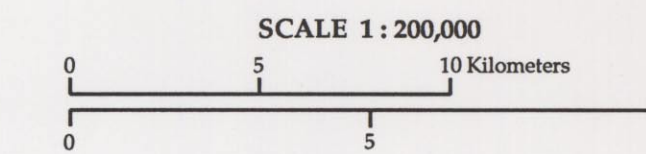
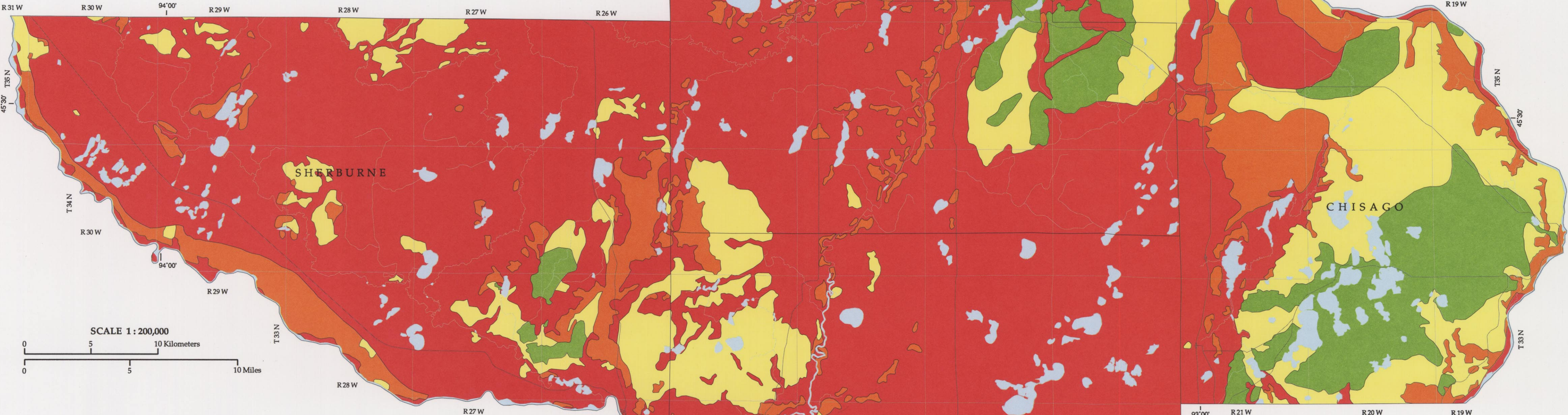
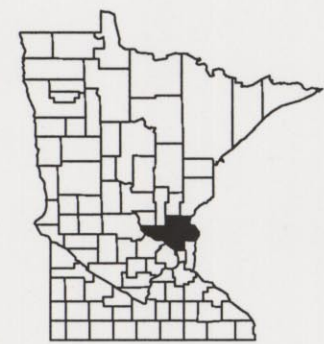


GEOLOGIC SENSITIVITY OF THE UPPERMOST AQUIFER TO POLLUTION

By
Gary N. Meyer
Minnesota Geological Survey



ASSESSING GEOLOGIC SENSITIVITY TO POLLUTION

Geologic sensitivity is the potential due to geologic characteristics for surface contamination to reach ground-water resources. The map portrays an estimate of the vertical travel time for water-soluble, geologically inert contaminants released at the surface to reach the uppermost aquifer. Travel times are controlled by the permeability, and thickness of the geologic materials through which contaminants would move. The sensitivity of an aquifer is inversely proportional to the time of travel. Longer travel times are associated with both a greater degree of geologic protection and reduced sensitivity to ground-water pollution. Shorter travel times represent an increased sensitivity and an inability to protect ground water from vertical contaminant movement. However, high sensitivity does not indicate that water quality has or will be degraded. Low sensitivity does not guarantee that ground water will remain pristine.

The geologic sensitivity of the study area was evaluated following a modified version of the guidelines set forth in a recent publication of the Minnesota Department of Natural Resources (1991). The rating matrix shows how sensitivity based on materials at the water table or uppermost confining aquifer are modified if overlying protective materials of lower permeability, which retard ground-water movement, are present. The rating matrix is consistent with the guidelines principle that the top 10 feet of the unsaturated zone be ignored because of the possible presence of "direct pathways opened by animal burrows, root casts, or fractures and joints caused by frost action or desiccation." Organic deposits (shown on the surficial geology map) were ignored because they were generally less than 10 feet thick and do not themselves constitute an aquifer. Alluvium throughout study area consists mostly of sand and gravel at depth and therefore was grouped in the rating matrix with other sands and gravels.

Assessment of the unsaturated materials above the water table was combined on the map with assessment of the uppermost confined aquifer where no water-table aquifer was present. This composite map of the uppermost aquifer in the study area is suitable for general planning and ground water protection activities.

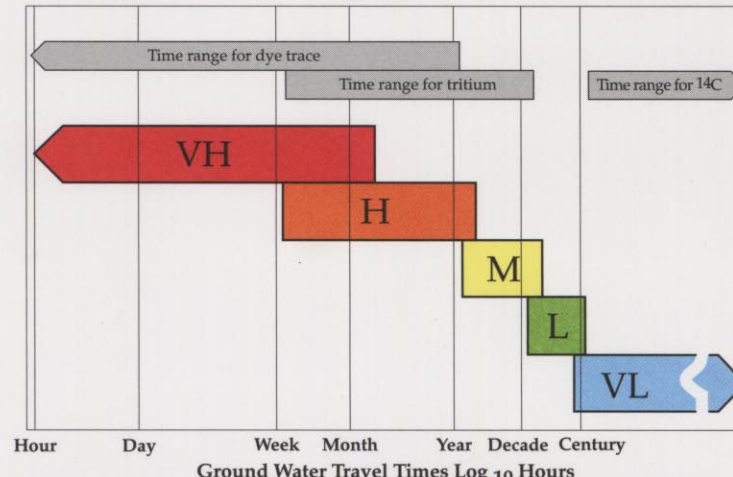
Ground water isotope data confirmed the generally high sensitivity ratings as discussed on Plate 2, Water-Table Hydrogeology. The presence of tritium in all sampled wells less than 131 feet deep confirmed ground-water recharge times of less than a decade or two and sensitivity ratings of High to Very High.

The geologic sensitivity of the uppermost aquifer in the Anoka Sand Plain study area is generally Very High in Anoka, Isanti and Sherburne Counties. Isanti County has significant areas of Moderate to Low sensitivity in the east-central and northern part of the county, reflecting the lower permeability of surficial till deposits. Chisago County has the greatest extent of Moderate and Low sensitivity areas, again reflecting the greater occurrence of lower permeability materials at or near the surface.

REFERENCE CITED

Geologic Sensitivity Workgroup, 1991, Criteria and guidelines for assessing geologic sensitivity of ground water resources in Minnesota: Minnesota Department of Natural Resources, Division of Waters, St. Paul, 122 p.

Geologic Sensitivity Rating and Ground Water Travel Time



Geologic sensitivity ratings are based on the estimated time for surface water to travel vertically to an aquifer. The longer the travel time, the less sensitive is an aquifer to pollution. Estimated travel times can be checked by comparing to dye tracing results for short travel times and tritium and 14C values for longer travel times.

Matrix For Rating the Geologic Sensitivity of the Uppermost Aquifer

| | Geologic material at the top of the uppermost aquifer | | Sand and gravel; alluvium; bedrock | | Sandy till | | Clay; loamy to clayey till | |
|---|--|-----|------------------------------------|-----|------------|-----|----------------------------|-----|
| | <20 | >20 | <20 | >20 | <20 | >20 | <20 | >20 |
| Depth to uppermost aquifer (feet) | | | | | | | | |
| Materials between 10 feet below land surface and top of uppermost aquifer | No sandy till, clay, or loamy to clayey till | VH | H | VH | H | VH | H | H |
| | Sandy till, clay, or loamy to clayey till <10 feet thick | VH | H | VH | H | M | M | M |
| | Sandy till >10 feet thick | -- | M | M | M | M | M | M |
| | Clay or loamy to clayey till >10 feet thick | -- | L | L | L | L | L | L |

SENSITIVITY RATINGS

Estimated travel time for water-borne contaminants at the land surface to reach the uppermost aquifer

- VH**
Very High
Hours to months
- H**
High
Weeks to years
- M**
Moderate
Years to decades
- L**
Low
Decades to a century
- Water**
Unrated

DNR Information Center phone numbers
Metro Area 296-6157
MN Toll Free 1-800-766-6000

TTD (Telecommunications Device for the Deaf)
Metro Area 296-5484
MN Toll Free 1-800-657-3929

This information is available in an alternative format upon request
Funding for this project approved by the Minnesota Legislature ML 1991, Chapter 254, Art. 1, Sec. 14, Subd. 4(f) as recommended by the Legislative Commission on Minnesota Resources from the Minnesota Environment and the Natural Resources Trust Fund.

This Map was compiled and generated using geographic information system (GIS) technology. Digital cartography by Joyce Meints, cartographic design and digital layout by Bruce Dahlman. Digital data products are available upon request.

Map products were prepared from publicly available information only. The Department of Natural Resources does not warrant the accuracy, completeness, or any implied uses of these data. Users may wish to verify critical information; sources include both the references listed here and information on file at the offices of the Minnesota Geological Survey in St. Paul. In addition, every effort has been made to ensure that the interpretation conforms to sound geologic and cartographic principles. This map should not be used to establish legal title, boundaries, or locations of improvements.

