Groundwater Vulnerability Regions of Iowa

Special Map Series 11

Prepared by
Bernard E. Hoyer and George R. Hallberg

Energy and Geological Resources Division
Geological Survey Bureau

June 1991

This program was supported, in part, through
the Groundwater Protection Fund to fulfill requirements
of the Iowa Groundwater Protection Act.

Iowa Department of Natural Resources
Larry J. Wilson, Director

This map identifies regions of Iowa which have similar hydrogeological characteristics affecting the relative vulnerability of aquifers and wells to contamination from surface and near-surface sources and activities. It is designed to help Iowans understand the complex issue of groundwater contamination and provides a general framework for understanding the distribution of known contamination. The map is based on an unprecedented compilation of hydrogeologic data, yet it represents a regional synthesis and should not be used to address site-specific issues except as a supplement to site evaluations.

The map units are defined by physical characteristics that affect groundwater recharge and contaminant transport. The units are primarily delineated by the distribution of mappable aquifers and the degree to which the soil and rock which overlie the aquifers confine and protect them. Aquifers are saturated soil and rock materials which readily yield groundwater to wells. Aquitards are soil and rock materials that retard groundwater recharge and confine aquifers. In Iowa, shale and glacial drift, especially till, are the primary aquitards. Where aquitards are thick, they effectively decrease the vulnerability of underlying aquifers to contamination. Map units were further subdivided based on information about well development and water quality. Sinkholes and agricultural drainage wells, special features which allow contamination to enter aquifers, are also identified.

Map users should be aware that although glacial drift generally retards groundwater recharge, and confines and protects the aquifers below, the drift, itself, is widely exploited by domestic wells. Drift-source wells generally yield small quantities of water and are most common where regional aquifers are not readily available or yield naturally poor-quality water. Locally, moderate to large quantities of water are developed from aquifers contained within the drift. Inadequate information prevents delineation of these aquifers on this map.

EXPLANATION

Map Unit

ALLUVIAL AQUIFERS: Area underlain by sand and gravel aquifers situated beneath floodplains along stream valleys and includes alluvial deposits associated with stream terraces and benches, contiguous wind-blown sand deposits, and glacial outwash deposits; natural water quality generally excellent (less than 500 mg/l, total dissolved solids) and yields vary with texture and thickness of alluvium (commonly greater than 100 gallons/minute in larger valleys, less in smaller valleys); most wells are very shallow; high potential for aquifer contamination; high potential for well contamination. Some of the areas underlain by alluvial aquifers are not shown because of map scale.

GOOD BEDROCK AQUIFERS: Area underlain by regional bedrock aquifers, primarily fractured carbonate units; other regional aquifers usually available at various depths; natural water quality usually excellent (less than 500 mg/l, total dissolved solids) and high yields commonly available (greater than 100 gallons/minute).

Thin Drift Confinement: Less than 100 feet (30 meters) of glacial drift overlie regional aquifers; most wells are deep and completed in the bedrock aquifers; high potential for aquifer contamination; high potential for well contamination.

Moderate Drift Confinement: 100 to 300 feet (30 to 90 meters) of glacial drift overlie regional aquifers; most wells are deep and completed in the bedrock aquifers; low potential for aquifer contamination; low potential for well contamination.

Shale Confinement: Thin drift and Brainard Shale overlie Galena carbonate aquifer; most wells are deep and completed in the aquifer; moderate potential for aquifer contamination; moderate potential for well contamination.

VARIABLE BEDROCK AQUIFERS: Area underlain by regional bedrock aquifers including carbonate and sandstone units; aquifers vary considerably in natural water quality (500 to 2000 mg/l, total dissolved solids) and yields (although generally above 20 gallons/minute).

Thin Drift Confinement: Less than 100 feet (30 meters) of glacial drift overlie bedrock aquifers; most wells are deep and completed in the bedrock aquifers; moderate to high potential for aquifer contamination; moderate to high potential for well contamination.

Moderate Drift Confinement: 100 to 300 feet (30 to 90 meters) of glacial drift overlie bedrock aquifers; many wells are deep and completed in the bedrock aquifers, and many are shallow and completed in the drift; low potential for aquifer contamination; low potential for contamination of bedrock wells; high potential for contamination of drift wells.

Shale Confinement: Cherokee shales or Upper Cretaceous shales overlie Mississippian carbonate or Dakota Sandstone aquifers, respectively; most wells are shallow and developed in the drift, some wells are deep and completed in the bedrock aquifers; low potential for aquifer contamination; high potential for contamination of drift wells; moderate potential for contamination of bedrock wells.

DRIFT GROUNDWATER SOURCE: Bedrock aquifers are absent or overlain by greater than 300 feet (90 meters) of glacial drift; wells are completed in thin, discontinuous deposits of sand and gravel within the till or at the interface between overlying loess and till; natural water quality is highly variable (250 - 2500 mg/l, total dissolved solids) and yields are generally low (less than 10 gallons/minute); most wells are shallow and completed in the drift; low potential for bedrock aquifer contamination; high potential for well contamination. Drift-source wells are developed in the glacial deposits which overlie each confined bedrock aquifer and can be found statewide.

Special Features Affecting Potential Contamination

SINKHOLES: Naturally occuring depressions in the landscape caused by solution or the collapse of carbonate rocks, common where limestone is less than 30 feet (9 meters) below land surface; contaminated surface water may enter the aquifer via the sinkholes, contaminating the aquifer in a localized area; contaminant levels can fluctuate significantly during periods varying from minutes to weeks; increases contamination potential in areas with thin drift confinement; mapped from county soil survey publications.

AGRICULTURAL DRAINAGE WELLS: Wells drilled to drain surface water and soil water into carbonate aquifers; their presence allows contaminants in surface or tile water to enter the aquifers at much higher rates than naturally would be possible; increases contamination potential much like sinkholes; mapped from registration records at the Iowa Department of Natural Resources.

Other Map Features

LAKES: Selected reservoirs and natural lakes.

ACKNOWLEDGEMENTS

Nearly a century of applied geological and groundwater research by staff at the Geological Survey Bureau and elsewhere is synthesized on this map. Recognized for direct contributions to the map's production: R.R. Anderson, L.L. Bean, E.A. Bettis, D.R. Bruner, M.C. Culp, J.D. Giglierano, M.P. Heitman, M.R. Howes, K.F. Jerbas, T.J. Kemmis, D.L. Koch, R.D. Libra, P.J. Lohmann, G.A. Ludvigson, R.M. McKay, M. Mohan, O.W. Plocher, J.C. Prior, D.J. Quade, R.S. Rosenberg, L.S. Seigley, C.A. Thompson, P.E. Van Dorpe, B.J. Witzke, and many graduate assistants at the University of Iowa, Department of Geology.