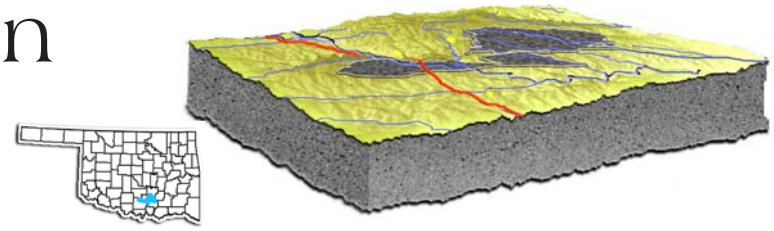
Arbuckle-Simpson Hydrology Study

Newsletter



THE OKLAHOMA WATER RESOURCES BOARD January 2006

Surface Water Committee to Balance Science, Policy

The Surface Water Subcommittee of the Arbuckle-Simpson Technical Peer Review Team has been created to evaluate surface water needs and impacts to flows in the study area. Among various tasks assigned to the group is the investigation of potential instream flow regimes that could be implemented to minimize impacts to the springs and streams. The Subcommittee will seek to balance legal and public policy considerations with technical findings of the ongoing Arbuckle-Simpson Hydrology Study.

Chaired by Derek Smithee, chief of the OWRB's Water Quality Division, the Subcommittee also includes representatives of the U.S. Geological Survey (USGS), Oklahoma Department of Environmental Quality, Department of Wildlife Conservation, U.S. Fish and Wildlife Service, Oklahoma State University, and area landowners.

Members of the Surface Water Subcommittee met for the first time on January 31 at the Chickasaw National Recreation Area near Sulphur.

Deep Well Drilling Halted

On September 14, the USGS began drilling a deep test well near the Blue River, just west of Connerville. The well was drilled to collect information on the lower portion of the Arbuckle-Simpson aquifer, for which information is currently sparse. The plan was to drill to a maximum depth of 3,000 feet, the approximate limit of the USGS drilling rig, and to collect water samples at varying depths.

Information on the deeper portion of the aquifer, the depth generally ranging from 1,000 to 4,000 feet, is needed to understand the full extent of the fresh-water zone and the volume of water in storage in the aquifer. It is essential to determine the base of the aquifer, which is defined by the base of the fresh-water zone or basement (granite). Although information from petroleum wells is abundant on the flanks of the aquifer, it is sparse directly over the aquifer. Members of the Arbuckle Study Technical Peer Review Team believe that the only way to determine the base of the aquifer and to obtain critical information, such as vertical flow gradients and water chemistry, is to drill several deep test holes.

Unfortunately, the drilling project experienced several difficulties, especially the enormous volumes of water produced from numerous fractured zones. The volume of water produced--estimated at up to 1,200 gallons per minute--forced the drillers to switch from an air hammer drill to much slower air rotary methods. When budgeted funds were exhausted, drilling ceased on November 30 at a depth of 1,820 feet. In addition, planned geochemical sampling was not performed because of fear that the water samples were adversely affected by air from the drilling.

Other methods are under consideration both to deepen the test hole or drill a different deep well and to collect depth-stratified samples that are not contaminated with drilling fluid. Additional deep drilling operations in the Arbuckle-Simpson aquifer will depend upon future funding and partnering opportunities.

USGS drilling rig at test well. While drilling the deep test hole, air lifted up large volumes of water estimated at up to 1,200 gallons per minute.

Water Levels Reflect Unusual Weather

In June 2004, the OWRB began installing water-level recorders in wells in the Arbuckle-Simpson aquifer as part of the Arbuckle-Simpson Hydrology Study. These water-level recorders, which measure the depth to groundwater, can be used to determine the aquifer's seasonal fluctuation and response to recharge from precipitation and discharge from pumping. A longer period of record is available from the Fittstown Well, which has been monitored by the U.S. Geological Survey (USGS) since 1958.

The amount of recharge to the aquifer depends on several factors, including rate and intensity of rainfall, soil moisture, evaporation, and depth to the water table. The magnitude and response time to a precipitation event in a particular well is partially dependent on aquifer characteristics--the amount of fractures, karst features, porosity, and permeability. Although water level responses have varied from well to well, the data show a correlation between water levels and the timing and amount of precipitation.

During 2005, rainfall totals in the region were low (14.42 inches below normal) and most of the year's rain occurred atypically in the winter and summer. The heavy late summer rains in 2005 had little effect on groundwater levels, because recharge is significantly lower in the summer when there is higher loss of moisture to evaporation and transpiration through plants (see hydrograph below). Following one of the driest years on record, water levels are again on the decline.

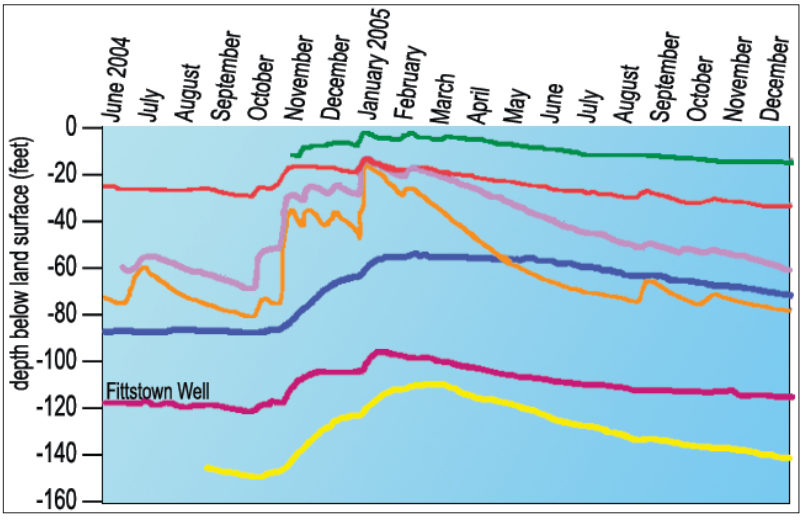
Although water levels are low, historically they have been lower, as illustrated at the Fittstown Well (see hydrograph below at right), which reached its lowest recorded depth in 1967 at 128 feet below surface. Currently, the water level is 118 feet, which is 26 feet lower than the same time last year. It is not yet as low as January 2004, when it was 122 feet below surface. Real-time water-level measurements from the Fittstown well can be viewed on the USGS Web site at http://waterdata.usgs.gov/ok/nwis/current/?type=gw.

Why Springs Bubble

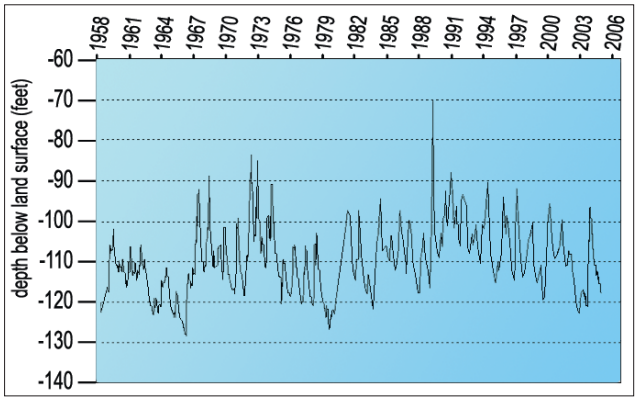
Many Arbuckle springs are bubbly. To determine the source of the bubbles, Dr. Andrew Hunt of the USGS Noble Gas Laboratory in Denver, Colorado, sampled bubbles emanating from Buffalo Spring at the Chickasaw National Recreation Area. Results indicate that the bubbles are composed primarily of nitrogen and carbon dioxide with trace amounts of argon and other gases. Small amounts of nitrogen gas occur naturally in the aquifer as a result of atmospheric nitrogen contained in precipitation.

Bubbles are most commonly observed at springs with pooled water and sandy bottoms. Dr. Hunt speculates that the groundwater degasses as temperature and hydrostatic pressure change. As groundwater discharging from the aquifer passes through sand in the spring pool, the sand provides nucleation sites for the gas to exsolve and form small lightly trapped pockets. When the gas pressure in the pockets overcomes the hydrostatic pressure in the spring pool, the gas bubbles out.

Andrew Hunt, USGS, samples Buffalo Spring.



Water levels recorded in observation wells from June 2004 to December 2005. The water level in one well rose 34 feet in 5 days in response to 3.78 inches of rain that fell in the area January 2-5, 2005. However, after 6.66 inches of rain August 14-16, 2005, water levels in the same well rose only 9 feet in 5 days.



Water levels at the Fittstown well from 1958 to present. The lowest recorded water level was 128 feet in April 1967, and the highest recorded level was 70 feet in May of 1990. Currently, the water level is at 118 feet.

State of Oklahoma
OWRB
Water Resources Board
the water agency

To join the Arbuckle-Simpson Study mailing list, call the OWRB at 405-530-8800.

For more information, visit the OWRB's Web site at www.owrb.state.ok.us.