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DEVELOPING A WATER SUPPLY FOR THE CITY OF GARDNER

by

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by Kenneth K. Landes, Ass't. State Geologist

There comes a time in the life of every municipality when it feels the need of a water system. Gardner, a city on the Santa Fe in southwestern Johnson County, felt that urge and acted upon it a few months ago by voting through a bond issue for the development of a water supply. After a city takes this initial step, it is the task of engineers and geologists to find the water. If a river flows nearby its water may be utilized, either by pumping directly from the river or from the so-called underflow, the water which flows down valley in the alluvial material adjacent to the stream. Another method of obtaining a water supply is to build a dam across a small stream and impound a sufficient supply of water to satisfy the city's needs. The latter is an expensive undertaking and is followed only when a satisfactory supply is not available elsewhere.

Still another possible source of water is the bed-rock formations which make up the uppermost crust of our earth. In Kansas these bed rocks (in the order of abundance) are shale, limestone and sandstone. Shale (sometimes erroneously referred to as soapstone) is a compact clayey rock which may contain water but is too dense to permit ready movement of this water. Limestones may be similarly dense, but as this rock is more rigid it is liable to be traversed by a multitude of cracks or joints in which water may accumulate and through which it may travel with considerable rapidity. However, limestone is composed of compounds which are slowly soluble in water so that water which has been stored in or which has passed through limestone dissolves various chemicals, the direct effect of which is to materially harden the water.

The third type of rock, sandstone, is the best bed-rock water source. Sandstone rock, as the name implies, consists of grains of sand. In rare instances the sand grains are completely tied together by compounds which have been precipitated between the grains by underground water. In a majority of cases, however, the sand grains are but slightly cemented together. As these grains are roughly spherical in shape they will not fit together to make a solid mass, but instead there will be a vast number of openings (just as there are when marbles are poured into a container) in which water may be stored and by means of which it may move from one part of the rock to another or from the rock into a well. As many sandstones have a porosity of 25 and 30 per cent, and even higher, the amount of water contained in a 10-foot bed of sandstone beneath even as small an area as one acre would be enormous. Assuming a porosity of 25 per cent, a 10-foot body of sandstone underlying one acre could carry enough water to supply the city of Gardner with 25,000 gallons a day for over a month. If the 10-foot sandstone bed covered a square mile its capacity would be sufficiently great to supply Gardner at the same rate for over five years (without the addition of any new water). As a general rule sandstones do not contain abundant soluble minerals, so the waters from sandstones are relatively low in hardness.

Unfortunately for most of the cities in eastern Kansas, sandstone is a rather scarce rock over that area, but there is one sandstone formation, known as the Stranger, which crops out over a number of square miles in southern Leavenworth, eastern Douglas, and western Johnson counties. In the vicinity of Gardner this sandstone caps the divides between the Kansas and the Marais des Cygnes drainages. In shape it is an elongate eastward-pointing tongue which extends no farther east than a point about 2 miles west of Gardner. This is close enough, however, for that city to utilize it as a source of

water which can be piped into town. The Stranger sandstone no doubt at one time extended farther east, covering the area that is now occupied by Gardner, Olathe and other cities in Johnson County, but in the fairly recent geologic past the agents of erosion, such as running water, have stripped off great quantities of the sandstone and exposed the underlying rock at the surface.

Most of the rocks in eastern Kansas were deposited upon the floor of marine seas. A sinking, or rather a large number of successive sinkings, of the North American continent permitted the ocean to cover many hundreds of square miles of what is now land. But for that matter, a settling of the continent today of a mere thousand feet would permit the waters from the Gulf of Mexico to surge northward and inundate a large part of the Mississippi Valley, including a part of eastern Kansas. Fish which differed somewhat from those that live today inhabited the ancient seas. The sea floor was inhabited by shelled and other marine animals, some of which belong to groups of the animal kingdom which are represented by living forms, but others belong to groups that are now extinct. In these seas mud and clay washed in from surrounding land areas slowly settled to the bottom and made the shale deposits of the present. Where the shelled animals accumulated in great abundance or calcium carbonate was precipitated on the sea floor limestone beds were made. Plant material which accumulated in vast abundance in swamps along the shores of these ancient seas eventually became coal beds.

In places the Stranger sandstone is immediately underlain by a thick limestone known as the Stanton. This limestone is of marine origin as shown by the occurrence within it of many types of marine organisms, especially the shell fish.

However, the Stranger sandstone does not contain any marine organisms. This fact, coupled with other evidence, indicates that it is a fresh-water

formation. Some time after the deposition of the Stanton limestone the sea withdrew. Rivers ran across the country as they do today. Locally, lakes were formed, into which the rivers washed sand from the surrounding uplands which was deposited on the lake floor. This is a process that is going on today in the Great Lakes and in other lakes of the world. Fortunately for the citizens now living in part of northeastern Kansas, one such lake occurred here and was the scene of deposition of what is now known as the Stranger sandstone.

Now to turn to the present. After the deposition of the Stranger sandstone, the continent was once more submerged and marine shales and limestones were deposited on top of the sandstone. Subsequently there were other periods of submergence and elevation. We are now in a time of elevation and erosion has uncovered many of the ancient under-water deposits such as the Stranger formation. To the westward of the area where the Stranger outcrops it is covered by younger formations. Unfortunately where it is buried by younger formations, the water in it has been contaminated by passage through the associated rocks and is not as potable as where the sandstone lies at or near the surface. The Stranger formation has been utilized by Tonganoxie, Baldwin and Wellsville as a source of water. Wellsville lies but a few miles southwest of Gardner and obtains its water from a well which is situated about 10 miles west of Gardner. The Water Laboratory of the State Board of Health has analyzed public water supplies of 289 municipalities in Kansas. Out of this number, only ten municipalities have a water supply with a total hardness of less than 100 parts per million. Wellsville is one of these ten.

The existence of large quantities of water in the tongue of Stranger sandstone extending toward Gardner is evidenced by the many farm wells which have been excavated in it over that area and by the presence of numerous

springs around the borders of the sand body. Contrary to popular opinion, a spring of this type is not a good place in which to attempt to develop a large water supply. The fact that the water is escaping shows that the spring is at the border of the sand body. Larger supplies are obtainable from wells located some distance within the sandstone boundary. Aided by advice from the Kansas Geological Survey, the Mayor and Council of the city of Gardner drilled twelve test wells through the Stranger sandstone in western Johnson County. Several of these wells penetrated from 20 to 25 feet of sand before encountering the underlying rock, and one well passed through 57 feet of sand between the soil cover and the underlying Stanton limestone. The existence of this thick sand is evidence that the floor on which the Stranger sandstone was deposited is unusually low at this point. Inasmuch as underground water runs down hill, just as it does on the surface, there should be movement toward this well from all sides. Consequently it has been recommended by the Geological Survey that the well from which the municipal supply of Gardner is to be obtained be dug at this point.

Johnson Co

Gardner

~~Wellsville~~ Test Wells

Well No.	Location	Log		Sand thickness	
1.	SE. cor. NW. ¼ 20-14-22	soil	9½		
		sand	35	25½	
		shale	46		
2.	SE. cor. SW. ¼ 21-14-22	soil	22		
		sand	41	19	
		shale	42½		
3.	Cen.W. 60 SW. ¼ 21-14-22	soil	12		
		sand	29½	17½	
		ls.	32		
		shale	35½		
4.	NE. ¼ SW. ¼ SW. ¼ 16-14-22	soil	6		
		sand	11	5	
		shale	28½		
5.	Cen. W. 80 NW. ¼ 21-14-22	soil	8		3½ bailers in
		sand	65	57	3½ minutes
		ls.	66		(8 gals. per bailer)
6.	SW. cor. NW. ¼ 21-14-22	soil	10		
		sand	30	20	
		shale	33		
7.	SE. cor.NE. ¼ NW. ¼ 21-14-22	soil	19		
		coarse sand	21	2 plus 1	
		shale	28		
		gravel	29		
		shale	35		
8.	Cen. SE. ¼ 20-14-22	27' well.		No sand	
9.	W. Cen. SW. ¼ 20-14-22	soil	15		
		sand	19	4	
		shale	23		
10.	Cen. SW. ¼ SW. ¼ 19-14-22	soil	14	0	
		shale	18		
11.	S. Cen. SW. ¼ NW. ¼ 20-14-22	soil	5		
		sand	29	24	
		shale	32	6½ bailers in 4 minutes	
12.	SW. cor. SE. ¼ SE. ¼ 17-14-22	sandy clay	19		
		shale	24	0	