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REPORT
ON
SEWERAGE SYSTEM AND SEWAGE DISPOSAL
FOR
CITY OF BOWLING GREEN, KENTUCKY.

August - 1931.



THE J. N. CHESTER ENGINEERS,
Pittsburgh, Pa.

MEMBERS AM. SOC. C. E.

APPRAISEMENTS
RATE INVESTIGATIONS
UTILITY ACCOUNTING
OPERATION OF UTILITIES

THE J. N. CHESTER ENGINEERS
CONSULTANTS AND DESIGNERS

CLARK BUILDING

PITTSBURGH, PA.

INVESTIGATIONS AND REPORTS
DESIGN AND SUPERVISION

WATER WORKS
FILTRATION PLANTS
PUMPING STATIONS
SEWERAGE
SEWAGE DISPOSAL
ELECTRIC POWER PLANTS
CONCRETE STRUCTURES

August 31st, 1931.

To the Mayor, Council and
Board of Public Works,
Bowling Green, Kentucky.

*First Report before
R. F. C. was formed*

Gentlemen:--

In accordance with your commission of October, 1930,
we have made a study of your sewerage problems and submit herewith
the following report.

PURPOSE OF REPORT

The purpose of this report is to collect and record
basic information necessary as a preliminary step leading to the
design and construction of a sewerage system essential to the
elimination of the nuisance now created by the discharge of
untreated sewage into Whisky Run, the gutters of the streets of
the City, and into inadequate sinks which, on account of their
inability to carry away the sewage, discharge it on the surface
of the ground or into the cellars of adjoining property, thus
menacing the health and well being of the community, as well as
causing obnoxious and offensive odors and creating and maintaining
a general nuisance.

This report incorporates the following general
provisions:

Investigation and report on the present
and future population of the City by districts.

Investigation and report on the water
consumption, both present and future, by districts
as effecting the sanitary sewage flow.

PURPOSE OF REPORT

Calculation of the quantities of sewage to be treated, as determined from the above studies.

Investigation and report on the present method of disposing of sewage by sink holes, together with a recommendation as to which sections of the town must abandon this method of disposal at the present time, in favor of carrying the sewage through pipe lines. This study, however, does not contemplate test borings or other similar work to determine the extent and the life of these sink holes, but does contemplate obtaining the information from the history and developments of such sink holes.

Making of complete topographic survey of the City of Bowling Green, which will include all built up sections, whether just in or just outside of the City limits, so as to determine elevation and grades for proposed sanitary sewerage system.

Preparation of a map on a scale of 1 inch to 250 feet, giving a comprehensive layout of a complete sanitary sewerage system with sizes and grades covering the entire City.

Estimates of costs for the various sections of the proposed sewerage system, together with recommendations as to what sections should be constructed first.

Plans showing proposed main collecting sewer to site of disposal plant or sink hole for disposing of sewage.

Outline plan of future sewage disposal plant with description of proposed units and degree of purification recommended.

Submission of the plans and report to the State Department of Health for their approval.

The survey and report to be of such a practical nature as to enable Bowling Green to go ahead with their sewerage system by degrees and will not contemplate the construction of an entire sewerage system at one time; understanding, however, that the State Department of Health must be a party to the plan as outlined. It is further contemplated that the survey shall include a survey of "Whisky Run Sewer" so as to ascertain to what extent and to what purpose it may be utilized; to what extent sewage is being emptied into or is seeping into it, and for what portion of its length a sanitary sewer can be provided in this Run."

EXISTING CONDITIONS

The City of Bowling Green is unique in that, with a population of approximately 18,000, a complete water works system second to none, well built homes, paved streets and all the up-to-date modern conveniences, the City yet has no sewerage system but relies on individual disposal of its sewage through sink holes found accidentally and without any idea as to their adequacy, proper protection to safeguard the health of the community, or the danger of their discharging the sewage to adjacent property. While it is true that this method of disposing of sewage, when the City was very much smaller, was adequate yet in recent years, due to the concentration of the population and the gradual filling up of the sinks, there has arisen the nuisance already mentioned and the time has arrived when, for the proper protection of the health of the community and their general well being, the City should begin to construct a sewer system which will ultimately carry the sewage of the entire City in underground pipe lines to a common point where it shall undergo treatment in accordance with the latest designs and requirements for the proper disposal of wastes; for not only does the improper disposal of waste jeopardize the health of the community in the manner previously described, but these wastes may find their way directly into the water supply system when they are discharged into the river above the intake or may so contaminate the streams as to render them unfit for water supply of towns which are situated below Bowling Green.

The results of the various investigations made in order to solve this problem have been set out in this report under

EXISTING CONDITIONS

separate headings for the purpose of simplicity and better understanding of the data upon which the designs are based.

POPULATION

Your population, as given by the Federal census from 1870 to date, is as follows:-

1870	-	4,574
1880	-	5,114
1890	-	7,803
1900	-	8,226
1910	-	9,173
1920	-	9,638
1930	-	12,340

These population statistics, however, do not give a fair picture of the true situation for, in addition to a number of persons outside the City limits which are served by your water supply system and which of necessity must also be served by any comprehensive sewer system, there are living in your community approximately 3,500 students of the Western Kentucky State Normal School, who are not included in the census population.

In order to determine the exact population to be cared for we have had access to the registration books and the records of the Bowling Green public schools, from which we have deduced that the present 1930 population, exclusive of the students at the Western Kentucky State Normal School, is 14,027. The following table shows the manner in which this was arrived at.

<u>Precinct</u>	<u>Registration</u>
33	1,078
34	888
35	711
36	<u>782</u>

Carried Forward, 3,459

POPULATION.

<u>Percent</u>	<u>Registration</u>	
Brought Fwd.,	3,459	
37	799	
38	518	
39	668	
40	779	
41	582	
42	455	
43	669	
44	1,203	
45	687	9,779
School Census, 1929,	2,686	
Estimated Increase,	62	
School Census, 1930		
(6-18 yrs.)	2,748	
0 to 6 years Estimated,	1,000	
18 to 21 yrs. Estimated,	500	
Total below 21 years of age,		4,248
TOTAL,		14,027

The maximum population at the Western Kentucky State Normal School we have assumed at 3,500 and the population outside of the City limits, but contiguous to the same, which is now served with water and which would contribute to the sewerage system, we have estimated at 1,000, making a total population to be served of 18,527.

In order to determine the size of sewers, it is necessary to estimate the population for some period in the future, for which the sewers shall be designed, and common engineering practice dictates that this period shall be from thirty to forty years in the future. We have, therefore, estimated the population to be served in the year 1970, which we find will amount to 38,413, as shown by the following table, No. 1.

POPULATION.TABLE NO. 1.CITY OF BOWLING GREEN, KY.POPULATION STUDY

<u>Voting Precincts</u>	<u>Registration</u>	<u>Population 1930</u>	<u>Area Acres</u>	<u>Density 1930</u>	<u>Density 1970</u>	<u>Population 1970</u>
33	1,078	1,543	303	5.1	15	4,545
34	888	1,262	195	6.5	15	2,925
35	711	1,010	74	13.6	20	1,480
36	782	1,122	91	12.4	20	1,820
37	799	1,136	91	12.5	20	1,820
38	518	743	55	13.5	15+	825
39	668	968	138	7.0	15	2,070
40	779	1,122	153	7.3	15+	2,338
41	542	772	46	15.7	20	920
42	455	645	31	20.8	25	775
45	669	968	96	10.1	20	1,920
44	1,203	1,754	231	7.6	20	4,620
45	687	982	121	8.1	25	3,025
	9,779	14,027	1,625	8.6	18.0	29,083

<u>Year</u>	<u>Population in City.</u>	<u>Population Outside City</u>	<u>Normal School</u>	<u>Total</u>
1930	14,027	1,000	3,500	18,027
1940	16,832	1,200	4,200	22,232
1950	20,197	1,440	5,040	27,677
1960	24,238	1,728	6,048	32,012
1970	29,083	2,073	7,257	38,413

Density.

The density of the population is an essential element in the design of any sewer system since the knowledge of the present and future density or the number of persons per acre will determine the distribution of the sewage and the volume of sewage entering the main collector at the various points. The density of the City has been determined for the various voting precincts for the year 1930 and varies from 5.1 persons per acre in Precinct 33 to 20.8 persons per acre in Precinct 42. This

POPULATION-Density.

density has been projected to 1970 with the results as shown in Table No. 1, wherein the density of the City, as a whole, is shown as 18 per acre as contrasted with the present density of 8.6 persons per acre. These figures do not include the students at the School, they being treated as a separate unit.

WATER CONSUMPTION

The City of Bowling Green is primarily a residential city with few manufacturers who use any considerable amounts of water. The study of the water consumption will therefore give an index of the sanitary sewage flow.

The average gallons per capita of water pumped has varied from 65 in 1912 to 82 in 1930 and during the year 1930 the average daily consumption was equal to 1,477,000 gallons with a maximum day of 2,578,000 gallons. Of the above the commercial and industrial did not amount to more than 200,000 gallons per day. The consumption at the school which runs approximately 200,000 gallons per day on the basis of 3,500 population would amount to 60 gallons per day per capita which figure will be used as a basis for figuring the sewage flow from the school.

Whether the town becomes fully metered or not will have a direct bearing on the design of the sewer system for we believe that with a fully metered system, water consumption will be reduced between one-third and one-half. However, since there is no certainty at this time when complete metering of this system will be accomplished, we have figured the sizes of the main collecting sewers on the basis of an unmetered water system which will throw the error on the size of safety.

SEWAGE FLOW.

In order to arrive at a rational figure for the per capita sewage flow, we have made the following assumptions:

Average flow per capita of water reaching the sewer - 80 gallons.

Maximum flow reaching sewer 175% of average or 140 gallons.

Leakage based on 56,000 gallons per mile of lateral 60 gallons.

From the above data 200 gallons per capita has been assumed for the maximum sewage flow from the main part of town with 150 gallons per capita from the school and 100 gallons per capita from the negro section of the City.

FUTURE SEWAGE FLOW.

The future sewage flow of the City in the year of 1970 on which the design is based has been assumed at the figures above given for the per capita flow which, in conjunction with the density per acre of the various sections of the City, will permit us to arrive at the total flow to be carried by the various collecting sewers. These collecting sewers will, therefore, be designed to take the above stated amount of the sewage when flowing seven-tenths full.

SANITARY SEWER DISTRICTS.

The topographic map of Bowling Green and vicinity, which we have prepared as a part of this report, shows that the City is divided into four (4) main sewer districts, three of which have been further sub-divided. These districts are shown on Plate 2, at the end of this report.

SANITARY SEWER DISTRICTS - District No. 1-A1 and 1-A2

District 1-A1 embraces that portion of the city bounded on the Southeast by the Reservoir Property, High Street and Park Avenue, on the Southwest by a line from 14th Street and Park Avenue to the grounds of the Western Kentucky State Normal School, on the Northwest by Center Street, and on the Northeast by Tenth Street, Park Row, Rock Alley, and Main Street to the Reservoir Property.

District 1-A2 embraces that portion of the city between District 1-A1 and the L. & N. R. R. bounded by Center Street, Thirteenth between Center and Kentucky, a line from Thirteenth and Kentucky to Twelfth and Adams, Twelfth from Adams to the L. & N. R. R., the L. & N. R. R. to Sixth Street, Sixth Street, Center Street, Eighth Street, State Street, Park Row, College Street, and Tenth Street.

These two districts embrace the heart of the city, including the business district, commercial district, and well built up section of the city and is drained by what is known as Whiskey Run Sewer.

Whiskey Run Sewer originates in a spring between Park and High Streets and runs parallel to Main Street between 10th and 11th. The sewer runs through private property and under houses until it intersects Park Street at which point it is 18 inches deep on the south side of the street and 24 inches deep on the north side. In the alley between Park and Elm there is an inlet into this sewer. The sewer then continues through private property until it intersects Elm Street, where it is 24 inches deep on the south side of the street and 30 inches on the north side. Half way between Elm and Chestnut the sewer becomes uncovered, at which point it is 36 inches deep. It is, however, confined between walls of rubble masonry being 5 feet 6 inches wide at this point. This rubble masonry probably extends backward to Elm Street.

SANITARY SEWER DISTRICT - District No. 1-A1 and 1-A2.

At Chestnut Street the sewer is 3 feet 3 inches deep on the south side and 5 feet deep on the north side. It is open on both sides of the street but is covered where it passes under the street and sidewalk. 210 feet from the center line of Chestnut Street towards State a sink has been discovered in the bed of the stream.

After passing this sink, above described, the sewer passes under the Jones Motor Company building to State Street, thence under the street and under a building on the north side of State Street. Between State and College the sewer is covered with a concrete slab passing through in the rear of the Court House. At the alley between 10th and 11th, which alley begins at 11th but only extends to the Court House property, the sewer is 4 ft. 6 in. deep. The sewer is 6 ft. wide at this point and has two storm water openings from the alley into it.

On College Street the sewer is 3 ft. 6 in. deep measured below the center line of College Street and passes between two houses to Center Street. The sewer is 5 ft. deep, at the center line of Center Street, and is covered for one-third of the distance from College towards Center and open the remaining two-third of the distance to Center. After passing Center the sewer is open but is confined between rubble walls. The sewer turns in the alley between Center and Kentucky. At this point, it is 6 ft. deep. At 10th the sewer is 7 ft. deep and carried under a stone arch culvert over 10th.

The sewer passes under a garage on 10th towards Main, then in an open channel with side walls to a store on Main Street.

SANITARY SEWER DISTRICT - District No. 1-A1 and 1-A2.

The sewer is 5 ft. deep at the alley off Kentucky between 10th and Main and has a width of 10 ft. at this point.

The sewer passes across Main Street and under a store, thence in a walled-up channel parallel to Kentucky to about half way towards 8th Street where it takes a right angle turn, at which point an existing 18 inch private sewer enters. The sewer then flows to Kentucky Avenue where it is 5 feet deep by 12 feet wide, extending under the sidewalk on the north side of the street. The sewer becomes open from 6th and Kentucky, it being 12 ft. wide at Kentucky and 6th and 14ft. wide by 6 ft. deep at Clay and Brown.

The sewer follows Brown around to a point 280 ft. North of the center line of Ida Street and is confined between rubble walls up to this point.

District No. 1-B.

This district embraces that portion of the town Northwest of the railroad tracks, bounded by Portage Railroad, Pearl Street, Gordon Avenue and Thomas Avenue. It is largely industrial and has a low density per acre at the present time, with very little sewage flow due to lack of water fixtures. It is drained by the lower end of the Whisky Run sewer, which empties into a large sink on Raven Street between Gilbert and Victoria Streets.

District No. 2.

District No. 2 embraces, generally, the Northeastern section of the City, East of the railroad tracks, with the exception of that portion known as Sewer District No. 3. In

SANITARY SEWER DISTRICTS - District No. 2.

the built-up portion of this district evidence of sewage flow can be discerned in the gutters along Fourth Street and it finally appears as an open stream between College and Center Avenues. This district ultimately drains into the sink known as Sally Ann's Hole, which in turn has an overflow connection with the Whisky Run sewer.

District No. 3.

Sewer District No. 3 embraces that section of the City between the alley Southwest of Second Street and the Barren River. At the present time there is very little sewage originating in this section, since a great portion of the district is occupied by negroes who have few water fixtures in their houses. What little sewage does originate in this district probably finds its way into the Barren River, both above and in the vicinity of the water works intake. No dangerous evidence of pollution, however, are apparent at this time.

District No. 4-A.

Sewer District 4-A embraces the Southeast section of the City bounded by 11th Street, Small House Pike, Fifteenth Street and the ridge from Park Avenue and Fourteenth Street to Eleventh and Younglove Avenue. This section has a low density at the present time, but has a promising future development.

District No. 4-B.

This district embraces the entire Southwestern and Northwestern section of the City and at the present time is

SANITARY SEWER DISTRICTS-District No. 4-B.

very sparsely settled. It does, however, include the Western Kentucky State Normal School and gives evidences of a future steady growth. The Normal School disposes of its sewage through nine (9) separate sinks, some of which, on account of their high elevation above the surrounding territory, discharge sewage on the surface of the ground at a lower elevation.

DESIGN DATADistrict No. 1-A1 and 1-A2 Whisky Run Sewer.

Since Whisky Run drains the entire sanitary sewer districts No. 1-A1 and 1-A2, and since rock lies very close to the surface in this district, the most economical location for the sanitary interceptor is in the bed of Whisky Run. Calculations show that a cast iron sewer laid in the bed of this rock, with its lower half in excavation and the upper half above the bed of the Run, will not restrict the use of Whisky Run as a storm water drainage channel. The design is, therefore, based on a cast iron sewer laid in the bed of Whisky Run into which terra cotta laterals will be connected through manholes at the street intersections as shown on the sewer map. Above Elm Street where Whisky Run is a closed culvert, from its point of beginning, it is recommended that this sewer be continued as a sanitary sewer; permitting, however, the water from the spring to flow in the same but excluding storm water from the streets and alleys above Elm Street. At Elm Street an overflow manhole should be constructed which will permit the sanitary or dry weather flow to pass into the proposed cast iron pipe line sewer and any excess, due to storm water getting into the run above Elm Street will be by-passed into the run below Elm

DESIGN DATA - District No. 1-A1 and 1-A2.

Street. From Elm to State Street the sewer will be constructed of 10 inch cast iron pipe with manholes located as shown on the plans. From State Street to 10th, near Kentucky Street, the sewer shall be constructed of 12 inch cast iron pipe and from this point to 7th and Kentucky Streets it shall be constructed of 16 inch cast iron pipe. This pipe shall be laid on the grades as shown on the accompanying table, which also gives the basic data on which the design was made, showing the population served, the future flow of the sewer in gallons per 24 hours, the size of the sewer, the grade on which it shall be laid, the maximum capacity which it is capable of carrying and the velocity in feet per second when carrying the future sewer flow.

<u>Location</u>	<u>Popula- tion</u>	<u>Flow</u>	<u>Size Sewer</u>	<u>Grade</u>	<u>Maximum Capacity</u>	<u>Velocity</u>
Elm Street,	860	175,000	10"	5.7%	3,200,000	4.1' sec.
Chestnut	1610	325,000	10"	.68%	1,100,000	2.6
State St.,	2610	525,000	12"	1.1 %	2,300,000	3.6
College	3410	685,000	12"	2.2 %	3,300,000	4.9
Center,	3935	790,000	12"	.33%	1,300,000	2.6
10th near Kentucky,	4610	925,000	16"	.37%	3,000,000	2.9

It is recommended that the first section of this sewer to be constructed shall extend from the point of beginning at Elm Street to a proposed septic tank between Center and Kentucky Streets in the location shown on the plan, at which point a sink has been discovered capable of taking all the sewage which will drain into the main collector above this point. Before being emptied into the sink, however, the sewage shall be treated in a septic tank constructed in accordance with details as shown on Plate 1 in the back of this report. This septic tank will settle

DESIGN DATA - District No. 1-A1 and 1-A2.

out the solids and permit the clarified effluent to enter the sink. If this septic tank is properly attended to and cleaned at necessary intervals, we believe that no trouble will develop due to the stopping up of the sink hole. The State Department of Health has approved of this method of disposal at this point, under date of June 9th, with the understanding that it is a temporary expedient and cannot be regarded as a means of final disposal of the sewage. It should, however, serve admirably until funds are available for the next step in the construction of the sewerage system. In the meantime, however, the laterals for conveying the sanitary sewage to this collector should be constructed throughout the entire District No. 1-A.

District No. 1-B.

The following table gives the design data for the main collector in Sewer District 1-B, which will begin with a 20 inch cast iron pipe at 6th and Kentucky Streets, at which point the sewage from Districts No. 1-A and No. 2 enters. This 20 inch pipe line shall be carried along Brown Street and Gordon Avenue to 3rd and Gordon at which point the sewage from District No. 3 will enter. From this point a 24 inch cast iron sewer shall convey the sewage to Beauty and 3rd Streets. At this point the main collector will leave the Run and will be carried in a 24 inch terra cotta or concrete sewer to Church and Johnson Streets, at which point sewage from Districts 4-A and 4-B will enter. Beyond this point a 36 inch terra cotta sewer will convey the sewage to the proposed disposal site.

DESIGN DATA -- District No. 1-B.

This section can be constructed conveniently to the sink on Raven between Gilbert and Victoria, at which location a septic tank similar to the one previously described, but of twice the capacity, shall be constructed and when this is placed in operation the septic tank in District 1-A shall be discontinued.

<u>Location</u>	<u>Popula- tion</u>	<u>Flow</u>	<u>Size Sewer</u>	<u>Grade</u>	<u>Maximum Capacity</u>	<u>Velocity</u>
6th and Kentucky	11,798	2,469,000	20"	.42%	5,800,000	3.9' sec.
Thomas and Brown,	12,137	2,537,000	20"	.39%	5,500,000	3.9 "
Brown and Gordon,	12,137	2,537,000	20"	.30%	4,800,000	3.5 "
Gordon and 3rd,	12,407	2,591,000	20"	.20%	3,900,000	3.1 "
3rd below Gordon,	14,627	2,813,000	24"	.20%	6,500,000	3.3 "
Hope and Raven	15,182	2,925,000	24"	1.0 %	16,000,000	5.4 "

District No. 2.

Sanitary Sewer District No. 2 will begin with a 10 inch terra cotta interceptor at Collett Avenue and Laurel Street and will continue as a 10 inch to Fairview Avenue where it will increase to a 12 inch, thence shall continue as a 12 inch to 4th and High Streets where it will be enlarged to a 15 inch terra cotta sewer. From this point on to its junction with Whisky Run interceptor at 6th and Kentucky Streets it shall be carried as a 15 inch terra cotta sewer. The design data is shown in the following table.

DESIGN DATA - District No. 2.

<u>Location</u>	<u>Popula tion</u>	<u>Flow</u>	<u>Size Sewer</u>	<u>Grade</u>	<u>Maximum Capacity</u>	<u>Velocity</u>
Laurel and Collett	1,680	350,000	10"	. 4%	830,000	2.30' sec.
East End of Younglove,	2,220	450,000	10"	3 %	2,300,000	4.8 "
Fairview and E. High,	2,500	500,000	12"	1.55%	2,800,000	3.9 "
High & 4th,	3,850	770,000	15"	.20%	1,800,000	2.6 "
E. Park and 4th,	4,135	827,000	15"	.60%	3,200,000	3.2 "
Chestnut & 4th,	4,765	953,000	15"	.30%	2,300,000	2.7 "
State & 4th,	5,185	1,027,000	15"	.40%	2,500,000	3.0 "
College & 4th,	5,785	1,157,000	15"	.22%	1,900,000	2.5 "
Center & 5th,	6,388	1,277,000	15"	.20%	1,800,000	2.9 "
6th & Kentucky,	6,848	1,369,000	15"	.20%	1,800,000	3.0 "

This sewer can be conveniently constructed in three steps - the first step being the construction from 4th and High Street to 6th and Kentucky Streets, which will care for the sewage in the built-up section of town which is now causing a nuisance by running in the gutters along 4th Street. This section we would recommend be constructed after District No. 1-A has been completely sewered.

The next section of sanitary District No. 2, which should be constructed, should be that portion along Nutwood to Collett and along Collett to the sink adjacent the City limits, where a septic tank of approximately one-third the capacity as that shown on the details should be constructed before the sewage is emptied into the sink. The third section of this interceptor from the sink to 4th and High need not be constructed for a considerable distance in the future, as the territory which it drains is but sparsely populated.

DESIGN DATA - District No. 3.

The interceptor for this district will begin at the City line and First Street extended with an 8 inch terra cotta sewer which will be carried to Center and First Streets. From this point to Gordon and 3rd Streets, where it empties into the main collector from Sanitary District 4-B, a 12 inch terra cotta sewer shall be constructed. The design data on which this interceptor is based is shown in the following table:-

<u>Location</u>	<u>Popula- tion</u>	<u>Flow</u>	<u>Size Sewer</u>	<u>Grade</u>	<u>Maximum Capacity</u>	<u>Velocity</u>
Park & 2nd,	315	31,500	8"	1.20%	800,000	1.4' sec.
Park & 1st,	315	31,500	8"	.54%	530,000	1.1 "
College & 1st,	705	70,500	8"	.4 %	430,000	1.4 "
Center & 1st,	840	84,000	12"	.22%	1,100,000	1.1 "
R.R. & 1st,	1,110	111,000	12"	.22%	1,100,000	1.2 "
3rd & Thomas	2,220	222,000	12"	.34	1,300,000	1.7 "

Inasmuch as this district is sparsely settled and drains the negro district where there are few water connections, it will probably be the last interceptor to be constructed. However, it takes care of the sewage which would otherwise empty into the Barren River in the vicinity of the intake and should not be delayed to the point where possible pollution of the water supply would result.

District No. 4.

Sewer District No. 4 has been sub-divided into two districts, 4-A and 4-B, and at the present time only 4-A and a portion of 4-B is in need of sanitary sewers. The interceptor for 4-A will start with an 8 inch terra cotta sewer at 13th and Kenton Streets, increasing to a 10 inch at 13th and Magnolia Streets further increasing to a 12 inch at 14th and Nutwood Streets. At

DESIGN DATA - District No. 4.

15th Street, near Neal Street, this sewer can empty into a sink which will take care of the sewage for some distance into the future. At this point a septic tank should be constructed of the same capacity as that shown on the detail plan. The accompanying table gives the design data for the interceptor for this district.

<u>Location</u>	<u>Popula- tion</u>	<u>Flow</u>	<u>Size Sewer</u>	<u>Grade</u>	<u>Maximum Capacity</u>	<u>Velocity</u>
Magnolia & 13th St.	1,760	352,000	10"	0.53%	980,000	2.6' sec.
14th and Nutwood	2,660	532,000	12"	0.22%	1,200,000	1.9 "
15th & Neal	3,620	724,000	12"	1.4%	2,600,000	4.4 "

District No. 4-B.

The greater portion of this district at present is sparsely settled. However, the Normal School being in this district with a large concentrated population makes necessary the sewerage of a portion of this district. We would, therefore, recommend that the 8 inch sewer be constructed on Normal School Drive, the 8 inch on Russellville Pike and that portion of the 20 inch interceptor from Normal School Drive across the L. & N. Railroad and a long Forrest and Ogden Avenues to the sink adjacent Cherry Avenue. This will take care of the sanitary sewage from most of the built up sections in this sanitary sewer district and will eliminate the nuisance created from the sinks on higher ground overflowing into the City streets and cellars. Ultimately, this entire section must be drained to Johnson and Church Streets where it will combine with the interceptor from Sewer District 1-A and from which

DESIGN DATA -- District No. 4-B.

point the sewage of the entire City will be carried to the disposal plant.

However, the main interceptor for this district, consisting of 24 and 27 inch, is an expensive proposition and in the event that it is deemed advisable to sewer that portion of the City just North of the L. & N. Railroad tracks, which is built up, including Stubbins Avenue, Payne Avenue and Fair Avenue, it would be advisable to construct the auxiliary 10 and 12 inch interceptor from the intersection of Glen Lilly Pike and the City limits eastward to Scott and Main Streets, thence along Scott to Church Street, along Church to Gilbert and along Gilbert to its junction with the 24 inch interceptor at Gilbert and Raven. This construction would delay, for a considerable distance in the future, the construction of the 24 inch and 27 inch interceptor in District 4-B and at the same time would afford drainage for the built up section of the City North of the railroad tracks and would permit the sewage from this section to be disposed of in the sink on Raven Street near Gilbert.

The data on which the design of the interceptor is based is shown on the following table:

<u>Location</u>	<u>Popula- tion</u>	<u>Flow</u>	<u>Size Sewer</u>	<u>Grade</u>	<u>Maximum Capacity</u>	<u>Velocity</u>
Neal & Akley S. of 15th	3,620	724,000	15"	0.16%	1,600,000	2.0' sec.
Kirby & Alley S. of 15th,	3,850	770,000	15"	0.16%	1,600,000	2.1 "
Cable & Wright	4,570	914,000	15"	0.16%	1,600,000	2.2 "

DESIGN DATA - District No. 4-B.

<u>Location</u>	<u>Popula- tion</u>	<u>Flow</u>	<u>Size Sewer</u>	<u>Grade</u>	<u>Maximum Capacity</u>	<u>Velocity</u>
Snell & High	6,130	1,226,000	15"	0.16%	1,600,000	2.4' sec.
Snell and Nashville Pk.	6,870	1,374,000	15"	0.47%	2,800,000	3.5 "
Normal School Dr. & Snell	13,530	2,531,000	20"	0.35%	5,200,000	3.8 "
R.R. So.of South Ave.	13,530	2,531,000	24"	0.08%	4,000,000	2.2 "
Forest and South,	14,090	2,643,000	24"	0.08%	4,000,000	2.2 "
Forest and Clark	14,920	2,809,000	24"	0.08%	4,000,000	2.3 "
Butler and Rochester,	15,540	2,933,000	24"	0.08%	4,000,000	2.3 "
Glen Lilly W.of Nugent	17,800	3,385,000	27"	0.08%	5,700,000	2.3 "
Woodford W. of Nugent,	20,800	3,985,000	27"	0.08%	5,700,000	2.4 "

SEWAGE DISPOSAL PLANT

Disposal of the sewage into sinks preceded by septic tanks cannot be regarded as more than a temporary method, for ultimately the sinks will tend to clog up and overflow onto the surface of the ground. Therefore, the ultimate disposal of the sewage of the City will be into the Barren River, after proper treatment in a modern sewage disposal plant.

Such a sewage treatment plant for Bowling Green should be designed to take care of a population of 38,000 people with a sewage flow of 7,500,000 gallons per day and while the art of sewage disposal may change by the time this plant is built, due to improved methods and new discoveries, from present knowledge

SEWAGE DISPOSAL PLANT.

we would recommend that the plant consist of a mechanically cleaned bar screen which would remove papers, rags and other like material, a two story Imhoff tank sub-divided into a number of units affording sedimentation of the solids in the upper or flowing-through chamber with sludge digestion in the lower chamber. The sewage after leaving the Imhoff tank should be treated on a sprinkling filter bed where the dissolved organic matter in the sewage would be oxidized and rendered stable. After leaving the sprinkling filters the oxidized sewage should be settled again in a secondary settling basin to remove further deposits of solid matter, after which the sewage would flow to the river.

A general layout and sectional drawing of such a plant is shown on Plate 3 attached to this report. The screen will be housed in the administration building, which should contain a sewage laboratory, offices, and on the lower floor an incinerator for burning the screenings. The Imhoff tank is divided into separate units for flexibility of operation and has a retention period of 1-1/2 hours in the flowing-through or settling compartment and sludge capacity of 2 cubic feet per capita.

The sprinkling filters are divided into separate beds, their design being based on 2500 persons per acre per one foot depth of bed. The resettling basin has a retention period of one hour and is divided into a number of units. The sludge from the resettling basin will be pumped back to the entrance of the Imhoff tank, where it will be settled and pass into the sludge compartment.

SEWAGE DISPOSAL PLANT.

Sludge beds are provided for drying the digested sludge from the Imhoff tanks, the beds being set at a lower elevation than the Imhoff tank so as to provide for a gravity flow.

RECOMMENDATIONS.

Realizing that it is beyond the financial ability of the City to completely sewer the entire area as shown on the map and construct a sewage disposal plant at the present time in one operation, we recommend that a plan be adopted whereby certain sections of the City are sewered progressively from year to year in accordance with the general scheme so that ultimately the entire City will have a sewerage system constructed in accordance with the comprehensive plan.

The order in which these sections should be constructed is as follows:-

First - The construction of Whisky Run interceptor from Elm Street to the septic tank between Center and Kentucky Streets and 8th and Main Streets, together with the construction of the above mentioned septic tank. \$ 18,000.

Second - A - The construction of the laterals and manholes in Sewer District 1-A1 which empty into the above mentioned Whisky Run interceptor, . . . \$ 36,000.

Second - B - Laterals in District 1-A2.

Third - The construction of the interceptor in Sewer District No. 4-B from Normal School Drive to the sink at Ogden and Cherry Avenues, together with laterals along Normal School Drive and Russellville Pike \$ 10,500.

Fourth - The construction of Whisky Run interceptor in Sewer District No. 1-B from the end of the first section to the sink on Raven Street near Gilbert. \$ 30,000.

Fifth - The construction of the interceptor sewer in sewer District No. 2 from Fairview Ave. and High St. to 6th and Kentucky Sts. \$ 10,000.

RECOMMENDATIONS.

Sixth - The construction of the laterals and manholes in Sewer District No. 2, which empty into the interceptor \$ 30,000.

Seventh - The construction of the interceptor in Sewer District No. 4-A from 13th and Kenton Streets to the sink on 15th Street adjacent Neal, together with the construction of the laterals and manholes for sewerage this entire district.

Eighth - The construction of the auxiliary interceptor from Glen Lilly Pike and City line to its junction with the 24 inch interceptor at Raven and Gilbert Streets, together with the construction of the laterals and manholes in the built-up section along Stubbins, Payne and Fair Streets.

Ninth - The construction of the interceptor and laterals in Sewer District No. 2 from Nutwood and 11th Streets to the sink at the intersection of Laurel Street and the City limits.

Tenth - The construction of the laterals and manholes in the built-up section of Sewer District 1-B.

Eleventh - The construction of the interceptor in Sewer District No. 2 from the sink at the intersection of Laurel Street and City limits to the intersection of Fairview Avenue and High Street.

Twelfth - The construction of the interceptor and the necessary laterals in Sewer District No. 3.

Thirteenth - The construction of that portion of the interceptor in Sewer District 4-B from the sink on 15th Street near Neal Street to the intersection of Normal School Drive and City line.

Fourteenth - The construction of the main interceptor in Sewer District 4-B from Cherry and Ogden Avenues to Johnson and Church Streets, together with construction of the main interceptor in Sewer District 1-B from the sink on Raven Street near Gilbert to the proposed sewage disposal plant.

Fifteenth - The construction of a screen chamber, Imhoff tanks and sludge bed of the sewage disposal plant.

Sixteenth - The construction of the sprinkling filters and resettling basins of the sewage disposal plant.

RECOMMENDATIONS.

The above recommendations, as to the order in which the sewerage system and disposal plant should be constructed, are based on the present distribution of the population. The future development of the City may necessitate the prior building of certain sections in a different order than called for above. However, this is a matter for the future and can be taken care of at that time.

We would also recommend that, in those sections of the City which are not sewered, no sewage should be emptied into sinks unless they are preceded by a septic tank of ample capacity to prevent solids from being carried into the sink, thereby causing the clogging of the sink with the resulting nuisance created by the sewer flowing into the streets and over private property.

The sanitation of the City should be under a special department of the City government and it should be this department's duty to see that sanitary regulations are strictly enforced and that septic tanks are cleaned periodically, as necessity demands, and further that no sewage be dumped into water courses or gutters. A complete record of the method of disposal of sewage should be kept by this Department, each individual property being listed with its method of disposal of sewage and pertinent facts relative to the same, together with date when such property was visited by the Inspector.

ESTIMATES OF COST.

Due to changing economic conditions, it is impossible to make up estimates of cost which would be accurate for work

ESTIMATES OF COST.

to be constructed some distance in the future. We will, therefore, not attempt to estimate the cost of the sections of this sewerage project beyond that of the sixth section under the recommendations. The following are our estimates based on average conditions.

Project 1.	- This work has been started, prior to this date, from plans developed in accordance with the comprehensive system. This cost, as shown by the City's records, is	\$ 18,000
Project 2.	- (Laterals in 1-A-1 only, excluding connections to houses from street sewer.)	\$ 36,000
Project 3.	\$ 10,500
Project 4.	\$ 30,000
Project 5.	\$ 10,000
Project 6.	\$ 30,000

The above estimates are based on work being done by contract, and if this work is done by the City forces in the same manner as that under Project 1 was undertaken these costs can probably be reduced to some extent.

ACKNOWLEDGMENTS.

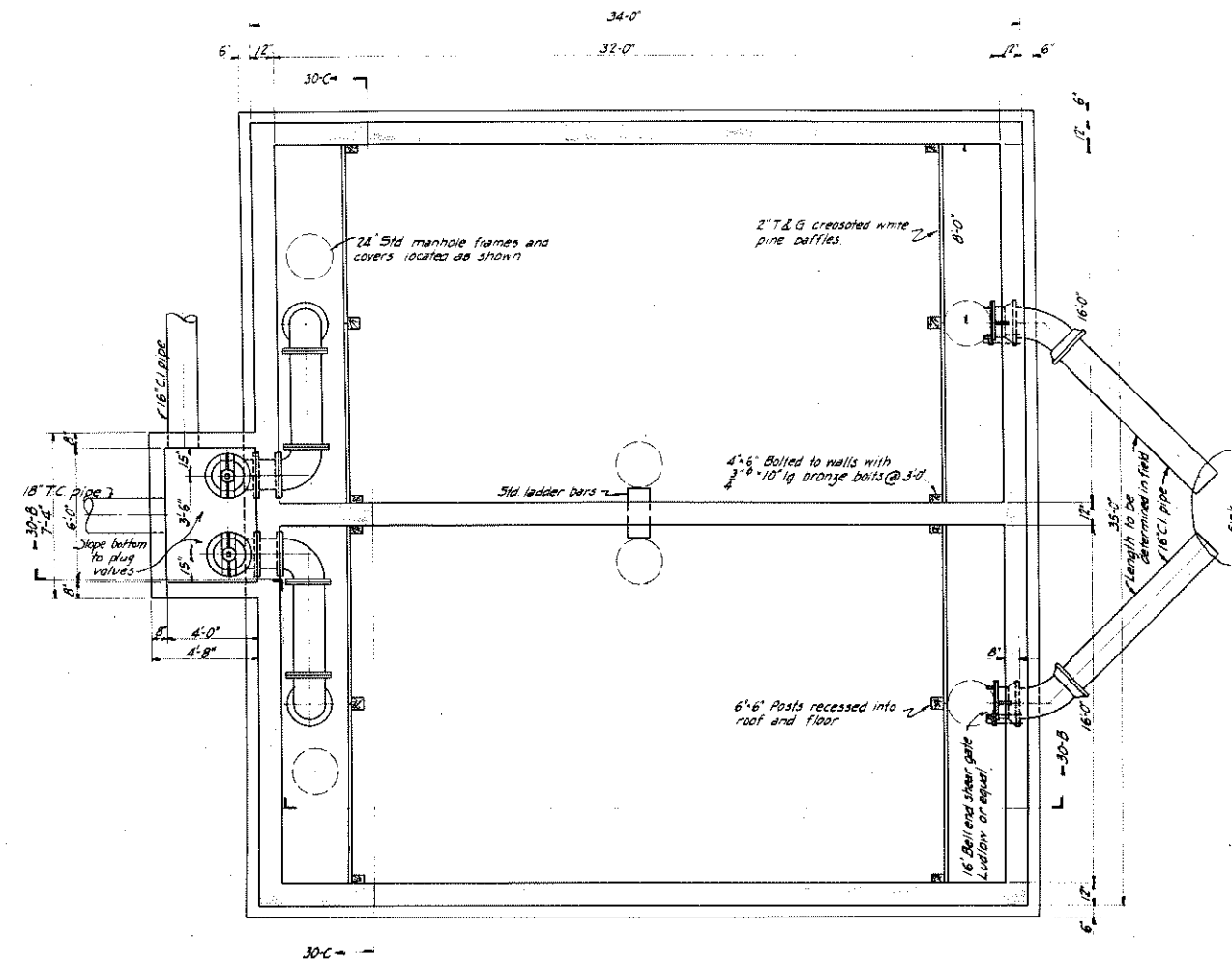
We desire to express our most cordial appreciation of the thorough co-operation and assistance rendered by each member of your official body, and especially the valuable assistance of Mr. J. C. Kirby, City Clerk, and Mr. James Davis, together with the other responsible employees, in each department, who have worked untiringly in support of our activities.

Respectfully submitted,

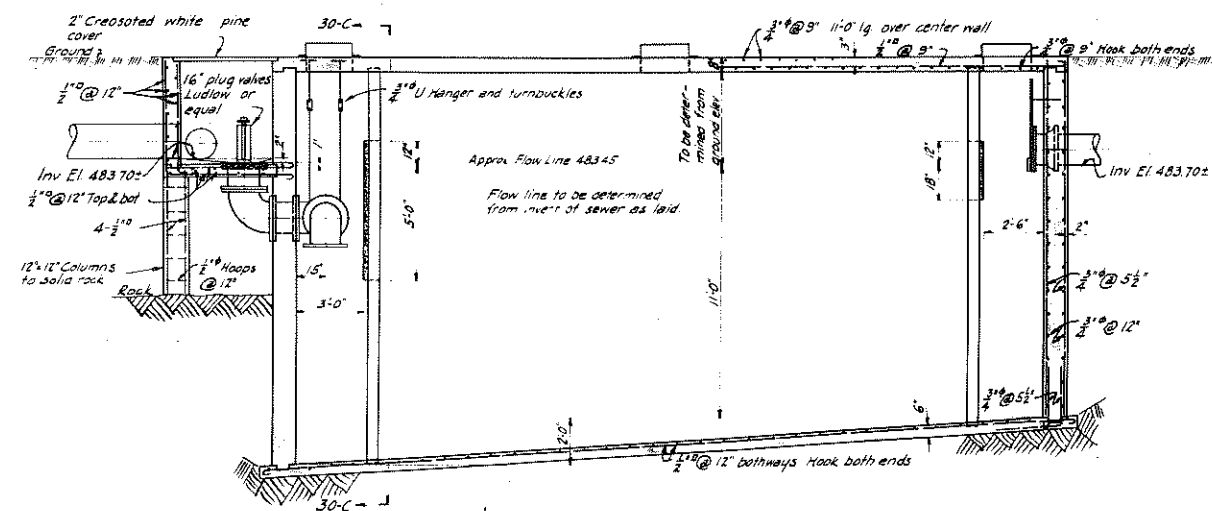
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THE J. N. CHESTER ENGINEERS.

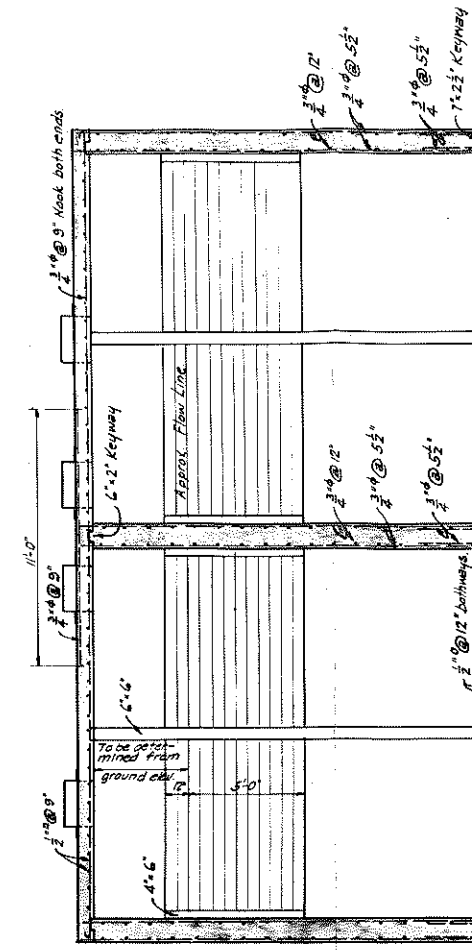
John J. Casapull



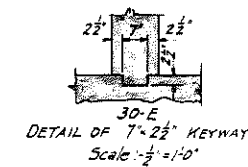
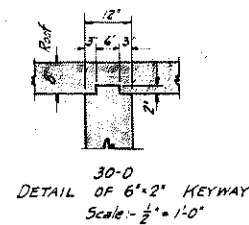
PLAN BELOW ROOF 30-A
Scale $\frac{1}{4}'' = 1'-0''$



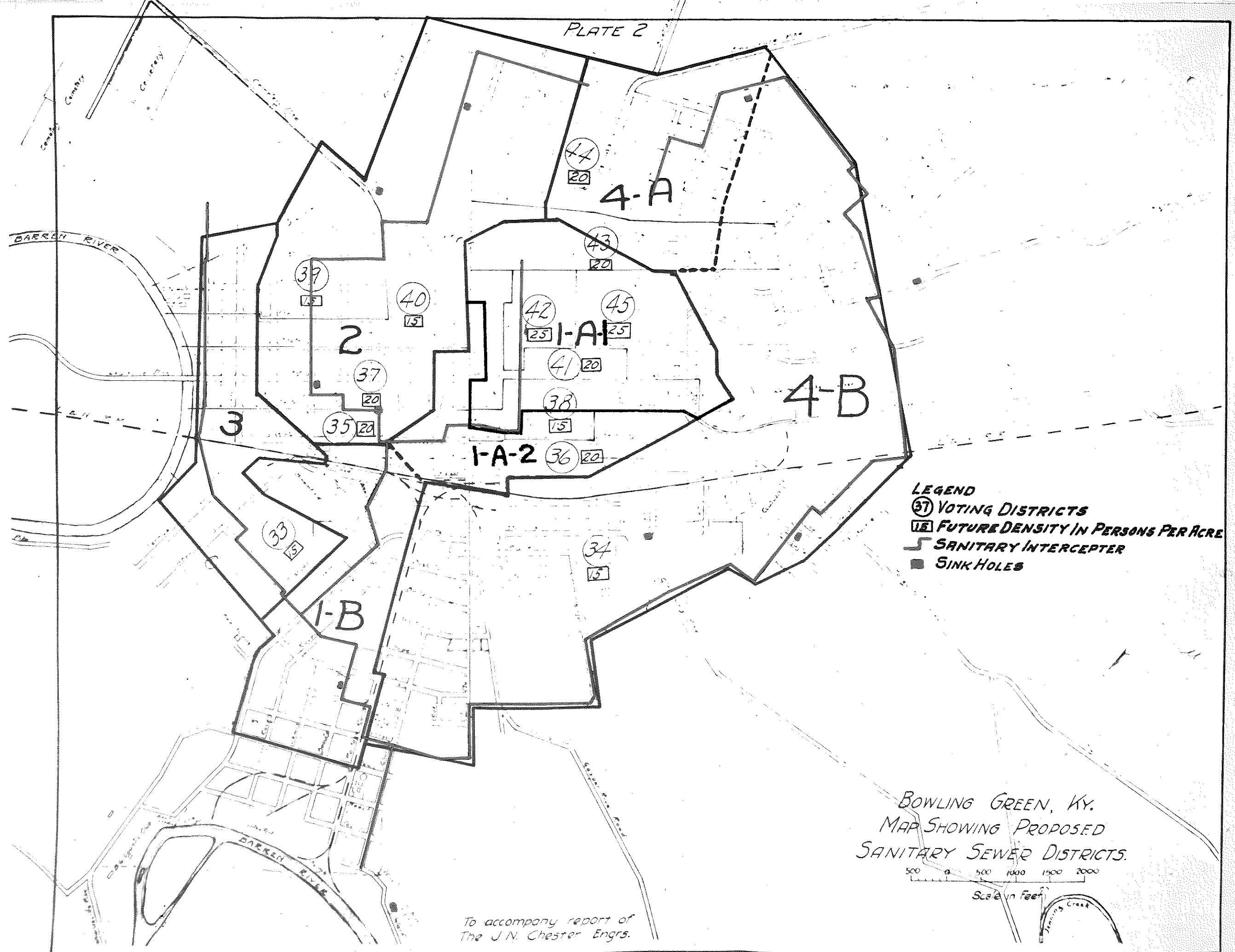
SECTION 30-B
Scale: $\frac{1}{4}'' = 1'-0''$

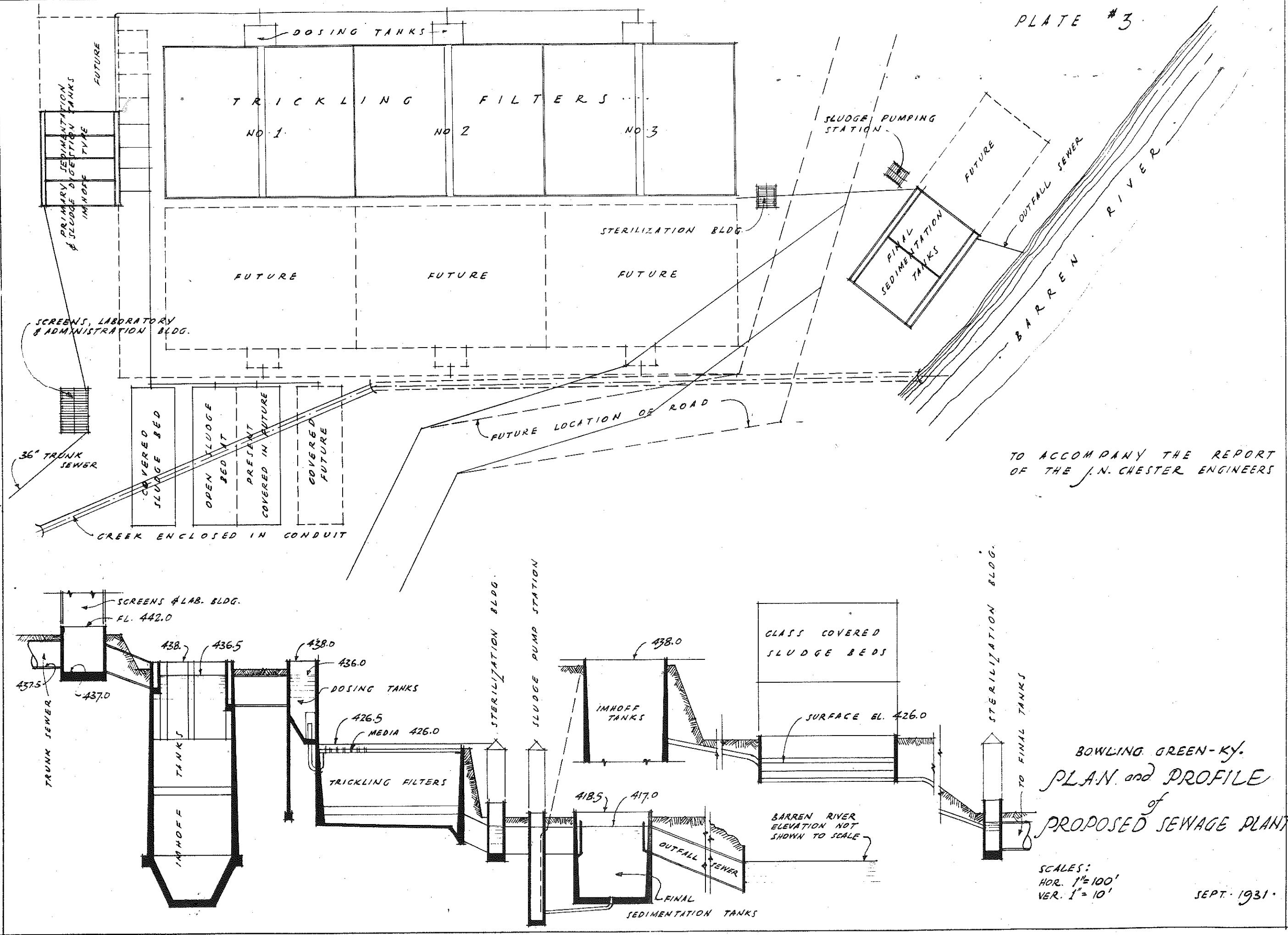


SECTION 30-C
Scale: $\frac{1}{4}'' = 1'-0''$



REVISIONS	APPROVAL	
		<p>BOWLING GREEN, KY. SEWERAGE SYSTEM DETAILS OF SEPTIC TANK</p> <p>Scale: $\frac{1}{4}" = 1'-0"$ June 5, 1931.</p> <p> DR CHS TR CAS CH OK </p> <p> The J. H. Chester Engrs. Clark Bldg. </p>





TO ACCOMPANY THE REPORT
OF THE J.N. CHESTER ENGINEERS

BOWLING GREEN-KY.
PLAN and PROFILE
of
PROPOSED SEWAGE PLANT

SCALES:
HOR. 1"=100'
VER. 1"=10'

SEPT. 1931.