Exhibit 4

Comments of Michael D. Smolen, Ph.D.

Lithochimeia, LLC

COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT ASSESSMENT OF C & H HOG FARMS, NEWTON COUNTY, ARKANSAS

Report to Earthjustice

Michael D. Smolen, Ph.D. Lithochimeia, LLC

8/28/2015

COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT ASSESSMENT OF C & H HOG FARMS, NEWTON COUNTY, ARKANSAS

M. D. SMOLEN, LITHOCHIMEIA, LLC. AUGUST 28, 2015

I have been asked by Earthjustice to review and comment on the USDA and SBA Draft Environmental Assessment of C & H Hog Farms[1], specifically with respect to water quality and nutrient management.

I. PROFESSIONAL EXPERIENCE AND EXPERTISE

My credentials and expertise in the area of water quality, and particularly the agricultural impact on water quality, extend back to 1973 when I began my career studying the impact of point and nonpoint sources on water quality. I earned my Ph.D. in Environmental Science and Engineering from Virginia Tech in a study of various sources of pollution in the Occoquan Watershed in Northern Virginia. Since that time I have focused primarily on agricultural water quality addressing watershed management, livestock waste management, nutrient management planning, and agricultural best management practices. I have studied design of waste treatment systems and nutrient management in cropland, and I have conducted research on agricultural pollution control, evaluating conservation practices, nutrient management, and animal waste management practices and their water quality impacts.

As Director of the National Water Quality Evaluation Project at North Carolina State University, I was the technical advisor to USDA and EPA on the Federal Clean Water Program, and developed guidance for states to meet requirements of the 1987 Nonpoint Source amendments to the Clean Water Act. From 1990 to 2010 I was the Coordinator of Water Quality programs for the Division of Agricultural Sciences and Natural Resources at Oklahoma State University. Since my retirement from OSU in 2010, I have consulted on water quality issues in North Carolina, New York, West Virginia, the Chesapeake Bay, and Arkansas. My numerous research papers and articles on agricultural pollution control, watershed management, and other areas affecting the quality of water resources and the various awards and recognitions for my work are presented in my curriculum vitae, which is attached.

II. BACKGROUND

I have reviewed the original Notice of Intent submitted by C & H Hog Farms to the Arkansas Department of Environmental Quality (ADEQ) in 2012[2], the 2014 Annual Report submitted by C & H Hog Farms[3], and the first proposed permit modification in 2015[4]. These reviews found a number of deficiencies in the original permit application and some issues that, although not addressed by the requirements of the permit, are particularly important for protection of the Buffalo River. Although some of these issues have been addressed, many persist till the present and have not been treated adequately in the Environmental Assessment.

Water Quality issues are discussed below in two groups: (1) Waste Storage Pond Design and Management, (2) Nutrient management and waste disposal. I conclude with some general

comments on the water quality observations and the inadequacy of the Arkansas permit and its associated Nutrient Management Plan.

III. WASTE STORAGE POND DESIGN AND MANAGEMENT

A. *Leakage from Waste Storage Ponds*

The ADEQ permit provides minimal protection from storage pond leakage, allowing as much as 5,000 gal/acre per day to leak through the clay liner. C&H's clay liner was designed based on analysis of only one soil sample and there was no testing of the permeability of the final liner construction. The high shrink-swell potential of the liner materials have a tendency to crack when allowed to dry, increasing the potential for leakage during the cycle of filling and emptying the ponds. An EPA inspection conducted April 15-17, 2014 found that the upper edge of the clay liner were protected by erosion control fabric, but did not indicate any effort to prevent liner cracking.

The EA indicates that C & H intends to install a HDPE plastic liner in the existing waste storage ponds. The original concerns for leakage could be alleviated by installation of such a liner, but retrofitting it to the C&H facility is not a simple matter. All seams must be carefully welded and tested, and there must be no organic matter decomposing under the liner as a gas bubble would cause the liner to float. Until I can be assured this liner is installed properly, my concern for leakage from the ponds remains.

B. *Danger of Embankment Failure*

The two waste storage ponds are situated on the side of a steep slope and designed to contain all waste, wash water, and rain water, including a 25-yr 24-hr design storm without discharging. The design meets the requirements of the CAFO permit and ADEQ, but does not consider the special nature of the Buffalo River. Because the waste pond design assumes there will be no discharge, the second pond in the series has no stabilized, emergency outlet. If the pond were to overtop the embankment due to a very large storm (much greater than the design storm) or a prolonged period of wet weather, or a combination of wet weather and extreme storm, there would be a danger of catastrophic failure of the embankment. Such failure could release as much as 2 million gallons of waste into the Buffalo River, a disaster not unlike the recent mine waste disaster in Colorado. In high risk areas, it is standard practice to include a stabilized outlet to allow discharge without failure of the embankment.

In addition, the waste system design assumes that overtopping can be avoided by pumping wastes from the waste storage ponds to a designated area, specifically Field 7. This plan is unrealistic, however, for two reasons. First, the farm does not appear to have a pumping system with sufficient capacity to pump down the waste storage ponds in an emergency (this is indicated by their request to use vacu-tankers for pumping down waste storage pond 2 in the Permit Modification Request), and second because the designated field, Field 7, is one of the worst places to use for emergency waste disposal because of its location directly adjacent to Big Creek and its high soil test P. Vacu-tankers or other wheel vehicles would not be suitable for waste application in extremely wet weather, and Field 7 is very likely to flood during such a period.

IV. NUTRIENT MANAGEMENT AND WASTE DISPOSAL

The nutrient management plan at C &H Hog Farms is based on disposal of Phosphorus as most of the fields already have medium to very high soil test P levels, and the crop has little to no need for additional P fertilizer. Consequently the Arkansas Phosphorus Index (API) is used to justify application of waste beyond the P-requirement of the crop. In my opinion, fields that receive waste application in amounts that exceed the crop requirements should be considered waste disposal making them potentially subject to stormwater rules.

C&H's Nutrient Management Plan indicates that virtually all of its designated fields are intended to receive waste application greater than the crop requirements, and some will exceed both the Nitrogen and Phosphorus requirements of the crop. As highlighted in the table below, the 2014 Annual Report to ADEQ showed that either N or P (or both) was applied in excess of the approved amounts in 6 fields (Fields 3, 4, 10, 13, 14, and 15) during 2014. This is surprising considering that some fields (6, 7, 9, and 13) allow application of very high amounts of waste.

Comparison of waste applied by field in 2014 with that approved in C&H permit (source C&H Annual Report 1-27-2015)

Field	Waste galx1000		N lb Total		P2O5 Total lbs	
	approved	actual	approved	applied	approved	applied
1	69.6	46	2,927	773	2,265	833
2	34.0	22.6	1,266	380	973	409
3	120.2	118.1	1,023	1,984	786	2,138
4	43.7	28.8	655	484	503	521
5	0.0		11,621			
6	0.0		16,895			-
7	464.9	396.2	36,346	6,656	27,921	7,171
8	146.5	25	7,583	420	5,826	453
9	312.0	103.8	20,178	1,744	15,501	1,879
10	527.4	249.2	4,487	4,187	3,449	4,511
11	140.6	51	1,541	857	1,184	923
12	163.5	48	2,668	806	2,050	869
13	503.9	453.55	4,587	7,620	3,526	8,209
14	72.3	73	1,340	1,226	1,030	1,321
15	318.8	401.4	1,543	6,744	3,492	7,265
16	212.8	56	8,380	941	6,441	1,014
17	574.2	294.75	12,006	4,952	9,228	5,335
Total	3,704.4	2,367.4	135,046	39,772	84,175	42,850

The continued over-application of P-rich waste water will result in buildup of soil P and increasing loss of P to nearby Big Creek and the Buffalo River. Soil-P-buildup is particularly likely if the fields are grazed by cattle rather than harvested for hay. Whereas cutting hay and removing it from the field removes nutrients, grazing by cattle removes very little as most of the nutrients remain in the field, promoting soil-P buildup. If the fields are grazed without removing

hay, the N-requirement of the crop is very much reduced making the NMP invalid. [It is not clear from the reports and the plans which, if any fields, will be harvested for hay and which will just be grazed. In the Draft EA only Fields 1, 2, and 4 are indicated as Rotational Grazing, and the rest are indicated as Hayland. On the other hand, the Certified Nutrient Management Plan submitted to ADEQ by C&H on December 22, 2013[5] showed only Fields 3, 8, 15, and 17 designated for grazing, and the Annual Aggregate Phosphorus spread sheet submitted February 26, 2015[6] indicates all fields designated for grazing. Further, all soil test samples submitted to UA for the initial NOI indicated grazing as the intended use of the fields.]

V. KARSTIC FEATURES, GRAVEL LENSES, AND FLOODING

The Draft EA states there are no flood plains in the C&H waste disposal area (page 3-2). This is clearly in error, as the fields directly adjacent to Big Creek and specified for waste application (Fields 3, 5, 6, 7, 9, 12, and 16) are indicated in the soil survey as "occasionally flooded" (Draft EA page 3-22). Although not identified as flood plain, these fields are the flood plain of Big Creek, as indicated by their position on the landscape, their low slope, and the presence of buried gravel lenses and alluvial soils (see the University of Arkansas Big Creek Research and Extension Team (BCRET) Quarterly Report April-June 2014[7]).

It has been well-documented that the Buffalo River watershed and Big Creek are generally underlain by limestone with sink holes, solution caverns, cherty soils, and gravel lenses (see reports by Brahana and others). Indications of gravel lenses, cherty soils, and even karst were found in the University of Arkansas Ground Penetrating Radar (GPR) study. This was confirmed by Electrical Resistivity Imaging in an Oklahoma State University Study (Fields and Halihan, BCRET 2nd Quarter 2015 Report[8]). Never-the-less, the EA dismisses karst as an issue.

Epikarst with coarse chert, and gravel lenses, as observed in the BCRET and OSU studies indicate that short-circuit pathways from the disposal fields to Big Creek and the Buffalo River are likely. Although UA and OSU only studied two fields, their results provide strong evidence that such features are active throughout the area along Big Creek, where hog waste will be spread by C&H, and excessive application of waste in this area is a threat to the Buffalo River.

VI. GENERAL COMMENTS

A. *Water quality observations*

The Draft EA presents water quality observations from the BCRET study as evidence that C&H Hog Farms has no impact on water quality of Big Creek or the Buffalo River. Although the BCRET study is very well instrumented, and the researchers are qualified to conduct the research they have undertaken, the results do not address the question at hand. First, the observations run for a period only 18 months, roughly the period that C&H has been in operation. This is a short period of record, and an even shorter period for waste disposal by C&H. A period of 5 to 10 years is needed to establish the impact on a large water body like Big Creek. Further the data are incomplete; the record does not show the location and timing of land application of wastes making it even more difficult to establish any cause-effect relationship.

Considering the watershed is very large and C&H has been in operation for only a short time, it is very difficult if not impossible to measure its impact on Big Creek. However in the long term, this impact is likely to become visible.

B. *Inadequacy of the Arkansas permit to protect the Buffalo River*

In my opinion the Arkansas CAFO general permit generally is not adequate to protect the High Quality resource of the Buffalo River. The C&H permit demonstrates this clearly. C&H has been allowed to operate with as much as 5,000 gal/acre per day leakage of waste from the waste storage ponds. Considering the cherty soils and karstic nature of the limestone bedrock, this leakage could be funneled directly into the river. Second, having a large waste storage pond on the side of a steep slope without a reinforced emergency outlet could result in disaster if there is a wet weather period compounded by a hurricane dumping 10- to 20 inches of rain in a few days. Third, the designated area for emergency pumping is a flood plain that is likely to have saturated soils or even be flooded when it is needed. Fourth, the permit allows C&H to continue to apply waste to soils that already have more P than is required by the growing crop

As implemented, the Arkansas permit allows a great deal of flexibility for the operator. The C&H nutrient management plan, which is a term of the permit, allows the operator to plan extremely high application rates, which if followed, would definitely contaminate the water resource. Only through the continued scrutiny of inspectors and interested citizens has this flexibility been constrained. Even so, several fields have been overloaded with waste, beyond that approved in the plan. This is likely to become more important and damaging to the quality of Big Creek as C&H continues to operate.

VII. REFERENCES

[1] USDA Farm Services Agency and US Small Business Administration, Draft Environmental Assessment of C&H Hog Farms, Newton County, Arkansas, August 2015

[2] NPDES Notice of Intent (NOI) ARG590000. Submitted by Jason Henson June 6, 2012.

[3] Annual Report Form for CAFO Operation Under the NPDES General Permit ARG590000, submitted by Jason Henson January 27, 2015

[4] Letter from Jason Henson to John Baily, January 24, 2015, Re: Major Modification Request – Utilization of Waste Storage Pond 2 AFIN: 51-00164, Permit No.: ARG 59001

[5] Letter from Jason Henson December 22, 2013 containing Nutrient Management Plan Cool Season Application Rates AFIN: 51-00164, Permit No.: ARG590001.

[6] Letter from Jason Henson to John Baily, February 26, 2015. Re: 2014 Annual Report. AFIN: 51-00164, Permit No.: ARG590001

[7] Big Creek Research and Extension Team, University of Arkansas System Division of Agriculture. Quarterly Report April 1 to June 30, 2014.

[8] Jon Fields and Todd Halihan. Preliminary Electrical Resistivity Survey of Mount Judea Alluvium Sites. 2nd Quarter Report. Boone Pickens School of Geology, Oklahoma State University.

Curriculum Vitae

Michael D. Smolen
3409 South Washington Av., Stillwater, OK 74074

Educational Background:

Ph.D. Environmental Sciences and Engineering, VA Polytechnic Inst. and State University, 1976.
MS. Botany (Minor in Biochemistry), University of Tennessee, 1970.
BS. Biology (Minor in Chemistry), University of Rochester, 1967.

Employment History:

August 2010 – Present Lithochimeia, LLC**.** Water Quality and Agricultural Waste Management Specialist and Agricultural Project Manager.

July 2010 - Present Professor Emeritus, Biosystems and Agricultural Engineering Department, Oklahoma State University

July 1994 – 2010. Professor, Biosystems and Agricultural Engineering Department, Oklahoma State University, Water Quality Coordinator for Division of Agricultural Sciences and Natural Resources. Member of Graduate Faculty.

November 1990 - June 1994. Associate Professor, Biosystems and Agricultural Engineering Department, Oklahoma State University, Water Quality Coordinator for Division of Agricultural Sciences and Natural Resources. Associate member of Graduate Faculty.

August 1985 to November 1990. Visiting Associate Professor, Biological and Agricultural Engineering Department, North Carolina State University. Leader of the Water Quality Group and principal investigator on all Group projects. Associate member of Graduate Faculty.

July 1983 to July 1985. Visiting Assistant Professor, Biological and Agricultural Engineering Department, North Carolina State University. Principal Investigator for the National Water Quality Evaluation Project and related water quality investigations. Associate member of Graduate Faculty.

January 1980 to July 1983. Assistant Professor, Agricultural Engineering Department, Virginia Polytechnic Institute and State University (VPI&SU). Research (80%): soil conservation and water quality management for agriculture and surface mining. Developed water quality laboratory and hydrologic/water quality monitoring program. Teaching 20%: Hydrologic Modeling, Animal Waste Management, and Microcomputer Programming.

July 1976 to December 1979. Assistant Professor, Southern Piedmont Research and Continuing Education Center, VPI&SU, Blackstone, VA. Project leader for Environmental Quality Research. Developed field monitoring and water quality laboratory.

February 1975 to June 1976. Research Associate, Southern Piedmont Research and Continuing Education Center, VPI&SU, Blackstone, VA. Developed proposals and plans for environmental research.

September 1972 to January 1975. Graduate Research Assistant, Civil Engineering Department, VPI&SU. Assisted in setting up laboratory and field sampling protocol for the Occoquan Watershed Monitoring Laboratory.

Professional Society Membership:

American Society of Agricultural and Biological Engineers (since 1975)
American Geophysical Union (since 1976)
American Association for the Advancement of Science (since 1976)
American Water Resources Association (since 1987)
Oklahoma Clean Lakes and Watersheds Association (since 1991)

Professional Consulting Lithochimeia, LLC (2010 to present)

Dairy Waste Management and, Diary CAFO rules, Swine Waste Treatment Technology, Evaluation of Swine CAFOs, Poultry Waste Management – Waterkeeper Alliance, Earth Justice
EPA Chesapeake Bay Program

Independent Professional Consulting (1982-present)
Aamodt Law Firm (2003, 2008, 2010, 2012, 2013) – Consulting Expert Stormwater and Sediment Control litigation
Texas Commission on Higher Education (2003, 2009) – Review of Environemntal Research Proposals
Johnston and Associates (2002) – Stormwater and Sediment Control litigation
City of Austin, Austin, TX (1998) – Stormwater and Sediment Control Education
University of Nebraska, Lincoln, NE (1997) – Develop undergraduate curriculua for Quantitative Biology in Engineering
Water Environment Research Foundation, Alexandria, VA (1995-97) – Review of water quality project
US Environmental Protection Agency, Science Advisory Board, Washington, DC (1987) – Nonpoint Source Pollution Policy
Woodward-Clyde Consultants (1987) – Water quality monitoring methods
Research Triangle Institute, Research Triangle Park, NC (1985) – evaluation of water quality research
VPI&SU Agricultural Engineering Dept. Blacksburg, VA (1984) – Finite Element Modeling for Hydrology and Water Quality Simulation
U. S. Army Corps of Engineers. Vicksburg, MS (1983) – Development of infiltration and lateral flow component for the HELP model for landfill design
GKY and Associates, Springfield, VA (1982) – Review of water quality research

Grant Support for Eduction and Research (Selected Projects):

Water and Waste Technology Projects

Oklahoma Tribal Institute for On-Site Wastwater Treatment Systems. 2007-2008. US EPA. M. D. Smolen, M. Kizer, L. McCowan OSU: $18,101; Federal: $32,750; Total: $50,851.

Reducing Nutrient Loss from Lawn, Garden, Parks and Golf Courses in the Grand Lake. 2005-2008. EPA and OCC. H. Zhang, D. Martin, M. D. Smolen Federal: $119,933; State: $79,837; Total: $199,770.

Grand Lake Education Support. 2006-2008. EPA, OCC, and OSU. M. D. Smolen. EPA/OCC: $49,000; OSU: $32,667; Total: $81,667.

Bioretention Cell Design, Evaluation and Technology Development in Grand Lake Watershed. 2005-2008. EPA and OCC. G. Brown, D. E. Storm, M. D. Smolen. Federal: $249,313; State: $166,206; Total: $415,519.

Soil Sampling Technique and Nutrient Variability Demonstration in a Nurtrient Limited Watershed. 2004-2008. EPA and OCC. H. Zhang, M. D. Smolen. Federal: $28,402; State: $18,935; Total: $47,337.

Nonpoint Source Education Program for Spavinaw Creek Watershed. 2004-2007. OCC. M. D. Smolen, J. Hollenback, M. Beem, B. Ross. OCC: $172,848; State: $116,120; Total: $288,968

Erosion Control on Rural Unimproved Roads in Stillwater Creek Watershed. 2002-2006. OCC. M. D. Smolen, D. Turton, D. Wright, M. Hinkston. EPA: $102,600; OSU: $68,400; Total: $171,000. (Completed)

Nonpoint Source Education Program in Stillwater Creek Watershed. 2002-2006. OCC. M. D. Smolen, B. Barfield, D. Martin, D. Hillock, M. Schnelle, T. Bidwell, P. Bolin. Federal: $87,000; State: $58,000; Total: $145,000. (Completed)

A Nutrient Management Decision Support System for the Eucha Basin. 2002-2005. USDA/CSREES and EPA. M. Matlock, I. Chaubey, B. Haggard, D. E. Storm, M. D. Smolen, W. Focht. Federal: $686,000.

Oklahoma Green Country Watershed Education Project. 2001-2004. USDA/CSREES. M. D. Smolen and W. Ross. Federal: $267,000. (Completed)

Illinois River Basin Education Program (Continuation). 2000-2002. USDA/CSREES. Federal: $56,700. Total: $94,500. (Completed)

Demonstration of Best Management Practices in the Salt Fork Watershed. 1997-2001. US EPA. M. D. Smolen, D. E. Storm, G. Cuperus, R. Gribble, J. Stiegler, G. Johnson, G. Krenzer, R. LeValley, S. Price, H. Zhang. Federal: $90,000; OSU: $60,000; Total: $150,000. (Completed)

Capture and Recycle Technology for Pollution Prevention in the Nursery Industry. 1996-2001. U.S. EPA. S. von Broembsen, M. Schnelle, R. Elliott, and M. D. Smolen. Federal: $94,500; State: $63,000; Total: $157,500. (Completed)

Small Farm Animal Waste Education Program. 1995-1999. U. S. EPA/OCC. D. Hamilton and M. D. Smolen. Federal: $160,000; State: $120,000; Total: $280,000. (Completed)

Swine Waste Management Education. 1994-1998. U.S. EPA and OCC. D. Hamilton and M. D. Smolen. Federal: $26,000; State: $17,333; Total: $39,333. (Completed)

Evaluation of BMPs to Protect Surface Water Quality from Pesticides and Nitrogen Applied to Common Bermudagrass Fairways. 1995-1998. U.S. Golf Association. J. Baird, R. Huhnke, D. E. Storm, M. D. Smolen. $38,889. (Completed)

Poteau River Comprehensive Watershed Management Program. 1994-1999. U.S. EPA and OCC. M. D. Smolen, D. E. Storm. Federal: $245,000; OSU: $163,334; Total: $408,334. (Completed)

Demonstrating BMPs to Protect Surface Water Quality from Land Application of Animal Wastes. 1994-1996. U. S. EPA and OCC. D. E. Storm, R. Huhnke, E. Allen, N. Basta, M. D. Smolen. Federal: $115,763; Total: $192,938. (Completed)

Estimating the Nonpoint Source Pollution Loading for the Grand Lake Basin Management Plan. 1994-1995. EPA and OCC. D. E. Storm and M. D. Smolen. $12,963. (Completed)

Evaluation of Hydrologic/Water Quality Models. 1993-1994. U.S. Geological Survey. C. T. Haan, D. E. Storm, and M. D. Smolen. Federal: $13,500; State: $27,000; Total: $40,500. (Completed)

Application of Geographic Information Systems for Developing a Total Maximum Daily Load (TMDL) System for the Upper Poteau River Basin. 1992-1994. Targeted Research Initiative Program, Oklahoma Agricultural Experiment Station. D. E. Storm, M. D. Smolen, C. T. Haan, G. W. Sabbagh, and M. S. Gregory. Total: $17,000. (Completed)

Basin-wide Pollutant Inventory for the Ilinois River Comprehensive Basin Management Program. 1992-1994. OCC. D. E. Storm, M. D. Smolen, D. W. Toetz, J. Wilhm, D. J. Turton, and C. T. Haan. Federal: $57,000; State: $24,075; Total: $81,075. (Completed)

Influence of Media, Fungicide Application Methods and Wetting Agents on the Amount of Fungicides Leaching from Container Grown Crops. 1992-1994. Targeted Research Initiative Program, Oklahoma Agricultural Experiment Station. S. L. von Broembsen, N. T. Basta, J. M. Dole, and M. D. Smolen. Total: $16,860. (Completed)

Poultry and swine litter disposal system. 1992-1993. Targeted Research Initiative Program, Oklahoma Agricultural Experiment Station. D. E. Storm, M. D. Smolen, C. T. Haan, R. L. Huhnke, N. T. Basta, and A. Sharpley. Total: $10,600. (Completed)

Illinois River Basin Non-Point Source Management. 1991-1997. US EPA and OCC. Federal: $40,400; Total: $67,334. (Completed)

Peacheater Creek Hydrologic Unit Area Project. **1991-1999. USDA/CSREES. Federal: $425,000;**

Battle Branch Hydrologic Unit Area Project. 1990-1998. USDA/CSREES. Federal: $560,000; Total: $840,000. (Completed)

Enhancement of the effectiveness of vegetative filter strips by dispersion of agricultural runoff. 1989. North Carolina, WRRI. E. C. Franklin, J. D. Gregory, and M. D. Smolen. Total: $39,831.

Estimation of nonpoint source loading factors for the Chesapeake Bay model. US EPA and USDA. M. D. Smolen and F. J. Humenik. Total: $77,000.

Development of a database system on the performance and selection of agricultural nonpoint source control practices. US EPA. M. D. Smolen and F. J. Humenik. Total: $38,000.

Impact of conservation practices and resource management systems on the quantity and quality of surface and ground water: a review of existing data sources. USDA. M. D. Smolen and F. J. Humenik. Total: $32,992.

Best management practice evaluation study. Virginia State Water Control Board. M. D. Smolen. Total: $119,903.

Simulating the hydrologic response of small forested watersheds. US Forest Service. M. D. Smolen. Total: $12,654.

Predicting soil loss for surface mined areas. Virginia State Mining and Minerals Research Institute. M. D. Smolen. Total: $20,000.

Effect of tillage practice on runoff quantity and quality. Virginia Water Resources Research Center. M. D. Smolen. Total: $10,329.

Effect of agricultural land use on the chemical quality of runoff and ground water. Virginia Water Resources Research Center. M. D. Smolen and V. O. Shanholtz. Total: $39,000.

Drinking Water and Ground Water Protection Projects

Drinking Water Education for Under-Served Communities. 2003-2007. USDA/CSREES. M. D. Smolen, L. McCowan. USDA: $250,000.

Well Head Protection and Water Testing in Rural Minority Communities. 1999-2000. USDA/CSREES. R. Vick, M. D. Smolen, K. Williams. (Langston University). Federal: $33,500; Total: $41,040. (Completed)

Well Head Protection Education in the South Canadian Watershed. 1997-2001. US EPA. M. Beem, N. Lansford, M. D. Smolen. Federal: $90,000; State: $60,000; Total: $150,000. (Completed

Evaluating Best Management Practices to Control Nitrate Contamination in Ground Water. 1993-1994. U.S. Geological Survey. D. E. Storm, M. D. Smolen, and M. A. Kizer. Federal: $13,314; State: $26,628; Total: $39,942. (Completed)

Channel Restoration and Riparian Management

Cow Creek Stream Restoration and Streambank Stabilization Project. 2009-2012. OCC/OWRB/EPA-ARRA. D. Maronek, M. D. Smolen, G. Fox, G. Brown. Total: $2,000,000.

Technical Assistance for the Establishment and Maintenance of Riparian Corridors. 1998-2000. U.S. EPA and OCC. M. D. Smolen. Federal: $57,390; OSU: $38,260; Total: $95,650. (Completed)

Characterization of Stream bank Erosion on the Illinois River in Northeast Oklahoma. U.S. EPA and OCC. Lead PI: C. T. Haan; Co-PI: M. D. Smolen, D. E. Storm. Federal: $12,000; OSU: $8,000; Total: $20,000. (Completed)

Management Program for Riparian Wetlands to Protect Water Quality. 1994-1998. U.S. EPA and OCC. M. D. Smolen and J. Hassell. Federal: $140,000; State: $60,000; Total: $200,000. (Completed

Water and Waste Policy

Alternative Water Conservation Policy Tools for Oklahoma Water Systems. 2009-2010. OWRRI. D. Adams, M. D. Smolen, L. Sanders. State: $50,000.

Water Conservation Programming and Website Development for Coordinating Extension and Research for the Environmental Quality and Waste Management Team. 2008-2009. OCES. M. D. Smolen, L. Sanders, M. Kizer, R. Daugherty, et al. Total: $27,808.

Deliberative Forum Framework for Water Issues for the Environmental Quality and Waste Management Team. 2008-2009. OCES. R. Daugherty, C. Bess, M. D. Smolen, L. Sanders, L. McDaniel Total: $19,011.

Development of a Stakeholder Involvement Component for the 2005 Oklahoma Comprehensive Water Plan (Listening Sessions). 2007-2011. OWWRI/OSU. M. D. Smolen, M. Kizer, L. Sanders, J. Schatzer, R. Daugherty, L. McCowan, S. Williams. OWRRI: $86,240; OSU: $26,662; Total: $112,702.

Partners Cooperating to Enhance Rural Waste Management Programs and Protect Natural Resources. 2006-2007. USDA and RUS. G. Doeksen, S. Kimball, M. D. Smolen, L. McCowan Total: $82,000.

Support for Implementing Effective Statewide Water Quality Programs in Oklahoma. 1994-1998. Oklahoma Board of Agriculture. M. D. Smolen and D. E. Storm. $35,000. (Completed)

Review of Animal Waste Control Options. 1994. In cooperation with the University of Oklahoma. Oklahoma Office of Secretary of Environment. M. D. Smolen, P. Norris. $10,000. (Completed)

Examination of Potential Risks to Water Quality from Animal Waste Applied to Soils of Eastern Oklahoma. 1990-1992. USDA/SCS. R. L. Huhnke, D. E. Storm, G. O. Brown, M. D. Smolen, B. J. Carter. Federal: $50,000; OSU: $45,000; Total: $95,000. (Completed)

Economic analysis of alternative cropland selection algorithms to promote water quality benefits under the Food Security Act of 1985. US EPA. M. D. Smolen and F. J. Humenik. Total: $64,989.

Guidance document on economic targeting of NPS implementation. US EPA. M. D. Smolen and F. J. Humenik. Total: $15,700.

National water quality evaluation project. 1981-1992. USDA, US EPA. Evaluation and technical assistance to the Rural Clean Water Program. M. D. Smolen and F. J. Humenik. Total: $1.95 million.

Workshops, Conferences, and Tours Organized (Selected)

Tribal Onsite Waste Treatment. Workshop Organizer. October 21, 2009. Stroud, OK.

From Dust Bowl to Mud Bowl: Sedimentation, Conservation Measures and the Future of Reservoirs. Conference Planner. September 14-16, 2009. Kansas City, KS.

Southern Region Biennial Water Quality Conferences. Program Chair: 2001, 2003, 2005, 2007.2009 Sponsored by the Southern Regional Water Quality Program and USDA-CSREES. Gulf Shores, AL., Ruidoso, NM. , Lexington, KY., Fayetteville, AR.

National Extension Water Quality Coordinators Conferences. Program Chair: 1999, 2000, 2001. Sponsored by USDA-CSREES. St. Louis, MO., San Antonio, TX., Boise, ID.

Water Quality Collaborative Conference, 1890-1862-1994 Land Grant Institutions Chair of Planning Committee Sponsored by the Southern Region Water Quality Program and CSREES. July 12-14, 2004

Riparian Area Management Workshops. One-day workshops for technical staffs of NRCS, Extension, Tribes, and other organizations. Conducted at 9 locations around Oklahoma, October 1998 through June 1999.

Water Quality and Animal Waste Conference. Oklahoma Chapter of AWRA. Oklahoma City. April 4-6, 1998.

Eco-Camp. Environmental Issues Camp. (June 1997, 1998) With Joe Bullard, Billie Chambers, Larry Sanders, Marty Green, Becki Rhea, and Marley Beem) Three days of camp for teenage youth were conducted in LeFlore County. Camp was initially funded by EPA Environmental Education Grant.

Regional CAFO Conferences for Producers. Educational support for animal producers to explain the EPA General Permit for Discharge from Concentrated Animal Feeding Operations (CAFOs). Five one-day conferences were held in: Broken Bow, Muskogee, Ft. Cobb, Enid, and Guymon. November 1993.

Satellite Teleconferences on Greenhouse IPM. Two educational programs down linked in 26 states. Developed and appeared in water quality segment. July and August 1993.

Satellite Teleconferences on the EPA Region 6 General Permit for Discharge from Concentrated Animal Feeding Operations (CAFOs). Two broadcasts, one afternoon telecast to answer questions for Extension and SCS staffs, a second evening telecast to answer questions from livestock producers. Both conferences featured EPA staff, the Commissioner of Agriculture, and the CAFO work group. April 21, 1993.

Animal Waste Management, Technical Conference. Conference to introduce the EPA General Permit for Discharge from CAFOs to the technical support agencies and private consultants. Conducted with the Oklahoma RC&D Council and SCS. Oklahoma City, October 6-7, 1993.

Storm Water Management and Sediment Control Training for Developers and Contractors. Sponsored by the Tulsa Builders Association. Developed with the Soil Conservation Service. September 1993.

Storm Water Management and Sediment Control Training for City of Tulsa Engineers and Inspectors. Planning committee with the Soil Conservation Service. June 1993.

Tulsa Blue Thumb Volunteer Water Quality Training. Thirty-three volunteers participated in eight-week water quality training. February through April 1993.

ASAE Urban Storm water and Sediment Control Tour. Planned and conducted at the 1992 ASAE Summer International Meeting. Charlotte, NC. June 1992.

Oklahoma-Arkansas Illinois River Tour. Three-day tour of the Illinois River Watershed coordinated with the Oklahoma Conservation Commission, the Arkansas Conservation Commission, the Arkansas Cooperative Extension Service and the Oklahoma Cooperative Extension Service. May 1992.

Public Meetings for the Illinois River Basin project. Four separate public meetings for Decision Makers, Nursery and Greenhouse Operators, Recreation Industry Operators, and Agricultural Producers to discuss water quality concerns and explore possible solutions. Conducted with the Oklahoma Conservation Commission. February 1992.

Battle Branch Tour of Best Management Practices for Public Officials. Adair County Cooperative Extension Service. June 1991.

Dissertations (7) and MS Theses (7):

Steven Bond. 2010. MS Thesis Topic: Rhizospheric Phosphorus and Nitrogen Reduction and Increased Infiltration in Bioretention Cells wiith Vascular Plants.

Adrian Sherman. 2009. MS Thesis Topic: Occurrence and Distribution of Fecal Indicator Bacteria with Respect to Urban and Rural Land Uses.

Khrishna E. Wright. 2007. MS Thesis Topic: Feasibility of Aquifer Storage Recovery for the Mustang, Oklahoma Well Field.

Carol V. Crouch. 2004. PhD Dissertation Topic: An Investigation of Perceptions, Concerns, and Awareness of Environmental Issues among American Indians.

Maifan Silitonga. 2004. PhD Dissertation Topic: Framework for Evaluating Impact of a CAFO in a Wellhead Protection Area. Oklahoma State University. Dissertation. Oklahoma State University.

Peter A. Kish. 2004. PhD Dissertation Topic: Effects of Roundup, Glean, Aatrex, and Their Active Ingredients (Glyphosate, Chlorsulfuron, and Atrazine) On Periphyton Communities Studied by Using Matlock Periphytometer and Bottle Tests. Oklahoma State University.

Brian R. Tucker, 2000. MS Thesis Topic: Poultry Litter Management Strategies to Reduce Phosphorus and Nitrogen in Runoff from Pastures. Oklahoma State Univeristy.

Thomas Jack Alexander, 1999. PhD Dissertation Topic: Evaluation of Performance and Management Strategies for a Nursery Irrigation Recycling System Designed for Pollution Control. Oklahoma State University.

Scott Stoodley, 1998. PhD Dissertation Topic: Economic Feadibility of Riparian Buffer Implementation – Case Study: Sugar Creek, Caddo County, Oklahoma. Oklahoma State University.

Maifan Silitonga, 1998. MS Thesis Topic: Evaluation of Risk Screening Versus Oklahoma Risk-Based Corrective Action for the Wellhead Protection Areas. Oklahoma State University.

Joseph D. Eigel. 1989. PhD Dissertation Topic: Application of Body Conforming Grids to Drainage Problems. North Carolina State University. (Co-Chairman with R. W. Skaggs).

Andrezj Baniukiewicz. 1983. PhD Dissertation Topic: Approximate Analytical Solutions for Modeling Subsurface Flow. Dissertation. Virginia Polytechnic Institute and State University. (Co-Chairman with C. Y. Kuo)

Eugene R. Yagow. 1983. MS Thesis Topic: Erosion and Nutrient Loading Characteristics in Two Small Agricultural Watersheds in Piedmont Virginia. MS Thesis. Virginia Polytechnic Institute and State University.

Susan M. Trapanese. 1982. MS Thesis Topic: A Systems Approach to Evaluate Water Quality Oriented Land Management Plans. MS Thesis. Virginia Polytechnic Institute and State University.

Publications:

Fact Sheets and other Extension Publications:

Whose Water is it Anyway? Comparing the Water Rights Frameworks of Arkansas, Oklahoma, Texas, new Mexico, Georgia, Alabama, and Florida. M. D. Smolen, A. Mittelstet, B. Harjo. E-1030. Division of Agricultural Sciences and Natural Resources, OSU 2012.

Phosphorus and Water Quality, Fact Sheet BAE-1512. M. D. Smolen. Division of Agricultural Sciences and Natural Resources, OSU 2009.

Treatment Methods for Removal of Pharmaceuticals and Hormones from Drinking Water. Fact Sheet BAE-1523. M. A. Kizer, M. D. Smolen. Division of Agricultural Sciences and Natural Resources, OSU 2008.

PPM Plus: A Tool to Aid in Nutrient Management Plan Development. Fact Sheet BAE-1522. M. J. White, D. E. Storm, H. Zhang, M. D. Smolen. Division of Agricultural Sciences and Natural Resources, OSU 2008.

Best Management Practices to Reduce Pesticide and Nutrient Runoff from Turf. 2000. Baird, J. B., N. T. Basta, R. L. Huhnke, G. V. Johnson, M. E. Payton, D. E. Storm, C. A. Wilson,

M. D. Smolen, D. L. Martin and J. T. Cole. p 268-293 in Fate and Management of Turfgrass Chemicals. J. M. Clark and M. P. Kenna. (eds.). Am. Chem. Soc. Washington, D.C. 20036.

Riparian Buffer Systems for Oklahoma. Co-authored with R. D. Harmel, A. Fallon, and M. D. Smolen. Oklahoma Cooperative Extension Water Quality Series. OSU Facts 1517. 1999.

Using Vegetation for Erosion Control on Construction Sites. S. Morrow and M. D. Smolen. Oklahoma Cooperative Extension Water Quality Series. OSU Facts 1514. 1999

Drinking Water Testing. H. Zhang and M. D. Smolen. Oklahoma Cooperative Extension Water Quality Series. OSU Facts 878 (revised). 1999.

Home*A*Syst. N. Gurski, M. D. Smolen, S. Williams, B. Brown and M. A. Kizer. Five fact sheet-worksheet combinations**.** 1995.

Pesticides in Residential Areas -- Protecting the Environment. J. Criswell, L. Nofziger, J. Pruitt, G. Cuperus, M. D. Smolen. Oklahoma Cooperative Extension Water Quality Series. OSU Facts 7461. 1994.

Pesticides in Ground Water. J. H. Stiegler, J. T. Criswell, M. D. Smolen. Oklahoma Cooperative Extension Water Quality Series. OSU Facts 7459. 1993.

Information Sheet: EPA Region 6 General Permit of Concentrated Animal Feeding Operations (CAFOs). Publication developed with USDA Soil Conservation Service. 1993.

EPA's General Permit for Storm Water Discharge from Concentrated Animal Feeding Operations (CAFO): Question and Answer Series Supplement. Numbers 1 through 4. Developed by the CAFO Work Group to explain details of the general permit. 1993.

Using Biocontrol Agents in the Commercial Greenhouse. L. A. Topliff, K. N. Pinkston, S. L. von Broembsen, M. A. Schnelle, M. D. Smolen. Oklahoma Cooperative Extension. IPM in the Greenhouse Series. OSU Facts 6713. 1991.

Water Rate Structure: A Tool for Water Conservation in Oklahoma. D. Adams, C. Boyer, M. D. Smolen**.** Oklahoma Cooperative Extension Fact Sheet AGEC-1017. 2009.

Phosphorus and Water Quality. M. D. Smolen**.** Oklahoma Cooperative Extension Fact Sheet BAE-1521. M. D. Smolen. 2007.

Handbooks and Manuals: (7)

No Till Cropping Systems in Oklahoma. M. D. Smolen. Oklahoma Cooperative Extension E-996. Chapter 3. 2007.

Water Quality Handbook for Nurseries. M. Schnelle, Criswell, Cuperus, Fallon, Kizer, Smolen, von Broembsen, White. Oklahoma Cooperative Extension E-951. 37p. 1998.

Riparian Area Management Handbook. A. Fallon and M. D. Smolen. Oklahoma Cooperative Extension E-952. 97p. 1998.

Pollution Prevention at Exploration and Production Sites in Oklahoma. Best Management Practices for Prevention and Control of Erosion and Pollution. B. A. Fulgenzi and M. D. Smolen. Oklahoma Cooperative Extension E-940. 42p. 1995.

CAFO Record Book. A record keeping system for compliance with the EPA permit for discharge from concentrated animal feeding operations. Designed by the CAFO Work Group. 1993.

Oklahoma Water Quality Reference Notebook. General reference notebook for Oklahoma Cooperative Extension Offices. Contains fact sheets, and subject matter brochures and reports relating to water quality and pollution control for farms and rural and residences. Developed by the Water Quality Initiative Committee for use in County Extension Offices. 1992.

North Carolina Erosion and Sediment Control Field Manual. 1991. North Carolina Department of Natural Resources and Community Development. Raleigh, NC.

North Carolina Erosion and Sediment Control Planning and Design Manual. 1987. North Carolina Department of Natural Resources and Community Development. Raleigh, NC.

Articles in Refereed Journals and Refereed Research Bulletins (49):

C. Baffaut, S. M. Dabney, M. Smolen, M. A. Youssef, J. V. Bonta, Ma L. Chu, J. A. Guzman, V. Shedekar, M. K. Jha, and J. G. Arnold. (Accepted for Publication). **Hydrologic and Water Quality Modeling: Spatial and Temporal Considerations.** Transactions of ASABE.

R. W. Zeckoski, M. Smolen, D. Moriasi, J. Frankenberger, G. Feyereisen. (Accepted for Publication) **Hydrologic and Water Quality Terminology as Applied to Modeling.** Transactions of ASABE.

Mahler, R., Smolen, M.D., Borisova, T., Boellstorff, D.E., & Sochacka, N. 2013. **The National Water Survey Needs Assessment Program.** Natural Sciences Education (42).

Adams, D. C., Allen, D., Borisova, T., Boellstorff, D., & Smolen, M.D. 2013. **The Influence of Water Attitudes, Perceptions, and Learning Preferences on Water-Conserving Action**s. *Natural Sciences Education* (42).

Boellstorff, D.E., Borisova, T., Smolen, M.D., Evans, J.M., Calabria, J, Adams, D.C., Sochacka, N., McFarland, M.L., & Mahler, R.L. 2013. **Audience Preferences for Water Resource Information from Extension and Other Sources.** *Natural Sciences Education (42*).

Borisova, T., Useche, P., Smolen, M.D., Boellstorff, D., Sochaka, N., & Calabria, N. 2013. **Differences in Opinions about Surface Water Quality Issues in the Southern United States: Implications for Watershed Planning Process**. *Natural Sciences Education (42*).

Borisova, T., Smolen, M.,, Boellstorff, D. E., McFarland, M.L., & Adams, D. 2013. **Public Preferences for Water Resource Topics and Information Sources in the Southern United States.** 11236RIB, *Journal of Extension* (online) http://www.joe.org/joe/2013april/rb6.php

Borisova T., J. Evans, M. Smolen, M. Olexa, D. C. Adams, J. C. Calabria. 2012**. Current and Future Water Availability: Public Opinion in the Southern US States. Journal of Extension (online**). 51(1)(2013):1R1B7. http://www.joe.org/joe/2013february/rb7.php

Borisova, T., Adams, D., Olexa, M., Evans, J., Calabria, J., & Smolen M. **Water availability, precipitation, and climate change: Public opinion in southern US states**. 11191RIB, *Journal of Extension (JOE)* (in press).

Borisova, T., A. Flores-Lagunes, D. Adams, M. Smolen, M. McFarland, D. Boellstorff, and B. Mahler, 2012. **"Participation in Volunteer-Driven Programs and Their Effects on Homeowners' Landscaping Practices."** Journal of Extension, [online] 50(3)(2012):3RIB4. http://www.joe.org/joe/2012june/rb4.php.

Mittelstet, Aaron R., Michael D. Smolen, Garey A. Fox, and Damian C. Adams, 2011. **Comparison of Aquifer Sustainability Under Groundwater Administrations in Oklahoma and Texas**. Journal of the American Water Resources Association (JAWRA) 47(2):424-431.

Demissie, T., D. E. Storm, M. S. Friend, N. T. Basta, M. E. Payton, M. D. Smolen, H. Zhang. 2010. **Rainfall Sequence Effects on Phosphorus Loss in Surface Runoff From Pastures That Received Poultry Litter Application**. American Society of Agricultural and Biological Engineers. 53(4): 1147-1158.

White, M. J., D. Storm, P. Busteed, M. D. Smolen, H. Zhang, G. Fox. 2010. **Quantitative Phosphorus Loss Assessment Tool for Agricultural Fields.** Environmental Modelling and Software 25(10): 1121-1129

White, M. J., D. E. Storm, M. D. Smolen, H. Zhang. 2009. **Development of a Quantitative Pasture Phosphorus Managmeent Tool Using the Swat Model.** Journal of the American Water Resources Association 45(2):397-406.

Turton . D. J., M. D. Smolen and E. Stebler. 2009. **Effectiveness of BMPs in Reducing Sediment from Unpaved Roads in the Stillwater Creek,** Oklahoma Watershed. Journal of the American Water Resources Association. 45:1343-1351.

Gallimore, L. E., N. T. Basta, D. E. Storm, M. E. Payton, R. H. Huhnke, and M. D. Smolen. 1999. **Water treatment residual to reduce nutrients in surface runoff from agricultural land**. Journal of Environmental Quality, 28: 1474-1478.

Matlock, M. D., D. E. Storm, M. D. Smolen and M. E. Matlock. 1999. **Determining the lotic ecosystem nutrient and trophic status of three streams in eastern Oklahoma over two seasons**. Aquatic Ecosystem Health and Management, 2:115-127.

Matlock M. D., D. E. Storm, M. D. Smolen, M. E. Matlock, A. McFarland and L. Hauck. 1999. **Development and application of a lotic ecosystem trophic status index.** Transactions of the ASAE, 42(3):651-656. (ASAE Honorable Mention Paper Award. 2000).

Toetz, D., D. E. Storm, T. Tetong, T. Mihue, M. D. Smolen. 1999. **Assessment of predictors of stream eutrophication potential. Journal of American Water Resources Association**, 35(4): 853-865.

Matlock M. D., M. E. Matlock, D. E. Storm, M. D. Smolen and W. J. Henley. 1998. **A quantitative passive diffusion periphytometer for lotic ecosystems**. Journal of the American Water Resources Association, 34(5): 1141-1147.

Ramanarayanan, T.S., D. E. Storm, M. D. Smolen. 1998. **Analysis of Nitrogen Management Strategies Using EPIC**. Journal of American Water Resources Association, 34(5): 1199-1211.

Cole, J. T., J. H. Baird, N. T. Basta, R. L. Huhnke, D. E. Storm, G. V. Johnson, M. E. Payton, M. D. Smolen, D. L. Martin, and. J. C. Cole. 1997. **Influence of buffers on pesticide and nutrient runoff from bermudagrass turf.** Journal of Environmental Quality. 26:1589-1598.

Hession, W. C., D. E. Storm, C. T. Haan, K. H. Rechhow, M. D. Smolen. 1996. **Risk analysis of total maximum daily loads in an uncertain environment using EUTROMOD**. Journal of Lake and Reservoir Management. 12(3): 331-347.

Ramanarayana, T. S., D. E. Storm, M. D. Smolen. 1995. **Seasonal pumping variation effects on wellhead protection area delineation.** Water Resources Bulletin 31:3, 1-10.

Matlock, M. D., D. E. Storm, S. L. Burks, M. D. Smolen, C. T. Haan. 1994. **An ecological risk assessment paradigm using the Spatially Integrated Model for Phosphorus Loading and Erosion (SIMPLE).** Journal of Aquatic Ecosystem Health, 3:287-294.

Chen, Z., D. E. Storm, M. D. Smolen, C. T. Haan, M. S. Gregory, and G. J. Sabbagh. 1994. **Prioritizing nonpoint source loads for phosphorus with a GRASS-modeling system**. Water Resources Bulletin, 30:589-593.

Spooner, J. L., W. Wyatt, S. W. Coffey, S. L. Brichford, J. A. Arnold, M. D. Smolen, G. D. Jennings, and J. A.. Gale. 1991. **Fate and Effects of Pollutants.** Nonpoint Sources. Water Pollution Control Federation, 63(4):527-536

Arnold, J. A., F. M. Nevils, Jr., and M. D. Smolen. 1991. **North Carolina's Sediment Control Program. Public Works**, 122(13): 48-50.

Spooner, J., L. Wyatt, W. Berryhill, A. L. Lanier, S. L. Brichford, M. D. Smolen, S. W. Coffey, and T. B. Bennett. 1989. **Nonpoint Sources (review of 1988 literature).** J. Water Pollution Control Federation, 61(6):911-924.

Coffey, S. W., W. S. Berryhill, D. W. Miller, and M. D. Smolen. 1989. **Making Molehills Out of Mountains: Using Models to Identify Nonpoint Sources.** Lake Line, North American Lake Management Society, 9(4):14-18.

Bottcher, A. B. and M. D. Smolen. 1988. **Crackdown on NPS Pollution. Agricultural Engineering**, 69(3):6-7.

Hoag, D., S. Lilley, M. D. Smolen, M. Cook, and J. Wright. 1988. **Extension's Role in Soil and Water Conservation**. J. Soil and Water Conservation, 43(2):126-129.

Maas, R. P., S. L. Brichford, M. D. Smolen, and J. Spooner. 1988**. Agricultural Nonpoint Source Control: Experiences from the Rural Clean Water Program.** Lake and Reservoir Management, 4(1):51-56.

Spooner, J., S. L. Brichford, R. P. Maas, M. D. Smolen, D. A. Dickey, G. Ritter, and E. Flaig. 1988. **Determining the Statistical Sensitivity of the Water Quality Monitoring Program in the Taylor Creek-Nubbin Slough, Florida Project**. Lake and Reservoir Management. 4(2):113-124.

Humenik, F. J., M. D. Smolen, and S. A. Dressing. 1987. **Nonpoint Sources - Where Do We Go from Here?** J. Environmental Science and Technology, 21:737-742.

Younos, T. M., M. D. Smolen, S. Mostaghimi, and J. Spooner. 1987. **Fate and Effects of Pollutants: Nonpoint Sources (review of 1986 research).** J. Water Pollution Control Federation, 59(6):487-490.

Spooner, J., C. A. Jamieson, R. P. Maas, and M. D. Smolen. 1987. **Determining Statistically Significant Changes in Water Pollutant Concentrations**. Lake and Reservoir Management, 3:195-201.

Maas, R P., A. Patchak, M. D. Smolen, and J. Spooner. 1987**. Benefit/cost Analysis of Nonpoint Source Control in the Tillamook Bay, Oregon, Watershed.** Lake and Reservoir Management, 3:157-162.

Maas, R. P., M. D. Smolen, and S. A. Dressing. 1985. **Selection of Critical Areas for Control of Nonpoint Source Pollution.** J. Soil and Water Conservation, 40:68-71.

Newell, A. D., T. M. Younos, M. D. Smolen, S. Mostaghimi, T. A. Dillaha, and R. P. Maas. 1985. Nonpoint Sources Literature Review. J. Water Pollution Control Federation, 57:630-634.

Younos, T. M., M. D. Smolen, C. A. Eiden, R. P. Maas, S. A. Dressing, and T. A. Dillaha. 1984. **Review of Nonpoint Source Pollution Research**. J. Water Pollution Control Federation, 56:689-692.

Trapanese, S. A., M. D. Smolen, and T. M. Younos. 1984. **A Systems Approach for Agricultural Land Management and Water Quality Control**. Transactions of ASAE, 27:817-821.

M. D. Smolen (Editor). Southern Regional Research Project. 1983. **Hydrologic/Water Quality Models for Agriculture and Forestry.** Southern Cooperative Series Bulletin No. 291. Virginia Agricultural Experiment Station, Blacksburg, VA. 104p.

Younos, T. M. and M. D. Smolen. 1983. **Simulating the Behavior of a Sewage Sludge-Amended Mine Soil.** Transactions of ASAE, 26:1397-1400.

Younos, T. M. and M. D. Smolen. 1983. **Nonpoint Sources Literature Review**. J. Water Pollution Control Federation, 55:748-752.

Younos, T. M., B. K. Theo, and M. D. Smolen. 1982. **Rice Cultivation on Sludge- amended Mine Soils**. BioCycle, 23(6):34-36.

Ross, B. B., M. L. Wolfe, V. O. Shanholtz, M. D. Smolen, and D. N. Contractor. 1982**. Model for Simulating Runoff and Erosion in Ungaged Watersheds.** Bulletin 130, Va. Water Resources Research Center, Blacksburg, VA.. 72p.

Smolen, M. D. 1981. **Nutrient Runoff from Agricultural and Non-agricultural Watersheds.** Transactions of ASAE, 24:981-987.

Smolen, M. D. and V.O. Shanholtz. 1980. **Agricultural Land Use: Effect on the Chemical Quality of Runoff.** Bulletin 125. Va. Water Resources Research Center, Blacksburg, VA. 82p.

Technical Reports (39):

Lovern, S.B. and M. D. Smolen. 2008. **Spavinaw Creek Implementation Project: Nonpoint Source Education Program for Agricultural Producers in the Spavinaw Creek Watershed**. Biosystems and Ag. Engineering Department, OSU, Stillwater, OK. 74078.

Turton D. J., E.Stebler, and M. D. Smolen. 2006. **Demonstrating the Effectiveness of Rural Unpaved Road Erosion Control Practices in Reducing Erosion in the Stillwater Creek Watershed**. Natural Resources and Ecology Management Department, OSU, Stillwater, OK. 74078.

McCowan L.C., M. D., Smolen, and N. Anderson. 2006. **Stillwater Creek Watershed Implementation Project, Report** to EPA. Biosystems and Agricultural Engineering Department, OSU, Stillwater, OK. 74078.

Propst, Timothy Lee, Mitchell Fram; M D Smolen. 2006. **Oklahoma Green Country watershed education project 2001-05**. Author:; Oklahoma Cooperative Extension Service, Stillwater, OK.

Fram, Mitchell, Timothy Lee Propst; M D Smolen. 2003. **Illinois River education program (continuation)**. Oklahoma Conservation Commission.; Oklahoma Cooperative Extension Service. Stilwlater, OK

Propst, T. L. M D Smolen. 2003**. Watershed protection through manure marketing (pilot program) :** final report. Oklahoma Cooperative Extension Service. Stillwater, OK.

Propst, T. L,. Sharon Lee Von Broembsen; Michael A. Schnelle; Ronald L Elliott; M D Smolen. 2002. **Capture & recycle technology for pollution prevention in the nursery industry**. Oklahoma Cooperative Extension Service Water Quality Programs, Stillwater, OK

Propst T. L. and M. D. Smolen. 2002. **Demonstration of Best Management Practices in the Salt Fork Watershed.** Report to EPA. Biosystems and Agricultural Engineering Department, OSU, Stillwater, OK. 74078.

Alexander T. and M. D. Smolen. 2002. **Evaluation of Performance and Management Strategies for a Nursery Irrigation Recycling System Designed for Pollution Control**. Biosystems and Agricultural Engineering Department, OSU, Stillwater, OK. 74078.

Storm, D.E., M. J. White, and M. D. Smolen. 2002. **Modeling the Lake Eucha Basin Using SWAT 2000.** Report to the Tulsa Metropolitan Utility Authority. Department of Biosystems and Agricultural Engineering, Oklahoma State University, Stillwater, OK.

White M. W., D. E. Storm, and M. D. Smolen. 2001. **Hydrologic Modeling of the Great Salt Plains Basin.** Report to EPA. Biosystems and Agricultural Engineering Department, OSU, Stillwater, OK. 74078.

Storm D. E., M. W. White, M. D. Smolen, and H. Zhang. 2001. **Modeling Phosphorous Loading for the Lake Eucha Basin.** Report to City of Tulsa. Biosystems and Agricultural Engineering Department, OSU, Stillwater, OK. 74078.

Smolen, M. D. Marley Dale Beem; Timothy Lee Propst. 2001. **Municipal wellhead protection manual for small communities : a guide for city managers and public utility managers**. Oklahoma Cooperative Education Service. Stillwater, OK.

Propst, Timothy Lee, J Wes Lee; M D Smolen. 2000. **Technical assistance to improve the quality of ground water-surface water interactions : task III, education component (final report).** Oklahoma Cooperative Extension Service, Stillwater, OK

Storm D. E., D. G. Gade, R. D. Tejral, M. D. Smolen, P. Kenkel, and M. S. Gregory. 2000. **Estimating Watershed Level Nonpoint Source Loading for the State Of Oklahoma.** Final Report to EPA. Biosystems and Agricultural Engineering Department, OSU, Stillwater, OK. 74078.

M. D. Smolen. 1999. **Water Quality and Water Quantity Issues in the Southern Region: an Overview.** Southern Perspectives Volume 3, Number 3. Southern Rural Development Center.

Propst, Timothy Lee, Anna Fallon, M D Smolen. 1999. **Management program for riparian wetlands to protect water quality: final project report.** Oklahoma Cooperative Extension Service. Stillwater, OK.

Storm D. E., N. T. Basta, D. W. Hamilton, M. D. Smolen, M. E. Payton, G. L. Bullard, and M. J. Fram. 1999. **Demonstrating BMPs to Protect Surface Water Quality from Land Application of Animal Wastes.** Final Report to EPA. Biosystems and Agricultural Engineering Department, OSU, Stillwater, OK. 74078.

Storm D. E., M. D. Smolen, D. G. Gade, M. S. Gregory, W. C. Hession, and R. Lakshminarayanan. 1999. **Poteau River Comprehensive Watershed Management Program TMDL** Component. Final Report to EPA. Biosystems and Agricultural Engineering Department, OSU, Stillwater, OK. 74078.

Storm D. E., G. J. Sabbagh, M. S. Gregory, M. D. Smolen, D. Toetz, C. T. Haan, and T. Komecki. 1996. **Basin-Wide Pollution Inventory for the Illinois River Comprehensive Basin Management Program**. Final Report to EPA. Biosystems and Agricultural Engineering Department, OSU, Stillwater, OK. 74078.

Smolen, M. D. (1995). **Land application of sewage sludge: Impact on water quality**. Land Application of Biosolids: A review of research concerning benefits, environmental impact, and regulations of applying treated sewage sludge. (ed. Basta, N. T.) Cooperatively published by the Oklahoma Agricultural Experiment Station and Center for Agriculture and the Environment Division of Agricultural Sciences and Natural Resources. No. B-808, p. 27-30.

Meo M., M. D. Smolen, and P. Norris. 1994. **Review of Animal Waste Control Options**. Report to the Governor's Animal Waste Task Force. 1994. Office of Secretary of Environment. Biosystems and Agricultural Engineering Department, OSU, Stillwater, OK. 74078.

Franklin, Carlyle E.; James D Gregory; Michael D Smolen. 1992. **Enhancement of the effectiveness of forested filter zones by dispersion of agricultural runoff.** Report No. 270. Water Resources Research Institute of the University of North Carolina,

K. J. Adler and M. D. Smolen. 1989. **Selecting Priority Nonpoint Source Projects: You Better Shop Around.** EPA 506/2-89/003.

Smolen, M. D., S. L. Brichford, J. Spooner, A. L. Lanier, K. J. Adler, S. W. Coffey, T. B. Bennett, and F. J. Humenik. 1989. **NWQEP 1988 Annual Report: Status of Agricultural Nonpoint Source Projects**. EPA 506/9-89/002.

Spooner, J., M. D. Smolen, A. L. Lanier, S. L. Brichford, and S. W. Coffey**. BMPs and Ground Water Annotated Bibliography. NWQEP**. Biological and Agricultural Engineering Department, NCSU.

Spooner, J., M. D. Smolen, S. L. Brichford, A. L. Lanier, and S.W. Coffey, 1989. **Annotated Bibliography of Nonpoint Source Literature. Version 89.**1. The National Water Quality Evaluation. Biological and Agricultural Engineering Department, NCSU..862 p.

Smolen, M. D., K. J. Adler, A. L. Lanier, D. L. Hoag, and D. W. Miller. 1988**. Interfacing Nonpoint Source Programs with the Conservation Reserve: Guidance for Water Quality Managers**. EPA 506/2-88/001. 24p.

Maas, R.P., M. D. Smolen, C. A. Jamieson, and A. C. Weinberg. 1987. **Setting Priorities: The Key to Nonpoint Source Control.** EPA, Office of Water Regulations and Standards, Washington, D.C. 20460.

Newell, A. D., L. C. Stanley, M. D. Smolen, and R. P. Maas. 1986. **Overview and Evaluation of Section 108a Great Lakes Demonstration Programs**. EPA 905/9-86-001. July, 1986.

Smolen, M. D., R. P. Maas, J. Spooner, C. A. Jamieson, S. A. Dressing, and F. J. Humenik. 1985. **Rural Clean Water Program. Status Report on the CM&E Projects**. Biological and Agricultural Engineering Department. NCSU.

Spooner, J., R. P. Maas, S. A. Dressing, M. D. Smolen, and F. J. Humenik. 1985. **Appropriate Designs for Documenting Water Quality Improvements from Agricultural NPS Control Programs**. Perspectives on Non-point Source Pollution. EPA 440/5-85-001. pp 30-34.

Maas, R. P., M. D. Smolen, S. A. Dressing, C. A. Jamieson, and J. Spooner. 1985**. Practical Guidelines for Selecting Critical Areas for Controlling Non-point Source Pesticide Contamination of Aquatic Systems.** Perspectives on Nonpoint Source Pollution. EPA 440/5-85-001. p363 - 367.

Smolen, M. D., S. A. Dressing, R. P. Maas, J. Spooner, C. A. Jamieson, A. D. Newell, and F. J.Humenik. 1985. **A Data Management System to Evaluate Water Quality Impacts of Nonpoint Source Pollution Control. Perspectives on Nonpoint Source Pollutio**n. EPA 440/5-85-001. pp 429-432.

Maas, R. P., M. D. Smolen, J. Spooner, S. A. Dressing, and F. J. Humenik. 1984. **Best Management Practices for Agricultural Nonpoint Source Control: IV. Pesticides**. NTIS PB8 5-11424.

Dressing, S. A., R. P. Maas, M. D. Smolen, and F. J. Humenik, Eds. 1984. **Proceedings of the Rural Clean Water Program C, M&E Workshop**. NTIS PB8 5.

Smolen, M. D., E. R. Yago, and T. M. Younos. 1984. **Agricultural Best Management Practices and Water Quality in the Bush River Watershed.** Virginia-Bulletin 84-5, Virginia Agricultural Experiment Station, Blacksburg, VA.

P R Schroeder; Anthony C Gibson; M D Smolen. 1984. **The hydrologic evaluation of landfill performance (HELP) model. Office of Solid Waste and Emergency Response. :** Municipal Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency ; Cincinnati, OH

Smolen, M. D., B. B. Ross, and V. Shanholtz. 1983. **The Finite Element Storm Hydrograph Model. In Hydrologic/Water Quality Models for Agriculture and Forestry**. (Ed: M. D. Smolen). Southern Cooperative Series Bulletin, No. 291 pp 60-71. Virginia Agricultural Experiment Station, Blacksburg, VA

Honors and Awards:

The G.B. Gunlogson Countryside Engineering Award, ASABE 2008
Sterling L. (Bud) Burkes Award for Outstanding Environmental Research, Environmental Institute Oklahoma State University 2005
USDA Group Honor Award for Excellence: Poultry Waste Management Education Team 2002
USEPA Regional Administrator's Environmental Excellence Award for Outstanding Service in Implementing the Requirements of the NPDES Concentrated Animal Feeding Operations General Permit, U. S. Environmental Protection Agency, Region 6, 1994
ASAE Blue Ribbon Award for Extension Method: "Trailer-Mounted Models to Educate about Natural Resource," 2001
ASAE Blue Ribbon Award for Educational Fact Sheet: "Phosphorus and Water Quality," 2009.
ASAE Blue Ribbon Award for Educational Manual: "Erosion and Sediment Control Field Manual," 1991.
ASAE Blue Ribbon Award for Educational Manual: "Erosion and Sediment Control Planning and Design Manual," 1989.
ASAE Blue Ribbon Award for Educational Slide Tape: "Protecting Crops Protecting Water," 1987.
ASAE Blue Ribbon Award for Newsletter: "NWQEP NOTES," 1987.
Alpha Epsilon
Gamma Sigma Delta.
Sigma Xi.

Committees and Task Forces:

Advisory Committee on Water Information, US Dept of Interior Subcommittee on Sedimentation) – 2010
Oklahoma Grand River Dam Authority Technical Committee 2007
Grand Lake 4-State Watershed Collaborative – Chair of Steering Committee 2007-2010

OSU DASNR Water Center Task Force – Chair 2007
OSU DASNR Environmental Quality and Waste Management Initiative Team – Coordinator 2005-2010
Universities Council on Water Resources – OSU Representative (2002-2010)
USDA-CSREES Water Quality Program, National Advisory/Leadership Team, Chair 1999-2001
Oklahoma Water Quality Monitoring Council, Academic Representative (1998-2010)
Oklahoma Poultry Rules Advisory Committee, Water Quality Representative (1998- present)
Oklahoma Nonpoint Source Work Group (1995-2010)
NRCS State Technical Committee for EQIP (1997- 2010)
Governor's Task Force on the Illinois River (1991-1994)
Southern Region Extension Water Quality Planning Committee (1991 - 2013), Chair: 1996-1997
Urban IPM Committee, Oklahoma State University
OSU Environmental Sciences Graduate Program, Steering Council, Oklahoma State University (1991-2010)
Great Plains Agricultural Council, Animal Waste Task Force Water Committee (1993-1994), Chair (1992-93)
Center for Agriculture and the Environment, DASNR, Oklahoma State University, Steering Committee (1992-1995)