

Report on Winnetka's Proposed \$80,000 Filtration Plant

Preliminary Report, December, 1916.

Present Water Works:
There is no need at present to give a detailed description of the present water works at Winnetka. A valuation and description were prepared by C. M. Larson, in August, 1915, in the form of a typewritten report, on file in the village hall.

The Winnetka water works serve the villages of Winnetka and Glencoe, with a total of 3,820 acres. These villages are residential in character, and are growing rapidly. The present population in the two villages is estimated to be 9,000 people, of which 5,500 are in Winnetka and 3,500 in Glencoe.

The water is taken from Lake Michigan through a 80-inch cast iron intake about 3,000 feet in length, which was built in 1911. Before this intake was built, the water was taken through a 12-inch cast iron intake about 2,000 feet long. This intake is maintained for emergency uses.

The water is pumped from a suction well at the shore end of the intake to the water tower standing on the bluff above the pumping station. This water tower has a capacity of 54,000 gallons. In view of the present population and water consumption in these two villages, this storage is small, particularly during very cold weather, when, at times, anchor ice seriously reduces the capacity of the intakes. Additional storage is, undoubtedly, desirable.

There is at present a pumping capacity amounting to 5.5 million gallons, which is sufficient to serve the villages for a number of years to come.

QUALITY OF WATER.

The water at present is analyzed once or twice a week at the laboratory of the Evanston Health Department. The results of these analyses are on file in the village hall. About one-fourth of these analyses indicate an unsafe water for drinking purposes. These analyses are not on samples of raw lake water, but on samples of the tap water after treatment with calcium hypochlorite. The unsafeness of the water is undoubtedly due to sewage pollution, which reaches the lake from a number of sources, among which may be mentioned the following:

- Sewage from municipal outlets from towns north of Winnetka.
- Sewage from overflows on Winnetka sewers, which operate during periods of heavy rainfall.
- Sewage from private houses and clubs, along the lake shore, which are so located that they cannot enter the general sewer systems.
- Pollution carried considerable distances by floating ice.
- Sewage from ships and pleasure boats.
- General pollution from surface run-off.

In addition to the bacterial impurities in the water originating from sewage pollution, the water is at times turbid, due to the action of waves in stirring up the more or less muddy bottom of the lake. This turbidity detracts from the quality of the water for nearly all domestic uses.

PRESENT TREATMENT OF WATER.

The water at present is dosed with calcium hypochlorite at the rate of 6 to 7 pounds per 1,000,000 gallons of water. This hypo is applied to the water in the suction well before it passes through the pumps. The dose is regulated by standard orifice box, and is practically constant from day to day, and from hour to hour.

No routine analyses are made at the pumping station to determine whether too much or too little, or just the right amount of hypo, is being added. It is a fact that the quality of the lake water, as regards its content of bacteria and organic matter, is subject to constant and abrupt changes. Special tests at Waukegan show that a water from an intake 4,000 feet long, requires a dose of hypo which at times varies from 10 to 25 pounds per 1,000,000 gallons in the short space of 24 hours. If the dose were continued at the lower rate, the higher rate was necessary, the entire value of the treatment would be practically eliminated. That the treatment with hypo, as practiced here, does not make the water safe for drinking purposes is not to be expected and is shown by the results of the analyses.

It becomes particularly important when it is realized that although analyses of the water are made at infrequent intervals, they indicate that the water is unsafe for about one-fourth of the time, or for one day in every four.

NEED FOR FILTRATION.

The need for filtering the water should be apparent from the statements already made. However, there are additional reasons why this is necessary.

Lake Shore Policy.

One of the controlling features in determining the desirability of installing a filtration plant is the question of the sanitary policy all along the north shore. About two years ago the North Shore Sanitary District was organized in Lake County. During the last two years the trustees of this district have been making a most exhaustive study of the sewage conditions within their district, and have recently published a report by Alvord, Eddy and Fuller, three of the foremost sanitary engineers in the country. This report recommends that the North Shore Sanitary District must rely upon water purification to assure the purity of the water supply taken from the lake. It states that sewage treatment can be relied upon to reduce the load on the water filtration plants, but that both sewage treatment and water filtration are necessary. As regards sewage treatment in the towns from Highland Park to Waukegan, involves the treatment of sewage in tanks with disinfection of the tank effluent, and the discharge of this effluent into the lake. While this program may be altered, it is most unlikely that any material change in the amount of sewage now entering the lake, north of the county line, will come in time to have a controlling influence on the water supplies of the north shore towns.

It is, therefore, my opinion that a diversion or treatment of sewage cannot be relied upon in this district as a means of protecting the water supply.

Intakes.

The water of Lake Michigan is usually of better quality farther from shore than near shore. It is, therefore, a disadvantage to take water from near shore. If any near-shore water should get into the intakes without the knowledge of the operator in charge of the water works, a sudden load of organic matter would come upon the hypo treatment, and practically eliminate its usefulness. Unexpected occurrences of this sort happen on account of broken intakes. An unsuspected break in the intake pipe was the cause of a typhoid fever epidemic at Evanston. A break in the intake pipe at Gladstone, Mich., was not discovered for several months, during which time polluted water was being pumped to the city.

The other way by which the shore

water gets into the intakes is during emergencies caused by anchor ice, or other troubles, when it is necessary to take water from a short intake that can be steam heated.

Under the present conditions at Winnetka the installation of a near-shore intake seems unavoidable, to avoid a water shortage due to anchor ice. The hypo treatment is difficult to adjust to these comparatively sudden and unforeseen changes in the quality of the raw water.

A filtration plant of proper design will also provide a storage of filtered

lake and supplies it to the people after treatment with hypo. They are at present actively considering methods for financing the installation of a filtration plant estimated to cost about \$150,000.00.

In addition to the municipal plants, the government posts at Fort Sheridan and the Naval Training Station, both take lake water and filter it before supplying it to the consumers.

It appears, therefore, that of the 12 communities from Evanston to Waukegan, six are already supplied with filtered water, and four others are at

with a capacity of 3,000 gallons is ample to meet the reasonable future requirements of the two villages.

GENERAL ARRANGEMENTS.

There seems to be little doubt that the best type of plant for the villages of Winnetka and Glencoe is an open gravity rapid sand filter. This matter is, or has, already been looked into by various authorities at Evanston, Winnetka, North Chicago and Waukegan, and in each instance this type of filtration plant has been recommended.

Plans of the existing water works have been studied and a tentative arrangement of the new filtration plant at this site has been laid out as shown in Figure 2. This lay-out should not be considered in any sense as final, but only to show that a filtration plant of this capacity can be built at the site of the present water works with reasonable allowance for future conditions, to serve beyond the year 1930. The lay-out is the basis for estimating the cost of the proposed new filtration plant.

ESTIMATES OF COST.

While we have not prepared an itemized detailed estimate of cost, we have adjusted the figures on file in our office to the conditions at Winnetka, in accordance with the general plan shown in Figure 2. This estimate of cost is shown in Table 4. We have actually computed the amount of excavation, the yardage of concrete, and the cost of the necessary buildings. These items constitute about 40 per

cent of the total cost. These and other prices have all been adjusted to present day market prices. Although these market prices are high, there is no means of judging the future, and they may go still higher.

We estimate, therefore, that a 3,000,000 gallon filtration plant at Winnetka can be built at present prices for approximately \$80,000.00. In addition, there must be an allowance for engineering and contingencies amounting to about 5 per cent, making a total cost of, say, \$85,000.00.

FINANCIAL ASPECTS.

An important element of this proceeding is the means for financing the work. This involves not only the securing of funds, but also the necessary charges for supplying filtered water, particularly to Glencoe, who is now purchasing water from Winnetka on an unfiltered basis. An estimate of the value of the present Winnetka water works has been made by Mr. Fitzgerald. To this has been added the cost of the filtration plant as estimated above. The necessary charge per 1,000 gallons to carry the existing and proposed plant costs have also been worked out on the basis of the water consumption during the six months ending September 30, 1916. This data is all shown in Appendix 1.

Glencoe is at present paying Winnetka at the rate of 7c per 1,000 gallons of water. To furnish them with filtered water it is necessary to increase this rate to 9c per 1,000 gallons.

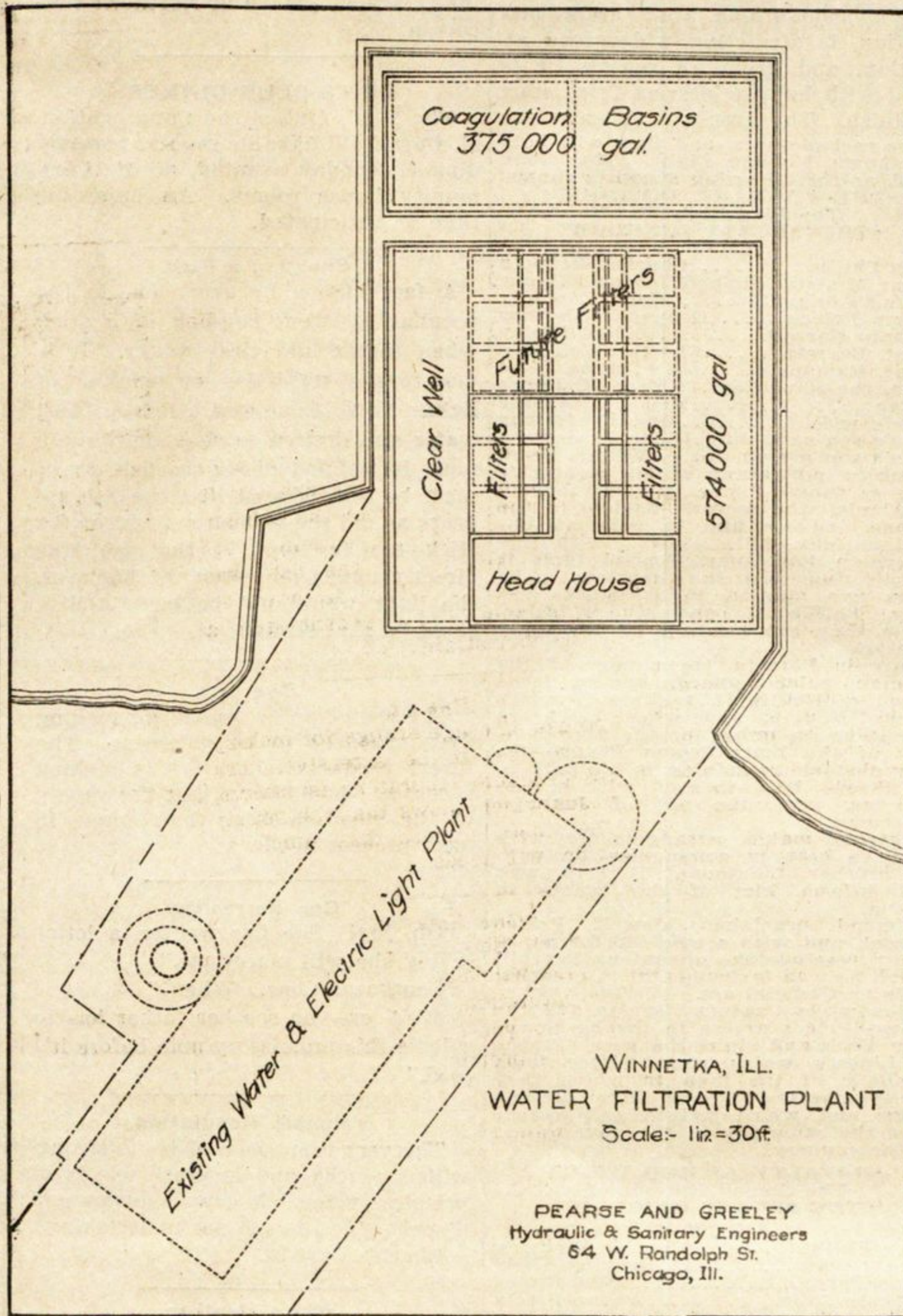


Diagram of Proposed Plant.

water amounting to from 3 to 5 hours' supply in addition to that already in the water tower, thus remedying a defect in the existing plant.

In view of the present quality of the Winnetka water, and of the present practice certain to continue, of discharging some sewage into the lake, and in view of the uncertainties of the hypo treatment, the need for a water filtration plant is beyond question.

OTHER COMMUNITIES.

In undertaking the installation of a filtration plant, costing upwards of \$80,000.00, it is pertinent to inquire about the practice in neighboring communities. This is briefly summarized as follows:

Evanston.

Two years ago, Evanston installed a rapid sand filter plant with a capacity of 12,000,000 gallons per day, which cost slightly over \$200,000.00. This plant has given marked satisfaction to the residents in Evanston and Wilmette, whom it supplies with water.

Wilmette.

Wilmette at present takes filtered water from Evanston. The present price is 6c per 1,000 gallons. Evanston has notified Wilmette that the rate is to be increased to 8c per 1,000 gallons to pay for filtering the water. On this account, Wilmette has had its water supply situation investigated by an engineer, who recommends that Wilmette install a filtration plant. A filtered lake water is preferred to a possible deep well water supply, and raw lake water, without filtration, is condemned.

Kenilworth.

The Kenilworth water supply is filtered through the old type of pressure filters. While these filters are not usually as efficient as the open gravity filters, nevertheless they are better than no filter at all.

Highland Park.

Highland Park is at present supplying raw lake water to its people. The water supply is listed by the Illinois State Water Survey as among the 18 worst water supplies in the state. Analytical data thoroughly substantiate this rating.

Lake Forest.

Lake Forest is supplied with a filtered water treated with hypo. The filters are of the old-fashioned closed pressure type. However, Lake Forest is fortunate in having a first-class superintendent in charge of the water works, who makes routine laboratory analyses, and the water supplied is, therefore, of satisfactory quality.

Lake Bluff.

Lake Bluff takes its water from deep wells, and is, therefore, not troubled with lake pollution. However, the well water is hard, and is, therefore, unsatisfactory from this point of view.

North Chicago.

North Chicago takes its water supply from Lake Michigan, and delivers it to the people after treatment with liquid chlorine. In the fall of 1915, plans were made up for a filtration plant, and a bond issue was submitted to the people early in 1916, the bond issue being defeated. During the winter of 1916, there was a considerable amount of typhoid fever in the city. The officials, however, recognize the need for filtration.

Waukegan.

Waukegan now takes its water supply from a point 4,000 feet out in the

present actively considering the installation of filters. One uses well water. The policy of water water filtration along the north shore is thus reasonably established.

Earlier Reports.

The desirability of water filtration for Winnetka was investigated by Alvord and Burdick, sanitary engineers of Chicago, in 1907. They state their conclusion as follows: "We recommend that the necessary gravity filtration plant of 1,000,000 gallons capacity per 24 hours be constructed. While there is no evidence that the community is suffering or has suffered from polluted water supply, we believe that physicians and sanitarians will join in the opinion that the present supply is, at best, dangerous, or detrimental to health, and that compliance with enlightened sanitary practice requires both the discontinuance of the present lake pollution and the better supply."

This report was written in 1907. During the last nine years there has been a substantial increase in the population, and there is no reason to consider that conditions have changed favorably. In fact, Messrs. Alvord and Burdick have expressed this view in a letter received by the Winnetka council in the spring of 1916.

SIZE OF FILTRATION PLANT.

The necessary size of filtration plant depends upon the estimates of the growth of population, upon the consumption of water, and upon the time in the future for which it is considered advisable to build the plant. These matters we have looked into tentatively as follows:

Population.

The past population and the estimated future population of Winnetka and Glencoe are shown in Table 1, the past population having been taken from the U. S. census. In forecasting the future, we have compared the growth of Winnetka and Glencoe with the growth in two other residential and metropolitan communities, as their population has increased beyond that of Winnetka and Glencoe. This comparison is shown graphically in Figure 1. It appears that by the year 1925 the combined population in the two villages will probably have reached 16,100 people.

Water Consumption.

The water consumption in Winnetka and Glencoe is computed from the records of the individual meter readings in Winnetka, and the meters on the main supply line to Glencoe during 1916. The consumption has ranged approximately as shown in Table 2. For residential communities having meters on most of the house connections, the water consumption is liberal. We do not think that there is any need for increasing the allowance and in fixing the necessary size of the filtration plant, we have used the figures of Table 2.

Future Provision

It does not appear unreasonable to build a plant of sufficient capacity to serve until about the year 1930. A filtration plant of the type proposed can filter water satisfactorily for short periods by overloading it above the rated capacity up to from 30 to 50 per cent. On this basis, the size of plant necessary in the years 1925 and 1930 with varying conditions and overload to handle the maximum day and the average day in the maximum month are shown in Table 3. From this data, it appears that a plant

TABLE 1.

Past and Estimated Future Population of Winnetka and Glencoe.

Year	Population		Total
	Winnetka	Glencoe	
1890.....	1,079	.....	.....
1900.....	1,833	1,020	2,853
1910.....	3,168	1,899	5,067
1920.....	7,100	5,300	12,400
1930.....	10,800	8,800	19,600
1940.....	14,700	12,700	27,400

TABLE 2.

Statistics of Water Consumption for Winnetka and Glencoe, Ill., During 1916.

	Rate of Pumpage	
	Gallons Per Day	Gallons Per Capita Per Day
Annual Average.....	1,100,000	110
Maximum Month.....	1,630,000	163
Maximum Day.....	2,250,000	225

TABLE 3.

Filter Plant Capacities Under Varying Conditions.

Year	150% Overload		133% Overload	
	on Maximum Day	on Maximum Month	on Maximum Day	on Maximum Month
1925.....	2,420,000	2,730,000	1,750,000	1,970,000
1930.....	2,950,000	3,320,000	2,130,000	2,400,000

ITEM

ITEM	Total	Million Gallons Capacity
Excavation, 2,200 cu. yd. @ \$1.50.....	\$ 3,300.00	\$ 1,100.00
Reinforcing Steel, 100,000 lbs. @ 0.06.....	6,000.00	2,000.00
Concrete, 983 yd. @ \$13.50.....	13,500.00	4,500.00
Piping.....	.....	2,000.00
Solution Piping.....	.....	100.00
Valves.....	.....	300.00
Hydraulic Valves.....	.....	75.00
Sluice Gates.....	.....	75.00
Rate Controllers.....	3,000.00	1,000.00
Buildings, 36,750 cu. ft. @ \$0.164.....	6,000.00	2,000.00
Chemical Feed Boxes.....	225.00	75.00
Electrical Work.....	.....	250.00
Plumbing and Heating.....	.....	850.00
Laboratory and Equipment.....	.....	170.00
Filter Gravel.....	.....	250.00
Filter Sand.....	.....	450.00
Underdrains.....	.....	1,000.00
Operating Tables.....	2,400.00	800.00
Grading and Ground Improvement.....	.....	500.00
Connections.....	.....	300.00
Low Lift Pumps.....	.....	3,000.00
Allowance for extra foundations, wet excavation and uncertain pieces.....	.....	1,800.00
Contingencies, 15%.....	.....	\$23,270.00
Or, \$81,000.00 for a 3,000,000 gallon plant.	.....	\$27,000.00

APPENDIX 1.

Glencoe Water Rate—Present Conditions.

Plant Value 4-1-1916—Higgins Audit—	
Buildings.....	\$15,266.47
Wells.....	2,760.00
Tower.....	14,518.56
Plant Equipment.....	13,973.28
Shop Equipment.....	983.25
Intakes and Suction.....	44,203.75
	\$91,705.31
12-inch water main from Plant to Glencoe Limits.....	\$ 5,000.00
Probable cost of Filtration Plant.....	85,000.00
Pumpage for Six Months Ending September 30, 1916—	
Winnetka.....	121,298 = 59.5%
Glencoe.....	82,134 = 40.5%
Total.....	203,431

Glencoe Costs—
Eight per cent in plant investment, 5 per cent interest, 3 per cent depreciation, 40 per cent Glencoe share. $.40 \times .08 \times \$91,705.31 = \$2,934.55$
Five per cent interest, 2 per cent depreciation on 12-inch main.
7 per cent of \$5,000.00 (entire cost)..... 350.00

Total fixed charges.....	\$3,284.55
Operating Expenses, Year Ending March 21, 1916—	
Pumping Expense.....	\$11,242.78 = 3.38 M. Gals
Total Pumpage.....	323,372 M. Gals.
Glencoe Pumpage, 40%.....	132,908 M. Gals.
Fixed Charges, Glencoe Proportion.....	\$3,284.55
	132,908 = 2.48 M. Gals.
Total Cost Glencoe Water.....	5.86 M. Gals.
Contingent Allowance.....	1.14
Selling Price.....	7.00

GLENCOE WATER RATES.

Additional Cost for Filtered Water.	
Estimated Cost of Filtration Plant.....	\$85,000.00
Interest and Depreciation at 8 per cent.....	6,800.00
Glencoe's Proportion 40 per cent.....	2,720.00
Fixed Charges per M. Gallons.....	.2720.00
	132,908 = .0206 per M.
Estimated additional operating expenses for Filtration.....	.0114
Total Additional Expense.....	.0320 per M.
Present Cost.....	5.86 cents per M.
Additional Cost.....	3.20 cents per M.
Total Cost Filtered Water.....	9.06 cents per M.
Reasonable rate at which to sell water.....	9.00 cents per 1,000 gallons

NOTE—The above figures do not include any allowance in operating expenses for distribution expense, office expense, or meter repair expense.