Milwaukee History

The Magazine of the Milwaukee County Historical Society

Spring, 1986

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COVER

Benjamin Franklin once said, "When the well's dry, they know the worth of water." Although Milwaukee had several natural sources of water, it was not until the 1870s that an efficient, well-planned water system was put into operation. Early area residents obtained water from nearby streams, rivers, springs, private wells, or a commercial water wagon. The city's efforts to construct a water distribution network are presented in "Origins of the Milwaukee Water Works." *(Milwaukee Water Works photo)*

Origins of the Milwaukee Water Works

By Bruce Jordan

ONE HUNDRED SIXTEEN YEARS ago the City of Milwaukee faced a serious problem — finding a source of clean water for its citizens and businesses. Such a problem seems strange for a city whose name means "gathering place by the waters," where the Milwaukee, Menomonee, and Kinnickinnic Rivers come together. But the topic was brought forward in the inaugural speech of Mayor Joseph Phillips on April 19, 1870, when he said that "An abundant supply of good, pure water is a great desideratum for any city, and no city containing the population of Milwaukee should be without it." He also stated that the existing wells and springs were not equal to the "present wants of the public."

Since several previous private attempts to solve the problem had failed and the demand for water kept increasing, Milwaukee's common council, in 1871, organized a Board of Water Commissioners to plan and build a water works system for the city. The planning, building, and organization of the Milwaukee Water Works from 1868 to 1875 and attempts to build a water works prior to 1868 are worthy of review.

At the outset, several points should be made. First, "clean, pure water" will be defined by the standards of 1870. Second, the water works system represents only the first half of man's water cycle, that of taking water from its natural location and putting it to use. The second half of that cycle, the return of used water to a natural basin, is the work of a sewerage system. Milwaukee built both halves about the same time, with the sewerage system having a head start. A third point to be considered is that shortly after the original system was finished, the water works had to change because of design problems and city growth. This paper will deal only with the first half of the water cycle, although the importance of the other half is not forgotten. Also, only the design problems encountered within the water works will be discussed.

Milwaukee's first recognized water works was built for the United States Hotel in 1840 by its owner, James H. Rogers. From a spring on the south side of Wisconsin, between Jackson and Van Buren Streets, he ran a pipeline south to Michigan Street, westward along Michigan to an alley just before Water Street, and then

Tamarack logs were bored lengthwise and used as very early waterpipes. This section dates from the 1850s and is displayed at the Milwaukee County Historical Center.

down the alley to Huron (Clybourn) Street and the hotel. The pipes were tamarack logs cut into ten- to twelve-foot sections from timber stands within the city limits. The logs were bored lengthwise through the center and connecting pieces were made by Milwaukee's first wood turner, Henry Bleyer. Bleyer also made the side taps for the residents along Michigan Street who used these pipes for water. The estimated length of this system was 2,250 feet. These pipes were still in sound shape and functioning well when the water works was built between 1872 and 1874.

The rest of Milwaukee's citizens obtained their water several ways. There were many local springs where people filled water containers and took them home. Others dug private wells behind their homes, so that by 1870 Milwaukee had an estimated 30,000 wells. These wells were vulnerable to seepage from the septic pits, also behind the house. Some of the more enterprising residents drove wagons through the streets to sell water from tanks filled from the river or lake.

As Milwaukee continued to grow through the 1840s and '50s, these sources were not sufficient, nor were the residents happy about the water situation. The first public cry for a water works came in an editorial by the *Milwaukee Sentinel* on July 18, 1845. As a result of citizen pressure, the common council passed an ordinance in June, 1857 to authorize the issuance of city bonds to the Milwaukee Hydraulic Company and gave that company seven

acres of city property where the water tower and St. Mary's complex stand today. The president of the Hydraulic Company, John Van Dyke, procured the designs and services of F. R. Snowden to build the Milwaukee works. Due to various problems, the greatest being that Snowden was busy constructing water works at Louisville, the Milwaukee Hydraulic Company never built anything. The only vestige of that experience was Hydraulic Avenue which today is the employees' parking lot for St. Mary's Hospital.

A second attempt to build a water works was undertaken by Hubbard & Converse of Boston in March, 1859. Their proposal was to build an "engine and boiler house, reservoir, and twenty-five miles of pipe before January 1, 1861 at a cost of $450,000." With the approaching Civil War and other circumstances, construction never took place. During the war itself, all thought of a water works was replaced by the drive to win the war. Therefore, all of Milwaukee's extra energy and money were funneled into the war effort.

Just before the Civil War broke out, on March 16, 1861 the Wisconsin state legislature passed a bill which prevented any immediate thoughts for a Milwaukee water works. This legislation, called the Readjustment Act, prohibited Milwaukee from issuing any new city bonds until its bonded indebtedness was below $500,000. Before the Civil War, the city had participated in the railroad expansion boom and issued $1,614,000 in bonds to aid in the construction of railroads to and from the city. Other obligations prior to June 1, 1861 brought the total city bonded indebtedness to $2,571,250 while the assessed value of real estate and personal property was approximately $12,000,000.

The city government handled the debt problems in three ways. First, under the provisions of the Readjustment Act, the city could assume no new debts. Second, the assessed value of real estate and personal property rose from $32,902,839 in 1867 to $44,086,025 in 1872. The rise in assessed values meant more tax money to settle the old bonded debt. Third, by 1867, $895,000 of the total $1,614,000 in railroad bonds (55 percent of the debt) had been retired. The United States Supreme Court declared void $200,000 worth of bonds issued to the Beloit and Superior Railway Companies, and the remaining $519,000 was placed under the supervision of the companies the city had helped. This last move greatly reduced the city's aggregate amount of bonded and floating debt outstanding.

After reviewing Milwaukee's debt reductions, the state legislature passed two acts in 1871. The first permitted the city to construct a water works, and the second authorized local officials to issue $1,000,000 worth of bonds to aid in that construction. These water bonds could be issued once the aggregate debt reached $500,000.

While Milwaukee's finances were being straightened out, various other actions took place. On October 22, 1867 the city placed

ads in the *New York Times* and the *Age* (in Philadelphia) giving notice that Milwaukee was considering the construction of a water works and would accept proposals. In November, 1867 John B. Ernshow & Company of Cincinnati presented a proposal to the common council. Although it rejected this proposal, the council decided to have one of the leading hydraulic engineers act as a consultant and submit several plans. Following this up, the city obtained authorization in 1868 to levy $5,000 in taxes "for surveys and estimates for the construction of water works," and it secured the services of Ellis Sylvester Chesbrough.

Chesbrough had been the building engineer of the Cochituate Aqueduct and the Brookline Reservoir for Boston from 1846 to 1849. In 1850 he was the sole commissioner of Boston's water works and in 1851 their first city engineer. Four years later he went to Chicago as its chief engineer to design a sewerage system and a water works in 1863. With these qualifications, Chesbrough met Milwaukee's demand for an experienced hydraulic engineer. Moreover he was only 100 miles away.

Chesbrough was hired in 1868 to "make a survey with plans, specifications and estimates, for the construction of waterworks in the city of Milwaukee." Since he was still employed by Chicago, his work in Milwaukee was on a part-time basis. At the common council meeting in November, 1868, Chesbrough made a partial report outlining four plans known as the Tunnel Plan, Lakeshore Plans, Milwaukee River Plan, and Western Lakes Plan.

The central point for all of these plans was a distributing reservoir with a twofold function. First, it had to hold more water than the estimated daily needs of the populace. Second, the pressure of the water held in the distributing reservoir or a combination of water pressure and reservoir height had to be sufficient to push the water through the pipes and out of the taps since the distribution system was fed by gravity pressure. Chesbrough found the best hill for these needs at the corner of North Avenue and Fratney Street. Most of his plans brought the water from various sources to this spot and then distributed it around the city.

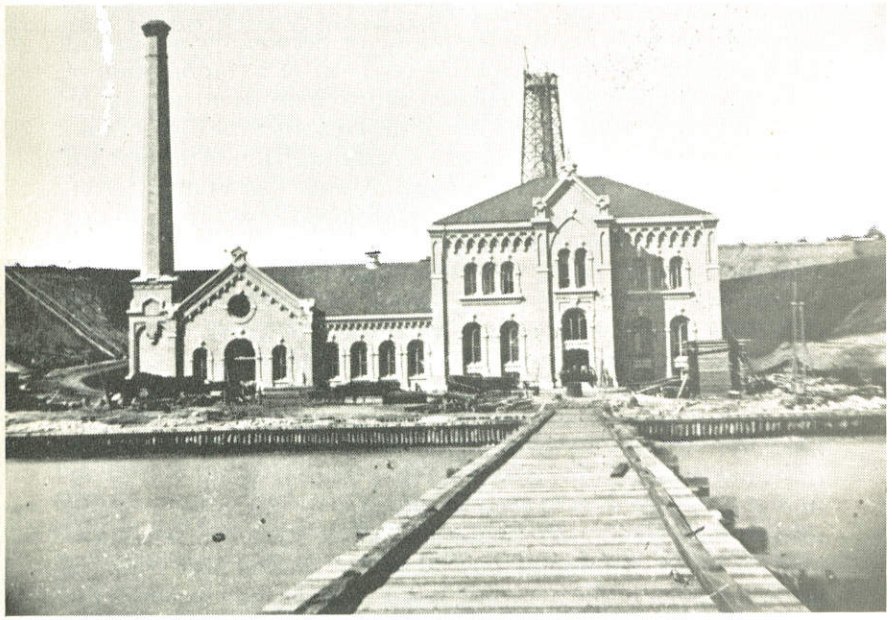
In the Tunnel Plan, a 3,000-foot tunnel would be constructed almost two miles north of the mouth of the Milwaukee River (where the flushing tunnel is today). From a point out in the lake, this tunnel would run under the bluffs, under Prospect and Farwell Avenues, under the Milwaukee River to a spot on the southern slope of the reservoir and on the western bank of the Milwaukee River. At this spot the pumping works would be built to pull the water through the tunnel and then push it up the hill to the reservoir. There were several advantages to this plan. It could utilize power generated from the Milwaukee River (the water flow over the North Humboldt dam) as well as smaller pipe mains to bring the water to the pumping house. Chesbrough had built the Chicago Waterworks with a very similar plan.

Lake Shore Plan Number 1 was located at the same place as the

Tunnel Plan. The two major differences between the plans were the method of obtaining water and the location of the pumping works. To obtain water Chesbrough considered three methods, all of which used locations closer to the shore than the tunnel was. The first idea was to build a breakwater with an intake on it. Although this was the cheapest to build, it was the most expensive to maintain. The second thought was a rigid aqueduct of masonry or iron. The aqueduct needed to be quite deep or it would alter the shoreline and fill the intake with sand. (A deep aqueduct was very similar to a tunnel.) The third concept, which Chesbrough favored, was the use of a flexible iron pipe. The pumping works would be located along the shoreline of Lake Michigan instead of below the reservoir.

Lake Shore Plan Number 2 also located the pumping works at the shoreline but nearly a mile farther north where the favored metal intake pipe would be placed into the lake. From the pumping works water would travel through large pipes to the reservoir. This plan also had its advantages. It was an estimated $200,000 cheaper than the Tunnel Plan and could be completed one or two years faster. Later on, the city could switch to the Tunnel Plan and lose only the cost of the intake pipe, the pump house and foundations, and a stand pipe.

Lake Shore Plan Number 3 was to bring water from the lake 500 yards farther north than Plan Number 2. As in the other Lake Shore Plans, the pumping works was placed along the shoreline.



The North Point pumping station during construction. Scaffolding surrounds the water tower being built on the bluff.

The difference in this plan was that the reservoir was placed on the highest ground east of the Milwaukee River. All of the other plans placed the reservoir west of the river.

The Milwaukee Plan called for placing the pumping works along the Milwaukee River near North Avenue and pumping water straight up the hill to the reservoir. Although this plan was the simplest and cheapest, it had several drawbacks. While the river could handle Milwaukee's present needs, Chesbrough believed the population would soon outgrow that water source. Also the tanners and brewers downstream on the Milwaukee River feared such use of the river would lower it to the point where ships could no longer come upstream to their factories and thus increase shipping costs.

Chesbrough's last plan was the Western Lakes Plan. Its water source came from four lakes west of the city: Muskego, Pine, Pewaukee, and Cedar Lakes. To connect these lakes with the reservoir, Chesbrough would construct an aqueduct similar to the Cochituate Aqueduct he built for Boston. This plan was presented mostly as a minor alternative and a reflection of Chesbrough's thoroughness. With Lake Michigan right next to the city, this proposal was an expensive option for obtaining water. Like the Milwaukee River, these large but relatively shallow lakes might not be able to meet Milwaukee's future needs.

After these ideas were presented, the common council instructed Chesbrough to "prepare plans with full and complete estimates and specifications" for Lake Shore Plan Number 2. The completed plans were in the hands of the common council by April, 1870. The costs for these surveys and estimates were $5,427 for 1868 and $2,500 for 1869. Another plan very popular in some groups was the Holly Company Plan, which would pump water from the lake through pipes straight to the water users. Although this proposal required double the engines compared to the Chesbrough plans, it had the advantage of not requiring a reservoir. However, the Holly Company Plan fell into disfavor after it was proved the estimates were off by $230,000. Its engineers had used Chesbrough's pipe figures when in fact they needed heavier pipes because of the increased pressure from more engines. Nevertheless, the city could not take any action on these plans because the aggregate debt was far above the $500,000 limit set by the Readjustment Act.

While Chesbrough was drawing up his plans, the common council reached a second important conclusion. The city would inaugurate, design, and construct its water works and in doing so would obtain the advantages and profits of this utility.

Conditions improved for the water works by the time Joseph Phillips became mayor of Milwaukee in 1870. Recognizing Milwaukee's growing need for water, Phillips believed the city could handle the situation one of two ways. The community could wait to meet the terms of the Readjustment Act, which might take too

long; or it could hope that some individual or group of people would supply the capital for the water works at terms fair and equitable to the city. The capital did not appear; however, the city's financial situation improved enough for the mayor to revive the water works project. To examine Milwaukee's water situation, he appointed a committee consisting of John Black (chairman) Casper Sanger, and H. J. Hilbert from the Board of Councilors and T. P. Collingbourne and Emil Durr from the Board of Aldermen. This committee made its report in August, 1870 to the common council. Impressed by this report, a joint committee of the water works and the judiciary, aided by the city attorney, drew up a petition to the state legislature asking that Milwaukee be permitted to build a water works and to issue bonds to pay for the system.

On October 19, 1870 John Lockwood of Milwaukee made a proposal to build a water works based on Chesbrough's Lake Shore Plan 2, but he was too late. With the upcoming session of the state legislature, the common council rejected his offer on October 22. The state legislature eventually granted the city's petition early in April, 1871.

The city's Board of Water Commissioners met for the first time on April 18, 1871. This initial meeting was primarily for the record since the board members were chosen before the state legislature

(Milwaukee Water Works Photo)

Workers installed a 36-inch water main under Prospect Avenue near East Woodstock, north of the old Chicago & Northwestern train tracks. This section was installed about 1886.

passed Chapter 475, Local Laws of 1871 (the law permitting Milwaukee to build the water works). The second section of Chapter 475 named the seven members and ordered them to establish their term in office within the next thirty days (from early April when the bill was passed).

These seven men were business leaders and prominent political figures. Edward O'Neill, who had been mayor for four years (1863, 1867-69) and was president of the Bank of Commerce, was elected president of the board on June 5, 1871. Edward Brodhead, who was reappointed to the board and became its president after O'Neill resigned in April, 1874, was by training an engineer. Guido Pfister was president of Pfister & Vogel Leather Company, located on the Milwaukee River about three-fourths of a mile south of the North-Humboldt dam. George Burnham had his own brickyard and made the famous cream colored brick which Milwaukee was known for. John Plankinton was partner of Plankinton, Armour & Company. Alexander Mitchell was one of the leading businessmen of Milwaukee, and president of the Wisconsin Marine Bank. Frederick Pabst was co-manager of the Best brewery and eventually became its president (later changing its name to his own).

The first task of the water commissioners was to plan the construction and estimate the costs for the water works. Realizing that several years had passed since Chesbrough had drawn up his designs and that conditions may have changed, the water commissioners asked for and obtained $2,500 from the common council "to employ competent engineers to investigate the subject of Water Works." They chose Moses Lane, the engineer for the Brooklyn Water Works, since he was the man Chesbrough recommended. Appointed August 31, 1871, he arrived in Milwaukee on September 22; by November 29 he had submitted a plan of construction and its estimated cost.

When Lane started planning the water works, he proceeded in steps of descending importance: source of water, plan to be adopted, estimated costs, main structures, and size of the distributing system. The source concerned several factors: cleanliness of the water, present and future needs of Milwaukee, and the ease of obtaining that water. Lane considered the same three sources that Chesbrough had: Lake Michigan, the Milwaukee River, and the lakes west of the city. He promptly rejected the last as unsatisfactory.

The other two sources, Lake Michigan and the Milwaukee River, he considered more closely. When these two water sources were compared chemically with the currently used spring water, Lake Michigan was found to be the best.

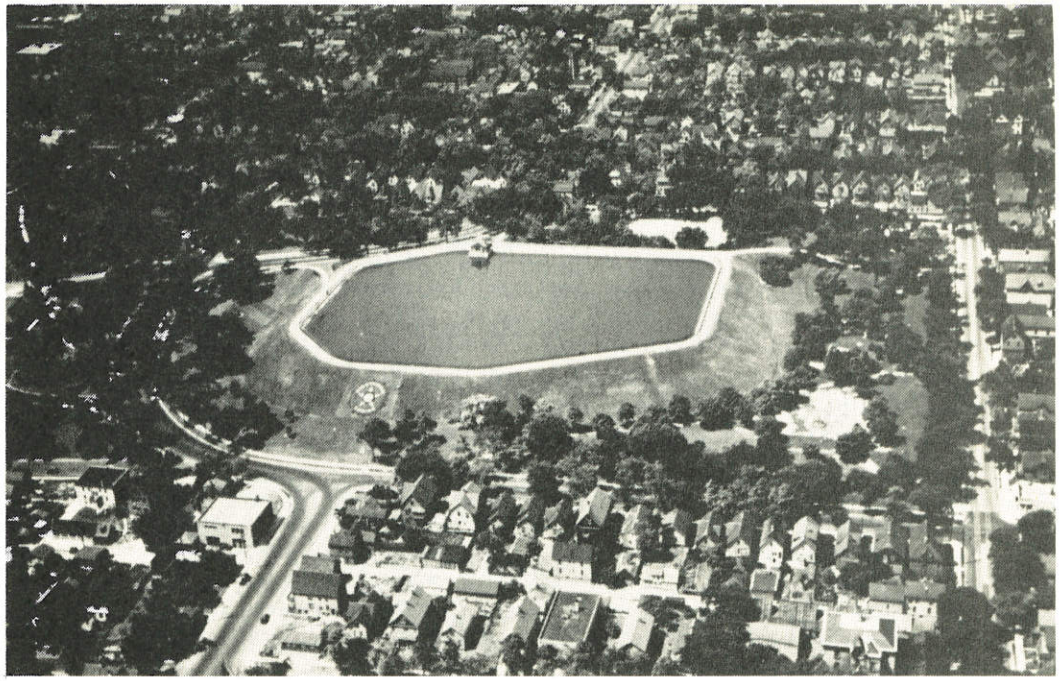
While the river could handle Milwaukee's current needs, Lane feared that future demands, or a dry season, or a combination of both would produce serious water problems. He knew that Baltimore and Hartford had abandoned their river-supplied water works for larger supplies from other sources. Lane also realized

ing reservoir was completed in 1873 near North Avenue and Fratney, the highest city.

that the river would become more polluted as Milwaukee grew, a factor which would make it less acceptable to the citizenry. This had been the case in Philadelphia and Cincinnati. Lake Michigan was, therefore, the best choice since it was the purest, largest, and easiest to obtain water source.

Once Lake Michigan was chosen as Milwaukee's water source, only the Tunnel Plan and the three Lake Shore Plans were left. All of these plans placed the water works on the north side of the city for three reasons. First, the prevailing winds in Milwaukee from the west-northwest pushed discharges from the Milwaukee, Menomonee, and Kinnickinnic Rivers towards southern Milwaukee and Racine. Second, in 1871 approximately 75 percent of Milwaukee was north of the Menomonee River Valley. Third, the best land for a reservoir was in the First and Sixth Wards. The First Ward location of the reservoir was rejected because of its small size. Its lower elevation and the need for more earth with higher walls would be more costly. A potential problem in this site was insufficient water pressure to supply the higher elevated northwest portion of the city.

The two differences between Lake Shore Plans 1 and 2 were location and cost. Lake Shore Plan 1 covered the same route from



The Kilbourn Park Reservoir's shape was irregular due to the topography of the hill. It had a capacity of 21½ million gallons at a depth of 21 feet.

the lake to the reservoir as the Tunnel Plan did. Lake Shore Plan 2 was two-thirds of a mile farther north than those two plans or two and one-half miles north of the Milwaukee River mouth, and it ran along North Avenue from the lake to the reservoir. The advantage of Lake Shore Plan 2 over Plan 1 was a lesser chance of water pollution because the intake was two-thirds of a mile farther north from the river mouth flow into the lake. The slight disadvantage of Lake Shore Plan 2 was the need for more force main pipe between the pumping house and the reservoir at an additional cost of $11,850. Both Lane and the water commissioners believed that a better source of water justified the extra expenditure.

The only two plans seriously considered were the Tunnel Plan and Lake Shore Plan 2. The first option was considered because Chesbrough had used a very similar plan with great success in Chicago. However, Lake Shore Plan 2 had three definite advantages. First, Lane estimated that the Lake Shore Plan 2 was about $200,000 cheaper than the Tunnel Plan. Second, Milwaukee desperately needed water, and Lane estimated the Lake Shore Plan 2 could be built one to two years sooner than the Tunnel Plan. Lastly, the city could adopt the Tunnel Plan later and pay only the cost of the inlet pipe, the pumping house and foundations, and the

stand pipe. Based on these advantages, Lake Shore Plan 2 was chosen for Milwaukee's water works for an estimated cost of $1,359,400.

The major structures for his plan were, in sequence from the lake to the city: the inlet pipe, the engine house, the stand pipe, the reservoir, and the distribution system. The inlet pipe extended 1,000 feet into the lake from the engine house to a protective crib built of timber and stone in ten feet of water.

The engine house was to be built right on the lake shore in line with North Avenue (if that street extended into the lake). A 30-inch diameter force main (pipe) ran up the 80-foot bluff behind the engine house 600 feet to the end of North Avenue, where the stand pipe was located. The stand pipe was to be 90 feet tall and open at the top. Its purpose was to absorb the increased pressure from the engines pushing water into the system and to keep the pipes from bursting.

A force main 30-inches in diameter extended 1,000 feet westward along North Avenue to where it crossed Prospect Street. At this junction a 24-inch diameter force main continued along North Avenue 4,700 feet west to the reservoir, while a 20-inch diameter force main extended down Prospect to serve the eastern part of downtown and eventually to the southern and western parts of the distributing system.

The reservoir measured 310 feet by 515 feet (a water area of 3½ acres), 20 feet deep, and had a capacity of 20 million gallons. It was built in the Sixth Ward at the corner of North Avenue and Fratney, the highest spot in the city. The reservoir's shape was irregular due to the topography of the hill, but the top water line was 150 feet above the lake.

Engineers described this as a distributing reservoir since it was the major point where water was distributed to the bulk of the city. (The exception was the 20-inch force main on Prospect.) No pumps were needed for the distribution system since gravity pushed the water through the system. From the reservoir a 30-inch cast iron distributing main went along North Avenue to the Fourth Street intersection. From here various mains radiated in all directions to connect with individual pipes to homes and businesses. The distribution system contained approximately 54 miles of pipe.

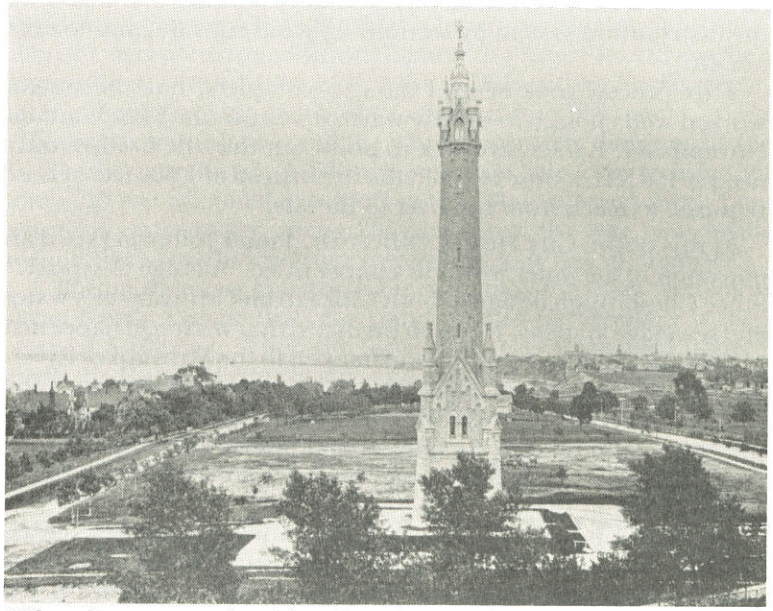
Lane also wanted to place a hydrant or fire plug at every street intersection. This would call for 420 hydrants spaced about 450 feet apart. A check valve was placed between the engine house and the stand pipe to prevent water from flowing back to the engine house once pumped up the bluff. Also a 24-inch main around the base of the reservoir connected the force main to the distributing main. This main was to be used during reservoir repairs so city water service would not be interrupted.

Lane's proposed plan was accepted by the water commissioners on December 4, 1871. During the winter, Lane perfected his plan

and investigated contractors, and the water commissioners carefully watched the city's aggregate debt in order to comply with the Readjustment Act. In early March, 1872 it became apparent to the city comptroller, and shortly thereafter to the water commissioners, that on April 15, 1872 (the end of Milwaukee's fiscal year) the aggregate debt would be below $500,000. The water commissioners then moved very quickly. On March 8 the commissioners let contracts to E. P. Allis & Company in Milwaukee and seven eastern iron foundries for water pipes. Gilbert and Charles Peterson of Lockport, New York received the contract to build the reservoir on April 9. Once the aggregate amount was official, the Petersons started work April 19, 1872.

The water works system was financed through two means: water bonds and water assessments. There were two types of bonds: coupon at $1,000 par and registered at $10,000 par. Both carried 7 percent interest and a commissioned selling fee of 1½ to 2½ percent. Water assessments came from the belief that property value increased when the city supplied water to it. To be fair to its citizens and to promote the water works, the city assessed 80 cents per foot front on each lot. Corner lots were assessed for both fronts minus one-third of the longer front. However, this deduction could not exceed 50 feet. Since income from assessments was relatively fixed, the amount of water bonds increased to meet the growing construction costs.

Along with the reservoir construction, different sections of the water works quickly started. The first contract for laying water



When it was completed in 1874, the North Point water tower was situated in a rural area. Cows are grazing in the adjacent field.

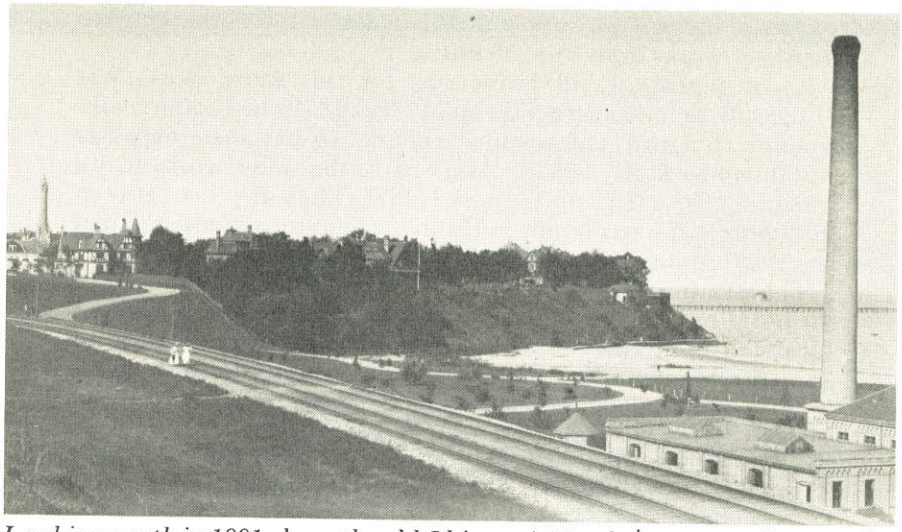
pipe was let on May 8, 1872, and the actual work began on June 11. The engine house and grounds were started in July. All work continued until November 15 when stopped by the approaching winter. By that date, 13.4 miles of water pipe had been placed in the ground. Although the construction was proceeding well, several changes were made in the plan. To aid city development, the water commissioners decided to build a bridge over the Milwaukee River at North Avenue with the 24-inch force main suspended underneath the road bed. The inlet pipe was to be extended 1,000 feet farther into the lake, and the engine house was enlarged to hold four engines. When the distribution system was lengthened from 53½ miles to 58 miles, Lane was forced to increase by six inches, the diameter of the force main from the engine to the reservoir. All of these changes caused an increase in the project's expense.

By September, 1873 the engine house, inlet pipe, crib, reservoir, and 55 miles of the distribution system were completed. However, the North Avenue bridge, the link between the engine house and the reservoir, had only the abutments completed while the piers had been left for the next spring season. Also, the pumping engines were not built yet. Desiring to supply water immediately, the water commissioners had Lane construct a temporary pumping works along the west side of the Milwaukee River just north of North Avenue. This temporary facility contained an engine which could pump 1,500,000 gallons in twenty-four hours from the river through the force main into the reservoir. The pumping started on October 24, 1873; by November 3 the water depth in the reservoir had reached ten feet. Water was gradually permitted to flow into the distribution system by sections to avoid ruptures and to vent out air.

This process took several days to complete, but the system worked well enough to supply water at a fire in the First Ward on November 7. Lane was quick to point out that the firemen only needed 450 feet of hose to reach the fire instead of 1,800 feet of hose required to reach from the river to the site.

At this point, City Health Officer Dr. James Johnson raised an objection to the water works in a paper titled "A Huge Cesspool." Since Chesbrough designed both Chicago and Milwaukee's water and sewerage systems, Johnson predicted that what had happened to the Chicago River would soon happen to the Milwaukee River. He reasoned that the increased amount of water supplied and used by Milwaukeeans through the water works would be more than the river could handle. Businesses and homeowners ignored his concerns, and the number of water permits issued went from 240 in 1873 to 1,787 in 1874.

On September 14, 1874, the regular pumping engines started drawing lake water into the system; the North Avenue bridge was completed in mid-December. The water main underneath the bridge was first used on December 23, 1874, marking the completion of the majority of the water works. The only construction left



Looking north in 1891 along the old Chicago & Northwestern tracks, near the Flushing Tunnel engine house. The North Point water tower is in the left background.

was to lay slightly more than three miles of pipe for the distributing system in 1875. By February, 1875, the daily consumption of water was 1,250,000 gallons.

The completed water works was slightly different than proposed. A three-foot diameter cast iron pipe ran 2,100 feet from the engine house to the crib in the lake. The engine house was built as planned, except for the additional space for a future fourth engine. The engines were built by E. P. Allis of Milwaukee. Each engine and its accompanying two boilers weighed over 250 tons.

Both the engine house and the water tower were designed by C. A. Gombert, architect. A 36-inch cast iron force main took the water 525 feet up an 80-foot bluff to the 130-foot stand pipe. The beautiful water tower, rising 255 feet above the lake, was built around the wrought iron pipe measuring four feet in diameter.

A 30-inch diameter cast iron force main took the water westward along North Avenue from the stand pipe to the reservoir, a distance of 5,700 feet. When the force main was suspended underneath the North Avenue bridge and exposed to the weather, Lane tried to protect it from frost by enclosing it in a box made of two thicknesses of wood planks.

The reservoir increased its capacity from 20 million gallons to 21½ million gallons, and its depth from 20 to 21 feet. The top water line stayed 150 feet above the lake. The reservoir was called the Kilbourn Park Reservoir after Byron Kilbourn, who had donated part of the site to the city.

The major distributing pipes from the reservoir remained the same. More six- and eight-inch pipe was added to the distribution

system to increase the number of Milwaukee streets connected to the water works from 54 to 58 miles.

As of January 1, 1875, the cost for this water works was $1,855,401.39 for construction and $1,888,623.29 including maintenance accounts. The income accounts to pay these expenses amounted to $1,917,862.01. As a result, the water works had a surplus of $29,238.72 on January 1, 1875. The difference between the amount of water bonds sold and the amount actually realized was the commission to those who sold the bonds.

The set annual water rates were based on the purpose and size of the building. Any business requiring a large amount of water to supply steam engines was charged two cents per 100 gallons on an annual estimated usage. Other examples of rates were an eight-room dwelling, $8.00 per year; a hotel, $1.50 per room per year; and a bakery, between $5 and $50 a year. Fees for builders and plumbers were also established, and rules were set for water use.

In its early operations, the water works encountered some problems. When the first pipes for the distribution system were being laid, many city streets were below the grade established by city ordinance. Consequently, some of the pipes were more susceptible to freezing. At first the city did little to rectify this problem, but it later lowered the level of all new pipes and those that were repaired. A layer of clay sediment on the reservoir's bottom and weed growth on its underwater surfaces gradually accumulated. This affected the taste of the water and could only be corrected by periodic draining and cleaning of the reservoir.

The Board of Water Commissioners ended their work on June 1, 1875 and turned control of the water works to the Board of Public Works. The water commissioners and their employees had built a system that gave Milwaukee many benefits. Its citizens and businesses were assured of a steady, clean supply of water. City insurance rates were lowered because the fire department was always within 400 feet of a water source when fighting fires. The water works was also large enough to handle increases in Milwaukee's population for many years to come. Thorough planning and determination helped Milwaukee obtain the water it sorely needed to remain a growing city.

About the author (1986)

Bruce Jordan received a master's degree from the University of Wisconsin-Milwaukee in applied history and is currently completing work for his PH.d. at Carnegie-Mellon University in Pittsburgh through a Rockefeller Fellowship.