Regional Groundwater Computer Modeling in Southeastern Wisconsin

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Wisconsin Geological and Natural History Survey

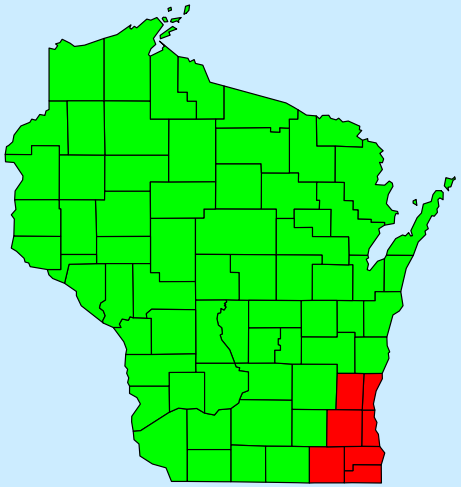
A cooperative project…

Southeast Wisconsin Regional Planning Commission

USGS
science for a changing world

Wisconsin Dept. of Natural Resources

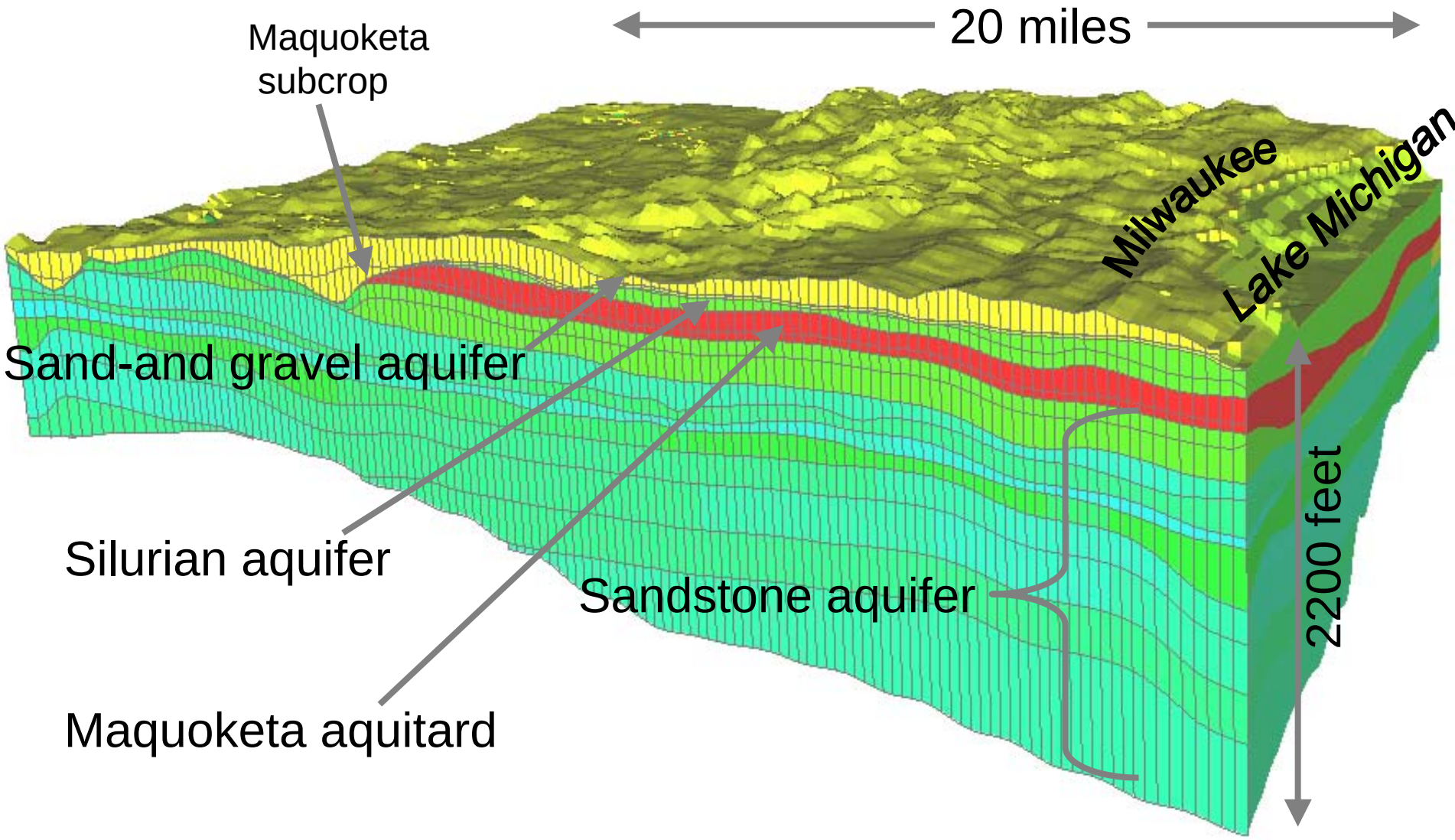
University of Wisconsin MILWAUKEE

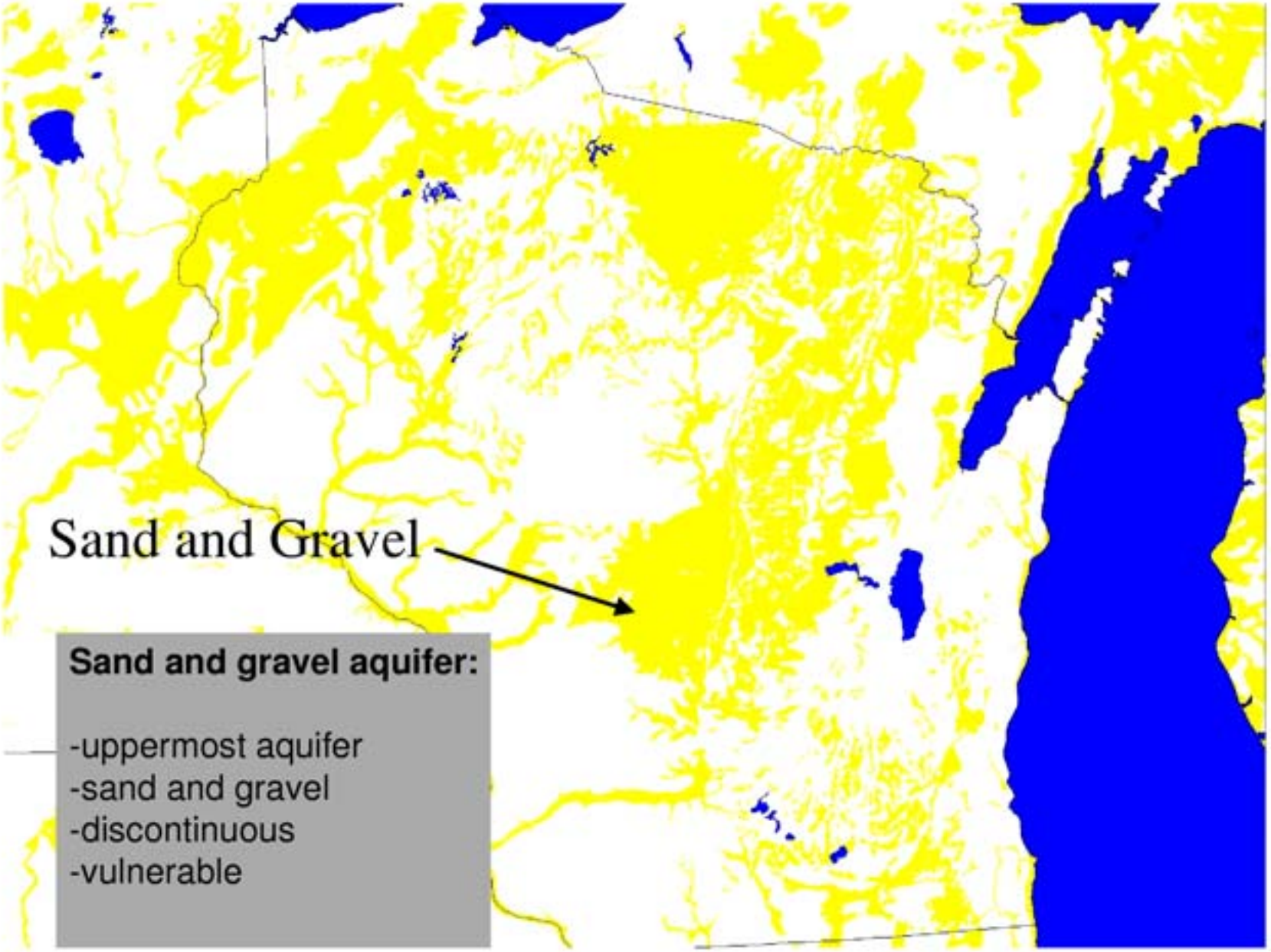


subcontinental divide

The Southeastern Wisconsin Regional Planning Commission (SEWRPC) area

General hydrogeology of southeast Wisconsin



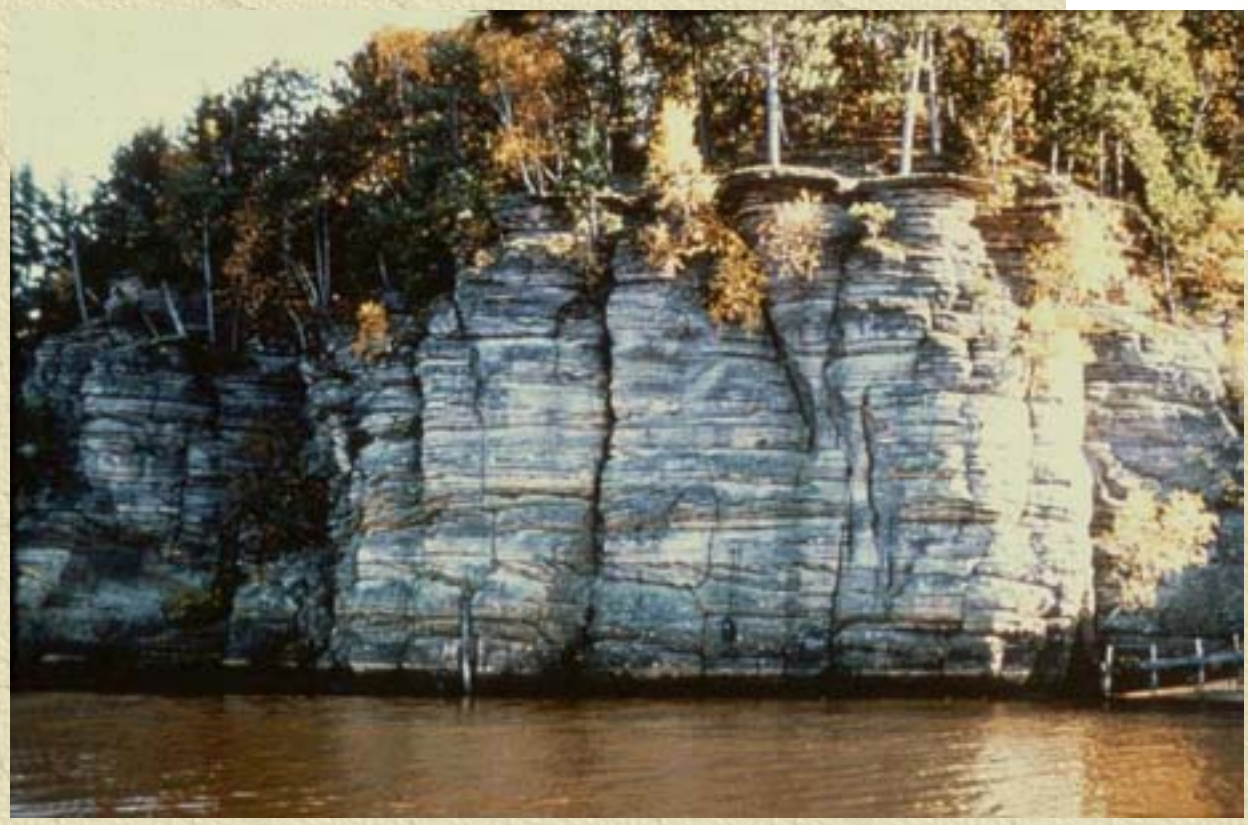

Sand and Gravel
Sand and gravel aquifer:
-uppermost aquifer
-sand and gravel
-discontinuous
-vulnerable

“Dolomite” aquifer:

-Silurian dolomite
-fracture-dominated flow
-only present in east
-important for municipal and domestic wells

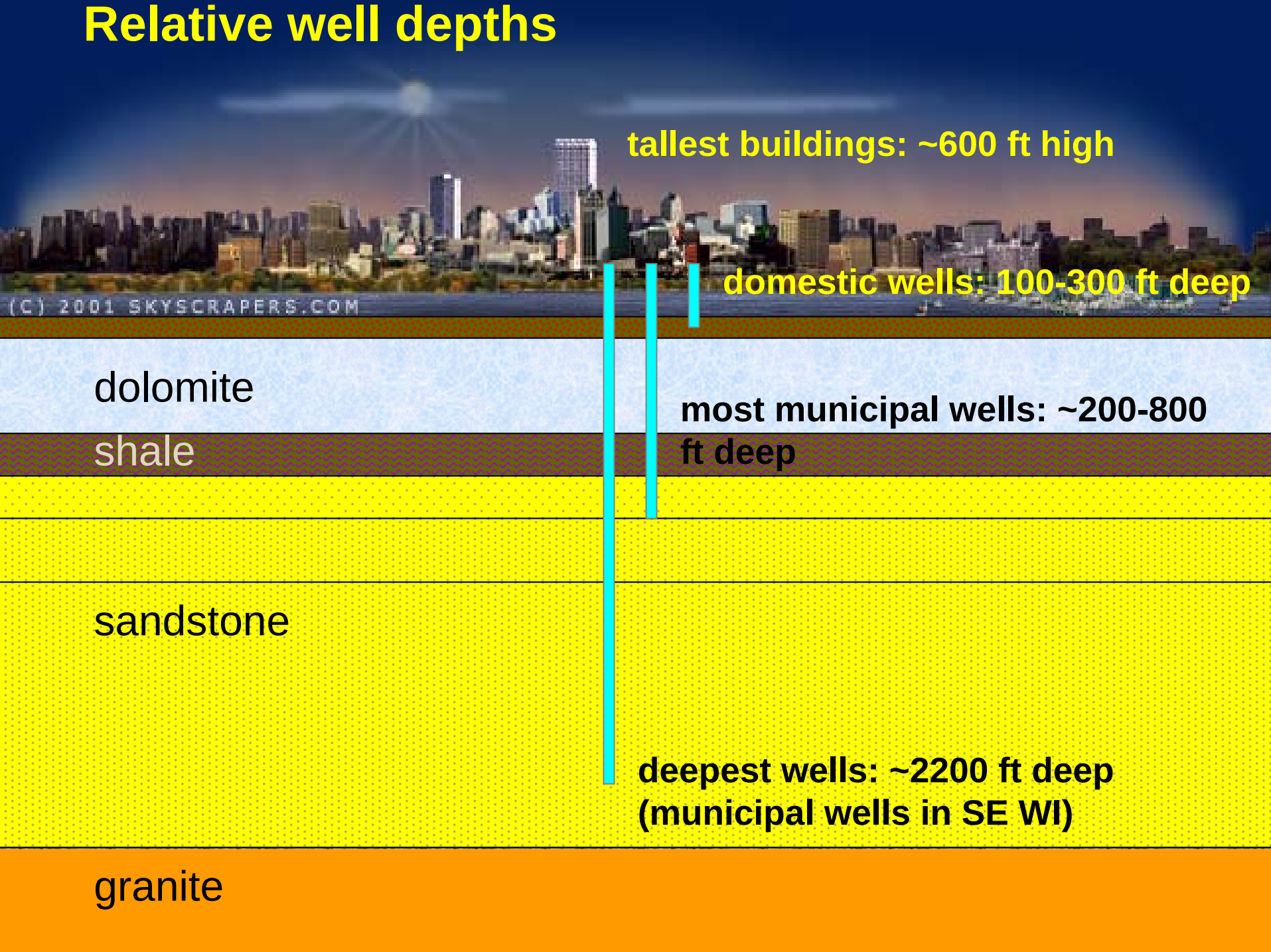
“Sandstone” aquifer:

-sandstone, dolomite
-regionally extensive
-excellent aquifer
-porous flow
-most high-capacity wells
-occurs beneath shale in east



Exposure of sandstone in the Wisconsin Dells

Relative well depths



Deep aquifer issues in southeast Wisconsin

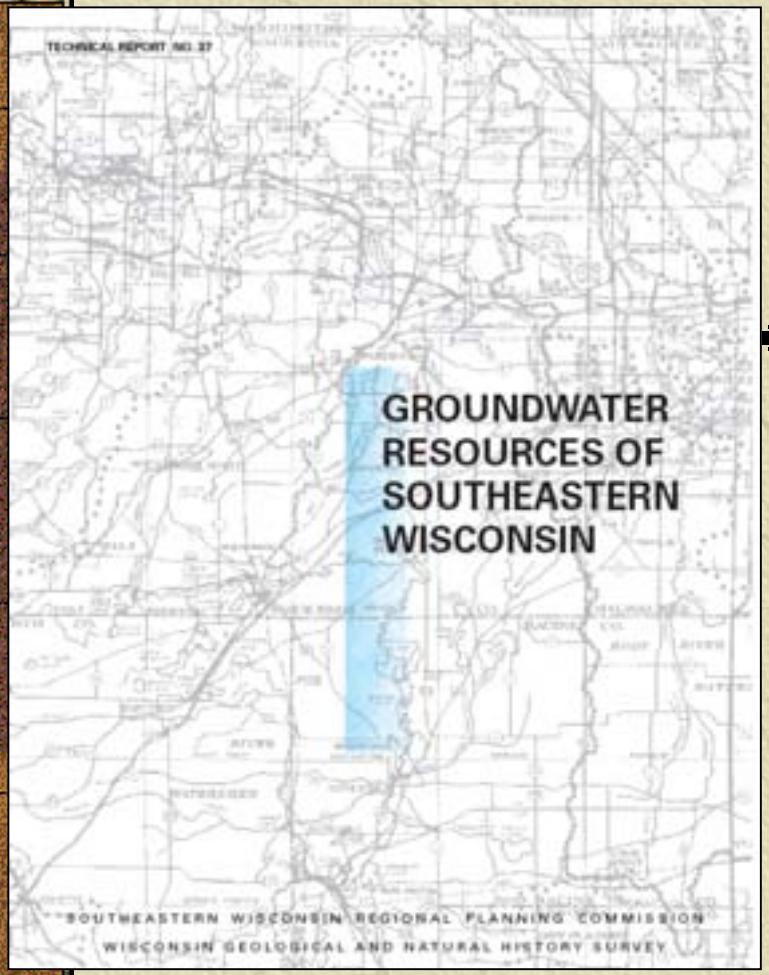
- Groundwater levels are declining (400-800 feet)
- Increasing groundwater demand
- Declining water quality (salinity, TDS, radium)
- Great Lakes water is off limits outside topographic basin

Deep municipal well, Waukesha County, WI

Shallow aquifer issues in southeast Wisconsin

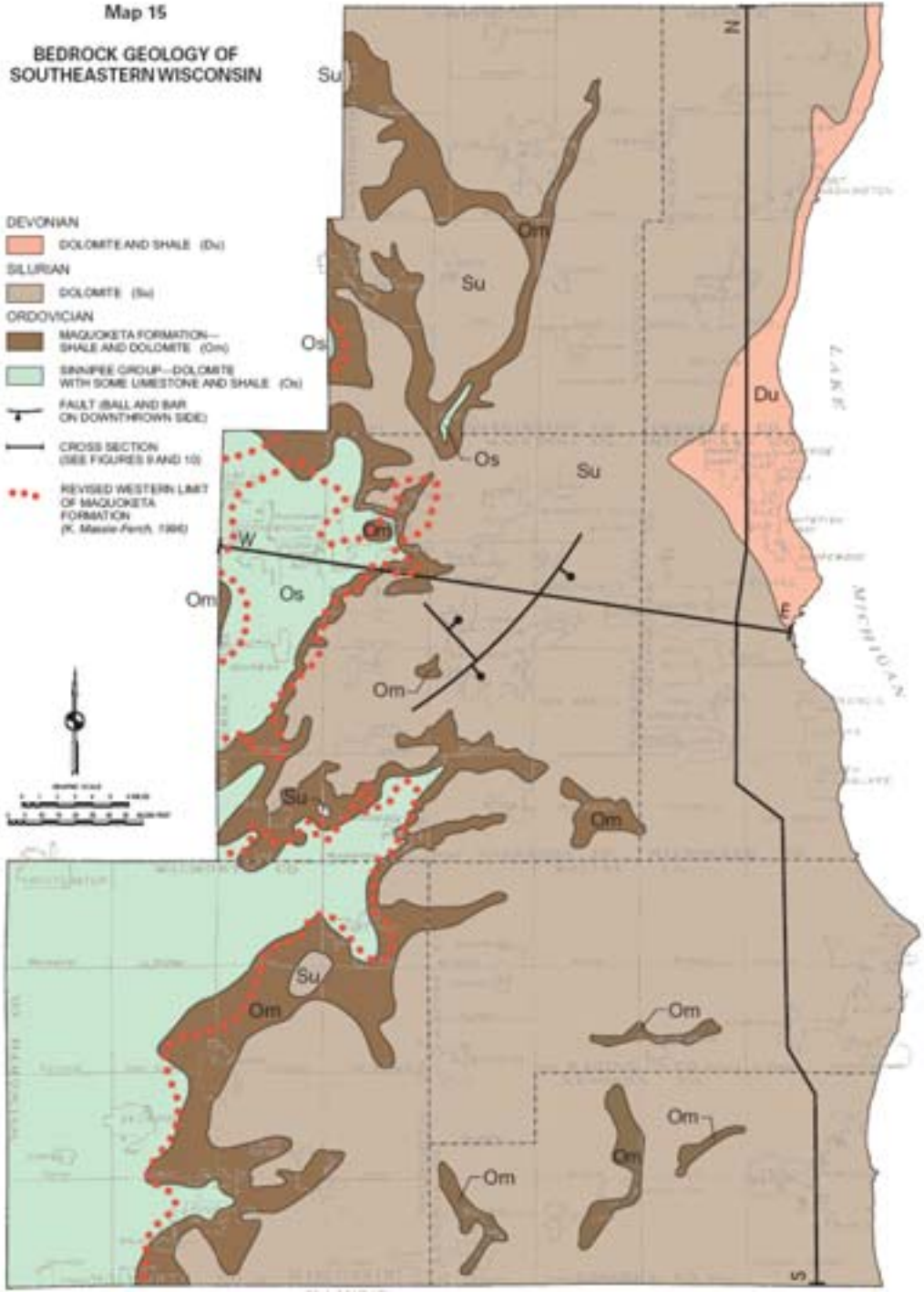
- Municipalities are shifting to shallow aquifer due to radium problems in deep aquifers
- Concerns about pumping impacts on shallow lakes, streams, and wetlands
- Shallow aquifer more vulnerable to contamination than deep aquifers
- Wellhead protection

Paradise Spring,
Waukesha County, WI

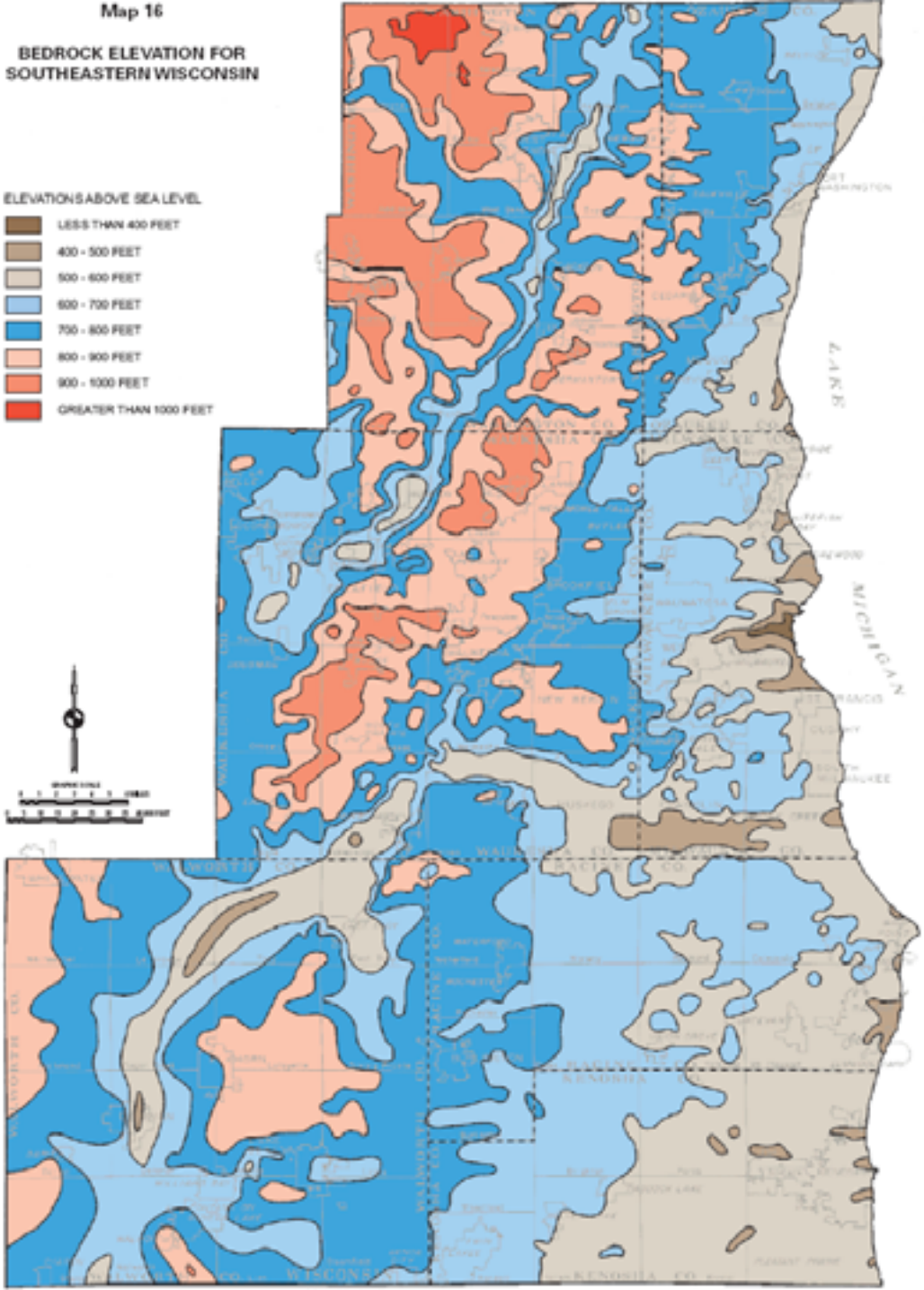


Background information

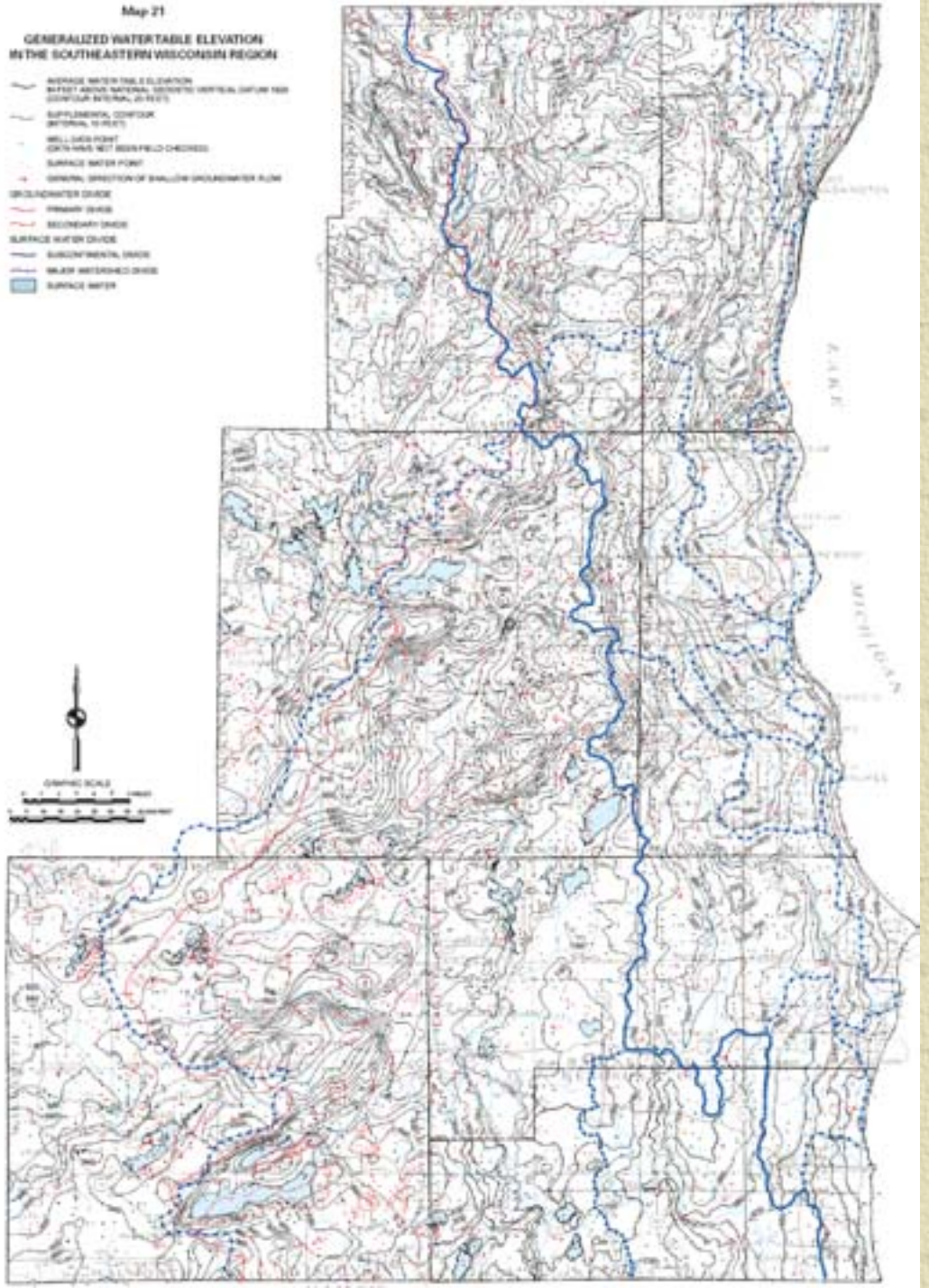
The modeling project would not have been possible without a comprehensive compilation of background data carries out through a joint SEWRPC/WGNHS project.



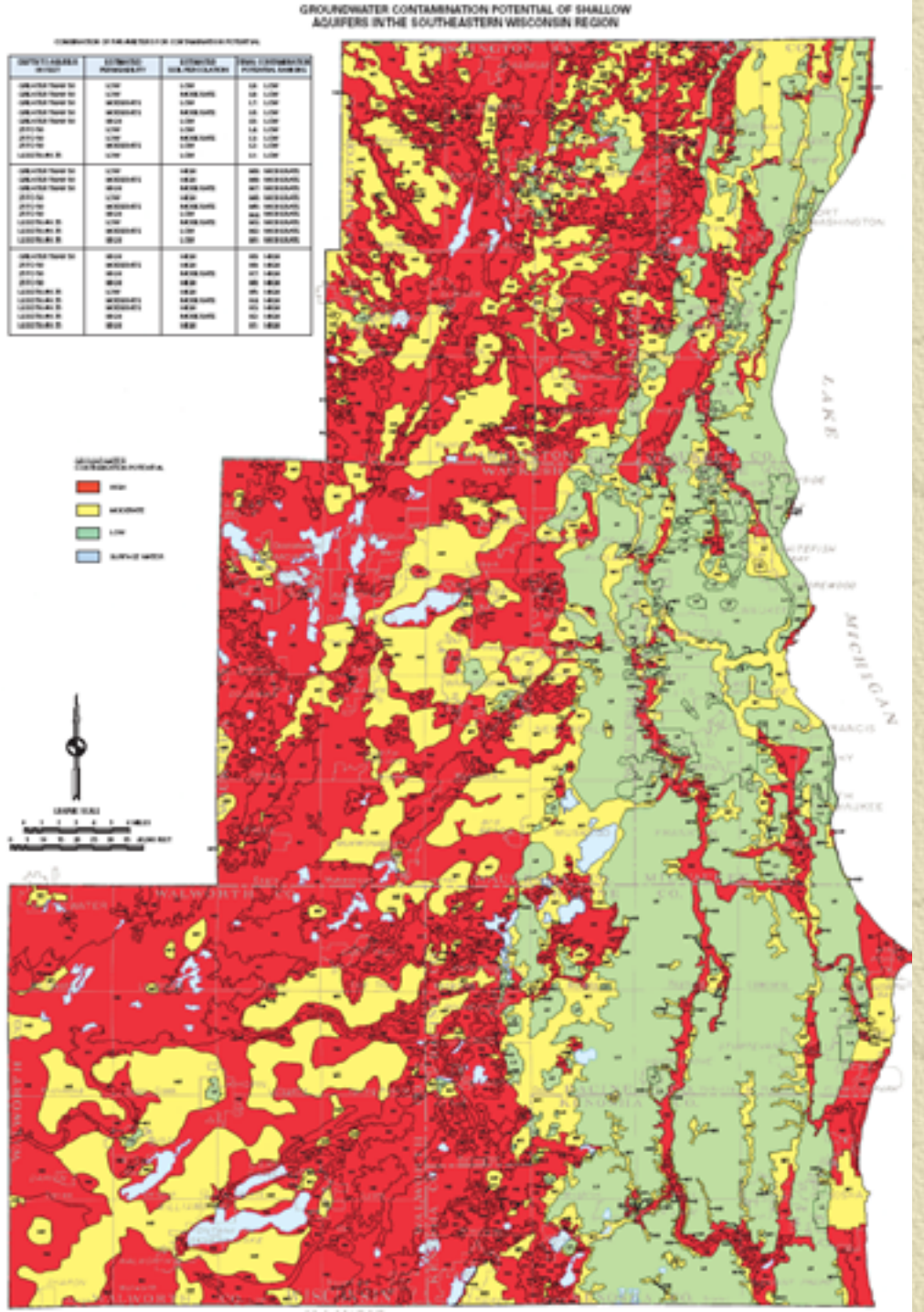
Bedrock geology of region



Bedrock elevation

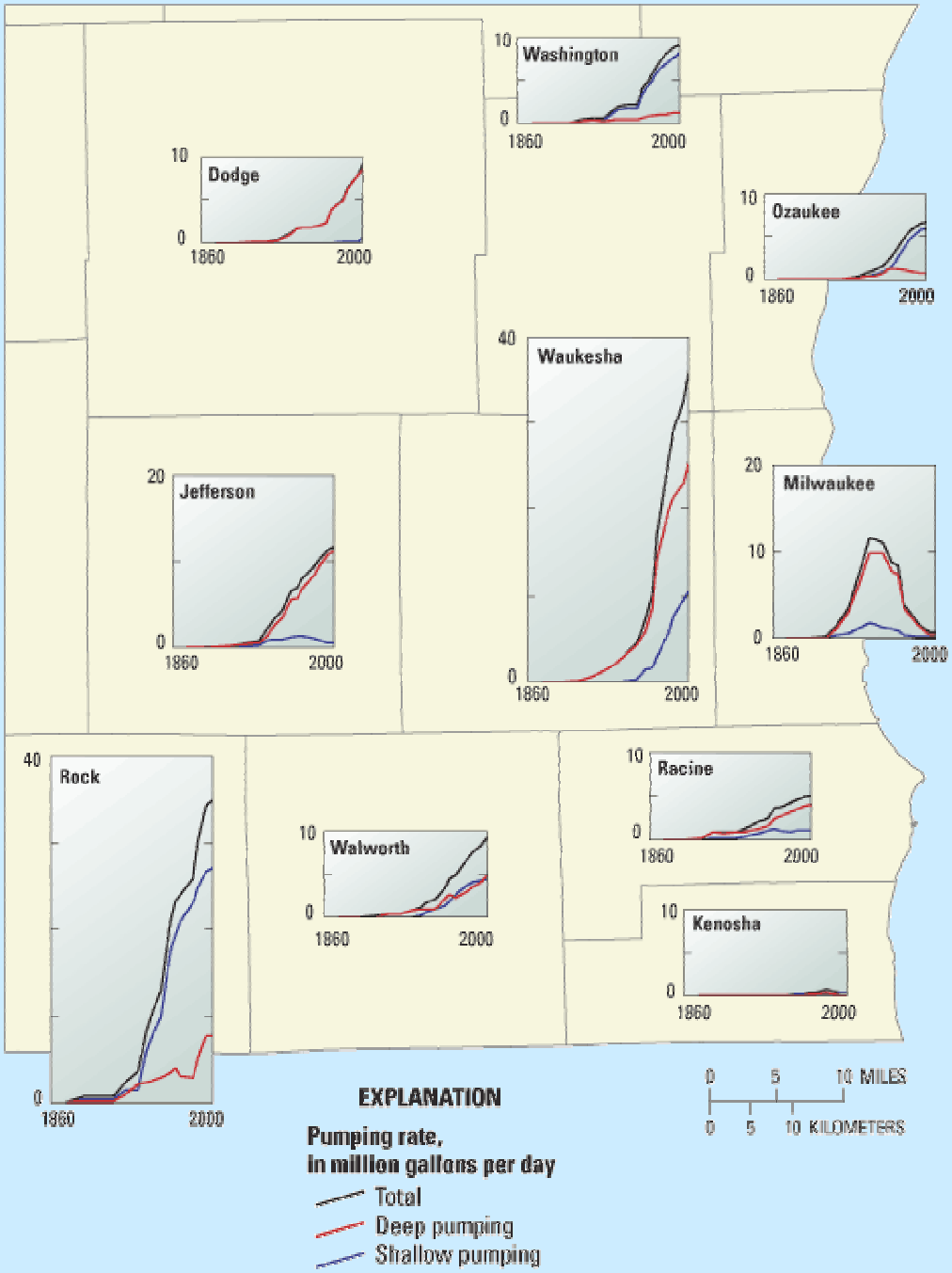


Water table configuration

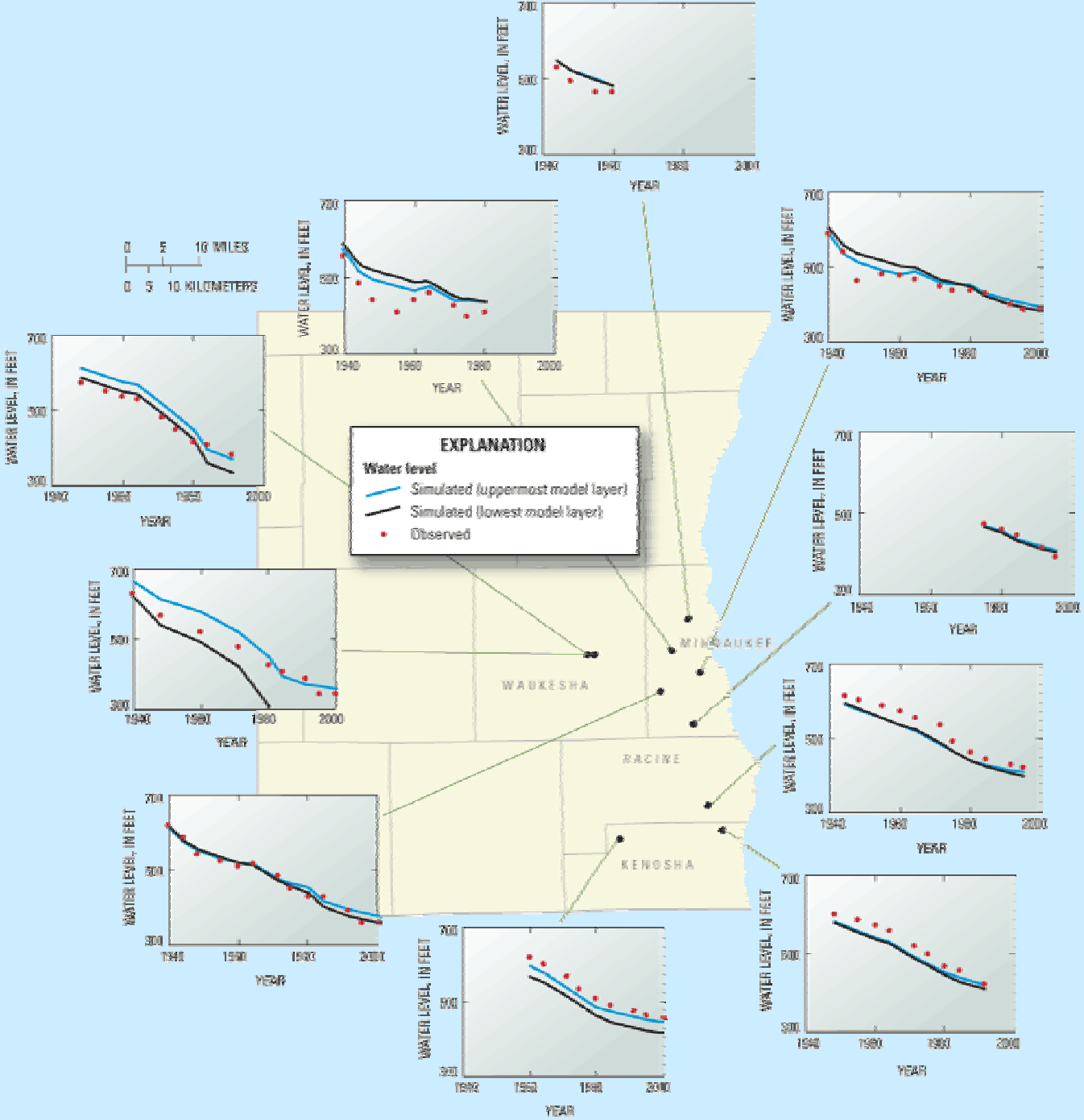


Contamination potential

Groundwater use by county

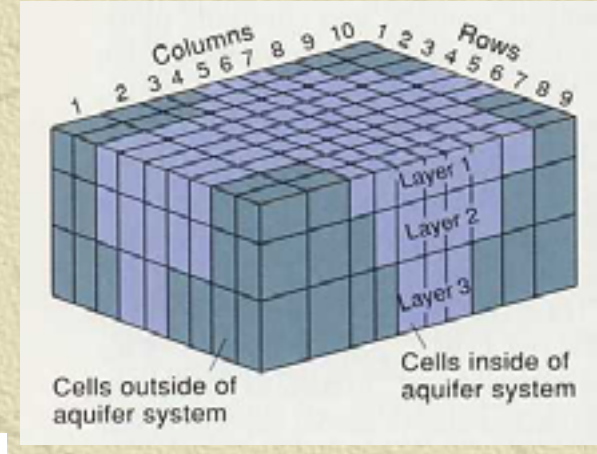


Water-level decline by county



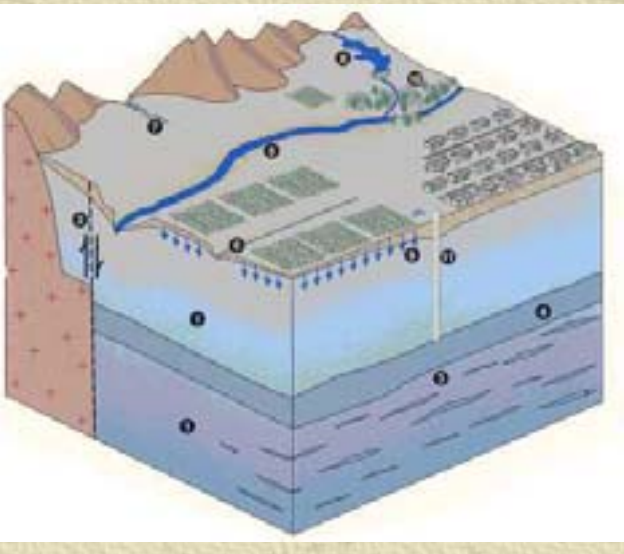
What is a groundwater flow model?

- Computers are used to solve mathematical equations describing groundwater flow
- Complex geology, wells, and surface water features are simulated using a three-dimensional grid
- Such models are powerful tools for interpreting the past and predicting future conditions



Mathematical grid

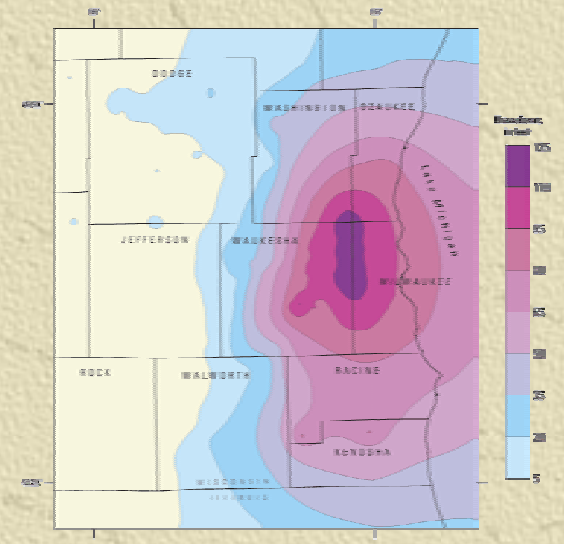
$q=Kdh/dx$



Real world

Steps in groundwater modeling

Computer solution



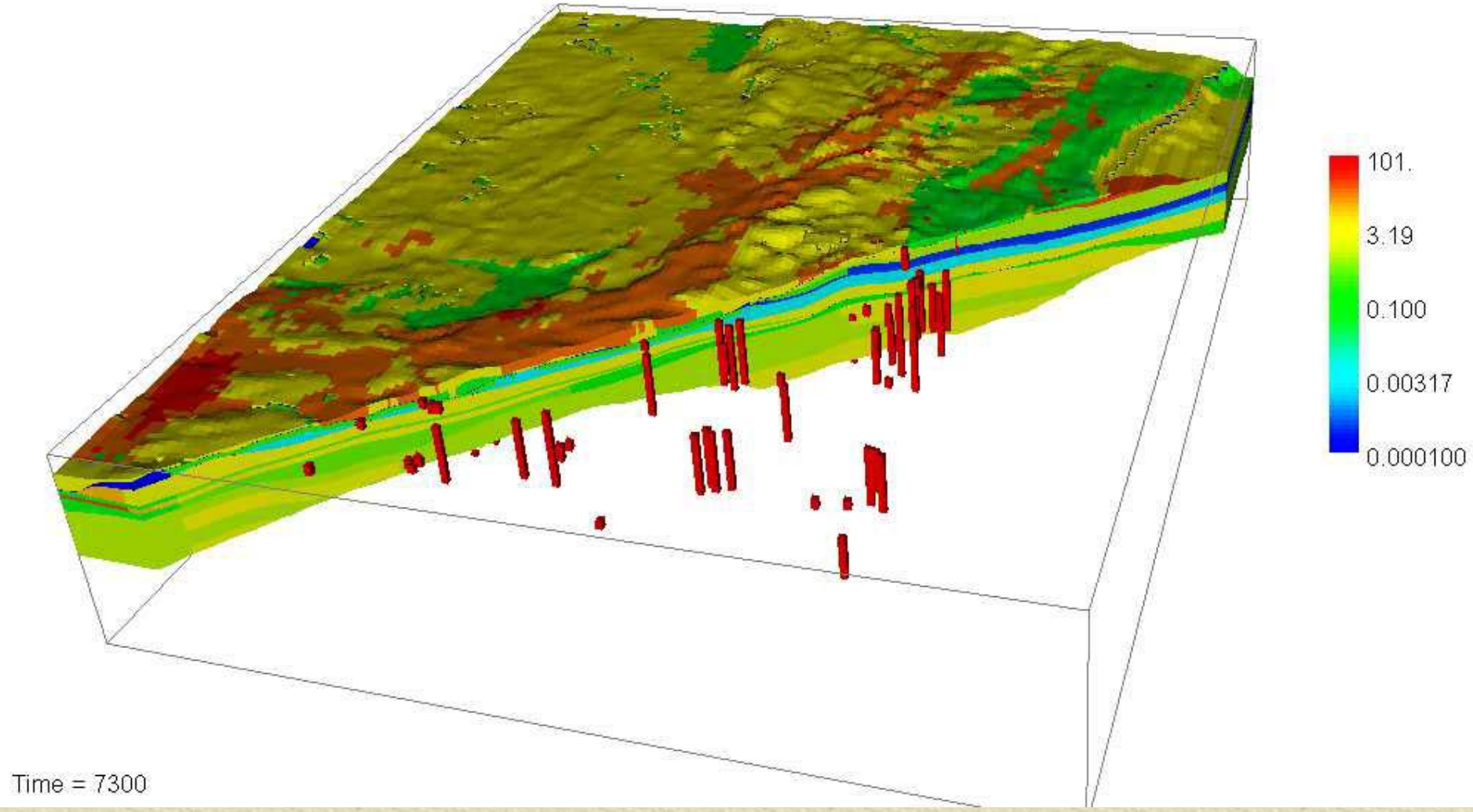
Simulated groundwater levels and flow rates

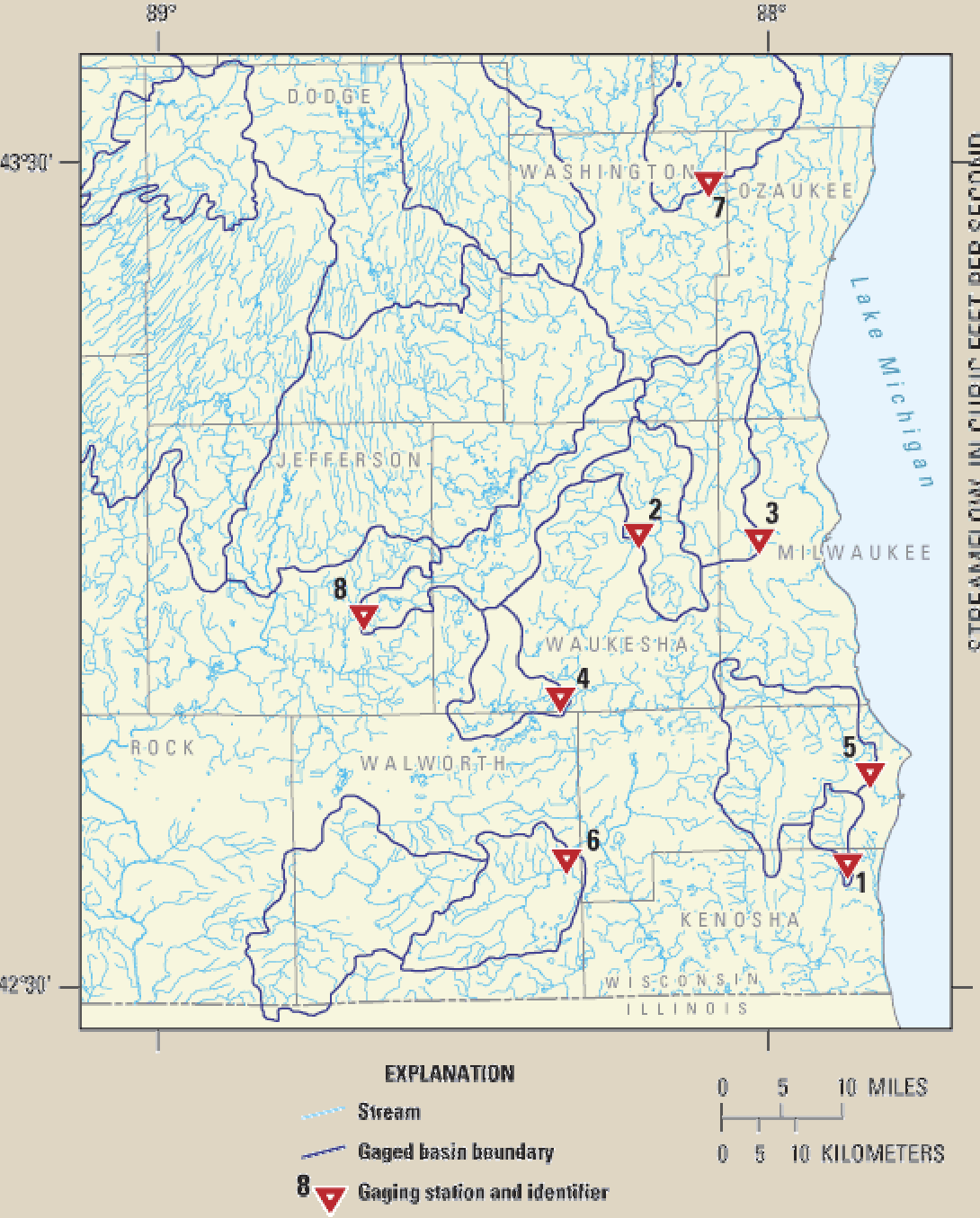
calibration

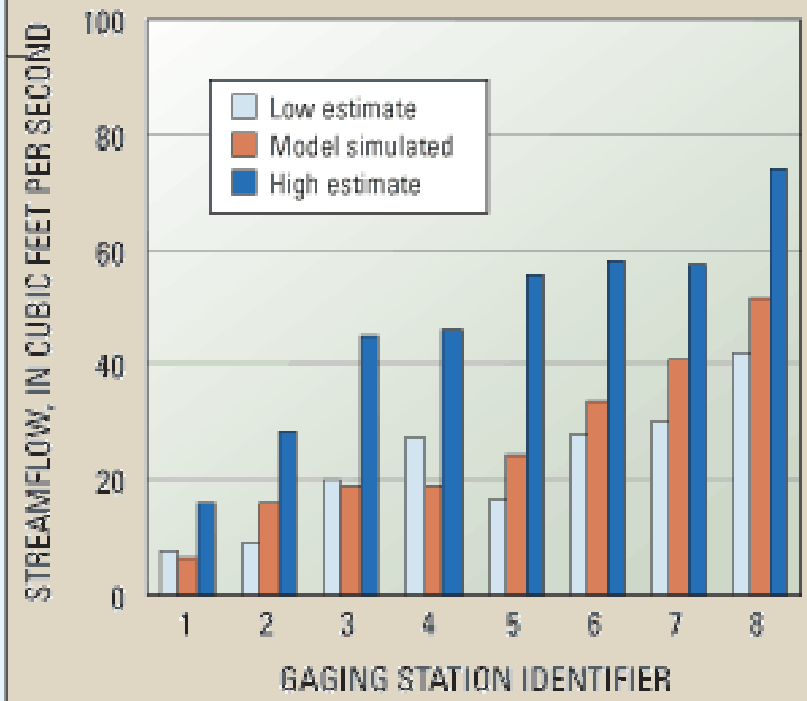
Modeling objectives in SE Wisconsin

- Understand present GW system
- Study current and future impacts of groundwater use
- Simulate alternative management options
- Delineate contributing areas for wellhead protection
- Provide a framework for site-specific models and studies

One view of the groundwater flow model of SE Wisconsin







Model is calibrated to surface streamflows and groundwater levels