BEFORE THE OKLAHOMA WATER RESOURCES BOARD
STATE OF OKLAHOMA

IN THE MATTER of Determining the Maximum Annual Yield for the Arbuckle-Simpson Groundwater Basin underlying parts of Murray, Pontotoc, Johnston, Garvin, Coal and Carter Counties	))))

ORDER

Pursuant to the Oklahoma Supreme Court's mandate of April 23, 2013, the undersigned hereby directs that the attached memorandum be disclosed and placed in the record. The parties shall have until 5 p.m. CDT on July 22, 2013 to file any responses that they may have to the material discussed in the memorandum. Any such responses shall be limited to ten pages and shall cite the record in this matter as necessary.

For more information, contact Anissa Campbell, Hearings Clerk for the OWRB, at (405) 530-8800.

Dated this 8th day of July, 2013.

Emily Hammond Meazell
Hearing Examiner

United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Water Resources Discipline
Oklahoma Water Science Center
202 Northwest 66th Building 7
Oklahoma City, Oklahoma 73116

September 27, 2012

Memorandum

To: Jerry Barnet, Oklahoma Water Resources Board

From: Scott Christenson, Hydrologist, Scientist Emeritus, retired and Noel Osborn, Hydrologist, Oklahoma Water Science Center

Subject: Technical comments regarding the Arbuckle-Simpson Hydrology Study

The following comments are in response to your request regarding questions about the Arbuckle-Simpson Hydrology Study.

1. Natural flow

   Natural flow for purposes of the Arbuckle-Simpson Hydrology Study was defined as follows: "The approach taken for this study was to interpret "natural flow" as observed streamflow conditions for water years 2004 through 2008" (USGS Scientific Investigations Report 2011-5029 (SIR 2011-5029) "OWRB exhibit 1", page 81).

2. Model Calibration to streamflow

   The process used to calibrate the model is documented in SIR 2011-5029 pages 62-79. As described in SIR 2011-5029, the USGS Arbuckle-Simpson groundwater-flow model was calibrated to 5-year average streamflow (that is, the total amount of water in the stream) and base flow (the groundwater component of streamflow) for the streamflow gages at Blue River near Connerville and Pennington Creek near Reagan. The model was calibrated to average flows to insure that the amount of flow (both streamflow and base flow) computed by the model is equal to the actual observed flows. From SIR 2011-5029, table 22, page 83:

	Blue River		Pennington Creek	
	Observed	Modeled	Observed	Modeled
5-Year Average Streamflow	92.92	92.98	42.97	42.69
5-Year Average Base Flow	61.28	61.34	32.47	32.19

All numbers in cubic feet per second

Monthly gaged and simulated streamflows are shown on figure 36 for the Blue River streamgage and figure 37 for the Pennington Creek gage (page 72). Regarding the model calibration to streamflow, Dr. Blaine Reely stated "It's almost a perfect calibration, or match. It's an amazing calibration" (Arbuckle-Simpson Hearing CD, Part 12, 14:50).

3. Streamflow depletion

   The effect of equally distributed groundwater withdrawals on streamflow was evaluated in terms of depletion of streamflow, base flow, and 75-percent exceedance (SIR 2011-5029 pages 80-89). Graphs and tables showing the depletion of streamflow, base flow, and 75-percent exceedance simulated with groundwater withdrawals distributed as an equal proportionate share were generated (SIR 2011-5029 pages 83-87). Table 22 (page 83) shows the depletion of the 5-year average streamflow and of the 5-year average base flow. The 75-percent exceedance and depletion of 75-percent exceedance of streamflow are shown on table 23 (page 87).

4. Storage coefficient

   As stated in SIR 2011-5029 (page 44),"Aquifer tests provide descriptions that apply at the scale of feet to hundreds of feet, and other techniques, such as the regional methods described in this report, provide descriptions of hydraulic properties that are applicable on the scale of miles." As described on pages 46-48, multiple regional methods were used to determine a storage coefficient of 0.008 for the Arbuckle-Simpson aquifer, including the subsurface drainage basins of Blue River and Byrds Mill Spring, which encompass an area of over 130 square miles. The regional methods were considered to be more representative of the Arbuckle-Simpson aquifer than a single aquifer test.

   The Arbuckle-Simpson Aquifer Hydrology Study emphasized recharge and flow in streams and springs, not storage coefficient. As stated in SIR 2011-5029 (page 81), long-term stream and springs flows are derived from recharge, not storage:

   > *Stream and spring flows are maintained in the long term (during time periods of years) by water entering the aquifer as recharge (during short time spans, on the order of days to weeks, stream and spring flows are maintained by water from storage), and, therefore, groundwater withdrawals could not exceed recharge. In fact, for longer time scales (years to decades) withdrawals must be less than recharge because if withdrawals equal or exceed recharge then stream and spring flow eventually would be reduced to zero.*

5. Data availability and review

   Data and methodology used in the Arbuckle-Simpson Hydrology Study were fully documented, archived and made available for public review and scrutiny. The data used for the Arbuckle-Simpson Hydrology Study are available on the USGS and OWRB web sites: http://ok.water.usgs.gov/ and http://www.owrb.ok.gov/maps/index.php.

   The USGS Arbuckle-Simpson groundwater flow model and report (SIR 2011-5029) were subjected to rigorous USGS report and technical review processes before being approved.

   Model data sets used by the MODFLOW model are available on-line. All USGS data and groundwater model files are archived in perpetuity.

The methods used for the Arbuckle-Simpson Hydrology Study are described in many documents included as exhibits by the protestants, including (to name only a few): Christenson and others (2011; protestants' exhibit 5), Christenson and others (2009; OWRB exhibit 3), Faith and others (2010; protestants' exhibit 8), and Puckette and others (2009; protestants' exhibit 8).

References:

Christenson, Scott, Hunt, A.G., and Parkhurst, D.L., 2009, Geochemical investigation of the Arbuckle-Simpson aquifer, south-central Oklahoma, 2004–06: U.S. Geological Survey Scientific Investigations Report 2009–5036, 51 p.

Christenson, Scott, Osborn, N.I., Neel, C.R., Faith, J.R., Blome, C.D., Puckette, James, and Pantea, M.P., 2011, Hydrogeology and simulation of groundwater flow in the Arbuckle-Simpson aquifer, south-central Oklahoma: U.S. Geological Survey Scientific Investigations Report 2011–5029, 104 p.

Faith, J.R., Blome, C.D., Pantea, M.P., Puckette, J.O., Halihan, Todd, Osborn, Noel, Christenson, Scott, and Pack, Skip, 2010, Three-dimensional geologic model of the Arbuckle-Simpson aquifer, south-central Oklahoma: U.S. Geological Survey Open-File Report 2010–1123, 26 p.

Puckette, Jim, Halihan, Todd, and Faith, Jason, 2009, Characterization of the Arbuckle-Simpson aquifer—Final report submitted to the Oklahoma Water Resources Board, Stillwater, Oklahoma State University School of Geology, 53 p.