COST OF PUMPING THROUGH PIPE LINES*

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MANY municipalities secure water for a public supply some distance from the municipality. In a few places water flows from the source to the municipality by gravity, but in nearly all installations in this state it is necessary to pump through a pipe line. Water may be delivered directly to consumers or to a reservoir from which it is pumped or flows by gravity to consumers. The choice of a proper-sized pipe line is of considerable importance. Where reservoir capacity is not provided, pump and pipe-line capacity should be sufficient to meet maximum demands. Occasionally high demand may be met in some installations by increasing pressure to correspond to increased friction losses in pipe line, or if water at low pressure will satisfy the extra demand, by allowing pressure at points of consumption to drop.

In choosing a pipe line for any certain installation, it is common to consider the economical velocity of flow through the pipe. This may be of considerable advantage, but it is probable that only on rare occasions will water flow at such velocity. The loss of pressure in various sized pipes carrying water at a given rate of flow is often computed and the extra cost of pumping in the smaller pipes balanced against the extra first cost of the larger pipes.

*Read March 26th before the Illinois Section, American Water Works Association.

Officials in charge of the installation of or changes in a water supply would do well to consider the entire cost of pumping through the pipe line reduced to cents per thousand gallons (or other unit by which water is sold). In some installations, knowing the comparatively low cost, more consideration would be given to securing a water of excellent quality at some distance, possibly from another public supply. In other instances the advantage of providing reservoir capacity to reduce fluctuations in rate of flow, or of providing good service with large sized pipe, could be more readily shown.

In many cities one of the greatest difficulties in installing a public water supply is to secure active co-operation for the support of one definite project. Intelligent citizens in two small cities have been found to favor taking water from Lake Michigan more than 200 miles away. Figures on cost of pipe and pumping, estimating that with aid of other cities the water could be conveyed the first 150 miles at practically no cost, would have been rather easy to secure and would probably have convinced these people at once that another supply was preferable.

The life of a pipe line carrying water such as is in general use for public supplies is not generally affected by the velocity of flow within ordinary ranges. Therefore, to double the rate of flow divides by two the interest and depreciation change per gallon. However, with increased rate of flow the friction increases; and with same pipe line, same cost of pumping 1,000,000 gallons one foot high, and not including interest and depreciation on pipe line, increasing the flow 50 per cent. multiplies the total cost of pumping by three.

COST (IN DOLLARS) PER MILE PER MILLION U.S. GALLONS OF PUMPING WATER AT VARIOUS RATES THROUGH DIFFERENT SIZES OF CAST-IRON PIPE LINES

	DIAMETER OF PIPE											
	6 Ins.			8 ins.			10 Ins.			12 Ins.		
Gallons a day	Operation	6% of pipe line cost	Total	Operation	6% of pipe line cost	Total	Operation	6% of pipe line cost	Total	Operation	6% of pipe line cost	Total
100,000	.42	6.92	7.34	.11	9.12	9.23						
150,000	.86	4.62	5.48	.22	6.08	6.30						
200,000	1.43	3.47	4.90	.36	4.56	4.92	.13	6.08	6.21	.05	7.81	7.86
250,000	2.11	2.77	4.88	.53	3.64	4.17	.18	4.84	5.02	.08	6.25	6.33
300,000	2.90	2.31	5.21	.73	3.03	3.76	.26	4.04	4.30	.11	5.21	5.32
400,000	4.80	1.73	6.53	1.21	2.27	3.48	.42	3.04	3.46	.18	3.90	4.08
500,000	7.10	1.39	8.49	1.78	1.82	3.60	.62	2.42	2.84	.27	3.12	3.39
600,000	9.77	1.15	10.92	2.46	1.52	3.98	.86	2.02	2.88	.36	2.60	2.96
800,000	16.15	.86	17.01	4.06	1.13	5.19	1.42	1.52	2.94	.60	1.95	2.55
1,000,000				6.00	.91	6.91	2.10	1.21	3.31	.89	1.56	2.45
1,200,000				8.26	.76	9.02	2.89	1.01	3.90	1.23	1.30	2.53
1,400,000							3.78	.87	4.65	1.61	1.11	2.72
1,600,000							4.77	.76	5.53	2.04	.97	3.01
2,000,000										3.01	.78	3.79
2,400,000										4.13	.65	4.78

	DIAMETER OF PIPE											
	14 Ins.			16 Ins.			20 Ins.			24 Ins.		
Gallons a day	Operation	6% of pipe line cost	Total	Operation	6% of pipe line cost	Total	Occupation	6% of pipe line cost	Total	Operation	6% of pipe line cost	Total
300,000	.05	6.22	6.27									
400,000	.09	4.66	4.75									
500,000	.13	3.72	3.85	.07	4.50	4.57						
600,000	.18	3.11	3.29	.09	3.75	3.84						
800,000	.29	2.33	2.62	.15	2.81	2.96	.05	3.90	3.95			
1,000,000	.43	1.87	2.30	.23	2.25	2.48	.08	3.12	3.20			
1,200,000	.59	1.55	2.14	.31	1.88	2.19	.11	2.60	2.71	.04	3.39	3.43
1,400,000	.78	1.33	2.11	.41	1.61	2.02	.14	2.23	2.37	.05	2.90	2.96
1,600,000	.98	1.16	2.14	.52	1.40	1.92	.18	1.95	2.13	.08	2.54	2.62
2,000,000	1.45	.94	2.32	.76	1.13	1.89	.25	1.56	1.81	.11	2.04	2.15
2,400,000	1.99	.77	2.76	1.05	.94	1.99	.36	1.30	1.66	.15	1.70	1.85
2,800,000	2.60	.66	3.26	1.37	.80	2.17	.48	1.11	1.59	.20	1.45	1.65
3,200,000	3.29	.58	3.87	1.74	.70	2.44	.60	.98	1.58	.25	1.27	1.52
3,600,000	4.03	.52	4.55	2.13	.63	2.76	.74	.87	1.61	.31	1.13	1.44
4,000,000				2.56	.56	3.12	.89	.78	1.67	.37	1.02	1.39
5,000,000				3.80	.45	4.25	1.32	.62	1.94	.55	.82	1.37
6,000,000							1.81	.52	2.33	.76	.68	1.44
8,000,000							3.00	.39	3.39	1.25	.51	1.76
10,000,000	*See article for assumptions*									1.86	.41	2.27
12,000,000	*re friction, cost of pipe, etc.*									2.56	.34	2.90