

APPENDIX A  
HISTORY OF WASTEWATER COLLECTION AND TREATMENT IN LINCOLN

November 7, 1958

## HISTORY OF SEWAGE TREATMENT IN LINCOLN

By D. L. Erickson

Although the Municipal Government of Lincoln has been operating a Sanitary Sewer System since 1888, and there has been a Sewage Treatment Plant at Lincoln since 1923, the Municipal Government did not enter the field of sewage treatment until 1957.

This apparent paradox is accounted for by the fact that the Sewage Treatment Plant was built by Sanitary District No. 1 of Lancaster County and operated by that District until September 1, 1957 when the District deeded the plant to the City of Lincoln.

This Sanitary District is a separate public agency organized under an Act of the State Legislature of 1891. Under this Act the function of the District was limited to the control of floods in the Salt Creek Basin. The boundaries of the District were largely confined to the City of Lincoln.

A great change in the size, powers and activities of the Sanitary District was brought about by the Legislature of 1919 when it passed an Act which provided for:

1. Specific power to the District to build and operate a Sewage Treatment Plant.
2. The District was given power to alter or relocate City sewers to connect with those of the District.
3. The District could enlarge its boundaries by an election if the questions received a majority of the combined and total vote in the original district and the territory proposed to be added thereto. This provision, which gave Lincoln the preponderance of voting power, seemed necessary to compel the adjacent independent suburbs of Havelock, Bethany, University Place and College View to cooperate and participate in a comprehensive plan for sewage treatment for the entire community.

At an alection held in 1919 the District was enlarged and plans began to formulate for the abatement of the sewage nuisance in Salt Creek, which was becoming very objectionable. The City of Lincoln commenced the construction of an intercepting sewer along the east bank of Salt Creek from South Street to 24th & Theresa Streets and the District employed consulting engineers to study and report on a Sewage Treatment Plant.

This plant was constructed by the District at 24th & Theresa Streets, located northeast of the State Fair Grounds, and placed in operation in 1923. This plant had a capacity of 5 M.G.D. and cost approximately \$370,000.

This Sewage Treatment Plant was provided with baffled, hopper bottomed primary and secondary tanks, separated by, and each connected by sludge pipes and scum wiers to a control sludge digestion chamber. At the design rates the sewage was detained in the primary and secondary tanks a period of 45 minutes each, giving a total tank period of  $1\frac{1}{2}$  hours.

The sludge digestion chamber had sufficient capacity to store the sludge for a period of 3 months when the tanks were operating at maximum capacity.

From the settling tanks the sewage flowed to 2 dosing chambers, located in a sprinkling filter bed, 300' x 600', filled with 6 feet of rock.

In 1937 two 70 ft. diameter clarifiers with 13.5 ft. sidewalls were constructed and floating covers were installed on 6 of the digesters for the purpose of collecting gas.

In 1941 a 65 ft. diameter digester with 28 ft. sidewalls with floating cover for gas collection was constructed. The filter bed was also reconstructed by changing to 8 rotating distributors and by washing and grading the rock.

In 1952 a new pump house was constructed which was equipped with 3 new 10 M.G.D. pumps and mechanical screens. An additional clarifier with 100 ft. diameter and 13.5 ft. sidewalls and a new 85 ft. diameter digester tank with 29 ft. sidewalls

were constructed. This new digester was provided with heat exchangers and 3 circulating pumps to circulate the sludge in the digester.

By this time the plant had a firm capacity of 20 M.G.D., as compared with the original capacity of 5 M.G.D., and the total plant investment amounted to approximately \$2,000,000.

During the 30-year period elapsing since the construction of the intercepting sewers, practically no additional sewer capacity had been provided. While these sewers were entirely adequate as to capacity at the time they were constructed, due to the large increase in population in the area and the increased usage of water per capita occurring since 1923, this situation had changed so that certain portions of the intercepting sewer became inadequate to serve peak flows and the remaining portions were just barely adequate. This was manifested by the fact that during peak flows, sewage backed into industrial buildings near "N" Street and residences from "N" to South Streets. During certain peak periods sewage rose to the top of manholes south of Van Dorn Street and overflowed onto the adjacent soil. As an emergency measure it became necessary during certain periods of the year to resort to bypassing certain portions of the sewage flow into Salt Creek at Van Dorn Street, "N" Street and "R" Street. Obviously this was not a good situation from a public standpoint. In a joint report by Walter Coale, Sanitary District Engineer, and D. L. Erickson, City Engineer, in 1954, this situation was called to the attention of the City and the Sanitary District and recommendations were made that a consulting engineer be jointly employed for the purpose of making a detailed engineering study and report on the additional sewers that might be required and an estimate of cost of their construction. Attention was also called that the lack of definite understanding between the District and the City as to the responsibility of each agency for the construction, operation and maintenance of any sewage facility was not conducive to effective planning, nor the efficient expenditure of public funds. It was recommended that the City and the District enter

into a formal agreement as to the jurisdiction of responsibility of each agency toward the construction, operation and maintenance of all of the trunk sewers in the entire Sanitary Sewer System.

In accordance with this recommendation, the City and the District employed consulting engineers for such a study and report. The consulting engineers confirmed the inadequacy of the intercepting sewer system and recommended a program of some 20 miles of supplementary intercepting sewers, varying from 12" to 60" in diameter, which were estimated to cost  $3\frac{1}{2}$  million dollars, and suggested that consideration be given to the establishment of a sewer use fee to finance this program.

Although the Home Rule Charter of the City of Lincoln did not authorize the City Council to issue Sewer Revenue Bonds, it was discovered that the Supreme Court of Nebraska had ruled in 1951 in a Grand Island case that the matter of sanitary sewage service was a matter of statewide concern, therefore, that a home rule City could issue Sewer Revenue Bonds under a State law which authorized all cities and villages in the State to issue such bonds.

The Bond Attorneys who were consulted by the City relative to the matter of issuing Sewer Revenue Bonds indicated quite strongly that the duplication and overlapping of authority and functions in the sanitary sewer field between the Sanitary District and the City of Lincoln was not a good situation and might jeopardize an advantageous sale of Sewer Revenue Bonds.

After a series of conferences between the City Council and the Sanitary District trustees, an agreement was reached that an attempt would be made to secure State Legislation authorizing the Sanitary District to turn over to the City the Sewage Disposal Plant and all existing sanitary sewage trunks, interceptors, mains and laterals, which had been constructed by the District. The 1957 Legislature passed such an Act and on August 19, 1957 the District and the City entered into a formal agreement for such a transfer of functions and property, which became effective on

September 1, 1957. Accordingly, on this date the City of Lincoln took over the operation of the Sewage Treatment Plant and some 46 miles of sanitary sewers built by the District. The addition of this amount of District sewers brought the City Sanitary Sewer System up to 364 miles, with an original cost of \$3,500,000. In making this change all of the District personnel directly employed at the Sewage Treatment Plant were retained by the City, including Mr. M. S. Fitzsimmons, who had been Superintendent of the Sewage Treatment Plant for many years.

Concurrently with the aforementioned series of conferences with the trustees of the Sanitary District, the City made a study of the cost of operating the Sewage Treatment Plant and the integrated Sanitary Sewer System, together with the annual fixed charges of a proposed Sewer Revenue Bond Issue in the amount of  $3\frac{1}{2}$  million dollars, to finance the cost of constructing the recommended additional intercepting sewers. This study disclosed that this combined cost would be approximately \$500,000 per year. A detailed study of the customer accounts indicated that a sewer charge of approximately 50% of the water bill, with certain variations, would produce this \$500,000.

Accordingly, in June, 1957 the City Council adopted an Ordinance imposing a sanitary use charge against all premises, both inside and outside the City Limits, served by the City's Sanitary Sewer System.

In the case of residential users the charge was to be 50% of the water bill during the winter quarter, which amount would also apply to the remaining three-quarters in the year. In the case of non-residential users the sewer use charge was to be 50% of the water bill each quarter or month during the year, with the further proviso that in cases where a portion of the water passing through the water meter was not discharged into the Sanitary Sewer System, the user could install sewage meters to measure all sewage discharged into the sanitary sewers and that sewer billings would be made at the rate of 50% of the applicable water bill, using the sewage meter readings in lieu of water meter readings. In actual practice, however, in all such instances the customer has elected, with the approval of the City, to install sub-meters to measure

the water that is not discharged into the Sanitary Sewer System and the customer sewer use charge is billed on the difference between the readings on the master water meter and the sub-water meter. In addition the Ordinance provided for a minimum charge per month, varying from 50¢ for a 5/8" meter to \$35.00 for an 8" meter.

Under the Ordinance there was created the City Sanitary Sewer Department for the purpose of performing the functions of the sanitary sewage collection, treatment and disposal, and charged with the administration of the provisions of the Ordinance, all under the direction of the City Council and the Director of the Department of Parks, Public Property and Improvements (Director of Public Works). The Ordinance further provided for the utilization of the personnel and the facilities of the City Water Department to bill and collect sewage use charges and to conduct such other administrative and business affairs of the City Sanitary Sewer Department as the Director might direct.

The City Water Department immediately commenced setting up some 33,000 sewer use accounts and was successful in completing this operation so that all of these accounts were rendered a sewer use bill, effective July 1, 1957.

The sewage use revenue produced by the residential accounts very closely approached the estimated amounts from this class of customers. In the case of non-residential customers, however, the revenue produced was some \$50,000, or 20% less than what was estimated.

As a result of this decrease of sewage use revenue, the City has been compelled to temporarily curtail its interceptor sewer program to 3 million dollars instead of 3½ million dollars. A 30-year term serial 2½ million dollar Sewer Revenue Bond Issue was sold in November, 1957 at an average interest rate of 3.97%. Contracts totalling \$2,021,827 have been awarded which, together with right-of-way, engineering and miscellaneous expense, produce a total present commitment of \$2,214,122. It is proposed in the next few months to sell an additional Sewer Revenue Bond Issue in the amount of \$500,000 and to complete this \$3,000,000 construction work by the summer of 1959.

The Sewage Disposal plant was built by Sanitary District #1 in 1922 and was completed in November 1923. started operation November 19, 1923.

It was designed by Alvord, Bureck & Howden of Chicago, built by Phelps & Sons of Knoxville, Iowa. Consisting of Barr screens, and 3 sewage pumps size 4, 6, and 8 million gallon. One tank room with 6 separators and 6 digesters. The tanks were 27 feet square and 25 feet deep with Hopper bottoms.

A filter bed 300' X 600' X 6' filled with crushed rock, and spray nozzles run off 2 dosing tanks at a cost of about \$370,000.00 plus \$20,000.00 for the site.

In 1937 designed by Scott & Scott, built by Chambers Construction Co. two 70' diameter clarifiers with 13½' sidewall depth and also put floating covers on 6 of the digesters to collect gas.

In 1941 remodeled again also with Scott & Scott engineers, built by W.P.A. They built a 65' digester with a depth 28' sidewall with floating cover for gas collector. Also remodeled filter bed, washing and grading the rock and changing to 8 rotating distributors also a depth of 6' of rock at a cost of \$170,000.00.

In 1952 a new pump house was built with mechanical Barr screens, with 3 new 10 million gal. pumps new aeration tank, and another 100' clarifier with a depth of 13½' sidewall.

These clarifiers all have mechanical scrapers on bottoms and scum removers on the top.

Also a new 85' digester tank with a 29' sidewall, with heat exchangers and 3 circulating pumps to circulate the sludge in the digester at a cost of about \$700,000.00.

The last remodeling was designed by Black and Veatch of Kansas City, Mo. and constructed by Chamber Construction Co.

September 1, 1967 the city of Lincoln took over control and operation of the plant.

The plant now has a designed capacity of 18 to 20 million gal. daily.

(An article in the Engineering News-Record, February 3, 1921)

Settling tanks of the separate digestion type, to which sewage is pumped from a receiving basin and from which the effluent passes to sprinkling filters, constitute the main element of sewage-works recommended to serve a sanitary district comprising the city of Lincoln, Nebr., and four suburban towns, the amount of sewage having become too great for adequate dilution in Salt Creek. This plant will treat all the sewage discharged above the works at 27th Street and for about ten years there will be ample dilution for sewage entering below that point. When this latter sewage increases to such an extent as to cause a nuisance, settling tanks may be constructed for the two suburban towns of Havelock and University Place, to be supplemented later by sprinkling filters if necessary. The above statement is summarized from a recent report by Alvord & Burdick, consulting engineers, Chicago, on the proposed sanitary district.

Lincoln and the four suburban towns have a population of 70,000 and more than 100 miles of sewers on the separate system. With the extensions to be built this year nearly 100 per cent of the population will be served. The daily sewerage discharge of the entire district is about 45,000,000 gallons nearly 80 per cent of this being from the City of Lincoln. It is estimated that by 1950 the population will be 175,000, the daily sewage discharge 13,000,000 gallons, and the area increased from 8,000 to 23,000 acres by extending the city limits.

The sewage is typically domestic and varies from fresh to a maximum age of five hours. Salt Creek has a minimum flow of 50 sec.-ft. and during a considerable part of the year it is a nuisance owing to odors and deposits. The principal requirements for the effluent of the sewage-works are that it must be stable and odorless and reasonably free from suspended matter, particularly coarse material. It is considered that further refinements, if involving additional expense, are not warranted.

To abate the present nuisance, an intercepting sewer is being built parallel with the creek and will be extended to the new plant. As all sewage will have to be pumped to give a gravity flow through the plant, the interceptor will discharge into a 125,000-gallon two-compartment reservoir to supply the pumps, which will be driven by electric motors and controlled automatically by floats. This interceptor is designed with sufficient capacity for 1950 conditions, but the sewage-works are designed for the conditions of 1930, with a population of 100,000, in order to allow for possible development in methods of sewage treatment. A diagrammatic section through the plant is shown in Figure 2.

The type of tank proposed is adapted particularly for such conditions as those at Lincoln, where the sewage is domestic and relatively fresh and will form considerable quantities of both sludge and

scum. This type was designed first by Mr. Alvord for the plant at Madison, Wis. (see *Engineering News-Record*, Sept. 11, 1919, p.510), and was used later for the naval training station at Great Lakes, Ill. As shown in Fig. 1, it includes baffled, hopper-bottom primary and secondary compartments separated by a sludge digestion chamber, each compartment being connected to this chamber by sludge pipes and scum weirs. Each of the six tanks will have a working capacity of 1,000,000 gallons daily, with a detention of 45 minutes in each compartment. This total detention period of  $1\frac{1}{2}$  hours is sufficient for reduction of about 75 per cent of the solids, but is not so long as to make the sewage too stale for economical subsequent treatment.

From the tanks, the sewage will flow to dosing chambers in circular sprinkling filters 375 feet in diameter, two of which will be sufficient for conditions up to 1930, when the tank effluent will be at the rate of about 4,500,000 gallons daily. The beds will be six feet deep, filled with broken stone ranging from 3 in. size at the bottom to  $\frac{1}{4}$  in. at the top. They will be equipped with cast-iron distributors and risers having nozzles spaced 12 feet center to center. Secondary sedimentation is believed unnecessary in view of the amount of dilution available. It is pointed out that the filter effluent will carry practically the same amount of suspended matter as the tank effluent, or 20 per cent of that in the raw sewage, but that these solids will be finely divided and as stable as the effluent.

The recommended plans of the engineers have been adopted, and the city will extend the intercepting sewer to the plant at an estimated cost of \$140,000.00. This will be done under the direction of George W. Bates, city engineer. As the city and four independent suburban towns will be served the sanitary district already mentioned has been organized to build and operate the works. The cost for a plant sufficient for 1930 conditions is estimated at \$330,000.00, with an annual operating cost of \$12,500.00.

Three other disposal methods were considered, but the operating costs were considerably higher, although the activated-sludge process gave a lower construction cost. For tanks and sand filters the estimated construction cost was \$525,800 and the annual operating cost \$15,400.00. With the activated-sludge process preceded by tank treatment the construction cost would be \$250,000.00, and for an activated-sludge alone it would be \$212,000.00. The corresponding annual operating costs would be \$44,800 and \$77,700, as compared with \$12,500 for the plant as adopted. Fixed charges are not considered in any of the estimates.