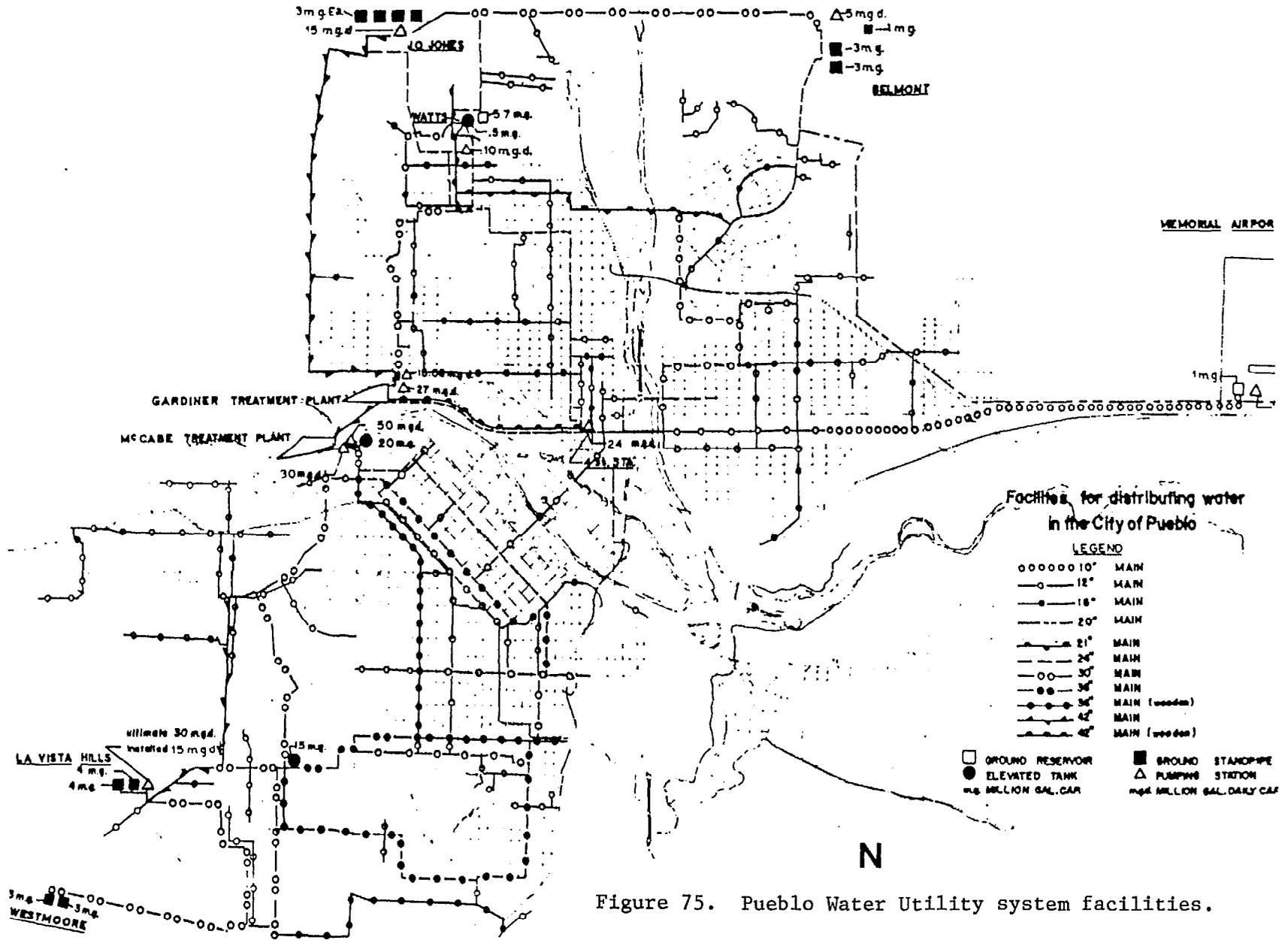


Figure 75. Pueblo Water Utility system facilities.

make it possible to aggregate capital and operating cost down to a specific utility; therefore, no schematic diagram is drawn for the Pueblo Water System.

Data were available to establish the operating cost within categories of services provided--acquisition, treatment, pumping, transmitting and distributing water, and general services necessary to support the operation from the standpoint of operations and maintenance and from the standpoint of depreciated capital. To complete the total cost picture, interest also had to be allocated. Because it was difficult to identify specific interest costs with any of the above categories, it was decided to allocate the entire interest amount against all the water produced. By identifying the total cost in the above categories and dividing that total by the amount of RPW, it was possible to identify the unit costs/(\$/mil gal) for those categories (Figure 76).

In addition these unit costs include depreciated capital allocated to the categories; the cost of interest must also be included.

A linear assumption is made to allow unit cost/(\$/mil gal) to be added as the water moves from one component of the system to another. Adding the cost of various components, it is possible to determine the average cost/mil gal of water delivered to the customer during the year. Total unit cost is \$616.46/mil gal. This figure includes an additional \$98.88/mil gal overhead. These data are summarized as follows:

Costs:

Incremental cost (\$/mil gal)	\$187.77
Distribution cost (\$/mil gal)	165.54
Interest cost (\$/mil gal)	164.27
Overhead (\$/mil gal)	98.88
Total cost (\$/mil gal)	616.46
Metered consumption (mil gal)	6,793
Revenue (\$)	\$4,187,612.78

Once these calculations are made, the cost/mil gal can be compared with the amount charged to the customers for water delivery. Tables 139, 140, and 141 summarize the typical monthly consumption rates charged by the Pueblo Water System.

Table 142 lists the RPW for the 10 largest consumers served by the Pueblo Water System. Examination of the amount billed to the 10 top users shows the Pueblo system is not recovering the cost of the water produced.

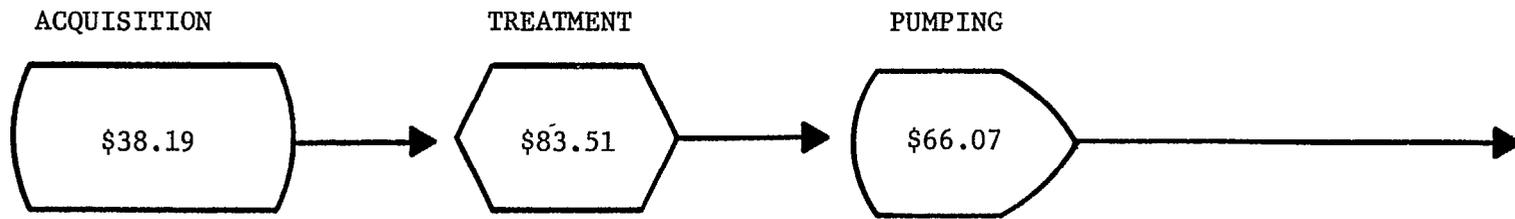


Figure 76. Pueblo Water Utility allocation of capital and operating expenses to water system components (\$/mil gal RPW).

TABLE 139. PUEBLO WATER UTILITY WATER RATES, MARCH 1974

Monthly usage (gallons)	Rate/1,000 gallons	
	Inside city	Outside city (Co.)
First 1,000	Minimum charge	Minimum charge
Next 98,000	\$0.55	\$0.83
Over 100,000	.45	.68

TABLE 140. PUEBLO WATER UTILITY MINIMUM MONTHLY CHARGE BY METER SIZE

Meter size (in.)	Inside city	Outside city (Co.)
5/8	\$ 2.96	\$ 4.44
1	3.59	5.39
1 $\frac{1}{4}$	4.11	6.17
1 $\frac{1}{2}$	4.68	7.02
2	6.24	9.36
3	13.10	19.65
4	20.90	31.35
6	40.35	60.53
8	59.80	89.70

TABLE 141. RATES FOR MULTIPLE DWELLING UNITS, INSIDE CITY\*

Unit	Minimum monthly charges	Next 98,000 gallons	Over 100,000 gallons
First unit	Minimum charge (above)	\$0.55	\$0.45
Each additional unit	\$1.10	.55	.45

\* County charges are 1.5 times inside-city charges.

TABLE 142. PUEBLO WATER UTILITY WATER COSTS FOR 10 MAJOR USERS (1974)

Major users	High or low month		Units used (mil gal)	Amount billed*	Unit charge (\$/mil gal)	cost zone
Colorado State Hospital	High	7	33.2	\$15,188.34	\$457.48	1
	Low	2	11.6	5,235.54	452.28	
C F & I Steel	High	2	32.5	14,130.00	434.82	1
	Low	10	22.9	10,475.77	457.14	
C F & I Steel	High	4	3.5	2,558.98	721.86	1
	Low	10	0.7	542.78	798.21	
Triplex of America	High	8	2.7	1,229.82	584.79	1
	Low	10	2.1	977.37	464.75	
Parkview Episcopal Hospital	High	3	1.5	714.89	473.12	1
	Low	4	0.9	472.79	498.20	
Ramada Inn	High	9	1.6	753.97	465.70	1
	Low	2	0.7	304.75	468.13	
Alpha Beta Packing	High	4	2.5	1,140.40	462.07	1
	Low	9	1.4	658.90	471.32	
M. Occhiato	High	7	1.9	874.90	465.87	1
	Low	1	1.2	542.03	454.34	
Corwin Hospital	High	8	2.4	1,141.40	470.29	1
	Low	6	0.8	419.60	537.26	
Pueblo Golf and Country Club	High	7	16.8	7,631.59	455.59	1
	Low	1	0.3	222.43	724.53	

The average unit costs for all water supplied during the most recent year studied are as follows:

	<u>\$/mil gal</u>
Support services-----	99
Acquisition-----	38
Treatment-----	84
Distribution-----	232
Interest-----	164
Total-----	617

## SECTION 16

### SEATTLE WATER DEPARTMENT

The Seattle Water Department provides water to nine out of 10 residents of King County, Washington. In 1974, the department provided retail service to over 558,000 customers, and through its wholesale customers provided service to an additional 360,000. Population in the service area increased rather rapidly in the 1960's but leveled off during the 1970's, showing a total increase of about 5% over the 10-year period of study. Some system facts are given in Table 143.

#### WATER SUPPLY SERVICE AREA

The Seattle Water Department provides water on a retail basis to all classes of customers in the City of Seattle and in an area of a few square miles north of the city and some small areas south of the city. In addition, water is wholesaled to other water distributors. Currently, the department provides service to one water district and a portion of the City of Edmonds in Snohomish County. No additional service area is anticipated in Snohomish County. The retail service area encompasses approximately 94 sq miles, and the wholesale area is more than double that size. The service area is shown in Figure 77.

Service is provided to water districts encompassing the more densely populated areas east of Lake Washington. Eventual expansion of service to the east is anticipated to include most of the Snoqualmie River Valley.

The service area is bounded on the south by a line generally extending westerly from the southern boundary of the department's Cedar River watershed. Several communities in the southern portion of the county will continue to be served by the Tacoma Municipal Water System.

Further extension of the service area is anticipated in the future. Therefore, even with a relatively stable population growth, the anticipated expansion will add a significant population to the service area.

#### ORGANIZATION

The Seattle Water Department utility is a department of the City of Seattle and operates a system for the purpose of supplying water only. The operation is relatively free from other city operations in that it generates its own revenue, including bond issues for capital improvements.

TABLE 143. SEATTLE WATER DEPARTMENT, BASIC FACTS (1974)

Item	Amount
Population:	
SMSA	1,413,307
County	1,146,207
Retail service area	558,200
Size of retail service area (sq miles)	94.5
Recognized customer classes:	
No. of meters	
Residential	152,021
Business	5,193
Commercial	6,022
Government	2,271
Educational and charitable	1,364
Wholesale	150
Purchased water	None
Source water	100% Surface
Pipe in system (miles)	1,547
Elevation of treatment plants (ft above mean sea level):	
Tolt	760
Cedar	540
Elevation of service area (min-max ft)	0-550
Revenue-producing water (mil gal)	45,967
Treated water (mil gal)	55,480
Maximum day/maximum hour (MGD)	300/600

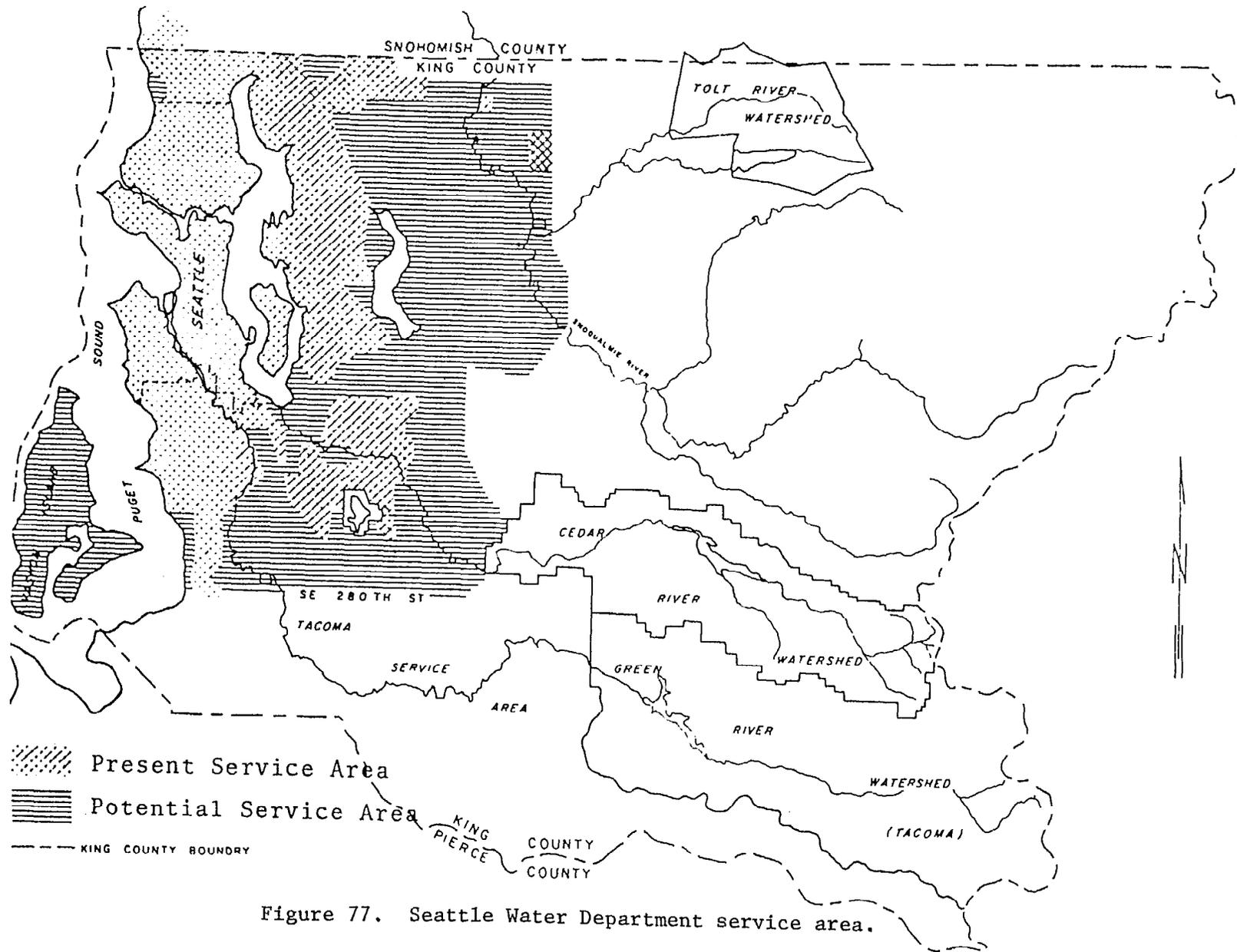


Figure 77. Seattle Water Department service area.

The organization is somewhat different from most city departments in that it is under the City Board of Public Works. The mayor of Seattle appoints the members of the Board of Public Works subject to confirmation by the city council. The Superintendent of Water, one of the five members of the Board, is charged with the operation of the City Water Department.

The Seattle Water Department prepares an annual budget that must be recommended for approval by the mayor and approved by the council. Major construction projects are first submitted to the Board of Public Works which administers the bidding process and the construction contracts for capital improvements. If the cost of the project cannot be defrayed from current revenues, a bond issue is authorized by the council and the Corporation Council prepares a plan or systems ordinance.

As shown in Figure 78, seven divisions report to the Superintendent of Water. Three of these divisions are somewhat different from the usual water organization: Water Resource Management, Office of Management and Planning, and Forestry and Watershed Management. The first two offices show the importance placed on managing the resources and planning ahead to assure that adequate water and service will be available to all areas desiring the service. The Forestry and Watershed Management Division is a function of the source of supply of the Seattle water. All of the raw water from the department comes from watershed areas that are heavily forested and tightly controlled to maintain the quality of the source water.

#### ACQUISITION

The raw water comes from watersheds located at a considerable distance east of Seattle. The two sources are the Cedar River and the Tolt River.

The area of the Cedar River watershed, approximately 143 sq miles, is forest covered and receives the entire run-off for the Cedar River and its tributaries from an elevation of 540 ft to the summit of the Cascade Mountains, over 6,000 ft in elevation. Precipitation ranges from an annual average of 55 in. at the intake to 110 in. at the headwaters of the river. Almost the entire area is forested with a commercial type forest ranging in age from reproduction to old growth.

The Tolt watershed includes both the north and south forks of the Tolt River and has an area of 40,407 acres, most of which is forest covered.

Both of these watershed areas have a combined ownership by the City of Seattle, private industry (Weyerhaeuser Company), and the Federal government. The majority of the Cedar River watershed is owned by the City of Seattle, whereas most of the Tolt watershed is owned by private industry. The city and private industry entered into a perpetual agreement to provide the fullest possible use of both the water resources for domestic supply and the land resources for sustained yield lumber products in a comparable manner. In the case of the Cedar River watershed, all access is controlled and unauthorized persons are not allowed entry. No camping or housing facilities are permitted and sanitary provisions are laid down and enforced by the city.

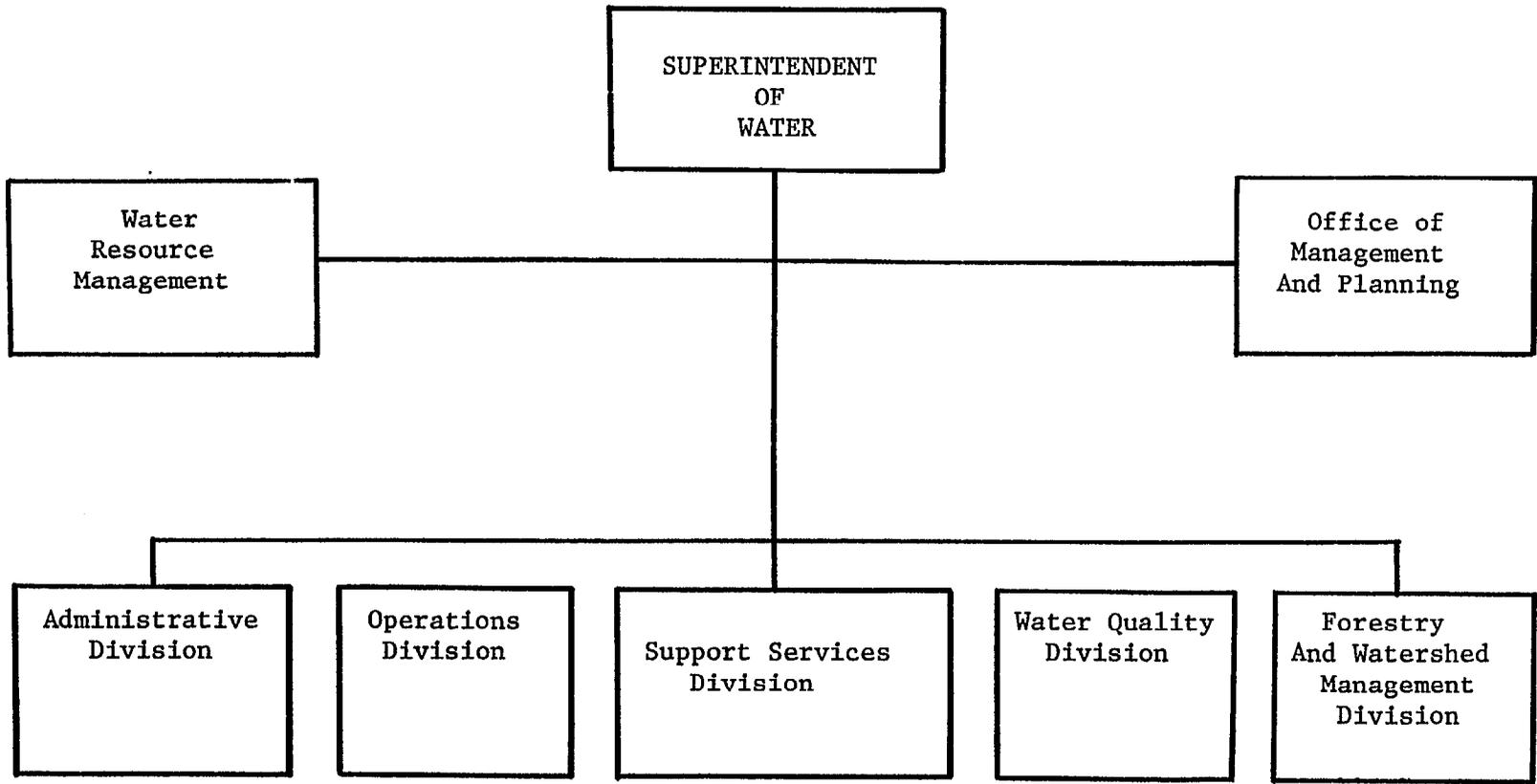


Figure 78. Seattle Water Department organizational chart.