TASK 1: Read and translate the text

AQUIFER PROPERTIES

The physical properties of geologic materials control the storativity and ability of fluids to move through them. Rock units that do not allow fluids through them become barriers to fluid flow and in turn change the direction of groundwater movement. Other features such as fault zones may serve as conduits to fluid flow or act as barriers. In this chapter the physical properties of saturated geologic materials are presented to provide a basic understanding of aquifers, confining layers, and boundary conditions as a basis for understanding groundwater flow. Boundaries are often determined directly through drilling, pumping tests, or geophysical methods.

From the Surface to the Water Table

When precipitation hits the land surface, some water enters the soil horizon. This process is known as ***infiltration*****.** Water that accumulates on the surface faster than it can infiltrate becomes ***runoff***. The rate at which water infiltrates or runs off is a function of the physical properties of the surficial soils. Some of the important factors appear to be thickness, clay content, moisture content, and intrinsic permeability of the soils' materials (Baldwin 1997). Infiltrating water that encounters soils with higher clay content tends to clog the pores, causing precipitation to mound up and run off, unless they are exceedingly dry (Stephens 1996). Sandier soils promote infiltration and exhibit less vegetative growth, while soils with a higher clay content appear to promote plant growth. Glaciated areas provide an example of an environment where many soil types can be found. Glacial sediments deposited via moving water become stratified or layered and tend to be well drained; examples include outwash deposits, kames and eskers. Sediments transported by ice that accumulate along the sides and end of a glacier are poorly sorted and contain a higher content of clay and silt; examples include lateral and end moraines, which are poorly drained. In the field well-drained soils can be distinguished by lessor plant growth. Once infiltration occurs, any groundwater that descends below the rooting depth eventually reaches the regional water table as recharge. This has serious implications for dissolved chemicals that accompany the descent waters.

Between the soil horizon and the regional water table is an area referred to as the **vadose zone** (Figure 1). The ability of the vadose zone to hold water depends upon the moisture content and grain size. Wells completed in the vadose zone will have no water in them, even though the geologic materials appear to be wet, while wells completed in saturated fine-grained soils will eventually contain groundwater.

Another part of the vadose zone immediately above the regional water table is the capillary fringe. The capillary fringe is essentially saturated, but groundwater is being held against gravity under negative pressure, a phenomenon known as **capillarity**. In groundwater applications atmospheric pressure is referenced as zero pressure. The water table for example, is at atmospheric pressure, while below the water table, water is under a pressure greater than atmospheric. Water in the capillary fringe and the rest of the vadose zone is under a pressure less than atmospheric. This same phenomenon is observed when one puts a paper towel into a pan of water. The water is attracted to the surfaces of the towel fibers being drawn up through very small pore tubes between the fibers. Similarly, in the capillary fringe groundwater seeks to wet the surfaces of geologic materials with an attraction greater than the force of gravity. The thickness of the capillary fringe is grain-size dependent. The finer grained the material, the thicker the capillary fringe because of the smaller pore throats, increased surface area, and surface tension.

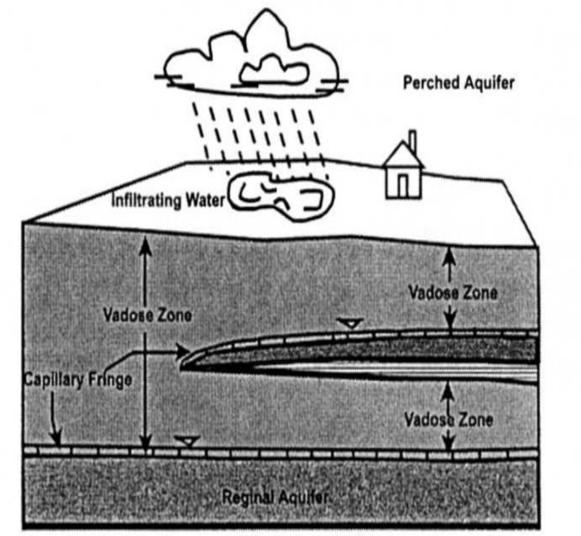

Figure 1 Schematic of the vadose zone, infiltrating water, and the capillary zone.

When drilling wells or installing monitoring equipment, one must also be careful that the first water encountered is actually the regional water table and not a perched aquifer. **Perched aquifers** represent infiltrating groundwater that accumulates over confining layers of limited areal extent above the regional water table (Figure 1). Perched aquifers may be capable of sustaining enough water for a few residences, but generally not enough for many residences or long-term production. Several water levels in wells in the same area would help one determine whether a perched water table exists or not.

Task 2: Write a summary to text (5-8 sentences)

- **What kind of text is it?**
- **What is the text about?**
- **What is the main idea of a text?**
- **How many parts can be distinguished in text?**
- **What is described in each part?**

CONFINED AND ARTESIAN AQUIFER

Geologic materials that outcrop at the surface at a relatively high elevation (recharge area) receive water by infiltration recharge. Materials of sufficient transmissivity that become saturated and are overlain and underlain by confining layers become aquifer units with trapped groundwater. The elevation of the zone of saturation propagates a pressure throughout the system from the weight of the water. When this occurs, there is sufficient pressure head within the system to lift the water within cased wells above the bottom of the upper confining layer or top of the aquifer. By definition, this is a confined or artesian aquifer. Both terms refer to the same condition.

Generally, most confined aquifers receive recharge through vertically leaking geologic materials above or below them (Freeze and Cherry 1979). When water levels in cased wells rise to the land surface and become flowing wells, they are still considered to be from a confined aquifer. The height to which water levels rise forms a surface known as the potentiometric surface. Confined aquifer and unconfined aquifer have different potentiometric surfaces. In an unconfined aquifer the potentiometric surface is the water table. The slope of this surface is called the hydraulic gradient. The slope of the hydraulic gradient is proportional to the hydraulic conductivity. The lower the hydraulic conductivity, the greater the slope of the hydraulic gradient. Each aquifer has its own potentiometric surface, from which groundwater flow and other interpretations are made. It is important to construct separate potentiometric surfaces for each aquifer to evaluate vertical connectivity.