

AQUIFER SENSITIVITY TO CONTAMINATION

KANE COUNTY, ILLINOIS

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2007

Aquifer Sensitivity

Introduction

The map aquifer sensitivity to contamination (Dey et al 2007) is a representation of the potential vulnerability of aquifers in an area to contamination from sources of contaminants at or near the surface. The U.S. Environmental Protection Agency (1993) defines aquifer sensitivity/contamination potential as “a measure of the ease with which a contaminant applied on or near the land surface can migrate to an aquifer. It is a function of the intrinsic characteristics of both the geologic materials comprising the aquifer as well as the overlying saturated and unsaturated material. It is independent of land use and the types of contaminant introduced.”

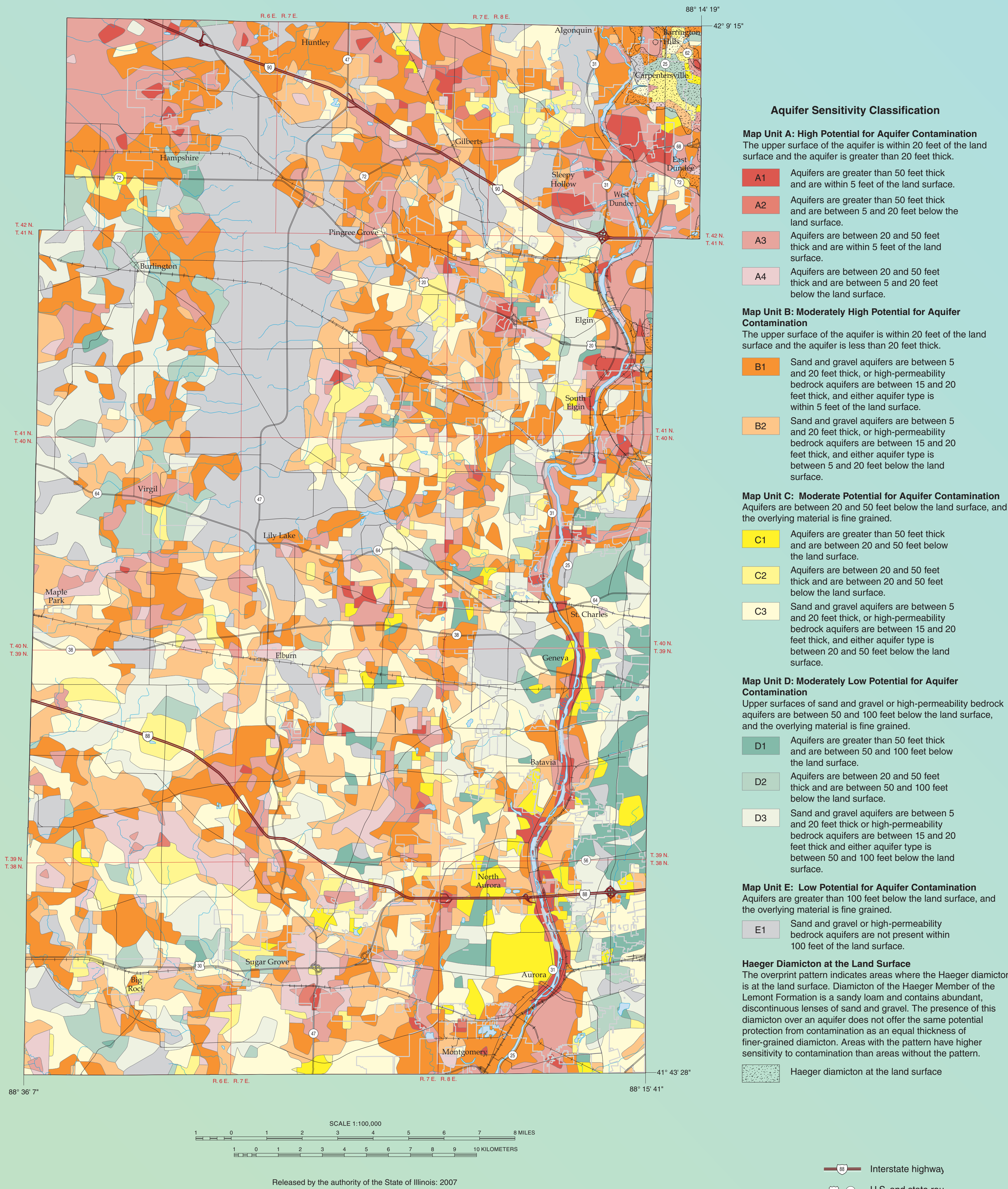
Methods

The method for classifying aquifer sensitivity used in producing the aquifer sensitivity map of Kane County (Dey et al., 2007) was based on the mapping system developed by Berg (2001). The system uses depth to and thickness of the uppermost aquifer or aquifer material and relative permeability of overlying material to assign a classification rating. Aquifers are defined as geologic materials that are saturated and sufficiently permeable to yield economic quantities of water to wells or springs (Fetter 1994). In Kane County, shallow aquifers are generally composed of un lithified sand and gravel deposits, or of bedrock units of fractured carbonates. For this map, sand and gravel deposits were defined as aquifers in areas where the units were greater than 5 feet thick (35 Ill. Adm. Code 620.210) and extended over at least a square mile of area. Carbonate bedrock of Silurian age was defined as an aquifer where it was the uppermost bedrock unit and greater than 15 feet thick (35 Ill. Adm. Code 620.210). The Silurian rock is commonly fractured at its upper surface (Graese et al. 1988). Geologic materials that would be classified as aquifers but are above the water table and therefore not saturated were grouped with aquifers in the interpretation for this map because they still provide a conduit for the vertical flow of water and potential contaminants. Glacial diamicton (an unsorted mixture of gravel, sand, silt, and clay commonly called “till”), wind-blown silt (loess), peat, silty and clayey river and lake sediment, shale, and unfractured carbonate bedrock are not considered aquifers because they are generally fine-grained and have limited potential to yield water to a well.

Aquifer vulnerability is assumed to decrease with depth. Studies in Minnesota (Klaseus et al. 1989) and Iowa (Libra et al. 1993) found a decrease in agricultural chemicals in water samples collected at a depth of greater than 100 feet. Schock et al. (1992) found that depth to uppermost aquifer was useful for predicting the occurrence of agricultural chemicals in drilled wells in rural Illinois, using depth intervals of less than 50 feet and greater than 50 feet. In a subsequent study, Mehnert et al. (2003) found that the depth to the uppermost aquifer was useful for predicting the occurrence of agricultural chemicals in monitoring wells in rural Illinois, using intervals of less than 20 feet, 20 to 50 feet, and greater than 50 feet.

Thicker aquifers provide a greater groundwater resource than thinner aquifers, potentially yielding more water and being utilized by more people. The importance of protection from contamination theoretically increases with aquifer thickness. Thus, vulnerability increases with aquifer thickness. Following Berg's (2001) recommendation, aquifer thickness intervals used were 5 to 20 feet (or 15 to 20 feet for fractured carbonate), 20 to 50 feet, and greater than 50 feet.

The Haeger Member is a sandy loam diamicton with abundant, discontinuous lenses of sand and gravel and thin beds of silt and clay. It is not uniformly coarse enough to be considered aquifer material. However it is coarse enough that its presence over an aquifer does not offer the same protection from contamination as an equal thickness of a finer-grained diamicton. Although the Haeger Member is treated as non-aquifer material for this aquifer sensitivity map, its presence at the land surface is uniquely noted due to the lower potential protection it offers underlying aquifers.



Aquifer Sensitivity Classification

Map Unit A: High Potential for Aquifer Contamination

The upper surface of the aquifer is within 20 feet of the land surface and the aquifer is greater than 20 feet thick.

A1 Aquifers are greater than 50 feet thick and are within 5 feet of the land surface.

A2 Aquifers are greater than 50 feet thick and are between 5 and 20 feet below the land surface.

A3 Aquifers are between 20 and 50 feet thick and are within 5 feet of the land surface.

A4 Aquifers are between 20 and 50 feet thick and are between 5 and 20 feet below the land surface.

Map Unit B: Moderately High Potential for Aquifer Contamination

The upper surface of the aquifer is within 20 feet of the land surface and the aquifer is less than 20 feet thick.

B1 Sand and gravel aquifers are between 5 and 20 feet thick, or high-permeability bedrock aquifers are between 15 and 20 feet thick, and either aquifer type is within 5 feet of the land surface.

B2 Sand and gravel aquifers are between 5 and 20 feet thick, or high-permeability bedrock aquifers are between 15 and 20 feet thick, and either aquifer type is between 5 and 20 feet below the land surface.

Map Unit C: Moderate Potential for Aquifer Contamination

Aquifers are between 20 and 50 feet below the land surface, and the overlying material is fine grained.

C1 Aquifers are greater than 50 feet thick and are between 20 and 50 feet below the land surface.

C2 Aquifers are between 20 and 50 feet thick and are between 20 and 50 feet below the land surface.

C3 Sand and gravel aquifers are between 5 and 20 feet thick, or high-permeability bedrock aquifers are between 15 and 20 feet thick, and either aquifer type is between 20 and 50 feet below the land surface.

Map Unit D: Moderately Low Potential for Aquifer Contamination

Upper surfaces of sand and gravel or high-permeability bedrock aquifers are between 50 and 100 feet below the land surface, and the overlying material is fine grained.

D1 Aquifers are greater than 50 feet thick and are between 50 and 100 feet below the land surface.

D2 Aquifers are between 20 and 50 feet thick and are between 50 and 100 feet below the land surface.

D3 Sand and gravel aquifers are between 5 and 20 feet thick or high-permeability bedrock aquifers are between 15 and 20 feet thick and either aquifer type is between 50 and 100 feet below the land surface.

Map Unit E: Low Potential for Aquifer Contamination

Aquifers are greater than 100 feet below the land surface, and the overlying material is fine grained.

E1 Sand and gravel or high-permeability bedrock aquifers are not present within 100 feet of the land surface.

Haeger Diamicton at the Land Surface

The overprint pattern indicates areas where the Haeger diamicton is at the land surface. Diamicton of the Haeger Member of the Lemont Formation is a sandy loam and contains abundant, discontinuous lenses of sand and gravel. The presence of this diamicton over an aquifer does not offer the same potential protection from contamination as an equal thickness of finer-grained diamicton. Areas with the pattern have higher sensitivity to contamination than areas without the pattern.

Haeger diamicton at the land surface

Legend:

- Interstate highway
- U.S. and state route
- Other roads
- Railroads
- Rivers and lakes
- Municipal boundary

Classification Sequence

The aquifer sensitivity classification rates sequences from Map Unit A to Map Unit E in order of decreasing sensitivity to aquifers becoming contaminated.

Map Unit A: High Potential for Aquifer Contamination

Map Unit A is defined as areas where the upper surface of the aquifer is within 20 feet of the land surface and with sand and gravel or high-permeability bedrock aquifers greater than 20 feet thick. Map Unit A is classified as an area of high aquifer sensitivity. It is most prevalent in southern and northwestern Kane County and along the Fox River where the drift is thin. In these areas, contaminants from any source can move rapidly through the sand and gravel deposits to wells or nearby streams. Land use practices should be very conservative in all areas mapped as unit A.

Map Unit A1. Aquifers are greater than 50 feet thick and are within 5 feet of the land surface. Small patches of Unit A1 occur throughout the county. Notable occurrences are found northwest of Hampshire (as part of a large alluvial fan extending west of the Marengo Moraine and north of the Bloomington Morainic System (fig. 1)) and along reaches of the Fox River (where glacial drift is thin, and fractured dolomite or thick sand deposits are at or very near ground surface).

Map Unit A2. Aquifers are more than 50 feet thick and between 5 and 20 feet below ground surface. This map unit is not very common in Kane County.

Map Unit A3. Aquifers between 20 to 50 feet thick occur within 5 feet of the land surface. Because of their similar definitions, the distribution of Unit A3 is in areas where Unit A1 is also mapped. It also is common in northern Kane County.

Map Unit A4. Aquifers are between 20 and 50 feet thick between 5 and 20 feet below the land surface. Unit A4 is much more common than similarly defined Unit A2. Large areas of Unit A4 also occur in southern Kane County associated with the Elburn Complex (fig. 1).

Map Unit B: Moderately High Potential for Aquifer Contamination

Unit B is defined as areas where aquifers are within 20 of the land surface, and sand and gravel aquifers are between 5 and 20 feet thick or high-permeability bedrock aquifers are between 15 and 20 feet thick. Groundwater is sensitive to contamination due to the minimal barrier of diamicton or silt and clay.

Map Unit B1. Sand and gravel aquifers are between 5 and 20 feet thick and high permeability bedrock aquifers are between 15 and 20 feet thick either type is within 5 feet of the land surface. This unit is common throughout the county. Notable occurrences include areas in the Elburn Complex (fig. 1) along Route 47 north of Sugar Grove, and in outwash terraces along the Fox River.

Map Unit B2. Sand and gravel aquifers are between 5 and 20 feet thick and high permeability bedrock aquifers are between 15 and 20 feet thick either type is between 5 and 20 feet of the land surface This unit is found in patches throughout the county in association with Unit B1. Unit B2 is most common in the Elburn Complex (fig. 1) and in north-central Kane County.

Map Unit C: Moderate Potential for Aquifer Contamination

In Unit C areas, aquifers are buried by 20 to 50 foot thick, fine-grained deposits, including all diamicton units and silt and clay of the Equality Formation. The mantle of fine-grained material offers moderate protection for underlying aquifers from waste spreading

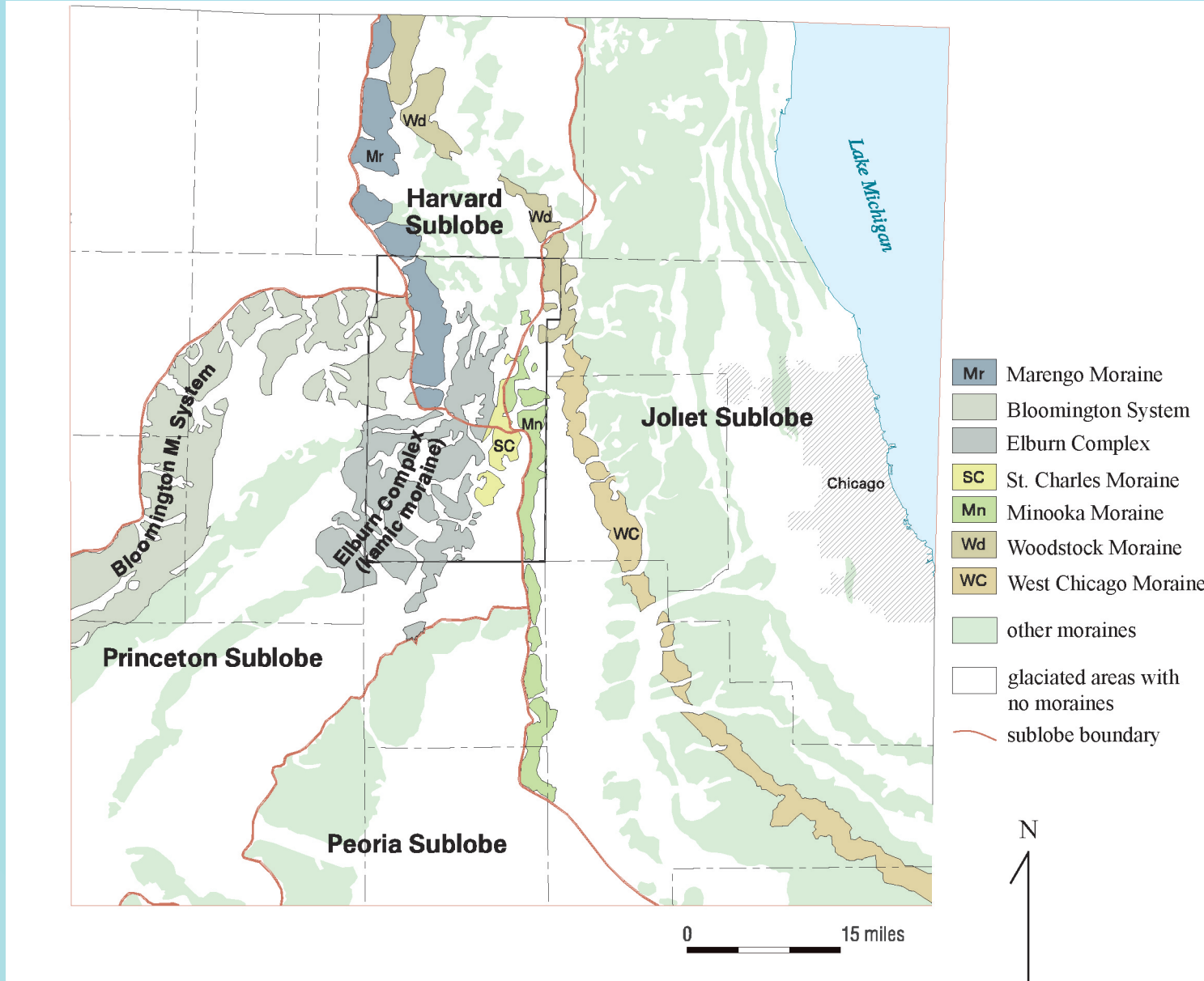


Figure 1 Wisconsin Episode moraines in northeastern Illinois.

or from septic systems. Schock et al. (1992) reported that pesticide and nitrate detections in Illinois were significantly fewer where aquifers were buried by 20 to 50 feet than where aquifers were shallower.

Map Unit C1. Aquifers are greater than 50 feet thick and buried by 20 to 50 feet of fine-grained material. Unit C1 occurs in isolated patches throughout the county. It is most common in southeastern Kane County near the Fox River.

Map Unit C2. Aquifers are between 20 to 50 feet thick and are buried by 20 to 50 feet of fine-grained material. This unit is widespread in the Elburn Complex (fig. 1).

Map Unit C3. Sand and gravel aquifers are between 5 and 20 feet thick and high-permeability bedrock aquifers are between 15 and 20 feet thick and either type is buried by 20 to 50 feet of fine-grained material. Again, these units are widespread in the Elburn Complex (fig. 1).

Map Unit D: Moderately Low Potential for Aquifer Contamination

The probability that groundwater will become contaminated is moderately low in places where sand and gravel aquifers are buried by fine-grained deposits 50 to 100 feet thick. In Kane County, such areas occur below moraines.

Map Unit D1. Aquifers are more than 50 feet thick and are buried by 50 to 100 feet of fine-grained material. The largest mapped areas of Unit D1 occur in southeastern Kane County.

Map Units D2. Aquifers are between 20 to 50 feet thick and are buried by 20 to 50 feet of fine-grained material. These units are widespread in the Bloomington Morainic System, Elburn Complex, and the Minooka and St. Charles Moraines (fig. 1).

Map Units D3. Sand and gravel are aquifers between 5 and 20 feet thick and bedrock aquifers between 15 and 20 feet thick that are buried by 20 to 50 feet of fine-grained material. These units have a similar distribution to Unit D2.

Map Unit E: Low Potential for Aquifer Contamination

Map Unit E occurs in places where diamicton, lacustrine silt and clay, or shale is more than 100 feet thick. Discontinuous lenses of sand and gravel may occur in the diamicton, but they typically are not aquifers. The large area mapped as Unit E is associated with the Marengo Moraine and, to a lesser degree, the Bloomington Morainic System. Isolated patches of this unit occur throughout the rest of the county.

Overprint Pattern: Sandy Diamicton (Haeger Member) at Land Surface

A stippled overprint pattern shows where the Haeger Member is at the land surface. Overprinted map units have a higher potential of sensitivity to contamination, than the same map unit in areas without the stipple overprint pattern. The Haeger Member only occurs in northeastern Kane County east of the Fox River.

Application

Kane County's 2030 Land Resource Management Plan (Kane County 2004) recognized the vulnerability of the county's water resources to contamination. Nine objectives for water-resources management are articulated in the Plan (p. 104), the second of which addresses protecting the county's groundwater resources. The Aquifer Sensitivity to Contamination Map (Dey 2007) is a useful tool for county wide planning. The map should be used as a guide in decisions that have a potential to impact groundwater quality. The map is based on generalized textural properties and assumptions about hydraulic characteristics of geologic materials and hydraulic gradients, but not results from water quality or groundwater flow analysis. Because of generalizations used in preparing the map, any mapped unit may contain small areas of greater or lesser aquifer sensitivity to contamination. This map should not be used as a substitute for evaluation of individual sites. It should not be enlarged. The map is available at http://www.isgs.uiuc.edu/maps-data-pub/icgm/pdf-files/kane_co_as_icgm.pdf

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