**INTRODUCTION**

Understanding how the geological framework of Illinois relates to groundwater is essential to comprehending where aquifers occur and how groundwater behaves in the subsurface. By definition, an aquifer is saturated geological material that can supply sufficient water to sustain a well or spring. The geological framework dictates where aquifers occur and where they do not, how well aquifers are protected from surface activities, and how readily their water is replenished. Understanding the state’s geological framework makes it easier to grasp why groundwater is available in some areas of Illinois but is difficult to obtain in others.

**GROUNDWATER WITHIN THE GEOLOGICAL FRAMEWORK**

Chapters 2 through 12 describe the geological framework of Illinois in detail. Two major aspects are especially relevant to a discussion of groundwater: (1) bedrock and (2) the unconsolidated deposits that overlie the bedrock throughout most of the state. This chapter concentrates on the water-yielding characteristics of these geological materials.

Although water can move through almost all geological materials, it does so at vastly different rates. The capacity of geological materials to transmit a fluid is called permeability. If the fluid is groundwater, the capacity is called hydraulic conductivity. Groundwater readily moves through geological materials with high hydraulic conductivity; that is, with relatively large pore spaces or fractures that are well interconnected. Coarse-grained geological materials—such as sandstone, sand, and gravel—and creviced limestone and dolomite are examples of materials that have high hydraulic conductivity.

Hydraulic conductivity is a measure of the quantity of groundwater that moves in a given unit of time under a unit hydraulic gradient through an area of one square foot (0.09 m²) of earth material oriented at right angles to the direction of groundwater flow. Hydraulic conductivity is commonly expressed in gallons (the volume of groundwater) per day (the unit of time) per square foot (the cross sectional area). A unit hydraulic gradient is a one-foot (0.3-m) vertical decline in hydraulic head over a horizontal distance of one foot (0.3 m) (Figure 18-1). Table 18-1 lists hydraulic conductivities of various aquifer and aquitard materials commonly found in Illinois.

**AQUIFERS AND AQUITARDS**

When materials with high hydraulic conductivity are saturated, these materials are aquifers. Groundwater does not readily move through geological materials with low hydraulic conductivity; such materials form aquitards. Aquitard materials, such as shale, nonfractured limestone and dolomite, or fine-grained silts and clays, have pore spaces that are relatively small and/or poorly interconnected.

Understanding the vertical and horizontal distribution of aquifer and aquitard materials is an integral part of determining the extent and quantity of groundwater resources, managing those resources, and assessing the susceptibility of groundwater to contamination. Such knowledge is needed, for example, to evaluate the impacts of well pumping on other wells, to site waste disposal facilities to minimize their groundwater contamination potential, and