

LOSS OF ARTESIAN PRESSURE IN EASTERN SOUTH DAKOTA

Harold D. Erickson

South Dakota State Geological Survey, Vermillion

INTRODUCTION

Many of us are aware of the fact that the state of South Dakota possesses many different kinds of natural resources. Yet few of us realize that ground water is the most valuable resource we possess. To be more specific it is not all ground water, but is the ground water that is classed as artesian that is most valuable. Artesian water does not sound valuable, but if one were to compare it to other resources, he would find that its actual dollar and cents value is much greater than any other resource. Artesian water seems of little value simply for the reason that people take for granted that it is to be found in sufficient quantities for almost any need which is required. In the past this has been true, but recent studies indicate a decline in artesian pressure which is nothing less than shocking. This great decline in pressure has seriously affected nearly all portions of eastern South Dakota, where people are directly dependent upon artesian supplies for both domestic and animal consumption.

CONDITIONS NECESSARY FOR GROUND WATER TO BE CLASSED AS ARTESIAN

In order to more fully understand the causes for the loss of artesian pressure, it is first necessary to be somewhat familiar with the conditions that are necessary to produce an artesian reservoir.

The conditions that must be present for ground water to be classified as artesian water are brief and relatively simple. Firstly, there must be a permeable layer of rock, such as sandstone, lying between two impermeable layers of rock such as shale. Under this condition no water can escape from the permeable layer of rock. Secondly, this permeable layer of rock must have a regional dip. That is, it must slant or tilt downwards in one general direction. When this permeable bed has a regional dip it is possible for the water within the layer of rock to percolate downward and eventually build up a hydrostatic pressure within the permeable horizon. Lastly, this permeable layer of rock must crop out at the surface either nearby or far away, so that it can replenish its original supply of water with water from melting snow, rainfall, and creeks or rivers running across the outcrop.

The time that it takes to replenish the supply of water is extremely long. It has been estimated that rainwater entering the Dakota and Lakota sandstones in the Black Hills would take approximately 400

years to percolate through the sand and reach eastern South Dakota. This means that the water that is being withdrawn from artesian wells in eastern South Dakota entered the artesian reservoir hundreds and maybe thousands of years before our time, for it has no doubt been accumulating since the sandstones were deposited.

After becoming acquainted with the conditions necessary for ground water to be classified as artesian, it is then possible by deductive reasoning to define the terms artesian water and artesian well. Artesian water is any ground water that rises above its reservoir because of the hydrostatic pressure built up within the reservoir, while an artesian well is any well that is drilled into the artesian reservoir. If the hydrostatic pressure within the formation is of great magnitude a flowing well results. If it is less, however, the well must be pumped.

Actually the word artesian is grossly misused. It does not signify depth, volume, or ability of a well to flow as many people believe, but as the definition states it simply means the water is able to rise above its reservoir. Many people have also designated a well artesian if the chemical characteristics of the water are the same as those found in artesian water. This, too, is a misnomer of the word artesian, for the chemical character of the water is not a condition used to classify artesian water.

CAUSES FOR LOSS IN PRESSURE

With the tremendous pressures that have been built up in the artesian reservoirs in the past thousands of years, one would think they could last forever. Why then has the loss in artesian pressure been so great in the Dakota-Lakota sandstone system, the largest artesian aquifer in the world? Basically the decline in pressure can be attributed to four different causes. Namely: the improper spacing of wells, lack of proper care of wells, underground leakage in wells, and wells running uncontrolled over a period of years.

Wells have been drilled throughout the Dakota-Lakota artesian area without any regard to methods of spacing the wells. The same principle should apply to spacing artesian wells as is applied in the oil fields; that is, only a certain number should be allowed to be drilled in one certain area. This, however, has never been adopted in eastern South Dakota as hundreds of wells have been drilled in the same area. It only stands to reason that the more wells there are in a relatively small area the more water there will be withdrawn from the artesian reservoir, and consequently in the case of artesian water the pressure is reduced considerably. In some of these small areas, wells have been drilled and as a result nearby wells have been reduced in pressure and production. In areas like this, well spacing should be watched extremely closely. If well spacing had been watched more closely in the last fifty years we would not find the loss of pressure to be as great as it is today.

The second cause which has decreased the artesian pressure is lack of proper care of wells. The big factor which dominates this cause is

that the well owner has failed to repair his well when it needed repair. As a result the well quit flowing and when an attempt was finally made to repair it, it was beyond repair. This, of course, necessitated the drilling of a new well which put an added burden upon the artesian reservoir in the area concerned, as well as being expensive for the well owner. The old proverb, "an ounce of prevention is worth a pound of cure", would seem to apply very well to this case, but people are odd creatures in that they are reluctant to do anything until it can no longer be avoided and is absolutely necessary.

Underground leakage in wells is another cause which has resulted in the loss of artesian pressure. This simply means that many old wells which are no longer used for domestic and animal consumption are still discharging water into permeable horizons other than the artesian horizon, by leaking through corroded casing. Actually no new well should be allowed to be drilled on a place unless the old well has first been plugged with cement or heavy mud. It is not known just how many old abandoned wells are still discharging water underground from the artesian reservoir into other permeable horizons, but there are probably many hundreds. These wells have helped to reduce the total available artesian pressure. If some of these old wells had been plugged in the past, the loss of artesian pressure would not have been so great.

Probably the factor which has decreased the artesian pressure more than the three just mentioned is letting wells run uncontrolled over a period of years. Ever since the first artesian well was drilled in the Dakota-Lakota artesian system, they have been allowed to flow freely. Actually a well flowing three to four gallons a minute supplies a sufficient quantity of water for most domestic and livestock needs. Rarely, however, does one find a well that is flowing less than three to four gallons a minute. The well owners continue to let their wells flow unchecked, while much of the water flows down the creeks and gullies, where it does no one much good. An extreme example of uncontrolled wells is found in the so called "wild" wells found along the Missouri River Valley.

These wells flow anywhere from 100 to 2000 gallons a minute, year in and year out. Most are too forceful and uncontrollable to be of any value. Large wells of this type should be plugged, but as yet little plugging has been done. If every well drilled was required to have a valve on it so that only a certain amount of water could flow out, we would reduce considerably the loss of artesian pressure.

Actually, to reduce the loss in pressure to a minimum, it is necessary to control all four of these factors. However, if even a few were controlled it would help considerably.

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If one looks at eastern South Dakota, he can see just how much these four factors have contributed to the tremendous loss of artesian pressure. Areas along the James and Missouri rivers indicate that the loss in

pressure has been as great as 150 pounds per square inch as measured in a well, or the level of the water has lowered between 300 and 350 feet in the last 45 years. It is also evident that the areas exhibiting the greatest number of wells have correspondingly exhibited the greatest decline in artesian pressure. It is interesting to note that the artesian pressure decreases fairly rapidly and uniformly as one goes northward in the James River Valley. As a result of this large decrease in artesian pressure, wells that formerly were flowing now have to be pumped.

If this rate of decline in artesian pressure continues as it has in the past, by the end of ten years we will see the last of flowing artesian wells in parts of eastern South Dakota.

From these recent studies, it is possible to realize without much effort that some method of control must be established to conserve our most valuable mineral resource, artesian water.