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A study of water supply districts in St. Louis where excessive waste of water has occurred

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Department:

A STUDY OF WATER SUPPLY DISTRICTS IN ST. LOUIS WHERE EXCESSIVE WASTE OF WATER HAS OCCURRED

by

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T H E S I S

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Approved by Joe B Butler

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INTRODUCTION

The City of St. Louis contains within its city limits, according to the latest census, 870,000 people. The City is supplied with filtered water from two sources, one on the Mississippi River at the Chain of Rocks and the other on the Missouri River at Howard Bend. This water is distributed to consumers through 1,170 miles of water pipe and 147,912 service taps. Included in this distribution system are 14,334 fire hydrants and 16,884 valves. Every pipe joint, every fire hydrant, every valve and every plumbing fixture is a potential source of leakage, and it has become necessary to develop an elaborate system of inspections, tests and records in order to control this waste. The average daily consumption for 1930 amounted to 123,400,000 gallons per day, and it has been estimated that 8.9% or about 11,000,000 gallons of this was wasted due to various types of leaks.

Since 1912 the engineers in the St. Louis Water Department have been using an instrument called a "Pitometer", based upon the theory of the Pitot tube, by which means the flow of water in pipes can be accurately measured. Practically the entire distribution system of St. Louis has been surveyed by means of these instruments and these surveys have indicated the areas in which the greatest

quantity of waste occurs. In order to control this waste periodical surveys are made and all plumbing fixtures in the entire district are carefully inspected for leaks. After such inspection is completed, another Pitometer survey is made of the district to determine if the leakage has been brought within allowable limits, and it is only by such periodical surveys and inspections that Water Waste in the City of St. Louis is kept within bounds.

RESUME OF PITOMETER SURVEYS IN ST. LOUIS

After the completion of the original survey made by the Pitometer Co. in 1929, the ninety-one pitometer districts were classified according to fixture and service leakage (See "General Summary Pitometer Survey"). The pitometer districts were grouped into five classes, the first class consisting of those districts showing 20% or more waste as compared to the Net Domestic and Unaccounted for Consumption, the second class consisting of those districts showing 15% to 20% waste, the third class consisting of those districts showing 10% to 15% waste, the fourth class consisting of those districts showing 5% to 10% waste and the fifth class consisting of all the remaining districts.

A year after the original measurements made by the Pitometer Co., the City Department resurveyed the districts in the first six sections in order to determine what improvement had been accomplished in regard to house waste. A comparison of resurvey with the original survey showed that a decrease in Total Consumption, Minimum Night Rate and Ratio of Night to Day occurred in 59% of the districts.

During the year 1930 fifty-one of the pitometer districts, consisting of 500 miles of main or 54% of the

City, were resurveyed by the Pitometer Co. and City Department, these districts being in Classes 1, 2, 3 and 4 of the "General Summary Pitometer Survey". An increase in waste or no improvement in waste whatever was found in 50% of the fifty-one districts measured.

A comparison of the three surveys made shows that after the original survey a reduction of waste had been accomplished but after a year or two this waste has reoccurred.

An estimate of 11,000,000 gallons per day has been made as the amount of water wasted through defective plumbing fixtures and services in the entire city during the past year, which amounts to a loss of $43,763.50 per year to the city for chemicals and fuel only. It is safe to assume that this waste has occurred yearly, probably being lower immediately after the first survey but increasing later as shown by the third survey.

PLANS FOR ELIMINATING WASTE

There are two plans by which this waste can be eliminated: first, by rigid inspection, and second, by selective metering.

Rigid inspection will accomplish a great deal in curbing this waste if inspections are made based upon pitometer data available in this office, details of which

will be explained later in this report. By basing inspections on pitometer data, those rates where no leakage has been found or zero rates, would not be inspected, thus the crew of inspectors would be able to cover those "rates" of large waste frequently, with the ultimate hope that the consumer will get tired of the inspector's presence and keep the leaks repaired. There is a hazard in this method, due to the fact that the consumer will become disgruntled and complain.

Selective metering is by far the best method of curbing waste. By this method the waste will be entirely eliminated or the consumer will pay for it. Selective metering can be accomplished by applying information obtained from pitometer data, careful consideration to be given to the number of times that leaks have reoccurred on individual services. (Details of this plan to be presented later in this report). Already pressure has been felt in regard to this plan, especially by those who are guilty of excessive waste and who show lack of civic pride in keeping their water fixtures in such condition that the burden of this waste is carried by the citizens of St. Louis as a whole.

Detailed Data pertaining to Districts - Each district is a problem in itself, each district is different from any of the others, thus making it very difficult

to set down hard and fast rules governing all the districts. In order to make comparisons between districts, it was necessary to list the following factors:

Character of the District - The character of the district depends upon the type of buildings that are in the district, priority given to that type which is most abundant. A district may be "Industrial and Residential". In this case, Industrial is of primary importance. If the district is "Residential and Industrial", Residential is of primary importance. The character of the district may be either Industrial, Mercantile, Apartments, Residential, Hospitals, Laundries or Poor Class Residential, or a combination of any of these types.

Total Consumption - Total Consumption consists of a 24-hour reading taken of the consumption in the district.

Minimum Night Rate - Minimum Night Rate is the smallest rate recorded during the 24-hour reading. It usually occurs between the hours of 3 A.M. to 4 A.M.

Ratio - The Ratio is the percent of the Minimum Night Rate to the Total Consumption.

Metered Consumption - This consumption consists of a 24-hour reading on all meters two inches and over within the district.

Miles of Main - Miles of main are the number of miles of main within the district boundaries.

Unavoidable Losses - Unavoidable Losses are those losses that cannot be eliminated and consist of small joint and other leaks on mains, an estimate between 2,000 to 3,000 gallons per day per mile of main being made, a higher estimate being used in the older parts of the city.

Fixture Leaks - Fixture Leaks consist of toilets, faucets and hydrants leaking. In establishing the amount of water wasted by this type of waste, an average figure of 0.4 gallon per minute has been estimated for each leak.

Service Leaks - This waste consists of broken service pipes, both underground and in buildings, an estimate of 1,000 to 5,000 gallons per day being made, according to the rate obtained, the number of fixture leaks and the number of service leaks, for those districts measured by the City Department. According to the Pitometer Co's report, the size of the service leak was estimated by their engineers from their previous experiences with thousands of leaks of this character, and thus will apply to the districts measured by them.

Total Estimated Leakage - The Total Estimated or Approximate Leakage consists of both fixture and service

leaks, main leaks and open valves bleeding into blow-offs.

Net Domestic Consumption - This consumption was obtained by subtracting all Losses and "Metered Consumption" from the Total Consumption, and includes both Metered and Flat Rate consumers. The Unaccounted for Consumption is also included, which consists of the following: Public Uses, Willful Waste, Uses other than Domestic and other Losses.

Population - The population of each district was estimated by the Pitometer Co. during their "Distribution Study".

Per Capita to Total Consumption - This consumption consists of the amount of water consumed by each person in the district, based upon the Total Consumption of the district.

Per Capita to Net Domestic - This consumption consists of the amount of water consumed by each person in the district, based upon the Net Domestic and Unaccounted for Consumption.

Number of Services - Number of Services in the district obtained in February, 1930.

Number of Meters - Number of Services metered in the district, obtained in February, 1930.

Percent Services Metered - Ratio of Meters to number of Services.

Percent Waste to Net Domestic Consumption - The Ratio between Waste and Net Domestic Consumption.

Reclassification - Each district was reclassified according to the percent of waste in each district.

Previous Classification - Classification of the district reported in the General Summary Pitometer Survey.

Those factors, namely, Total Consumption, Metered Consumption, Unavoidable Losses and Estimated Leakage were necessary to obtain the percent of Waste in each district. This percent of Waste governs the position of the districts in respect to each other, the district showing the greatest percent of Waste heading the list (See Table No. 1).

It is well to remember that the Unavoidable Losses, Leakage and Population are the only factors that are estimated, the remainder being either measured or computed. In endeavoring to obtain the Leakage or Waste, a conservative estimate was made by both the New York Pitometer Engineers and the City Pitometer Engineer in order not to present an erroneous conception of Waste. Thus it may be assumed that the quantity of Leakage or Waste reported is reasonably accurate.

Detailed Data pertaining to Subdivision Rates - Subdivision "Rates" consist of all rates obtained by

subdivision, showing the size of rate, the location, time of measurement; Leaks, including toilets, faucets, service and miscellaneous leaks (Fire Hydrants and Valves); Rate of Waste and the Ratio of Waste in each "Rate" compared with the Total Waste in the district.

The "Rate" consists of the amount of water in gallons per day flowing into it at "that time of shut"; for instance, a rate of 10,000 gallons per day was measured on Sixth Street, between Hickory and Rutger, at 1:45 A.M.

The Location consists of the boundaries of the Shut, as, Sixth Street between Hickory and Rutger.

The Time of Shut consists of the time the feed valve was opened, as, 1:45 A.M.

The Leaks consist of the number of toilet, faucet, services or miscellaneous leaks found in that "Rate" by inspectors.

The Rate of Waste consists of the Estimated Waste in each "Rate", adding toilet, faucet, service and miscellaneous leakage together and reported in gallons per day.

The Ratio of Waste consists of that percent of waste in each "Rate" in comparison with Total Waste in the District.

In determining the order in which each rate of a district should either be inspected rigidly or metered, it was necessary to pick those "Rates" according to the percent of waste compared to the whole waste of the district, priority given to those rates which show the greatest percent of waste due to fixture and service leakage.

A sample of the detailed forms is shown. Each district appearing in Class I is similarly recorded and on file in this office.

Sect. 3 - Dist. 10 Measured by City Dept. 1/8/31

District Boundaries - North - Cass Ave.	
East - Garrison Ave.	
South - Franklin Ave.	
West - Grand - Francis St.	
Character of District - Poor Class Residential	
Total Consumption	615,000 G.P.D.
Minimum Night Rate	495,000 G.P.D.
Ratio	80.5%
Metered Consumption	44,100 G.P.D.
Miles of Main	3.0
Unavoidable Losses	9,000 G.P.D.
Fixture Leaks - Number 342 - Amount	198,000 G.P.D.
Service Leaks (Approx.) 28 - "	109,000 G.P.D.
Total Approx. Leakage	307,000 G.P.D.
Net Domestic Consumption	254,900 G.P.D.
Population	6,800
Per Capita to Total Consumption	90.5
Per Capita to Net Domestic Consumption	38.0
Number of Services	748
Number of Meters	39
Per cent Services Metered	5.2%
Per cent Waste to Net Domestic Consumption	120%
Reclassification	I
Previous Classification	IV

SUBDIVISION

Sect. 3 - Dist. 10 - Character of District - Poor Class Residential

*T-Toilet. F-Faucet. S-Services. M-Misc.

Rate G.P.D.	Street	Between	Time of Shut	Leaks				Rate of Waste G.P.D.	Ratio
				T	F	S	M		
79,400	Franklin	Grand - Channing		16	16	5		42,560	13.4%
	Channing	Franklin- Bell	11:15						
8,900	Channing	Thomas - Bell	11:24						
69,700	School	Channing- Leonard		39	12	1		34,000	11.5%
	Bell	Channing- Compton							
	Leonard	Franklin- Thomas	11:35						
26,500	Compton	Franklin- Bell		16	11	1		21,660	7.2%
	Bell	Cardinal- Compton	11:46						
5,500	Franklin	Leonard - Garrison	12:05	12	7	1		5,500	1.8%
17,500	Cardinal	Franklin- Easton	12:25	3	4			4,060	1.4%
43,500	Compton	Bell - Easton		21	10	2		28,000	9.3%
	School	Cardinal- Compton	1:18						
0	Easton	Cardinal- Garrison	1:28					0	
35,000	Easton	Leonard - Garrison		16	5	2		22,180	7.4%
	Webster	Easton - Dayton							
	Gamble	Garrison- Easton	2:01						
22,000	Thomas	Leonard - W.D.End						0	
	Leonard	Thomas - Easton	11:00	Polar Wave				Ice Co.	
0	Easton	Leonard - Francis	11:11					0	

SUBDIVISION

Sect. 3 - Dist. 10 - Character of District - Poor Class Residential

*T-Toilet. F-Faucet. S-Services. M-Misc.

Rate G.P.D.	Street	Between	Time of Shut	Leaks				Rate of Waste G.P.D.	Ratio
				T	F	S	M		
43,500	Sheridan	Easton - Garrison	11:30	24	12	3		35,880	11.8%
47,000	Thomas	Easton - Garrison		46	7	2		40,740	14.9%
	Garrison	Dickson - Thomas	11:45						
0	Garrison	Dickson - Gamble	12:07					0	
30,000	Garrison	Franklin- Gamble						10,000	3.4%
	Easton	Garrison- Ewing							
	Bell	Garrison- Ewing	12:26				1		
23,000	Garrison	Thomas - Glasgow P.		13	1			8,120	2.7%
	Glasgow	Garrison- Webster	12:38						
17,000	Webster	Sheridan- Cass	12:47	9	6	2		14,700	5.0%
20,000	Brantner	Webster - Francis	12:55	4	1	1		7,900	2.6%
23,000	Clifton	Webster - Francis	1:00	22	10	7		23,000	7.6%

PLAN FOR RIGID INSPECTION

In this report those districts with 20% or more waste appear in order according to their percent of waste. It is intended to remeasure and reinspect these districts, compare the results and determine what improvement has been accomplished. If the waste still remains high, these districts will again be inspected and continue to be inspected until the waste is reduced to a minimum. When waste has reached a minimum, the district will again be measured and comparisons made. At this point we assume that all the fixtures within the districts have been repaired. In order to prevent the recurrence of leakage, these districts will be measured periodically, depending upon the time required to cover districts in the first four classes.

PLAN FOR SELECTIVE METERING

The first part of this plan is similar to the one shown for Rigid Inspection, that is, the districts will be remeasured and reinspected, and compared with the previous measurement. If the waste still remains high in each district, each individual "rate" will be analyzed. The district showing the greatest percent of

waste will be given priority and the "rates" within that district arranged according to the percent of waste in each rate compared to the total percent of waste.

Let us assume that in Section 3, District 10, on Thomas Street, between Easton and Garrison, a rate of 47,000 gallons per day was measured. When the rate was inspected 45 toilets, 7 faucets and 2 service leaks were found, causing an estimated waste of 40,700 gallons per day, amounting to 14.9% of the total waste in the district. After six months this district was remeasured and subdivided and on the same "Rate" a rate of 30,000 gallons per day was found, and when inspected 35 toilets and 4 faucets were found, causing an estimated waste of 22,620 gallons per day. This "Rate" still shows a large number of fixture leaks. From the card index system in the Inspection Branch Office, each service within this rate will be studied and meters placed upon those services showing a repetition of waste. Thus meters would be installed at 3003 Thomas - toilet leaks occurred twice; 3006 Thomas - toilet leaks occurred three times - 3010½ Thomas - toilet and faucet leaks occurred twice, and so on. This method of selective metering is based upon percent of waste found by Pitometer data and the placing of meters on services showing the recurrence of leakage.

CONCLUSIONS

Either plan would materially reduce house waste, selective metering being the positive method due to the fact that if leakage would reoccur it would not be a loss to the Water Department. Rigid inspection would require frequent Pitometer measurements and inspections, and, naturally, between such measurements and inspections some waste would again appear. A study of the three previous measurements has proven it.

The advantage of selective metering can readily be seen in a district bounded by Grand, Compton, Laclede and Franklin. In this district 145 meters were added. One year's revenue on these metered services amounted to $5,154.36, while a year's revenue on the same service on flat rate basis amounted to $3,038.90 - a gain in revenue of $2,115.46 per year or 69%.

More districts appear in Class I in the reclassification than in the original classification. This is due to the fact that leaks have increased, and in reclassifying the service leaks were estimated according to the "Rate" and number of fixture and service leaks in that rate, while in the original classification the

fixture and service leaks were added together and an estimate of 0.4 gallons per minute applied to both.

The total estimated waste of the twenty-five districts in Class I amounted to 6,026,500 gallons per day. All but 430,000 gallons per day was due to leaking fixtures and services. Of the 430,000 gallons per day, 115,000 gallons per day consisted of a main leak; 139,000 gallons per day on open blowoff valves and 176,000 gallons per day open valve bleeding into a lake in Benton Park.

A study of the accompanying map shows the path of waste which extends approximately from Seventh Street westward to the City Limits, between Laclede and Bartmer on the south, and Cass and Natural Bridge on the north. Referring to the zone map of the City it can readily be seen what type of dwellings are in this area. The bulk of the area consists of these zoning districts:- Multiple Dwellings, Commercial and Industrial. This means that most of the property in this area is rented property. Leakage will naturally be more abundant on rented property, due to the fact that in most cases the owners do not live in the property and are not around often enough to notice leaking fixtures. If the tenant should complain it is often some time before the owner or agent takes steps to repair leaks.

Those isolated districts, Section 6, Districts 1 and 4; Section 5, Districts 3, 8, 9 and 14; Section 4, District 10, also consist of rented property.

STATISTICS GOVERNING CLASS I

Total Consumption	32,603,000 G.P.D.
Metered Consumption	6,456,000 G.P.D.
Ratio of Metered to Total Consumption	19.8%
Estimated House Waste	4,379,600 G.P.D.
Estimated Service Waste	1,388,500 G.P.D.
Other Waste accounted for	430,000 G.P.D.
Unavoidable Losses	776,700 G.P.D.
Ratio of Unavoidable Losses to Total Consumption	2.4%
Ratio of Waste to Net Domestic Consumption	32.5%
Ratio of Waste to Total Consumption	19.0%
Average per Capita Consumption to Total Consumption	106
Average per Capita Consumption to Net Domestic Consumption	63
Ratio of Services Metered	8.0%
Ratio of Miles of Mains to Total Miles in Distribution System	28.3%
Population of Class I Districts	305,884
Ratio of Population of Class I to Population of City	35.0%

FACTS GOVERNING ALL DISTRICTS

More leaking fixtures found in winter than summer in the same district.

Waste due to faucets left open during cold weather usually occurs in such districts where fixture leakage is large.

The ratio of Night to Day rate is smaller in summer than in winter due to lawn sprinkling, which occurs between the hours of 6 P.M. to 9 P.M.

This report can be condensed into this phrase, "The only method of selling Water is by Meter". No private public utility would attempt to sell water, gas or electric any other way except by meter, this being the fairest method both to the utility and consumer. By metering, waste is eliminated as far as the Water Department is concerned and the fairness to the consumer can be illustrated by this example: Suppose there are two homes of the same number of rooms and water outlets; one of these homes is occupied by an elderly couple and the other by a family of five. It is natural to assume that the family of five would use more water than the elderly couple, but both pay the same amount for water. Any number of these cases do exist in the city.

It is apparent from this report that if the City is not metered selectively or universally, flat rates will have to be changed in order to receive revenue for the water wasted and meter rates reduced to the equivalent of the flat rates on services using the average amount of water. Doing this would present a more favorable light on the advantage of metering.

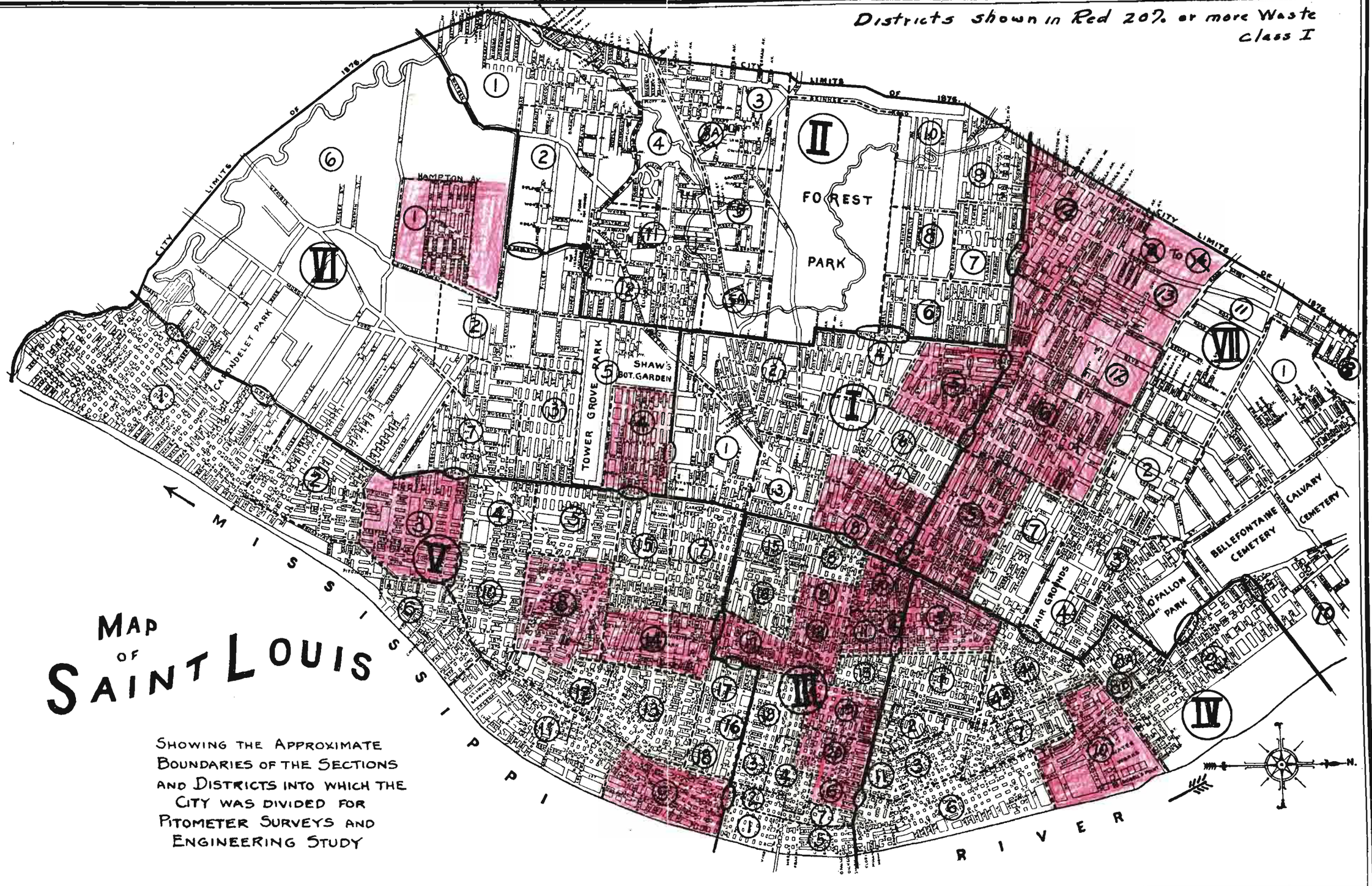
TABLE NO. 1 - SUMMARY OF DISTRICTS GROUPED IN CLASS I - ARRANGED ACCORDING TO PER CENT OF WASTE

Sect.	District	Total Consumption G.P.D.	Minimum Night Rate G.P.D.	Ratio %	Metered Consumption G.P.D.	Miles of Main	Unavoidable Losses G.P.D.	Fixture Leaks	Service Leaks	Total Estimate Waste G.P.D.	Net Domestic & Unaccounted Consumption G.P.D.	Population	Per Capita to Total Consumption G.P.D.	Per Capita to Net Domestic Consumption G.P.D.	Number Services
3	10	615,000	495,000	80.5	44,100	3.0	9,000	342	28	307,000	254,000	6,800	91	38	748
3	20	1,232,000	810,000	66.0	32,000	7.0	21,000	182	22	518,000	561,000	7,600	162	74	1,033
4	5	767,000	528,000	55.0	86,000	13.0	39,000	400	22	263,000	379,000	12,310	63	31	1,735
3	12	819,000	617,000	75.0	140,000	4.3	12,900	268	21	188,000	479,000	7,270	113	66	1,054
3	17	1,190,000	735,000	61.5	405,000	5.0	15,000	277	19	215,000	555,000	5,960	200	94	661
1	8	1,320,000	840,000	63.5	817,500	6.0	18,000	219	4	136,000	348,500	5,240	252	67	583
3	6	299,000	245,000	82.0	0	2.5	7,500	49	14	79,400	212,000	12,110	25	18	259
6	1	605,000	340,000	56.0	236,000	27.6	72,800	115	2	75,700	219,600	9,650	63	23	1,982
7	5	3,060,000	1,900,000	62.0	260,000	18.5	55,500	858	67	702,000	2,042,500	25,700	119	81	3,806
3	11-14	1,060,000	820,000	77.0	82,500	4.3	11,400	354	19	245,000	721,000	6,260	170	115	948
5	8	1,780,000	1,080,000	61.0	380,000	14.5	44,000	226	10	338,000	1,018,000	17,380	103	59	2,681
5	14	1,811,000	980,000	54.0	624,000	14.1	43,000	381	31	276,000	868,000	6,080	298	143	1,782
1	5	1,771,000	1,005,000	57.0	308,000	9.2	27,000	496	16	332,000	1,104,000	13,530	131	82	1,951
7	6	1,740,000	930,000	53.0	85,000	21.5	64,500	546	14	356,000	1,234,000	32,200	54	38	4,062
3	3	605,000	342,000	60.0	215,000	3.3	9,900	83	8	83,000	297,100	670	905	440	310
7	12	1,610,000	1,020,000	63.0	55,000	7.5	22,500	434	18	331,000	1,201,500	17,900	90	67	3,383
1	7	1,170,000	782,000	67.0	189,000	5.6	17,000	324	6	203,000	761,000	12,300	95	62	1,604
6	4	1,680,000	870,000	52.0	357,000	14.0	42,000	288	11	253,000	1,028,000	11,710	168	88	1,991
5	3	1,005,000	489,000	48.5	260,000	14.0	42,000	227	4	138,000	565,000	17,880	56	32	2,877
5	9	1,700,000	1,001,000	59.5	767,000	14.5	44,000	76	11	171,600	718,000	2,930	580	245	1,178
7	14	2,500,000	1,510,000	60.0	59,500	14.5	45,000	570	43	447,900	1,947,600	33,794	74	58	2,718
3	19	1,534,000	881,000	57.0	424,000	7.9	23,700	290	27	197,000	889,300	12,050	128	74	1,071
3	9	889,000	528,000	59.0	207,000	4.0	12,000	185	7	114,000	556,000	6,160	144	90	713
7	13	1,130,000	620,000	57.0	10,500	12.0	34,500	283	14	184,000	901,000	17,900	63	505	2,502
4	10	711,000	187,000	26.0	412,000	14.5	43,500	49	5	43,500	212,000	4,500	159	47	802
TOTAL AND AVERAGE		32,603,000	19,555,00	60.5	6,456,000	262.3	776,700	7,521	444	6,198,100	19,073,000	305,884	106	63	42,480
AVERAGE OF TOTAL					19.8%	28.3%	2.4%			19.0%	58.8%	35.0%			

Number Meters	% Services Metered	Theoretical % of Waste to Net Domestic Consumption	Theretical % of Waste to Total Consumption	Reclassification Number	Previous Classification Number	Measured By	Character of Districts	Reasons for Districts Appearing in Class I
59	5.2	120.0	50.0	I	IV	C.D.	Poor Class Residential	Fixture & Service Leakage
190	18.3	92.0	43.0	I	IV	P.C.	" " "	Main Leak 115,000 GPD. B.O.Balve Open 139,000 GPD.
100	5.6	69.0	34.0	I	III	P.C.	Residential	Fixture & Service Leakage
125	11.9	39.0	23.0	I	I	P.C.	Poor Class Res. & Small Business	" " " "
86	13.0	38.0	18.0	I	III	C.D.	" " " Laund's. & Merc.	" " " "
98	17.0	39.0	10.3	I	IV	C.D.	Theatres, Merc. & Residential	" " " "
194	75.0	37.5	26.6	I	I	P.C.	Residential & Markets	" " " "
46	2.3	35.0	12.7	I	I	C.D.	Residential & Minor Industrial	" " " "
227	6.0	34.4	22.9	I	I	P.C.	Poor Class Residential	" " " "
43	4.5	34.0	23.0	I	III	C.D.	" " "	" " " "
213	8.0	32.0	18.2	I	III	C.D.	Residential & Laundries	Valve Open 5 Turns Bleeding into Benton Pk. 176,000 GPD.
116	6.5	31.8	15.2	I	II	P.C.	Residential	Fixture & Service Leakage
150	7.7	30.0	18.8	I	I	P.C.	Apartment & Residential	" " " "
151	3.7	28.8	20.5	I	I	P.C.	Residential	" " " "
120	38.6	26.0	13.7	I	I	P.C.	Mercantile	" " " "
105	3.1	27.5	20.5	I	III	C.D.	Residential, Minor Mercantile	" " " "
87	5.3	26.6	17.3	I	I	P.C.	Apartments & Residential	" " " "
113	5.7	24.6	15.0	I	II	P.C.	Residential & Mercantile	" " " "
145	5.0	24.4	17.7	I	III	C.D.	" " "	" " " "
407	34.5	23.6	10.0	I	IV	C.D.	Industrial & Residential	Service Leak 90,000 G.P.D.
155	5.7	23.2	18.0	I	III	C.D.	Residential & Minor Merc.	Fixture & Service Leakage
214	70.0	22.2	12.8	I	I	P.C.	Industrial & Poor Class Res.	" " " "
98	13.7	20.6	12.8	I	II	P.C.	Small Business & Poor Res.	" " " "
46	1.8	20.4	16.3	I	II	C.D.	Residential & Minor Mercantile	" " " "
127	15.8	20.1	6.1	I	IV	C.D.	" " Industrial	" " " "
3,395	8.0	32.5	19.0					

G. P. D. - Gallons per Day
C. D. - City Department
P. C. - Pitometer Co.

Districts shown in Red 20% or more Waste
Class I



MAP OF SAINT LOUIS

SHOWING THE APPROXIMATE BOUNDARIES OF THE SECTIONS AND DISTRICTS INTO WHICH THE CITY WAS DIVIDED FOR PITOMETER SURVEYS AND ENGINEERING STUDY

9

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