Arkansas Water Resources Center
Annual Technical Report
FY 2004

Introduction

Statewide Mission: The Arkansas Water Resources Center (AWRC) has a statewide mission to plan and conduct water resource research. AWRC cooperates closely with colleges, universities, and other organizations in Arkansas to address the state's water and land-related problems, promote the dissemination and application of research results, and provide for the training of scientists in water resources. Through the years, projects have included irrigation, ground water modeling, non-point source pollution, quality of ground water and surface water, efficient septic tank design, and ecosystem assessment. These projects have been funded by a variety of federal, state, local, and tribal sources.

Support Provided: The Center acts as a liaison between funding groups and the scientists, and then coordinates and administers grants once they are funded. Accounting, reporting, and water analyses are major areas of support offered to principal investigators.

Technology Transfer: AWRC sponsors an annual water conference held in Fayetteville, Arkansas each spring, drawing on average 100 researchers, students, agency personnel, and interested citizens to hear about results of current research and hot topics in water resources throughout the state. AWRC also co-sponsors short courses and other water-related conferences in the state and region. In addition, AWRC maintains a technical library containing over 900 titles, many of which are on-line. This valuable resource is utilized by a variety of user groups including researchers, regulators, planners, lawyers, and citizens.

AWRC Water Quality Laboratory: The Center maintains a modern water quality laboratory that provides water analyses for researchers, and for farmers and others who submit samples through the Cooperative Extension Service and the Department of Housing and Urban Development.

Research Program

AWRC has contributed substantially to Arkansas water resources via research and training of students. In 2004, 49 projects passed through the Center which included funding from a variety of organizations including 1) USGS 104 B program, 2) National Science Foundation, 3) USEPA, 4) USDA, 5) Arkansas Soil and Water Conservation Commission, 6) Arkansas Department of Environmental Quality, 7) Upper White River Basin Foundation, 8) Audubon Arkansas, and 9) Santee Sioux Nation, among others. These projects involved training of 54 students made up of 20 undergraduates, 28 master's, 4 Ph.D. candidates and 2 Post doctoral students.

Vadose-zone losses of soluble heavy metals from pasture soil amended with varying rates of poultry litter

Basic Information

Title:	Vadose-zone losses of soluble heavy metals from pasture soil amended with varying rates of poultry litter
Project Number:	2004AR70B
Start Date:	3/1/2004
End Date:	2/28/2005
Funding Source:	104B
Congressional District:	3
Research Category:	Water Quality
Focus Category:	Non Point Pollution, Solute Transport, Water Quality
Descriptors:	equilibrium-tension lysimeters, leaching, heavy metals, arsenic, chromium, cadmium, pasture, and poultry litter
Principal Investigators:	Kristofor R. Brye

Publication

1. Brye, K.R. and A.L. Pirani. Metal Uptake by Tall Fescue as Affected by Poultry Litter Application. Forage & Grazinglands (Submitted/In Review)
2. Pirani, A. 2005. Leaching Losses of Plant Nutrients and Heavy Metals from Poultry Little Amendedd Pasture Soil (tentative). MS Thesis, Department of Crop, Soil, and Environmental Sciences, College of Agriculture, Food & Life Sciences, University of Arkansas, Fayetteville, AR. (To be completed by August 20005).
3. Brye, K.R. and A.L. Pirani. 2004. Characterizing solute leacing using equilibrium-tension lysimeters. 2004 Annual Arkansas Water Resources Conference Proceedings, April 20-21, 2004, Fayetteville, Arkansas.
4. Pirani, A.L., and K.R. Brye. 2004. Mass balance of heavy metals applied to pasture soil in poultry litter. Agronomy Abstracts, American Society of Agronomy Annual Meeting, Seattle, Washington.
5. Pirani, A., and K.R. Brye. 2005. Heavy metal leaching from poultry litter amended pasture soil. 2005. Arkansas Water Resources Conference Proceedings. April 19-20, 2005, Fayetteville, Arkansas.

Problem and Research Objectives:

Problem: Agriculture and the economies of the Ozark Highlands, (i.e., northwest Arkansas and northeast Oklahoma), and other regions throughout the southern United States, are largely influenced by the poultry industry. Consequently, animal waste disposal and, ultimately, surface and groundwater quality become major issues in areas with a large concentration of confined-animal-feeding operations. Since poultry litter contains notable amounts of heavy metals and despite the cost-effective use of poultry litter as an organic N and P fertilizer, the potential impairment of groundwater drinking supplies from heavy metals contained in poultry litter is an important concern to those requiring clean drinking water supplies. Relatively little information exists on the nature and concentration of these compounds in the soil solution as a result of the addition of poultry litter. The likelihood of heavy metals leaching from pasture soils with a history of repeated poultry litter applications is too great to ignore.

Research Objective: To continuously monitor water movement and heavy metal leaching from the root zone of tall fescue (*Festuca arundinacea* Schreb.) vegetation amended with varying rates of poultry litter using equilibrium-tension lysimeters.

Methodology:

Equilibrium-tension lysimeters were employed to provide continuous, year-round drainage, solute concentration, and solute leaching loss data from the root zone of tall fescue as a function of poultry-litter application rate (0, 2.5 and 5 tons/acre) Equilibrium-tension lysimeters (0.19 m^2), with a 0.2-μm porous-stainless-steel plate, were installed below undisturbed root zones of the tall fescue vegetation, at approximately a 0.9-m depth, in each of six plots with high soil-test P in the top 5 cm. Filtered leachate samples collected from the lysimeters were acidified and analyzed for soluble heavy metals by ICAP. Drainage fluxes were multiplied by solute concentrations to obtain leaching losses (i.e., loads) from the root zone of pasture soil.

Principal Findings and Significance:

Leachate was collected continuously throughout the year for two consecutive years (2003 and 2004), with flow-weighted mean concentrations and mass losses calculated by 3-month season and year. Total annual leachate collected did not differ among treatments. In 2003, there were no significant differences in flow-weighted mean concentrations or mass losses of heavy metals (Fe, Cu, Zn, Mn, As, Se, Cd, and Cr) among treatments. In 2004, several significant differences among treatments were observed in flow-weighted mean concentrations, however they were inconsistent among element, treatment, and season. Treatment differences in mass loss were also inconsistent among elements and seasons in 2004. The data suggest that the addition of poultry litter to pasture soil will influence concentrations and mass losses of heavy metals in areas of concentrated poultry production. Further monitoring is necessary to evaluate the longer-term effects of repeated annual poultry litter applications on soil solution water quality.

The type of data generated in this study will provide credible scientific evidence for soil leachate solution concentrations and loads that may aid regulators in defining new and/or adjusting existing solute concentration and load limits to realistic and achievable thresholds to maintain high quality groundwater resources in the Ozark Highlands region of the mid-South.

Oxide-Catalyzed Oxidation of 17b-Estradiol to Estrone

Basic Information

Title:	Oxide-Catalyzed Oxidation of 17b-Estradiol to Estrone
Project Number:	2004AR72B
Start Date:	3/1/2004
End Date:	2/28/2005
Funding Source:	104B
Congressional District:	3rd
Research Category:	Water Quality
Focus Category:	Water Quality, Agriculture, Non Point Pollution
Descriptors:	animal waste, biosolids, estradiol, water quality, land application, non-point source pollution, oxidation
Principal Investigators:	Guangyao Sheng

Publication

1. Park, Jeong and G. Sheng. 2005. Catalytic oxidation of 17b-estradiol to estrone in soil. Arkansas Water Resources Center Annual Conference. Fayetteville, Arkansas.

Problem and Research Objectives:

Estrogens in the environment interfere with the endocrine / reproductive functions of wildlife and humans. Land application of biosolids and animal wastes as fertilizers in Arkansas is a common practice. Surface runoff and potential leaching may significantly contribute to the occurrence of estrogens in the aquatic environment. The objectives of this project are to examine the abiotic oxidation of 17β-estradiol in soil, to identify the soil oxides responsible for the degradation, and to evaluate the factors that influence the degradation.

Methodology:

A soil was collected from the University of Arkansas Animal Farm, dried, and sterilized. The soil was subjected to chemical treatment with $NH_2 \cdot HCl$ to remove manganese oxides. The soil and water containing 17β-estradiol were mixed and rotated at pH of 4.4 or 7.7. At various sampling times, soil was extracted for degradation product(s). Both solution and soil extract were analyzed for 17β-estradiol and its product(s) by HPLC and GC-MS and for Mn(II) by AAS.

Principal Findings and Significance:

The GC-MS analysis identified that 17β-estradiol in soil was oxidized to estrone. The amount of 17β-estradiol continuously decreased while estrone increased with reaction time. No other degradation products were found. The degradation was faster at pH 7.7 than at pH 4.4, as the oxidation releases protons. The amount of Mn(II) increased with time, suggesting that soil manganese oxides were reduced. The degradation was not observed in Mn-free soil, demonstrating the oxidative role of soil manganese oxides. Manganese oxides may thus be used to effectively remediate the soil and water contaminated with 17β-estradiol.

Nutrient losses in runoff and leaching from poultry litter applications to loblolly pine stands and pastures

Basic Information

Title:	Nutrient losses in runoff and leaching from poultry litter applications to loblolly pine stands and pastures
Project Number:	2004AR73B
Start Date:	3/1/2004
End Date:	2/28/2005
Funding Source:	104B
Congressional District:	4th
Research Category:	Water Quality
Focus Category:	Surface Water, Water Quality, Non Point Pollution
Descriptors:	Runoff, poultry litter, leaching nitrogen phosphorus, arsenic, loblolly pine, best management practices
Principal Investigators:	Hal O. Liechty, Adrian Ares, Mike B Daniels

Publication

Problem and Research Objective:

The poultry industry in the United States and Arkansas produces large amounts of poultry litter that needs to be disposed of in an environmentally sound manner. This litter is commonly applied to pastures to increase forage production. Repeated application of poultry litter in pastures has led to reductions in water quality and increases in the amount of nutrients that are drained from watersheds that contain high densities of poultry production. Current policies and regulation may limit the amounts of poultry litter that can be applied to pastures in these watersheds and suitable, alternative applications sites are needed to maintain a viable poultry industry in many locations in Arkansas. Loblolly pine forests could be suitable application sites for poultry litter since pine tree growth responds well to nutrient additions and forest soils have attributes that limit surface runoff or mitigates off site transport of contaminates. The objective of this study is to evaluate the ability of loblolly pine plantations to environmentally mitigate nutrient and metal additions from poultry litter application. Specific objectives include to: 1) quantify and compare the impacts of poultry litter application to forests and pastures on nutrient and other environmentally important elements in surface water runoff 2) quantify and compare the impacts of poultry litter application to forests and pastures on nutrients and other environmentally important elements in soil water.

Methodology:

A field study was implemented on pastures and a loblolly pine plantation growing on similar soils in Southwestern Arkansas. The trees were 26 years old at the time of study establishment and the pastures, which are used for hay production, contain a mixture of Bermuda grass, Bahia grass, tall fescue and clovers. Treatment application and water monitoring occurs on six 0.4-ha plots within the pine plantation and another six plots in the pastures. Three of the plots in the pine plantation and three of the plots in the pastures received a nine Mg/ha application of poultry litter in April of 2004. Surface water was collected in a 102 m^2 runoff plot and soil water was collected using four tension lysimeters within each 0.4 ha plot in the pastures and loblolly pine plantation. Total flux of surface water was determined for each runoff plot. Nutrient concentrations (N, P, K, Ca, Mg, Total As, As(V), As(III) and other selected micronutrients) were determined for all or a subset of water samples collected by the runoff plots and lysimeters.

Principal Findings and Significance:

Preliminary results indicate substantial increases in nitrogen and phosphorus in surface and soil water from both the pastures and the loblolly pine plantation following litter application. For example concentrations of P in soil water during the initial four months following litter application were 0.11 mg/l in plots receiving poultry litter but only 0.03 in control plots. Differences in the response of P to litter application between the pastures and plantations were not significant. PO_4-P concentrations in runoff, collected from three storm events that occurred 7-10 months after litter application, were 15 times higher in litter amended plantation plots but only 0.5 times in litter amended pasture plots than in the associated unamended plots for each landuse type. Fluxes of PO_4-P from litter applied to each landuse

are more similar since greater amounts of runoff occurred in the pastures than loblolly pine plantation.

Poultry litter application increased NO_3-N and NH_4-N concentrations of soil water in both the pine stands and pastures. The magnitude of increases was greater in the pine plantations than the pastures. For example NO_3-N concentrations in soil water collected in the pine stands and pastures were respectively 0.03 and 1.7 mg/l in the unamended plots but 2.1 and 5.2 mg/l in the poultry litter amended plots. Overall NO_3-N concentrations were consistently greater in the pastures than the pine stands regardless of the litter treatment. The higher concentrations of N in the pastures were most likely related to the accumulation of N as result of long-term, repeated application of fertilizer in this pastures. Differences in NO_3-N concentrations in surface water between amended and unamended plots were similar to differences found for PO_4-P, discussed above.

Hydrodynamics of a Karst Soil Catena in the Ozark Plateau, USA

Basic Information

Title:	Hydrodynamics of a Karst Soil Catena in the Ozark Plateau, USA
Project Number:	2004AR74B
Start Date:	3/1/2004
End Date:	2/28/2005
Funding Source:	104B
Congressional District:	Third
Research Category:	Water Quality
Focus Category:	Hydrogeochemistry, Non Point Pollution, Agriculture
Descriptors:	Dentrification potential; ground water; hydraulic conductivity; infiltration; karst hydropedology; nitrate-N; soil water, vadose zone
Principal Investigators:	John Van Brahana, Phil D Hays

Publication

1. DeFauw, S.L., 2005 (in progress), Hydrodynamics of a Hillslope Assemblage in the Ozark Highlands, USA. Ph.D. Dissertation, Environmental Dynamics Program, College of Arts and Sciences, University of Arkansas, Fayetteville, Ar, xxxpp.
2. DeFauw, S.L., T.J. Sauer, K.R. Brye, M.C. Savin, P.D. Hays, and J.V. Brahana, 2005 (in press), Nitrate-N distributions and dentrification potential estimates for an agroforestry site in the Ozark Highlands, USA. In: Proceedings of the Ninth North American Agroforestry Conference, CINRAM, St. Paul, MN. xx-xx. [Invited paper]
3. DeFauw, S.L., T.J. Sauer, K.R. Brye, M.C.Savin, P.D. Hays, and J.V. Brahana, 2005 (in press), Nitrate-N distributions and dentrification potential estimates for an agroforestry site in the Ozark Highlands, USA. In: Abstracts of the Ninth North American Agroforestry Conference, 12-15 June 2005, Rochester, MN, xx-xx. [Invited abstract]
4. DeFauw, S.L., T.J. Sauer, P.D. Hays, K.R. Brye, and J.V. Brahana, 2004, Hydrodynamics of an Experimental Silvopastoral Field in the Ozark Plateau of Northwestern Arkansas, USA. In: Book of Abstracts, First World Congress of Agroforestry, 27 June-2 July 2004, Orlando, FL, USA, p. 176.
5. Thomas, A.L., S.L. DeFauw*, T.J. Sauer, and D. Brauer, 2004, Hydrologic Influences on the Growth of yound Grafted Black Walnut Trees in Arkansas, USA. In: Book of Abstracts, First World

Congress of Agroforestry, 27 June-2July 2004, Orlando, FL, USA, p.213. [*presenter]
6. Sauer, T.J., S.L. DeFauw, K.R. Brye, J.V. Brahana, J.V. Skinner, W.K. Coblentz, A.L. Thomas, P.D. Hays, D.C. Moffitt, J.L. Robinson, T.A. James, D.K. Brauer, and K.A. Hickie, 2004, N and P Assimilation in a Silvopastoral System Receiving Poultry Litter or Inorganic Fertilizer. In: Book of Abstracts, First World Congress of Agroforestry, 27 June-2 July 2004, Orlando, FL, USA, p.207.

Problem and Research Objectives:

The dynamics of nutrient infiltration and subsurface transport and transformation in karst terrains characterized by high soil heterogeneity, multi-level permeability contrasts within the vadose zone (e.g., plowpans, fragipans, and relict chert layers), rapidly fluctuating unconfined aquifers, and preferential flow paths is very poorly understood. Despite these gaps in our knowledge of basic soil-water relations and biogeochemical processing, land application of animal manures has intensified, in this region, over the past five decades. The main objectives of this research are fivefold: (1) determine saturated and unsaturated hydraulic conductivities at the soil surface for the three soil series (Nixa, Captina, and Johnsburg) that dominate an experimental silvopastoral field on the University of Arkansas Farm; (2) estimate saturated hydraulic conductivities for various subsoil horizons penetrated by select shallow wells; (3) track fluctuations in the unconfined aquifer, throughout the year, and produce a probability map for the water table surface; (4) evaluate nutrient (NO_3-N) sources, transformations and transport, within a karst catena, using stable isotopes; and (5) examine current management practices (i.e., the timing and rate of poultry litter and commercial fertilizer applied per hectare) in light of the hydrodynamic patterns that develop in this field throughout the year (and suggest modifications that should be implemented to enhance fertilizer use efficiency).

Methodology:

Soil Water and Ground Water Monitoring and Analysis. Concentrations of nitrate-N and total P in the soil and ground waters have been regularly monitored over the past three growing seasons (March 2002 – October 2004), and include a several storm events. Water samples from porous cups and shallow wells were colorimetrically analyzed for nitrate-N using a Lachat continuous-flow ion analyzer. Ground water DOC (collected over two growing seasons, from May 2003 – October 2004) was determined using a Shimadzu TOC-V_{CSH} Analyzer.

Subsoil Hydraulic Conductivities. Saturated hydraulic conductivities for select wells were derived from bail-down data. Well recoveries were plotted in Excel. The Bouwer and Rice method (incorporating modifications from Bouwer, 1989) was used to estimate subsoil saturated hydraulic conductivities. This methodology was designed to account for the geometry of partially penetrating or fully penetrating wells in unconfined aquifers.

GIS Database. A DGPS unit was used to produce a high-resolution topographic map of the AEF. The GIS database (ArcView 3.3) incorporates topography, soils, unconfined aquifer fluctuations (including basic water quality parameters), electromagnetic induction (EMI) geophysical surveys, tree growth patterns, nitrate-N profiles, and the spatiotemporal delineation of N pools developed at the soil-karst interface of this agroecosystem. The ArcView Hydro extension was used to produce a simple model of the AEF's surface hydrology. Field-scale nitrate-N distributions for porous cup and well datasets were mapped using grid interpolation techniques (i.e., Spline method with a 1 meter cell size, weight varied 100-700 for the purpose of optimization, number of points

varied from 2-4, type Tension). Change detection operations were performed on optimized grid maps using Map Calculator.

Principal Findings and Significance:

Transport and biogeochemical processing of nitrate-N in upland watersheds is poorly understood, and denitrification potential estimates for the thin soil veneers of the Ozark Highlands have yet to be documented. Since March 2001, nitrate-N distributions have been monitored from an array of 53 shallow wells (0.5-5.6 m deep) emplaced in a 4.3 ha experimental agroforestry site (receiving split-field treatment of poultry litter to the eastern half in Spring, and a comparable annual N-load from commercial fertilizer applied on the western half in Spring and Fall). The field integrates subsurface flows from a small upland catchment and, in March 2001, contained several "hot spots" with ground water nitrate-N varying from 25.0-64.5 mg/L. Late winter peaks in nitrate-N from this 6 year-old alley cropping system have steadied over the last 2 years (13.2 mg/L for mid-March 2003; 12.0 mg/L for late-February 2004). Saturated hydraulic conductivity means for 3 down-gradient wells (2.0-3.6 m) ranged from 0.83$\pm$0.17 to 1.12$\pm$0.20 m/day during baseflow conditions. High aquifer-stand hydraulic conductivity estimates were significantly lower for two out of three wells, expanding the range to 0.41$\pm$0.05 to 1.39$\pm$0.02 m/day, with the well in the lowest landscape position stemming the flow through this hillslope soil assemblage. Mean denitrification potentials, based solely on declines in nitrate-N throughout the growing season for this key ground water integration area, were 8.15$\pm$6.20 kg/ha (2002), 20.80$\pm$10.23 kg/ha (2003), and 7.11$\pm$3.65 kg/ha (2004). Cross-validation of these estimates, using dissolved organic carbon (DOC), resulted in mean denitrification potentials of 22.45$\pm$4.41 kg/ha and 16.78$\pm$3.63 kg/ha for the 2003 and 2004 growing seasons, respectively. Results of this field-to-small-watershed scale investigation provide much-needed data on key soil physical properties, transit times, and biogeochemical processes useful in the development of nutrient management strategies that adequately reflect the "N-loading capabilities" as well as seasonal vulnerabilities of a common hillslope soil assemblage in the Ozark Highlands. Data collection and analysis for the stable isotope component of this investigation is still in process and will be completed by 31 August 2005.

Information Transfer Program

AWRC sponsors an annual water conference held in Fayetteville each spring, drawing in about 100 researchers, students, agency personnel, and interested citizens to hear about results of current research and hot topics in water resources throughout the state. AWRC also co-sponsors short courses and other water-related conferences in the state and region. The 2004 conference entitled, "Diverse Research in Support of Quality Water Resources," featured 15 oral presentations and thirteen posters during the one and one-half day conference.

In addition, AWRC maintains a technical library containing over 900 titles, many of which are on-line. This valuable resource is utilized by a variety of user groups including resarchers, regulators, planners, lawyers, and citizens. Many AWRC publications have been converted to electronic pdf format which can be accessed via our WEB site at http://www.uark.edu/depts/awrc. Click the "Publications" link on the left-hand side of the page to view these publications.

Diverse Research in Support of Water Quality Water Resources

Basic Information

Title:	Diverse Research in Support of Water Quality Water Resources
Project Number:	2004AR117B
Start Date:	4/20/2004
End Date:	4/21/2004
Funding Source:	104B
Congressional District:	3rd
Research Category:	Water Quality
Focus Category:	Water Quality, Water Supply, Non Point Pollution
Descriptors:	
Principal Investigators:	Ralph K. Davis

Publication

Diverse Research In Support of Quality Water Resources

2004 Arkansas Water Resources Center Conference

TUESDAY, April 20
8:00am to 7:00pm

Registration and Continental Breakfast……....**8:00 am**

Welcome and Introductions

Ralph K. Davis, Director
Arkansas Water Resources Center……**8:40 am**

PRESENTATIONS
*** Denotes Speaker**

Session Moderator: J. Van Brahana, Professor, Geosciences, University of Arkansas, Fayetteville

Modeling Groundwater Flow Within the Mantled Karst of the Savoy Experimental Watershed, Northwest Arkansas
*Tim Unger , Graduate Research Assistant, Department of Geosciences, J.V. Brahana, Professor Geosciences, T. Ting, Graduate Research Assistant Chemical Engineering, and G. Thoma, Associate Professor Chemical Engineering……..**8:45 am**

Hydrogeologic Characteristics of Four Public Drinking-Water Supply Springs in Northern Arkansas
Joel M. Galloway, Hydrologist, U.S. Geological Survey, Little Rock…….…….**9:15 am**

Constructed Wetlands for the Pre-Treatment of Drinking Water Obtained From Abandoned, Flooded, Underground Coal Mines
*Curtis Varnell, Ph.D. Candidate Environmental Dynamics Program, and J. V. Brahana, Professor Geosciences...…..**9:45 am**

Break ……..**10:15 am**

Decision Support System for the Beaver Lake Watershed
*Indrajeet Chaubey, Assistant Professor Biological and Agricultural Engineering, S. Panda, Graduate Research Assistant Biological and Agricultural Engineering, K.L. White, Ph.D. Candidate, Biological and Agricultural Engineering M. Matlock, Associate Professor, Biological and Agricultural Engineering, B. Haggard, Adjunct Assistant Professor, Biological and Agricultural Engineering, and T.A. Costello, Associate Professor, Biological and Agricultural Engineering……. **10:45 am**

Arkansas' Nutrient Management Program
Adrian Baber, Assistant Director For Conservation, Arkansas Soil and Water Conservation Commission……..….**11:15 am**

Lunch Buffet Provided…… ..**11:45 am**

Session Moderator: Ken Steele, Professor, Geosciences, University of Arkansas, Fayetteville

Dynamics of Dissolved Organic Matter in Contrasting Ozark Streams
*Sue Ziegler, Assistant Professor Biological Sciences, and Sherri Brisco, Ph.D. Candidate Biological Sciences…… **1:30 pm**

Characterizing Solute Leaching Using Equilbrium-Tension Lysimeters
*Kristofor R. Brye, Assistant Professor, Crop, Soil and Environmental Sciences and Mandy L. Pirani, Graduate Research Assistant…..…….…….…..**2:00 pm**

The Influence of Water Quality on Trace Metal Bioavailability
*Kristen Keteles, Assistant Professor Biology, David Johnson, Taldi Walter, and Matt Schroeder, University of Central Arkansas .....……..…**2:30 pm**

Break ……..……3**:00 pm**

Critical Ground Water Areas in Arkansas: The Next Step
Todd Fugitt, Geology Supervisor, Groundwater Protection and Management, Arkansas Soil and Water Conservation Commission……..…….3**:30 pm**

Ground-Water Models of theAlluvial Aquifer: Management Tools for Quantifying Sustainable Yield
*John B. Czarnecki, Hydrologist, U.S. Geological Survey, Little Rock and Todd Fugitt, Geology Supervisor, Groundwater Protection and Management, Arkansas Soil and Water Conservation Commission …..…….…….....**4:00 pm**

RECEPTION AND POSTER SESSION*…….4:30-7:00 pm
***See back page for information**

WEDNESDAY, April 21
8:00am to 12:30pm

Registration and Continental Breakfast..……..…….8**:00 am**

Session Moderator: Brian Haggard, Adjunct Assistant Professor, Biological and Agricultural Engineering, University of Arkansas, Fayetteville

Non-Point Source Pollution Program: Past, Present and Future
Tony Ramick, Supervisor, Non Point Pollution Program, Arkansas Soil and Water Conservation Commission……..……**8:30 am**

Ecological Assessment of Northwest Arkansas Streams – 1998 and 2003
Robert Morgan, Ph.D. Candidate Biological and Agricultural Engineering, *Marty Matlock, Associate Professor Biological and Agricultural Engineering, Eric Cummings, Research Assistant Biological and Agricultural Engineering, Andrea Ludwig, Research Assistant Biological and Agricultural Engineering , Brian Schafer, Research Assistant Biological and Agricultural Engineering, Brian Haggard, Adjunct Assistant Professor Biological and Agricultural Engineering, and Indrajeet Chaubey, Assistant Professor Biological and Agricultural Engineering…….…….…**9:10 am**

Break.....…….……**9:40 am**

Antibiotic Resistance of Bacteria Isolated From Run-Off and Soils Receiving Poultry Litter
*Mary Savin, Assistant Professor Crop, Soil and Environmental Sciences and Peter J. Tomlinson, Graduate Research Specialist, Crop, Soil and Environmental Sciences…….....….**10:10 am**

Acoustic Mapping of Bathymetry and Sediment Thickness in Beaver Reservoir, Northwest Arkansas
Stephen K. Boss, Associate Professor Geosciences, University of Arkansas, Fayetteville .....……..…1**0:40am**

Beaver Lake Hydrodynamic and Water-Quality Modeling
*W. Reed Green, Hydrologist, U.S. Geological Survey, and Joel M. Galloway, Hydrologist, U.S. Geological Survey……..……..……...**11:10 am**

Wrap Up.....……..……..**11:40 am**

RECEPTION AND POSTER SESSION 4:30PM – 7:00PM

Considering Water Quality in Rural Development on Beaver Lake
Anna Slawsky, Avoca, Arkansas.

Constructed Wetlands for the Pre-Treatment of Drinking Water Obtained from Abandoned, Underground Coal Mines
Thomas McGuire, Curtis Varnell, and Salem Thawaba, Department of Geosciences, University of Arkansas, Fayetteville, Arkansas.

Groundwater Protection/Source Water Protection
Joy Wasson and Wayne Rose, Arkansas Rural Water Association, Lonoke, Arkansas.

Demonstration of Greenway Development to Protect Ecological Services in Small Urban Streams
Robert Morgan, MS, PE, Marty Matlock, Ph.D., Biological and Agricultural Engineering, University of Arkansas, Fayetteville, Arkansas.

Possible Extent and Depth of Salt Contamination in Ground Water Using Geophysical Techniques, Red RiverAluminum Site, Stamps, Arkansas, April 2003
Gregory P. Stanton, U.S. Geological Survey, Austin, TX, Wade Kress, U.S. Geological Survey, Lincoln, Nebraska, Christopher Hobza, Geosciences, University of Arkansas, Fayetteville, and John B. Czarnecki, U.S. Geological Survey, Little Rock, Arkansas.

Quantification of Internal Phosphorus Load in Beaver Lake, Northwest Arkansas Under Aerobic and Anaerobic Conditions
S. Sen, B.E. Haggard, I. Chaubey, T. Costello, and M.D. Matlock, Biological and Agricultural Engineering, University of Arkansas, Fayetteville, Arkansas.

Fayetteville Water Quality
Mike Rozelle, PE, Staff Engineer, City of Fayetteville, Fayetteville, Arkansas.

Farm Bill 2002 and Water Quality
Tony L. Stevenson, NRCS, Little Rock, Arkansas.

Ballard Creed, Illinois River, Washington County, Arkansas, Section 319, Best Management Practice Implementation Project
Casey D. Dunigan, Resource Conservationist, Washington County Conservation District.

Urban Nutrient Management in the Illinois River Watershed, Washington, County, Arkansas
David Duncan, Water Quality Technician, Washington County Conservation District.

Developing Resource Management Systems for Golf Courses in Washington County, Arkansas: Phase I
Sarah Franklin & Donald West, Washington County Conservation District.

Strategies to Improve Water Quality in the Beaver Lake, White River, Arkansas are Implemented through the Beaver Lake Watershed Project, Washington County
Sarah Franklin, Water Quality Technician, Washington County Conservation District.

Confined Feeding Operation (CFO) Inventory and Assessment, Arkansas Portion of Illinois River Watershed, Northwest Arkansas
Chad D. Cooper, Department of Biological and Agricultural Engineering, Ralph K. Davis and Michael T. Smith, Department of Geosciences, University of Arkansas, Fayetteville.

WELCOME TO THE

ARKANSAS WATER RESOURCES CENTER ANNUAL CONFERENCE

Focus Topic:

DIVERSE RESEARCH IN SUPPORT OF QUALITY WATER RESOURCES

April 20 & 21, 2004

at the

Center for Continuing Education
and the
Fayetteville Radisson
70 North East Avenue
Fayetteville, Arkansas

Student Support

Student Support					
Category	**Section 104 Base Grant**	**Section 104 RCGP Award**	**NIWR-USGS Internship**	**Supplemental Awards**	**Total**
Undergraduate	4	0	0	0	4
Masters	4	0	0	0	4
Ph.D.	1	0	0	0	1
Post-Doc.	1	0	0	0	1
Total	10	0	0	0	10

Notable Awards and Achievements

Investigation of transport and storage of E. coli bacteria in streams and aquifers of Northwest Arkansas. Results of this project are In Press in the Journal of the American Water Resources Association with expected publication in Fall 2005. The initial state and Federal funds provided via the Arkansas Science and Technology Authority and the USGS 104 B program provided initial data sets which were then used as the basis for a proposal to the National Sciencce Foundation which was awarded for continued research in this area.

Dr. Phil Hays who holds a joint appointment with the USGS and the University of Arkansas, is conducting an interdisciplinary study with USGS, USDA, and the UA Departments of Geosciences and Biological Sciences to define biogeochemical processes occurring in karst, and how N transport and utilization is controlled by the interplay of biological and hydrological inputs to the complex systems. Additional funds provided by the USGS 104 B program have augmented this project providing resources to investigate nitrogen processing in a Karst Soil Catena.

The Arkansas Water Resource Center (AWRC) continues to be a leader in non-point source water-quality monitoring related to nutrient loading of surface waters in the Ozark Plateaus Province. Dr. Marc Nelson, who heads up the AWRC Water Quality Laboratory, leads the monitoring program for six sites throughout the area. High quality nutrient loading data collected by Dr. Nelson and his team are regarded as the best available data for calculation of Total Maximum Daily Loads. These data are also routinely used by other researchers involved with development of non-point source pollution decision support systems. The decision support systems which are being developed for the ten high priority watersheds in the state will be used to prioritize resource allocation to minimize non-point source nutrient and sediment loading to the surface waters of the state.

Dr. Indrajeet Chaubey, University of Arkansas, Department of Biological and Agricultural Engineering has utilized targeted funds to build additional infrastructure at the University’s Savoy Experimental Watershed. Through the efforts of the University, U.S. Geological Survey, Arkansas Department of Environmental Quality, and the Arkansas Soil and Water Conservation Commission the infrastructure at the site is now capable of providing detailed water budget information for one of the six basins. As a

result, this basin is being used by a large number of researchers to conduct both basic and applied research related to impacts associated with animal agriculture in a mantled karst environment. These data are critical to development and implementation of effective management strategies to minimize impacts associated with large-scale animal agriculture in the region.

Through the efforts of the Arkansas Water Resources Center, the Center for Advanced Spatial Technologies, the Arkansas Soil and Water Conservation Commission, and the Natural Resources Conservation Service, digital county soils maps, SURGO level, are available for all but one of Arkansas 75 counties. The linkage between the AWRC, CAST, ASWCC, NRCS, and the state legislative delegation make projects like this a reality. The base support provided to the AWRC through the USGS 104 B funding truly facilitates these linkages between various local, state, and federal entities.

Publications from Prior Projects

1. 2002AR13B ("Processes And Controls Affecting Water/Rock Interaction in Abandoned Underground Coal Mines, Including Feasibility and Risk Assessment of Using Mine Water for Public Drinking Water Sources") - Dissertations - Varnell, C.J. 2004, The Environmental Dynamics of Utilizing Water from Flooded Coal Mines in Greenwood, Arkansas, as a Supplemental Public Drinking Supply - Physical, Chemical, Social, Economic, and Public Perception Considerations: Ph.D. dissertation, Program of Environmental Dynamics, University of Arkansas, Fayetteville, Arkansas, 169 p. [in preparation]
2. 2002AR13B ("Processes And Controls Affecting Water/Rock Interaction in Abandoned Underground Coal Mines, Including Feasibility and Risk Assessment of Using Mine Water for Public Drinking Water Sources") - Other Publications - Cooper, K.W., 2003, Processes and Controls Affecting Water Quality in flooded Coal Mines in the Arkansas River Valley. M.S. Thesis. Department of Geosciences, University of Arkansas, Fayetteville, Arkansas, 88 p. [in reivew]
3. 2003AR47B ("Antibiotic resistance and the relationship between enzyme activity and P in runoff from poultry litter amended soil") - Conference Proceedings - 3. Savin, Mary, 2004, Antibiotic Resistance of Bacteria Isolated From Run-Off and Soils Receiving Poultry Litter. Arkansas Water Resources Center Annual Conference. April 20 and 21, University of Arkansas, Fayetteville, AR.
4. 1999AR13B ("Survival of Escherichia coli in the Sediments of a Northwest Arkansas Stream and Spring") - Articles in Refereed Scientific Journals - Davis, R.K., S. Hamilton, and J.V. Brahana, In Press, Escherichia Coli Survival in Springs and Streams of Mantled Karst Aquifers, Northwest Arkansas. J. Amer. Water Resources Assoc., Paper 03134.