Let’s Talk Water

By Dr. Mike Strobel, U.S. Geological Survey

This is the initial article of a weekly column that will appear in the Ely News. The purpose of this article is to address various water topics and try to help educate the readers on concepts and definitions. In other articles and in various meetings, people hear science terms that may not be familiar to them, so this column will attempt to clarify and describe what these terms mean. In addition, the column will address questions from the readers and try to provide answers in everyday language. Please keep in mind that some questions might be oriented towards management or political decisions, and these cannot be addressed in this column because the USGS does not participate in the decision-making process. The role of the USGS is to provide scientific tools for private citizens and public agencies to make informed decisions based on valid science. So keep in mind that I will discuss general water topics but not specific issues related to water management.

Today the topic is aquifers and confining units. An aquifer is a geologic unit that can store and transmit water in sufficient quantities and rates in order to supply wells. It’s a pretty nebulous term and in reality, one person’s aquifer is another person’s confining unit. For example, in many parts of South Dakota, the Pierre Shale is a source of water for local residents in rural areas because at shallow depths, wells produce a few gallons per minute. However, on a regional scale, the Pierre Shale is widely considered a confining unit, that is, a geologic unit that inhibits flow. In eastern Nevada, there are areas where siltstones are considered confining units to underlying aquifers, yet in some locations, fractures and faults in the siltstones allow large quantities of water to be withdrawn. In the Sierra Nevada, granitic rocks usually are considered to be impermeable, yet where fractured, these can be sources of water for domestic and municipal use. So, the term aquifer often has a local or regional definition depending on specific settings.

For most parts of the country, an aquifer is considered to supply reasonable rates of ground water if one can pump at least 5-10 gallons per minute from a well. This is sufficient for many domestic (household) needs, but not for most communities. One would need to pump many times this amount of water to supply the needs for residential, municipal, and industrial requirements for a larger population.

Aquifers can be unconfined or confined. An unconfined aquifer is one where the water in the aquifer is open to the air. These also are referred to as water table aquifers. In such conditions, water that falls on the land surface as rainfall or snow can infiltrate into the ground to the depth where the pore spaces are completely saturated. Therefore, if a person put a well into an unconfined aquifer, the water in the well would reflect the depth of the water table (the surface below which there is 100 percent saturation of all the pores in the aquifer). Sometimes streams leak into the ground and actually recharge (supply) these aquifers. These are called losing streams. A good example of this would be along the edge of mountain ranges where streams coming off of ridges disappear before

reaching the valley floor. In other cases, streams gain flow along their course and these are gaining streams. In other words, ground water is contributing to streamflow. A good example of this would be an area of springs that can occur in the central part of some valleys. Many lakes and wetlands are areas where the water table intersects the land surface. In these situations, the lakes and wetlands are “windows” to the water table.

The other type of aquifer is a confined aquifer. This is where the geologic unit that stores water is isolated from the air by some unit that restricts water movement, typically a shale or clay unit. These aquifers are also referred to as artesian. If a person puts a well in a confined aquifer, the water in the well will rise to a level somewhere above the top of the aquifer because the aquifer is sealed by the overlying strata (the confining unit). If the pressure is great enough, the water level in the well could rise above the land surface and flow. Confined aquifers are saturated entirely, unlike unconfined aquifers where air-filled pore spaces exist above the water table.

Aquifers in the Basin and Range of eastern Nevada are comprised primarily of three major hydrogeologic units. One is the alluvial aquifer, which is the material that makes up the valleys between mountain ranges. Alluvial aquifers mostly consist of gravels, sands, silts, and clays, and typically are unconfined. However, because of clay and silt layers within the alluvium, some parts of the alluvial aquifer may act confined. Another aquifer in the Basin and Range would be the carbonate aquifer, which is mainly made up of limestone and dolomite. These rocks comprise many mountain ranges and underlie the alluvial aquifer in places. This aquifer can be either unconfined or confined, depending on the setting. The third major aquifer type in the Basin and Range consists of volcanic rocks and, like the carbonate aquifer, makes up many mountain ridges and can underlie the alluvial aquifer. Likewise, this aquifer can be either unconfined or confined depending on the local setting.

In summary, water stored underground in geologic units in sufficient quantities for use occurs in either unconfined or confined aquifers. Both aquifers are important sources for water and many places rely entirely on the water stored in the ground for their water supplies. Future articles will discuss how water gets into these units and how it moves through the ground.

If you have questions about water, please write to me at Dr. M. Strobel, USGS, 333 W. Nye Lane, Carson City, NV 89706 or email me at mstrobel@usgs.gov.