INTRODUCTION

An important consideration for land-use planning, especially in areas of rapid population growth, is ensuring that groundwater resources are readily known and that those resources are adequately protected. Groundwater contamination problems must be prevented or eliminated to optimize the resource potential of the groundwater. The U.S. Environmental Protection Agency (1993) has placed a national priority on identifying potential contaminant sources and routes of transport and on evaluating methodologies for identifying water-bearing geological units, particularly aquifers, that are vulnerable to contamination. Only when the geological framework is well-understood and the groundwater resources are located and evaluated for their potential to become contaminated can subsequent land-use planning effectively prevent contaminants from entering aquifers. This chapter discusses the contamination potential for groundwater resources in Illinois and provides examples of maps that have been created to aid planners in protecting groundwater resources.

BACKGROUND

In Illinois, aquifer materials are mainly glacially deposited sands and gravels or sandstone and fractured and jointed limestone and dolomite bedrock, all of which are sufficiently permeable that when saturated they can yield useful quantities of groundwater to wells, springs, or streams (Illinois Groundwater Protection Act 1987). The presence of sand and gravel or highly permeable bedrock indicates aquifers or potential aquifers. Because 90% of Illinois’ land area has been glaciated—in some areas more than three times—multiple former landscapes are buried beneath the present land surface, including sands and gravels from ancient rivers and streams, silts and clays from ancient lakes, and old soils. The buried sands and gravels, as well as sands and gravels on the surface, constitute glacial aquifer materials that are not uniformly distributed across the state. Beneath the glacial deposits are layers of bedrock, mainly limestone, dolomite, sandstone, and shale. Where the sandstones are not heavily cemented and where the limestone and dolomite are fractured and jointed, the bedrock may also constitute an aquifer. Because aquifers yield economically significant quantities of water and allow water and/or contaminants to travel at relatively rapid rates, they are potentially vulnerable to contamination. Fine-grained, low-permeability materials such as clay, silt, till, shale, and non-fractured, non-jointed bedrock and cemented sandstone are not considered aquifers even if these materials are water-saturated, because they will not yield sufficient quantities of water to be economically useful. They are aquitards.

The distribution of aquifers and aquitards directly controls the movement of contaminants in groundwater (Chapter 18, Aquifers). The potential for an aquifer to become contaminated largely depends on the natural protective properties of the geological materials that lie above and below it. The thicker the aquitard between an aquifer and a potential contaminant source, the less likely the aquifer is to become contaminated (Berg et al. 1984a, 1984b). Hydraulic conductivity (the ability of geological materials to transmit water) of the protective fine-grained materials is also important. For example, water moves much more slowly through clayey tills than through sandy tills (Berg 2001). The presence of low-permeability materials beneath an aquifer can also restrict further downward migration of potential contaminants into deeper aquifers. Schock et al. (1992) investigated the presence of agricultural chemicals in aquifers, and the results of this Illinois study indicated that aquifers lying within 50 feet (15 m) of the surface generally are the ones most vulnerable to potential contamination.

Many chemical and biological agents can enter into the surface soil, be transmitted into the groundwater flow system, be stored in aquifers, and eventually be pumped from wells and consumed. Examples of surface or near-surface activities that have the potential to contaminate aquifers are accidental spilling of chemicals; applying agricultural chemicals to farm fields; applying herbicides and pesticides to residential and other lawns and gardens; leaking of substances from municipal or hazardous waste landfills, septic systems, or salt storage areas; leaking of petroleum products and chemicals from storage tanks; seeping of water contaminated with road salts and other chemicals from stormwater detention areas that are improperly placed; and infiltrating metals and nitrates from surface spreading of sewage sludge and septage (Chapter 29, Pollution of Natural Waters). Each can pose serious environmental and health hazards (Soller and Berg 1992). Depending on the degree of contamination and intended future land-use