From: John Van Brahana
To: Water Draft Permit Comment
Cc: John Van Brahana
Subject: C&H Hog Farms Request--Do NOT Approve
Date: Thursday, April 06, 2017 10:43:44 AM

Mr. Caleb Osborne and Director Becky Keogh:

I hereby express my strong opposition to issuing a permit to spread hog feces and urine on fields, and storage of said wastes in lagoons by C&H Hog Farms in Big Creek, near Mt. Judea, Arkansas. It is my understanding that the state of Arkansas requires any facility with a National Pollutant Discharge Elimination System (NPDES) discharge permit be required to submit an application for a Construction Permit for the planned facility from a registered professional engineer (P.E). in the Arkansas Department of Environmental Quality, so the design plans can be reviewed and approved prior to construction of the facility. In the case of C&H Hog Farms, I have been unable to find any evidence that a construction permit was ever submitted for approval. The Clean Water Act prohibits anybody from discharging "pollutants" through a "point source" into a "water of the United States" unless they have an NPDES permit. The permit will contain limits on what can be discharged, with monitoring and reporting requirements, and other provisions to ensure that the discharge does not hurt water quality or people's health. In essence, the permit translates general requirements of the Clean Water Act into specific provisions tailored to the operations of each entity discharging pollutants.

This Construction Authorization is typically covered under a State Permit. Plans and specifications for the construction of any facility with a planned discharge, which included C&H Farms, are typically submitted with the application package to be reviewed by a Professional Engineer (P.E.) to determine if the design plans were adequate for the facility. Under State regulations, it is unlawful for any facility that has applied for and received a NPDES Discharge Permit, to construct the permitted facilities without having first received a “Construct Authorization Permit” from ADEQ, signed and approved by a P.E. from the Department prior to the Permittee constructing the approved facility. The facility should never have been granted approval to begin operation by ADEQ if the “Construction Permit” was not issued. This was the law at the time of approval.

Who was the P.E. who approved this action in direct violation of existing state statutes? Did this P.E. do this deed at the urging or request of another ADEQ manager? Please provide the complete concurrence sheet during this period of ADEQ approval of the C&H original request. Please respond directly to me at your earliest convenience at the following email address: brahana@uark.edu

John Van Brahana, Professor Emeritus
Department of Geosciences
20 Gearhart Hall
University of Arkansas
Fayetteville, Arkansas 72701

cc: The Honorable Asa Hutchinson, Governor of Arkansas
Director Becky Keogh, Arkansas Department of Environmental Quality
Teresa Marks, Previous Director, Arkansas Department of Environmental Quality
Sam Ledbetter, Esq., Attorney
Richard Mayes, Esq., Attorney

From:	John Van Brahana
To:	michael.lamoureux@governor.arkansas.gov; Missy.Irvin@senate.ar.gov; phillip_moore@boozman.senate.gov; tom.cotton@cotton.senate.gov; Commissioners; Keogh, Becky; Mike.Knoedl@agfc.state.ar.us; Nathaniel.Smith@Arkansas.gov; chrisc@arkansasheritage.org; admin@buffaloriverchamber.com; buffaloriverfloatservice@gmail.com; sheilahroenfeldt@aol.com; ozarktom@gmail.com; jstewart@audubon.org; theloosecayuse@gmail.com; burrel.monica@epa.gov; kaspar.paul@epa.gov; hunt.laura@epa.gov; hodgkiss.miranda@epa.gov; riverfriend@friendsoftherivers.org; Water Draft Permit Comment; Carol Bitting; artzbarn@gmail.com; Quick, Ray; Joe Nix; Gordon Watkins; Mike Masterson
Cc:	John Van Brahana
Subject:	Please Deny C&H Request for Permit for Hog CAFO on Karst Upstream from Buffalo National River Based on Economics, NOT Politics
Date:	Thursday, April 06, 2017 11:03:49 AM

Thousands Call To Reject Permit Requested By Industrial Hog Farm Upstream Of Buffalo National River

By NPT Staff on March 28th, 2017

The public has through April 6 to submit comments regarding the operation of a commercial hog operation six miles upstream of Buffalo National River/NPS

The state of Arkansas is accepting through April 6 public comments regarding a new permit for an industrial hog farm located upstream of Buffalo National River.

The C&H Hog Farms, Inc., operation at Mount Judea is located along Big Creek about six miles upstream of the national river. Under a contract with Cargill, Inc., an international agricultural and food conglomerate, C&H confines approximately 6,500 pigs at a time, making the operation the first of its size and scale in the Buffalo River watershed.

Though it has been operating since 2013 under a general National Pollutant Discharge Elimination System permit, the company is now seeking a change in its permit to one that presumes there will be no waste discharges from the property.

The hog farm is located in a region of karst geology, which is is composed of easily dissolved rocks, such as limestone and dolomite. Via sinkholes and underground caves in the geology, groundwater can flow miles very quickly. In the National Park System, karst geology is perhaps mostly visibly connected to Mammoth Cave National Park in Kentucky, but it can also be found along the Buffalo National River and at Ozark National Scenic Riverways in Missouri.

Keeping pollutants out of this geology is particularly important for the Buffalo National River, as its boundaries encompass just 11 percent of the Buffalo River watershed. The C&H Hog Farms' "concentrated animal feeding operation," or CAFO, generates an "estimated nitrogen output ... equivalent to a human population of 7,000, and the phosphorus output is equivalent to 23,000 humans, in a watershed with a total human population of approximately 17,000."

So far, according to the National Parks Conservation Association, more than 14,000 comments have been submitted to the Arkansas Department of Environmental Quality asking that the new permit be denied.

ADEQ's contact person for submitting written comments, requesting information regarding the draft permit, or obtaining a copy of the permit and the Statement of Basis is Katherine McWilliams, at 5301 Northshore Drive, North Little Rock, Arkansas 72118-5317, 501-682-0650, or at Water-Draft-Permit-Comment@adeq.state.ar.us.

In 2012, the state granted C&H a permit for this facility without allowing adequate public input or consultation from the National Park Service, the U.S. Fish and Wildlife Service, or local

communities. The state permit expired on October 31, 2016. Now, Arkansas Gov. Asa Hutchinson and the ADEQ "have an opportunity to protect America's first national river by denying the company's application for a permit 5264-W, which seeks to allow C&H to continue spreading hog waste in this fragile ecosystem," NPCA said.

The feedlot has generated a lot of controversy among environmental groups because of the potential threat it poses to the Buffalo National River. Last fall, water testing in Big Creek downstream of C&H by the Big Creek Research and Extension Team found higher levels of nitrate, total nitrogen, total coliform bacteria, chloride, specific conductance, alkalinity, and total dissolved solids than water samples taken upstream of the farm.

While state testing in 2014 found state limits for E. coli were exceeded both upstream and downstream of the farm, in 2015, higher levels were detected only in the upstream samples.

A lengthy report by the director of the U.S. Geological Survey's Wyoming Water Science Center on these tests and water quality impacts to the national river offered nearly a dozen recommendations, including one for dye tracing studies around the pig feedlot in a bid to determine how surface water enters the surrounding karst topography and show where it exits.

"This is our last chance to protect the Buffalo National River, our country's first national river and a beloved national park, which belongs to all Americans. Allowing C&H to continue spreading millions of gallons of waste in the Buffalo's watershed could do irreparable damage to the regional tourism economy and threatens local drinking water," said Emily Jones, NPCA's senior program manager for the Southeast Region. "Along with thousands of our members and supporters in Arkansas and across the country, NPCA urges Governor Hutchinson to protect this precious resource and keep the Buffalo safe for people to swim, fish, and float."

The Buffalo National River offers recreational opportunities along 135 miles of free-flowing river, and is a major economic driver for the region. The river welcomed more than 1.7 million visitors in 2016, pumping millions of dollars into nearby communities and supporting local jobs.

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From: John Van Brahana
To: Water_Draft_Permit_Comment; michael.lamoureux@governor.arkansas.gov; Missy.Irvin@senate.ar.gov; Commissioners; Keogh, Becky; Nathaniel.Smith@Arkansas.gov; chrisc@arkansasheritage.org; dmin@buffaloriverchamber.com; buffaloriverfloatservice@gmail.com; ozarktom@gmail.com; jstewart@audubon.org; theloosecayuse@gmail.com; kaspar.paul@epa.gov; hunt.laura@epa.gov; hodgkiss.miranda@epa.gov; riverfriend@friendsoftherivers.org; lcbitting@gmail.com; gwatkins@ritternet.com; sarahrobertson82@gmail.com; vroland@usgs.gov; artzbarn@gmail.com; river1939@suddenlink.net; raqec@att.net; Robert Cross; teresa_turk@hotmail.com; thompsonadd@gmail.com; masullo.ginny1@gmail.com; katarinakosic84@gmail.com; dane.schumacher@yahoo.com; Michael J. Wavering; mmasterson@arkansasonline.com; jeffmontgomery@earthlink.net
Cc: John Van Brahana
Subject: Please DENY C&H Factory Hog Farm Request for Permit
Date: Thursday, April 06, 2017 3:34:28 PM

Request to Deny C&H Hog Farms a Regulation 5 Permit
Comments by Dr. John Van Brahana, Ph.D., P.G.
Research Scientist Emeritus, U.S. Geological Survey
Professor Emeritus, University of Arkansas, Department of Geosciences
April 8, 2017

Based on my following numbered objections shown below, I respectfully request that the Arkansas Department of Environmental Quality deny a Regulation 5 permit to C&H Hog Farms.

1. ***Major Objection—The Groundwater Component of the Water Budget Is Large in Karst Areas, and Groundwater Was Ignored in Assessing Contamination from C&H.*** The following documents showed none to very little discussion of groundwater flow or contaminant transport, although these are dominant in karst. Erroneous, incomplete, documents include: the Notice of Intent (Pesta, 2012); the Final Environmental Assessment (U.S. Department of Agriculture Farm Service Agency and U.S. Small Business Agency, 2015); Big Creek and the associated waste-spreading fields of C&H Farms are on the Boone Formation, which includes pure limestone and interbedded thin limestone and chert layers. The limestone has been intensively karstified (Braden and Ausbrooks, 2003: Hudson, 1998; Mott et al., 2000; Murdoch et al., 2016; Brahana et al., 2017). Being karstified means that much of the hydrologic budget of rainfall and wastes placed on the land surface moves underground as groundwater, and this part of the flow path is not easily seen. Multiple springs, wells, and contiguous surface-drainage basins are sampled using non-toxic dyes that are added to flowing groundwater. Dye receptors are placed in wells along the potential flow path, and at the discharge points in rivers and streams to assess if dye input flowed past each point. Dye tracing is essential in showing the pathways of water movement in karst (Quinlan; Aley; Ewers), and in the Big Creek basin where C&H operates, multiple dye traces have been undertaken by the Karst Hydrogeology of the Buffalo National River (KHBNR) team of citizen scientists using scientifically accepted and approved methodologies. The results of these tests are currently being published in peer-reviewed scientific paper (U.S. Geological Survey Scientific Investigations Report) indicating that the groundwater flow moves underground to Big Creek, and underneath topographic divides into contiguous surface water drainage basins. It returns to the surface from springs, ultimately discharging into the Buffalo National River (Brahana et al., 2017a). In addition to flow path identification, dye tracing indicates that most groundwater flow rates are very rapid, about 2000 to more than 3000 feet per day. When the water has both surface and groundwater flow components, it can travel faster than 5 miles in a single day.

2. ***Major Objection—Intensive groundwater sampling from springs, wells and streams in the area is showing that water quality is degrading, with greatest impact occurring closest to the CAFO and springs draining its permitted spreading fields.*** In addition to the dye tracing, KHBNR team members collected water-quality data, which indicate groundwater quality is degrading. The KHBNR team, which has been collecting groundwater quality data since 2013, found that the groundwater quality near the C&H Hog Farms and its spreading fields shows high concentrations of the trace metals zinc-66, copper-63, and copper-65, additives to pig food, and the isotope phosphorus-31 (Brahana et al., 2017), common in pig excretia. Additional water quality data are enlightening, with *Escheria coli* (*E. coli*) concentrations in receiving streams (Big Creek and Left Fork of Big Creek), having values of these indicator bacteria that range well above 20,000 colonies per 100 milliliters, expressed as most probable number per 100 milliliters (MPN/100 ml). Dissolved oxygen (DO) concentrations during the summer of 2015 were less than the lower limits of impaired streams (summertime values of 5.0 mg/L). *E. coli* is indicative of water contamination by warm-blooded animals, and DO concentrations are indicators of the overall ecological health of waters. Excessive algal blooms can be yet another indicator of impaired water quality. From the U.S. and around the world, CAFOs have a horrible record of contaminating environments unless they are properly sited and professional studies show that the feces and urine of the animal waste are properly contained.

3. ***Major Objection—The Final Environmental Assessment provided by the U.S. Department of Agriculture Farm Service Agency and the U.S. Small Business Agency is flawed and inaccurate.*** The Final EA continues to assert that the cherty section of the Boone Formation in the vicinity of the C&H hog factory is not karst. This claim of no Boone karst is based on "lack of identifiable surface features on topographic maps and areal photos" in the immediate area of the farm. This is a flawed interpretation based on an erroneous definition that karst is "karst topography", or that karst topography is always an essential component of karst. Karst is a hydrogeologic term, wherein groundwater plays a greater role in the hydrologic budget. The CAFO study site is formally called mantled karst, which means that many of the internally drained depressions (sinkholes) the EA sought on maps were covered with a thin, nearly-flat layer of insoluble soil and regolith, and therefore not visible using the methods employed by the Final EA. Furthermore, in the area of outcrop of the Boone Formation in northern Arkansas, karst topography is not visible at areal-photographic or map scales (1:24,000), because many of the karst features are too small to be seen on maps of this scale (figure 1), or below land surface (figures 2 and 3). However, Arkansas Geological Survey geologic mapping of the 7.5-minute Mount Judea quadrangle (Braden and Ausbrooks, 2003), was described and based on intensive field work. Description of the Boone Formation includes this statement: "Boone Formation (Lower Mississippian, Osagean and Kinderhookian) – Coarse-grained fossiliferous and fine-grained limestones interbedded with anstamosing and bedded chert. Light to medium-gray on fresh surface but usually weathers dark-gray. The chert varies in color from light-gray to dark-gray. Springs and sinkholes are abundant…" If sinkholes are present, so is karst. A further claim that the Mt. Judea topographic map (U.S. Geological Survey, 1980) was used for identification of karst features visible on the land surface appears to be scientifically inconsistent, inasmuch as names of streams that drain the region within 1 mile of the CAFO have names shown clearly on the map as Dry Creek, Cave Spring Branch, and Dry Branch, strongly suggesting that the area is likely underlain by karst. This was not evaluated nor pursued in any of the documentation offered, including the Notice of Intent (NOI), the draft EA, or the Final EA.

   Another field-observable feature, erroneously interpreted from the 7.5-minute topographic map (U.S. Geological Survey, 1980), interprets Big Creek near C&H Hog Farms and its spreading fields as a continuously flowing stream and Dry Creek as an intermittent creek. In fact, under varying recharge and seasonal conditions, both show dry-stream reaches, zones of continuous streamflow upstream of dry reaches where streamflow has ceased (Brahana and Hollyday, 1988). Dry-stream reaches reflect underlying karst, where all streamflow is captured in an interval that flows completely underground. The continued denial of the existence of karst in the Final EA not only fails to describe actual environmental conditions in Big Creek basin in the vicinity of the CAFO, it represents a serious flaw in the argument of a FONSI. The definition of karst in the Final EA ignores consideration of the key fact that the area is underdrained by interconnected zones of high permeability created by dissolution of the soluble bedrock. This is an essential component of the definition of karst, not the limited aspects of "karst topography" to which the Final EA erroneously and steadfastly adheres. Because the waste, the contamination, and the water have moved underground and bypassed many of the surface measuring sites that the Final EA used to establish a FONSI, this negates claims that there is no impact from C&H. The Big Creek Extension and Research Team (BCRET) funded with tax dollars by Governor Beebe at the request of the Farm Bureau in 2013 acknowledges karst in some of their ancillary documents, but their focus is not karst. The Final EA simply failed to sample the natural groundwater outlets (springs) downstream from the karst resurgences, water and waste derived initially from the hog-waste spreading fields.

   Scientific data collection by the Karst Hydrogeology of the Buffalo National River (KHBNR) team included field-based sampling starting in July 2013, when fewer than 500 hogs were housed at C&H Hog Farm. The KHBNR team rigorously followed U.S. Geological Survey (USGS) and U.S. Environmental Protection Agency (EPA) protocols and procedures, conducting karst inventorying, dye-tracing studies, major constituent water-quality sampling, continuous groundwater level monitoring, trace-metal sampling, microbial sampling, and dissolved oxygen analyses with continuous-sampling probes. The Final EA claims to adhere to the "best science", implying unbiased, fair assessment of all scientific facts that are readily available, but made no effort to pursue any data from KHBNR. KHBNR includes retired professors (Ph.D.s), professional geologists (P.G.s), previous employees of state and federal agencies (Arkansas Department of Environmental Quality [ADEQ], USGS, and National Park Service [NPS]), consultants, and graduate students. Discipline backgrounds are diverse, all are well-informed, honest, concerned citizens who pay the taxes that ultimately have provided funding for the EA, as well as for the BCRET study. The claim of "best science" is hollow unless the Final EA provides a full discussion of KHBNR data and interpretations, including the web address https://buffaloriveralliance.org under numerous headings of data, research and Dr. Van Brahana in red. This was done for BCRET webpage (page 3.8 of Section 3.2.1, Surface Water section of the Final Environmental Assessment), but not for KHBNR, the website where these important data and studies reside. The present Final EA reinforces the appearance of bias.

   Field observation conclusively provides visual documentation that karst is indeed present in the immediate area of the CAFO and its spreading fields. The Final EA requires a thorough and adequate reevaluation of the karst groundwater prior to the finding of a FONSI. No groundwater nor karst studies were used nor studied, further discrediting the Final EA.

   Another major flaw of the Final EA is the lack of discussion of the relation of surface and groundwater, clearly pointed out by Tom Aley (2015) and myself (Brahana, 2015) in the draft EA. Karst scientists understand that the degree of groundwater/surface water interaction in Big Creek basin is another major characteristic of karst. Stated simply, water and waste in karst lands are not confined only to surface streams, but flow underground along unseen pathways until resurgence as springs or baseflow to surface streams occur (Winter et al., 1998). Figure 7 shows the relation of precipitation measured at 10-minute intervals over the course of more than a year, as well as the timing of water level response in several key wells in the area, and the stream level in Big Creek. Cause and effect are nearly coincident. The nearly identical timing of response of wells and the stream (near-identical lag times) clearly establishes the fact the water in the Boone Formation has moved from surface to groundwater amazingly rapidly, an essential characteristic of karst.

   One reason for establishing the existence of close groundwater/surface water interaction concerns the economics of widely spreading dye on the waste-spreading fields. Dye injection into a point source ("dug" wells), rather than areally broadcasting a large amount of dye on the waste-spreading fields (for which we have not been given permission by the CAFO and spreading field owners) requires much less dye be utilized in the test. Because: 1) the KHBNR is operating on a meager budget that is based on donations of cash and *pro bono* contributions of field sampling and lab analyses; because the cost of the dye represents a large part of the KHNBR budget; because some of our fluorescent dyes photodegrade on land surface in sunlight; and because these "dug" wells offer direct access to flowing groundwater in the Boone aquifer, we can optimize our scientific study while minimizing our expenditures.

   The third major flaw in the Final EA is the continued ignoring of dye-tracing studies that have been conducted and described in peer-reviewed literature (Brahana et al., 2014; Kosic et al., 2015), and the noted existence of these studies in my previous review of the preliminary EA (Brahana, 2015). One such study is shown here, with the injection occurring in a dug well surrounded by waste-spreading fields, and wide and rapid dispersal of the dye not only in Big Creek, but in contiguous drainage basins, and downgradient as far as the Buffalo National River (figure 8). It should be noted that within 24 hours of

dye injection, a major storm of about 6 inches of rain fell, and this recharge facilitated the rapid groundwater level rise and mobilization of the dye.

Completely discounting the key details of the dye-tracing studies, including very rapid groundwater flow velocities and unexpected groundwater flow dispersal that the KHBNR team has established, ignores well-documented and important data that have a direct bearing on a FONSI. Dye tracing is an essential tool for studying karst hydrogeology, and the KHBNR dye studies utilize extensive experience involving project planning and objectives, challenging field conditions, thorough karst inventorying, and rigorous QA/QC (Aley, 2002). KHNBR studies were conducted to the highest of scientific standards (Brahana et al., 2014; Kosic et al., 2015). The importance of dye tracing in karst is that it documents where the water and waste flows in the subsurface (in this case, from a well immediately across the road from the pig factory, and another well surrounded by waste spreading fields near Dry Creek), how fast it flows (from about 1700 to 2500 feet per day), and the location where it reemerges at springs (in the middle of Big Creek, along upstream and downstream tributaries to spreading fields, and springs in Left Fork of Big Creek), and at 7 locations along the Buffalo National River (figure 8). None of this was mentioned in the Final EA. Especially noteworthy, dye recovery at John Eddings Cave from dye injection at BS-36 during conditions of high groundwater flow clearly indicates an hydraulic connection between CAFO waste-spreading fields and this cave. John Eddings Cave is a recognized hibernaculum for the endangered gray bat, *Myotis grisescens*. By failing to reference this most relevant information, it is my opinion that the Final EA has failed to pursue the potential for negative environmental impact to this

Dye-tracing results in Big Creek are mirrored by many other researchers throughout the Buffalo National River, especially with reference to the hydrogeology of the Boone Formation and its karst nature (Aley and Aley, 1989; Mott, 2003; Soto, 2014; Aley, 2015; Kosic et al., 2015; Brahana et al., 2017a).

Water-quality trends of dissolved oxygen (DO) as measured continuously in Big Creek during the past few summers indicate disturbing long-term decreases below calculated EPA standards, prompting a request by the National Park Service (NPS) that Big Creek be assigned "impaired" status last summer (Usrey, 2013; Usrey, 2015). DO measurements were ignored in the Final EA, and the "impaired" status request was rejected by the Arkansas Department of Environmental Quality (ADEQ) because the NPS data-collection scheme did not originate from an approved lab. This is the first time that ADEQ rejected NPS water-quality data, an unexpected decision, especially considering the time and careful development and rigorous sampling protocols implemented, clearly written, and carefully followed by NPS and USGS scientists (Green and Usrey, 2014).

The duration and extent of the low nighttime DO concentrations the last few summers (Usrey, 2013; Usrey, 2015) reinforces the observation that the added burden of waste from 6500 pigs, creating more than 2 million gallons of feces and urine per year is producing an impact in Big Creek, and downstream in the Buffalo. Informal observation by local landowners along the creek that the algae and biomass was particularly luxuriant last summer, following about 6 months of waste spreading on nearby CAFO fields. These values alone are not necessarily proof that the hog factory is the cause of the degraded water quality, but they are remarkably consistent that this CAFO has added to the total agricultural loading from this valley, and that data exist to suggest that it is stressed.

As a comparison of water quality in Big Creek with a nearby surface stream, the Little Buffalo River, the DO concentration in the Little Buffalo 7 miles upstream from the confluence of Big Creek and the Buffalo River dropped below 6 parts per million only 1 time (less than 3 hours total for the period of measured) during the sampling interval of summer 2013. The drainage area of the Little Buffalo River has similar land use and karst geology as Big Creek; what is not similar is that the Little Buffalo River does not have a huge hog factory upstream. Waiting until these water-quality degradations to build up to greater than EPA levels before seeking remediation for Big Creek and the Buffalo National River, Arkansas' Extraordinary Water Resource, seems short-sighted and potentially risky.

Major Objection—The original notice of intent (NOI) had fraudulent signatures, inaccurate map locations, errors of scientific fact, omissions of required legal and numerous flaws clearly reported by an independent Civil Engineering M.S. graduate (Hovis, 2014). This report is an eye-opening account of shortcomings in the NOI by an individual who had no bias. If you would like a copy of this paper, it is available on the Buffalo River Watershed Alliance webpage, or you can request a copy from me. I encourage all politicians, all ADEQ personnel, and all interested stakeholders to read this. She documents misrepresentations of who owned land that was reported to be available for spreading feces and urine, it includes factual misrepresentations in the NOI, coupled with secretive awarding of the General Permit without the knowledge of the Director of ADEQ, and allowing only two ADEQ employees from Little Rock to perform inspections at C&H. This demand was initiated after a surprise inspection by the ADEQ employees from the Jasper, Arkansas, office, who were later forbidden to continue with any addition inspections.

5. ***Major Objection—Design of the BCRET sampling plan did not include intensive groundwater data sites, which are essential to describe the hydrology of Big Creek and contiguous basins.*** Discontinuous flow along sections of Big Creek during low flow make flow and water-quality comparisons highly questionable, owing to the fact that major aspects of the hydrology are neither monitored nor quantified. This is a common feature of surface water in karst lands. The title of the BCRET sampling, paid for by "Rainy Day Funds" by the Governor, is stated in the title of BCRET reports; it is "DEMONSTRATING AND MONITORING THE SUSTAINABLE MANAGEMENT OF NUTRIENTS ON C&H FARM IN BIG CREEK WATERSHED". Governor Beebe indicated that he was funding the project to assess if the CAFO were impacting Big Creek and the Buffalo National River, not to help the CAFO find the least-harmful impact on the environment. This overall emphasis of "Demonstrating"…overall "Sustainability" implies a strong bias we has been consistent since the CAFO was permitted.

Historical documents, long-term studies by the U.S. Geological Survey throughout the conterminous U.S., and from numerous locations throughout the world indicate that huge concentrations of animal feces and urine will follow the laws of physics and chemistry, and contaminate downstream waters. In karst regions, this is exacerbated by the high permeability of the conduits to allow rapid flow, with little attenuation of the contaminants. Big Creek and contiguous drainage ways that flow into the Buffalo National River in Newton County, Arkansas, show degraded effects of animal production. Recent study of groundwater by the KHBNR team shows strong evidence that springs and wells closest to the waste sources are seeing the most impact. Delaying action, whether by inactivity or by requesting "needed additional years of data collection" ignores the wisdom we have gained from so many other sites.

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Sincerely yours,

Van Brahana, Professor Emeritus, Ph.D., P.G.
Department of Geosciences
20 Gearhart Hall
University of Arkansas
Fayetteville, Arkansas 72701

From: Robinson, Kelly
To: Deardoff, Amy; McWilliams, Katherine
Subject: FW: Please DENY C&H Factory Hog Farm Request for Permit
Date: Thursday, April 06, 2017 3:51:01 PM

Several comments coming your way.

Kelly Robinson

Public Information Officer
5301 Northshore Drive
North Little Rock, AR 72118

501-682-0916

From: Goff, Patricia
Sent: Thursday, April 06, 2017 3:37 PM
To: Moulton, Charles; Robinson, Kelly
Subject: FW: Please DENY C&H Factory Hog Farm Request for Permit

From: John Van Brahana [mailto:brahana@uark.edu]
Sent: Thursday, April 06, 2017 3:33 PM
To: Water Draft Permit Comment; michael.lamoureux@governor.arkansas.gov; Missy.Irvin@senate.ar.gov; Commissioners; Keogh, Becky; Nathaniel.Smith@Arkansas.gov; chrisc@arkansasheritage.org; dmin@buffaloriverchamber.com; buffaloriverfloatservice@gmail.com; ozarktom@gmail.com; jstewart@audubon.org; theloosecayuse@gmail.com; kaspar.paul@epa.gov; hunt.laura@epa.gov; hodgkiss.miranda@epa.gov; riverfriend@friendsoftherivers.org; lcbitting@gmail.com; gwatkins@ritternet.com; sarahrobertson82@gmail.com; vroland@usgs.gov; artzbarn@gmail.com; river1939@suddenlink.net; raqec@att.net; Robert Cross; teresa_turk@hotmail.com; thompsonadd@gmail.com; masullo.ginny1@gmail.com; katarinakosic84@gmail.com; dane.schumacher@yahoo.com; Michael J. Wavering; mmasterson@arkansasonline.com; jeffmontgomery@earthlink.net
Cc: John Van Brahana
Subject: Please DENY C&H Factory Hog Farm Request for Permit

Request to Deny C&H Hog Farms a Regulation 5 Permit
Comments by Dr. John Van Brahana, Ph.D., P.G.
Research Scientist Emeritus, U.S. Geological Survey
Professor Emeritus, University of Arkansas, Department of Geosciences
April 8, 2017

Based on my following numbered objections shown below, I respectfully request that the Arkansas Department of Environmental Quality deny a Regulation 5 permit to C&H Hog Farms.

1. ***Major Objection—The Groundwater Component of the Water Budget Is Large in Karst Areas, and Groundwater Was Ignored in Assessing Contamination from C&H.*** The following documents showed none to very little discussion of groundwater flow or contaminant transport, although these are dominant in karst. Erroneous, incomplete, documents include: the Notice of Intent (Pesta, 2012); the Final Environmental Assessment (U.S. Department of Agriculture Farm Service Agency and U.S. Small Business Agency, 2015); Big Creek and the associated waste-spreading fields of C&H Farms are on the Boone Formation, which includes pure limestone and interbedded thin limestone and chert layers. The limestone has been intensively karstified (Braden and Ausbrooks, 2003: Hudson, 1998; Mott et al., 2000; Murdoch et al., 2016; Brahana et al., 2017). Being karstified means that much of the hydrologic budget of rainfall and wastes placed on the land surface moves underground as groundwater, and this part of the flow path is not easily seen. Multiple springs, wells, and contiguous surface-drainage basins are sampled using non-toxic dyes that are added to flowing groundwater. Dye receptors are placed in wells along the potential flow path, and at the discharge points in rivers and streams to assess if dye input flowed past each point. Dye tracing is essential in showing the pathways of water movement in karst (Quinlan; Aley; Ewers), and in the Big Creek basin where C&H operates, multiple dye traces have been undertaken by the Karst Hydrogeology of the Buffalo National River (KHBNR) team of citizen scientists using scientifically accepted and approved methodologies. The results of these tests are currently being published in peer-reviewed scientific paper (U.S. Geological Survey Scientific Investigations Report) indicating that the groundwater flow moves underground to Big Creek, and underneath topographic divides into contiguous surface water drainage basins. It returns to the surface from springs, ultimately discharging into the Buffalo National River (Brahana et al., 2017a). In addition to flow path identification, dye tracing indicates that most groundwater flow rates are very rapid, about 2000 to more than 3000 feet per day. When the water has both surface and groundwater flow components, it can travel faster than 5 miles in a single day.

2. ***Major Objection—Intensive groundwater sampling from springs, wells and streams in the area is showing that water quality is degrading, with greatest impact occurring closest to the CAFO and springs draining its permitted spreading fields.*** In addition to the dye tracing, KHBNR team members collected water-quality data, which indicate groundwater quality is degrading. The KHBNR team, which has been collecting groundwater quality data since 2013, found that the groundwater quality near the C&H Hog Farms and its spreading fields shows high concentrations of the trace metals zinc-66, copper-63, and copper-65, additives to pig food, and the isotope phosphorus-31 (Brahana et al., 2017), common in pig excretia. Additional water quality data are enlightening, with *Escheria coli* (*E. coli*) concentrations in receiving streams (Big Creek and Left Fork of Big Creek), having values of these indicator bacteria that range well above 20,000 colonies per 100 milliliters, expressed as most probable number per 100 milliliters (MPN/100 ml). Dissolved oxygen (DO) concentrations during the summer of 2015 were less than the lower limits of impaired streams (summertime values of 5.0 mg/L). *E. coli* is indicative of water contamination by warm-blooded animals, and DO concentrations are indicators of the overall ecological health of waters. Excessive algal blooms can be yet another indicator of impaired water quality. From the U.S. and around the world, CAFOs have a horrible record of contaminating environments unless they are properly sited and professional studies show that the feces and urine of the animal waste are properly contained.

3. ***Major Objection—The Final Environmental Assessment provided by the U.S. Department of Agriculture Farm Service Agency and the U.S. Small Business Agency is flawed and inaccurate.*** The Final EA continues to assert that the cherty section of the Boone Formation in the vicinity of the C&H hog factory is not karst. This claim of no Boone karst is based on "lack of identifiable surface features on topographic maps and areal photos" in the immediate area of the farm. This is a flawed interpretation based on an erroneous definition that karst is "karst topography", or that karst topography is always an essential component of karst. Karst is a hydrogeologic term, wherein groundwater plays a greater role in the hydrologic budget. The CAFO study site is formally called mantled karst, which means that many of the internally drained depressions (sinkholes) the EA sought on maps were covered with a thin, nearly-flat layer of insoluble soil and regolith, and therefore not visible using the methods employed by the Final EA. Furthermore, in the area of outcrop of the Boone Formation in northern Arkansas, karst topography is not visible at areal-photographic or map scales (1:24,000), because many of the karst features are too small to be seen on maps of this scale (figure 1), or below land surface (figures 2 and 3). However, Arkansas Geological Survey geologic mapping of the 7.5-minute Mount Judea quadrangle (Braden and Ausbrooks, 2003), was described and based on intensive field work. Description of the Boone Formation includes this statement: "Boone Formation (Lower Mississippian, Osagean and Kinderhookian) – Coarse-grained fossiliferous and fine-grained limestones interbedded with anstamosing and bedded chert. Light to medium-gray on fresh surface but usually weathers dark-gray. The chert varies in color from light-gray to dark-gray. Springs and sinkholes are abundant…" If sinkholes are present, so is karst. A further claim that the Mt. Judea topographic map (U.S. Geological Survey, 1980) was used for identification of karst features visible on the land surface appears to be scientifically inconsistent, inasmuch as names of streams that drain the region within 1 mile of the CAFO have names shown clearly on the map as Dry Creek, Cave Spring Branch, and Dry Branch, strongly suggesting that the area is likely underlain by karst. This was not evaluated nor pursued in any of the documentation offered, including the Notice of Intent (NOI), the draft EA, or the Final EA.

   Another field-observable feature, erroneously interpreted from the 7.5-minute topographic map (U.S. Geological Survey, 1980), interprets Big Creek near C&H Hog Farms and its spreading fields as a continuously flowing stream and Dry Creek as an intermittent creek. In fact, under varying recharge and seasonal conditions, both show dry-stream reaches, zones of continuous streamflow upstream of dry reaches where streamflow has ceased (Brahana and Hollyday, 1988). Dry-stream reaches reflect underlying karst, where all streamflow is captured in an interval that flows completely underground.
   The continued denial of the existence of karst in the Final EA not only fails to describe actual environmental conditions in Big Creek basin in the vicinity of the CAFO, it represents a serious flaw in the argument of a FONSI. The definition of karst in the Final EA ignores consideration of the key fact that the area is underdrained by interconnected zones of high permeability created by dissolution of the soluble bedrock. This is an essential component of the definition of karst, not the limited aspects of "karst topography" to which the Final EA erroneously and steadfastly adheres. Because the waste, the contamination, and the water have moved underground and bypassed many of the surface measuring sites that the Final EA used to establish a FONSI, this negates claims that there is no impact from C&H. The Big Creek Extension and Research Team (BCRET) funded with tax dollars by Governor Beebe at the request of the Farm Bureau in 2013 acknowledges karst in some

of their ancillary documents, but their focus is not karst. The Final EA simply failed to sample the natural groundwater outlets (springs) downstream from the karst resurgences, water and waste derived initially from the hog-waste spreading fields.

Scientific data collection by the Karst Hydrogeology of the Buffalo National River (KHBNR) team included field-based sampling starting in July 2013, when fewer than 500 hogs were housed at C&H Hog Farm. The KHBNR team rigorously followed U.S. Geological Survey (USGS) and U.S. Environmental Protection Agency (EPA) protocols and procedures, conducting karst inventorying, dye-tracing studies, major constituent water-quality sampling, continuous groundwater level monitoring, trace-metal sampling, microbial sampling, and dissolved oxygen analyses with continuous-sampling probes. The Final EA claims to adhere to the "best science", implying unbiased, fair assessment of all scientific facts that are readily available, but made no effort to pursue any data from KHBNR. KHBNR includes retired professors (Ph.D.s), professional geologists (P.G.s), previous employees of state and federal agencies (Arkansas Department of Environmental Quality [ADEQ], USGS, and National Park Service [NPS]), consultants, and graduate students. Discipline backgrounds are diverse, all are well-informed, honest, concerned citizens who pay the taxes that ultimately have provided funding for the EA, as well as for the BCRET study. The claim of "best science" is hollow unless the Final EA provides a full discussion of KHBNR data and interpretations, including the web address https://buffaloriveralliance.org under numerous headings of data, research and Dr. Van Brahana in red. This was done for BCRET webpage (page 3.8 of Section 3.2.1, Surface Water section of the Final Environmental Assessment), but not for KHBNR, the website where these important data and studies reside. The present Final EA reinforces the appearance of bias.

Field observation conclusively provides visual documentation that karst is indeed present in the immediate area of the CAFO and its spreading fields. The Final EA requires a thorough and adequate reevaluation of the karst groundwater prior to the finding of a FONSI. No groundwater nor karst studies were used nor studied, further discrediting the Final EA.

Another major flaw of the Final EA is the lack of discussion of the relation of surface and groundwater, clearly pointed out by Tom Aley (2015) and myself (Brahana, 2015) in the draft EA. Karst scientists understand that the degree of groundwater/surface water interaction in Big Creek basin is another major characteristic of karst. Stated simply, water and waste in karst lands are not confined only to surface streams, but flow underground along unseen pathways until resurgence as springs or baseflow to surface streams occur (Winter et al., 1998). Figure 7 shows the relation of precipitation measured at 10-minute intervals over the course of more than a year, as well as the timing of water level response in several key wells in the area, and the stream level in Big Creek. Cause and effect are nearly coincident. The nearly identical timing of response of wells and the stream (near-identical lag times) clearly establishes the fact the water in the Boone Formation has moved from surface to groundwater amazingly rapidly, an essential characteristic of karst.

One reason for establishing the existence of close groundwater/surface water interaction concerns the economics of widely spreading dye on the waste-spreading fields. Dye injection into a point source ("dug" wells), rather than areally broadcasting a large amount of dye on the waste-spreading fields (for which we have not been given permission by the CAFO and spreading field owners) requires much less dye be utilized in the test. Because: 1) the KHBNR is operating on a meager budget that is based on donations of cash and *pro bono* contributions of field sampling and lab analyses; because the cost of the dye represents a large part of the KHNBR budget; because some of our fluorescent dyes photodegrade on land surface in sunlight; and because these "dug" wells offer direct access to flowing groundwater in the Boone aquifer, we can optimize our scientific study while minimizing our expenditures.

The third major flaw in the Final EA is the continued ignoring of dye-tracing studies that have been conducted and described in peer-reviewed literature (Brahana et al., 2014; Kosic et al., 2015), and the noted existence of these studies in my previous review of the preliminary EA (Brahana, 2015). One such study is shown here, with the injection occurring in a dug well surrounded by waste-spreading fields, and wide and rapid dispersal of the dye not only in Big Creek, but in contiguous drainage basins, and downgradient as far as the Buffalo National River (figure 8). It should be noted that within 24 hours of dye injection, a major storm of about 6 inches of rain fell, and this recharge facilitated the rapid groundwater level rise and mobilization of the dye.

Completely discounting the key details of the dye-tracing studies, including very rapid groundwater flow velocities and unexpected groundwater flow dispersal that the KHBNR team has established, ignores well-documented and important data that have a direct bearing on a FONSI. Dye tracing is an essential tool for studying karst hydrogeology, and the KHBNR dye studies utilize extensive experience involving project planning and objectives, challenging field conditions, thorough karst inventorying, and rigorous QA/QC (Aley, 2002). KHNBR studies were conducted to the highest of scientific standards (Brahana et al., 2014; Kosic et al., 2015). The importance of dye tracing in karst is that it documents where the water and waste flows in the subsurface (in this case, from a well immediately across the road from the pig factory, and another well surrounded by waste spreading fields near Dry Creek), how fast it flows (from about 1700 to 2500 feet per day), and the location where it reemerges at springs (in the middle of Big Creek, along upstream and downstream tributaries to spreading fields, and springs in Left Fork of Big Creek), and at 7 locations along the Buffalo National River (figure 8). None of this was mentioned in the Final EA. Especially noteworthy, dye recovery at John Eddings Cave from dye injection at BS-36 during conditions of high groundwater flow clearly indicates an hydraulic connection between CAFO waste-spreading fields and this cave. John Eddings Cave is a recognized hibernaculum for the endangered gray bat, *Myotis grisescens*. By failing to reference this most relevant information, it is my opinion that the Final EA has failed to pursue the potential for negative environmental impact to this

Dye-tracing results in Big Creek are mirrored by many other researchers throughout the Buffalo National River, especially with reference to the hydrogeology of the Boone Formation and its karst nature (Aley and Aley, 1989; Mott, 2003; Soto, 2014; Aley, 2015; Kosic et al., 2015; Brahana et al., 2017a).

Water-quality trends of dissolved oxygen (DO) as measured continuously in Big Creek during the past few summers indicate disturbing long-term decreases below calculated EPA standards, prompting a request by the National Park Service (NPS) that Big Creek be assigned "impaired" status last summer (Usrey, 2013; Usrey, 2015). DO measurements were ignored in the Final EA, and the "impaired" status request was rejected by the Arkansas Department of Environmental Quality (ADEQ) because the NPS data-collection scheme did not originate from an approved lab. This is the first time that ADEQ rejected NPS water-quality data, an unexpected decision, especially considering the time and careful development and rigorous sampling protocols implemented, clearly written, and carefully followed by NPS and USGS scientists (Green and Usrey, 2014).

The duration and extent of the low nighttime DO concentrations the last few summers (Usrey, 2013; Usrey, 2015) reinforces the observation that the added burden of waste from 6500 pigs, creating more than 2 million gallons of feces and urine per year is producing an impact in Big Creek, and downstream in the Buffalo. Informal observation by local landowners along the creek that the algae and biomass was particularly luxuriant last summer, following about 6 months of waste spreading on nearby CAFO fields. These values alone are not necessarily proof that the hog factory is the cause of the degraded water quality, but they are remarkably consistent that this CAFO has added to the total agricultural loading from this valley, and that data exist to suggest that it is stressed.

As a comparison of water quality in Big Creek with a nearby surface stream, the Little Buffalo River, the DO concentration in the Little Buffalo 7 miles upstream from the confluence of Big Creek and the Buffalo River dropped below 6 parts per million only 1 time (less than 3 hours total for the period of measured) during the sampling interval of summer 2013. The drainage area of the Little Buffalo River has similar land use and karst geology as Big Creek; what is not similar is that the Little Buffalo River does not have a huge hog factory upstream. Waiting until these water-quality degradations to build up to greater than EPA levels before seeking remediation for Big Creek and the Buffalo National River, Arkansas' Extraordinary Water Resource, seems short-sighted and potentially risky.

Major Objection—The original notice of intent (NOI) had fraudulent signatures, inaccurate map locations, errors of scientific fact, omissions of required legal and numerous flaws clearly reported by an independent Civil Engineering M.S. graduate (Hovis, 2014). This report is an eye-opening account of shortcomings in the NOI by an individual who had no bias. If you would like a copy of this paper, it is available on the Buffalo River Watershed Alliance webpage, or you can request a copy from me. I encourage all politicians, all ADEQ personnel, and all interested stakeholders to read this. She documents misrepresentations of who owned land that was reported to be available for spreading feces and urine, it includes factual misrepresentations in the NOI, coupled with secretive awarding of the General Permit without the knowledge of the Director of ADEQ, and allowing only two ADEQ employees from Little Rock to perform inspections at C&H. This demand was initiated after a surprise inspection by the ADEQ employees from the Jasper, Arkansas, office, who were later forbidden to continue with any addition inspections.

5. ***Major Objection—Design of the BCRET sampling plan did not include intensive groundwater data sites, which are essential to describe the hydrology of Big Creek and contiguous basins.*** Discontinuous flow along sections of Big Creek during low flow make flow and water-quality comparisons highly questionable, owing to the fact that major aspects of the hydrology are neither monitored nor quantified. This is a common feature of surface water in karst lands. The title of the BCRET sampling, paid for by "Rainy Day Funds" by the Governor, is stated in the title of BCRET reports; it is "DEMONSTRATING AND MONITORING THE SUSTAINABLE MANAGEMENT OF NUTRIENTS ON C&H FARM IN BIG CREEK WATERSHED". Governor Beebe indicated that he was funding the project to assess if the CAFO were impacting Big Creek and the Buffalo National River, not to help the CAFO find the least-harmful impact on the environment. This overall emphasis of "Demonstrating"…overall "Sustainability" implies a strong bias we has been consistent since the CAFO was permitted.

Historical documents, long-term studies by the U.S. Geological Survey throughout the conterminous U.S., and from numerous locations throughout the world indicate that huge concentrations of animal feces and urine will follow the laws of physics and chemistry, and contaminate downstream waters. In karst regions, this is exacerbated by the high permeability of the conduits to allow rapid flow, with little attenuation of the contaminants. Big Creek and contiguous drainage ways that flow into the Buffalo National River in Newton County, Arkansas, show degraded effects of animal production. Recent study of groundwater by the KHBNR team shows strong evidence that springs and wells closest to the waste sources are seeing the most impact. Delaying action, whether by inactivity or by requesting "needed additional years of data collection" ignores the wisdom we have gained from so many other sites.

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Sincerely yours,

Van Brahana, Professor Emeritus, Ph.D., P.G.
Department of Geosciences
20 Gearhart Hall
University of Arkansas
Fayetteville, Arkansas 72701

From:	Robinson, Kelly
To:	Deardoff, Amy; McWilliams, Katherine
Subject:	FW: Please Deny C&H Request for Permit for Hog CAFO on Karst Upstream from Buffalo National River Based on Economics, NOT Politics
Date:	Thursday, April 06, 2017 3:51:36 PM

Kelly Robinson

Public Information Officer
5301 Northshore Drive
North Little Rock, AR 72118

501-682-0916

From: Goff, Patricia
Sent: Thursday, April 06, 2017 3:32 PM
To: Robinson, Kelly
Subject: FW: Please Deny C&H Request for Permit for Hog CAFO on Karst Upstream from Buffalo National River Based on Economics, NOT Politics

From: John Van Brahana [mailto:brahana@uark.edu]
Sent: Thursday, April 06, 2017 11:01 AM
To: michael.lamoureux@governor.arkansas.gov; Missy.Irvin@senate.ar.gov; phillip_moore@boozman.senate.gov; tom.cotton@cotton.senate.gov; Commissioners; Keogh, Becky; Mike.Knoedl@agfc.state.ar.us; Nathaniel.Smith@Arkansas.gov; chrisc@arkansasheritage.org; admin@buffaloriverchamber.com; buffaloriverfloatservice@gmail.com; sheilahroenfeldt@aol.com; ozarktom@gmail.com; jstewart@audubon.org; theloosecayuse@gmail.com; burrel.monica@epa.gov; kaspar.paul@epa.gov; hunt.laura@epa.gov; hodgkiss.miranda@epa.gov; riverfriend@friendsoftherivers.org; Water Draft Permit Comment; Carol Bitting; artzbarn@gmail.com; Quick, Ray; Joe Nix; Gordon Watkins; Mike Masterson
Cc: John Van Brahana
Subject: Please Deny C&H Request for Permit for Hog CAFO on Karst Upstream from Buffalo National River Based on Economics, NOT Politics

Thousands Call To Reject Permit Requested By Industrial Hog Farm Upstream Of Buffalo National River

By NPT Staff on March 28th, 2017

The public has through April 6 to submit comments regarding the operation of a commercial hog operation six miles upstream of Buffalo National River/NPS

The state of Arkansas is accepting through April 6 public comments regarding a new permit for an industrial hog farm located upstream of Buffalo National River.

The C&H Hog Farms, Inc., operation at Mount Judea is located along Big Creek about six miles upstream of the national river. Under a contract with Cargill, Inc., an international agricultural and food conglomerate, C&H confines approximately 6,500 pigs at a time, making the operation the

first of its size and scale in the Buffalo River watershed.

Though it has been operating since 2013 under a general National Pollutant Discharge Elimination System permit, the company is now seeking a change in its permit to one that presumes there will be no waste discharges from the property.

The hog farm is located in a region of karst geology, which is is composed of easily dissolved rocks, such as limestone and dolomite. Via sinkholes and underground caves in the geology, groundwater can flow miles very quickly. In the National Park System, karst geology is perhaps mostly visibly connected to Mammoth Cave National Park in Kentucky, but it can also be found along the Buffalo National River and at Ozark National Scenic Riverways in Missouri.

Keeping pollutants out of this geology is particularly important for the Buffalo National River, as its boundaries encompass just 11 percent of the Buffalo River watershed. The C&H Hog Farms' "concentrated animal feeding operation," or CAFO, generates an "estimated nitrogen output ... equivalent to a human population of 7,000, and the phosphorus output is equivalent to 23,000 humans, in a watershed with a total human population of approximately 17,000."

So far, according to the National Parks Conservation Association, more than 14,000 comments have been submitted to the Arkansas Department of Environmental Quality asking that the new permit be denied.

ADEQ's contact person for submitting written comments, requesting information regarding the draft permit, or obtaining a copy of the permit and the Statement of Basis is Katherine McWilliams, at 5301 Northshore Drive, North Little Rock, Arkansas 72118-5317, 501-682-0650, or at Water-Draft-Permit-Comment@adeq.state.ar.us.

In 2012, the state granted C&H a permit for this facility without allowing adequate public input or consultation from the National Park Service, the U.S. Fish and Wildlife Service, or local communities. The state permit expired on October 31, 2016. Now, Arkansas Gov. Asa Hutchinson and the ADEQ "have an opportunity to protect America's first national river by denying the company's application for a permit 5264-W, which seeks to allow C&H to continue spreading hog waste in this fragile ecosystem," NPCA said.

The feedlot has generated a lot of controversy among environmental groups because of the potential threat it poses to the Buffalo National River. Last fall, water testing in Big Creek downstream of C&H by the Big Creek Research and Extension Team found higher levels of nitrate, total nitrogen, total coliform bacteria, chloride, specific conductance, alkalinity, and total dissolved solids than water samples taken upstream of the farm.

While state testing in 2014 found state limits for E. coli were exceeded both upstream and downstream of the farm, in 2015, higher levels were detected only in the upstream samples.

A lengthy report by the director of the U.S. Geological Survey's Wyoming Water Science Center on these tests and water quality impacts to the national river offered nearly a dozen recommendations, including one for dye tracing studies around the pig feedlot in a bid to determine how surface water enters the surrounding karst topography and show where it exits.

"This is our last chance to protect the Buffalo National River, our country's first national river and a beloved national park, which belongs to all Americans. Allowing C&H to continue spreading millions of gallons of waste in the Buffalo's watershed could do irreparable damage to the regional tourism economy and threatens local drinking water," said Emily Jones, NPCA's senior program manager for the Southeast Region. "Along with thousands of our members and supporters in Arkansas and across the country, NPCA urges Governor Hutchinson to protect this precious resource and keep the Buffalo safe for people to swim, fish, and float."

The Buffalo National River offers recreational opportunities along 135 miles of free-flowing river, and is a major economic driver for the region. The river welcomed more than 1.7 million visitors

in 2016, pumping millions of dollars into nearby communities and supporting local jobs.

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From: Robinson, Kelly
To: Deardoff, Amy; McWilliams, Katherine
Subject: FW: Please DENY C&H Factory Hog Farms Permit Request
Date: Thursday, April 06, 2017 3:53:13 PM

I think some of these are duplicative.

Kelly Robinson

Public Information Officer
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North Little Rock, AR 72118

501-682-0916

From: Goff, Patricia
Sent: Thursday, April 06, 2017 3:32 PM
To: Robinson, Kelly
Subject: FW: Please DENY C&H Factory Hog Farms Permit Request

From: John Van Brahana [mailto:brahana@uark.edu]
Sent: Thursday, April 06, 2017 3:18 PM
To: michael.lamoureux@governor.arkansas.gov; Missy.Irvin@senate.ar.gov; Commissioners; Keogh, Becky; Nathaniel.Smith@Arkansas.gov; chrisc@arkansasheritage.org; admin@buffaloriverchamber.com; buffaloriverfloatservice@gmail.com; ozarktom@gmail.com; jstewart@audubon.org; theloosecayuse@gmail.com; kaspar.paul@epa.gov; hunt.laura@epa.gov; hodgkiss.miranda@epa.gov; riverfriend@friendsoftherivers.org; lcbitting@gmail.com; gwatkins@ritternet.com; vroland@usgs.gov; artzbarn@gmail.com; river1939@suddenlink.net; raqec@att.net; Robert Cross; cjbitting@hotmail.com; teresa_turk@hotmail.com; thompsonadd@gmail.com; masullo.ginny1@gmail.com; katarinakosic84@gmail.com; dane.schumacher@yahoo.com; Michael J. Wavering; mmasterson@arkansasonline.com; jeffmontgomery@earthlink.net; water-draft-permits-comments@adeq.state.ar.us
Cc: John Van Brahana
Subject: Please DENY C&H Factory Hog Farms Permit Request

Request to Deny C&H Hog Farms a Regulation 5 Permit
Comments by Dr. John Van Brahana, Ph.D., P.G.
Research Scientist Emeritus, U.S. Geological Survey
Professor Emeritus, University of Arkansas, Department of Geosciences
April 8, 2017

Based on my following numbered objections shown below, I respectfully request that the Arkansas Department of Environmental Quality deny a Regulation 5 permit to C&H Hog Farms.

1. ***Major Objection—The Groundwater Component of the Water Budget Is Large in Karst Areas, and Groundwater Was Ignored in Assessing Contamination from C&H.*** The following documents showed none to very little discussion of groundwater flow or contaminant transport, although these are dominant in karst. Erroneous, incomplete, documents include: the Notice of Intent (Pesta, 2012); the Final Environmental Assessment (U.S. Department of Agriculture Farm Service Agency and U.S. Small Business Agency, 2015); Big Creek and the associated waste-spreading fields of C&H Farms are on the Boone Formation, which includes pure limestone and interbedded thin limestone and chert layers. The limestone has been intensively karstified (Braden and Ausbrooks, 2003: Hudson, 1998; Mott et al., 2000; Murdoch et al., 2016; Brahana et al., 2017). Being karstified means that much of the hydrologic budget of rainfall and wastes placed on the land surface moves underground as groundwater, and this part of the flow path is not easily seen. Multiple springs, wells, and contiguous surface-drainage basins are sampled using non-toxic dyes that are added to flowing groundwater. Dye receptors are placed in wells along the potential flow path, and at the discharge points in rivers and streams to assess if dye input flowed past each point. Dye tracing is essential in showing the pathways of water movement in karst (Quinlan; Aley; Ewers), and in the Big Creek basin where C&H operates, multiple dye traces have been undertaken by the Karst Hydrogeology of the Buffalo National River (KHBNR) team of citizen scientists using scientifically accepted and approved methodologies. The results of these tests are currently being published in peer-reviewed scientific paper (U.S. Geological Survey Scientific Investigations Report) indicating that the groundwater flow moves underground to Big Creek, and underneath topographic divides into contiguous surface water drainage basins. It returns to the surface from springs, ultimately discharging into the Buffalo National River (Brahana et al., 2017a). In addition to flow path identification, dye tracing indicates that most groundwater flow rates are very rapid, about 2000 to more than 3000 feet per day. When the water has both surface and groundwater flow components, it can travel faster than 5 miles in a single day.

2. ***Major Objection—Intensive groundwater sampling from springs, wells and streams in the area is showing that water quality is degrading, with greatest impact occurring closest to the CAFO and springs draining its permitted spreading fields.*** In addition to the dye tracing, KHBNR team members collected water-quality data, which indicate groundwater quality is degrading. The KHBNR team, which has been collecting groundwater quality data since 2013, found that the groundwater quality near the C&H Hog Farms and its spreading fields shows high concentrations of the trace metals zinc-66, copper-63, and copper-65, additives to pig food, and the isotope phosphorus-31 (Brahana et al., 2017), common in pig excretia. Additional water quality data are enlightening, with *Escheria coli* (*E. coli*) concentrations in receiving streams (Big Creek and Left Fork of Big Creek), having values of these indicator bacteria that range well above 20,000 colonies per 100 milliliters, expressed as most probable number per 100 milliliters (MPN/100 ml). Dissolved oxygen (DO) concentrations during the summer of 2015 were less than the lower limits of impaired streams (summertime values of 5.0 mg/L). *E. coli* is indicative of water contamination by warm-blooded animals, and DO concentrations are indicators of the overall ecological health of waters. Excessive algal blooms can be yet another indicator of impaired water quality. From the U.S. and around the world, CAFOs have a horrible record of contaminating environments unless they are properly sited and professional studies show that the feces and urine of the animal waste are properly contained.

3. ***Major Objection—The Final Environmental Assessment provided by the U.S. Department of Agriculture Farm Service Agency and the U.S. Small Business Agency is flawed and inaccurate.*** The Final EA continues to assert that the cherty section of the Boone Formation in the vicinity of the C&H hog factory is not karst. This claim of no Boone karst is based on "lack of identifiable surface features on topographic maps and areal photos" in the immediate area of the farm. This is a flawed interpretation based on an erroneous definition that karst is "karst topography", or that karst topography is always an essential component of karst. Karst is a hydrogeologic term, wherein groundwater plays a greater role in the hydrologic budget. The CAFO study site is formally called mantled karst, which means that many of the internally drained depressions (sinkholes) the EA sought on maps were covered with a thin, nearly-flat layer of insoluble soil and regolith, and therefore not visible using the methods employed by the Final EA. Furthermore, in the area of outcrop of the Boone Formation in northern Arkansas, karst topography is not visible at areal-photographic or map scales (1:24,000), because many of the karst features are too small to be seen on maps of this scale (figure 1), or below land surface (figures 2 and 3). However, Arkansas Geological Survey geologic mapping of the 7.5-minute Mount Judea quadrangle (Braden and Ausbrooks, 2003), was described and based on intensive field work. Description of the Boone Formation includes this statement: "Boone Formation (Lower Mississippian, Osagean and Kinderhookian) – Coarse-grained fossiliferous and fine-grained limestones interbedded with anstamosing and bedded chert. Light to medium-gray on fresh surface but usually weathers dark-gray. The chert varies in color from light-gray to dark-gray. Springs and sinkholes are abundant…" If sinkholes are present, so is karst. A further claim that the Mt. Judea topographic map (U.S. Geological Survey, 1980) was used for identification of karst features visible on the land surface appears to be scientifically inconsistent, inasmuch as names of streams that drain the region within 1 mile of the CAFO have names shown clearly on the map as Dry Creek, Cave Spring Branch, and Dry Branch, strongly suggesting that the area is likely underlain by karst. This was not evaluated nor pursued in any of the documentation offered, including the Notice of Intent (NOI), the draft EA, or the Final EA.

   Another field-observable feature, erroneously interpreted from the 7.5-minute topographic map (U.S. Geological Survey, 1980), interprets Big Creek near C&H Hog Farms and its spreading fields as a continuously flowing stream and Dry Creek as an intermittent creek. In fact, under varying recharge and seasonal conditions, both show dry-stream reaches, zones of continuous streamflow upstream of dry reaches where streamflow has ceased (Brahana and Hollyday, 1988). Dry-stream reaches reflect underlying karst, where all streamflow is captured in an interval that flows completely underground.
   The continued denial of the existence of karst in the Final EA not only fails to describe actual environmental conditions in Big Creek basin in the vicinity of the CAFO, it represents a serious flaw in the argument of a FONSI. The definition of karst in the Final EA ignores consideration of the key fact that the area is underdrained by interconnected zones of high permeability created by dissolution of the soluble bedrock. This is an essential component of the definition of karst, not the limited aspects of "karst topography" to which the Final EA erroneously and steadfastly adheres. Because the waste, the contamination, and the water have moved underground and bypassed many of the surface measuring sites that the Final EA used to establish a FONSI, this negates claims that there is no impact from C&H. The Big Creek Extension and Research Team (BCRET) funded with tax dollars by Governor Beebe at the request of the Farm Bureau in 2013 acknowledges karst in some

of their ancillary documents, but their focus is not karst. The Final EA simply failed to sample the natural groundwater outlets (springs) downstream from the karst resurgences, water and waste derived initially from the hog-waste spreading fields.

Scientific data collection by the Karst Hydrogeology of the Buffalo National River (KHBNR) team included field-based sampling starting in July 2013, when fewer than 500 hogs were housed at C&H Hog Farm. The KHBNR team rigorously followed U.S. Geological Survey (USGS) and U.S. Environmental Protection Agency (EPA) protocols and procedures, conducting karst inventorying, dye-tracing studies, major constituent water-quality sampling, continuous groundwater level monitoring, trace-metal sampling, microbial sampling, and dissolved oxygen analyses with continuous-sampling probes. The Final EA claims to adhere to the "best science", implying unbiased, fair assessment of all scientific facts that are readily available, but made no effort to pursue any data from KHBNR. KHBNR includes retired professors (Ph.D.s), professional geologists (P.G.s), previous employees of state and federal agencies (Arkansas Department of Environmental Quality [ADEQ], USGS, and National Park Service [NPS]), consultants, and graduate students. Discipline backgrounds are diverse, all are well-informed, honest, concerned citizens who pay the taxes that ultimately have provided funding for the EA, as well as for the BCRET study. The claim of "best science" is hollow unless the Final EA provides a full discussion of KHBNR data and interpretations, including the web address https://buffaloriveralliance.org

Buffalo River Watershed Alliance - Home

buffaloriveralliance.org

The Buffalo River Watershed Alliance was formed to prevent pollution of the Buffalo National River watershed through monitoring, advocacy, and public policy ...

under numerous headings of data, research and Dr. Van Brahana in red. This was done for BCRET webpage (page 3.8 of Section 3.2.1, Surface Water section of the Final Environmental Assessment), but not for KHBNR, the website where these important data and studies reside. The present Final EA reinforces the appearance of bias.

Field observation conclusively provides visual documentation that karst is indeed present in the immediate area of the CAFO and its spreading fields. The Final EA requires a thorough and adequate reevaluation of the karst groundwater prior to the finding of a FONSI. No groundwater nor karst studies were used nor studied, further discrediting the Final EA.

Another major flaw of the Final EA is the lack of discussion of the relation of surface and groundwater, clearly pointed out by Tom Aley (2015) and myself (Brahana, 2015) in the draft EA. Karst scientists understand that the degree of groundwater/surface water interaction in Big Creek basin is another major characteristic of karst. Stated simply, water and waste in karst lands are not confined only to surface streams, but flow underground along unseen pathways until resurgence as springs or baseflow to surface streams occur (Winter et al., 1998). Figure 7 shows the relation of precipitation measured at 10-minute intervals over the course of more than a year, as well as the timing of water level response in several key wells in the area, and the stream level in Big Creek. Cause and effect are nearly coincident. The nearly identical timing of response of wells and the stream (near-identical lag times) clearly establishes the fact the water in the Boone Formation has moved from surface to groundwater amazingly rapidly, an essential characteristic of karst.

One reason for establishing the existence of close groundwater/surface water interaction concerns the economics of widely spreading dye on the waste-spreading fields. Dye injection into a point source ("dug" wells), rather than areally broadcasting a large amount of dye on the waste-spreading fields (for which we have not been given permission by the CAFO and spreading field owners) requires much less dye be utilized in the test. Because: 1) the KHBNR is operating on a meager budget that is based on donations of cash and *pro bono* contributions of field sampling and lab analyses; because the cost of the dye represents a large part of the KHNBR budget; because some of our fluorescent dyes photodegrade on land surface in sunlight; and because these "dug" wells offer direct access to flowing groundwater in the Boone aquifer, we can optimize our scientific study while minimizing our expenditures.

The third major flaw in the Final EA is the continued ignoring of dye-tracing studies that have been conducted and described in peer-reviewed literature (Brahana et al., 2014; Kosic et al., 2015), and the noted existence of these studies in my previous review of the preliminary EA (Brahana, 2015). One such study is shown here, with the injection occurring in a dug well surrounded by waste-spreading fields, and wide and rapid dispersal of the dye not only in Big Creek, but in contiguous drainage basins, and downgradient as far as the Buffalo National River (figure 8). It should be noted that within 24 hours of dye injection, a major storm of about 6 inches of rain fell, and this recharge facilitated the rapid groundwater level rise and mobilization of the dye.

Completely discounting the key details of the dye-tracing studies, including very rapid groundwater flow velocities and unexpected groundwater flow dispersal that the KHBNR team has established, ignores well-documented and important data that have a direct bearing on a FONSI. Dye tracing is an essential tool for studying karst hydrogeology, and the KHBNR dye studies utilize extensive experience involving project planning and objectives, challenging field conditions, thorough karst inventorying, and rigorous QA/QC (Aley, 2002). KHNBR studies were conducted to the highest of scientific standards (Brahana et al., 2014; Kosic et al., 2015). The importance of dye tracing in karst is that it documents where the water and waste flows in the subsurface (in this case, from a well immediately across the road from the pig factory, and another well surrounded by waste spreading fields near Dry Creek), how fast it flows (from about 1700 to 2500 feet per day), and the location where it reemerges at springs (in the middle of Big Creek, along upstream and downstream tributaries to spreading fields, and springs in Left Fork of Big Creek), and at 7 locations along the Buffalo National River (figure 8). None of this was mentioned in the Final EA. Especially noteworthy, dye recovery at John Eddings Cave from dye injection at BS-36 during conditions of high groundwater flow clearly indicates an hydraulic connection between CAFO waste-spreading fields and this cave. John Eddings Cave is a recognized hibernaculum for the endangered gray bat, *Myotis grisescens*. By failing to reference this most relevant information, it is my opinion that the Final EA has failed to pursue the potential for negative environmental impact to this

Dye-tracing results in Big Creek are mirrored by many other researchers throughout the Buffalo National River, especially with reference to the hydrogeology of the Boone Formation and its karst nature (Aley and Aley, 1989; Mott, 2003; Soto, 2014; Aley, 2015; Kosic et al., 2015; Brahana et al., 2017a).

Water-quality trends of dissolved oxygen (DO) as measured continuously in Big Creek during the past few summers indicate disturbing long-term decreases below calculated EPA standards, prompting a request by the National Park Service (NPS) that Big Creek be assigned "impaired" status last summer (Usrey, 2013; Usrey, 2015). DO measurements were ignored in the Final EA, and the "impaired" status request was rejected by the Arkansas Department of Environmental Quality (ADEQ) because the NPS data-collection scheme did not originate from an approved lab. This is the first time that ADEQ rejected NPS water-quality data, an unexpected decision, especially considering the time and careful development and rigorous sampling protocols implemented, clearly written, and carefully followed by NPS and USGS scientists (Green and Usrey, 2014).

The duration and extent of the low nighttime DO concentrations the last few summers (Usrey, 2013; Usrey, 2015) reinforces the observation that the added burden of waste from 6500 pigs, creating more than 2 million gallons of feces and urine per year is producing an impact in Big Creek, and downstream in the Buffalo. Informal observation by local landowners along the creek that the algae and biomass was particularly luxuriant last summer, following about 6 months of waste spreading on nearby CAFO fields. These values alone are not necessarily proof that the hog factory is the cause of the degraded water quality, but they are remarkably consistent that this CAFO has added to the total agricultural loading from this valley, and that data exist to suggest that it is stressed.

As a comparison of water quality in Big Creek with a nearby surface stream, the Little Buffalo River, the DO concentration in the Little Buffalo 7 miles upstream from the confluence of Big Creek and the Buffalo River dropped below 6 parts per million only 1 time (less than 3 hours total for the period of measured) during the sampling interval of summer 2013. The drainage area of the Little Buffalo River has similar land use and karst geology as Big Creek; what is not similar is that the Little Buffalo River does not have a huge hog factory upstream. Waiting until these water-quality degradations to build up to greater than EPA levels before seeking remediation for Big Creek and the Buffalo National River, Arkansas' Extraordinary Water Resource, seems short-sighted and potentially risky.

Major Objection—The original notice of intent (NOI) had fraudulent signatures, inaccurate map locations, errors of scientific fact, omissions of required legal and numerous flaws clearly reported by an independent Civil Engineering M.S. graduate (Hovis, 2014). This report is an eye-opening account of shortcomings in the NOI by an individual who had no bias. If you would like a copy of this paper, it is available on the Buffalo River Watershed Alliance webpage, or you can request a copy from me. I encourage all politicians, all ADEQ personnel, and all interested stakeholders to read this. She documents misrepresentations of who owned land that was reported to be available for spreading feces and urine, it includes factual misrepresentations in the NOI, coupled with secretive awarding of the General Permit without the knowledge of the Director of ADEQ, and allowing only two ADEQ employees from Little Rock to perform inspections at C&H. This demand was initiated after a surprise inspection by the ADEQ employees from the Jasper, Arkansas, office, who were later forbidden to continue with any addition inspections.

5. ***Major Objection—Design of the BCRET sampling plan did not include intensive groundwater data sites, which are essential to describe the hydrology of Big Creek and contiguous basins.*** Discontinuous flow along sections of Big Creek during low flow make flow and water-quality comparisons highly questionable,

owing to the fact that major aspects of the hydrology are neither monitored nor quantified. This is a common feature of surface water in karst lands. The title of the BCRET sampling, paid for by "Rainy Day Funds" by the Governor, is stated in the title of BCRET reports; it is "DEMONSTRATING AND MONITORING THE SUSTAINABLE MANAGEMENT OF NUTRIENTS ON C&H FARM IN BIG CREEK WATERSHED". Governor Beebe indicated that he was funding the project to assess if the CAFO were impacting Big Creek and the Buffalo National River, not to help the CAFO find the least-harmful impact on the environment. This overall emphasis of "Demonstrating"...overall "Sustainability" implies a strong bias we has been consistent since the CAFO was permitted.

Historical documents, long-term studies by the U.S. Geological Survey throughout the conterminous U.S., and from numerous locations throughout the world indicate that huge concentrations of animal feces and urine will follow the laws of physics and chemistry, and contaminate downstream waters. In karst regions, this is exacerbated by the high permeability of the conduits to allow rapid flow, with little attenuation of the contaminants. Big Creek and contiguous drainage ways that flow into the Buffalo National River in Newton County, Arkansas, show degraded effects of animal production. Recent study of groundwater by the KHBNR team shows strong evidence that springs and wells closest to the waste sources are seeing the most impact. Delaying action, whether by inactivity or by requesting "needed additional years of data collection" ignores the wisdom we have gained from so many other sites.

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Sincerely yours,

Van Brahana, Professor Emeritus, Ph.D., P.G.
Department of Geosciences
20 Gearhart Hall
University of Arkansas
Fayetteville, Arkansas 72701

From: Robinson, Kelly
To: McWilliams, Katherine
Cc: Deardoff, Amy
Subject: FW: Please DENY C&H Factory Hog Farms Request for Permit
Date: Thursday, April 06, 2017 3:53:35 PM

Kelly Robinson

Public Information Officer
5301 Northshore Drive
North Little Rock, AR 72118

501-682-0916

From: Goff, Patricia
Sent: Thursday, April 06, 2017 3:32 PM
To: Robinson, Kelly
Subject: FW: Please DENY C&H Factory Hog Farms Request for Permit

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From: John Van Brahana [mailto:brahana@uark.edu]
Sent: Thursday, April 06, 2017 2:56 PM
To: michael.lamoureux@governor.arkansas.gov; Missy.Irvin@senate.ar.gov; phillip_moore@boozman.senate.gov; tom.cotton@cotton.senate.gov; Commissioners; Keogh, Becky; Mike.Knoedl@agfc.state.ar.us; Nathaniel.Smith@Arkansas.gov; chrisc@arkansasheritage.org; admin@buffaloriverchamber.com; buffaloriverfloatservice@gmail.com; sheilahroenfeldt@aol.com; ozarktom@gmail.com; jstewart@audubon.org; theloosecayuse@gmail.com; burrel.monica@epa.gov; kaspar.paul@epa.gov; hunt.laura@epa.gov; hodgkiss.miranda@epa.gov; riverfriend@friendsoftherivers.org; lcbitting@gmail.com; gwatkins@ritternet.com; sarahrobertson82@gmail.com; vroland@usgs.gov; artzbarn@gmail.com; river1939@suddenlink.net; raqec@att.net; John Van Brahana; Robert Cross; cjbitting@hotmail.com; grantscarsdale@me.com; stowe.lucy@gmail.com; Dina_Nash@yahoo.com; tricia.roger@gmail.com; teresa_turk@hotmail.com; thompsonadd@gmail.com; vwsoccer@gmail.com; masullo.ginny1@gmail.com; katarinakosic84@gmail.com; dane.schumacher@yahoo.com; Michael J. Wavering; mmasterson@arkansasonline.com; jeffmontgomery@earthlink.net
Cc: John Van Brahana
Subject: Please DENY C&H Factory Hog Farms Request for Permit

Request to Deny C&H Hog Farms a Regulation 5 Permit
Comments by Dr. John Van Brahana, Ph.D., P.G.
Research Scientist Emeritus, U.S. Geological Survey
Professor Emeritus, University of Arkansas, Department of Geosciences
April 8, 2017

Based on my following numbered objections shown below, I respectfully request that the Arkansas Department of Environmental Quality deny a Regulation 5 permit to C&H Hog Farms.

1. ***Major Objection—The Groundwater Component of the Water Budget Is Large in Karst Areas, and Groundwater Was Ignored in Assessing Contamination from C&H.*** The following documents showed none to very little discussion of groundwater flow or contaminant transport, although these are dominant in karst. Erroneous, incomplete, documents include: the Notice of Intent (Pesta, 2012); the Final Environmental Assessment (U.S. Department of Agriculture Farm Service Agency and U.S. Small Business Agency, 2015); Big Creek and the associated waste-spreading fields of C&H Farms are on the Boone Formation, which includes pure limestone and interbedded thin limestone and chert layers. The limestone has been intensively karstified (Braden and Ausbrooks, 2003: Hudson, 1998; Mott et al., 2000; Murdoch et al., 2016; Brahana et al., 2017). Being karstified means that much of the hydrologic budget of rainfall and wastes placed on the land surface moves underground as groundwater, and this part of the flow path is not easily seen. Multiple springs, wells, and contiguous surface-drainage basins are sampled using non-toxic dyes that are added to flowing groundwater. Dye receptors are placed in wells along the potential flow path, and at the discharge points in rivers and streams to assess if dye input flowed past each point. Dye tracing is essential in showing the pathways of water movement in karst (Quinlan; Aley; Ewers), and in the Big Creek basin where C&H operates, multiple dye traces have been undertaken by the Karst Hydrogeology of the Buffalo National River (KHBNR) team of citizen scientists using scientifically accepted and approved methodologies. The results of these tests are currently being published in peer-reviewed scientific paper (U.S. Geological Survey Scientific Investigations Report) indicating that the groundwater flow moves underground to Big Creek, and underneath topographic divides into contiguous surface water drainage basins. It returns to the surface from springs, ultimately discharging into the Buffalo National River (Brahana et al., 2017a). In addition to flow path identification, dye tracing indicates that most groundwater flow rates are very rapid, about 2000 to more than 3000 feet per day. When the water has both surface and groundwater flow components, it can travel faster than 5 miles in a single day.

2. ***Major Objection—Intensive groundwater sampling from springs, wells and streams in the area is showing that water quality is degrading, with greatest impact occurring closest to the CAFO and springs draining its permitted spreading fields.*** In addition to the dye tracing, KHBNR team members collected water-quality data, which indicate groundwater quality is degrading. The KHBNR team, which has been collecting groundwater quality data since 2013, found that the groundwater quality near the C&H Hog Farms and its spreading fields shows high concentrations of the trace metals zinc-66, copper-63, and copper-65, additives to pig food, and the isotope phosphorus-31 (Brahana et al., 2017), common in pig excretia. Additional water quality data are enlightening, with *Escheria coli* (*E. coli*) concentrations in receiving streams (Big Creek and Left Fork of Big Creek), having values of these indicator bacteria that range well above 20,000 colonies per 100 milliliters, expressed as most probable number per 100 milliliters (MPN/100 ml). Dissolved oxygen (DO) concentrations during the summer of 2015 were less than the lower limits of impaired streams (summertime values of 5.0 mg/L). *E. coli* is indicative of water contamination by warm-blooded animals, and DO concentrations are indicators of the overall ecological health of waters. Excessive algal blooms can be yet another indicator of impaired water quality. From the U.S. and around the world, CAFOs have a horrible record of contaminating environments unless they are properly sited and professional studies show that the feces and urine of the animal waste are properly contained.

3. ***Major Objection—The Final Environmental Assessment provided by the U.S. Department of Agriculture Farm Service Agency and the U.S. Small Business Agency is flawed and inaccurate.*** The Final EA continues to assert that the cherty section of the Boone Formation in the vicinity of the C&H hog factory is not karst. This claim of no Boone karst is based on "lack of identifiable surface features on topographic maps and areal photos" in the immediate area of the farm. This is a flawed interpretation based on an erroneous definition that karst is "karst topography", or that karst topography is always an essential component of karst. Karst is a hydrogeologic term, wherein groundwater plays a greater role in the hydrologic budget. The CAFO study site is formally called mantled karst, which means that many of the internally drained depressions (sinkholes) the EA sought on maps were covered with a thin, nearly-flat layer of insoluble soil and regolith, and therefore not visible using the methods employed by the Final EA. Furthermore, in the area of outcrop of the Boone Formation in northern Arkansas, karst topography is not visible at areal-photographic or map scales (1:24,000), because many of the karst features are too small to be seen on maps of this scale (figure 1), or below land surface (figures 2 and 3). However, Arkansas Geological Survey geologic mapping of the 7.5-minute Mount Judea quadrangle (Braden and Ausbrooks, 2003), was described and based on intensive field work. Description of the Boone Formation includes this statement: "Boone Formation (Lower Mississippian, Osagean and Kinderhookian) – Coarse-grained fossiliferous and fine-grained limestones interbedded with anstamosing and bedded chert. Light to medium-gray on fresh surface but usually weathers dark-gray. The chert varies in color from light-gray to dark-gray. Springs and sinkholes are abundant…" If sinkholes are present, so is karst. A further claim that the Mt. Judea topographic map (U.S. Geological Survey, 1980) was used for identification of karst features visible on the land surface appears to be scientifically inconsistent, inasmuch as names of streams that drain the region within 1 mile of the CAFO have names shown clearly on the map as Dry Creek, Cave Spring Branch, and Dry Branch, strongly suggesting that the area is likely underlain by karst. This was not evaluated nor pursued in any of the documentation offered, including the Notice of Intent (NOI), the draft EA, or the Final EA.

   Another field-observable feature, erroneously interpreted from the 7.5-minute topographic map (U.S. Geological Survey, 1980), interprets Big Creek near C&H Hog Farms and its spreading fields as a continuously flowing stream and Dry Creek as an intermittent creek. In fact, under varying recharge and seasonal conditions, both show dry-stream reaches, zones of continuous streamflow upstream of dry reaches where streamflow has ceased (Brahana and Hollyday, 1988). Dry-stream reaches reflect underlying karst, where all streamflow is captured in an interval that flows completely underground.
   The continued denial of the existence of karst in the Final EA not only fails to describe actual environmental conditions in Big Creek basin in the vicinity of the CAFO, it represents a serious flaw in the argument of a FONSI. The definition of karst in the Final EA ignores consideration of the key fact that the area is underdrained by interconnected zones of high permeability created by dissolution of the soluble bedrock. This is an essential component of the definition of karst, not

the limited aspects of "karst topography" to which the Final EA erroneously and steadfastly adheres. Because the waste, the contamination, and the water have moved underground and bypassed many of the surface measuring sites that the Final EA used to establish a FONSI, this negates claims that there is no impact from C&H. The Big Creek Extension and Research Team (BCRET) funded with tax dollars by Governor Beebe at the request of the Farm Bureau in 2013 acknowledges karst in some of their ancillary documents, but their focus is not karst. The Final EA simply failed to sample the natural groundwater outlets (springs) downstream from the karst resurgences, water and waste derived initially from the hog-waste spreading fields.

Scientific data collection by the Karst Hydrogeology of the Buffalo National River (KHBNR) team included field-based sampling starting in July 2013, when fewer than 500 hogs were housed at C&H Hog Farm. The KHBNR team rigorously followed U.S. Geological Survey (USGS) and U.S. Environmental Protection Agency (EPA) protocols and procedures, conducting karst inventorying, dye-tracing studies, major constituent water-quality sampling, continuous groundwater level monitoring, trace-metal sampling, microbial sampling, and dissolved oxygen analyses with continuous-sampling probes. The Final EA claims to adhere to the "best science", implying unbiased, fair assessment of all scientific facts that are readily available, but made no effort to pursue any data from KHBNR. KHBNR includes retired professors (Ph.D.s), professional geologists (P.G.s), previous employees of state and federal agencies (Arkansas Department of Environmental Quality [ADEQ], USGS, and National Park Service [NPS]), consultants, and graduate students. Discipline backgrounds are diverse, all are well-informed, honest, concerned citizens who pay the taxes that ultimately have provided funding for the EA, as well as for the BCRET study. The claim of "best science" is hollow unless the Final EA provides a full discussion of KHBNR data and interpretations, including the web address https://buffaloriveralliance.org under numerous headings of data, research and Dr. Van Brahana in red. This was done for BCRET webpage (page 3.8 of Section 3.2.1, Surface Water section of the Final Environmental Assessment), but not for KHBNR, the website where these important data and studies reside. The present Final EA reinforces the appearance of bias.

Field observation conclusively provides visual documentation that karst is indeed present in the immediate area of the CAFO and its spreading fields. The Final EA requires a thorough and adequate reevaluation of the karst groundwater prior to the finding of a FONSI. No groundwater nor karst studies were used nor studied, further discrediting the Final EA.

Another major flaw of the Final EA is the lack of discussion of the relation of surface and groundwater, clearly pointed out by Tom Aley (2015) and myself (Brahana, 2015) in the draft EA. Karst scientists understand that the degree of groundwater/surface water interaction in Big Creek basin is another major characteristic of karst. Stated simply, water and waste in karst lands are not confined only to surface streams, but flow underground along unseen pathways until resurgence as springs or baseflow to surface streams occur (Winter et al., 1998). Figure 7 shows the relation of precipitation measured at 10-minute intervals over the course of more than a year, as well as the timing of water level response in several key wells in the area, and the stream level in Big Creek. Cause and effect are nearly coincident. The nearly identical timing of response of wells and the stream (near-identical lag times) clearly establishes the fact the water in the Boone Formation has moved from surface to groundwater amazingly rapidly, an essential characteristic of karst.

One reason for establishing the existence of close groundwater/surface water interaction concerns the economics of widely spreading dye on the waste-spreading fields. Dye injection into a point source ("dug" wells), rather than areally broadcasting a large amount of dye on the waste-spreading fields (for which we have not been given permission by the CAFO and spreading field owners) requires much less dye be utilized in the test. Because: 1) the KHBNR is operating on a meager budget that is based on donations of cash and *pro bono* contributions of field sampling and lab analyses; because the cost of the dye represents a large part of the KHNBR budget; because some of our fluorescent dyes photodegrade on land surface in sunlight; and because these "dug" wells offer direct access to flowing groundwater in the Boone aquifer, we can optimize our scientific study while minimizing our expenditures.

The third major flaw in the Final EA is the continued ignoring of dye-tracing studies that have been conducted and described in peer-reviewed literature (Brahana et al., 2014; Kosic et al., 2015), and the noted existence of these studies in my previous review of the preliminary EA (Brahana, 2015). One such study is shown here, with the injection occurring in a dug well surrounded by waste-spreading fields, and wide and rapid dispersal of the dye not only in Big Creek, but in contiguous drainage basins, and downgradient as far as the Buffalo National River (figure 8). It should be noted that within 24 hours of dye injection, a major storm of about 6 inches of rain fell, and this recharge facilitated the rapid groundwater level rise and mobilization of the dye.

Completely discounting the key details of the dye-tracing studies, including very rapid groundwater flow velocities and unexpected groundwater flow dispersal that the KHBNR team has established, ignores well-documented and important data that have a direct bearing on a FONSI. Dye tracing is an essential tool for studying karst hydrogeology, and the KHBNR dye studies utilize extensive experience involving project planning and objectives, challenging field conditions, thorough karst inventorying, and rigorous QA/QC (Aley, 2002). KHNBR studies were conducted to the highest of scientific standards (Brahana et al., 2014; Kosic et al., 2015). The importance of dye tracing in karst is that it documents where the water and waste flows in the subsurface (in this case, from a well immediately across the road from the pig factory, and another well surrounded by waste spreading fields near Dry Creek), how fast it flows (from about 1700 to 2500 feet per day), and the location where it reemerges at springs (in the middle of Big Creek, along upstream and downstream tributaries to spreading fields, and springs in Left Fork of Big Creek), and at 7 locations along the Buffalo National River (figure 8). None of this was mentioned in the Final EA. Especially noteworthy, dye recovery at John Eddings Cave from dye injection at BS-36 during conditions of high groundwater flow clearly indicates an hydraulic connection between CAFO waste-spreading fields and this cave. John Eddings Cave is a recognized hibernaculum for the endangered gray bat, *Myotis grisescens*. By failing to reference this most relevant information, it is my opinion that the Final EA has failed to pursue the potential for negative environmental impact to this

Dye-tracing results in Big Creek are mirrored by many other researchers throughout the Buffalo National River, especially with reference to the hydrogeology of the Boone Formation and its karst nature (Aley and Aley, 1989; Mott, 2003; Soto, 2014; Aley, 2015; Kosic et al., 2015; Brahana et al., 2017a).

Water-quality trends of dissolved oxygen (DO) as measured continuously in Big Creek during the past few summers indicate disturbing long-term decreases below calculated EPA standards, prompting a request by the National Park Service (NPS) that Big Creek be assigned "impaired" status last summer (Usrey, 2013; Usrey, 2015). DO measurements were ignored in the Final EA, and the "impaired" status request was rejected by the Arkansas Department of Environmental Quality (ADEQ) because the NPS data-collection scheme did not originate from an approved lab. This is the first time that ADEQ rejected NPS water-quality data, an unexpected decision, especially considering the time and careful development and rigorous sampling protocols implemented, clearly written, and carefully followed by NPS and USGS scientists (Green and Usrey, 2014).

The duration and extent of the low nighttime DO concentrations the last few summers (Usrey, 2013; Usrey, 2015) reinforces the observation that the added burden of waste from 6500 pigs, creating more than 2 million gallons of feces and urine per year is producing an impact in Big Creek, and downstream in the Buffalo. Informal observation by local landowners along the creek that the algae and biomass was particularly luxuriant last summer, following about 6 months of waste spreading on nearby CAFO fields. These values alone are not necessarily proof that the hog factory is the cause of the degraded water quality, but they are remarkably consistent that this CAFO has added to the total agricultural loading from this valley, and that data exist to suggest that it is stressed.

As a comparison of water quality in Big Creek with a nearby surface stream, the Little Buffalo River, the DO concentration in the Little Buffalo 7 miles upstream from the confluence of Big Creek and the Buffalo River dropped below 6 parts per million only 1 time (less than 3 hours total for the period of measured) during the sampling interval of summer 2013. The drainage area of the Little Buffalo River has similar land use and karst geology as Big Creek; what is not similar is that the Little Buffalo River does not have a huge hog factory upstream. Waiting until these water-quality degradations to build up to greater than EPA levels before seeking remediation for Big Creek and the Buffalo National River, Arkansas' Extraordinary Water Resource, seems short-sighted and potentially risky.

Major Objection—The original notice of intent (NOI) had fraudulent signatures, inaccurate map locations, errors of scientific fact, omissions of required legal and numerous flaws clearly reported by an independent Civil Engineering M.S. graduate (Hovis, 2014). This report is an eye-opening account of shortcomings in the NOI by an individual who had no bias. If you would like a copy of this paper, it is available on the Buffalo River Watershed Alliance webpage, or you can request a copy from me. I encourage all politicians, all ADEQ personnel, and all interested stakeholders to read this. She documents misrepresentations of who owned land that was reported to be available for spreading feces and urine, it includes factual misrepresentations in the NOI, coupled with secretive awarding of the General Permit without the knowledge of the Director of ADEQ, and allowing only two ADEQ employees from Little Rock to perform inspections at C&H. This demand was initiated after a surprise inspection by the ADEQ employees from the Jasper, Arkansas, office, who were later forbidden to continue with any addition inspections.

5. ***Major Objection—Design of the BCRET sampling plan did not include intensive groundwater data sites, which are essential to describe the hydrology of Big Creek and contiguous basins.*** Discontinuous flow along sections of Big Creek during low flow make flow and water-quality comparisons highly questionable, owing to the fact that major aspects of the hydrology are neither monitored nor quantified. This is a common feature of surface water in karst lands. The title of the BCRET sampling, paid for by "Rainy Day Funds" by the Governor, is stated in the title of BCRET reports; it is "DEMONSTRATING AND MONITORING THE SUSTAINABLE MANAGEMENT OF NUTRIENTS ON C&H FARM IN BIG CREEK WATERSHED". Governor Beebe indicated that he was funding the project to assess if the CAFO were impacting Big Creek and the Buffalo National River, not to help the CAFO find the least-harmful impact on the environment. This overall emphasis of "Demonstrating"…overall "Sustainability" implies a strong bias we has been consistent since the CAFO was

permitted.

Historical documents, long-term studies by the U.S. Geological Survey throughout the conterminous U.S., and from numerous locations throughout the world indicate that huge concentrations of animal feces and urine will follow the laws of physics and chemistry, and contaminate downstream waters. In karst regions, this is exacerbated by the high permeability of the conduits to allow rapid flow, with little attenuation of the contaminants. Big Creek and contiguous drainage ways that flow into the Buffalo National River in Newton County, Arkansas, show degraded effects of animal production. Recent study of groundwater by the KHBNR team shows strong evidence that springs and wells closest to the waste sources are seeing the most impact. Delaying action, whether by inactivity or by requesting "needed additional years of data collection" ignores the wisdom we have gained from so many other sites. For these and numerous other reasons, I strongly urge you to DENY the permit request to C&H CAFO.

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