IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA

STATE OF OKLAHOMA, ***et al.***	)	
	)	
Plaintiffs,	)	
	)	
v.	)	**Case No. 4:05-cv-00329-GKF-SAJ**
	)	
TYSON FOODS, INC., ***et al.***	)	
	)	
Defendants.	)	

Declaration of Dr. Victor J. Bierman, Jr.

I, **Victor J. Bierman, Jr.**, state the following:

1. My name is Victor J. Bierman, Jr.

2. I earned a PhD in Environmental Engineering from the University of Notre Dame in 1974. I previously earned a master's degree in physics from the University of Notre Dame in 1971, and an A.B. in Science from Villanova in 1966.

3. I am currently a senior scientist with LimnoTech, an environmental consulting firm specializing in water quality issues and water system modeling. I served previously as a National Expert in Environmental Exposure Assessment for the United States Environmental Protection Agency. I was also formerly an Associate Professor in the Department of Civil Engineering at the University of Notre Dame.

4. I have nearly 35 years experience in the development and application of water quality models for eutrophication and the fate and transport of chemicals. I have published or contributed to over 100 technical papers and reports regarding these subjects. My experience includes the assessment of water quality issues related to nutrients, algal blooms, nitrogen fixation, and ecosystem processes. I have also analyzed the fate, transport, partitioning and bioaccumulation of chemicals. I have conducted assessments in a wide variety of locations including rivers and lakes, and including U.S. EPA superfund sites. I have extensive experience using computer models to analyze aquatic systems and addressing errors and uncertainties in such models.

5. I have been retained by the Defendants in this matter to analyze and respond to the Plaintiffs' modeling of the Illinois River Watershed (IRW). I have reviewed the reports submitted by Darren Brown, Lowell Caneday, Berton Fisher, Gordon Johnson, Todd King, Robert Lawrence, Roger Olsen, Megan Smith, Robert Taylor, Chris Teaf, Bernard Engel, Valerie Harwood, Jan Stevenson, Dennis Cooke, Eugene Welch, and Scott Wells in support of Plaintiffs' case.

6. Modeling a watershed with the size and complexity of the IRW is an extremely challenging and complicated task. Indeed, it may not be possible to accurately account for all of the factors present in the real-world system. Accordingly, the utility of models in such complex systems may be limited to helping develop initial management decisions, and then helping to inform subsequent revisions and improvements with increasing knowledge and reduction of model uncertainties. Nonetheless, given that Plaintiffs' experts are employing models to support specific claims of historic and current contributions, causation and injuries, it is my charge to evaluate how the Plaintiffs' models were constructed and used.

7. In my experience, any serious attempt to develop a comprehensive and calibrated model of such a complex system requires from one to three years of work on the part of the modeler. The development of a site-specific model usually begins with one of several "off-the-shelf" computer programs available in the public domain such as HSPF, GLEAMS, EFDC, and CE-QUAL-W2. The selected model often must be modified to apply to the particular site. This process involves ensuring that the assumptions built into the model – such as, for example, the equations that depict phosphorous moving from land to water – are appropriate for the particular site. Any modifications made to the off-the-shelf model introduce additional assumptions regarding the characteristics of the site.

8. Once the generic model has been modified to apply to the particular system, the modeler must gather the dataset to feed into the model in order to allow it to predict the desired output. A model of a system the size of the IRW requires a huge amount of data to even attempt to characterize each of the relevant environmental processes. In addition to gathering data to feed into the model, the modeler must also gather independent "real world" data against which to test the model. Such data are used to calibrate the model to demonstrate the credibility and utility of the model. A model of a system the size of the IRW performs such a staggering number of calculations that the model can take days to complete a single run. In other words, if the modeler changes a single assumption, parameter, or model input, the computer can take several days to complete a new calibration run. In addition, it may take several additional days to completely process, analyze, and interpret these new results. Properly calibrating such a model usually requires dozens, and sometimes hundreds, of separate calibration runs.

9. While reviewing and commenting on models such as the Plaintiffs' does not always require the same length of time as the initial development of the model, it is also a hugely time-consuming process. It is necessary to review any modifications made to tailor the off-the-shelf model to the particular site. An important part of critiquing a model is identifying where the modeler may have adopted assumptions about important environmental processes of the particular site that may not be appropriate or accurate. A central part of critiquing a model is reviewing the input data set. A model of a system the size of the IRW requires a massive volume of data covering such diverse topics as land cover, land use, rainfall patterns, topography, soil conditions, etc. Unless the dataset used is complete and representative of the important environmental processes in the system, it could significantly affect the accuracy of the model's output. For much the same reasons, it is necessary to thoroughly review the data used to test the model and confirm its

accuracy. Reviewing a model could require a large number of separate runs as each of the individual assumptions must be identified and tested.

10. Many of the assumptions and calculations in a model are not obvious. Rather, they are concealed within the code and calculations of the model. As a result, each individual calculation must be independently tested. Where an error in coding or a flawed assumption is discovered, the model must be modified and re-run in order to compare its output with the prior results and with the calibration data. Unlike some other expert reports, it is impossible to review and critique a watershed or water quality model based solely on the written report describing its results. A model is a working computer program.

11. It appears that Plaintiffs have not one, but several models. Each of these multiple models will need to be tested. Bernard Engel, for example, appears to have attempted to model the entire IRW and discusses the results of a model designed apparently to predict phosphorous loading into Lake Tenkiller. Dr. Engel reports loading results under six scenarios. *See* Engel Report Table 10.11. Each of these scenarios will entail numerous separate assumptions built into the model itself and not necessarily apparent on the face of his report.

12. Dr. Scott Wells is also being offered as a modeling expert, and has apparently attempted to model Lake Tenkiller. His model will likely contain site-specific modifications and assumptions that must be individually checked for accuracy. As each of these assumptions is reviewed it will likely be necessary to re-run the model repeatedly.

13. In addition to checking each model separately, it appears that Dr. Engel's and Dr. Wells' models may couple together, with one feeding the other. If this is the case, it adds another layer of complexity and time to any critique thereof as these models must be run in series.

14. As noted above, running a model of the size and complexity such as Plaintiffs have attempted to create is a time-consuming task. Plaintiffs have informed the Court that Dr. Wells' model takes 4 to 7 days to run for a 50-year simulation, and an additional 2 to 5 days to analyze the results from each simulation. *See* Plaintiffs' Emergency Motion for a Brief Extension, Dkt. # 1702, at 2-3; Wells Affidavit. It therefore requires an average of 9 days to complete a single cycle of Dr. Wells' model. As noted, Dr. Engel developed at least six separate 50-year scenarios. In order to critique properly Dr. Wells' and Dr. Engel's work, it is reasonable to assume that, at the very least, Defendants will need to re-create each of those six runs with each model. I do not yet know how long it takes to run Dr. Engel's model. However, looking just at Dr. Wells' model, it will take approximately 60 days just to evaluate these scenarios. This is in addition to the time discussed above that must be invested first in reviewing the site-specific application, calibration, and validation of the models.

15. In view of the foregoing, and based on my years of professional experience working with environmental models, assuming diligent effort, it will take seven months to fully review

and critique the plaintiffs' models after the working models themselves and their associated data sets are provided to me.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on June 12, 2008