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Chicago Water System, A Description:
The System and its Sanitary Protection.
(1956)

ILLINOIS HISTORICAL SURVEY

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CHICAGO WATER SYSTEM

a description:

the system and its sanitary protection

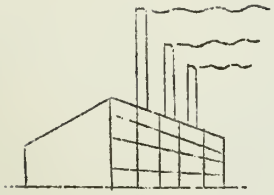
JAMES W. JARDINE
COMMISSIONER

W. W. DeBERARD
DEPUTY COMMISSIONER FOR WATER AND CHIEF WATER ENGINEER

DEPARTMENT OF WATER & SEWERS

ILLINOIS HISTORICAL SURVEY

CHICAGO WATER SYSTEM



DEPARTMENT OF WATER AND SEWERS

BUREAU OF WATER

CHICAGO 2, ILL.

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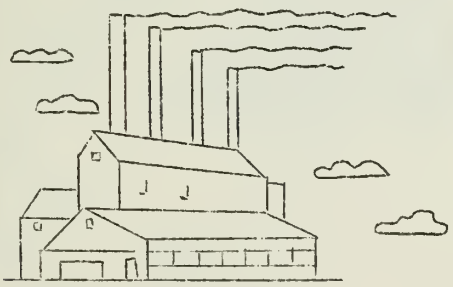

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Water Supply of early Chicago.

Courtesy Chicago Historical Society

City of Chicago
Department of Water and Sewers
Bureau of Water
Division of Water Purification

July, 1956

THE WATER SYSTEM OF CHICAGO
A Description of the System and its Sanitary Protection

FOREWORD

The community of Chicago began its existence with the building of Fort Dearborn in 1803. The small frontier settlement first drew water from the Chicago River and the shores of Lake Michigan. From this early pioneer settlement, the community has grown to a population of 4,428,000 and an area of 349 square miles. Chicago's water system has developed with the growth of the city, from the first public well built in 1834 to the present vast system of intakes, pumps and water mains. The subject matter of this booklet is based on technical and detailed data compiled by the Bureau of Water, and explains the composition and current operations of one of the world's largest water supply systems. It is prepared for the purpose of giving Chicagoland water consumers a better understanding of their water works and of the round-the-clock service which they receive daily from this department.

HISTORICAL

The early settlers of Chicago first drew water from the Chicago River. Soon the river became polluted and the settlers turned to the lake shore or shallow wells. For a safer supply, the village trustees built a public well in 1834, from which the settlers carried water home in buckets and barrels. One of the earlier methods of water distribution is pictured on the frontispiece. This enterprising vendor collected the water as shown and sold it by the bucketful from door to door.

Chicago's first water system costing $24,000 and privately owned, was placed in operation in 1842. The intake pipe extended 150 feet into the lake off Lake Street, with the pumping station at Michigan Avenue. The water was elevated by means of a 25-horsepower steam-driven pump to a wooden elevated tank where it flowed by pressure from the tank through wooden pipe lines in the streets. The pipes were made from 10-foot cedar logs, bored with internal diameters ranging from two to six inches. (See Figure 1)

The water works served only a portion of the city south and east of the river. Operating records indicate there was much trouble at that time with fish entering the intake, with turbid water following lake storms and with ice in the winter. This system soon became inadequate for the fast growing city, and a new water works, municipally owned, was built and put in operation in 1854. (See Figure 1) The new pumping station was equipped with a steam driven walking beam type pump known as "Old Sally", and furnished water through cast iron mains that replaced the wooden pipe. A section of this old cast iron water main was recently unearthed at Michigan Avenue while excavating for the new lake front parking project. The pumps at first were operated nine hours daily, and not at all on Sundays, except in case of fire.

At the close of the Civil War, the population of Chicago had grown to 178,500. The growth in turn caused increasing pollution at the lake front and created a demand for more and safer water.

The old water tower that stands in Michigan Boulevard near Chicago Avenue, was erected in 1869, and is a relic of the early construction. It stood undamaged after the great Chicago fire of 1871 that destroyed everything around it, and now it has become a landmark dear to most Chicagoans. The first water tunnel, 5 ft. inside diameter, dug through clay 60 feet below lake level and extending 10,567 ft. into the lake, to a crib of timber construction was completed on March 25, 1867. Contrast this early supply with the system of today, and you have some idea of its growth.

Since 1870, the record of Chicago's water works has been one of almost constant expansion and improvement. More and larger lake intakes, located at greater distances from shore, larger and longer tunnels to the pumping stations, a filtration plant that serves one-third of the population (approximately one-half of the city in area), and construction work started on another filtration plant to serve the other two-thirds of the population, have characterized the growth of the system. Accompanying this has been the almost continuous installation of new and larger water mains.

ORGANIZATION OF DEPARTMENT OF WATER & SEWERS

January 1, 1953, a new Department of Water and Sewers was created to take over all activities in connection with the operation and maintenance of the Chicago Water Works System and the Chicago Sewer System which were formerly in the Department of Public Works. Activities pertaining to the design and construction of water works, sewers, bridges, subways, expressways, viaducts, parking garages, streets and lighting, remain in the Department of Public Works in the newly formed Bureau of Engineering. Design and construction of the water distribution system will be retained in the Water Distribution Division of the Bureau of Water of the Department of Water and Sewers.

The Department of Water and Sewers is divided into two major units——the Bureau of Water and the Bureau of Sewers.

The Bureau of Water provides water supply to all of Chicago and 51 suburbs, and bills and collects water charges for this service. The Bureau is composed of a Pumping Station Operation Division which operates the water intake cribs and 11 pumping stations to pump the water into the system; the Water Purification Division, which supervises treatment of the water to insure its safety and palatability; the Water Distribution Division, which plans, constructs and maintains the water mains to transport the water from the pumping stations to the user's faucet; the Meter Division, which maintains and checks the accuracy of the meters that measure the amount of water used by the consumers; and the Collection Division which bills, collects and accounts for water charges.

ADMINISTRATION, Dept. of Water & Sewers

James W. Jardine . . . . . Commissioner

R. D. Johnsos . . . . . Administrative Engineer

Bureau of Water

W. W. DeBerard . . . . . Deputy Com'r. for Water & Chief Water Engineer

H. H. Gerstein . . . . . Asst. Chief Water Engineer

J. A. Elger . . . . . General Secretary

DIVISIONS

Purification

J. R. Baylis. . . . . Engineer of Water Purification

South District Filtration Plant

O. Gullans . . . . . .Chief Water Chemical Engineer

J. C. Vaughn . . . . . Asst. Chf. Water Chemical Engineer

Water Safety Control Section

M. H. Kuehn. . . . . .Chief Sanitary Engineer

Pumping

J. L. Weeks . . . . . .Mechanical Engineer in Charge

Distribution

B. W. Cullen. . . . . Superintendent

J. B. Eddy . . . . . Engineer

Metering

M. I. Sheridan. . . . . Superintendent

Collection

J. J. Ellicott. . . . . Superintendent

DESCRIPTION OF WATER WORKS

Chicago's water works is divided into three districts--North, Central and South. (See map Figure 1-A). The map also shows the location of the cribs, the water tunnels, filtration plant and the pumping stations.

INTAKE CRIBS

The water is now obtained from Lake Michigan through four intake cribs located two to three miles off shore in water depths of 32 to 37 feet; and one shore intake at the filtration plant. Two additional cribs have been abandoned, one of which may again be used if contemplated improvements to the water system are made.

The cribs are massive structures, built to withstand water pressure and high waves during storms. The Dunne Crib, main source of supply for the South District Filtration Plant, was constructed in 1911 and is typical of crib construction at that date. It is built of wood, steel, concrete and stone. In the early crib construction, wood was used for much of the underwater work. The crib is circular with an outside diameter of 112 feet, and inside diameter of 60.5 feet. It rests on firm ground 32 feet below lake level. Two shafts, each 12 feet inside diameter extend from inside the crib

down 146 feet below lake level to a 14-foot tunnel. Solid rock at the location of the tunnel is 100 feet below lake level. Eight port openings 7 by 7 feet, with the bottom of the openings 25 feet below lake level, are spaced around the crib wall. The bottom part of the crib is constructed solidly of timber grillage, five feet in thickness over the entire area, except where the two shafts pass through. The crib wall, which extends from 27 feet below lake level to 8 feet below, is also of timber and is 26 feet in thickness. The crib wall from this height to 16 feet above lake level is concrete with stone facing 8 to 16 feet above water level. A house with a stone-faced wall covers the crib. Around each of the two 11.0 ft. shafts is a steel shaft 14 feet in diameter that extends 9 feet above the water and down to rock, forming the outer shell of the shaft. Gates and fish screens are located around the shafts inside the crib and below water level.

Wood was not used in the cribs recently constructed. The Dever Crib intake of the Chicago Avenue tunnel system serves the largest population and is the latest to be placed in service. The steelwork of this crib was assembled on shore, floated to position, and lowered to the lake bottom. The outer ring of steel 90 feet in diameter formed a cutting shoe at the bottom, and the inner ring 40 feet in diameter also had a cutting shoe. The water was pumped from the inside and the earth excavated to firm ground 38 to 40 feet below water level. The bottom, and the space between the outer and inner steel rings was filled with concrete. The inside diameter of the crib is 40 feet, down to 36 feet below lake level, and the wall thickness at the bottom is 25 feet. The intake ports, eight in number, are 8 ft. in diameter. The outside diameter of the crib at the water surface is 75 feet.

The shaft, 16 ft. inside diameter, is concrete from 15 ft. below lake level down to the tunnel 190 ft. below lake level. Twelve fish screens, with total area of 385 square feet, rest on the top of the shaft below water level. These screens can be raised for cleaning. The total weight of the crib is 16,000 tons.

Table 1 gives the names of the cribs, dates of construction and depths of water:

TABLE 1

Intake Cribs and Shore Intake

	Date Placed in Service	Distance from Shore Miles	Depth of Water Feet
North District			
Wilson Avenue	1918	2.1	33.5
Central District			
Four Mile	1892	3.15	37.0
Carter H. Harrison (Not in service)	1900	2.62	33.8
William E. Dever	1935	2.65	34.0
South District			
Edward F. Dunne	1911	2.0	32.0
Filtration Plant	1945	0.0	24.0
68th Street (Not in service)	1894	2.0	32.0

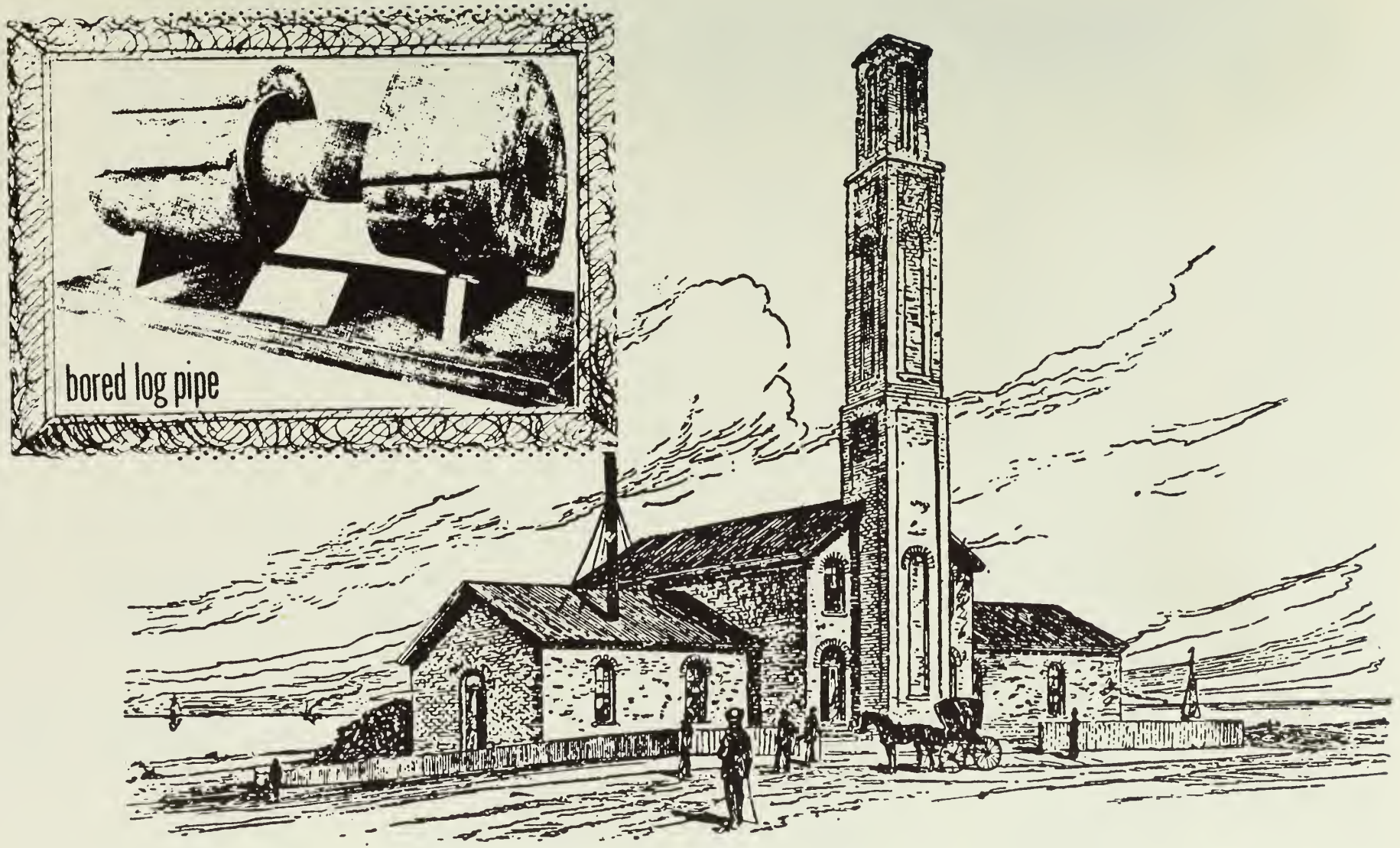


Figure 1—Original Municipal Water Works—In service 1854

TUNNELS

Tunnels convey the water from the cribs to the pumping stations. Chicago's record in tunnel construction forms a bright page in water works history. The first runnel, 5 feet in diameter, and 2 miles in length, was dug through clay 60 ft. below lake level. It was lined with two shells of brick. This tunnel was placed in service in 1867. The second tunnel, completed in 1874, was 7 ft. in diameter and 6 miles in length. It was dug through clay and lined with brick.

Between 1867 and 1900, thirty miles of brick-lined tunnels, 5 to 10 feet in diameter, were constructed. Since 1900 all tunnels have been lined with concrete. The first concrete-lined tunnels are drilled in solid rock and are 50 to 190 feet below lake level. The rock surface beneath Chicago varies from near lake level to 100 feet below. The Chicago Avenue Tunnel, completed in 1935, is typical of recent tunnel construction. The tunnel is horse-shoe shaped, 16 feet in diameter, and is 170 to 190 feet below lake level for the section underneath the lake. Table 2 summarizes the main data for tunnels in use and abandoned tunnels likely to be used in the future.

TABLE 2

Tunnels

	Year Placed in Service	Length Miles	Diameter Feet
North District			
Lake View	1892	2.00	6
Wilson Avenue	1918	8.62	13,12 & 8
Total Miles		10.62	
Central District			
Four Mile Lake	1892	6.45	8 & 6
14th St. Connections (Not in service)	1892	.50	8 & 6
Chicago Avenue Pumping Station	1904	.13	6
Polk Street	1907	1.42	7
Blue Island Avenue	1909	5.10	8
Harrison St. Cross Conn.	1932	.24	7
Chicago Ave. Lake & Land	1935	11.50	16,13 & 10
Desplaines St.	1940	1.60	13
Harrison Crib Tunnel (Not in service)			
Northeast Lake (Abandoned)	1900	2.66	10
Total Miles		29.60	
South District			
Southwest Lake and Land	1911	9.65	14,12,9
68th St. Connection to S.W. Tunnel	1916	.63	8 & 6
Western Avenue	1927	6.02	12 & 10
Stewart Avenue	1943	4.28	10
Connection to Filtration Plant	1945	2.80	16,13,9
Total Miles		23.38	

PUMPING STATIONS

Pumping is the easy way to lower a bucket into a deep well, fill it with water, lift it, carry it many miles across town, and up to a 3rd floor kitchen. Chicago's pumping units do just that.

Eleven pumping stations with a total of forty-nine pumps force the water through the city mains. These pumps lift more than one billion gallons a day from the underground supply tunnels, and force it into the 4,000 miles of pipe line for delivery to the consumer. The pumping pressure moves the water in an endless flow across the city and lifts it to heights of 80 feet. Large mains feed water into smaller mains, small mains spread into branching lines, and finally connect to the service pipes at the consumer's front door Figure 1-A (page 18), shows the location of these stations, and TABLE 3 gives dates of construction and their capacities. In some of the stations the pumps are driven by electric motors, and in other stations steam turbines or triple-expansion steam pumps are used.

TABLE 3

Pumping Stations

STATION	Year Placed in Service	Power Used	Number of Pumps	Installed Capacity Million Gallons Daily	Average Pumpage Millions Gallons Daily 1955
North District					
Lake View	1889	Steam	4	100	26.96
Mayfair	1918	Steam	8	325	100.45
Thomas Jefferson	1928	Electric	4	160	71.02
Totals			16	585	198.43
Central District					
Chicago Avenue	1854	Electric	4	160	85.94
29nd Street	1876	Electric	3	70(103 da)	46.72
Central Park Ave.	1900	Steam	4	280	153.89
Springfield Ave.	1901	Steam	4	280	137.24
Cermak	1936	Electric	6	300	103.97
Totals			21	1090	527.76
South District					
68th Street	1889	Electric	5	200	101.67
Roseland	1911	Steam	3	225	104.08
Western Ave.	1927	Steam	4	300	139.67
Totals			12	725	345.42

PUMPS

Chicago's municipal water system has grown from one pumping station with one 8 million gallon per day pump to eleven stations with 49 pumps having a combined capacity of 2,400,000,000 gallons every 24 hours. Figure 1-A (page 18) shows location of the stations, and Table 3 gives data on the equipment in the stations. The first pump, installed in 1853, was used for 50 years.

The present Chicago Avenue Pumping Station was completed in 1869. The original pumps in this station were replaced with more modern pumps, and new pumps installed as the water consumption increased. The second pumping station, known as the Twenty-Second Street Station was placed in operation in 1876. This station changed to motor-driven centrifugal pumps in 1912.

The Harrison Street Pumping Station (rebuilt and called Cermak Station) was placed in service in 1889, Lake View in 1889, and Fourteenth Street Station in 1892. The original 68th Street Station was placed in service in 1889. More pumping stations, and newer and greater capacity pumps have characterized the growth of the pumping stations. The Cermak Pumping Station, with a capacity of 300 million gallons of water daily, was placed in service in 1936. It is typical of modern-day pumping station construction.

DISTRIBUTION SYSTEM

Chicago's vast distribution system covers the city with a network of pipes, which, if placed end to end, would extend across the United States from east to west. Almost every street in Chicago on which a house is located has a city water main within the street, and fire hydrants close enough for fire protection. A twenty-four hour a day delivery service is maintained to reach 474,414 homes, schools, factories and other service outlets. Along the delivery route, the network stands by ready to supply the Fire Department with water from 44,548 fire hydrants. At the city limits, large mains deliver water to supply 51 suburban communities. Day and night, the consumer gets as much as he needs - for home use, for industrial processes, for power plants, for sprinkling, for air conditioning and for fire fighting. Chicago's water rate is one of the lowest in the country, as consumers pay less than 3 cents a ton for treated water delivered in the city. The following is a summary of the distribution system:

GENERAL STATISTICS-1955

Date of Construction	1852 to Date
By whom owned	City of Chicago
Source of Supply	Lake Michigan

Supplied by gravity from intakes 2 to 3 miles out in Lake Michigan through tunnels to Pumping Stations. Direct pumping into mains.

WATER CONSUMPTION

Population of Chicago supplied	3,750,000
Population of Outside communities supplied from Chicago Water Supply System	678,000
Total Population Supplied	4,428,000
Total annual pumpage of Water System - gallons	378,532,000,000
Average daily pumpage of Water System- "	1,037,074,000
Maximum day's pumpage in 1955-July 27- "	1,513,140,000
Record High day's pumpage -July 27, 1955- "	1,513,140,000
Average daily consumption of water supplied thru meters to Communities, Industries, etc., outside of Chicago-gallons	106,430,000
Average daily consumption within City of Chicago -gallons	930,644,000

Average daily consumption of water passed thru meters within City of Chicago (Free metered water not included) -gallons.	445,973,000
Percentage of water consumption metered - City	47.9%
Gallons per day to each inhabitant - City	248.2
Gallons per day to each inhabitant - Outside consumption	157.0
Annual average of total head at Pumping Stations - feet.	136.0

SERVICES

Kind of Pipe and Sizes: Lead 3/4 in. to 2-in.; Cast Iron 3-in. to 16 in.	
Assessed Services	341,978
Meters in Service	132,436
Total Services	474,414
Percentage of Services Metered	$7,167,956.37
Revenue from Metered Rates	$23,670,632.64
Percentage of Revenue from Metered Rates	76.76%

DISTRIBUTION SYSTEM

Kind of Pipe: Lead (1",1-1/2"), Concrete, Steel and Cast Iron	
Size (inches)	1 to 54
Pipe in use: Miles (Lead .27; Concrete 19.48; Steel 8.01; Cast Iron 4,039.66 --- Total	4,067.12
Hydrants in use	44,548
Gate Valves in use	42,261
Pressure Range in Mains - Lbs. per sq. inch.	25 to 50

EARLY HISTORY

Chicago incorporated as a village	August 10,	1833
Chicago incorporated as a city	March 4,	1837
State charter to Chicago Hydraulic Co. for first public water supply	January 18,	1836
First public water service began		1842
City obtained permission from legislature to build water supply system	February 15,	1851
First cast iron pipe in distribution system laid in Clark Street		1852
City supplied by own water works system - North Pumping Works (8 M.G.D. Pump known as "Old Sally")	February	1854
Work on first water tunnel under Lake began	March 17,	1864
Water from first intake (2-Mile Crib) and tunnel supplied to North Pumping Works	March 25,	1867
North Pumping Works (present Chicago Avenue Station) New buildings and water tower completed	Early in	1869
Great Chicago Fire damaged North Pumping Works	October 8-9	1871
Pumps were out of service for 8 days.		

STATISTICAL

Lake Intake Cribs	6
Water Pumping Stations	11
Filtration Plant	1
Sewage Pumping Station	1
Municipal Power Plant	1
Tunnels connecting cribs with pumping stations (including 2.8 miles of tunnels, connecting 79th St. Filtration Plant into Southwest Land Tunnel System).	63.6 miles

FILTRATION PLANT

	Year placed in service
South District Filtration Plant	Oct. 1945 - - - Partial Treatment
(79th St. & Lake Michigan)	May 14, 1947 - Complete "

Stations supplied: - 68th Street, Roseland and Western Avenue.

RECENT IMPROVEMENTS

In 1955, 378,532,000,000 gallons of water were pumped, an increase of 2% over the previous year. Record rates of pumpage were reached with a peak day of 1,513,140,000 gallons on July 27 and a peak hour of 1,788,000,000 gallons on July 28 at 3 P.M.

The Central District Filtration Plant coffer dam was completed and the enclosed area dewatered and graded.

Underground leakage control saved over eleven million gallons of water per day.

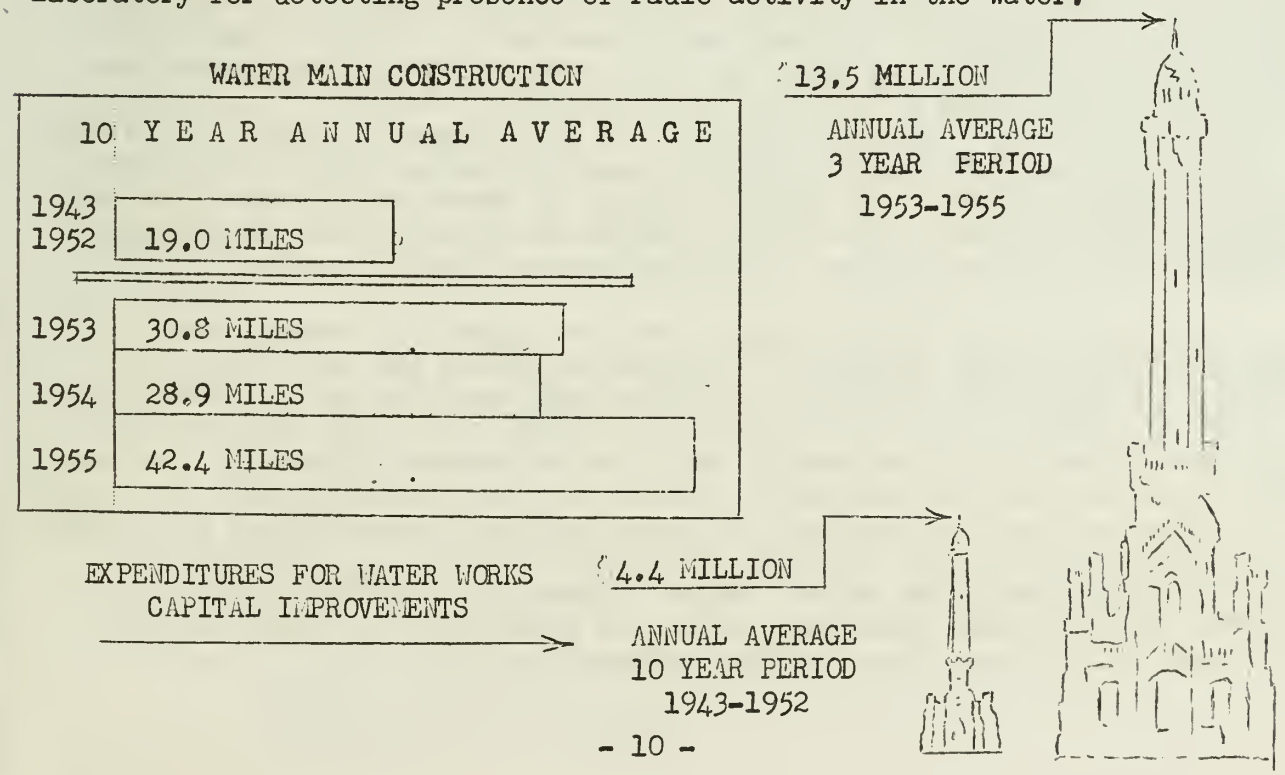
The department safety program effectively reduced accident frequency and severity rates.

Construction of a 30,000,000 gallons reservoir at Western Avenue pumping station, the first in the Chicago water system, was 51% completed during 1955.

Two new 60 million gallon per day pumps, a new 650 horse power boiler and electric switch control panels were added to the pumping facilities. Major construction work is now in progress to modernize and increase capacities at eight of the pumping stations.

Water distribution system was improved by the installation of 10.3 miles of feeder mains 24 inch or over in diameter and 32.11 miles of smaller service mains.

New recording monitors were installed at the South District Filtration Laboratory for detecting presence of radio activity in the water.



Gate valves added during year	635
Gate valves abandoned during year	172
Gate valves now in use	42,261
Pressure Range in Mains - Lbs. per sq. inch	25 to 50

THE WORK OF THE WATER PURIFICATION DIVISION

The Water Purification Division is a part of the Department of Water and Sewers and is assigned the duty of insuring the purity and safety of the water supplied to the citizens of Chicago. It is divided into three sections:

1. Filtration
2. Water Testing
3. Water Safety Control

The Filtration Section operates the South District Filtration Plant.

The Water Testing Section functions in connection with the South District Filtration Plant and Water Safety Control Section to conduct bacteriological and other tests on samples of water collected throughout the city. It operates the chlorination control laboratory located at the Chicago Avenue Pumping Station.

The Water Safety Control Section controls the chlorination at pumping stations in the part of the city not supplied by the filtration plant, collects water samples throughout the city, investigates complaints of water quality, inspects for pollution entering the lake, controls the chlorination of new and repaired water mains, and performs a variety of other sanitary engineering work in connection with the water system.

SOUTH DISTRICT FILTRATION PLANT

The South District Filtration Plant, placed in full operation in 1947, is the world's largest plant for the filtration of water. It is composed of a low-lift pumping station, three chemical mixing basins, three settling basins, eighty filters, two filtered water reservoirs, a chemical building, laboratories, administration building, shops, and a garage. The area of the city served by the plant is shown as the shaded area in Figure 1, and Figure 2 is an aerial photo of the plant. Figure 3 is a diagrammatic sketch of the plant. It filters the water for three south side pumping stations (68th Street, Roseland and Western Avenue). The average pumpage of these stations for 1955 was 345 million gallons daily. The maximum amount of water filtered in 24 hours in 1955 was 478 million gallons. The plant serves 1,543,000 people.

In the low-lift pumping station there are eight large motor driven pumps that have a total capacity of 750 million gallons per day (Figure 4). Briefly, the pumps lift the water from below lake level in the intake basin up to 20 to 25 feet up into the raw-water conduits. From this elevation the water flows through the remainder of the plant by gravity (Figure 5). The raw water is divided into three separate flows before passing through the three two story mixing and settling basins. The three settling basins connect to a common settled-water header, from which the water then flows to the filters. The filtered water first flows to four basins underneath the filters, then to the two main filtered-water reservoirs, which are connected by a tunnel through solid rock to the three South District pumping stations.

To briefly describe the functions of each part of the treatment process, let us follow the flow of the water through the plant. After the raw water is pumped up into the raw water conduit by the low lift pumps, the flow is divided into three equal parts. The rate of flow of the water entering the three mixing basins is measured by three large meters, one for each basin. From the meters, each one-third portion of the water then passes through a chemical application conduit where the chemicals, used to purify the water, are added. Here the chemicals are mixed rapidly with the water by means of revolving paddles, and the mixture then flows through another conduit to the mixing basin (Figure 6). Each mixing basin consists of six long conduits equipped with slowly revolving paddles where the water is gently agitated for 30 to 50 minutes as it flows through. This treatment produces coagulation, which is the clumping together of all suspended matter in the water.

In coagulation, all suspended particles such as mud, bacteria, microscopic organisms and other impurities, are brought together by the coagulant into masses of particles that are large enough and heavy enough for most of them to settle to the bottom of settling basin. After coagulation, the water flows slowly through the three settling basins, one for each mixing basin (Figure 7). These are long, deep two-story concrete basins where the water is retained for a period of 3 to 5 hours, and 70 to 90 percent of the coagulated material and impurities are removed by settling. The sediment, on the floor of each basin, is removed daily by a system of scrapers, and is pumped back into the lake a considerable distance from the plant. The sediment is heavy and most of it remains on the lake bottom.

The masses of particles not settled from the water during the slow flow through the settling basins are removed by filtration. Eighty filters are used to filter the water. Each filter is composed of a sand bed 54 feet by 25.7 feet supported by gravel in a reinforced concrete tank (Figure 8). In the bottom of each filter is 1/4 mile of 4-inch cast-iron pipe spaced 12 inches apart with holes spaced six inches apart in the pipe for the passage of water. The pipes are covered with 21-1/2 inches of gravel in six layers varying from 3-1/2 inches in diameter at the bottom to 1/12 inch at the top. On top of this is 25 inches of sand of .65 mm effective size. In filtration, the water flows from the top of the settling basins into conduits to the top of the filters, passes downward through the sand and gravel, collects in the underdrain pipes, then flows through a filter rate controller and into the filtered water basin underneath. The capacity of each filter is from 2 to 8 million gallons of filtered water daily, depending on requirements. Each filter is provided with nine concrete troughs that empty into a gutter extending the length of the filter for use in carrying away the wash water. Impurities removed by filtration are washed from the filters on the average of once daily, by shutting off the filter and reversing the flow through the sand bed. Four to ten million gallons of filtered water are required daily to wash the 80 filters.(Figure 9).

The capacity of the filtered water basins and reservoirs is 47 million gallons of water. The two main filtered water reservoirs connect to a shaft 16 feet in diameter that extends 160 feet below lake level to the tunnel leading to the pumping stations.

Chemical Treatment

The treatment of the water in the South District Filtration Plant consists of:

1. Chlorination, to kill the bacteria.
2. Aluminum sulfate and chlorinated ferrous sulfate, to produce coagulation of the water.

3. Lime, to lessen the corrosion of iron pipe.
4. Activated Carbon, to remove objectionable tastes and odors.
5. Sodium Silicate, used occasionally to aid coagulation.
6. Ammonium Sulfate, for preventing chlorinous tastes.
7. Fluoride, for the control of dental caries.

WATER QUALITY

The first requirement of drinking water is that no disease-producing germs be present. With chlorination and filtration, all bacteria are killed and then removed from the water.

The second requirement of drinking water is that it be palatable. With the use of activated carbon, the objectionable tastes and odors in the water are removed. Extensive provision for the use of activated carbon is a feature of this filtration plant.

The third requirement of drinking water is that it be clear. The sparkle of water as we lift the glass to drink gives confidence in its purity. Only water free of all turbid material will sparkle. The two hundred thousand tons of mud removed annually from the water at the filtration plant are ample proof of the need of filtration. Few would believe so much mud is in the lake water. Algae are present at times in the water in numbers up to 5,000 per cubic centrimeter of water.

Purity Control

Laboratory samples examined	
Bacteriological Laboratory	44,182
Chemical Laboratory	132,466
Electron Microscope Laboratory	7,446
Total samples examined	184,094

Bacteriological Results

Annual Average coliform organism per 100 ml*

	South District (filtered)	North & Central District (chlorinated only)
Raw	43.69	2.75
Plant Outlet	0.002	--
Pumping Stations	0.003	0.293
Distribution System	0.007	0.121

*U. S. Public Health Service standard for safe drinking water permits a maximum average of 1.0 coliform organisms per 100 ml.

Purification Treatment	Gallons
Complete filtration treatment	129,498,200,000
Chlorination treatment only	252,830,670,000

Chemicals applied - Tons

	Filtration Treatment	Chlorination Only
Chlorine	6,069	1,290
Aluminum Sulfate	4,128	-

(Cont'd)	Filtration Treatment	Chlorination Only
Ferrous Sulfate	1,999	-
Lime	1,315	-
Activated Carbon	1,029	-
Sodium Silicate	-	-
Sulfuric Acid	-	-
Ammonium Sulfate	548	-
Hydrofluosilicic Acid	2,700	-

L A B O R A T O R I E S

The laboratories at the South District Filtration Plant have two divisions. The bacteriological laboratory has a sub-division in the electron microscope laboratory, the chemical laboratory has a sub-division in the control laboratory. Both laboratories perform the dual function of serving the entire city of Chicago, and also the South District Filtration Plant. In 1955, the bacteriological laboratory examined a total of 43,552 samples, about 60% of these were from the city and adjacent suburbs, and the remainder from various points of treatment of the South District Filtration Plant. The electron microscope laboratory sub-division serves a purpose in shortening the period of the bacteriological testing of water. Samples are tested according to the usual bacteriological procedure for at least 18 hours. Specimens are then prepared and examined on the electron microscope. The presence or absence of coliform bacteria in the water may thus be determined within the maximum time of 26 hrs. This compares very favorably with the standard bacteriological test period of 48 to 96 hrs., this being very important in cases of sterilizing mains or community disaster, such as the floods in 1954. The electron microscope is further used in studies of corrosion and chemical coagulation.

The main chemical laboratory is devoted to the analyses of chemicals received, surveys of the southern end of Lake Michigan and its tributaries, and investigations into the problems of water treatment, corrosion and radioactivity. The control laboratory (sub-division of the chemical laboratory) performs the routine tests essential to the proper operation of the South District Filtration Plant. This laboratory works around the clock, with a chemist always on duty. The tests performed consist of the determinations of turbidity, residual chlorine, pH, alkalinity, ammonia nitrogen, threshold odor, hardness and a few other tests. In 1955 the chemical and control laboratories examined a total of 132,466 samples. These were divided almost equally between survey samples and samples from the South District Filtration Plant, with a small percentage coming from complaints out in the distribution system.

CENTRAL DISTRICT FILTRATION PLANT

Construction work is now under way on the Central District Filtration Plant. This plant, when completed, will supply the Central and North water districts of Chicago and the adjacent suburbs. These two water districts have a combined water consumption twice that of the South Water district. The average daily water consumption in 1955 was 677 million gallons.

The plant is being constructed on made land north of Navy Pier. The rated capacity of the plant is 960 million gallons of water daily. The plant will consist of the following main units:

1. Tunnel connections to existing tunnels.
2. Low lift pumping station.
3. Sixteen mixing units.
4. Sixteen settling basins.
5. Ninety-two filters with two filter beds each.
6. Filtered water storage reservoirs.
7. Chemical building.
8. Laboratories.
9. Administration building.
10. Shops and storerooms.

CHLORINATION OF NORTH AND CENTRAL DISTRICT WATER

In the North and Central water districts, the only treatment given the water is chlorination. A chlorinating plant is located in each of the eight pumping stations. A total of 45 chlorinating machines are installed in these stations. The chlorine received as a liquid in steel cylinders. Three of the stations use one-ton cylinders, and the others use 150-lb. cylinders.

Chlorination of the water supplied to Chicago, as a safeguard to public health, was started in 1912. Since chlorination is the only line of defense against water-borne disease for two-thirds of the population of Chicago, its control must be the very best. This line of defense should never be broken. The system of checking the amount of chlorine added to the water is thorough, and it is unlikely that any water not properly chlorinated will be delivered to the consumers. A chlorine attendant is on duty all of the time at each chlorinating plant in the pumping stations. The Water Purification Division makes frequent inspections of the chlorinating equipment to be assured the plants are in good operating condition.

The water is tested hourly, or more often, to see that sufficient chlorine is added to leave the desired residual in the water. A small amount of residual chlorine is necessary for good sterilization. Instruments for continuous automatic measuring and recording the residual chlorine have been installed in each pumping station. This is aiding in the control of the chlorination.

CHLORINATION CONTROL LABORATORY

During 1947, a chlorination control laboratory was installed in the Chicago Avenue pumping station to provide better control of chlorination of the water at the Central Water District. A chemist is on duty all the time at this station. The chlorine demand of the water is determined hourly and adjustments in chlorine dosage are made promptly.

QUALITY OF WATER IS GOOD

The chlorinated water supplied the Central and North Water Districts, while not equal to that of the filtered water supplied the South Water District is of good bacteriological quality. The water at times is turbid and contains algae to a very objectionable extent. Pollution of the lake water is not high because of diversion of the sewage from the lake by the Sanitary District of Chicago.

PREVENTION OF LAKE POLLUTION BY CHICAGO SANITARY DISTRICT

No domestic sewage from Chicago or nearby suburbs in Illinois now enters the lake. The sewage is treated in four large sewage disposal plants, and the effluent discharged into the Chicago or Calumet Rivers, and is drained to the Illinois River. Outflow of the Chicago River into Lake Michigan is prevented by control locks located at the mouth of the river. The Calumet River at times does flow into the lake, and carries with it sewage from Indiana cities, but almost none of the sewage from Chicago gets into the lake. Other sources of pollution are the Indiana Harbor Ship Canal, and the discharge from certain industrial plants located in Northern Indiana.

WATER SAMPLES FROM DISTRIBUTION SYSTEM

Samples of water for bacteriological analyses are collected daily from the pumping stations and from the water pipes of the distribution system. These samples are tested at the filtration plant laboratory. In addition, samples are collected from the distribution system for testing by the City Health Department.

INVESTIGATION OF COMPLAINTS

In the area of Chicago not supplied with filtered water, many complaints are investigated, and in most instances samples of water are collected for testing. The complaints vary from water containing much sediment, to dead fish and other causes. Investigation reveals that most complaints result from sediment deposited in the water mains being picked up by some unusual distrubance such as a high velocity through the main. On rare occasions, the cause of taste in the water is from some chemical gaining access to the water, such as an ammonia leak in a refrigerating plant. Investigation of complaints is an important part of the work of the Water Purification Division.

MISCELLANEOUS WORK

The Water Purification Division inspects the water tunnel shafts each year. Sewers located near water shafts are potential sources of pollution. Should pollution seem possible, recommendation for replacing tile piping with cast iron is made.

The chlorine dosage may be ordered increased at a pumping station serving some area where there is a large demand for water, or the pressure is lower than usual. General supervision is given the chlorination at three pumping stations operated by the Chicago Park District during the summer months. The Division cooperates with the suburbs that use Chicago water in adding additional chlorine to the water, and the exercise of other sanitary precautions to prevent contamination of the water. It also supervises dumping of waste material in the lake to avoid contamination of the water.

STERILIZATION OF NEW AND POLLUTED WATER MAINS

All newly installed water mains are sterilized with chlorine and approved as to sanitary quality before being placed into service. Repaired mains are sterilized when possibility of contamination is believed to exist. In the sterilization of a main, it is flushed at high velocity, then a chlorine dosage of approximately 400 lbs. per million gallons of water content is applied and permitted to remain for one day. The main is again flushed at high velocity before sampling to determine the bacteriological quality of the water.

CHICAGO'S RECORD

From the reputation as a typhoid city in years past, Chicago has improved its water supply and other health measures to a degree where it can now boast of the lowest typhoid rate of any large city in the United States. In 1955 the Health Department reported no deaths from water-borne diseases. There were 8 cases of typhoid and 49 cases of amoebic dysentery: however, all these illnesses were traced and it was found they were contracted either in foreign countries or rural areas outside of Chicago.

A BARGAIN IN PUBLIC SERVICE

The public takes for granted that when they turn on a faucet that they will get an unlimited supply of water. They do not recognize the miracle of efficient service performed by public employees that makes this possible. Only when something goes wrong with this vital service does the public recognize the existance of the water department. Neither do they realize that this most essential commodity comes to them at "Bargain Basement" rates. Compared with other major cities in the United States, Chicago furnishes the cheapest water. It is delivered to the consumer at the approximate cost of 3¢ per ton.

Chicago's water works system is owned and controlled by the citizens of Chicago as a community enterprise, self supporting and not-for-profit.

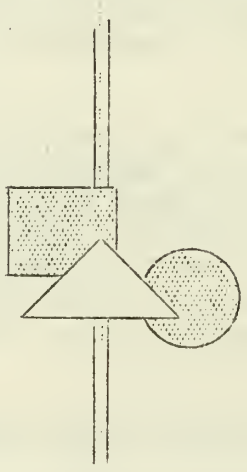
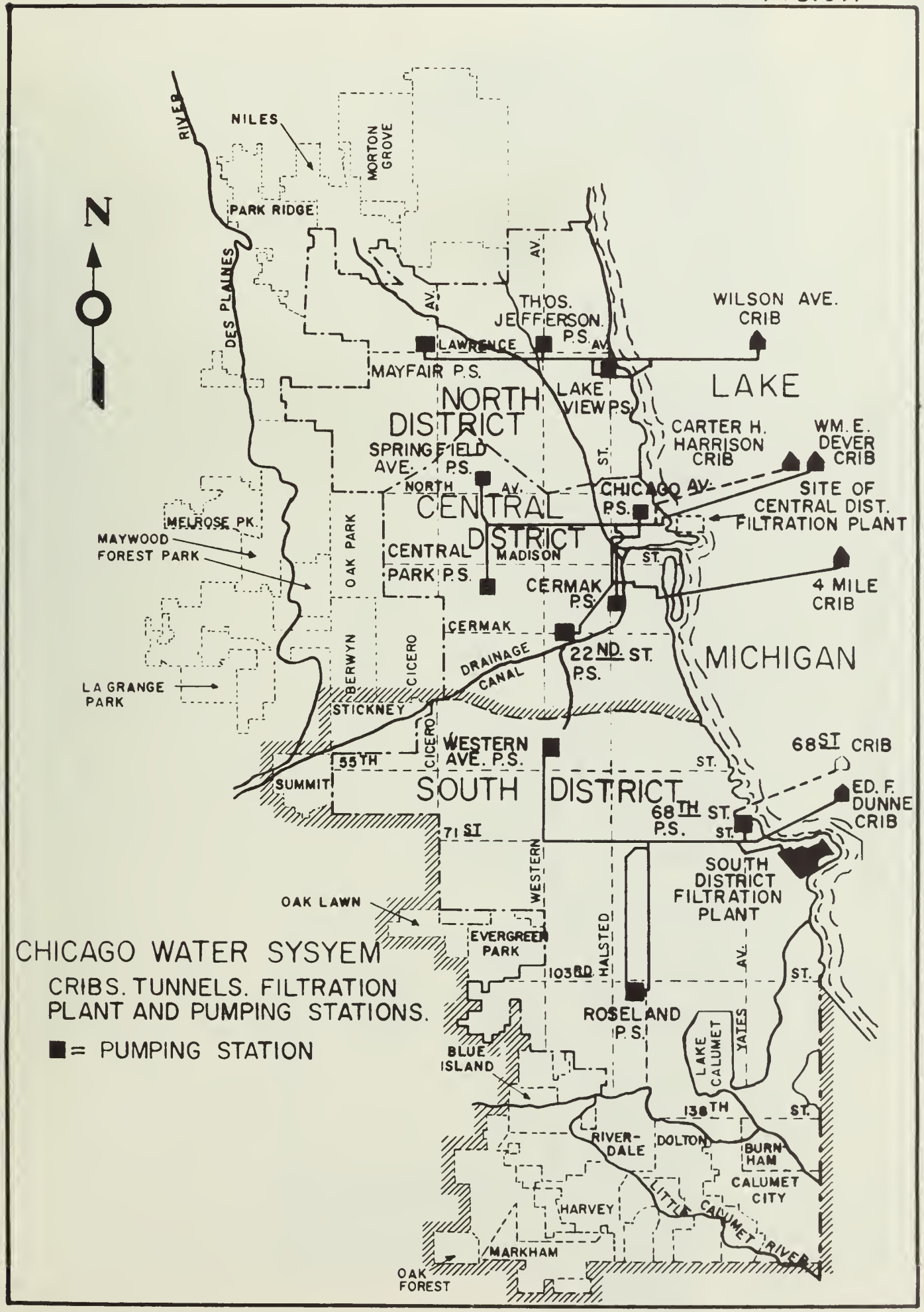


FIG. 1A


N
NILES
MORTON GROVE
PARK RIDGE
DES PLAINES
RIVER
THOS. JEFFERSON P.S.
WILSON AVE. CRIB
LAWRENCE AV.
MAYFAIR P.S.
LAKE VIEW P.S.
LAKE
NORTH DISTRICT
CARTER H. HARRISON CRIB
WM. E. DEVER CRIB
SPRINGFIELD AVE. P.S.
NORTH AV.
CHICAGO AV. P.S.
SITE OF CENTRAL DIST. FILTRATION PLANT
CENTRAL DISTRICT
MELROSE PK.
MAYWOOD FOREST PARK
OAK PARK
CENTRAL PARK P.S.
MADISON ST.
CERMAK P.S.
4 MILE CRIB
CERMAK
22ND ST. P.S.
MICHIGAN
DRAINAGE CANAL
BERWYN
CICERO
LA GRANGE PARK
STICKNEY
WESTERN AVE. P.S.
68ST CRIB
55TH
SUMMIT
SOUTH DISTRICT
68TH ST. P.S.
ED. F. DUNNE CRIB
71 ST
SOUTH DISTRICT FILTRATION PLANT
OAK LAWN
WESTERN
HALSTED
EVERGREEN PARK
103RD ST.
ROSELAND P.S.
LAKE CALUMET
YATES AV.
BLUE ISLAND
138TH ST.
RIVERDALE
DOLTON
BURNHAM
CALUMET CITY
HARVEY
LITTLE CALUMET RIVER
MARKHAM
OAK FOREST
CHICAGO WATER SYSYEM
CRIBS. TUNNELS. FILTRATION PLANT AND PUMPING STATIONS.
■ = PUMPING STATION

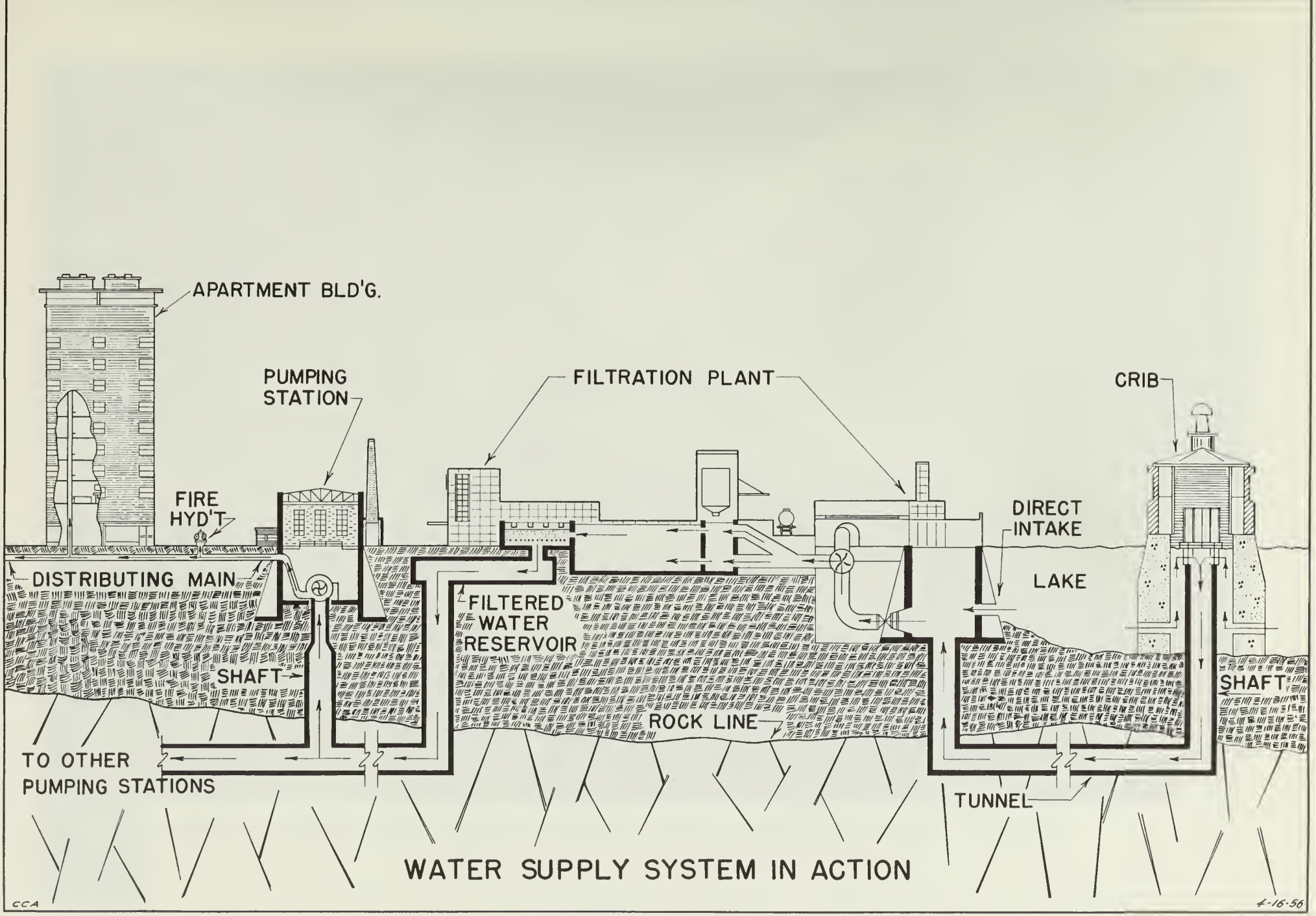
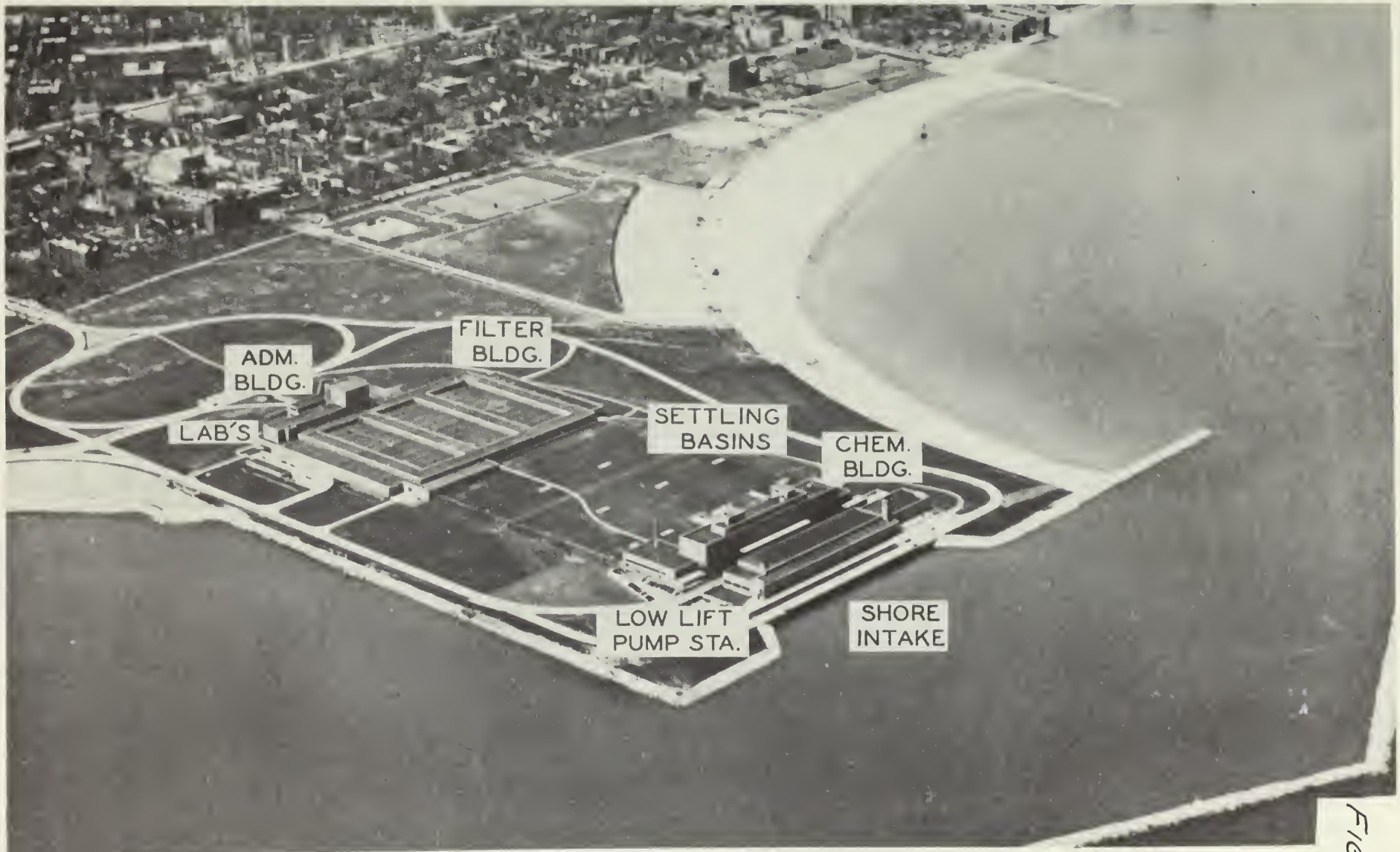
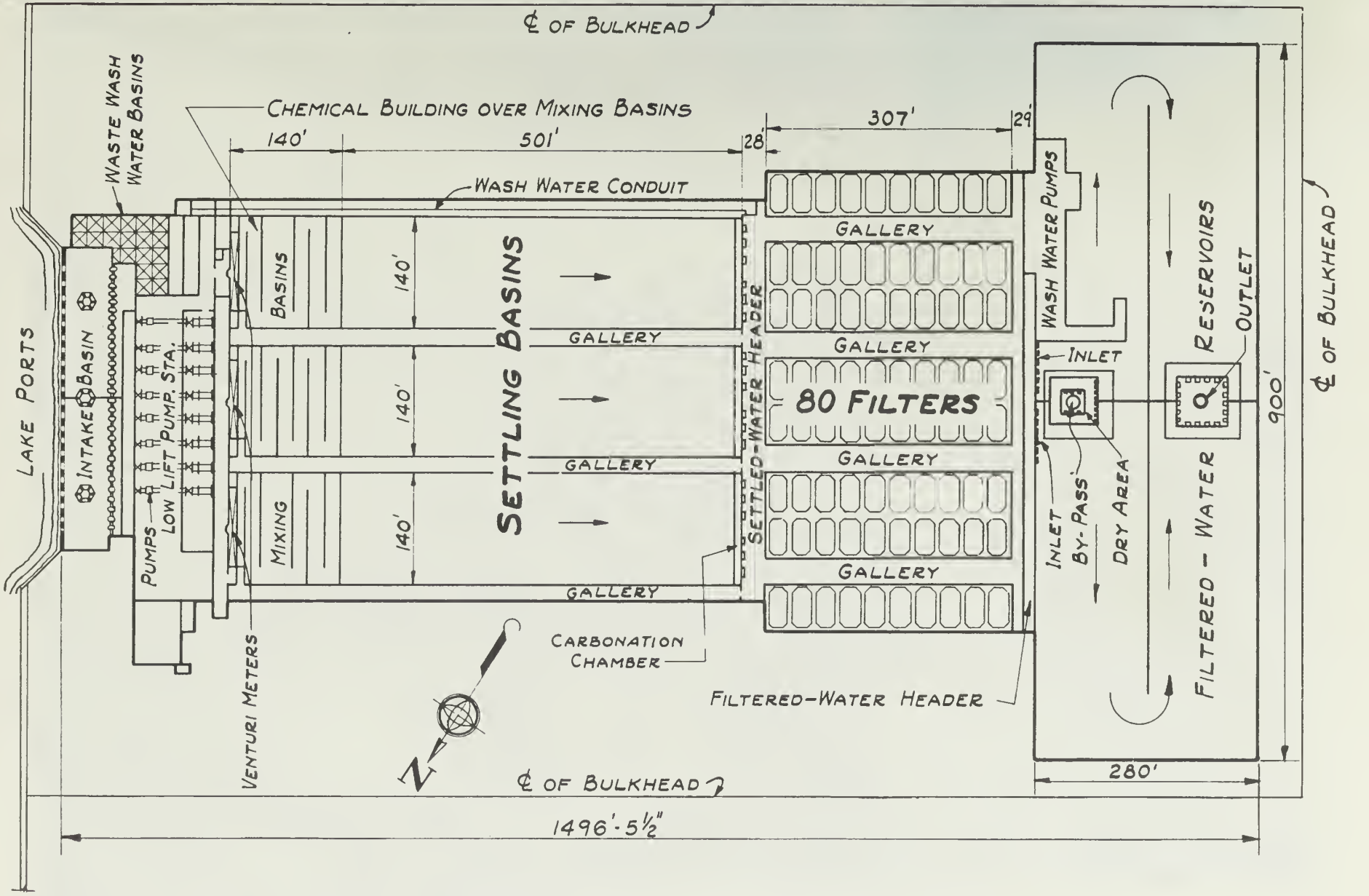

APARTMENT BLD'G.
PUMPING STATION
FILTRATION PLANT
CRIB
FIRE HYD'T
DIRECT INTAKE
LAKE
DISTRIBUTING MAIN
FILTERED WATER RESERVOIR
SHAFT
SHAFT
ROCK LINE
TO OTHER PUMPING STATIONS
TUNNEL
WATER SUPPLY SYSTEM IN ACTION
CCA
4-16-56

FIGURE-IB



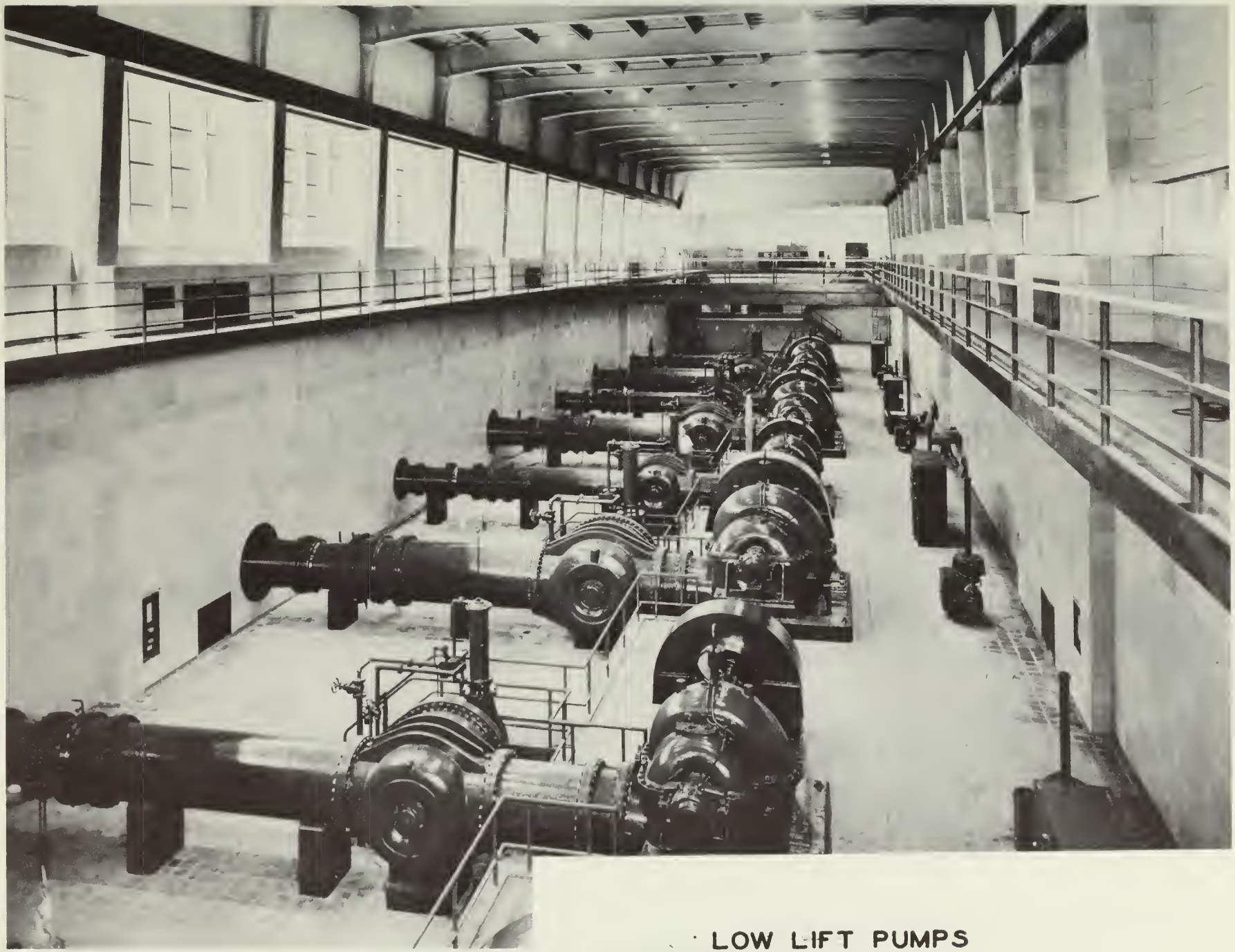
AERIAL VIEW OF THE SOUTH DIST. FILTRATION PLANT

FIG. 2



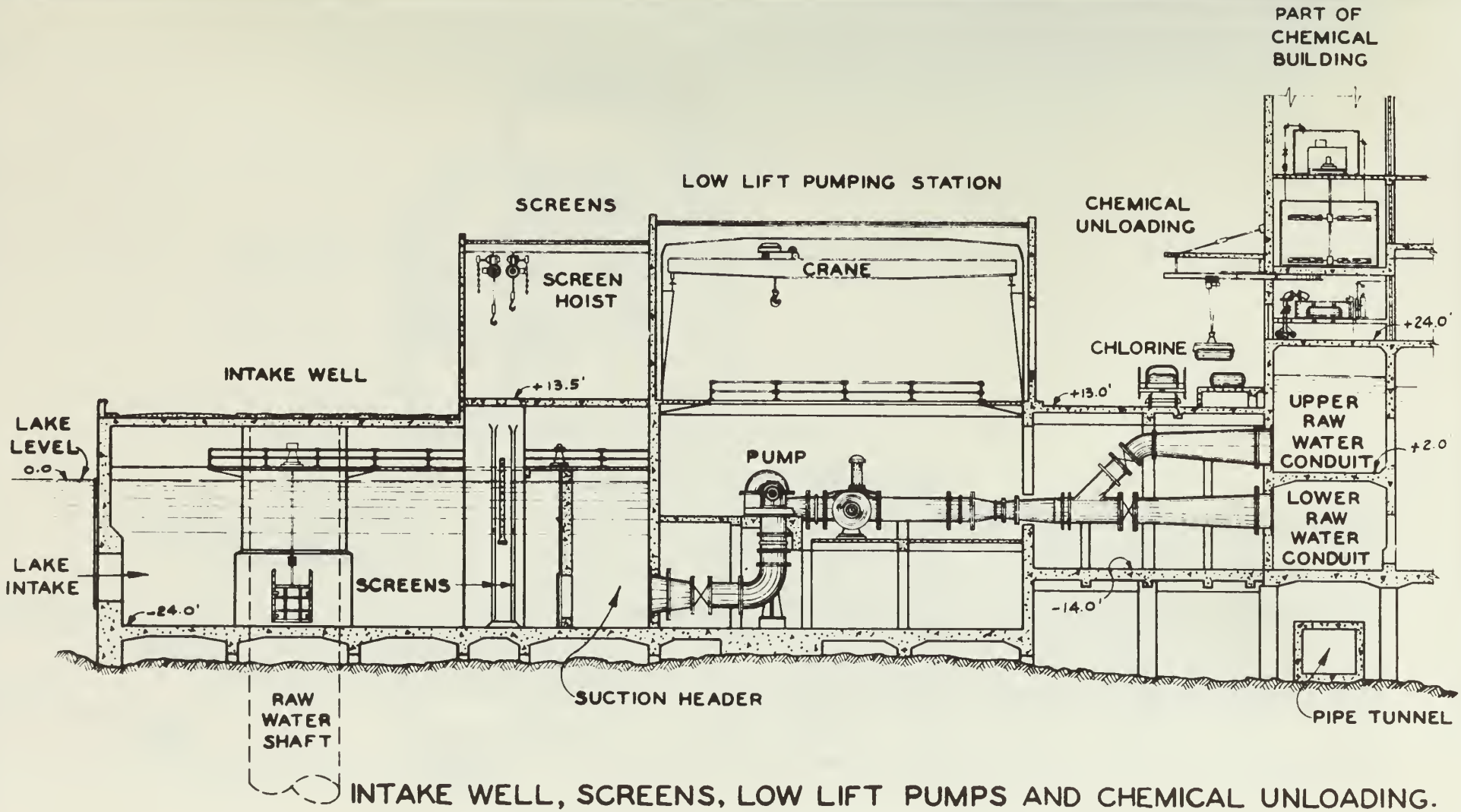
PLAN OF SOUTH DISTRICT FILTRATION PLANT

FIG. 3



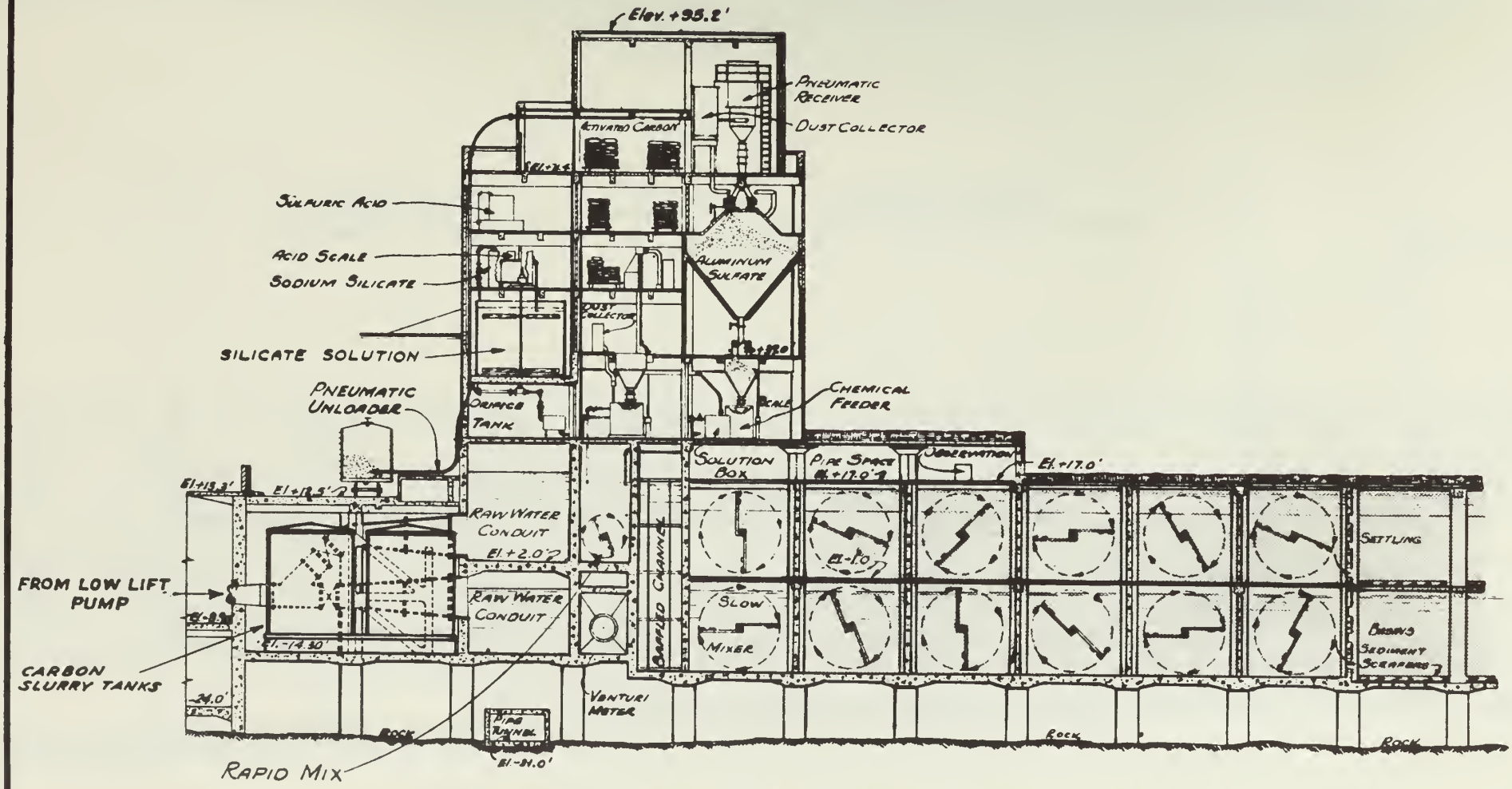
LOW LIFT PUMPS

FIG. 4



INTAKE WELL, SCREENS, LOW LIFT PUMPS AND CHEMICAL UNLOADING.

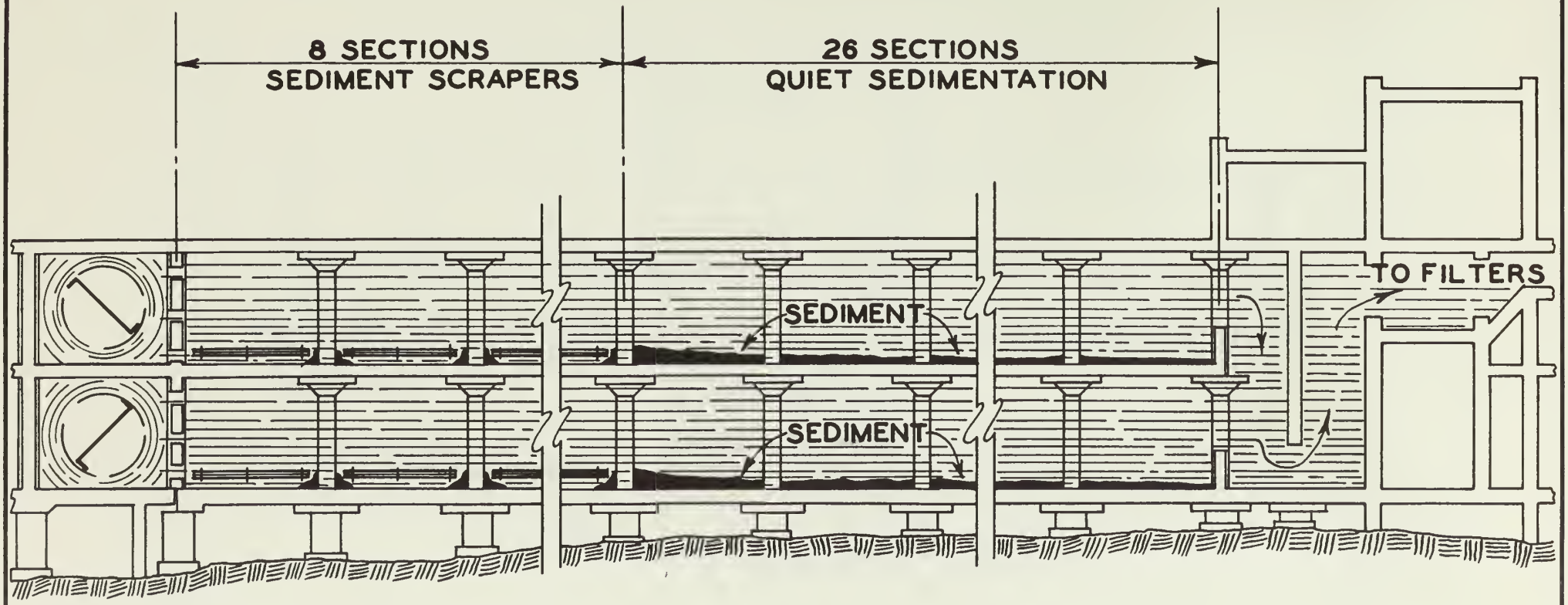
FIG. 5



TYPICAL SECTION THROUGH CHEMICAL BUILDING AND MIXING BASINS

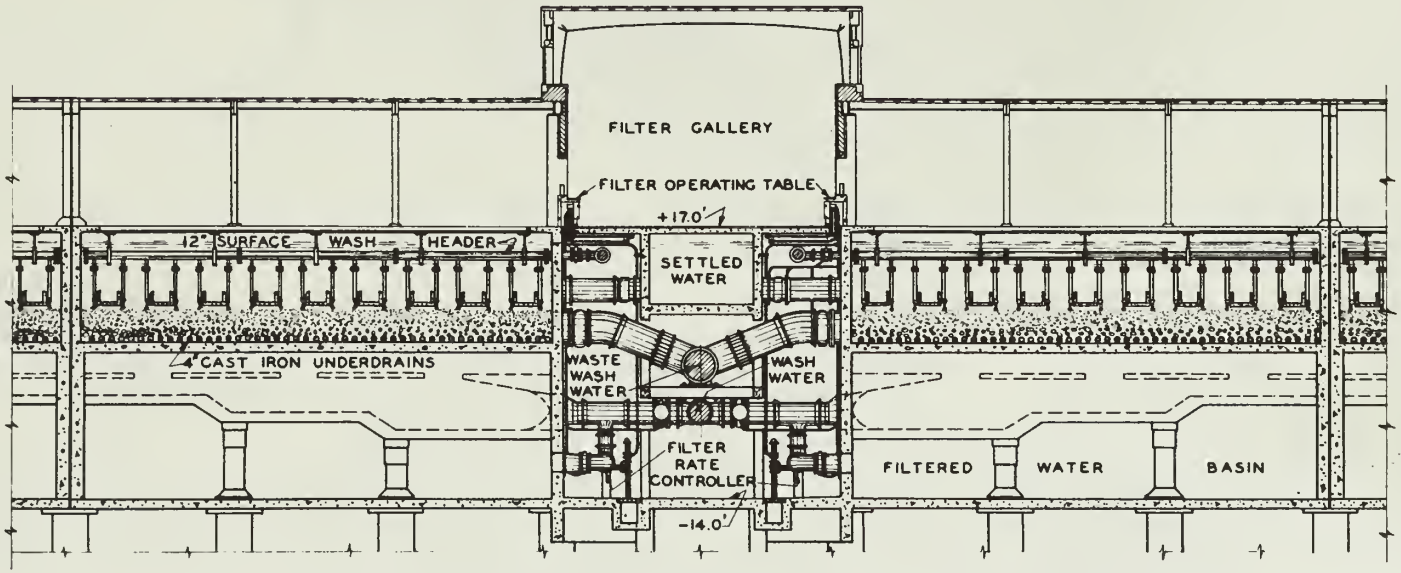
FIG. 6

L.O.S.



TYPICAL SECTION THROUGH SETTLING BASIN

FIG. 7



TYPICAL SECTION THRU FILTERS AND FILTER GALLERY

SOUTH DISTRICT FILTRATION PLANT

FIG. 8

FILTER GALLERY NO. 2

FIG. 9

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CHICAGO WATER SYSTEM CHGO
3 0112 025314201