Arbuckle Simpson Aquifer (ASA) Maximum Annual Yield Comments

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My wife and I are residents of the City of Ada, and were present during the entire two-day hearing in Sulphur on May 15 and 16, 2012. The following comments are respectfully submitted in opposition to the proposed Maximum Annual Yield for the Arbuckle Simpson Aquifer. Our opposition is based on:

- The application of the Study results to the central and western lobes of the Aquifer
- The instream flow determination as an input to the hydrologic model
- Errors in the hydrologic model used in support of the proposed Maximum Annual Yield
- The process used in the development of the proposed Maximum Annual Yield

Application of the Study results to the central and western lobes of the Aquifer

Several other aquifers have been studied by the OWRB in which different Equal Proportionate Shares were developed for specific areas within them[1;] however, the State made a "peculiar" decision to apply the study of the eastern lobe to all three lobes of the Arbuckle Simpson Aquifer, treating it as a single homogenous unit[5]. Several expert witnesses from both sides testified to the following geological comparison of the eastern versus the central and western lobes of the ASA: the rock types (lithology) are the same, the central and western lobe exhibit substantially more folding and faulting, the rock layers are generally thicker in the central and western lobes[2, 5]. Folding and faulting have turned many of the rock layers on end from their

original horizontal position. The reaction to precipitation falling on the surface is best illustrated by the pages of a book. Pour water on a book lying flat, and it runs off, dampening only the top few pages. Now, pour water on a book standing on end, and it is absorbed until the entire book is saturated. Clearly, the hydrologic characteristics of the three lobes vary enough to cast serious doubt on the study team's conclusion that the geologic characteristics are "substantially similar enough"[2] to apply the same analytical parameters to all three.

Instream Flow Determination as an input to the hydrologic model

Lacking comprehensive instream flow data collected over a period spanning several decades, none of the witnesses called by the OWRB were able to clearly quantify the "natural flow" in a stream overlying or emanating from the Arbuckle-Simpson Aquifer[1]. Several OWRB witnesses did, however, testify that the natural flow of a stream is subjective, varies on a daily basis, and is sometimes zero[3, 4].

The Stream Flow Work Group chaired by Derek Smithee was charged with empirically defining stream flow input for use by the modeling team. The Work Group was comprised primarily of representatives of various state and federal governmental agencies, most of whom share an agenda of maximizing the flow in the Blue River and Pennington Creek. Rather than devoting their efforts and resources to measuring actual flow at various locations in key streams over the 6-year period of the study to determine the "natural flow," they chose a one-year average of flow data to estimate the required minimum stream flow using an inventory of fish habitats.

In addition, the significant impact of seasonal variations and climate on the "natural flow" in streams was all but ignored by the State's studies[5]. A layman comparing stream flow and rainfall data available on the State's own websites will easily recognize an unmistakably strong correlation between the two, so it is curious that this factor would be omitted from an empirical definition of stream flow for the model.

The end product of the Work Group was an arbitrary decision on how much water had to remain in the streams. The arbitrary nature of the decision and the biased makeup of the Group is evidenced by the fact that no consensus could be reached. In fact, a number of members could not be swayed from their opinion that no reduction on natural flow should be permitted. Mr. Smithee was forced to make what amounted to a command decision to set the allowable flow reduction at a level different than most of his Group desired.[8]

Hydrologic modeling in support of the proposed Maximum Annual Yield

The entire MAY effort focused on maintaining flow in streams without regard for the impact on groundwater users over the aquifer. To this end, the modelers were given unrealistic assumptions by the Technical Review Team, including the 75% instream flow minimum, and existence of one groundwater well per acre across the entire aquifer basin. This assumption is ludicrous (600 square miles x 640 acres per square mile = 384,000 wells), and is "not ever going to happen" [2].

The USGS groundwater modeling effort also contained multiple errors, all of which contributed to setting the MAY lower. A single storage coefficient of "0.008 was used as a simplification"[2] throughout the entire 600 square mile and multiple rock layers of the aquifer,

including the geologically complex central and western lobes. The USGS justification for this gross oversimplification was that "storage coefficients are not important".[2] Storage coefficient is important. It is, in fact, a key driver in the modeling process. Accurate storage coefficients are an absolute requirement for MODFLOW.[3]

A previous study set the average recharge rate for the ASA at 0.47 acre-feet per acre (afpa). This scientifically-developed data was never entered into the model simulation; however, when the model required more complexity to support a lower MAY, extra time and effort was taken to "zone" the recharge data for either side of the Sulphur Fault[2]. In this case, a five-fold difference in recharge factor on either side of the fault was assumed in order to manipulate the model's stream flow sufficiently to mimic the stream gauge data[10]. This is the level of detail that should have been required for a legitimate study of the central and western lobes.

The USGS manipulated recharge assumptions to force a nearly perfect mimic of available stream flow data for calibration purposes in the eastern lobe; however, the MODFLOW model was poorly calibrated with respect to multiple parameters. No effort was made to calibrate the huge variability in the potentiometric surface (groundwater level) [10]. The impact of this omission would most assuredly result in a marked reduction in stream flow. The MODFLOW model has the capability to consider multiple layers of varying rock types when simulating a bedrock aquifer. The USGS modeling team had data for these layers, and chose not to use it. Several witness testified to the presence of an unconfined zone of the aquifer that exists at or near the surface[2, 5, and 9]. Unconfined aquifer zones are substantially more porous than confined zones. They hold more water (storage coefficients are at least 10 times higher than for unconfined zones), they drain rapidly, and recharge rapidly.[5] The USGS used a model configured for a confined aquifer to simulate the unconfined zones. "This misrepresents the drainage from the

upper pores" and results in "substantial difference in the low flow levels in streams and springs"[9].

Development of the proposed Maximum Annual Yield

The Maximum Annual Yield was only loosely based on the model. The "peer review" process was weak, and when an Oklahoma Geological Survey hydrogeologist challenged the modeling assumptions and conclusions, State agencies, including the OWRB and the University of Oklahoma, descended on the Director of the OGS. They characterized the hydrogeologist's opinions as "late in the game,"[6] as "placing the OGS in a precarious position with another state agency,"[7] "and [they] discourage[ed] his participation in the hearing".[7]

The proposed MAY was reached by the OWRB without the benefit of a documented, transparent process[1]. Given the disjointed efforts and apparent lack of overall project management, one has to question the validity of the result. The Instream Flow Work Group provided a flow assumption that was not based on a study of actual flow. The USGS modelers ignored the input from the Work Group and ran its own set of input parameters[1 1]. They made assumptions of convenience and ignored scientifically determined data. They failed to include data from a shallow well in the unconfined zone, and left out groundwater pressure data during the calibration process. The end result was a model that wasn't as good as it could be and is not ready for use in important policy decisions[9]. Further, the model results appear to have been largely ignored by the OWRB in development of the proposed MAY.

The proposed MAY is discriminatory. There was no cost-benefit analysis, and the availability of free, plentiful water for downstream users comes at the expense of the

groundwater rights of municipalities and landowners over the aquifer that truly have no other source of drinking water.

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2 Neil Christiansen, USGS

3 Jennifer Back, NPS

4 Peter Burck, NFWS

5 Dr. Kyle Murray, OGS

6 J.D. Strong, OWRB

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8 Derek Smithee, OWRB

9 Dr. Eileen Poeter, Colorado School of Mines

10 Dr. Blain Reeley, Envirotech

11 Noel Osborne, USGS