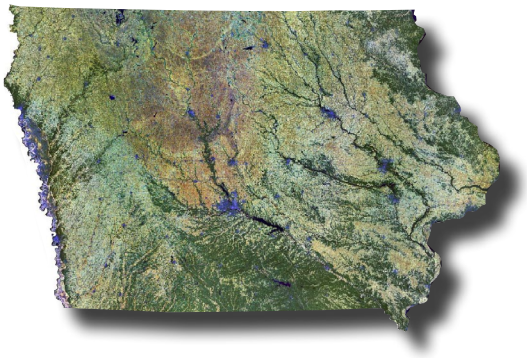
Our Common Ground

Iowa Department of Natural Resources

Iowa Geological and Water Survey
Resource Information Fact Sheet 2011-1



Groundwater Availability Modeling of the Cambrian-Ordovician Aquifer

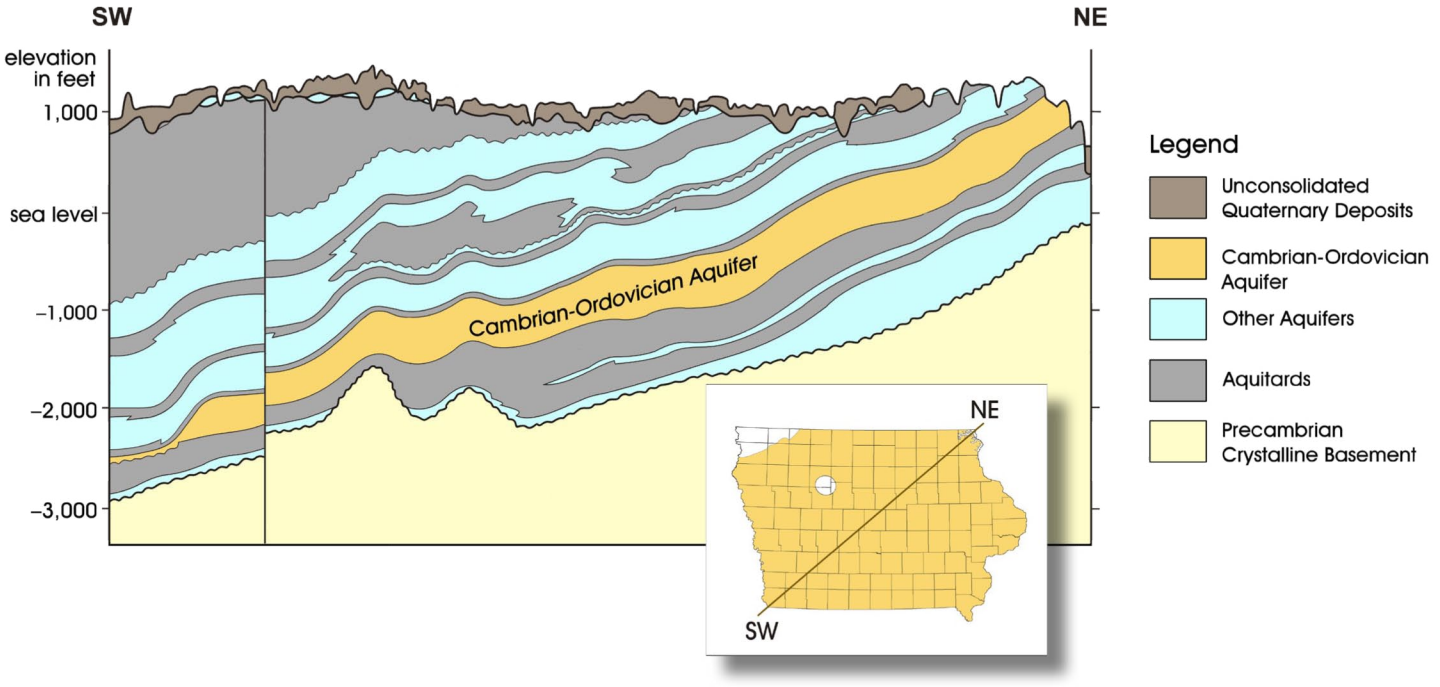
Increased demands for groundwater by agriculture, industries, and municipalities have raised concerns about the future availability of groundwater. However, the information necessary for water resource managers to answer basic questions regarding how much water can be withdrawn from Iowa's aquifers was not previously available. In 2007, the Iowa Legislature began funding a comprehensive Water Resources Management program. A key aspect of the program is to evaluate and quantify the groundwater resources across the state using three-dimensional computer simulation models, which help answer questions such as: "How much water can be pumped from an aquifer over 10 or 20 years?" or "Will my well go dry?"

Cambrian-Ordovician Aquifer

The Cambrian-Ordovician aquifer, or more commonly the "Jordan aquifer," is one of the most dependable sources of groundwater in Iowa. The Cambrian-Ordovician aquifer is comprised of three separate water-bearing units. The St. Peter Sandstone is the upper unit, dolomites and sandstones of the Prairie du Chien Group are the middle units, and the Jordan Sandstone is the lower unit of the Cambrian-Ordovician aquifer. The Cambrian-Ordovician aquifer is widespread and is only absent in extreme northeast and northwest Iowa (Figure 1).

Younger geologic units cover the Cambrian-Ordovician aquifer over most of Iowa. The Cambrian-Ordovician aquifer's main water source is water

Figure 1. *Area of occurrence of the Cambrian-Ordovician aquifer in Iowa.*



leaking, or recharge, from these units into the aquifer. Once in the aquifer, water generally flows southeast toward Missouri and Illinois.

Wells drilled into the Cambrian-Ordovician aquifer supply large volumes of water to both industry and municipalities across the state. The amount of groundwater withdrawn from the Cambrian-Ordovician aquifer has increased through time (Figure 2). Increased water use by eastern Iowa municipalities and by ethanol plants across the state is responsible for much of the recent increase in groundwater withdrawals.

The Cambrian-Ordovician aquifer is one of two Iowa aquifers protected from overuse. Iowa Administrative Code Chapter 52.4(3) states that water levels are not to decline more than 200 feet from the 1975 baseline. The water level map of the Cambrian-Ordovician aquifer prepared by Horick and Steinhilber (1978) is used as the baseline.

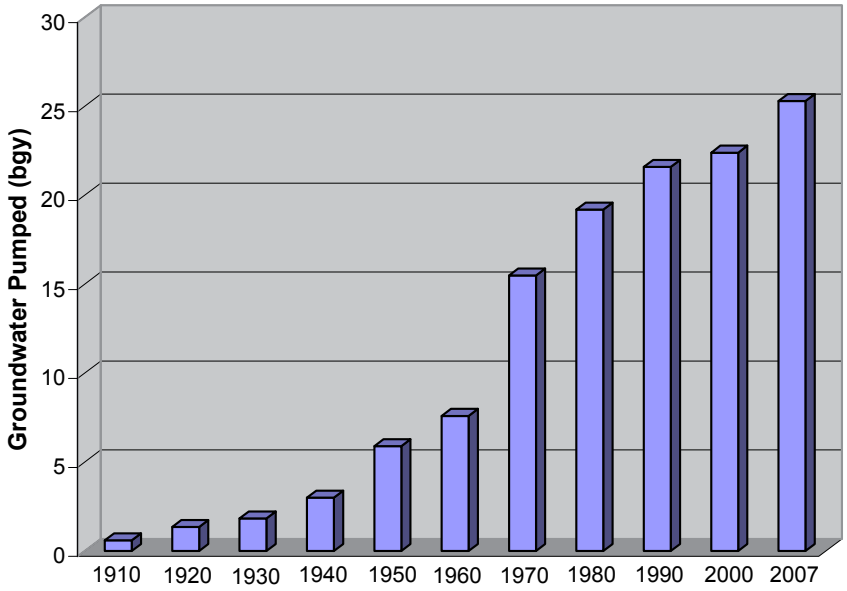


Figure 2. *Water-use data for the Cambrian-Ordovician aquifer from 1910 to 2007. Data include total yearly volume pumped in billion gallons per year (bgy). Totals include wells completed in more than one aquifer (dual completion wells).*

Aquifer Study

In 2008, an intensive one-year investigation was initiated to provide a comprehensive assessment of groundwater resources in the Cambrian-Ordovician aquifer. Numerous activities associated with this investigation culminated in the creation of a computer simulation model of the Cambrian-Ordovician aquifer. This model evaluates current groundwater availability and predicts future groundwater availability to guide economic development and increased demand.

To evaluate impacts of current water uses, the computer simulation model created a map of water levels in the Cambrian-Ordovician aquifer in 2008. Water levels in the Cambrian-Ordovician aquifer have declined over much of Iowa from the 1975 baseline compared to simulated levels in 2008 (Figure 3). Increased pumping rates have resulted in declines that exceed 140 feet in the Johnson/Linn County area in eastern Iowa and Fort Dodge/Webster City area in north-central Iowa.

A further application of the computer simulation model was to estimate the availability of groundwater in Linn County. Currently, industries and municipalities are permitted to withdraw a certain amount of water from the Cambrian-Ordovician aquifer. In Linn County, several municipalities and industries were not withdrawing the maximum amount allowed in their permits. The computer simulation model tested a scenario where all water users withdrew the maximum amount allowed in their permits. Declines in water levels exceeded the 200-foot limit over much of Linn County. The model results have forced water resource managers to scrutinize new permits to withdraw water from the Cambrian-Ordovician aquifer in Linn County.

A powerful use of the computer simulation model is to predict future impacts to the Cambrian-Ordovician aquifer based on various pumping scenarios. A "low future" usage scenario assumes a relatively slow population and industrial growth. A "low future" usage increases the current groundwater use in the Cambrian-Ordovician aquifer by 25% and predicts water level results in 20 years. In this scenario, water levels in the Cambrian-Ordovician aquifer will show a significant decline from the 1975 baseline over much of Iowa (Figure 4).

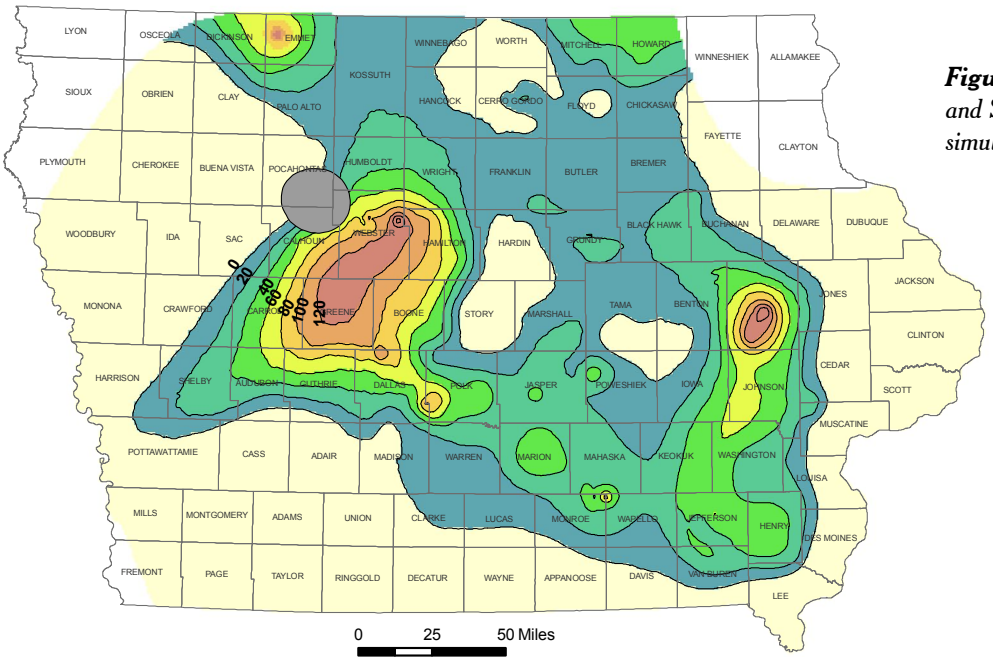


Figure 3. *Declines in water levels from Horick and Steinhilber (1978) baseline map to computer simulated results in 2008.*

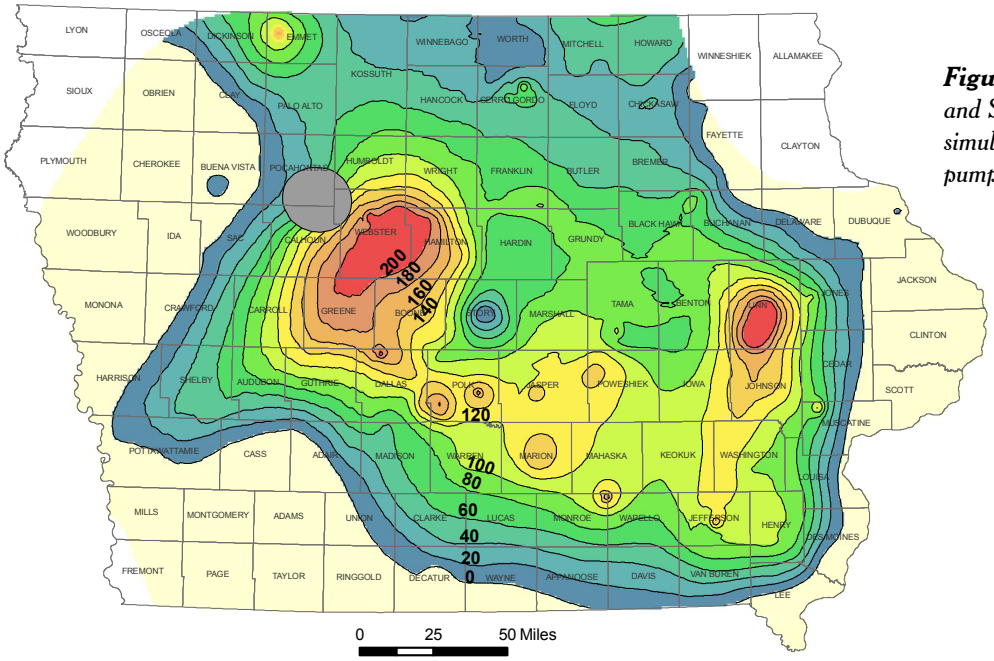


Figure 4. *Declines in water levels from Horick and Steinhilber (1978) baseline map to computer simulated results in 2029 with a 25% increase in pumping rates.*

Declines in water levels would likely exceed the 200-foot limit established in the Iowa Administrative Code in the Fort Dodge/Webster City and Marion areas.

A "high future" usage scenario assumes large population and industrial growth. A "high future" usage increases current groundwater use in the Cambrian-Ordovician aquifer by 100% and predicts water level results in 20 years. Water levels in the Cambrian-Ordovician aquifer will show a significant decline from the 1975 baseline over much of Iowa, exceeding the 200-foot limit in several counties across Iowa (Figure 5).

The computer simulation model has also been applied to local scale problems. The model was utilized to establish the casing depths in new wells for the cities of Fort Dodge and Marion.

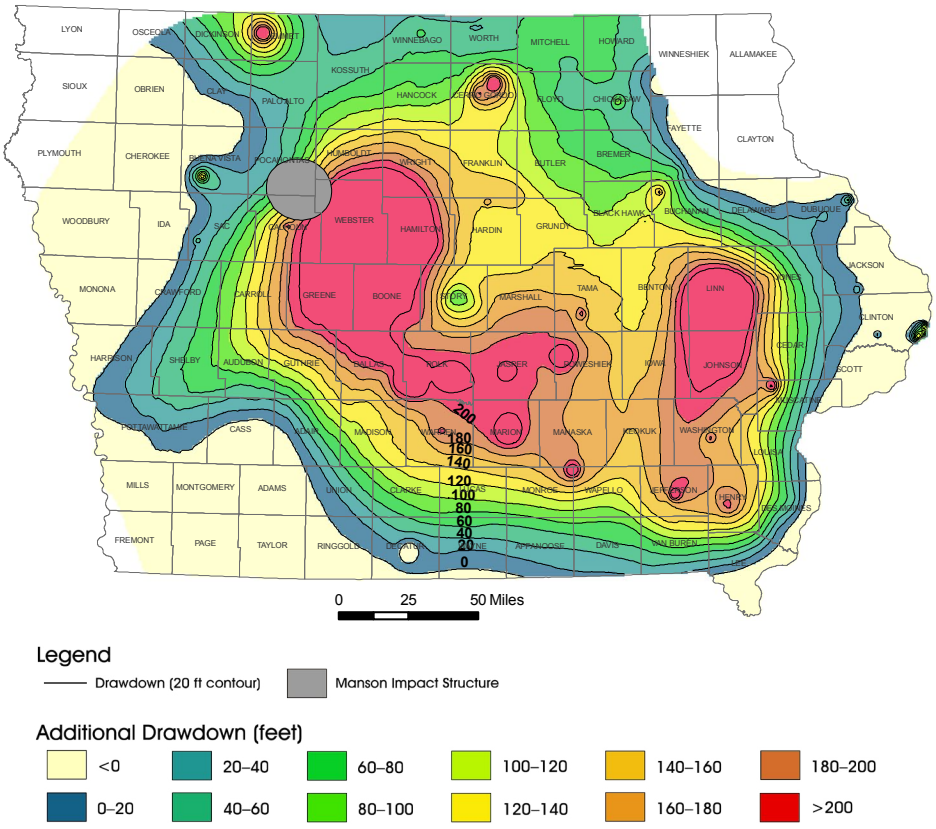


Figure 5. *Declines in water levels from Horick and Steinhilber (1978) baseline map to computer simulated results in 2029 with a 100% increase in pumping rates.*

The model was also used to evaluate potential problems for existing nearby wells if proposed wells at both an ethanol plant near Lawler (Chickasaw County) and a new public well at Pella (Marion County) were to be drilled.

Conclusion

The computer simulation model for the Cambrian-Ordovician aquifer provides a powerful tool for water resource managers to evaluate the Cambrian-Ordovician aquifer. The investigation found water levels in the Cambrian-Ordovician aquifer have declined over much of Iowa from the 1975 baseline map based on results from the computer simulation model. Although no current violations of the 200-foot limit were found, the model predicts violations within 20 years with only small water use increases. Water resource managers can use the computer simulation model to predict the results of any water use changes they make.

More detailed information about the Cambrian-Ordovician aquifer and its computer simulation model can be found at www.igsb.uiowa.edu/webapps/gsbpubs/pdf/wri-2a.pdf or www.igsb.uiowa.edu/StateMap/StateWaterPlan.htm.

Reference

Horick, P.J., and Steinhilber, W.L., 1978, Jordan aquifer of Iowa: Iowa City, Iowa Geological Survey Miscellaneous Map Series 6, 3 sheets, scale 1:1,000,000.

Acknowledgements

Much of our understanding of the Cambrian-Ordovician aquifer in Iowa is built on the work of previous Iowa Geological Survey geologist Paul Horick and United States Geological Survey geologists Walter Steinhilber, Michael Burkart, and Robert Buchmiller. Various companies, including Fox Engineering, Howard R. Green Company, IIW Engineers & Surveyors, P.C., Layne Christiansen Company, and Shawver Well Company, supplied pump test and recovery test data that was utilized in the creation of the computer simulation model.

Funding

Water resource management activities of the Iowa Department of Natural Resources are funded by Iowa Infrastructure—Environment First Fund appropriations.

Iowa Department of Natural Resources, Geological and Water Survey
109 Trowbridge Hall, Iowa City, IA 52242-1319
(319) 335-1575
www.igsb.uiowa.edu

Printed on Recycled Paper