

URBAN SERVICES IN EARLY NORTH DAKOTA:
THE ADVENT OF MUNICIPAL WATER SYSTEMS, 1880-1900

by

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Water is the one food element which the body demands with an insistence and continuity not approached by the need of any other thing.¹

The truth is this quotation explains in large part why nineteenth century Americans viewed the semi-arid Great Plains of North America with great trepidation and initially wrote the whole region off, stamping their maps with the words "Great American Desert." Eventually, as the frontier diminished explorers found the region habitable although its climate provided an uncertain and not particularly reliable source of moisture.

Much depended on the year, for the plains are prone to a boom or bust system where a resident might wallow in mud one year and be dry as dust the next. Thus, during 1873 when the Northern Pacific Railroad began building its main line west from Fargo "construction parties were obliged to advance like an army across the desert, bringing all their materials and provisions over the road they were building from a base of supplies ever becoming more and more distant." General W. B. Hazen, military commander at Fort Buford, Dakota Territory, that same year, was so impressed by the lack of rainfall that he began a personal campaign in the national press to discourage prospective settlers. Little wonder then that the first immigrants to the west side of the Red River of the North tended to hug the rivers and streams and established their farmsteads under the comforting branches of riverine woods.²

Of course, these early settlers soon discovered that the stories of Dakota's dryness were as exaggerated as those broadcast by land promoters claiming heavy annual rainfall to be the norm. A little experimentation revealed that shallow wells reached the water table with ease; one could find plenty of water for human consumption, the trick being to find enough to grow a crop.

Most of Dakota's cities and towns are by location, at least, products of railroad construction. While the nineteenth century railroad was the only means of rapid and dependable transportation, its builders on the Northern Plains were also sensitive to locating their stations (and the cities which subsequently grew up) at the best sources of available water. Along the Northern Pacific's main line all of today's larger towns--Fargo, Valley City, Jamestown, Bismarck, Mandan and Dickinson--are located at river crossings. On the Great Northern the same was true of Grand Forks, Devils Lake, Minot and Williston, all of which began as serving points and grew into substantial communities. Between these points sidings were established often where wells or handy potholes would provide convenient

sources of water, since the locomotives of the 1870's and 1880's were both small and thirsty.

Indeed, the railroad water tank was often the chief source of water for early residents of North Dakota's railroad towns and company managements seldom objected unless it was in extremely short supply. But most townspeople of the day obtained their water from tank-wagon dealers who sold it from door to door. After being drawn from the Missouri River, water was sold at Bismarck for twenty-five cents a barrel, sediment and all. At Grand Forks water dealers had at least one unusual hazard to contend with--having their pumps run over by passing steamers. As time went on more wells, both privately and publicly owned, were driven and the door-to-door water salesman began to disappear. In his place came citizen pressures for water piped directly to each house.³

Like the railroads, early residents of North Dakota's prairie towns found the rivers a simple and handy source for a municipal water system. The first of these were thus established at the Red River towns of Fargo, Grand Forks and Wahpeton along the eastern border and at the capital city of Bismarck on the Missouri. Notable also is that most were privately owned, a fact attributable not so much to the spirit of nineteenth century private enterprise as to restrictions in Dakota Territory law designed to prevent the rapid acquisition of heavy municipal bonded debt.⁴

Fargo got northern Dakota's first water system during 1880 when the city council awarded a franchise to the Fargo Water & Steam Co. which by the end of the year had installed a system of mains throughout the business district and close-in residential areas to serve the city's several thousand people. Powerful steam-driven pumps on the riverbank in a city park forced turbid Red River water into a brick, one million gallon settling basin and from there directly into the mains. A brief period of sedimentation was the only concession toward purification. In its early years, the water company built extensions as rapidly as requested and even developed a residential sub-division of its own.⁵

A similar system was built at Grand Forks during 1882 involving an initial 3,500 feet of underground pipe. There, however, the mains and pumps were city-owned with steam being purchased under a 15-year franchise with a local flour mill. The system was installed at a cost of \$12,275.⁶

The Wahpeton water works, constructed in 1885, was another joint venture but in this case the city issued \$20,000 of its own bonds to help finance the efforts of the private Wahpeton Water Co. As built, the plant allowed Red River water to run by gravity flow into a 40-foot deep "settling well," from which it was pumped into the mains. Unfortunately, the building of the Wahpeton system was, from beginning to end, the child of conniving promoters and naive city councilmen which resulted in a physical plant smaller than that of Grand Forks but with a debt of more than \$80,000. In nineteenth century business terms, there was more water in the stock

than in the mains at Wahpeton.⁷

Soon after becoming territorial capital in 1883, Bismarck issued a water franchise to a local hotelman and promoter, Eber H. Bly, who put his first efforts into drilling an artesian well on the heights overlooking the city. Six months later the only result was a 1,300-foot deep dry hole. In 1886 Bly, now joined by political boss Alexander McKenzie, obtained another franchise and the following year the Bismarck Water Co. completed what was then the most elaborate and expensive system in Dakota. Water was pumped from the river up to a rock-lined reservoir on a bluff above the city. After being given sufficient time to settle--the Missouri River has often been described as too thick to drink and too thin to walk on--gravity brought it down a feeder pipe to the city distribution system. The Bismarck Water Company's plant was viewed as a proud asset to the community and the local press seldom lost an opportunity to describe it in glowing and reverential terms.⁸

Though records are non-existent, it seems clear that the business of the private water companies in North Dakota was not particularly profitable. In Fargo, for example, the city fathers wrung a number of concessions during franchise negotiations which subsequently proved damaging. Several public fountains were required to serve out-of-town visitors as well as the city's many horses. Meters were for a time outlawed, the company being forced to sell at a flat monthly rate. Within months, the management was complaining bitterly that to avoid the expense of a hook-up and rental rate, residents were carrying water from the fountains or the taps of willing friends. To add insult to injury, enterprising local water dealers often drew their supply from these sources rather than buying from the company. The franchise ordinance not only outlawed this procedure but made provision for arrest and fines, but in practice it proved difficult to enforce. The water company later forced an amendment through the council allowing meters, but the devices proved extremely unpopular and were the source of much of the agitation which later forced them to sell out. When that occurred during 1890 it was learned the company had only 466 connections in a city with a population of 9,600.⁹

Water quality also left much to be desired. Being untreated, the Fargo water often carried a nasty smell; one writer noted that "a forgetful traveler, awakening in the dark hours at a hotel and [being] unable to remember in what town he was in, should merely open a faucet over his wash basin, [and] the odor of the first cup of outflowing water would at once inform him that he was at Fargo." Drinking water was often purchased bottled from Minnesota or drawn from nearby wells and sold from a tank-wagon on the street. The well water, however, "was exceedingly hard and considerable discussion was carried on from time to time as to the desirability of using a water carrying a large amount of solids in solution." It was considered an improvement over water drawn from the mains.¹⁰

While Wahpeton residents had many of the same complaints, their preoccupation was with merely keeping the water system functioning at all.

Their plight is perhaps the classic example of the difficulties facing an overcapitalized private company trying to serve a town with too few residents. While most of the company stock was owned locally, the bondholders were from Eastern states. When revenues were insufficient to pay interest, the situation became one of intense pressure from a trust company representing the bondholders, on the one hand, and a frantic scramble by stockholders and the city government, on the other, to keep an important local utility in business. In defending "a little raise in the water rent," an editor pointed out that "the price...is much less than we had to pay when we bought "Adam's ale" by the barrel." A public subsidy appeared in the form of a city offer to pay for public watering troughs; previously the city got this and other water free in return for their earlier bond investment.

Inevitably, perhaps, the New Hampshire Trust Co. foreclosed on behalf of the bondholders during the summer of 1889 and took over operation of the plant. Later developments are vague--Wahpeton's three newspapers simply quit talking about the matter--but there is abundant evidence that rates went up while the services performed diminished.¹¹

Grand Forks semi-public water works became a full municipal system, the first in North Dakota, during 1885 when the city built its own power plant. The blessings of city ownership proved mixed; while rates dropped somewhat the demand for extensions skyrocketed and their location and extent often became the subject of intense political maneuvering. The city was left with both high bonded debt and municipal operating expenses.¹²

The Bismarck Water Company was probably the most successful of the state's private firms. Certainly it was the longest-lived, surviving until 1923 when it was sold to the city. Much of this success can probably be credited to Alexander McKenzie, who took over full ownership in 1898 when the company was reorganized as the Bismarck Water Supply Co. McKenzie was a typical late nineteenth century political boss, who made his fortune through influence peddling, land jobbing and political manipulations. Through the shrewd use of secret hook-ups and free water supplies, McKenzie was able to keep local progressives seeking to take over his system off balance until after his death. To his credit, the Bismarck water works was not inexpensive to operate and the constant repairs needed were often not reflected in increased rates.

The unstable glacial soil covering the bluffs on which the settling reservoir stood were constantly crushing pipe through slides and settling; one repair job required 100 men working up to their waists in icy water for thirty days at the bottom of a deep trench. To make matters worse, the hill on which the reservoir stood overlooked the Northern Pacific's Missouri River bridge, the latter resting on three massive stone piers. Over a period of years, leaking water percolated through the subsoil until it reached the hard clay strata under the easternmost bridge pier. When the clay became wet enough the pier began moving slowly but inexorably toward the west bank, a situation viewed with some alarm by the railroad's management. The solution involved cofferdamming the pier, digging out the wet soil

and pushing the stonework back into position with hydraulic jacks, an expensive process born largely by the water company.¹³

While cities located on major water courses such as the Missouri and Red Rivers had a readily available water source in the quantities necessary for municipal water systems, prairie villages and those located along smaller streams faced serious problems. Wells seemed the only solution but shallow ones seldom produced sufficient water. As technology improved drillers began boring deeper and what they found touched off a revolution in water availability on the Dakota plains.

Much of North and South Dakota are underlaid by a strata known as Dakota sandstone which lies at depths ranging from 400 to 1,800 feet below the surface. This forms an excellent aquifer which is charged with water from the foothills and eastern slopes of the Black Hills and Rocky Mountains. Between the Missouri escarpment and the Red River Valley this sandstone is covered by a thick and continuous layer of impermeable shale. In the early 1880's drillers began to puncture this layer of rock, bringing water to the surface in gratifying quantities and with sometimes spectacular force.

These were artesian wells, in which the water rose considerably above the ground water table through natural hydrostatic pressure since their sources in the far-distant mountains were at a higher elevation than the prairie well-sites. What made residents so enthusiastic about them was not only that they seemed to present an endless quantity but that the pressure appeared to negate the need for expensive pumping equipment. When the flow of the first Dakota artesian wells appeared undiminished after several years, it gave rise to some extravagant theories particularly on the part of promoters and speculators. Writing in 1887, P. F. McClure, Commissioner of Immigration for the Dakota Territory, was moved to declare that "a cessation of the flow because of the exhaustion of the supply may be considered as disproved by science and history." In fact, history and science was to prove him thoroughly wrong but for a time the artesian wells seemed a gift from the gods to the water-conscious denizens of the eastern Dakotas.

The first artesian well, 918 feet deep, was apparently drilled at Aberdeen during 1882 and became the basis for the city's first water system. The first successful city well in northern Dakota came in at Ellendale four years later at a depth of 1,100 feet. Moreover the water arrived at the surface under a pressure of 115 pounds per square inch, spouting into the air like a runaway oil well.

Yet the mere drilling of an artesian well was not always a guarantee of success. The sandstone strata was simply too deep for existing equipment to reach in many parts of Dakota, as attested by Bismarck's dry hole in 1883. About 1890 Mandan drilled an expensive artesian well that was noted for its depth--2,000 feet--and its failure to bring up any water under any pressure whatsoever.¹⁴

Even in areas where water seemed certain to be found the process

was often nerve-racking and uncertain, particularly to the drilling contractor and the city councilmen who were financing the endeavor. The experience at Jamestown, a city of about 2,000 in east-central North Dakota, makes a good illustration. Although located on its namesake the James River, that stream was deemed too unreliable and polluted for a good municipal supply so in July 1886 the city council contracted for an artesian well. The cost was based on the depth at which water would be found--\$4 per foot down to 1,000 feet, \$5.75 a foot thereafter.

New Years Day, 1887, found the bore at 1,000 feet and a special council meeting authorized another 300 feet of drilling. That depth was reached by mid-February and another special meeting wrought a lively discussion between citizens and aldermen over the prospects of finding water. The council nervously approved another 200 feet, noting that with the \$5,000 budgeted already spent "they would have to rustle [some] more money." Then began a series of equipment breakdowns that stretched local nerves to the breaking point; the mayor and several councilmen were denied re-election in the annual spring campaign.

Scarcely ten days later, however, with less than 25 feet remaining on the renewed contract, the well blew in with a pressure of 95 pounds per square inch. The completed well produced water at a rate of 375 gallons a minute and cost the city less than \$7,000. And it maintained sufficient pressure to power the local water system until 1903.

As the city moved ahead with plans to install a distribution system it came up against the same bugaboo which bedeviled other cities--statutory restrictions on both bonded debt and taxing authority for municipal improvements. It was finally decided to go ahead with construction in anticipation that subsequent legislatures would "legalize" their deeds and before the end of 1887 more than a half-mile of 8-inch water main was in use.¹⁵

The legal difficulties facing Dakota's cities stemmed partly from the lack of a general municipal incorporation act and partly from laws preventing cities from levying special assessments in order to tax abutting property which would benefit from improvements. In the latter case, the only recourse was to lay a general tax on all property and face the inevitable opposition from non-benefitting landowners. In the former, it was necessary for any community desiring to incorporate to obtain a special charter from the territorial legislature, a process which left them at the mercy of non-sympathetic rural lawmakers as well as jealous representatives from sister cities.

Even while the Jamestown city fathers were puzzling over their situation the 1887 legislature of Dakota Territory took the first steps toward remedying the region's water problems. The first action was passage of a comprehensive law governing the drilling, financing and maintenance of artesian wells which, though aimed primarily at aiding rural users did contain provisions useful to municipal systems.

Of greater significance to the territory's municipalities were measures

drawn up by and introduced at the behest of the Fargo Board of Trade. One was a long but carefully written city incorporation act, designed to equalize the rights of urban communities as well as strengthen their taxing and bonding capacity. The second specifically authorized municipal water works and fire-fighting systems and allowed an excess mill levy, conditional upon approval at the polls, where necessary to pay for them. It passed after amendments extended its benefits to all incorporated communities over 1,000 in population. The latter enactment proved the foundation stone for municipal water systems in Dakota and not only firmly established the principle that water utilities ought to be publicly-owned but made such ownership financially feasible.¹⁶

Subsequent legislation gave it additional strength. Delegates to North Dakota's constitutional convention during the summer of 1889 wrote in a clause limiting municipal debt to 4% of assessed valuation but allowed an additional 4% "without regard to the existing indebtedness" for building or buying water works.¹⁷

During the decade which followed, North Dakota lawmakers added more municipal water legislation to the codes. Special levies against abutting property to pay up to half of a plant's operating costs were allowed while municipal officials were forbidden to sell any part of a water system without voter approval. More notable, an 1895 statute extended the right to finance and operate a water works to unincorporated towns and communities. Finally, the 1899 session noted emphatically that "there is now no law authorizing cities, towns and villages to raise sufficient revenue for water works" and pushed the mill levy authorization to an impressive 7 per cent of assessed valuation.¹⁸

As a result of these legislative manipulations both private water companies at Fargo and Wahpeton were soon city-owned. At Fargo passage of the 1887 law had been intended not so much as a bid for municipal take-over as a means of pressuring new concessions from the Fargo Water & Steam Co. By April 1890, however, the situation had changed radically. North Dakota was now a full-fledged state and the legislative fight during the winter of 1889-90 to keep out the Louisiana Lottery had turned many citizens against out-of-state corporations. Newly elected Mayor Wilbur Hall, an attorney, declared in his inaugural address the firm belief "that the city should own and control the water works." When the company seemed unwilling to come to terms the city went ahead with plans to construct its own competing plant. A bargain was then struck which for a time was itself jeopardized when the city's bonding capacity, even under the liberalized legislation, seemed insufficient for the purchase. The difficulties were worked out under the impetus of a 90 per cent favorable vote in the bond issue election and on September 23, 1890 the city of Fargo took charge of its water works.¹⁹

The escalating cost of building a city water distribution system, as exemplified by Fargo's problems, probably explains why despite favorable laws few new municipal water plants were installed prior to the end of the nineteenth century. Generally poor economic conditions following the Panic

of 1893 were also a factor; North Dakota in the mid-1890's was not an auspicious place to incur new debt even though the depression meant cheaper construction costs. Whatever the reason only Lisbon, a community of about 1,000 in the state's southeastern corner, built a water system during that era. Citizens had little apparent fear of the depression, voting a \$10,000 water works bond issue in October 1895 by an impressive 124-17 majority. Though located in the Sheyenne River valley, Lisbon chose to drill a well and pump its water to a tank overlooking the city. The water system proved so popular that work had barely commenced before residents of a new subdivision across the river were clamoring for its extension. New bonds were sold and by 1898 the city had a complete water system with two miles of mains and a fully-equipped fire department, all at a cost of \$16,000.²⁰

Viewed from the safe distance of nearly a century, perhaps the most amazing aspect of our ancestor's life in North Dakota cities was that the water they drank, even that from the best of the city water plants, was totally unfiltered and untreated. Since much of it came from heavily polluted rivers, such as the Red, early health authorities could hardly be faulted for "waiting for the other shoe to drop" when their warnings against water-borne disease went unheeded. True, later studies did strongly suggest that river water as well as ice taken from that water had a natural tendency to purify itself and the citizenry seemed hardly bothered by the occasional case of fever.

The other shoe finally did drop at Grand Forks in November of 1893 and within days the city was in the grip of a major typhoid epidemic, more than fifty families being struck simultaneously. There were relatively few doctors, only one small hospital and the nature of the disease was so poorly understood that starvation was considered an effective treatment. Although one doctor quickly diagnosed the problem as typhoid fever this was hushed up by the local booster press which first denied the existence of any epidemic and then identified it as influenza or "la grippe," as it was known in those days. The Grand Forks Herald stubbornly referred to the affliction as "the prevailing malady" and railed against newspapers in neighboring towns which carried counts of the dead and ill. Even after the cause was officially recognized the Daily Herald triumphantly carried stories blaming the epidemic on malaria and sewer gas, and once stated authoritatively that very few deaths had occurred--this in a week when its own columns had carried numerous typhoid-victim obituaries.

A special committee appointed by the city council soon pinned the blame where it belonged--on a sewage-infected city water system. Modifications to the water plant had moved the intake to the mouth of the Red Lake River, which entered the Red at Grand Forks, and carried significantly less sediment. "This served to exchange the sewage of Fargo and the farms of the Red River for the sewage of Crookston, [Minn.] only twenty-six miles away on a smaller and more rapid stream." And Crookston had suffered from a year-long typhoid epidemic.

To the credit of all, once the cause of the outbreak was pinpointed

little time was lost in combatting it. All water was ordered boiled, infected quarters were to be sterilized and local health authorities were given ample enforcement powers. Looking toward more long-term measures, the city council sent a committee headed by City Engineer W. S. Russell to study contemporary methods of water purification. Russell's report urged construction of a sand filter modeled upon designs used in Europe and at Lawrence, Massachusetts, where a state-sponsored purification experiment had been going on for five years. In July 1894 the council authorized the filter's construction after standing off several alternate (and cheaper) plans, including one that "might not keep out the germs, but it would make the water clear." By the end of the year Grand Forks citizens were drinking the first artificially purified water in this part of the United States.²¹

While a rush to install filters would seem a natural reaction by other Dakota cities to the Grand Forks disaster, nothing of the kind occurred. The reason can be ascribed in equal parts to cost (\$40,000 for the Grand Forks sand filter) and a belief that it couldn't happen here. It did, of course--Wahpeton experienced a typhoid outbreak of lesser proportions during the winter of 1905-06 caused by polluted river water, which prompted the city to turn to wells for its source of supply. On the other hand the state's largest city, Fargo, continued to safely serve its citizens Red River water until well into the twentieth century.²²

As the twentieth century dawned, then, it can be safely said that nearly all of North Dakota's urban places with a population greater than 1,000 had municipal water distribution systems of one form or another. But, if a water works is one of the most common trappings associated with an urban place, this is a startling statistic. How does it square with the comment of a major urban study published in 1899 which placed North Dakota with six other non-urban states? How could it be true of a region whose settlement was delayed significantly by fears that its semi-arid climate simply would not support a sizeable population?²³

First, while the two decades leading up to 1900 were of only average rainfall, plentiful supplies of both surface and ground water made it possible to establish and operate a city water works successfully on the semi-arid plains. Water to support a series of small urban centers is one thing; water sufficient to support an entire agricultural industry is something altogether different. Dakota's reputation for dryness has been built on crop failures, not municipal water shortages.

Second, the Weber study was largely a statistical one and based its results on the proportion of a state's population living in cities of 10,000 and upward. Since no North Dakota City had reached that level by 1900, statistically the state was deemed to have no urban population.

In the final analysis it was probably the demand of the residents of North Dakota's small urban centers that their cities have all the trappings of urban life, even if they lacked the population, which created this

paradox. Municipal water was considered an important amenity and was given an appropriately high priority when tax time came along. And it may also have been a convenient (and irrefutable) means of thumbing their noses at outsiders who dared call Dakota dry!

NOTES

¹John C. Sinclair, "Grand Forks: A Western Pioneer in Water Supply Treatment," The Quarterly Journal of the University of North Dakota, XIV-4 (June, 1924), 316. Hereafter referred to as Quarterly Journal.

²Eugene V. Smalley, History of the Northern Pacific Railroad, (New York: G. P. Putnam's Sons, 1883), 388.

³Kenneth Ruby, "A Brief History of the Fargo Water Works System," North Dakota Water and Sewage Works Conference, Official Bulletin, XXXIII-3 (September, 1965), 11; Harry Hanson, "Growth of City of Bismarck Water Utilities," North Dakota Water and Pollution Control Conference, Official Bulletin, XXXVIII-4 (October, 1970), 11. This source will hereafter be referred to merely as Official Bulletin. See also Grand Forks Daily Herald, August 24, 1882, 4.

⁴Lawrence H. Larsen, The Urban West and the End of the Frontier, (Lawrence: The Regents Press of Kansas, 1978), 69-71.

⁵Ruby, "A Brief History of the Fargo Water Works System," 11, 21; A Century Together: A History of Fargo, North Dakota, and Moorhead, Minnesota, (Fargo: Fargo-Moorhead Centennial Corp., 1975), 79-80; Fargo Daily Argus, September 20, 1881. See also the Fargo Times issues for the year 1880.

⁶The best description of the construction of Grand Forks' first water system, including the political infighting and maneuvering which accompanied it, can be found in the Grand Forks Daily Herald for the months of June, 1882 to January, 1883. Other early contemporary descriptions are found in Grand Forks Illustrated, (Detroit, Mich., 1891), 7; The Early History of Grand Forks, North Dakota, (Larimore, N.D.: Printed by H. V. Arnold, 1918), 142-143 and The Record (Fargo), October, 1896, 6-7.

⁷The story of Wahpeton's early water system can be found in the columns of its early newspapers, the Wahpeton Times, Dakota Globe and Richland County Gazette. Unfortunately, no files exist for the promotional period prior to 1885. The Gazette is perhaps the best source.

⁸The Bismarck Tribune for the years 1883, 1886 and 1887 is probably the best source for the ill-fated artesian well and subsequent construction of the city system. See also Hanson, "Growth of City of Bismarck Water Utilities," 11, and "City of Bismarck vs. Bismarck Water Supply Co.," in Formal Case File No. 1506, Records of the North Dakota Public Service Commission, North Dakota State Archives, Bismarck, N.D. The latter records in great detail the results of a complaint brought by the city charging excessive rates and poor service and includes data on events, 1919-23, leading up to the city's purchase of the system. Feature stories printed by the Daily Tribune and the weekly Bismarck Capital during this period also shed light on the system's construction and early history.

⁹Fargo Daily Argus, January to March, 1887, particularly the report of the Board of Trade published in the February 11, 1887, edition.

¹⁰Elwyn F. Chandler, "Three Decades of Water and Sewage Development in North Dakota," Official Bulletin, XXXVIII-11 & 12 (May-June, 1971), reprinted from the April 1935 issue; Ruby, "A Brief History of the Fargo Water Works System," 11.

¹¹Richland County Gazette (Wahpeton), March 30, April 6, October 5, 1888, April 12, July 12, 1889.

¹²A. E. Forsman, "Grand Forks Water Works System," Official Bulletin, XXXV-4 (October, 1967), 16; The Record (Fargo), October, 1896, 6-7.

¹³Since no company records have survived the best sources on the later years of the Bismarck company are those cited in note 8 above. For a modern slant on problems facing a water works drawing from the Missouri River see Harry Hanson, "Sand Bars and the Bismarck City Water Plant Intake," Official Bulletin, XXXIII-3 (September, 1965), 22.

¹⁴A measure of the excitement engendered by the discovery of artesian wells can be found in Resources of Dakota, (Pierre, D.T.: Department of Immigration and Statistics, 1887), from which McClure's quotation is taken. A more realistic (and reasonable) assessment is found in Howard E. Simpson, "The Principles of Conservation as Applied to Artesian Waters," Quarterly Journal, XV-4 (May, 1925), 287-297. Other useful sources are Richard J. Hinton, "A Report on Irrigation and the Cultivation of the Soil Thereby," in 52 Cong., 1 Sess., Senate Executive Document No. 41, Part 1 (Washington: Government Printing Office, 1892), Robert Hay, "Final Geological Reports of the Artesian and Underflow Investigation between the Ninety-Seventh Meridian of Longitude and the Foothills of the Rocky Mountains," being part 3 of the federal document listed above, Nelson H. Darton, "Preliminary Report on Artesian Waters of a Portion of the Dakotas," United States Geological Survey, Seventeenth Annual Report, Part II (Washington: Government Printing Office, 1895-'96), 609-694 and Herbert A. Hard, "Artesian Wells of North Dakota," printed as part of Report to the Governor of North Dakota on Flood Control, (Grand Forks, 1920).

¹⁵Events attending the drilling of Jamestown's artesian well and subsequent developments, including the political pressures involved, are best described in the issues of the Jamestown Daily Alert, July, 1886 to July, 1887. See particularly the issues of February 19, April 10, 14, 27, May 10 and July 7. Helpful in assessing the system's later years is Alfred Swanson, "A Brief History of Jamestown Water System," Official Bulletin, XXXI-4 (October, 1973), 12.

¹⁶Session Laws of Dakota, 1887, Chapters 73 and 105. Fargo Daily Argus, January 26, February 7, 12, 17, 1887.

¹⁷Official Report of the Proceedings and Debates of the First Constitutional Convention of North Dakota, (Bismarck: Bismarck Tribune, 1889), 182-184.

¹⁸See North Dakota Session Laws, 1890, Chapters 96, 97 and 100; 1891, Chapter 43; 1893, Chapter 134; 1895, Chapter 27 and 28; 1899, Chapter 172.

¹⁹Fargo Daily Argus, April to December, 1890; see particularly April 16, May 7, 13, 26, June 24, September 23, ff.

²⁰Lisbon Free Press, October, 1895 to January, 1897, particularly October 25, 1895 and May 29, 1896. See also The Record (Fargo), May, 1896, 216.

²¹While the best understanding of the day-to-day events surrounding the Grand Forks typhoid epidemic and the installation of the sand filter can be found, despite the obvious bias, in the daily issues of the Grand Forks Herald, an adequate and much shorter version is Sinclair, "Grand Forks: A Western Pioneer in Water Supply Treatment," Quarterly Journal, XIV-4 (June, 1924), 315-328. For comment on natural purification and specific problems facing Red River water users, see Gustav F. Ruediger's "A Study of the Purity of Natural Ice from Polluted Water" and "Studies on the Self-Purification of Streams," both in Quarterly Journal, I-3 (April, 1911), 256-263, 272-277, and Elwyn F. Chandler, "The Floods of the Red River Valley," Quarterly Journal, VIII-3 (April, 1918), 207-232. Dr. J. E. Engstad of Grand Forks identified the epidemic as typhoid in the Herald of January 6, to which the paper retorted in editorials entitled "No Occasion for Alarm" (January 13) and "The All Pervading LaGrippe" (January 16). The malaria and sewer gas stories appeared on January 27 and 23, respectively.

²²Ninth Biennial Report of the State Board of Health to the Governor of North Dakota for the Years 1905 and 1906, (Bismarck: Bismarck Tribune, 1906), 13-14.

²³Adna Ferrin Weber, The Growth of Cities in the Nineteenth Century: A Study in Statistics, (Ithaca, N.Y.: Cornell University Press, 1963; originally published in 1899 for Columbia University at Volume XI of Studies in History, Economics and Public Law), 31-33.