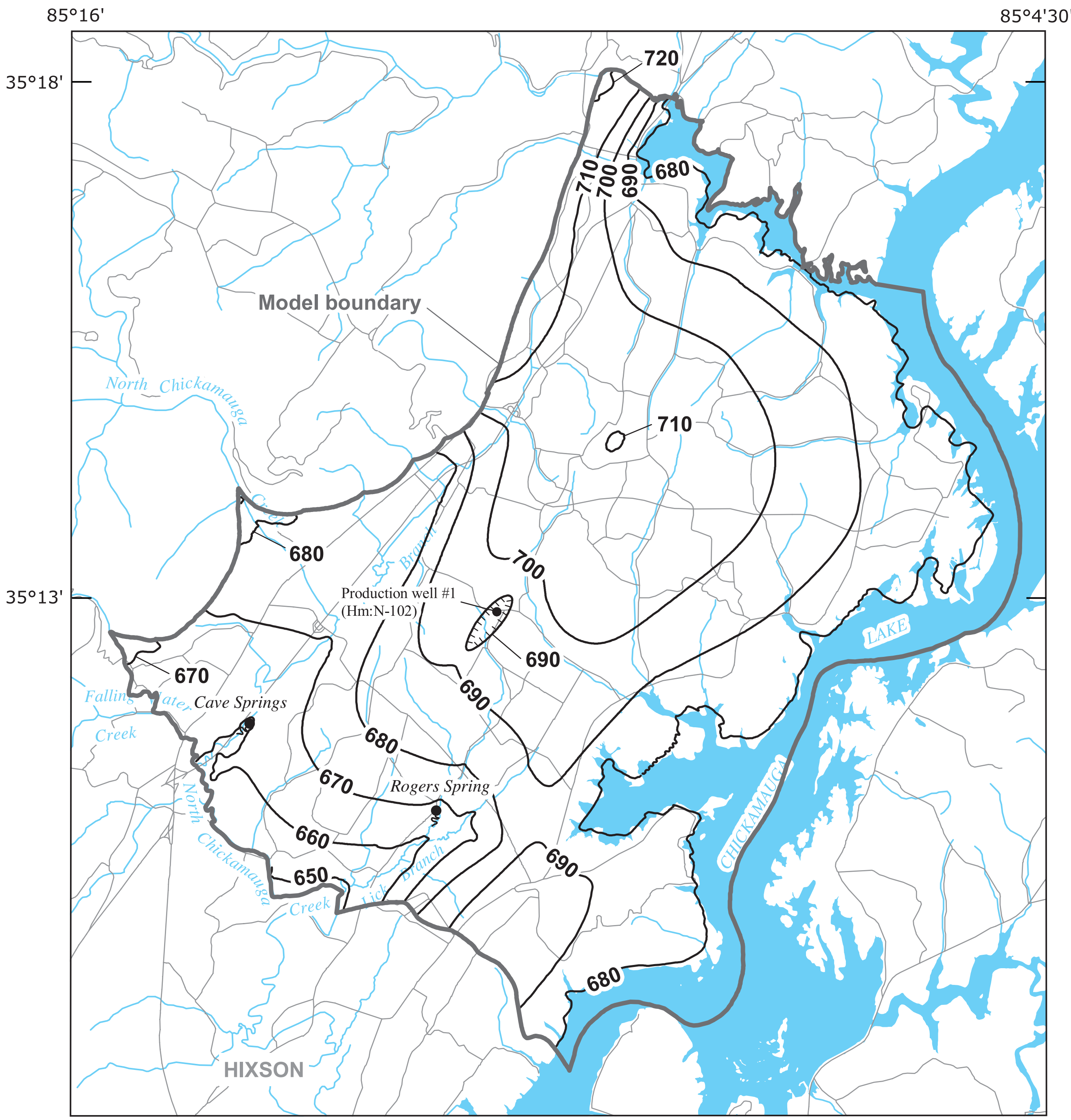


Base from U.S. Geological Survey
Digital line graphs 1:100,000

EXPLANATION

—650— POTENTIOMETRIC CONTOUR—Shows simulated altitude of water levels. Hachures indicate depression. Contour interval 10 feet. Datum is sea level

Figure 23. Model-simulated steady-state water levels with Walkers Corner production well #1 in use, layer 1.

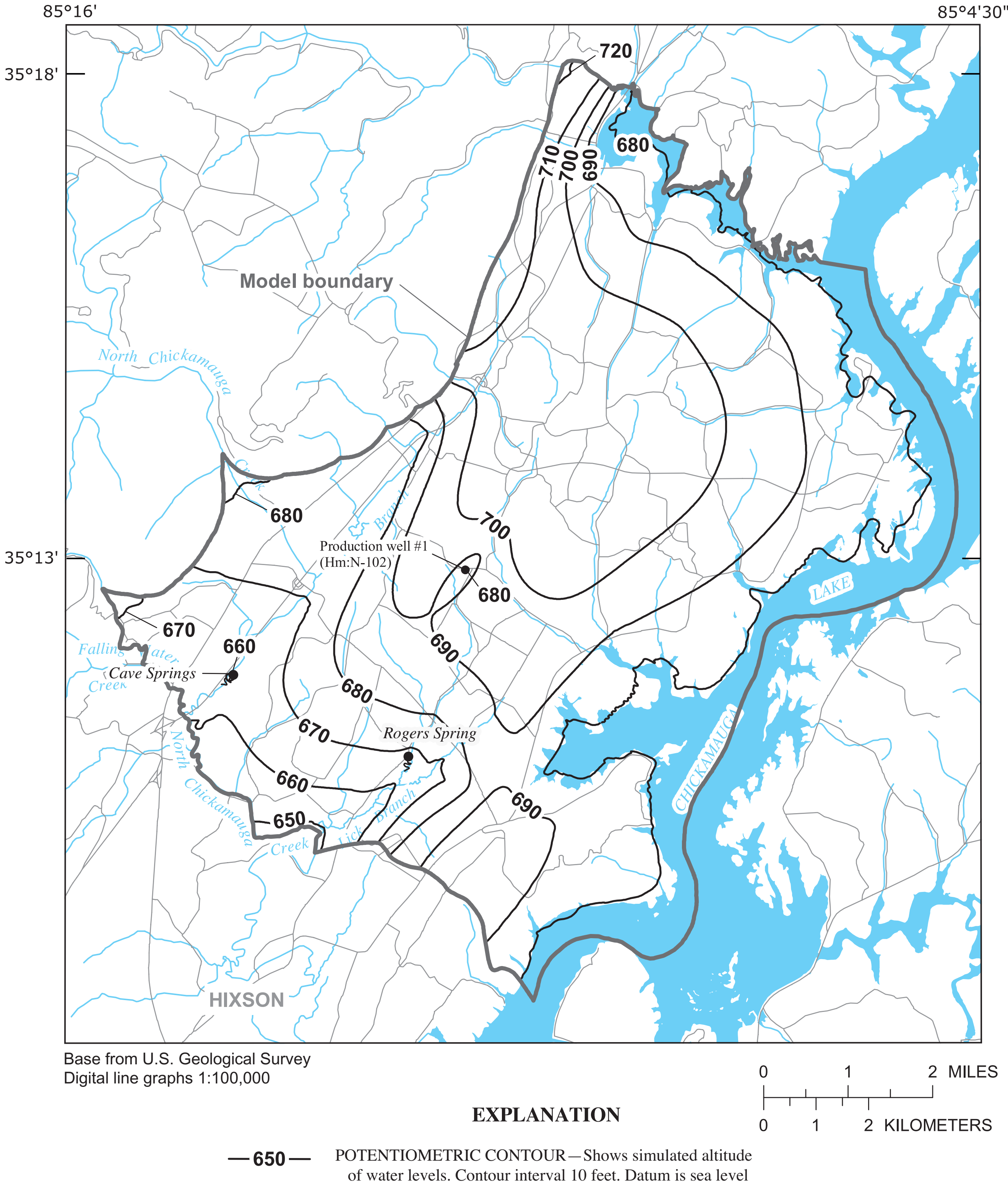


Figure 24. Model-simulated steady-state water levels with Walkers Corner production well #1 in use, layer 2.

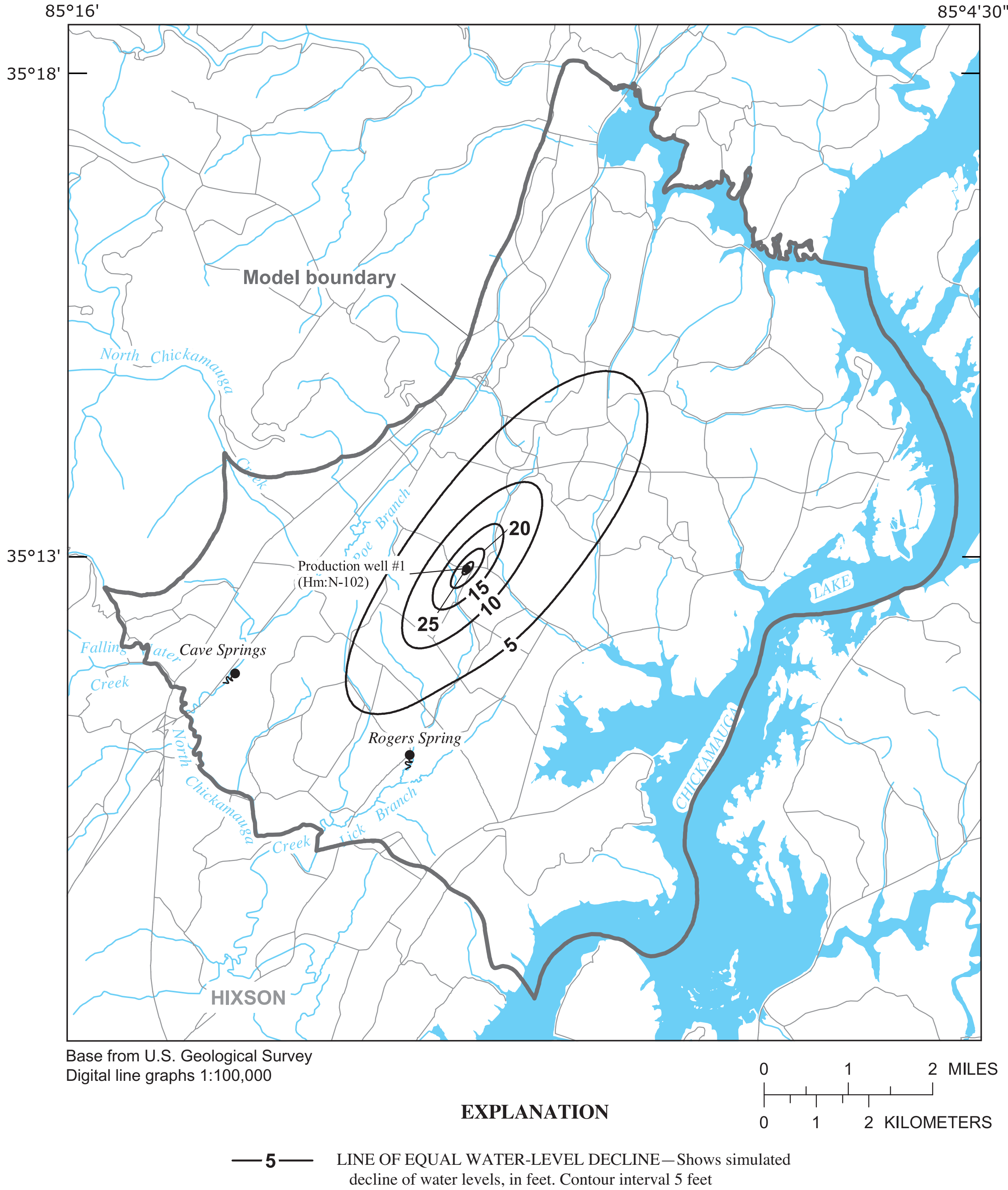


Figure 25. Model-simulated steady-state water-level decline with Walkers Corner production well #1 in use, layer 1.

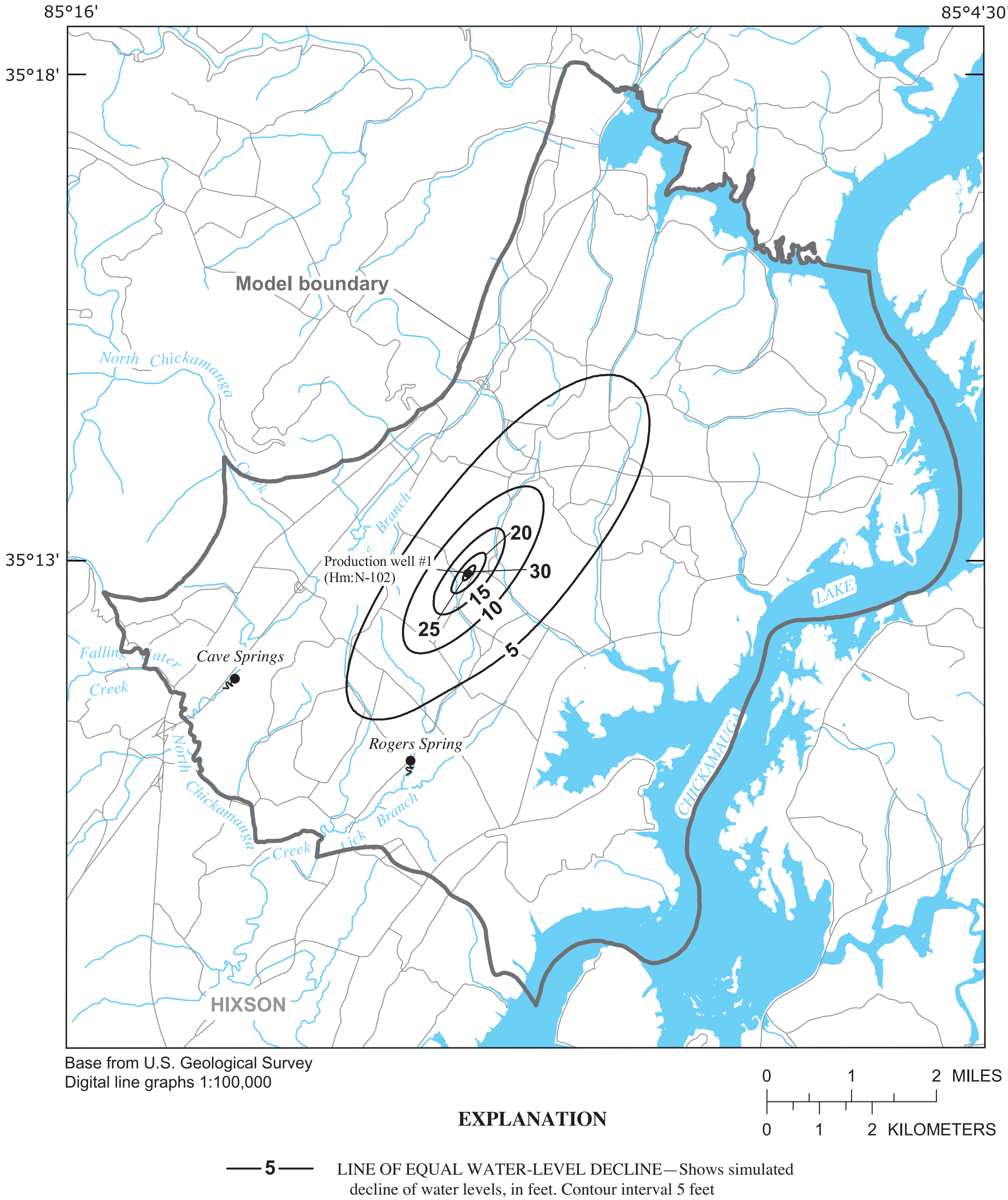


Figure 26. Model-simulated steady-state water-level decline with Walkers Corner production well #1 in use, layer 2.

streamflow data are available to compare with these simulated base-flow decreases.

Hydraulic testing indicates that the second production well at Walkers Corner can sustain a yield of 3 ft^3/s (2 Mgal/d) (Hixson Utility District, written commun., 2000). A model simulation was run with production wells #1 and #2 operating at Walkers Corner to estimate the effects of possible additional pumping from the second production well. This steady-state simulation with the Walkers Corner production wells #1 and #2 in use shows a similar pattern as the simulation using only production well #1 pumping; water levels are depressed along strike from the well field and the highest contour along the ridge near the center of the study area at 700 feet above sea level (figs. 27 and 28). The maximum steady-state water-level decline was 57 feet in model layer 1 and 61 feet in layer 2 (figs. 29 and 30, respectively). This decline results in a water-level altitude in the production wells of about 640 feet above sea level. Preliminary field observations suggest Walkers Corner production well #2 may have a greater specific capacity than Walkers Corner production well #1. If this is true, then production well #2 would produce less drawdown than the model currently estimates. The model water budget indicates that additional ground-water withdrawal at Walkers Corner from production well #2 would result in additional decreases in simulated ground-water discharge of 1.0 ft^3/s to Chickamauga Lake, 0.8 ft^3/s to North Chickamauga Creek, 0.5 ft^3/s to Lick Branch and Rogers Spring, 0.5 ft^3/s to Poe Branch, and 0.2 ft^3/s to Cave Springs (table 8).

The water budget from these two additional model simulations indicate that withdrawals at the Walkers Corner well field decrease ground-water discharge to all streams in the study area. The largest change in discharge is to Chickamauga Lake whereas the smallest change is to Cave Springs (table 8).

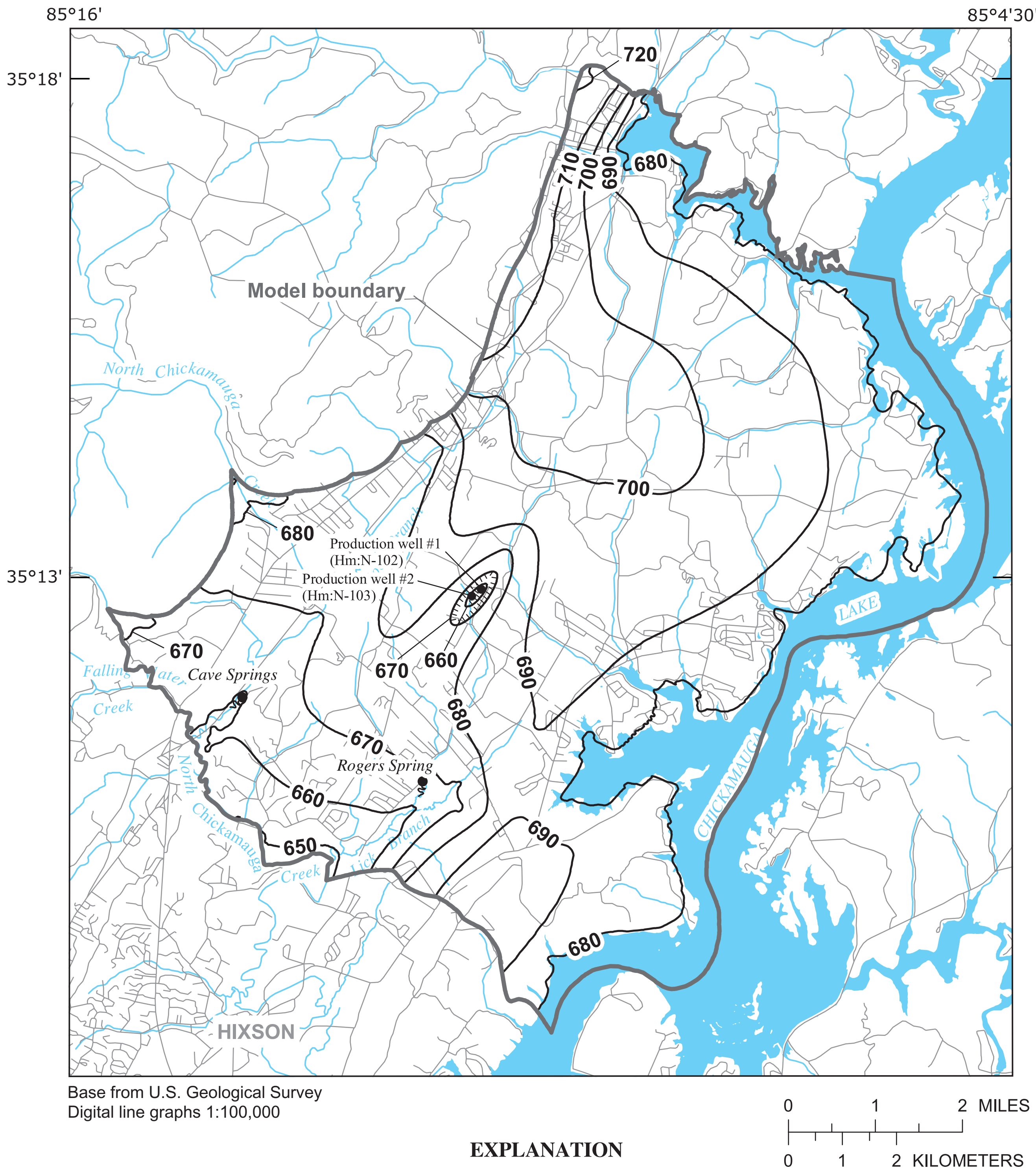
Drought Simulation

The effects of a drought were evaluated with a transient model simulation assuming no recharge occurs. A transient calibration was made to determine the best storage coefficients for the model. Because the model layers are convertible, specific yield and specific storage need to be input for each layer. The model then uses the appropriate coefficient depending on whether the model layer is fully or partially saturated (Harbaugh and others, 2000). Generally, most model cells in layer 1 are partially saturated, and most model cells in layer 2 are fully saturated.

The storage coefficients were calibrated by matching the slope of the seasonal recession of water levels from well Hm:N-051 (fig. 7). To model the seasonal recession of water levels, the transient calibration simulation was made using a period of 5 months with no recharge input. The simulated potentiometric-surface map for May 1999 (fig. 12) was used to define starting water levels because this surface represents steady-state conditions with the Walkers Corner production well #1 in use. Ground-water withdrawals during the transient calibration simulation were constant at 9 ft^3/s (5.8 Mgal/d) from the Cave Springs well field and 2.8 ft^3/s (1.8 Mgal/d) from Walkers Corner well field production well #1. The specific yield and specific storage coefficient were assumed to be uniform across the study area. A specific yield of 0.012 and a specific storage of 0.0001 produced the best match between observed and simulated water levels in well Hm:N-051 (fig. 31). Both values are within expected ranges.

The effects of a drought were then analyzed by simulating a 12-month period without recharge. The initial conditions and rates of ground-water withdrawal were the same as for the transient calibration simulation. Results indicate that water levels decline as the ground-water system drains (figs. 32 and 33). While a 12-month period with no recharge may not be realistic, the results from this simulation can be used to estimate the effects on water levels in the study area if no recharge occurs for several months, given observations of the current conditions at any point in time. For example, if after a winter and spring of lower than average recharge, field observations show that ground-water levels are similar to the results at the 4-month simulation time; and if no significant recharge is expected for 4 more months, then the 8-month simulation time would be an estimate of the water-level conditions expected to exist if no recharge were to occur for the next 4 months. Hydrographs of simulated water-level recessions at five locations in the study area show that, away from the pumping centers, water levels recede quickest farthest from the natural discharge areas (Hm:N-063, fig. 34). Additionally, water levels at the pumping centers, Walkers Corner production well #1 (Hm:N-102) and Cave Springs well field (Hm:N-035), recede quicker than water levels at wells similarly situated with respect to natural discharge area and farther away from pumping centers (Hm:N-051 and Hm:N-047) (fig. 34).

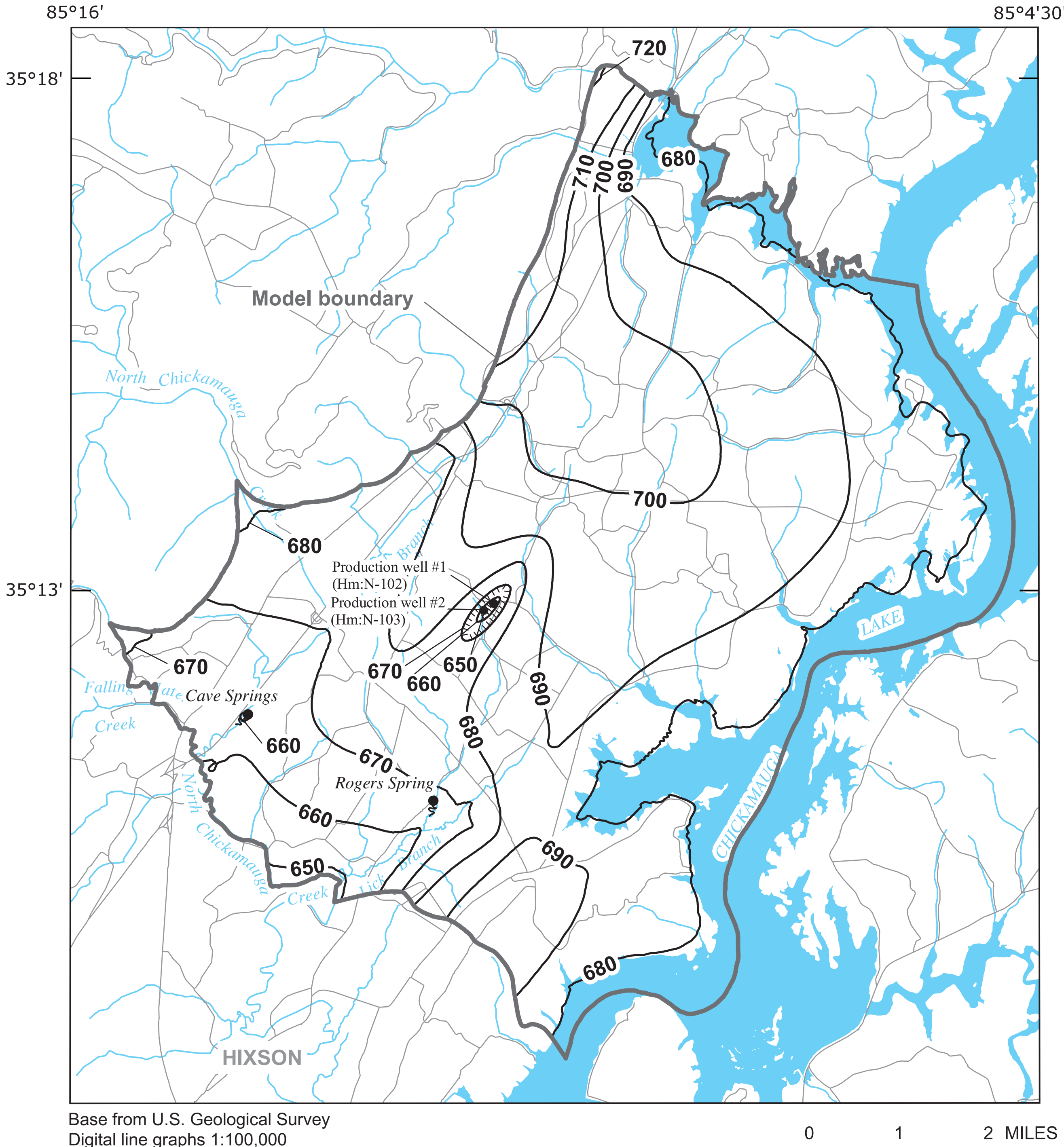
The simulated drought scenario would overestimate the decline in water levels at the Cave Springs well field because the model simulates an extreme



EXPLANATION

— 650 — POTENTIOMETRIC CONTOUR—Shows simulated altitude of water levels. Hachures indicate depression. Contour interval 10 feet. Datum is sea level

Figure 27. Model-simulated steady-state water levels with Walkers Corner production wells #1 and #2 in use, layer 1.



EXPLANATION

— 650 — POTENTIOMETRIC CONTOUR—Shows simulated altitude of water levels. Hachures indicate depression. Contour interval 10 feet. Datum is sea level

Figure 28. Model-simulated steady-state water levels with Walkers Corner production wells #1 and #2 in use, layer 2.