# SPAVINAW

## City's Only Water Source

# The Report of Mr. Pressey, Consulting Engineer, Says No Other Project Would Meet the Needs of Future Tulsa

## This Is the Report In Full:

Tulsa, Okla., March 1, 1919.

To the Honorable Mayor and City Commissioners, Tulsa, Okla.

Gentlemen: In accordance with your request, I have made examinations and studies for a future water supply for the city, and beg leave to make the following report:

You have stated that this investigation should be for a supply of water not only for the present city but such as can be utilized when the city has reached the population of 200,000 to 250,000. It is evident that it would be unwise for the city to spend money in the construction of dams, conduits or other structures for a source of supply that would be inadequate as the city's population increases, necessitating the abandonment of these works and the construction of others at a new source.

It is not necessary that the entire works be built for full capacity of the requirements of a city of 200,000 people, but it is important that the source of the water shall have this capacity and that whatever structures are built shall be such that they can continue to be utilized with the future growth of the city and its waterworks system.

The study of this additional water supply has covered every practicable source for the city, and one by one these sources have been eliminated as it has been found that they are inadequate or undesirable, or that they have not as great advantages as a supply as some other. It has been the effort to make this report as brief as possible in order that it may be brought to the attention of all interested citizens. The statements, however, made herein are based upon extensive personal examination, analysis, surveys and computations that have in every case gone far enough to show without the least question or doubt, as to the relative merits of each of the sources considered.

### The Arkansas River.

This, the present source of supply of the city, is unsatisfactory as to quality as is well known to all citizens. It has been suggested that the supply might be taken from the Arkansas at a point farther up stream, perhaps above the junction of the Cimarron and the Salt Fork, thus obtaining a better quality of water. The examination, however, of the water of this river shows that its quality is not good for domestic purposes even above the junction of the two branches—in fact, is not of good quality as it enters the state of Oklahoma from Kansas.

### Ground Water.

Water from wells either shallow or deep should always be taken into consideration as a supply for a city, but the extensive drilling that has already been done near Tulsa, the quantity of water obtained from these wells, and particularly the quality, shows clearly that this city should not depend upon such a supply at the present time, and certainly not in the future when its demands will be much greater.

### Bird Creek.

This stream is within 10 miles of the city but its drainage area is too small and the quality of the water makes it unfit for municipal use, and Bird creek has therefore been eliminated.

### Caney River.

This river, within 20 miles of the city, is of a quality that could not be used as a city supply, being salt and otherwise chemically unfit, and is therefore eliminated.

### Verdigris River.

The Verdigris is a much larger stream, flowing from the state of Kansas, and the records of its flow for considerable periods are available. Throughout the greater part of most years there would be sufficient water in the Verdigris for the use of the city of Tulsa. The river becomes extremely turbid after rains and remains so for long periods of time. Any supply taken for Tulsa would necessarily be from the river at a point above the junction of Bird creek and Caney river, as these two branches add considerable salt to the main stream. The intake would be necessarily 25 to 30 miles from the city. A dam would be required across the Verdigris in order to get storage through dry periods. The very high turbidity would require extensive filtration.

During the year 1918 the Verdigris river ceased to flow even at points where the bed was rocky and where there was no opportunity for underground seepage through the riverbed. The city of Claremore, which takes its supply from the Verdigris at a point near where Tulsa would build its intake, was so short of water last year that they were compelled to blast through the rock ledges and drain the pools stagnant above the city intake, and even with these efforts and the construction of a small temporary dam below the intake Claremore was dangerously near a water shortage.

These conditions, together with the fact that extensive storage on the Verdigris is difficult to obtain, and that extensive filtration would be required, eliminates the Verdigris river as a source of supply.

### Hominy Creek.

This branch of Bird creek and its neighboring tributary, Delaware creek, are both too small to be seriously considered as supplies for Tulsa.

### Spring Creek.

This stream, flowing from the east into Grand river, has a water of excellent quality, but has a drainage area of only 175 square miles, and while it would furnish the city of Tulsa excellent potable water, the size of its drainage area is a strong argument for its elimination. It is nearer to the city of Tulsa than Spavinaw creek, another tributary of the Grand flowing from the east, but has less than half of its drainage basin, and is eliminated from further consideration entirely on the grounds of the quantity of water available from its flow.

Salina creek, another stream flowing from the east into the Grand river, with a drainage area of approximately 115 square miles, also would furnish water of excellent quality but the size of its drainage area precludes its use as a source of supply for the city.

### Pryor Creek.

This stream, flowing into the Grand from the west, just below the mouth of the Salina, is also to be eliminated both on account of the size of its drainage area and the fact that the quality of the water is not as good as the streams flowing into the Grand from the mountain regions of the east.

### Shell Creek.

Shell creek, a tributary of the Arkansas, about four miles west of Sand Springs, has a drainage area at the point where a dam could be constructed, of approximately 24 square miles. During dry years there is no flow in the stream during a large part of the year and during the year 1918, a dry year, there was no flow in the stream except immediately after heavy rains. This drainage area, even if Euchee creek which lies just to the east, were added to it would not supply sufficient water for a city of a population you have stipulated to me, and therefore must be eliminated as a source upon which the city of Tulsa should spend money in the construction of a dam and conduit on the basis as laid down at the beginning of this report, that it is unwise for a city to spend money in developing a source of supply of a capacity insufficient for its future needs, requiring later the abandonment of all works constructed.

### Grand River.

Grand river, a much larger stream than any of the others that have been considered, drains a large section of Kansas, and flowing south through the state of Oklahoma, receives many tributaries, carrying excellent water, particularly those draining the hilly and mountainous country to the east of the river. There are few rivers the size of the Grand in the southwest country that have a quality of water better for domestic use than this stream. As a source of supply for the city of Tulsa it has been very carefully considered. An excellent potable water could be obtained from this source.

The proper place for an intake from the Grand would be at the point due east from the city of Tulsa just to the south of where the Cherokee Creek nation line crosses the river. Water from this source would be pumped through 38 to 40 miles of conduit, the intake being at an elevation below the city of Tulsa. Steam power would be required for this purpose unless the city constructed a dam across the Grand river for the purpose of developing electrical power, such power to be used for pumping the water to the city. Such a dam could not be built at the nearest point of intake on the Grand, but could be constructed three miles farther down stream where the banks of the river are comparatively steep, forming abutments for a dam across the Grand river. Such a dam, however, would involve the expenditure of a considerable sum of money both for the structure itself and for the areas of land that would be submerged. This site has been suggested in years past as the possible location of a hydro-electric power plant for the development of power. Fifteen million gallons of water a day for Tulsa is equivalent to 23.3 cubic feet per second, and there has never been a time during the last four or five months when there has not been at least 10 or 20 times this amount of water.

The flow of the stream, however, during dry periods, and especially during the long dry period of 1918 is much lower than during the last few comparatively wet months but at no time according to the best information available, was the flow insufficient to provide for the wants of the city of Tulsa, even with a population of a quarter of a million people.

For a part of the summer, however, the water of the Spavinaw was too low for creating sufficient power for pumping all of the water for the city of Tulsa and as a precaution against any future insufficient supply for the creation of adequate electric power for pumping, it is planned to install an auxiliary steam plant, which shall be maintained ready for use in case there is a shortage of water power. By this arrangement the city can feel assured that at all times it will have sufficient power to deliver water to Tulsa. The electric current generated at the dam will be conducted by a transmission line following the conduit to the pumping stations on the conduit and the pumps operated by electric current. The line will be built in duplicate as will the power and pumping units, thus insuring constant service; but if so desired, as a still further precaution, the lines will be connected to the present operating electric plants in the city of Tulsa, so that when there is an excess of water this excess can be utilized in the city and if at any time it should be necessary electric current would be carried from some of the electric plants in Tulsa to the pumping plants on the conduit. This is an emergency that in all likelihood would never occur, but it is a further assurance of the constant operation of the plant.

As a still further assurance that the city of Tulsa shall at no time be short of water due to unprecedented low water in Spavinaw creek, provision will be made for an intake from Grand river at the point of crossing of the conduit from Spavinaw so that in this last emergency, water could be taken directly from Grand river, and Tulsa need then have no fear of a shortage of water even though the conditions of drouth became far greater than have maintained up to this time.

The general plans and estimates of cost have been made on a basis of 15,000,000 of gallons of water per day, but for the present and possibly for a few years to come, the necessary supply will be less than one-half this amount and the pumping requirements will be correspondingly reduced.

The dam on Spavinaw will be built of solid masonry or of reinforced concrete, on rock foundation and rock abutments, and the water wheels will be installed at the dam in accordance with plans that have been followed in many other hydro-electric plants, and the first cost of the machinery with the stand-by of steam is not a large item in comparison to the total cost of the system.

The conduit from the reservoir to Tulsa, a distance of approximately 58 miles, may be constructed of several different materials, wood stave pipe being probably the cheapest, and cast iron the most expensive but all estimates of cost have been based upon a conduit of reinforced concrete of 36" and 42" diameter. For the most part the pressure on this conduit will be well within the limit that can be practically and economically used with reinforced concrete pipe and cast iron pipe will be utilized in the length under higher pressure and for river crossings. Reinforced concrete pipe and cast iron pipe used in many cities of the United States, and is the type that has been installed in Oklahoma City. The commission at Oklahoma City before closing a contract on this type of conduit sent one of their commissioners to many cities to examine particularly this type of construction, but incidentally other types, so that a careful investigation was made before contracts were signed. The report of this commissioner is available to you. This point is mentioned particularly so that it may be clearly understood that the estimates of cost have been made on types of construction that are universally recognized as standard and safe, and that therefore the work can be done within the limits of cost estimated herein.

For the better protection of the city both in its domestic supply and also for fire protection, it will be desirable to construct a reinforced concrete reservoir on the high ground near the city so that there shall be at all times a sufficient storage supply to regulate properly the supply and demand, and to insure that the city shall always be thus additionally protected, while the danger of a break in the conduit is exceedingly small (the commissioner from Oklahoma City found in making his examinations of conduits of this type not a single break in all the time they had been operated), care for the interests of the city requires that there should be storage sufficient to supply the requirements of the city for a period long enough to permit the repairs of any possible breaks. Guarantees against cracks, breaks, or leaks can be obtained for a reasonable period of time from the contractor building the conduit.

It is not here intended to preclude the use of any other type that the city may wish to install, all the above statements being merely to show that the estimate has been made on a basis that is sufficient. For example, a wood stave conduit could be installed for a considerably less sum of money.

The total cost of this plant, installed, will be not more than $5,000,000. The price of materials, machinery and labor is now changing rapidly and it can't be prophesied accurately as to the prices at the time that you are ready to let your contracts, but it would seem likely that they would be lower than the figures that have been used in these estimates of cost.

The operation of the above described plants would be extremely small in that the water will require no treatment, thus avoiding the expense incident to filtration and the purchase of chemicals. The pumping plant will require some attention, but there is no known method of creating power that is so simple and requires so little attendance as the hydro-electric plant. When the steam plant is operated fuel will be required and additional attendance, but this will only be through a small part of the year, this part varying in duration with the amount of rainfall in the basin.

The city might also well maintain the present intake from the Arkansas river as a standby.

If the city of Tulsa installs the waterworks as outlined above her citizens will be relieved from the heavy burden they have been carrying of bottled water, chemicals for filtration and excessive repairs on plumbing and are assured of a constant water supply of good quality, a water which will add materially to the health and happiness of her people and will be available for any and all industries that may now or in the future locate in Tulsa. It will be one of the great assets of the city and will supply her wants until she has reached a population of a quarter of a million people or more.

The facts and data upon which the above conclusions have been reached are available to you. Respectfully submitted,

HENRY A. PRESSEY,
Consulting Engineer.

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