UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA

STATE OF OKLAHOMA, ex. rel. W.A. DREW EDMONDSON, in his capacity as ATTORNEY GENERAL OF THE STATE OF OKLAHOMA and OKLAHOMA SECRETARY OF THE ENVIRONMENT, J. D. Strong, in his the capacity as the TRUSTEE FOR NATURAL RESOURCES FOR THE STATE OF OKLAHOMA,	)	
Plaintiffs,	)	
	)	**Case No. 05-CV-329-GKF-SAJ**
v.	)	
	)	
TYSON FOODS, INC., TYSON POULTRY, INC., TYSON CHICKEN, INC., COBB-VANTRESS, INC., AVIAGEN, INC., CAL-MAINE FOODS, INC., CAL-MAINE FARMS, INC., CARGILL, INC., CARGILL TURKEY PRODUCTION, LLC, GEORGE'S, INC., GEORGE'S FARMS, INC., PETERSON FARMS, INC., SIMMONS FOODS, INC., and WILLOW BROOK FOODS, INC.,	)	
Defendants.	)	

EXPERT REPORT OF

Timothy J. Sullivan, Ph.D.
President

E&S
Environmental
Chemistry, Inc.

January 29, 2009

EXHIBIT
"A"

TIMOTHY J. SULLIVAN

EDUCATION

Ph.D. Biological Sciences/Environmental Chemistry, Oregon State University - 1983
M.A. Biological Sciences, Western State College of Colorado - 1977
B.A. History, Stonehill College - 1972

CURRENT POSITION

President, E&S Environmental Chemistry, Inc. Dr. Sullivan co-founded this scientific research and consulting corporation in September, 1988.
President, E&S Environmental Restoration, Inc. Dr. Sullivan founded this environmental restoration corporation in June, 1996.

EXPERIENCE

Dr. Sullivan is President and Principal Scientist of E&S Environmental Chemistry, Inc. He has over 25 years of professional experience, including 12 years of environmental project management experience. His expertise includes the effects of air pollution on aquatic and terrestrial resources; watershed analysis; nitrogen cycling; aquatic acid/base chemistry; mobilization, speciation and toxicity of metals in acidic waters; episodic processes controlling surface water chemistry; and environmental assessment. He is author of the National Acid Precipitation Assessment Program (NAPAP) State of Science and Technology Report on past changes in surface water acid/base chemistry throughout the United States from acid deposition. In recent years, he has also been principal investigator for a comparison between paleolimnological reconstructions of lakewater acid/base chemistry and process-based model reconstructions (U.S. Department of Energy), incorporation of an organic acid submodel into the watershed model MAGIC and testing of the revised model using data from ecosystem manipulation experiments in Norway and the U.S. (U.S. Department of Energy), investigation of the role of land use and landscape in the acidification of surface waters (U.S. Department of Energy), an analysis of the feasibility of adopting standards for deposition of nitrogen and sulfur (U.S. EPA), and a variety of nonpoint source pollution studies in forest/agricultural watersheds. His research and project management experience includes the following:

- Served as Co-PI of Diatom Paleolimnology Data Cooperative, 1993-present, housed at the Academy of Natural Sciences in Philadelphia and funded by NOAA and NSF. This data cooperative disseminates lake sediment core paleolimnological data focused on past climate reconstructions to the climate modeling and research community (http://diatom.acnatsci.org/dpdc/).
- Served as project manager for preparation of an Air Quality Review for Class I national parks throughout California. Also co-authored similar reviews for the Pacific Northwest and the Rocky Mountain and Great Plains regions of the National Park Service.
- Coordinated and analyzed available data bases throughout the United States, and internationally, providing evidence regarding the extent and magnitude of surface

water acidification. Summarized and synthesized pertinent data and authored the State of Science and Technology Report for the National Acid Precipitation Assessment Program (NAPAP) on historical acidification.

- Served as project manager for a modeling project to assess aquatic and terrestrial effects of air pollutants throughout the southern Appalachian Mountains for the Southern Appalachian Mountain Initiative (SAMI).
- Served as lead author and individual responsible for synthesis and integration for report to the National Park Service on the sensitivity of natural resources in Shenandoah National Park to air pollution degradation.
- Coordinated research efforts of a team of experts in the fields of surface water chemistry, mathematical modeling, and paleoecology for the purpose of comparing paleoecological inferences and process-based model hindcasts of Adirondack Mountain lakewater chemistry. This project constitutes the most comprehensive, and only statistically-based, model validation exercise conducted to date for an acid-base chemistry watershed model. Supervised data analyses and interpretation, and served as lead author for final agency report.
- Directed field research project for the Alaska Department of Environmental Conservation on the Kenai Peninsula to investigate forest effects from industrial emissions of nitrogen. Coordinated and supervised all logistics and field sampling activities, including aerial infrared photography, measurements of forest growth and health, and collection of soil solution, conifer needles, precipitation, and throughfall. Directed data base construction, QA, data analyses, and interpretation; served as lead author on final report.
- Served as member of NAPAP's working group that prepared the aquatic portions of the 1990 Integrated Assessment (IA), NAPAP's final policy document for Congress. Drafted major portions of the IA; participated in a series of assessment meetings attended by federal, national laboratory and industry scientists, economists, and policy specialists; provided input on all aquatics sections of the final document. Also authored the aquatic sections of NAPAP's 1996 Report to Congress.
- Served as project manager for the Tillamook Bay National Estuary Project for several water quality monitoring projects to evaluate the concentrations and loads of nutrients, sediment, and fecal coliform bacteria in the five rivers that flow into Tillamook Bay, Oregon. These projects include long-term monitoring, storm monitoring, source area identification, and evaluation of the relationships between land use and water quality.
- Served as project manager for E&S's role in the construction and management of a diatom paleoclimate data cooperative for North and South America. The data cooperative brought together paleolimnological data from a multitude of sources that can be used to reconstruct aspects of historical regional climates from diatom remains in dated lake sediment cores.

AWARDS AND HONORS

Academic scholarship, Stonehill College, 1968-72
Massachusetts State Scholarship, 1969-72
Cum laude, Stonehill College, 1972

Postdoctoral fellowship, Royal Norwegian Council for Scientific and Industrial Research, 1984-86
Director's Technical Contribution Award, Corvallis Environmental Research Laboratory, U.S. EPA, 1987
Northrop Services, Inc., Best Orator, Effective Winning Presentations, 1987
Best Scientific Paper Award, Corvallis Environmental Research Laboratory, U.S. EPA, 1988

PUBLICATIONS

Books, Special Issues

Sullivan, T.J. 2005. Acidification - chronic. In: Lehr, J.H. and J. Keeley (Eds.). Water Encyclopedia: Surface and Agricultural Water. John Wiley & Sons.

Sullivan, T.J. 2000. Aquatic Effects of Acidic Deposition. Lewis Publ., Boca Raton, FL. 373 pp.

Seip, H.M., L. Pawlowski, and **T.J. Sullivan** (eds.). 1994. Environmental degradation due to heavy metals and acidifying deposition - A Polish-Scandinavian Workshop. Ecol. Engr. Special Issue. 3(3):205-314.

Pawlowski, L., H.M. Seip, and **T.J. Sullivan** (eds.). 1994. Aluminum in the environment. J. Ecol. Chem. 3(3).

Sullivan, T.J. and C. Moersch. 1993. Radon Alert (Teacher Guides for Junior High School Education). E&S Geographic and Information Services, Corvallis, OR. 2 vol., 204 pp.

Sullivan, T.J. and C. Moersch. 1992. Radon Alert (Teacher Guides for High School Education). E&S Geographic and Information Services, Corvallis, OR. 4 vol., 368 pp.

Sullivan, T.J. 1991. Oregon Coast Recreational Atlas. A Guide to Natural Resources and Recreational Opportunities. E&S Geographic and Information Services, Corvallis, OR. 106 pp.

NAPAP Aquatic Effects Working Group (Multiple authors including **Sullivan, T.J.**). 1991. National Acid Precipitation Assessment Program 1990 Integrated Assessment. National Acid Precipitation Assessment Program, Washington, DC. 520 pp.

Sullivan, T.J. 1990. Historical Changes in Surface Water Acid-Base Chemistry in Response to Acidic Deposition. State of the Science, SOS/T 11, National Acid Precipitation Assessment Program. 212 pp.

Journal Articles/Book Chapters

Sullivan, T.J., B.J. Cosby, B. Jackson, K.U. Snyder, and A.T. Herlihy. In review. Acidification and Prognosis for Future Recovery of Acid-Sensitive Streams in the Southern Blue Ridge Province.

Sullivan, T.J., B.J. Cosby, B. Jackson, and K.U. Snyder. In review. Critical Loads of Atmospheric Sulfur Deposition for the Protection and Recovery of Acid-Sensitive Streams in the Southern Blue Ridge Province.

Sullivan, T.J., B.J. Cosby, J.R. Webb, R.L. Dennis, A.J. Bulger, F.A. Deviney Jr. 2008. Streamwater acid-base chemistry and critical loads of atmospheric sulfur deposition in Shenandoah National Park, Virginia. Environ. Monit. Assess. 137:85-99. DOI 10:1007/s10661-007-9731-1

Zhai, J., C. T. Driscoll, **T. J. Sullivan**, and B. J. Cosby. 2008. Regional application of the PnET-BGC model to assess historical acidification of Adirondack lakes. Water Resour. Res., 44, W01421, doi:10.1029/2006WR005532.

McNeil, B.E., J.M. Read, **T.J. Sullivan**, T.C. McDonnell, I. J. Fernandez, and C.T. Driscoll. 2008. The spatial pattern of nitrogen cycling in the Adirondack Park, New York. Ecol. Appl. 18:438–452.

Sullivan, T.J., B.J. Cosby, A.T. Herlihy, C.T. Driscoll, I.J. Fernandez, T.C. McDonnell, C.W. Boylen, S.A. Nierzwicki-Bauer, and K.U. Snyder. 2007. Assessment of the extent to which intensively-studied lakes are representative of the Adirondack region and response to future changes in acidic deposition. Water Air Soil Pollut. 185:279-291.

Sullivan, T.J., J.R. Webb, K.U. Snyder, A.T. Herlihy, and B.J. Cosby. 2007. Spatial distribution of acid-sensitive and acid-impacted streams in relation to watershed features in the southern Appalachian Mountains. Water Air Soil Pollut. 182:57-71.

McNulty, S.G., E.C. Cohen, J.A. Moore Meyers, **T.J. Sullivan**, and H. Li. 2007. Estimates of critical acid loads and exceedances for forest soils across the conterminous United States. Environ. Poll. 149(3):281-292.

Sullivan, T.J., I.J. Fernandez, A.T. Herlihy, C.T. Driscoll, T.C. McDonnell, N.A. Nowicki, K.U. Snyder, and J.W. Sutherland. 2006. Acid-base characteristics of soils in the Adirondack Mountains, New York. Soil Sci. Soc. Amer. J. 70:141-152.

Sullivan, T.J., M. Wustenberg, K.U. Snyder, J. Moore, D. Moore, E. Gilbert, and E. Mallery. 2006. Relationship between size of vegetated buffers and transport of fecal coliform bacteria from pasturelands treated with dairy cow manure. Abstract. J. Dairy Sci. 89 (Suppl. 1): Abstract 298.

Sullivan, T.J., B.J. Cosby, K.A. Tonnessen, and D.W. Clow. 2005. Surface water acidification responses and critical loads of sulfur and nitrogen deposition in Loch Vale Watershed, Colorado. Water Resour. Res. 41:W01021, doi:10.1029/2004WR003414.

Sullivan, T.J., K. U. Snyder, E. Gilbert, J.M. Bischoff, M. Wustenberg, J. A. Moore, and D. Moore. 2005. Assessment of water quality in association with land use in the Tillamook Bay Watershed, Oregon. Water Air Soil Pollut. 161:3-23.

Sullivan, T.J., M.C. Saunders, B.L. Nash, K.A. Tonnessen, and B.J. Miller 2005. Application of a regionalized knowledge-based model for classifying the impacts of nitrogen, sulfur, and organic acids on lakewater chemistry. Knowledge Based Systems. 18(1):55-68.

Saunders, M.C., **T.J. Sullivan**, B.L. Nash, K.A. Tonnessen, and B.J. Miller. 2005. A knowledge-based approach for classifying lake water chemistry. Knowledge Based Systems. 18(1): 47-54.

Sullivan, T.J., B.J. Cosby, A.T. Herlihy, J.R. Webb, A.J. Bulger, K.U. Snyder, P.F. Brewer, E.H. Gilbert, and D.L. Moore. 2004. Regional model projections of future effects of sulfur and nitrogen deposition on streams in the southern Appalachian Mountains. Water Resour. Res. 40(2), W02101 doi:10.1029/2003WR001998.

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Sullivan, T.J., J.M. Eilers, B.J. Cosby, and K.B. Vaché. 1997. Increasing role of nitrogen in the acidification of surface waters in the Adirondack Mountains, New York. Water Air Soil Pollut. 95:313-336.

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Sullivan, T.J., B.J. Cosby, C.T. Driscoll, D.F. Charles, and H.F. Hemond. 1996. Influence of organic acids on model projections of lake acidification. Water Air Soil Pollut. 91:271-282.

Sullivan, T.J., B. McMartin, and D.F. Charles. 1996. Re-examination of the role of landscape change in the acidification of lakes in the Adirondack Mountains, New York. Sci. Total Environ. 183(3):231-248.

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Manipulation Experiments: Scientific Approaches, Experimental Design, and Relevant Results. Ecosystems Research Report No. 20. ECSC-EC-EAEC, Brussels. pp. 344-352.

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Husar, R.B., **T.J. Sullivan**, and D.F. Charles. 1991. Methods for evaluation of historical change. pp. 65-82. In: Charles, D.F. (Ed.), Acid Deposition and Aquatic Ecosystems: Regional Case Studies, Springer-Verlag, New York.

Eilers, J.M., **T.J. Sullivan**, and K.C. Hurley. 1990. The most dilute lake in the world? Hydrobiologia 199:1-6.

Sullivan, T.J., D.F. Charles, J.P. Smol, B.F. Cumming, A.R. Selle, D.R. Thomas, J.A. Bernert, and S.S. Dixit. 1990. Quantification of changes in lakewater chemistry in response to acidic deposition. Nature 345:54-58.

Sullivan, T.J., D.L. Kugler, M.J. Small, C.B. Johnson, D.H. Landers, B.J. Rosenbaum, W.S. Overton, W.A. Kretser, and J. Gallagher. 1990. Variation in Adirondack, New York, lakewater chemistry as a function of surface area. Water Resour. Bull. 26:167-176.

Seip, H.M., D.O. Anderson, N. Christophersen, **T.J. Sullivan**, and R.D. Vogt. 1989. Variations in concentrations of aqueous aluminum and other chemical species during hydrological episodes at Birkenes, southernmost Norway. J. Hydrol. 108:387-405.

Johnson, C.B., **T.J. Sullivan**, and D.J. Blick. 1989. Defining regional populations of lakes for the assessment of surface water quality. Water Resour. Bull. 25:1-8.

Seip, H.M., N. Christophersen, and **T.J. Sullivan**. 1989. Episodic variations in streamwater aluminum chemistry at Birkenes, southernmost Norway. pp. 159-169. In: Lewis, T.E. (Ed.), Environmental Chemistry and Toxicology of Aluminum, Lewis Publishers Inc., Chelsea, MI.

Sullivan, T.J., C.T. Driscoll, S.A. Gherini, R.K. Munson, R.B. Cook, D.F. Charles, and C.P. Yatsko. 1989. The influence of organic acid anions and aqueous aluminum on measurements of acid neutralizing capacity in surface waters. Nature 338:408-410.

Sullivan, T.J., J.M. Eilers, M.R. Church, D.J. Blick, K.N. Eshleman, D.H. Landers, and M.S. DeHaan. 1988. Atmospheric wet sulfate deposition and lakewater chemistry. Nature 331:607-609.

Sullivan, T.J., C.T. Driscoll, J.M. Eilers, and D.H. Landers. 1988. Evaluation of the role of sea salt inputs in the long-term acidification of coastal New England lakes. Environ. Sci. Technol. 22:185-190.

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Røyset, O. and **T.J. Sullivan**. 1986. Effect of dissolved humic compounds on the determination of aqueous aluminum by three spectrophotometric methods. Int. J. Environ. Anal. Chem. 27:305-14.

Sullivan, T.J. and M.C. Mix. 1985. Persistence and fate of polynuclear aromatic hydrocarbons deposited on slash burn sites in the Cascade Mountains and Coast Range of Oregon. Arch. Environ. Contam. Toxicol. 14:187-192.

Sullivan, T.J. and M.C. Mix. 1983. Pyrolytic deposition of polynuclear aromatic hydrocarbons due to slash burning on clear-cut sites. Bull. Environ. Contam. Toxicol. 31:207-215.

Sullivan, T.J. and M.C. Mix. 1983. A simple and inexpensive method for measuring integrated light energy. Environ. Sci. Technol. 17:127-128.

Sullivan, T.J. 1982. Avian species diversity: Its relation to the competition hypothesis. Proc. Oregon Acad. Sci. 18:10-20

Sullivan, T.J. 1977. Avian and mammalian distribution in the Powderhorn Primitive Area, Colorado. M.A. thesis. Western State College, Gunnison, CO. 209 pp.

Reports

Sullivan, T.J., B.J. Cosby, K.U. Snyder, A.T. Herlihy, B. Jackson. 2007. Model-Based Assessment of the Effects of Acidic Deposition on Sensitive Watershed Resources in the National Forests of North Carolina, Tennessee, and South Carolina. Final report prepared for USDA Forest Service, Asheville, NC. E&S Environmental Chemistry, Inc., Corvallis, OR.

Sullivan, T.J., A.T. Herlihy. 2007. Air Quality Related Values and Development of Associated Protocols for Evaluation of the Effects of Atmospheric Deposition on Aquatic and Terrestrial Resources on Forest Service Lands. Final report prepared for the U.S.D.A Forest Service.

Sullivan, T.J. 2007. What's up with the Air? Shenandoah National Park. National Park Service, Luray, VA.

Sullivan, T.J., C.T. Driscoll, B.J. Cosby, I.J. Fernandez, A.T. Herlihy, J. Zhai, R. Stemberger, K.U. Snyder, J.W. Sutherland, S.A. Nierzwicki-Bauer, C.W. Boylen, T.C. McDonnell, and N.A. Nowicki. 2006. Assessment of the Extent to Which Intensively-Studied Lakes are Representative of the Adirondack Mountain Region. Final Report 06-17. New York State Energy Research and Development Authority, Albany, NY.

Snyder, K., **T. Sullivan**, D. Moore, and R. Raymond. 2006. Lower Umpqua River Watershed Assessment. Prepared for the Umpqua Basin Watershed Council. E&S Environmental Chemistry, Inc., Corvallis, OR.

Snyder, K., **T. Sullivan**, D. Moore, and R. Raymond. 2006. Mill Creek Watershed Assessment. Prepared for the Umpqua Basin Watershed Council. E&S Environmental Chemistry, Inc., Corvallis, OR.

Snyder, K., **T. Sullivan**, D. Moore, and R. Raymond. 2006. Middle Umpqua River Watershed Assessment. Prepared for the Umpqua Basin Watershed Council. E&S Environmental Chemistry, Inc., Corvallis, OR.

Snyder, K., **T. Sullivan**, D. Moore, and R. Raymond. 2006. Upper Umpqua River Watershed Assessment. Prepared for the Umpqua Basin Watershed Council. E&S Environmental Chemistry, Inc., Corvallis, OR.

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Webb, J.R., **T.J. Sullivan**, and B. Jackson. 2004. Assessment of Atmospheric Deposition Effects on National Forests. Protocols for Collection of Supplemental Stream Water and Soil Composition Data for the MAGIC Model. Report prepared for USDA Forest Service, Asheville, NC. E&S Environmental Chemistry, Inc., Corvallis, OR.

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Sullivan, T.J., B.J. Cosby, J.R. Webb, K.U. Snyder, A.T. Herlihy, A.J. Bulger, E.H. Gilbert, and D. Moore. 2002. Assessment of the Effects of Acidic Deposition on Aquatic Resources in the Southern Appalachian Mountains. Report prepared for the Southern Appalachian Mountains Initiative (SAMI). E&S Environmental Chemistry, Inc., Corvallis, OR.

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Cosby, B.J. and **T.J. Sullivan**. 2001. Quantification of dose-response relationships and critical loads of sulfur and nitrogen for six headwater catchments in Rocky Mountain, Grand Teton, Sequoia, and Mount Rainier National Parks. Report 97-15-01. E&S Environmental Chemistry, Inc., Corvallis, OR.

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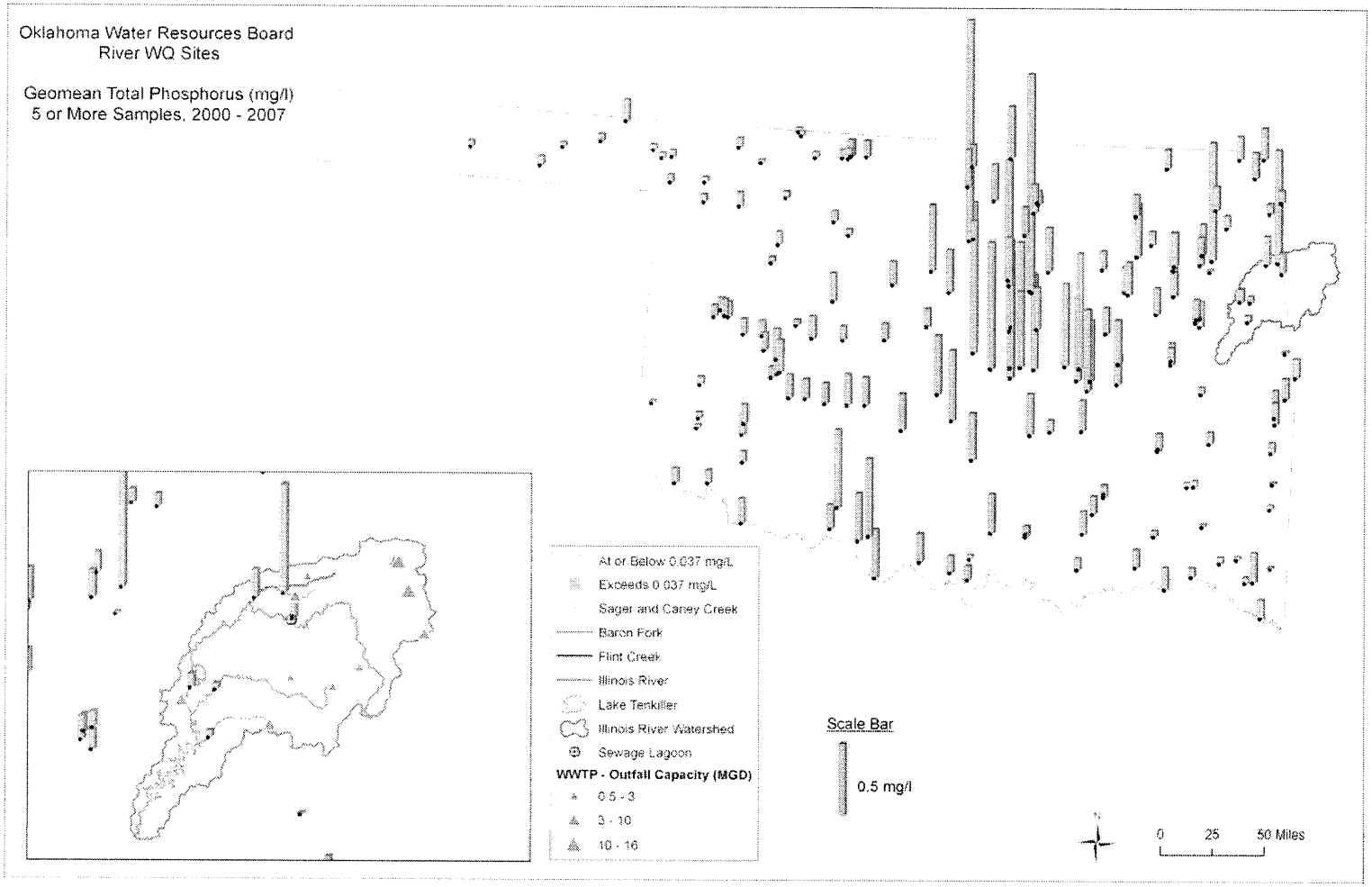

Figure 2-1. **Map showing the geomean of total phosphorus concentration measured at all sites in Oklahoma represented in OWRB's database by five or more samples. The height of each bar is proportional to the geomean concentration. Dots at the base of each bar show the locations of sample collection. The boundaries of the IRW are shown in eastern Oklahoma and northwestern Arkansas. Samples that exceed the 0.037 mg/L standard are shown in orange; those that do not exceed the standard are shown in green. The one very high bar within the IRW is located on Sager Creek, approximately 3 miles below the Siloam Springs WWTP.**