

Department of Geosciences

20 Ozark Hall

Fayetteville, Arkansas 72701

August 31, 2013

Governor Mike Beebe

State of Arkansas

State Capitol-Room 250

Little Rock, Arkansas 72201

Dear Governor Beebe:

***This letter, together with relevant attachments, is provided to express our sincere interest in conducting groundwater characterization, a karst inventory, and fluorescent dye tracing in the area of C & H Farms on Big Creek, Mt. Judea, Arkansas, and to apply for formal funding from a portion of the rainy-day funds you have requested to conduct the study. These data we propose collecting are essential to evaluating the impact of concentrated waste from the C # H Farm leaking and contaminating groundwater in the vicinity of Big Creek and the Buffalo National River. We have been actively sampling groundwater since July (pro bono), and I am including a preliminary summary of what we have found to date (Attachment A). In addition to this table, I would like to briefly introduce you to our research team, and explain why we feel it is in the best interest of the State to select a diverse group with extensive environmental credentials that is not allied with either agriculture or environmental funding. This latter requirement is for perception primarily, but there are other aspects that I feel are necessary to establish not only equitable, non-biased science, but confidence that this team is fair, ethical, and wholly knowledgeable regarding conducting studies in this unique environment underlain by karst.***

Personnel—Brief Introduction

**Carol Bitting-**Carol serves as our local representative, coauthor, and logistical facilitator (*pro bono*). She has lived in Arkansas most of her life, finally settling down in Newton County in 2001. She has been studying cave systems since the early 1980s. She has been involved in numerous geological, hydrological, and biological studies of the karst terrain of north Arkansas and southern Missouri as well as dozens of cartographic surveys of caves with active stream systems. She has worked in a wide variety of positions doing habitat assessments, biological surveys, cadastral surveys, and wildlife habitat management. She has done a great deal of wildland firefighting where her understanding of landforms has proven invaluable for the success of operations and the safety of co-workers. She has been active in the local community, including serving two years on the Newton County Fair Board where she became familiar with a wide segment of the population of Newton County. Her knowledge and understanding of local politics, people, and karst have opened the door for our sampling on many properties whose owners are concerned about the safety of the springs and wells they have relied upon for generations. She has facilitated well and spring sampling as well as anyone with whom I have ever worked.

**Dr. Joe Nix**-Joe is serving as chemist and coauthor, and he is providing *(pro bono)* chemical analyses of water from his State-approved lab in Arkadelphia. He is a retired Distinguished Professor of Chemistry at Ouachita Baptist University, earning his Ph.D. in Chemistry from the University of Arkansas in Fayetteville. He has contributed significantly to understanding the geochemistry of Arkansas waters from across the State, and he has served on numerous commissions and held special appointments in which he has provided valuable insight and candid assessments of controversial topics. He brings a wisdom and knowledge not only of the chemical processes that underlie Big Creek Basin, but throughout the broad region of mid-America.

**Dr. Van Brahana**-I am serving as karst hydrogeologist, project coordinator, and coauthor for this project *(pro bono)*. I have worked for 28-years with the U.S. Geological Survey and 23-years as a Professor of Geosciences at the University of Arkansas, Fayetteville. For my first 10 years in Fayetteville, I held a joint appointment with the USGS and the University. I retired from the University in May 2013. I earned my Ph.D. in Hydrogeology at the University of Missouri, Columbia, in 1973. Since 1990, I have worked closely with members of the State (ADEQ, ARNC, AGC) striving to help address water-quality issues in the karst terrane of northern Arkansas. I have supervised numerous student theses and research projects dealing with karst science, and I have conducted and published nationally and internationally on topics relevant to karst (my CV is included as Attachment B). I have worked closely with the University of Arkansas- Division of Agriculture, Department of Animal Science, to conduct meaningful research to determine animal-waste loading on karst lands, optimum levels of animals that can be raised without doing environmental damage, and tracing and “fingerprinting” of underground waters. Dr. Tom Sauer (U.S. Department of Agriculture, Agricultural Research Service) and I developed the Savoy Experimental Watershed (SEW) on Division of Agriculture property contiguous to the Illinois River, and we have established an intensive infrastructure of karst water-related studies. I have collaborated with and worked closely with numerous personnel of the Division of Agriculture.

Students Faculty and Staff in Geosciences and Environmental Dynamics at the University of Arkansas, Fayetteville. These four volunteers have accompanied us in the field, donating their time and effort to help us identify possible dye-injection sites, collect background water-quality information and samples, and interview the private land owners regarding details of wells and springs on their property. These individuals have been trained in proper data collection, sample storage, chain-of-custody documentation, and quality assurance/quality control (QA/QC) methods.

Progress Thus Far

Permits and Permissions—We have applied and been granted sampling permits from 1) the Buffalo National River (BUFF 2013-SCI-0001) and 2) the U.S. Department of Agriculture, Forest Service (SO-FW-FY13-22). We have applied (July 18, 2013), but have not yet been granted a permit to inject dye in the study area by the Arkansas Department of Water Quality. We have permission to sample private wells, springs, rivers, ponds and related waters throughout the basin thanks to the work of Carol Bitting.

Preliminary Characterization of Groundwater Quality —We have collected data and analyzed 22 sites thus far (Attachment A), and in general, the background water quality has been typical of what we would expect for wells, springs, and streams that derive their groundwater from the shallow Boone Formation. Water type is a calcium-bicarbonate type, derived from dissolution of the limestone by slightly acidic recharge that evolves into a mildly basic (>7.5 pH) type as it follows a fairly short path through the reactive rock.

Specific conductivity of samples collected varies from 129 to 813 S/cm, the minimum value representing flow system of hundreds of feet through the Boone, the maximum value representing flow systems with highly mineralized water from an aquifer overlain by Pennsylvanian-age deposits that occurs beneath the high ridges that separate major streams. Recharge through the Pennsylvanian=age rocks cannot be directly downward because the thick, overlying shales inhibit the flow and divert it laterally along bedding-planes. Groundwater flow beneath the ridges does not appear to be well-integrated into the main flow system of the Boone Formation.

Temperature is an easy to measure yet meaningful parameter, with most of the springs having temperatures that range from 14 to 17 oC. Samples of streams are much warmer during summer months, and colder during winter. Temperatures of water in streams during July and August typically are in the mid-20s to greater than 30 oC. Temperature shows great promise in assessing depth of the flow as well as degree of mixing, which appears to be significant in this basin.

Chemically we have focused on major constituents of the groundwater, nutrients, and microbes, components that will allow us to interpret geochemical processes that are naturally altering the water, as well as contributing sources of recharge; the hog waste will have a distinctive fingerprint is it is leaking into the groundwater. The calcium to magnesium ratio (Ca/Mg) is a clear indicator of the dominant lithology of the aquifer, either limestone (Ca/Mg ratio of about 40:1) or deeper flow systems with dolomite (Ca/Mg ratio of about 3:1). Of particular interest are the nitrate concentrations, which for the Boone Formation are generally 0.6 mg/L or less. This is much lower than nitrate in the Boone Formation elsewhere, which typically ranges from 2-4 mg/L where poultry litter has been spread on the fields of Washington and Benton Counties. Our data from the Big Creek area suggest that the Boone aquifer has not been significantly altered from predevelopment conditions, especially with respect to the nutrient nitrogen.

Bacteriologically, two additional parameters warrant discussion. The first is E. coli, an indicator organism for fecal matter. In this case, it appears that the source is cattle, and it is directly related to cows having access to springs and creeks. Where the cattle have access, and where the water is turbid, values can range from many 10s to almost 1000 colony forming units/100 mL. These analyses reflect a range of land use near the wells and springs, but all indicate the water should be treated before it is used for human consumption, and that aquifer is karstic, because it is capable of transporting microbes along enlarged pathways in the aquifer. Fecal coliform data are consistent with the same interpretation.

Summary of Groundwater in Big Creek Basin Prior to C & H Farms-The groundwater in Big Creek Basin is part of an open, dynamic karst flow system that is recharged by precipitation, that experiences significant interrelation of groundwater with surface water, and because of this, is susceptible to contamination by numerous human activities. Discharge appears to be to Big Creek and the Buffalo National River, and these water bodies would be at risk if storms, leakage, or catastrophic failures allow highly concentrated waste into karst aquifer. At present, there is mild evidence of human and animal production activity in the basin, but the waters overall are not degraded, except with respect to microbes.

Proposal of Work

To address groundwater and karst elements we feel were missing from the initial C & H proposal (see Attachment C), we will 1) continue to conduct a background assessment of water quality in wells, springs, and surface water bodies; 2) complete a karst inventory, wherein we will map all known karst features from upstream of the farm down the valley of Big Creek to a point below the confluence with the Buffalo National River; 3) we will conduct dye-tracing studies, in which we will inject as many as five fluorescent dyes and measure the time of travel and document the point-to-point connections; and 4) we will synthesizing the relation of groundwater and surface water in Big Creek Basin and write scientific reports documenting our findings. This will enable us to fill the data gaps so that we will more completely understand how water, soil, pigs, and humans impact this specific area of this state, and what, if any threat they pose to the water resources, the environment in general, and specifically, to the health of the Buffalo National River. The study will rely primarily on field collection of new data, but will include a compilation of all previous studies that are relevant, and a synthesis and synopsis of these studies.

Deliverable Products

Quarterly reports describing progress; report on the background water quality of Big Creek Basin, including the interaction of surface and groundwater, and a karst inventory; updated reports reflecting variability of water quality based on hydrology; report on the dye=tracing results, synthesizing time of travel and point-to-point flow paths.

Cost

The expenses of this project are expected to be significant. Typically, these charges are the responsibility of the individuals who are requesting the permit (C & H Farms), inasmuch as these are the individuals who will benefit most from this endeavor. Previous work on our part has been completely at our own expense, but we are nearing the limit of our personal resources. Therefore, we have chosen to alter our initial *pro bono* donation and charge actual costs for these benefits and for our time. The activities and work tasks include: cost of chemical analyses of water samples, including 15N as an indicator of swine waste (stable isotopes); cost of microbial sampling of water; construction of dye receptors; purchase of five fluorescent dyes; dye receptor placement and retrieval in field; report generation (8 quarterly reports, background water quality, dye-tracing report, overall interpretive impacts of the farm on the water quality); report reviews; field work collecting samples; dye-tracing injection and sampling; fluorescent analysis of dye samples; salaries; student stipends; travel to and from the project area; shipping fees; and equipment costs. No overhead will be assessed for this project. None of the preliminary costs we have already borne will be charged to the project. Total charges are estimated to be $69,350.

Justification for Selecting Us

An obvious question is “Why select us rather than Division of Agriculture personnel to conduct this study?” We have briefly synthesized the major reasons below, but we would be delighted to meet with you at your convenience and explain our plans in detail, and why we feel we are best suited to most effectively undertake this project.

1. We are experienced karst researchers—We have a long history of numerous related studies successfully completed (see Brahana CV).
2. Our focus is on the relation of groundwater and surface water, which in karst areas such as this is a single resource; typically, agricultural studies do not include groundwater; it is a major concern in this project.
3. Public perception is very important to this study. We are unbiased and scientifically ethical, with no economic ties or funding from either agriculture or environmental entities.
4. We operate transparently; we welcome agriculture or environmental groups to accompany us as we conduct our studies, as well as the press.
5. We are cost-effective and less expensive. As retired University professors (Nix and Brahana), we do not charge overhead on our projects; typically, University projects are assessed an overhead charge that can amount to as much as 43.5% of the total project funds.
6. We have already established a data-collection network, and have initiated the karst inventory for dye-tracing studies; we have our sampling permits in place, and an effective, efficient work plan that has been field tested.
7. As a final note, professional geologists are required to be registered. I hold the State of Arkansas-Board for Professional Registration of Geologists #1884, and American Institute of Professional Geologists #2275. I am not aware of any professional geologist in the Division of Agriculture at the University of Arkansas.

If you would like to meet with us to discuss any aspect of our proposal, we would be delighted to do so. I have also copied Representative David L. Branscum, member of the PEER Committee, and asked him to present our proposal to the Committee during initial discussions of this matter. If you have questions, please contact me at 479-236-1347 (cell), or by email at [brahana@uark.edu](mailto:brahana@uark.edu). Thank you for your time and consideration.

Sincerely yours,

John Van Brahana, Professor Emeritus

Department of Geosciences

cc: Representative David L. Branscum