Aquifers

Aquifers and the Ogallala Aquifer

From Amanda Briney, Contributing Writer,

Water is one of the most essential components to life on earth but because precipitation does not fall in equal amounts everywhere, surface water alone is not enough to sustain many areas. In places where there is not enough water above ground, farmers and local water agencies turn to the groundwater found in aquifers to meet their growing demands. Because of this aquifers have become one of the most important natural resources found in the world today.

Aquifer Basics

An aquifer (image)[1] is defined as a rock layer that is permeable to the flow of groundwater in amounts that are usable to a population. They form as water from the surface seeps down through the rock and soil in what is called the zone of aeration and is absorbed into the porous (open) spaces between the rock granules. The more permeable the soil, the more water it is able to absorb and conduct downward over time.

As the water gathers in the spaces between the rocks, it eventually builds up to a layer of groundwater below the surface and fills to its water table- the upper limit of the collected water. The area below the water table is the zone of saturation.

There are two types of aquifers that form under these circumstances. The first is an unconfined aquifer and these have a permeable layer of rock above the water table and an impermeable one beneath it. The impermeable layer is called an aquiclude (or aquitard) and it prevents any movement of water because it is so tightly compacted that there are no porous spaces into which water can gather.

The second type is a confined aquifer. These have an aquiclude on top of the zone of saturation and below it. Water generally enters these aquifers where the permeable rock is present at the surface but is between two types of rock that are not permeable.

Human Impacts on Aquifers

Because people in many areas of the world are so dependent on groundwater, we often have significant impacts on the structures of aquifers. One of the most common impacts is the overuse of groundwater. When the rate of water extraction exceeds that of replenishment, the water table in an unconfined aquifer experiences a "drawdown" or is lowered.

Another problem with removing too much water from an aquifer is that of aquifer collapse. When present, the water acts as internal support for the soil around it. If the water is removed too quickly and nothing is put in to replace it, air fills the void left in the rock pores. Because air is compressible, the internal structure of the aquifer can fail, causing it to collapse. On the surface this results in land subsidence, cracking house foundations, and changes in drainage patterns.

Finally if not carefully managed, aquifers can become polluted with various items making them useless. Those that are over pumped near the ocean can be polluted with saltwater when it enters to fill the void left by the removal of fresh water. Contaminants are also a huge problem for aquifers as they can also seep through the zone of aeration and pollute the water. This also makes such water useless when the aquifer is near factories, dumps, and other sites with hazardous waste.

The Ogallala Aquifer

One aquifer important to note is the Ogallala Aquifer, or High Plains Aquifer, located in the United States Great Plains region. This is the world's largest known aquifer with an approximate area of 174,000 square miles (450,600 square kilometers) and runs from southern South Dakota through parts of Nebraska, Wyoming, Colorado, Kansas, Oklahoma, New Mexico, and northern Texas. It is considered an unconfined aquifer and though it is large in area, much of the aquifer is shallow.

The Ogallala Aquifer was formed about 10 million years ago when water flowed onto the highly permeable sand and gravel of the plains from retreating glaciers and streams from the nearby Rocky Mountains. Because of changes due to erosion and the lack of glacial meltwater, today the Ogallala Aquifer is no longer being recharged by the Rockies.

Because precipitation in the region is only around 12-24 inches (30-60 cm) per year, this heavily agricultural region relies on water from the Ogallala to maintain crop production but also support municipal and industrial development. Since the aquifer was first tapped for irrigation in 1911, its use has increased dramatically. As a result, its water table has dropped and has not been naturally replenished due to the altered stream flow in the Rockies and lack of precipitation. The drop is most prominent in northern Texas because the thickness there is least, but it is also a problem in parts of Oklahoma and Kansas.

Recognizing the problems associated with a dropping water table such as collapsing aquifers, the resultant damage to infrastructure, and the loss of a water source in a normally dry region, portions of Nebraska and Texas have invested in groundwater recharge to allow the Ogallala Aquifer to remain useful for the area. Recovery of aquifers is a long process though and the full impact of such plans is not yet fully known. Current irrigation practices in the region though could use up about half of the Ogallala's water within the next decade.

Early settlers to the Great Plains recognized the dryness of the area as their crops continually failed and sporadic droughts occurred. Had they known about the Ogallala Aquifer prior to 1911, life in the region could have been much easier. Using the water found in the Ogallala Aquifer transformed this region as such water usage has done in many areas around the world, truly making aquifers an important natural resource for development and survival in areas where surface water is not enough to successfully support the population.

Links in this article:

1. http://upload.wikimedia.org/wikipedia/commons/thumb/0/04/Aquifer_en.svg/400px-Aquifer_en.svg.png