Response to Comments
Final Permitting Decision

Permit No.: 5264-W

Applicant: C&H Hog Farms, Inc.

Prepared by: ADEQ Technical Staff

The following comments were received regarding the draft permit number above. The response to comments was developed in accordance with APC&EC Regulation 8, Administrative Procedures.

Introduction

The initial draft denial was published for public comment on September 17, 2018. The Arkansas Department of Environmental Quality (ADEQ or "Department") conducted two (2) public hearings: one at ADEQ Headquarters in North Little Rock on October 9, 2018, and one at the Jasper School Cafetorium in Jasper on October 16, 2018. The public comment period ended on October 24, 2018, after the Hearing Officer granted a seven (7) day extension during the public hearing in Jasper and prior to the original end of the comment period.

Acronyms

APC&EC	Arkansas Pollution Control and Ecology Commission
NMP	Nutrient Management Plan
API	Arkansas Phosphorus Index
ANRC	Arkansas Natural Resources Commission
BCRET	University of Arkansas Big Creek Research and Extension Team
AWMFH	Agricultural Waste Management Field Handbook
NRCS	United States Department of Agriculture Natural Resources Conservation Service
ERW	Extraordinary Resource Water
TMDL	Total Maximum Daily Load
NPS	United States Department of the Interior National Park Service

This document contains comments and summaries of comments that the ADEQ received during the public comment period. The Department has addressed several similar issues raised throughout the comments by grouping those similar comments together and providing one response to each comment group.

People or organizations that submitted comments to ADEQ during the public notice period and public hearing are listed beneath each comment and are available on the ADEQ website at the web address below.

https://www.adeq.state.ar.us/home/pdssql/p_permit_details_water_spb.aspx?AFINDash=51-00164&AFIN=5100164&PmtNbr=5264-W

Comment: I am a native, rancher, friend, and neighbor. I have been to most meetings, and have yet to be told by ADEQ a legitimate reason for denying this permit. I have a test field in the evaluation of the litter and there has been no adverse effects. I am 38 years old, and have been raised on Big Creek. This worry about the algae is a bs talking point. All my life in the summer there is algae. I bale the hay on some of the hay fields that are sprayed with the litter. As you well know there is a buffer between big creek and the litter spread. If you would take time to look there is an unmistakable line where the grass thrives, and the buffer that does very little to produce hay. That's tangible proof that runoff is not an issue. I have been in the application fields at the time of spreading, and during the summer months the litter is only wet for a matter of minutes. I am sorry that there are people who feel like this farm is a problem for the environment, but as someone who lives close, and has dealings with, it's just simply not a problem. I don't believe any decision based on emotion is a good decision, and I feel that is what has happened in this case. I feel that if ADEQ can not make a sound scientific decision, without basing it from the outcries of people with an agenda, then the folks of ADEQ need to be examined, and removed.

Commenter: Jake Moenning

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section

651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

> Algal blooms have, and continue to, cause concern on the Buffalo River. As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[1]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Comment: These photographs, taken by this writer, are graphic statements of why ADEQ should continue and forever deny C&H a Reg. 5 permit, and never issue a permit of any kind involving spreading of manure of any kind in the Buffalo River Watershed in general and Newton County and Boone County in particular. These images are taken in the summers of 2017 and 2018 at Top of the Rock Restaurant. They show the epikarst of the Boone Formation, which extends over all of this local area and the aforementioned Arkansas counties and well as a vast contiguous area of Missouri and Arkansas. The site viewed here was a tree covered hill just east of U.S. Hwy 65 at Ridge, Missouri about 2 miles north of the Arkansas state line. A pond of about 3 acres was created over the present “canyon” area about 2015. In 2017 it is documented that an edge of the pond collapsed into a suddenly forming sinkhole, and within a day all of the pond water drained into the sinkhole in a catastrophic collapse.

It is reported that muddy water flowed after the collapse from a cave approximately ¾ mile westerly (toward Table Rock Lake) . The sinkhole cavity has been undergoing archeological style careful excavation of the cherty clay residium by the property owner, John Morris of Bass Pro Shop, ever since. A truck haul road emerging from the canyon can be seen in the upper photo. As of the summer of 2018, excavation was still actively underway at a depth of 300 feet according to employees on the site.

When Boone limestone is dissolved by water, the red clay and chert are insoluble byproducts, or residium. This is the common residual in other limestones. These photos show the natural effects of water solution of limestone with the non-soluble residual materials excavated to leave the natural pinnacles of not yet dissolved limestone.

The second photo shows better detail of the approximately 30 feet thick red clay residium with high chert content overlying and filling the tremendous cutters (the result of solution of Boone limestone) and remaining pinnacles of limestone hundreds of feet high. THIS IS TYPICAL OF BOONE FORMATION EPIKARST (Upper layer of karst, typically very permeable and usually covered by a thin layer of humus soil) ACROSS THE OZARKS OF ARKANSAS (INCLUDING ALL OF NEWTON COUNTY). It is usually exposed by road cuts. This Top of the Rock site is a rare nearby opportunity to see epikarst exposed by simple removal of the residium, even among the cutters and pinnacles over an extensive area.

The second photo also shows the equipment used to transfer the medium truck loads being excavated from the collapsed sinkhole site to highway class dump trucks which I observed hauling loads off the visible premises.

This Boone limestone also underlies C&H buildings, and it also lies unseen under their sewage lagoons and manure spreading fields. The residium provides ubiquitous invisible pathways for unfiltered water/sewage/pathogens to enter the water table to contaminate wells, springs, and surface streams including the now polluted BUFFALO RIVER! Even ADEQ has finally conceded at last that the Buffalo has miles of ‘impaired (that means POLLUTED!) waters”. That springs in the Buffalo impaired area are fed by karst infiltration at C&H has been substantiated by highly credential groundwater hydrologists Tom Aley of Protem, Missouri, and others such as David Mott of Buffalon National River, and Dr. John Van Brahana, retired Geology Professor at U of A. Now the Arkansas Department of Health has at last warned people and even dogs of dangerous toxic effects and infection from the algae now super abundantly blooming grossly in the Buffalo, and over safe limit pathogens present in the water. IS THIS ENOUGH FOR ADEQ? OUR GOVERNOR? OR DO YOU WANT TO BE RESPONSIBLE FOR KILLING SOMEBODY? DENY THIS REG 5 PERMIT. RESCIND THEIR CURRENT OBSOLETE REG 6 PERMIT. NEVER PERMIT MANURE SPREADING IN THE BUFFALO DRAINAGE AGAIN.

Commenter: Duane Woltjen

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Comment: I support the decision to deny a permit to C&H Hog Farms. Please continue to deny permits to large animal feeding operations that want to locate near rivers, especially the Buffalo National River. The State of Arkansas should more effectively regulate water pollution from Animal Feeding Operations, including both those sources that are subject to regulation under the Clean Water Act (CWA), as well as sources that are exempted from CWA regulation pursuant to the agricultural storm water runoff exemption. Congress passed the CWA with the intent to end all pollution in navigable waters by 1985. To effectuate this goal, the CWA prohibits the discharge of pollutants from any "point source" into waters of the United States

unless the discharge is authorized pursuant to a permit that is issued by the EPA or a qualified state. The CWA was also supposed to end the myth that "dilution is the solution to pollution." However, the CWA fails to regulate pollution that is deemed to have been discharged from a "nonpoint source" because it is diluted via agricultural storm water runoff, including waste from livestock operations, leaving this to state regulation and management. Given that nonpoint source pollution accounts for almost half of all water pollution in the United States, it is highly troubling that many states do not seek to control nonpoint source water pollution with effective regulation. This is partly because agricultural runoff is the largest source of nonpoint source water pollution, and many states do not want to put their agricultural industry at a competitive disadvantage by regulating nonpoint source water pollution more than their neighbors. Thus, many states that have chosen to regulate nonpoint source water pollution have waited until water quality deteriorates to the point that it is obvious to the local population and politically untenable not to regulate. Arkansas should not make this mistake and wait until its rivers and lakes are heavily polluted to take action. In 1996, the Arkansas legislature officially adopted "The Natural State" as the official nickname for the State of Arkansas in order to highlight its "unsurpassed scenery, clear lakes, free-flowing streams, magnificent rivers, meandering bayous, delta bottomlands, forested mountains, and abundant fish and wildlife." In order to uphold its official nickname as "The Natural State," Arkansas should be proactive in protecting its state treasures, including the Buffalo National River and the many other smaller rivers and lakes that sustain wildlife and offer various recreational activities. Although farming is a large part of Arkansan culture, so is canoeing, kayaking, rafting, boating, swimming, fishing, and otherwise enjoying the rivers and lakes. Proactive and effective nonpoint source pollution regulation is needed to protect Arkansas' drinking water supplies, recreation, fisheries and wildlife. The Arkansas Natural Resources Commission currently has a Nonpoint Pollution Management Plan, which consists of promoting green infrastructure and development, watershed management, and restoration efforts. While beneficial, the plan essentially promotes voluntary Best Management Practices, and does not directly address nonpoint source pollution from agriculture, which is a major problem in Arkansas. Nonpoint source pollution caused by animal agriculture is a primary concern in three of Arkansas' four regions of the State. Thus, decisive regulation of nonpoint source agricultural pollution is needed in order to more effectively combat pollution by stopping it at its source, whether the source is discrete or diffuse.

Commenter: Andrew Cox

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Beautiful Buffalo River Action Committee (BBRAC) has been established for the purpose of addressing potential water-quality concerns throughout the Buffalo River Watershed and to protect the vitality of the Buffalo National River as a national, state, and local landmark. Governor Asa Hutchinson directed five agencies to develop an Arkansas-led approach to identify and address potential

issues of common concern in the watershed. A key priority of BBRAC was to initiate the development of a Buffalo River Watershed Management Plan. The nine-element watershed management plan was developed for the Buffalo River Watershed, and the final plan was submitted and accepted by EPA in June 2018. Watershed management plans are recognized by EPA as comparable, state-led management approaches expected to result in the attainment of water-quality standards.

Comment: I support ADEQs decision to deny C&H Hog Farm's Regulation 5 permit application. Tourism on Buffalo National River Creates $71.1 Million in Economic Benefits in 2017. We have one of the last great places for ecotourism which will bring far more money to the state than a lot of hog waste. The river has become more toxic than ever due to C&H hog farm and ADEQ needs to truly serve the public interest and not the corporate agribusiness interest. I strongly encourage all ADEQ employees and any other state employee to release any information relating to corruption and incompetence within ADEQ or any other state agency. We will protect you and help you find better employment if you are punished for being a true public servant. You can also tell me what information to FOIA so that I can release to the media/public. You can email me at jmingram@ualr.edu or reach me by phone at 501-749-2979.

Commenter: Jeff Ingram

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Consideration of tourism is not within the Department's regulatory authority.

The Arkansas Department of Health did not submit a comment regarding C&H Hog Farms, Inc., AFIN 51-00164, during the public comment period ending October 24, 2018.

Comment: The C&H facility was approved without public awareness or input. There was virtually no geologic investigation, and the engineering was inadequate and assumed that karst was not a concern. The spreading fields clearly exhibit karst features, and the three fields that were looked at by the Oklahoma State University geological team show thin soils, epikarst, karst as the point of refusal, and hidden karstic features such as sinkholes and gravel lenses. Clearly, with such a limited review, other fields, particularly the upland fields are of great concern in regard to their ability to handle the volumes of waste that are being applied. The facility and the ponds themselves were engineered at the exclusion of basic investigative steps that are recommended in the Agricultural Waste Management Field Handbook. It appears that the economy of the project was the over-riding concern, and not the Buffalo National River whose name did not even appear in ANY of the documentation submitted in the original permit

application. The operation owners and their backers are now using legal maneuvering to stall on closing this facility for as long as possible. It is extremely unfortunate that this family finds themselves in this position, though there were some conscious choices made on the front end that appear to have been made for the purpose avoiding scrutiny that might have headed all of this off. This permit needs to be denied. The facility needs to go through the proper closing procedure. A permanent moratorium on all future such facilities in the Buffalo River Watershed needs to be imposed. The Buffalo National River, the most important natural resource in the State of Arkansas, needs to be allowed to recover, which could take years.

Commenter: Brian Thompson

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

APC&EC Regulation 6 General Permit ARG590000 and the coverage (permit tracking number ARG590001) granted under the General Permit are outside the scope of the current permitting decision. The initial Notice of Intent and the corresponding NMP for coverage under the prior APC&EC Regulation 6 permit tracking number ARG590001 were available for public comment during the 30-day public comment period beginning on June 25, 2012.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table

5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

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Rule-making regarding a permanent moratorium is outside the scope of this permitting decision.

Comment: What proof does this department have that the C&H Hog Farm has caused any harm to the BNR? Have extensive tests been conducted on the Big Creek tributary, below the mouth of Big Creek on the BNR, above the mouth, above and below the mouth of Mill Creek, above and below the mouth of the Little Buffalo River? Just trying to see where the river is being affected the greatest. If extensive testing has not been on all or at least several points why has it not been? What impact does the high population of feral hogs have on the BNR? What impact does the annual flow of people have on the BNR? I think many things can have an impact on the river. I want it to remain as clean as possible but I'm having a very hard time understanding how this operation has any more or less contamination than any other activities or contact has? There are 2 tributaries which have sewer treatment facilities entering, farms on all tributaries, farms directly on the BNR at the upper end, numerous roadways intersecting the river and all of it's tributaries plus many other points of access to which contaminates can and more than like do enter the river. I am not in favor of denying anyone use without much more study on the matter of where the contaminates enter the flow.

Commenter: Jimmy Keys

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four

Assessment Units (two segments of Big Creek and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.
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In the April 1 to June 30, 2018 Quarterly Report, BCRET presents data that documents a statistically significant increase of nitrate-N in the ephemeral stream (BC4) since 2014. However, BCRET notes that chloride, a conservative tracer, did not show a statistically significant increase. Four years of data also indicate a steady increase of geometric mean nitrate-N within the house well (W1) (BCRET

April–June 2018, Figure 24). Increased nitrate-N in both the ephemeral stream and the house well does suggest that these systems may be hydrologically connected to areas where farm activities take place.

Comment: I am very pleased that the State has decided to deny operation permit to the large scale hog farm within the watershed of the Buffalo National River. I have trouble imagining why this was ever an issue. I'm also having trouble understanding why even more public comment is necessary to follow through. It all seems like delay tactic, pro-business at any cost. So I am sending in this comment that I strongly agree the permit must be denied. I really am embarrassed that the government of our beautiful State feel it needs many many personal comments repeatedly to do the right thing. It should have been a no-brainer to deny this facility from the get-go. Making it necessary for citizens to continually protest allowing this foul pollution of the national treasure entrusted to our care says a lot more about you than you may realize. In case I wasn't clear, please deny deny deny this permit and any others in the future. Show this State that you care about this State!

Commenter: Dana Bassi

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Comment: I have loved the Buffalo River most of my life. The permit must be denied to protect the river from the abuses of corporate agriculture. I have crawled through hundreds of caves in the Buffalo River Watershed. I have sampled water from numerous springs and streams. I have conducted several dye traces. The waste is and has been getting to the river from the CAFO. I believe the evidence is strong that the huge and persistent algae blooms the river has been subjected to the past three years are a direct result of the nutrients passing a tipping point. The 32 tons of phosphorus which C&H dumps on the ground every year is feeding the algae well. The ponds are leaking into the Karst. The waste disposal fields are underlain by Karst. The groundwater is now heavily polluted. The Buffalo River is impaired with E. coli for miles. Big creek near the CAFO is impaired for E. coli. Big Creek near the river is impaired by low dissolved oxygen. The Buffalo River is impaired by algae all the way down from the CAFO. I am glad ADEQ finally appears to have woken up and smelled the hog crap. Please do what is right and cast this abomination out of Paradise Thanks More data and comments to follow.

Commenter: Charles Bitting

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit

application, the public comments on the record, and other available and relevant data and information.

ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen.

> Algal blooms have, and continue to, cause concern on the Buffalo River. As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[1]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.
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Ground penetrating radar studies at Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed investigations.

Seepage from waste storage ponds has the potential to pollute surface and ground water. The record included one recompacted permeability test that is insufficient to determine liner integrity. The necessary soil investigations including, but not limited to, percentage of fines and soil permeability characteristics, have not been

performed at this facility in accordance with the AWMFH 651 Table 10-4 and Appendix 10D. Plasticity index analysis was performed on one sample of the in situ clay material in boring 2. The variability in the regolith expected in this geologic setting coupled with the insufficient data creates additional concerns about the siting and soil sources for the clay liner. The required number of borings were not advanced within the pool areas in accordance with AWMFH 651.0704(b)(4); these additional borings would have provided more data for assessment of clay source material. Proper soil investigations for the liner material are necessary to determine the suitability and location of the clay source material and to consider any additional geotechnical testing to confirm material properties, which will reduce the potential for downward and/or lateral seepage of the stored wastes.

Comment: In light of the overwhelming evidence of water sampling results, spread overloads, and potential of ponds flooding, the state has made a huge mistake in allowing the hog operation in this area. The state of Arkansas should take responsibility and buyout this farm. The state is very negligent in not protecting all of our waterways and caving to pressure from the Farm Bureau. It is time for the governor and ADEQ to do their jobs and be the leaders in doing what is right and required by law in protecting our few waterways that are not totally ruined beyond restoration.

Commenter: Kirk Wasson

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Comment: I am writing as a concerned citizen. The opinions contained herein are solely my own. I do not represent any other organizations or individuals. It is my position that the application for the Regulation 5 permit for this CAFO be denied and that a permanent moratorium on all such facilities be immediately established in the Buffalo National River watershed. A final permit should be denied for the following reasons: ADEQ is Precluded Under 5.303 of Regulation 5 From Approv Lack of Compliance With AWMFH Notwithstanding the fact that Regulation 5 cannot be used to obtain point source permit, C&H's application does not comply with Regulation 5.402 which states, Designs and waste management plans shall be in accordance with this Chapter and the following United States Department of Agriculture Natural Resource Conservation Service technical publications: (1) Field Office Technical Guide, as amended. (2) Agricultural Waste Management Field Handbook [AWMFH], as amended. C&H did not comply with the AWMFH. Therefore C&H did not comply with guidance required under Reg. 5.402 and this permit should be denied. Among other items, the application/waste management plan: 1. Do not consider geologic (Karst) and groundwater conditions (Chapter7),

2. Applies waste in excess of agronomic needs, 3. Fails to consider the impact of breach or accidental release from storage lagoons 4. Contains no contingency or emergency plan in case of accidental release Failure to comply with the AWMFH is a violation of Regulation 5.402. Therefore this permit should be denied. Deficient Nutrient Management Plan(1) The Nutrient Management Plan is in error. For example: 1. Assumptions of forage production at 6 tons per acre are unrealistically high for the area 2. Waste is applied in excess of agronomic need as evidenced by most recent soil tests showing that a number of fields have "above optimum" levels of phosphorus and U of A recommends no additional phosphorus be applied. Winter waste applications when forage is dormant is contrary to agronomic need. 3. Hay is not harvested from all fields so the nutrients are not removed efficiently 4. Assumptions of rotational grazing are not correct. Grazing practices in the area are not as beneficial as projected, resulting in higher API than calculated. 5. Soil Test Phosphorus is rising on most fields increasing the long term impact on receiving waters. This is not well accounted for in the API Planner. 6. Some of the spreading fields have very high slopes and very thin soils that cannot meet the assumptions in the API. 7. The Arkansas Phosphorus Index does not adequately account for erosion of pasture. Erosion is very effective in transferring Phosphorus to receiving waters. 8. It appears that other nutrient sources (i.e.: poultry litter) are used in the area. These must be accounted for in the API planner. 9. Long-term waste application at rates indicated in the Planner will cause eutrophication in the receiving waters, specifically the Buffalo River. Based on these and other deficiencies in the NMP this permit should be denied. Adverse Economic Risks Greatly Outweigh Benefit According to a National Parks Service report issued in 2016, the Buffalo National River was visited more than 1.4 million times in 2015 resulting in an economic output of more than $72 million. Nearly 1,000 jobs exist because of this tourism. Conversely, C&H has generated approximately 10 jobs for family members of the owners. I know of no reasonably prudent person who would risk $72 million of economic value for 10 jobs. Violation of The Arkansas Water and Air Pollution Control Act The Arkansas Water and Air Pollution Control Act of 1949 makes it unlawful to "cause pollution...of any waters of this state," or to place any sewage, industrial waste or other wastes in a location where it is likely to cause pollution of any waters of this state." It is inevitable by locating point source animal waste lagoons and application fields so close to Big Creek that water pollution will occur (and in fact there is already evidence of discharge). Granting this permit would be in violation of The Arkansas Clean Water and Air Pollution Control Act and should be denied.

Commenter: Mark Richards

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as

required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.
[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Seepage from waste storage ponds has the potential to pollute surface and ground water. The record included one recompacted permeability test that is insufficient to determine liner integrity. The necessary soil investigations including, but not limited to, percentage of fines and soil permeability characteristics, have not been

performed at this facility in accordance with the AWMFH 651 Table 10-4 and Appendix 10D. Plasticity index analysis was performed on one sample of the in situ clay material in boring 2. The variability in the regolith expected in this geologic setting coupled with the insufficient data creates additional concerns about the siting and soil sources for the clay liner. The required number of borings were not advanced within the pool areas in accordance with AWMFH 651.0704(b)(4); these additional borings would have provided more data for assessment of clay source material. Proper soil investigations for the liner material are necessary to determine the suitability and location of the clay source material and to consider any additional geotechnical testing to confirm material properties, which will reduce the potential for downward and/or lateral seepage of the stored wastes.

Data supplied from the C&H Hog Farms, Inc. 2014–2017 annual reports document an increase of soil test phosphorus (STP) from 20 ppm to 68 ppm in Field 17 to a more significant increase in Field 1, which increased from 45 ppm to 173 ppm. As stated in University of Arkansas Division of Agriculture Soil Phosphorus: Management and Recommendations FSA1029[3], "Arkansas scientists agree that there is no agronomic reason or need for STP to be greater than about 50 ppm (Mehlich-3 extraction)." However, "with the move from agronomic to environmental concerns with P, soil P testing has been used to indicate when P enrichment of runoff may become unacceptable. A common approach has been to use agronomic soil P standards, following the rationale that soil P in excess of crop requirements is vulnerable to removal by surface runoff or leaching" (FSA1029). "A large amount of research between 1985 and 2000, showed that as STP (Soil Test Phosphorous) increased, especially in the top 2–4 inches of soil, so did the concentrations of soluble P in runoff (Figure 1)" (FSA1029).

As of the C&H Hog Farms, Inc. 2017 Annual Report, results of all soil test phosphorus were greater than 50 ppm. Despite a reported increase of soil test phosphorus in waste application fields, pursuant to NRCS Code 590, the Arkansas Phosphorus Index may still allow application of swine waste because of other factors including phosphorus source potential, transport potential, and best management practice multipliers. FSA9516[2] states that the phosphorus index approach is most appropriate as it accounts for multiple risk factors and provides a better risk assessment of P loss in runoff.

Geotechnical investigations at all land application sites in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3 are necessary to ensure the efficacy of the API and demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River by rapid infiltration through highly permeable or thin soils.

[2] https://www.uaex.edu/publications/PDF/FSA-9516.pdf

[3] https://www.uaex.edu/publications/pdf/FSA-1029.pdf

Based on data submitted by USGS for the 2018 303(d) list, ADEQ proposed listing Big Creek (AR_11010005_022) as impaired for dissolved oxygen.

Groundwater can greatly influence seasonal ionic composition, specific conductance, nutrient concentration, and dissolved oxygen [4](Kresse et al. 2014, Cox et al. 2007, Soulsby et al. 2009, Robertson, et al. 2013, Justus et al. 2016). In 2016, the USGS completed an evaluation of continuously collected dissolved oxygen data from five USGS Boston Mountain ecoregion stations. Land use and base flow nutrient concentration were combined to develop a disturbance index for each site. Big Creek was considered moderately disturbed with the combined nutrient and land use index. Big Creek dissolved oxygen was negatively correlated with conductivity, which suggests groundwater influence. Dissolved oxygen variability and percent of exceedances of dissolved oxygen criterion (APC&EC Reg. 2.505) increased with land use and nutrient index disturbance index.

[4] Kresse, T. M., P. D. Hays, K. R. Merriman, J. A. Gillip, D. T. Fugitt, J. L. Spellman, A. M. Nottmeier, D. A. Westerman, J. M. Blackstock, and J. L. Battreal. 2014. Aquifers of Arkansas—Protection, Management, and Hydrologic and Geochemical Characteristics of Groundwater Resources in Arkansas. U.S. Geological Survey Scientific Investigations Report 2014–5149.

Cox, M.H., Su, G.W. and Constantz, J., 2007. Heat, chloride, and specific conductance as ground water tracers near streams. Ground Water, 45(2), pp.187-195.

Justus, B. G., D. R. L. Burge, J. M. Cobb, T. D. Marsico, and J. L. Bouldin. 2016. Macroinvertebrate and diatom metrics as indicators of water-quality conditions in connected depression wetlands in the Mississippi Alluvial Plain. Freshwater Science 35:1049–1061.

Robertson, W.D., D.R. Van Stempvoort, D.K., Solomon, J. Homewood, S.J. Brown, J. Spoelstra, and S.L. Schiff. 2013. Persistence of artificial sweeteners in a 15-year-old septic system plume. Journal of Hydrology, 477, pp.43-54.

Soulsby, C., I. A. Malcolm, D. Tetzlaff, and A. F. Youngson. 2009. Seasonal and inter-annual variability in hyporheic water quality revealed by continuous monitoring in a salmon spawning stream. River research and applications 25:1304–1319.

Consideration of tourism and revenue is not within the Department's regulatory authority.

Rule-making regarding a permanent moratorium is outside the scope of this permitting decision.

Comment: The Arkansas Department of Environmental Quality ("ADEQ") recently provided public notice of a denial (for the second time) of C & H Hog Farms, Inc. ("C & H") application for an Arkansas Pollution Control and Ecology Commission Regulation No. 5 permit. More about C & H here. The reasons given by ADEQ for denying the permit as stated in Section 8 of the "Statement of Basis" of the Public Notice are summarized as follows: Deficiencies in the Geological Investigation: ADEQ's findings confirm the presence of Karst hydrogeology at the C & H site and surrounding area which allows ground water to flow through interconnected underground fissures and cracks and into aquifers which are extremely vulnerable to contamination. Water Quality Issues: ADEQ's findings confirm two segments of Big Creek in Newton County and two segments of the Buffalo National River are now impaired due to the presence of pathogens and low levels of dissolved oxygen. Dye tracing has documented that underground streams which may be hydrologically connected to C&H activities have allowed residential water wells to be contaminated. Our members continue to see massive algal blooms in the Buffalo National River which are confirmed to include dangerous cyanotoxins. The presence of these algal blooms and related toxins are not only a threat to public health but are also a threat to the $70 million contribution the Buffalo National River provides to Arkansas's economy and in particular to those counties which border the river. Sound science supports the permit denial and reaffirms the position of tens of thousands of concerned citizens dedicated to the protection of the Buffalo National River.

Commenter: Cynthia Peterson

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

> Algal blooms have, and continue to, cause concern on the Buffalo River. As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[1]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed

makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.
[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

The Department did not receive any comments during the comment period ending on October 24, 2018, from the Arkansas Department of Health.

Consideration of tourism and revenue are not within the Department's regulatory authority.

Comment: Is there a property ownership trail for the property on which the existing hog farm rests? I and others want to know who benefitted from this site being selected versus a site that is not near the Buffalo or other fragile ecosystem site. Second, is this the only place in all of AR for an additional, profitable hog operation? Third, while the legal process is delayed, over and over,

the damages(factual science) from the hog operation continue and the cost to remedy damage will mount. Whatever happened to NIMBY?

Commenter: Douglas Isanhart

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Comment: Dear sirs, I would like to offer these 7 points of interest concerning the C&H Hog Farms as comments. Please consider the following statements. 1.C&H Hog Farms has been in business for more than five years with NO environmental violations. 2.Changing the rules of their permit requirements AFTER the permit is issued is unfair and damaging to small businesses of any type. 3.The introduction of "karst topography" as a reason to deny an operational permit potentially brings 30 percent of all farmland in Arkansas into regulatory question, as karst covers much of north and southwest Arkansas. 4.The use of the Animal Waste Management Field Handbook are recommendations and not requirements. 5.Out of 2,243 agriculture applications received by the ADEQ, C&H is the first and only permit application to be denied. 6.Allow sound science, and not emotion, to drive decisions concerning Arkansas' environmental standards. 7.Listen to the scientists who have spent their lives studying water-quality issues, and not the citizen vigilantes whose sole intent is to shut down this farm.

Commenter: Mark Weathers

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Applications for Regulation 5 permits are evaluated according to Regulation 5 requirements. The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department

acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.
[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Comment: C&H Hog Farms has been in business for more than five years with NO environmental violations; Changing the rules of their permit requirements AFTER the permit is issued is unfair and damaging to small businesses of any type; The introduction of "karst topography" as a reason to deny an operational permit potentially brings 30 percent of all farmland in Arkansas into regulatory question, as karst covers much of north and southwest Arkansas; The use of the Animal Waste Management Field Handbook are recommendations and not requirements. Out of 2,243 agriculture applications received by the ADEQ, C&H is the first and only permit application to be denied. Allow sound science, and not emotion, to drive decisions concerning Arkansas' environmental standards. Listen to the scientists who have spent their lives studying water-quality issues, and not the citizen vigilantes whose sole intent is to shut down this farm. It is ridiculous to deny C&H Hog farm their rightfully due permit.

Commenter: Ken and Virginia Hulsey

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department has noted violations during its inspections of the C&H facility near Mt. Judea, Arkansas. However, those violations have not led to a formal enforcement action by the Department against C&H.

The requirements set forth in APC&EC Regulation 5 have not changed.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

The Department relied upon data from BCRET in making this permitting decision.

Comment: As a life long supporter of agricultural endeavors in our beautiful state of Arkansas, I feel strongly compelled to weigh in on this issue. My concern is that any regulatory decision concerning C&H could negatively impact our farmers and ranchers in the future. Over the past months I have been weighing both sides of this issue in order to draw a reasonable conclusion. As a result, I think it would be in the best interest of our farmers and the ADEQ if a few key points were considered. 1. Using karst topography as a reason to deny a permit is very concerning, as karst covers a significant portion of the state. 2. C&H has committed zero environmental violations. 3. Changing the rules after a permit is issued is questionable. 4. C&H is the only permit application to be denied out of 2,243 ag applications. 5. True water quality scientists should be consulted on the issue instead of citizens intent on shutting down the farm. My final statement has to do with point number 5 above. It appears that Big Creek and 14 miles of the Buffalo has been declared impaired. I would like to point out in addition to C&H the number of feral hogs that are in this area. This is a variable that can only be estimated. Also, another variable to consider is the amount of human contact the rivers and streams are exposed to. What I mean by that is the amount of human waste and excrement that end up in the river from tourists whether they be floating the river, fishing, hiking or hunting. That is a very long stretch of river without a lot of options for rest rooms. Yes the river can be tested for pollutants, but it will be very difficult to pinpoint a source considering C&H is certainly not the only possible contributor. I love the Buffalo River and I spend a lot of time up there hiking. I want the river to be as clean as possible and for people to enjoy it when I am gone. C&H is a family operation that has absolutely no desire to see harm come to the natural resources around them. In my own experience with farmers and ranchers they tend to be the best stewards of the water and land we enjoy. I would ask the ADEQ to consider the record of C&H in this case and the lack of concrete evidence to their operation having a negative impact on the Buffalo River.

Commenter: Joey Rhoda

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

ADEQ does not regulate all types of farming operations. The Department's permitting decision for this APC&EC Regulation 5 Individual No Discharge permit application pertains only to this individual permit application for a liquid

animal waste management system, not all farming operations. Applications for Regulation 5 permits are evaluated according to Regulation 5 requirements.

The Department has noted violations during its inspections of the C&H facility near Mt. Judea, Arkansas. However, those violations have not led to a formal enforcement action by the Department against C&H.

Consideration of tourism is not within the Department's regulatory authority.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.
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The Department considered all available scientific data and information from, but not limited to, BCRET, United States Geological Survey, University of Arkansas Department of Agriculture, and ADEQ in making this permitting decision.

Comment: Commission Members: I am not an activist. I am a lifetime Arkansas, citizen of North Little Rock and business owner. The Buffalo River is very important in our family life. My wife and I own land adjacent to the National Park Service in Marion County. We spend our weekends and holidays at the Buffalo River. Many of our friends are farmers in the area of the Buffalo River water shed. The first time I became fully aware of CAFOs was when I heard the news about the CAFO permit in Newton County on NPR. I immediately began searching for successes and failures, reading both sides of the case, reading NPS objections and talking with my friends in the farming community. Being a fellow business owner I feel the applicant deserves the right to earn money with his 650 acres. He deserves to put his money to work to feed his family. The last thing any of us want is more government regulation. When a business plan requires distributing waste over a large area and cannot be confined or destroyed by the business, where the outcome cannot be guaranteed and bonded by the business this is where regulation is required to protect the common good. Being a proud Arkansas I am totally against any CAFO that has a nature defined, direct path to the Buffalo River. Furthermore the surrounding terrain is a geologic formation known as Karst which is in essences distributes liquids like pouring through swiss cheese. Aside from Big Creek, there are many unknown paths to the river via the Karst. 1. I know isolation from flooding is said to be above the last 100 year flood predictions. There has been so much change in the weather that I have seen over the last 50 years I don't believe the legacy data should be fully trusted for future events. 2. In researching successes and failures in other states there are many instances that indicate a CAFO could be a significant risk to the Buffalo River. I have found no data saying a CAFO will have a neutral or positive impact. Check out recent and long term behaviors in North Carolina. 3. The National Park Service was against the construction but were given no legal voice. We pay and trust the NPS as civil servants to look out for our public assets. I feel they should be fully trusted by Sate and Federal Government and have full support in matters where they are most qualified. 5. The approval process was unprofessional. There should have been no family relationship between anyone submitting the application and anyone approving the application. There were other shady business practices and they can be found in the public record. 6. We have seen what other honorable and reputable food manufacturers have done to our natural streams. They beg forgiveness, attempt a cleanup, pay a fine, apologize and return to normal operations. No amount of money or "I am sorry" will undo a spill into the Buffalo River. If a worst case scenario happens we will all pay with our recreational freedom. Some will lose there tourism based businesses. Instead of America's First National River we will have American's First National River that was destroyed by poor regulation, lobbying and political favoritism. 7. The federal government took the land of those that once occupied what is now the park. The USA did this for the benefit of our nation. Those people sacrificed to allow us this national treasure. We as Arkansas should now do our part to be good stewards of the reserve. Our families and businesses can benefit from this preservation for generations. Risking the park for corporate profits cheapens all of the sacrifice and investment that has been made. 8. Folks on the other side of the

issue will say that tourists relieving themselves in the river is a bigger threat. This is simply not true. If you consider the liquid waste of 4000 hogs being suddenly discharged into the river via a sink hole there would be very few things that could generate this destructive capacity. Even comparing the slow continuous leaching of hog waste through the Karst with visitors it is unlikely the visitors are on the same high scale of risk as the CAFO. We cannot reasonably control tourists relieving themselves in the river. We can certainly control the presence of a CAFO within kill distance of the river. 9. Some will say that the lack of rainfall is the root of the current algal blooms. They are certainly a factor. When there is a lot of water some of the excess nutrients will be washed down to the White River. When there is low water the excess nutrients will feed the algal blooms and degrade the river. We cannot control the rainfall. We can certainly control the risk that a business places on the welfare of a national and state treasure. 10. The CAFO will benefit one family, small group of families or corporation. It has the potential to damage or destroy a centerpiece of tourism and beauty for our state and nation. There are attributes of a CAFO that are not conducive to tourism. There are times that only the government can protect us from misguided and business profit based decisions. The precautionary principle should be applied. The CAFOs cannot prove that they are not a clear an present risk to the public good and therefore they should not exist. Please act in the public interest and ban this CAFO and future manufacturing facilities that discharge waste into the watershed. I am for family farms. I am totally against CAFOs and similar manufacturing facilities in the Buffalo Watershed.

Commenter: Jay Stanley

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section

651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

> Algal blooms have, and continue to, cause concern on the Buffalo River. As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[1]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Consideration of tourism is not within the Department's regulatory authority.

Comment: To Ms Becky Keogh, I fully support the decision by ADEQ to deny the permit for C&H Hog Farm. I have felt like, from the first time I knew the hog farm was being built and would soon have hogs, the risk in placing this facility so close to The Buffalo was too high. And now Big Creek and parts of The Buffalo are officially on the impaired list. Miles and miles of the river are choked with algae. People and pets are warned the river isn't safe to swim in. I feel like ADEQ should do everything in their power to stop, to attempt to reverse, what is happening. But that isn't your track record. I know the issue is complicated. I know much denial is made, that these conditions exist because of the hog farm. But it exists because of surplus nutrients and the

hog farm supplies surplus nutrients in a karst region. Please continue to deny this permit. I want to be able to have a healthy river again. To keep taking my grandchild there to take in the splendor of The Buffalo. I can only do that now above Carver. That it is no ok! This is appalling.

Commenter: Glenda Allison

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Arkansas Department of Health did not submit a comment regarding C&H Hog Farms, Inc., AFIN 51-00164, during the public comment period ending October 24, 2018.

> Algal blooms have, and continue to, cause concern on the Buffalo River. As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[1]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Comment: I'm not sure where this subject is at this time but my thoughts lean toward the river. I think any existing farm should be left alone. However, no expansion should be allowed and no new waste or toxins should be allowed into the river. I hate it for the farm owner but the beauty and revenue from the river has to come first. It is just a beautiful gem of Arkansas and is worth protecting!

Commenter: Jeffrey Wyborny

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit

application, the public comments on the record, and other available and relevant data and information.

ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen.

APC&EC Regulation 5 requires the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. ADEQ has determined that a detailed geological investigation of the facility is required because karst includes highly permeable foundations with the associated potential for groundwater contamination and potential for sinkholes to open up with collapsing ground or cause differential settlement. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies, i.e. karst, that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. Additionally, ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of two segments of Big Creek and two segments of the Buffalo National River as impaired further illustrates the need for these detailed studies.

Consideration of revenue is not within the Department's regulatory authority.

Comment: I am writing in absolute support of the denial of a reg. 5 permit for C&H Hog Farms. Large and spreading algal blooms have been documented over the past three years on our country's first national river, the Buffalo River in Northwest Arkansas. In 2016 and 2017, algae growth covered at least 20 river miles. This year, 2018, blooms were documented extending

along seventy or more miles of the river, with the heaviest blooms occurring downriver of the Carver access, which is directly across from the confluence with Big Creek. An algal expert from West Virginia examined the river in September and said that by EPA Region 3 standards, the Buffalo River below Gilbert and all the way to Rush (and no doubt beyond, but he exited the river at Rush) would be considered recreationally impaired because algae covered in excess of 40% of that portion of the river. Even those of us who have been active in opposing the placement of a hog CAFO in this watershed have been astonished at the rapidity with which the river has been overwhelmed by algal growth. But in retrospect, it is not surprising. In the initial permit application for C&H Hog Farms Inc., the majority of 600 acres proposed to receive hog waste were already designated as being 'above optimum', with the recommendation that they 'receive 0 additional application of P.' Clearly there is something wrong with a system in place to protect water quality when such fields were approved by your agency anyway, and then continuously used to dispose of phosphorus-rich waste for years, far in excess of any agronomic need. Carroll County and much of NW Arkansas has already been designated as an excess nutrient area where application of litter is regulated to correct previous over-application that has left the region with legacy nutrients that will continue to impact waterways and reservoirs into the future. It is insane to support a regulatory system that only reacts to degradation rather than taking every available measure to prevent it. Currently Arkansas has only a limited narrative standard for algae. Existing standards are inadequate, vague and ambiguous, and certainly not protective of the waters of the state or the health of the humans who may wish to fish, swim or float our waterways. Reg. 2.509 Nutrients (A) Materials stimulating algal growth shall not be present in concentrations sufficient to cause objectionable algal densities or other nuisance aquatic vegetation or otherwise impair any designated use of the waterbody. While it is wonderful news that ADEQ now acknowledges that it erred in allowing C&H its initial permit and is denying a new Reg. 5 permit, we are still left with a very sick river. Please describe how your agency plans to address the fact that legacy phosphorus will continue to leach from the soils where 14 million gallons of waste have been deposited over the past five years. Is there any reason not to designate this watershed as a nutrient-excess area? Will your agency advocate for that? One argument heard often around the issue of algae growth in the Buffalo River is that all rivers in our Ozark region in late summer have algae in them. I floated the Kings River in mid-September 7 miles above the Hwy. 62 bridge and we saw only one place where there was a limited algal bloom of note. The rest of that stretch above and below that one spot was absolutely devoid of floating mats and long strings that have changed the nature of the Buffalo River and will continue to impact it as a recreational resource for years to come. Both the Kings River and the Buffalo begin in the same area of the Boston Mountains and traverse very similar terrain, fields, pastures, chicken houses and cattle ranches. Both are popular with floaters, swimmers and fishermen and see heavy use in summer months. Berryville and part of Eureka Springs are in the watershed, and there are a number of homes along the river. Yet it has retained its health and beauty.

Commenter: Lin Wellford

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit

application, the public comments on the record, and other available and relevant data and information.

> Algal blooms have, and continue to, cause concern on the Buffalo River. As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[1]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Data supplied from the C&H Hog Farms, Inc. 2014–2017 annual reports document an increase of soil test phosphorus (STP) from 20 ppm to 68 ppm in Field 17 to a more significant increase in Field 1, which increased from 45 ppm to 173 ppm. As stated in University of Arkansas Division of Agriculture Soil Phosphorus: Management and Recommendations FSA1029[3], "Arkansas scientists agree that there is no agronomic reason or need for STP to be greater than about 50 ppm (Mehlich-3 extraction)." However, "with the move from agronomic to environmental concerns with P, soil P testing has been used to indicate when P enrichment of runoff may become unacceptable. A common approach has been to use agronomic soil P standards, following the rationale that soil P in excess of crop requirements is vulnerable to removal by surface runoff or leaching" (FSA1029). "A large amount of research between 1985 and 2000, showed that as STP (Soil Test Phosphorous) increased, especially in the top 2–4 inches of soil, so did the concentrations of soluble P in runoff (Figure 1)" (FSA1029).

As of the C&H Hog Farms, Inc. 2017 Annual Report, results of all soil test phosphorus were greater than 50 ppm. Despite a reported increase of soil test phosphorus in waste application fields, pursuant to NRCS Code 590, the Arkansas Phosphorus Index may still allow application of swine waste because of other factors including phosphorus source potential, transport potential, and best management practice multipliers. FSA9516[2] states that the phosphorus index approach is most appropriate as it accounts for multiple risk factors and provides a better risk assessment of P loss in runoff.

Geotechnical investigations at all land application sites in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3 are necessary to ensure the efficacy of the API and demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River by rapid infiltration through highly permeable or thin soils.

[2] https://www.uaex.edu/publications/PDF/FSA-9516.pdf
[3] https://www.uaex.edu/publications/pdf/FSA-1029.pdf

The water quality standards set forth in APC&EC Regulation 2 are outside the scope of this permitting decision.

Comment: I would like to ask A.D.E.Q. two questions. What is the difference between chicken liter and hog litter. You do not have any restriction on chicken litter.Its my understanding that it is used on park food plots. I know of no violation, citation, or fines against C.H. Why would you deny their permit. Jasper Arkansas, sewer system and the three park sewer systems are all on the river bank. If these are safe why cannot this same old technology be used by C&H? #2. My second question to you, how many people have refused to float the river because of C.& H. Real numbers. No estimates please.

Commenter: Mitchell Mccutchen

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Chicken litter is regulated by the Arkansas Natural Resources Commission.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity

assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

The Department has noted violations during its inspections of the C&H facility near Mt. Judea, Arkansas. However, those violations have not led to a formal enforcement action by the Department against C&H.

Consideration of tourism is not within the Department's regulatory authority.

Comment: I fully support the decision by the Arkansas Department of Environmental Quality (ADEQ) to deny Regulation 5 permit No. 5264-W, AFIN 51-00164. My support is based on the conclusive technical data and supporting documentation. In addition to ADEQ's "Statement of Basis", the following links provide additional scientific insight that support grounds for denial of this permit: https://buffaloriveralliance.org/resources/Documents/Reg 5 BRWA Denial Comments.pdf https://www.adeq.state.ar.us/water/bbri/c-and-h/pdfs/2018-09-17/Expert Report Aley.pdf

Commenter: John Murdoch

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Comment: ADEQ Please use sound scientific evidence from unbiased U of A study, When making the decision about C&H hog farm reg5 permit and not the opinion of environment elitist. PLEASE EXTEND THE COMMENT PERIOD. Thank You

Commenter: Betty Eddings

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The public comment period was extended seven (7) calendar days until October 24, 2018.

Comment: To the ADEQ Regarding Its Denial of C&H Hog Farm's Regulation 5 Permit Application: I am submitting these comments via email to voice my concern regarding the permitting process for C&H Hog Farm's Regulation 5 permit. These rural farm families, the Henson's and Campbell's, have been operating their family farm operation for more than 5 years with no environmental violations. They are providing needed jobs and tax revenue to the Mt Judea school district in one of the most economically depressed counties in Arkansas. They submitted everything that was requested of them during their first permitting process for the Regulation 6 General CAFO (CAFO) permit as is evidenced by the Department's previous approval of that permit. They originally sought coverage under both the CAFO permit and the Regulation 5 permit; however, after assuring the owners of C&H they would renew the CAFO permit the ADEQ decided to not renew it which left C&H which only its Regulation 5 (Reg 5) permit application. As a tax payer and a life long resident of this great state I do not understand why the ADEQ is changing the rules after their CAFO permit was been granted and the farm constructed. This is unfair and not to the standards that we hold our state agencies and state government workers too. These rural farm families that own and operate C&H Hog Farm have not had any issues that would cause their Reg 5 permit to be denied. They have gone above and beyond in their operation to follow all the requirements requested by the ADEQ. They allowed the drilling of a test hole on their private property to prove that their holding ponds are sound and are built to your standards. These drilling results showed the ponds are not leaking. They worked with the owner of EC Farms, via your permitting process, to obtain additional acres allowing them to land apply their natural fertilizer to even more area which reduces the environmental impact. They attempted to comply with every request for additional information during your review of the response to comments. I understand that some citizens are concerned about Karst topography. Karst topography underlays all of northwest and north central Arkansas from the Arkansas/OKlahoma boarder to the Black River in northeast Arkansas and down to just north of the Arkansas River Valley. Karst topography also exists in several southwest Arkansas counties near the Oklahoma boarder. If Karst topography is going to be used as an "excuse" to deny C&H's Reg 5 Permit then the US National Park Service's (NPS) permit for its sewage treatment

plant's spray field at the Tyler Bend Visitor Center should be revoked as well. That field is underlain by Karst and is mere hundreds of feet from the banks of the Buffalo River. The NPS's NPDES permits at the Buffalo Point Camp Grounds should also be revoked. They actually discharge directly into the Buffalo River and no account exists detailing what they do with the sludge. The cities of Jasper and Marshall also operate WWTPs in the Buffalo River watershed. Maybe those permits should be reconsidered as well. Throughout north central and northwest Arkansas there are potentially hundreds of municipal sewage treatment plants that either use spray irrigation as treatment or discharge directly into "environmentally sensitive" creeks, streams and rivers used by tourists. What do these municipalities do with their WWTP sludges? Do they land apply it? To fields that are underlain by Karst topography? Those permits should be given serious reconsideration as well. Furthermore, at one point there were literally dozens of hog farms, dairies and maybe a few poultry houses with Reg 5 permits in the Buffalo River watershed and hundreds more across northwest and north central Arkansas. Is the Department now saying that they would not issue permits to these farms based on the presence of Karst? What ADEQ has done is bowed down to a small group of very vocal special interest groups, mainly irrational environmentalists and wealthy plutocrats, that say that C&H is "harming the Buffalo. These so called "citizen scientists" have conducted their "own" studies using what should be considered highly questionable sampling protocols, considering their publicly stated agenda of shutting down C&H, in an effort to intentionally slant the results to match their cause. If these so called "citizen scientists" are that concerned with the health and viability of the Buffalo River then they really should care about the environmental impacts caused by the human poo and urine that 1.7 million deposited directly by tourists into the Buffalo River. These deposits no doubt contributed greatly to the summer algae blooms. To address this issue, the Department should use its position of authority on the Beautiful Buffalo River Action Committee to propose that the NPS place limits on the number of individuals allowed to visit the national park and float the Buffalo River. Title 36 of the Code of Federal Regulations gives the NPS superintendent the authority to impose such limits. Implementing a lottery system to allow only a very small portion of these 1.7 million visitors/floaters to the Buffalo River National Park would greatly reduce the nutrient load from canoeists and floaters relieving themselves either in the river, on the banks of the river, in a "cathole" away from the river, or in the very limited number of NPS outhouses. The NPS should also adopt the "red can" policy. It is not a fair allegation or comparison to say that C&H spreading their natural fertilizer over several hundred acres including grass pastures and hay fields that are located several miles away from the main stream of the Buffalo Riverat rates recommended by their nutrient management plan which is based on the Arkansas P-Index (the 2010 revision of which the Department was a participant) is harmful to the Buffalo River. I strongly encourage the Department to allow the Big Creek Research & Extension Team to continue its work and rely on this work rather considering and incorporating questionable data produced by "citizen scientists" with a publicly stated agenda of shutting down C&H. I again request that the ADEQ reconsider its denial and issue a Reg 5 permit to this hog farm which has been operating for 5 years without violations or impact to the Buffalo River. These farmers are just trying to provide a decent living for their families and their workers in a very rural and economically depressed area. Denying C&H this permit sets a precedent that all other Reg 5 permits operating inside the state could be subject to, i.e. the denial of an operating permit when special interest groups don't like what a private land owner/farmer/rancher is doing

on his/her farm. I want to thank the ADEQ for the opportunity to allow public comment on C&H's permit. These are good rural farm families that are doing the right things to provide for an honest living and making a bright future for these multi generational Arkansans.

Commenter: Bob Shofner

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department has noted violations during its inspections of the C&H facility near Mt. Judea, Arkansas. However, those violations have not led to a formal enforcement action by the Department against C&H.

Consideration of tourism and tax revenue is not within the Department's regulatory authority.

The prior permit issued under APC&EC Regulation 6 General Permit ARG590000 and the coverage under that permit tracking number ARG590001 are outside the scope of the current permitting decision. The initial Notice of Intent and the corresponding NMP for coverage under the prior APC&EC Regulation 6 permit tracking number ARG590001 were available for public comment during the 30-day public comment period beginning on June 25, 2012.

The requirements set forth in APC&EC Regulation 5 have not changed.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section

651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Although the analytical data from the C&&H Drilling Study did not indicate a leak at the borehole drilling location at the time of the sampling, the Study does not support the conclusion that there is not any leakage from the ponds.

Seepage from waste storage ponds has the potential to pollute surface and ground water. The record included one recompacted permeability test that is insufficient to determine liner integrity. The necessary soil investigations including, but not limited to, percentage of fines and soil permeability characteristics, have not been performed at this facility in accordance with the AWMFH 651 Table 10-4 and Appendix 10D. Plasticity index analysis was performed on one sample of the *in situ* clay material in boring 2. The variability in the regolith expected in this geologic setting coupled with the insufficient data creates additional concerns about the siting and soil sources for the clay liner. The required number of borings were not advanced within the pool areas in accordance with AWMFH 651.0704(b)(4); these additional borings would have provided more data for assessment of clay source material. Proper soil investigations for the liner material are necessary to determine the suitability and location of the clay source material and to consider any additional geotechnical testing to confirm material properties, which will reduce the potential for downward and/or lateral seepage of the stored wastes.

Pursuant to the Memorandum of Agreement between the Board of Trustees of the University of Arkansas System for and on behalf of the University of Arkansas System-Division of Agriculture and the Arkansas Department of Environmental Quality, the study performed by BCRET is being carried out for the use and

benefit of ADEQ; however, the study shall be funded and conducted independently of ADEQ and shall meet the requirements of an independent study conducted by professionals in the field of water quality.

Pursuant to Ark. Code Ann. § 8-2-202, ADEQ administers an environmental laboratory accreditation program so that laboratories that submit data and analyses to the Department may be accredited by the Department as having demonstrated acceptable compliance with laboratory standards so that the validity of scientific data submitted to the Department may be further assured. All consulting laboratories performing analyses for which results are to be submitted to the ADEQ are required to obtain a laboratory accreditation through ADEQ's Environmental Laboratory Accreditation Program. Ark. Code Ann. § 8-2-206(a)(1)(A)(i). ADEQ's Environmental Laboratory Accreditation Program ensures that data submitted for regulatory, planning, permitting, or other functions will be of acceptable quality.

Pursuant to 40 C.F.R. § 130.7(b)(5), ADEQ assembles and evaluates all existing and readily available water quality data and information, from ADEQ and outside entities, to make water quality standard attainment decisions. Data are evaluated for use by determining adherence (or not) to data quality considerations outlined in the 2018 Assessment Methodology[2], Sections 3.3 and 6.0 and subsections thereof. The primary data used in the assessment of Arkansas's water quality are generated as part of ADEQ's water quality monitoring activities, described in the State of Arkansas's Water Quality Monitoring and Assessment Program, Revision 5 (ADEQ 2013). Additionally, local, state, and federal agencies, and other entities are solicited by ADEQ to provide water quality data that meets or exceeds ADEQ's or USGS' QA/QC protocols. Any entity may submit water quality data to ADEQ without solicitation. All data received will be evaluated for use by determining adherence (or not) to data quality considerations outlined in the 2018 Assessment Methodology.

Data sets that meet all Phase I[3] and Phase II[4] data quality requirements can be used for attainment decisions. Phase I Data Quality Requirements are as follows:

- ► Be characteristic of the main water mass or distinct hydrologic areas. For example, not taken within a mixing zone, side channel, tributary, or stagnant back water, etc.
- ► Be reported in standard units recommended in the relevant approved method and that conform to APC&EC Regulation 2 or can be directly compared or converted to units within APC&EC Regulation 2.
- ► **Have been collected and analyzed under a QA/QC protocol equivalent to or more stringent than that of ADEQ or the USGS**. Data collection protocols should either be readily available or accompany the data. This includes *in situ* data.

- **All laboratory analyzed parameters (not *in situ*) must be analyzed pursuant to the rules outlined in the Environmental Laboratory Accreditation Program Act, Ark. Code Ann. §§ 8-2-201 *et seq.*** The name and location of the laboratory should either be readily available or accompany the data.
- **Be accompanied by precise collection metadata such as time, date, stream name, parameters sampled, chain-of-custody, and sample site location(s)**, preferably latitude and longitude in either decimal degrees or degrees, minutes, seconds.
- Be received in either an Excel spreadsheet or compatible format not requiring excessive formatting by ADEQ
- Have been collected within the period of record for the current assessment cycle.

(emphasis added)

All data used in the 2018 Assessment of the State's water quality met the Phase I and Phase II data quality requirements.

[2] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/final-2018-assessment-methodology.pdf
[3] pages 13–14, 2018 Assessment Methodology
[4] pages 14–15, 2018 Assessment Methodology

Comment: Thank you for the opportunity to comment on the denial of the Regulation 5 permit to C&H Hog Farms. I support ADEQ's "Statement of Basis" in the denial of this permit. I would like to provide additional supporting information to the "statement of basis". "Under Reg. 2.509 Nutrients (A) Materials stimulating algal growth shall not be present in concentrations sufficient to cause objectionable algal densities or other nuisance aquatic vegetation or otherwise impair any designated use of the waterbody. Impairment of a waterbody from excess nutrients is dependent on the natural waterbody characteristics such as stream flow, residence time, stream slope, substrate type, canopy, riparian vegetation, primary use of waterbody, season of the year and ecoregion water chemistry." During the past three years, the Buffalo National River has experienced significant algal blooms primarily downstream of the confluence of the Big Creek at Carver on the Buffalo. I have videotaped these large blooms and posted them on the following You Tube URLs: https://www.youtube.com/watch?v=nSwFXzCBXr0&t=45s https://www.youtube.com/watch?v=sDf02aDFTvI These videos document "objectionable algal densities and other nuisance aquatic vegetation" that should be incorporated into the current "statement of basis" and future ADEQ 303(d) assessments. The videos identify that the Buffalo National River is not meeting the designated use and river impairment is likely due to nutrient contributions from C&H Hog Farms. From 2013-2017, the C&H Hog Farms annual reports noted that almost 14 million gallons of hog waste was deposited in the Big Creek valley. No other source of nutrients in the Buffalo River watershed comes close to the amount of nutrients produced by C&H Hog Farms. In sum, C&H Hog Farms Regulation 6 permit should never have

been approved by ADEQ in 2012. Fortunately, ADEQ has recently analyzed much of the scientific information in denying C&H Hog Farms Regulation 5 permit. Medium and large hog CAFO operations are not sustainable nor compatible in the Buffalo River watershed due to the karst geology and the designated recreational use and Extraordinary Resource Waters status. Please continue on this path of examining the peer reviewed and creditable science by denying any current and future permits for C&H Hog Farms and EC Campbell Farms. Please close this operation immediately. It is unacceptable that C&H Hog Farms has been allowed to continue operating under an almost two-year-old expired Regulation 6 permit. The science is in and this operation is destroying the Buffalo National River, American's first national river. Can't Arkansas do a better job to preserve its natural environment for the health of the river, its people, and its tourism revenue?

Commenter: Teresa A. Turk

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

> Algal blooms have, and continue to, cause concern on the Buffalo River. As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[1]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH,

a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

The prior permit issued under APC&EC Regulation 6 General Permit ARG590000 and the coverage under that permit tracking number ARG590001 are outside the scope of the current permitting decision. The initial Notice of Intent and the corresponding NMP for coverage under the prior APC&EC Regulation 6 permit tracking number ARG590001 were available for public comment during the 30-day public comment period beginning on June 25, 2012.

ADEQ evaluated total phosphorus concentrations in Big Creek according to the 2016 Assessment Methodology[2] and the 2018 Assessment Methodology[3]. For the 2016 assessment cycle, Big Creek (BUFT06, AU 11010005_020) mean total phosphorus and total nitrogen were 0.026 mg/L and 0.33mg/L, respectively. The assessment methodology for APC&EC Reg. 2.509 screens the monitoring station's mean total phosphorus and total nitrogen concentration to the 75th percentile for a given ecoregion for the assessment cycle period of record. Screening values for the Boston Mountain ecoregion for 2016 total phosphorus and total nitrogen were 0.036 mg/L and 0.46 mg/L, respectively. The 2018 screening values were 0.036 mg/L and 0.55 mg/L for total phosphorus and total nitrogen. The mean values for 2018 for BUFT06 were 0.028 mg/L total phosphorus and 0.297 mg/L total nitrogen. All mean total phosphorus and total

nitrogen for Big Creek were below the Boston Mountain ecoregion 75th percentile. At this time, neither the Buffalo National River nor Big Creek have been identified as impaired for phosphorus based on the EPA-approved Assessment Methodology.
[2] https://www.adeq.state.ar.us/water/planning/integrated/assessment/pdfs/2016-assessment-methodology-draft-04apr16-305b.pdf
[3] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/final-2018-assessment-methodology.pdf

Consideration of tourism is not within the Department's regulatory authority.

Comment: One thing that really concerns me is the lack of evidence that lead to the denial of this permit. Big Creek was proposed to be placed on the 303(d) list as a result of high contamination levels. My question is who took this sample, and Why is it so much higher than the samples taken by The Big Creek Research Team? Did this sample go through the same scrutiny and peer review of their testing methods as others? This is a dangerous precedent to set. Can I walk the 1/2 mile from my house to the creek and take samples? Should my samples be used to make decisions when there are peer reviewed and heavily scrutinized researchers that are collecting data?

Commenter: Dustin Cowell

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Pursuant to Ark. Code Ann. § 8-2-202, ADEQ administers an environmental laboratory accreditation program so that laboratories that submit data and analyses to the Department may be accredited by the Department as having demonstrated acceptable compliance with laboratory standards so that the validity of scientific data submitted to the Department may be further assured. All consulting laboratories performing analyses for which results are to be submitted to the ADEQ are required to obtain a laboratory accreditation through ADEQ's Environmental Laboratory Accreditation Program. Ark. Code Ann. § 8-2-206(a)(1)(A)(i). ADEQ's Environmental Laboratory Accreditation Program ensures that data submitted for regulatory, planning, permitting, or other functions will be of acceptable quality.

Pursuant to 40 C.F.R. § 130.7(b)(5), ADEQ assembles and evaluates all existing and readily available water quality data and information, from ADEQ and outside entities, to make water quality standard attainment decisions. Data are evaluated for use by determining adherence (or not) to data quality considerations outlined

in the 2018 Assessment Methodology[1], Sections 3.3 and 6.0 and subsections thereof. The primary data used in the assessment of Arkansas's water quality are generated as part of ADEQ's water quality monitoring activities, described in the State of Arkansas's Water Quality Monitoring and Assessment Program, Revision 5 (ADEQ 2013). Additionally, local, state, and federal agencies, and other entities are solicited by ADEQ to provide water quality data that meets or exceeds ADEQ's or USGS' QA/QC protocols. Any entity may submit water quality data to ADEQ without solicitation. All data received will be evaluated for use by determining adherence (or not) to data quality considerations outlined in the 2018 Assessment Methodology.

Data sets that meet all Phase I[2] and Phase II[3] data quality requirements can be used for attainment decisions. Phase I Data Quality Requirements are as follows:

- Be characteristic of the main water mass or distinct hydrologic areas. For example, not taken within a mixing zone, side channel, tributary, or stagnant back water, etc.
- Be reported in standard units recommended in the relevant approved method and that conform to APC&EC Regulation 2 or can be directly compared or converted to units within APC&EC Regulation 2.
- **Have been collected and analyzed under a QA/QC protocol equivalent to or more stringent than that of ADEQ or the USGS**. Data collection protocols should either be readily available or accompany the data. This includes *in situ* data.
- **All laboratory analyzed parameters (not *in situ*) must be analyzed pursuant to the rules outlined in the Environmental Laboratory Accreditation Program Act, Ark. Code Ann. §§ 8-2-201 *et seq.*** The name and location of the laboratory should either be readily available or accompany the data.
- **Be accompanied by precise collection metadata such as time, date, stream name, parameters sampled, chain-of-custody, and sample site location(s)**, preferably latitude and longitude in either decimal degrees or degrees, minutes, seconds.
- Be received in either an Excel spreadsheet or compatible format not requiring excessive formatting by ADEQ
- Have been collected within the period of record for the current assessment cycle.

(emphasis added)

All data used in the 2018 Assessment of the State's water quality met the Phase I and Phase II data quality requirements.

[1] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/final-2018-assessment-methodology.pdf
[2] pages 13–14, 2018 Assessment Methodology

[3] pages 14–15, 2018 Assessment Methodology

Comment: Thank you for the opportunity to comment on the draft denial for permit application #5264-W. I support ADEQ's proposed decision to deny C & H Hog Farms' permit application after determining that the record lacks necessary and critical information to support granting of the permit, and the record contains information that the operation of this facility may be contributing to water quality impairments of waters of the state. ADEQ's proposed decision to deny the permit application, which incorporates but is not limited to the science-based information contained in the expert reports, expert depositions, and Big Creek Research and Extension Team (BCRET) data, indicates the following with regard to the C & H Hog Farm facility: • karst-highly permeable foundations- at the site of the C & H Hog Facility • increased nitrate-N in both the ephemeral stream and the house well, which suggests hydrological connections to areas where farm activities take place • BCRET study does not qualify in any regard as a geologic study • potential for groundwater contamination • void/fracture beneath the ponds • a liner does not protect against a collapse in the event of a large void in karst • potential for sinkholes to open up with collapsing ground or cause differential settlement • seepage is the same thing as a leak • a leak could occur when the pond is pumped down periodically to remove the waste and get the solids • C & H facility may be contributing to water quality impairments of Big Creek and the Buffalo National River ADEQ states that the ultimate aim of the Arkansas Pollution Control and Ecology Commission (APC&EC) and the Animal Waste Management Field Handbook (AWMFH) is that pollutants are not being released from the facility and its operations, into waters of the State. ADEQ's inclusion of the waterbody impairment issue with respect to the existing point source facility and its operations has brought the ARG590001 permit into full scope of the draft denial decision for permit application 5264-W. Therefore, to achieve the ultimate aim that pollutants are not being released from the facility and its operations into waters of the state, I urge that ADEQ not only to take immediate action with regard to a thorough geologic investigation as outlined in the Statement of Basis, but that it adhere to its legal obligation and conduct an immediate and thorough investigation to identify any and all unauthorized illegal discharges from C & H Hog Farm - NPDES Permit ARG590001- to impaired waterbodies.

Commenter: Dane Schumacher

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Issues related to ARG590001 are outside the scope of this permitting decision.

Each permit applicant is responsible for submitting all information in support of its application, including any required geologic investigations.

Comment: I am writing in support of ADEQ granting a permit to C&H Hog Farm. As a Reg 5 permit holder with a dairy in Arkansas, I feel that I have a grasp of what it takes to obtain a permit. It is a necessary process that not everyone is willing to endure. The dairy industry is suffering all over, but Arkansas has lost 90% of its farms in the last 15 or so years. With under 50 left in the state we have become a milk deficit area. This has created extra strain on our state's dairy farmers because the cost of importing milk to meet supply has fallen on our shoulders without any avenue to make up for those costs. You may wonder why this is relevant to a permit for a hog farm a few counties away. More dairies in our state would help alleviate the milk deficit which would keep us from shipping out of state milk into our area, relieving us from extra shipping costs that we are forced to carry. As of late there have been dairy farmers from Georgia, Texas and New Mexico that have considered relocating to Arkansas. After researching and seeing how ADEQ has handled C&H's Reg 5 permit, they have decided to stay put or have chosen another state; in the most recent case, Missouri. It has been said that this "reinterpretation" of requirements won't affect other farms, but it already has. It has deterred growth and development that would have alleviated some pressure on an already strained dairy industry. Floating goal posts are a game nobody wants to gamble their livelihoods on. ADEQ knows the history of this family and this farm. You are aware of the many generations of famers that have competently cared for their land. They have passed down the land and the farms to their family with full confidence that they would do what is best for the land and the surrounding treasures. They have exceeded that expectation. I am beyond saddened by what this family has endured in the name of "environmentalism" and people who are only fueled by feelings while being completely immune to scientific facts and results of intense environmental studies. These families care for their surroundings. The proof is in the way they went above and beyond to secure their state of the art facility. You are fully aware of the fiery hoops they have and continue to jump through. It is a waste of time and resources to have this cycle continued over and over. I could write a novel on the facts. I could also appeal to your feelings when it comes to this farm. At the end of the day this decision will come down to doing what is right or wrong for our state's agricultural community, economy, and residents. Agriculture is a huge contributor to Arkansas' economy. We have proven our ability to be conservationists and farmers. We have tried to bring in new farms that stimulate the economy and provide jobs. I can assure you, not allowing this farm to move forward with what their family has spent generations building, will cause harm to the future of agriculture, not only already established farms, but most certainly to anyone looking to build in this state. This will, without a doubt, set precedence that will alter the future of agriculture. Our society has resorted to allowing a loud minority to dictate what is and is not allowed. We have quit using what is real and solid and replaced it with what ifs and bad feelings. Continuing down that path will lead to the destruction of what many before us sacrificed everything to build. We have to be able to use real life, science, and facts to make decisions. There is no doubt that this decision has more players than any of us can imagine. You have pressure from every angle, but someone has to hold on to doing the right thing. Protests fade, focus shifts, the noise dies down, the river is and will continue to be cared for, but stealing from these farmers what many generations have built for the future of their family, based on the feelings of a few who have nothing to lose, will not only steal a legacy, but any faith the

agricultural community has in the organizations that are supposed to help and guide us. Please don't be overwhelmed by the amount of comments. Don't be shaken by the politics. Don't allow the credibility and respect that has been built between agriculture and ADEQ relationships be crumbled. You know how you eat an elephant? One bite at a time. Take this case apart, once more. Look at every piece. Look at the family, their dedication, their farm plan, the engineering, the science and facts that have come from studies beyond what anyone else has ever submitted to, look at how this has already affected agriculture in our state, and come to a conclusion. Then, factor comments based on facts vs feelings. Give credit where it is due and disregard what isn't relevant. Pull out the politics and the pressure. Please, consider this from a standpoint of facts, real life, and economic impact. Your decision will not alter the fate of the Buffalo River, we've already proven this farm poses no risk, but it will alter the future of Arkansas agriculture as well as your relationship with it, and the life of a family that has given many generations of conservation efforts to preserve their heritage as well as a treasured river.

Commenter: Cassie Davis

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Consideration of the economy is not within the Department's regulatory authority.

ADEQ does not regulate all types of farming operations. The Department's permitting decision for this APC&EC Regulation 5 Individual No Discharge permit application pertains only to this individual permit application for a liquid animal waste management system, not all farming operations. Applications for Regulation 5 permits are evaluated according to Regulation 5 requirements.

The Department has noted violations during its inspections of the C&H facility near Mt. Judea, Arkansas. However, those violations have not led to a formal enforcement action by the Department against C&H.

ADEQ must follow its regulations. ADEQ cannot issue a permit if the permit application does not meet the requirements of the applicable regulation. APC&EC Regulation 5 requires the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. ADEQ has determined that a detailed geological investigation of the facility is required because karst includes highly permeable foundations with the associated potential for groundwater contamination and potential for sinkholes to open up with collapsing ground or cause differential settlement. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies, i.e. karst, that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm

integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. Additionally, ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of two segments of Big Creek and two segments of the Buffalo National River as impaired further illustrates the need for these detailed studies.

Comment: 1.) What are the current nitrate levels and historic nitrate levels over the last 46-47 years since designation of the Buffalo River as a National River? 2.) Could it have been the rain event of 2017 followed by the dry period of 2018? Are there any barriers preventing decomposing material from entering waterways? 3.) Have we seen an uptick in nitrate and phosphate levels as a result of increased ecotourism since the declaration of the Buffalo River as a national river? Are there any containment zones preventing pollutants from surface runoff as a result of ecotourism? 4.) Have we seen hard evidence that C&H Hog Farms is producing any elevated levels of nitrates and phosphates? 5.) Have we really looked at all the contributing factors in the watershed or are we harassing one entity based on the emotion of fellow citizens that dont have a full and accurate understanding of the history behind the livelihoods that were an integral part in the management of the pristine land and waters associated with all the settlements along the Buffalo River? Are there any containment zones and prevention measures being taken to prevent excess levels of nitrates through surface runoff? 6.)Why is C&H Hog Farms the only entity in the spotlight?

Commenter: Pam Schmick

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Beautiful Buffalo River Action Committee (BBRAC) has been established for the purpose of addressing potential water-quality concerns throughout the Buffalo River Watershed and to protect the vitality of the Buffalo National River as a national, state, and local landmark. Governor Asa Hutchinson directed five agencies to develop an Arkansas-led approach to identify and address potential

issues of common concern in the watershed. A key priority of BBRAC was to initiate the development of a Buffalo River Watershed Management Plan. The nine-element watershed management plan was developed for the Buffalo River Watershed, and the final plan was submitted and accepted by EPA in June 2018. Watershed management plans are recognized by EPA as comparable, state-led management approaches expected to result in the attainment of water-quality standards.

In the April 1 to June 30, 2018 Quarterly Report, BCRET presents data that documents a statistically significant increase of nitrate-N in the ephemeral stream (BC4) since 2014. However, BCRET notes that chloride, a conservative tracer, did not show a statistically significant increase. Four years of data also indicate a steady increase of geometric mean nitrate-N within the house well (W1) (BCRET April–June 2018, Figure 24). Increased nitrate-N in both the ephemeral stream and the house well does suggest that these systems may be hydrologically connected to areas where farm activities take place. APC&EC Regulation 5 requires the design and waste management plans for liquid animal waste management systems be in accordance with the AWMFH. ADEQ has determined that a detailed geological investigation of the facility is required because karst includes highly permeable foundations with the associated potential for groundwater contamination and potential for sinkholes to open up with collapsing ground or cause differential settlement. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies, i.e. karst, that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. Detailed geologic investigations, including a groundwater flow direction study, are necessary to determine that the ephemeral stream and house well are not influenced by the waste storage holding ponds, on-farm activities, or waste management practices.

BCRET data document that nitrate-N is variable; however, Figure 12 of the April 1 to June 30, 2018 BCRET Quarterly Report demonstrates that nitrate-N is higher downstream (BC7) than upstream (BC6). Chlorides and nitrates follow similar seasonal fluctuations in that they are higher during summer and autumn months when stream discharge is most influenced by groundwater. ADEQ reviewed Jim Petersen's May 31, 2018 expert report, which presents an analysis of temporal trends among nitrate-N and E. coli from January 2014–December 2017 at BC6 and BC7. Mr. Petersen's analysis presents decreasing trends of ammonia and chlorides and increasing concentrations of E. coli at BC6. Yet, increasing concentrations of nitrate-N were observed downstream at BC7. The conflicting temporal analysis prompted Mr. Petersen to further review trends upstream to downstream. By analyzing paired concentration data (collected same day) at BC6 and BC7 from January 2014 through December 2017, Mr. Petersen reports significant increases in total nitrogen, ortho-phosphorus, and chlorides, but non-

significant changes in E. coli and nitrate-N. The significant increase of nitrate-N in the house well and ephemeral stream does correspond to increases of total nitrogen at BC7. Mr. Petersen's analysis illustrates the complexities of evaluating water chemistry in karst systems.

Data supplied from the C&H Hog Farms, Inc. 2014–2017 annual reports document an increase of soil test phosphorus (STP) from 20 ppm to 68 ppm in Field 17 to a more significant increase in Field 1, which increased from 45 ppm to 173 ppm. As stated in University of Arkansas Division of Agriculture Soil Phosphorus: Management and Recommendations FSA1029[2], "Arkansas scientists agree that there is no agronomic reason or need for STP to be greater than about 50 ppm (Mehlich-3 extraction)." However, "with the move from agronomic to environmental concerns with P, soil P testing has been used to indicate when P enrichment of runoff may become unacceptable. A common approach has been to use agronomic soil P standards, following the rationale that soil P in excess of crop requirements is vulnerable to removal by surface runoff or leaching" (FSA1029). "A large amount of research between 1985 and 2000, showed that as STP (Soil Test Phosphorous) increased, especially in the top 2–4 inches of soil, so did the concentrations of soluble P in runoff (Figure 1)" (FSA1029).

As of the C&H Hog Farms, Inc. 2017 Annual Report, results of all soil test phosphorus were greater than 50 ppm. Despite a reported increase of soil test phosphorus in waste application fields, pursuant to NRCS Code 590, the Arkansas Phosphorus Index may still allow application of swine waste because of other factors including phosphorus source potential, transport potential, and best management practice multipliers. FSA9516[1] states that the phosphorus index approach is most appropriate as it accounts for multiple risk factors and provides a better risk assessment of P loss in runoff.

Geotechnical investigations at all land application sites in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3 are necessary to ensure the efficacy of the API and demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River by rapid infiltration through highly permeable or thin soils.

[1] https://www.uaex.edu/publications/PDF/FSA-9516.pdf
[2] https://www.uaex.edu/publications/pdf/FSA-1029.pdf

Consideration of tourism is not within the Department's regulatory authority.

Comment: I'd like to start by saying: I am not for/nor against the C&H farm, because I do not feel informed well enough to make a decision. Ridicule me if you must, but I hope this farm and the heated discussion serve as a testament to the importance of agricultural communicators. I

grew up in Newton County, went away to college, and have returned to serve our community through the Cooperative Extension Service. I am conscious of the employment challenges of our area, and share the farmers' desire to keep our livelihood close to home. I am also conscious of the karst geology of this area, and the challenges related to tracking the underground passages. I love our natural resources and the preservation of such for generations to come... I would like to see an objective portrayal of the C&H hog farm issue and attached ideals. What is the fight about? The first commercialized farm in a county recognized for un-manned beauty? The fear of compromising our water system(s)? The addition of hog waste to soils of hay fields and pastures? Although I am a native (somewhat) to this area – I have not followed this issue closely. I have been busy working to learn the methods of agricultural communicators and extension educators. Where are the objective communicators and educators for this issue? I see/hear the polarities associated with the issue, but why isn't there information available to the common person without the added heat? Where is the common ground? Where is the desire to draw consumers closer to farmers rather than spreading fear and uncertainty? Where is the protection of the public with respect to farming practice and awareness? At this point, I feel I would need to conduct a rigorous research project to track down information related to this issue to develop a summary. And, thereby, develop an educated opinion. Why is the common person responsible for scratching up resources to learn about a topic so close to home? I believe the responsibility for the public to become educated about agricultural topics is an added quake in the fractured connection between growers and consumers. Also in this case, local stakeholders.

Commenter: Fawn Kurtzo

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Statement of Basis for this permitting decision is located at https://www.adeq.state.ar.us/water/bbri/c-and-h/pdfs/20180917-statement-of-basis.pdf.
The following sources were used in the development of the Statement of Basis:
1. APC&EC Regulation No. 8, Administrative Procedures, as amended.
2. APC&EC Regulation No. 9, Fee System for Environmental Permits, as amended.
3. APC&EC Regulation No. 5, Liquid Animal Waste Management Systems, as amended.
4. Water and Air Pollution Control Act, Ark. Code Ann. § 8-4-101 et seq.
5. Application for permit No. 5264-W received April 7, 2016.
6. NMP dated April 6, 2016.
7. Additional information received on June 29, 2016.
8. Additional information received on December 6, 2017.
9. Additional information received on December 26, 2017.
10. Additional information received on December 29, 2017.

11. C&H Drilling Study report by Harbor Environmental and Safety, Inc. dated December 2016, as amended.
12. Agricultural Waste Management Field Handbook, as amended.
13. Additional resources at the following link:
https://www.adeq.state.ar.us/home/pdssql/p_permit_details_water_spb.aspx?AFINDash=51-00164&AFIN=5100164&PmtNbr=5264-W

Comment: The board of the Pope County Conservation District appreciates the opportunity to make a public comment in support of the C&H Hog Farm regarding the denial of the Regulation 5 permit. Being located in an adjacent county that is a direct route to the Buffalo River, we are aware of the impact that could affect our tourism dollars in Pope County if the Buffalo River was to become an undesirable and unusable recreation site. The Buffalo River is a great tourist attraction with a large number of visitors, and their pets, floating the river without the benefit of sanitary facilities, using campgrounds that rely on septic systems for disposal for human waste, the lodging/cabins and other agriculture interest. All of these things can and do add to the pristine condition of the streams and rivers. Have these things been considered and balanced in the equation? We have watched with great interest the proceedings, comments, accusations and meetings concerning this farm. It would appear that the owners of C&H have gone above and beyond to meet the requirements as they knew them to be when they initially applied for the Reg 5 permit. It also appears that, due to certain groups, the process has changed along the way at great expense to the owners The Board of the Pope County Conservation District respectfully requests that ADEQ reconsider the denial of this permit and work with the owners to eliminate any known, scientifically proven issues that exist, leaving behind the emotionally charged "what if's" and theoretical possibilities that are not based on data that has been required of agriculture users in the past. Please accept this correspondence of our unanimous support of C&H Hog Farm and the issuance of their permit.

Commenter: Pope County Conservation District

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

APC&EC Regulation 5 requirements, specifically the requirements in APC&EC Regulation 5.402, have not changed. The application submitted for this permit, including supplemental information, did not satisfy the requirements of APC&EC Regulation 5.

Consideration of tourism is not within the Department's regulatory authority.

ADEQ must follow its regulations. APC&EC Regulation 5 requires the designs and waste management plans for liquid animal waste management systems to be

in accordance with the AWMFH. The permit application record lacks the requisite information to evaluate the permit application for compliance with APC&EC Regulation 5. ADEQ cannot issue a permit when the permit application does not meet the requirements of the applicable regulation.

Comment: I respectfully ask that you honor the work of scientific experts, follow the facts, and protect the Buffalo National River by issuing the final denial of C&H Hog Farm, Inc.'s application for a Regulation 5 Permit. Arkansas Department of Environmental Quality (ADEQ) has done its work. Now it is up to you! ADEQ has determined that the application C&H filed for a Regulation 5 Permit fails to provide detailed and critical information required by the State's Liquid Animal Waste Management Systems. The state of Arkansas can take a giant step in protecting the health of the Buffalo River and the health of thousands of visitors and residents who enjoy America's first national river. Please stand by the state's preliminary decision and deny C&H's application for a Regulation 5 Permit once and for all. Thank you for the opportunity to submit comments to help protect the Buffalo.

Commenter: NPCA; Individual comments are available in file 5264-W_NPCA Group Comment on Draft Denial_2018 under https://www.adeq.state.ar.us/home/pdssql/p-response-20181116.aspx

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department considered all available scientific data and information from, but not limited to, BCRET, United States Geological Survey, University of Arkansas Department of Agriculture, and ADEQ in making this permitting decision.

Comment: As a concerned citizen who cares about the water quality of the Buffalo River, I am writing to express my support for ADEQ's draft decision to deny C&H Hog Farm's Regulation 5 permit application. I believe that the permit application should be denied for the following reasons: 1. The Buffalo River is home to at least four species of wildlife that are listed as endangered or threatened. The excess nutrient runoff from C & H Farm and the resulting disruption of the aquatic ecosystem are a serious threat to all Ozark wildlife and especially those species that are already in trouble. 2. There is now clear scientific evidence of a negative environmental impact to the Buffalo River Watershed. The damage is attributable to nutrient overloading within the last few years. ADEQ has established its proposed 2018 impaired waterbodies list, and has placed four impaired Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) as impaired waterbodies. 3. C&H Hog farm has not complied with requirements, especially those that pertain to karst locations, and this has increased the impairment of the Buffalo National River and its tributary,

Big Creek, along which C&H is located. 4. The presence of karst makes the location of this hog factory particularly troublesome. Dye trace studies have shown that a maze of interconnected pathways exist in the area where C&H is located. Only one core sample was obtained at the site of the facility when at a minimum three were recommended by experts. The one core sample that was taken strongly suggests the possible presence of voids under the hog waste storage ponds. I support the ADEQ denial of the C&H Hog farm permit. The proposed listing of Big Creek and the Buffalo National River as impaired waterbodies, the statistically significant increase of nitrate-N in the ephemeral stream and house well, and the increase of STP in all land application fields receiving waste further illustrate the need for the C&H Hog CAFO to be denied a permit to operate in the Buffalo National River watershed.

Commenter: Cody Hughes

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department acknowledges the following statements from the Buffalo River Watershed-Based Management Plan dated May 22, 2018, regarding threatened and endangered species in the Buffalo River watershed:

> The Buffalo River and its tributaries are considered high quality water resources. The Buffalo River and its tributaries support over fifty (50) species of fish and over twenty (20) species of mussels. Portions of the Buffalo River have been designated critical habitat for the threatened Rabbitsfoot mussel, *Quadrula cylindrical cylindrical* (State/Federal Status: Endangered/Threatened, respectively). The watershed also includes important habitat for endangered bat species: Gray Bat, *Myotis grisescens* (State/Federal Status: Endangered); Indiana Bat, *Myotis sodalis* (State/Federal Status: Endangered); Ozark Big-eared Bat, *Corynorhinus townsendii ingens* (State/Federal Status: Endangered); and Northern Long-eared Bat, *Myotis septentrionalis* (State/Federal Status: Endangered/Threatened, respectively). Cave and other karst features in the Buffalo River watershed are important habitats for all of the protected bat species.[1]

However, the Department did not receive any comments during the comment period ending on October 24, 2018, regarding endangered or threatened species and their associated habitats from Arkansas Game & Fish Commission, Arkansas Natural Heritage Commission, or U.S. Fish and Wildlife Service.

ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

The Department does not have a clear understanding regarding your statement about core samples, and thus, cannot provide a response.

The Department acknowledges the statements made that reiterate statements in the Statement of Basis.

Comment: See Attached: BRWA

Commenter: Buffalo River Watershed Alliance

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Rule-making regarding a permanent moratorium is outside the scope of this permitting decision.

ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. ADEQ has determined that a detailed geological investigation of the facility is required because karst includes

highly permeable foundations with the associated potential for groundwater contamination and potential for sinkholes to open up with collapsing ground or cause differential settlement. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Seepage from waste storage ponds has the potential to pollute surface and ground water. The record included one recompacted permeability test that is insufficient to determine liner integrity. The necessary soil investigations including, but not limited to, percentage of fines and soil permeability characteristics, have not been performed at this facility in accordance with the AWMFH 651 Table 10-4 and Appendix 10D. Plasticity index analysis was performed on one sample of the *in situ* clay material in boring 2. The variability in the regolith expected in this geologic setting coupled with the insufficient data creates additional concerns about the siting and soil sources for the clay liner. The required number of borings were not advanced within the pool areas in accordance with AWMFH 651.0704(b)(4); these additional borings would have provided more data for assessment of clay source material. Proper soil investigations for the liner material are necessary to determine the suitability and location of the clay source material and to consider any additional geotechnical testing to confirm material properties, which will reduce the potential for downward and/or lateral seepage of the stored wastes.

Additionally, NRCS, in Appendix 10D of the AWMFH, indicates that special design measures are necessary where agricultural waste storage ponds are constructed in soils with high calcium content (BCRET Quarterly Report for October 2016 to December 2016, Table 10, page 71) or highly unfavorable geologic conditions, such as karst formations.

C&H Hog Farms, Inc. submitted an Emergency Action Plan to the Department on October 23, 2018. The Emergency Action Plan did not address possible failure of the liner resulting from potential damage, such as pumping and agitation, liner desiccation, or any other site-specific operational risks are not addressed, in accordance with AWMFH 651.0204(a), (b).

The Department reviews all buffers to ensure that the applied buffers are in accordance with the buffer distances proscribed in APC&EC Regulation 5.406(D).

NRCS's Web Soil Survey provides a general guide to soil characteristics and ground-truthing is necessary to confirm those soil characteristics. Walking the fields cannot provide the data necessary to evaluate the fields in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3. The ground penetrating radar studies[2] at Fields 1, 5, and 12 indicated that land application to those fields should be limited in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3. The ground penetrating radar studies suggest that these fields have characteristics identified in AWMFH 651.0504 (a)–(n) and Table 5-3, such as areas of higher permeability, thin soils of less than twenty (20) inches (see excerpts from the ERI Study below), and soils with a significant fractions of rock fragments preventing some soils samples from being taken. The limitations for land application sites based on these soil characteristics are part of the AWMFH with the purpose of preventing contamination of ground water. Geotechnical investigations of the land application fields are necessary to account for the soils characteristics that require limitations on animal waste application.

[2] As part of the BCRET study, USDA, NRCS conducted Ground Penetrating Radar (GPR) Surveys for Fields 1 and 5 in November of 2013 and Field 12 in April of 2014.

Field 5a exhibits average soil thicknesses of 0.5 to 4.5 meters (1.5 to 14.75 feet). Field 12 is a low-lying grazing area with low relief and an uneven topsoil surface. Field 12 exhibits similar average soil thicknesses at 0.7 to 4 meters (2.25 to 13 feet). Field 1 shows an average soil thickness of 0.5 meters (1.5 feet) determined from the ERI surveys and soil sampling. Field 1 has thinner and rockier soils than either Fields 5a or 12. In Field 12, there appears to be a large doline feature (a closed topographic depression caused by dissolution or weathering of underlying rock or soil) within the bedrock, approximately 61 meters (200 feet) across at the

top of the feature, starting 8 meters (26 feet) below the land surface and extending 23 meters (75 feet) vertically downward.[3] Geotechnical investigations of the land application fields are necessary to account for the soils characteristics that require limitations on animal waste application.

[3] Jon Fields and Todd Halihan, Electrical Resistivity Surveys of Applied Hog Manure Sites, Mount Judea, AR (2015).

Data supplied from the C&H Hog Farms, Inc. 2014–2017 annual reports document an increase of soil test phosphorus (STP) from 20 ppm to 68 ppm in Field 17 to a more significant increase in Field 1, which increased from 45 ppm to 173 ppm. As stated in University of Arkansas Division of Agriculture Soil Phosphorus: Management and Recommendations FSA1029[4], "Arkansas scientists agree that there is no agronomic reason or need for STP to be greater than about 50 ppm (Mehlich-3 extraction)." However, "with the move from agronomic to environmental concerns with P, soil P testing has been used to indicate when P enrichment of runoff may become unacceptable. A common approach has been to use agronomic soil P standards, following the rationale that soil P in excess of crop requirements is vulnerable to removal by surface runoff or leaching" (FSA1029). "A large amount of research between 1985 and 2000, showed that as STP (Soil Test Phosphorous) increased, especially in the top 2–4 inches of soil, so did the concentrations of soluble P in runoff (Figure 1)" (FSA1029).

As of the C&H Hog Farms, Inc. 2017 Annual Report, results of all soil test phosphorus were greater than 50 ppm. Despite a reported increase of soil test phosphorus in waste application fields, pursuant to NRCS Code 590, the Arkansas Phosphorus Index may still allow application of swine waste because of other factors including phosphorus source potential, transport potential, and best management practice multipliers. FSA9516[5] states that the phosphorus index approach is most appropriate as it accounts for multiple risk factors and provides a better risk assessment of P loss in runoff.

Geotechnical investigations at all land application sites in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3 are necessary to ensure the efficacy of the API and demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River by rapid infiltration through highly permeable or thin soils.

[4] https://www.uaex.edu/publications/PDF/FSA-9516.pdf

[5] https://www.uaex.edu/publications/pdf/FSA-1029.pdf

ADEQ evaluated total phosphorus concentrations in Big Creek according to the 2016 Assessment Methodology[6] and the 2018 Assessment Methodology[7]. For the 2016 assessment cycle, Big Creek (BUFT06, AU 11010005_020) mean

total phosphorus and total nitrogen were 0.026 mg/L and 0.33mg/L, respectively. The assessment methodology for APC&EC Reg. 2.509 screens the monitoring station's mean total phosphorus and total nitrogen concentration to the 75th percentile for a given ecoregion for the assessment cycle period of record. Screening values for the Boston Mountain ecoregion for 2016 total phosphorus and total nitrogen were 0.036 mg/L and 0.46 mg/L, respectively. The 2018 screening values were 0.036 mg/L and 0.55 mg/L for total phosphorus and total nitrogen. The mean values for 2018 for BUFT06 were 0.028 mg/L total phosphorus and 0.297 mg/L total nitrogen. All mean total phosphorus and total nitrogen for Big Creek were below the Boston Mountain ecoregion 75th percentile. At this time, neither the Buffalo National River nor Big Creek have been identified as impaired for phosphorus based on the EPA-approved Assessment Methodology.
[6] https://www.adeq.state.ar.us/water/planning/integrated/assessment/pdfs/2016-assessment-methodology-draft-04apr16-305b.pdf
[7] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/final-2018-assessment-methodology.pdf

The prior permit issued under APC&EC Regulation 6 General Permit ARG590000 and the coverage under that permit tracking number ARG590001 are outside the scope of the current permitting decision. The initial Notice of Intent and the corresponding NMP for coverage under the prior APC&EC Regulation 6 permit tracking number ARG590001 were available for public comment during the 30-day public comment period beginning on June 25, 2012.

In the April 1 to June 30, 2018 Quarterly Report, BCRET presents data that documents a statistically significant increase of nitrate-N in the ephemeral stream (BC4) since 2014. However, BCRET notes that chloride, a conservative tracer, did not show a statistically significant increase. Four years of data also indicate a steady increase of geometric mean nitrate-N within the house well (W1) (BCRET April–June 2018, Figure 24). Increased nitrate-N in both the ephemeral stream and the house well does suggest that these systems may be hydrologically connected to areas where farm activities take place. APC&EC Regulation 5 requires the design and waste management plans for liquid animal waste management systems be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies, i.e. karst, that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. Detailed geologic investigations, including a groundwater flow direction study, are necessary to determine that the ephemeral stream and house well are not influenced by the waste storage holding ponds, on-farm activities, or waste management practices.

BCRET data document that nitrate-N is variable; however, Figure 12 of the April 1 to June 30, 2018 BCRET Quarterly Report demonstrates that nitrate-N is higher downstream (BC7) than upstream (BC6). Chlorides and nitrates follow similar seasonal fluctuations in that they are higher during summer and autumn months when stream discharge is most influenced by groundwater. ADEQ reviewed Jim Petersen's May 31, 2018 expert report, which presents an analysis of temporal trends among nitrate-N and E. coli from January 2014–December 2017 at BC6 and BC7. Mr. Petersen's analysis presents decreasing trends of ammonia and chlorides and increasing concentrations of E. coli at BC6. Yet, increasing concentrations of nitrate-N were observed downstream at BC7. The conflicting temporal analysis prompted Mr. Petersen to further review trends upstream to downstream. By analyzing paired concentration data (collected same day) at BC6 and BC7 from January 2014 through December 2017, Mr. Petersen reports significant increases in total nitrogen, ortho-phosphorus, and chlorides, but non-significant changes in E. coli and nitrate-N. The significant increase of nitrate-N in the house well and ephemeral stream does correspond to increases of total nitrogen at BC7. Mr. Petersen's analysis illustrates the complexities of evaluating water chemistry in karst systems.

While no losing/gaining study has been performed to date on Big Creek between BC6 and the confluence with the Buffalo National River, BCRET notes seasonal dryness and rewatering between these two sites. Thomas Aley notes in his expert report of May 24, 2018, that "Big Creek also goes dry during much of the year where it passes over the Boone Formation near C&H Hog Farms." Dye studies performed by Brahana et al. (2016, 2017)[8] and hydrologic studies by Murdoch et al. (2016)[9] in the Big Creek watershed identify potential confounding factors that make direct upstream to downstream comparisons difficult, particularly given the uncertainty that comes with the connectivity of karst hydrology. Groundwater upwelling can greatly influence ionic composition, nutrient concentration, and dissolved oxygen concentrations (Kresse et al. 2014, Cox et al. 2007, Soulsby et al. 2009, Robertson, et al. 2013, Justus et al. 2016).[10]

[8] Brahana, V., J. Nix, C. Kuyper, T. Turk, F. Usrey, S. Hodges, C. Bitting, K. Ficco, E. Pollock, R. Quick, and others. 2016. Geochemical Processes and Controls Affecting Water Quality of the Karst Area of Big Creek near Mt. Judea, Arkansas. Journal of the Arkansas Academy of Science 70:45–58.

Brahana, V., C. Bitting, K. Kosic-Ficco, T. Turk, J. Murdoch, B. Thompson, and R. Quick, 2017, Using fluorescent dyes to identify meaningful water-quality sampling locations and enhance understanding of groundwater flow near a hog CAFO on mantled karst—Buffalo National River, southern Ozarks: *in* Kuniansky, E.L., and Spangler, L.E., eds., U.S. Geological Survey Karst Interest Group Proceedings, San Antonio, Texas, May 19-23, 2017, U.S. Geological Survey Scientific Investigations Report 2017-5023, p. 147-160.

[9] Murdoch, J., C. Bitting, and J. Van Brahana. 2016. Characterization of the karst hydrogeology of the Boone Formation in Big Creek Valley near Mt. Judea,

Arkansas—documenting the close relation of groundwater and surface water. Environmental Earth Sciences 75:1160.
[10] Kresse, T. M., P. D. Hays, K. R. Merriman, J. A. Gillip, D. T. Fugitt, J. L. Spellman, A. M. Nottmeier, D. A. Westerman, J. M. Blackstock, and J. L. Battreal. 2014. Aquifers of Arkansas—Protection, Management, and Hydrologic and Geochemical Characteristics of Groundwater Resources in Arkansas. U.S. Geological Survey Scientific Investigations Report 2014: 5149.
Cox, M.H., Su, G.W. and Constantz, J., 2007. Heat, chloride, and specific conductance as ground water tracers near streams. Ground Water, 45(2), pp.187-195.
Justus, B. G., D. R. L. Burge, J. M. Cobb, T. D. Marsico, and J. L. Bouldin. 2016. Macroinvertebrate and diatom metrics as indicators of water-quality conditions in connected depression wetlands in the Mississippi Alluvial Plain. Freshwater Science 35:1049–1061.
Robertson, W.D., D.R. Van Stempvoort, D.K., Solomon, J. Homewood, S.J. Brown, J. Spoelstra, and S.L. Schiff. 2013. Persistence of artificial sweeteners in a 15-year-old septic system plume. Journal of Hydrology, 477, pp.43–54.
Soulsby, C., I. A. Malcolm, D. Tetzlaff, and A. F. Youngson. 2009. Seasonal and inter-annual variability in hyporheic water quality revealed by continuous monitoring in a salmon spawning stream. River research and applications 25:1304–1319.

On March 25, 2016, John Bailey, on behalf of ADEQ, sent a letter to C&H Hog Farms, Inc. notifying C&H that the requested modification to install a synthetic liner in both lagoons was approved and that the requested modification would expire after one year. Should C&H not install the liners within that one-year period, C&H would be required to resubmit plans and obtain a new approval from the Department. Mr. Bailey approved the installation of synthetic liners under the terms of the now expired General Permit ARG590000, tracking number ARG590001. Mr. Bailey's approval authorizing C&H to install the synthetic liners expired on March 25, 2017.

Although the analytical data from the C&H Drilling Study did not indicate a leak at the borehole drilling location at the time of the sampling, the Study does not support the conclusion that there is not any leakage from the ponds.

> Algal blooms have, and continue to, cause concern on the Buffalo River. As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[1]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.

The Arkansas Department of Health did not submit a comment regarding C&H Hog Farms, Inc., AFIN 51-00164, during the public comment period ending October 24, 2018.

The Department is actively engaged in developing an antidegradation implementation procedure to address the revision of 40 CFR § 131.12. The Department implemented 40 CFR § 131.12 in APC&EC Regulation 2 Chapter 2. As stated in APC&EC Regulation 2.203, it is not the intent of the regulation to dictate regulatory authority over private land within the watershed of an ERW, other than what exists under local, state, or federal law.

The Department acknowledges the following statements from the Buffalo River Watershed-Based Management Plan dated May 22, 2018, regarding threatened and endangered species in the Buffalo River watershed:

> The Buffalo River and its tributaries are considered high quality water resources. The Buffalo River and its tributaries support over fifty (50) species of fish and over twenty (20) species of mussels. Portions of the Buffalo River have been designated critical habitat for the threatened Rabbitsfoot mussel, *Quadrula cylindrical cylindrical* (State/Federal Status: Endangered/Threatened, respectively). The watershed also includes important habitat for endangered bat species: Gray Bat, *Myotis grisescens* (State/Federal Status: Endangered); Indiana Bat, *Myotis sodalis* (State/Federal Status: Endangered); Ozark Big-eared Bat, *Corynorhinus townsendii ingens* (State/Federal Status: Endangered); and Northern Long-eared Bat, *Myotis septentrionalis* (State/Federal Status: Endangered/Threatened, respectively). Cave and other karst features in the Buffalo River watershed are important habitats for all of the protected bat species.[1]

However, the Department did not receive any comments during the comment period ending on October 24, 2018, regarding endangered or threatened species and their associated habitats from Arkansas Game & Fish Commission, Arkansas Natural Heritage Commission, or U.S. Fish and Wildlife Service.

Consideration of tourism is not within the Department's regulatory authority.

The Department acknowledges all the documents referenced in the commenter's comments that are part of the permitting record.

Pursuant to the Memorandum of Agreement between the Board of Trustees of the University of Arkansas System for and on behalf of the University of Arkansas System-Division of Agriculture and the Arkansas Department of Environmental Quality, the study performed by BCRET is being carried out for the use and benefit of ADEQ; however, the study shall be funded and conducted independently of ADEQ and shall meet the requirements of an independent study conducted by professionals in the field of water quality.

Please refer to the Response to Comments for those individuals' or groups' comments which have been incorporated by reference into your comments.

Comment: Please accept my following comment letter that is in response to the ADEQ's decision to hold a public hearing for the denial of the C&H Hog Farm's permit (5264-W) at the ADEQ headquarters in North Little Rock on October 9, 2018. In addition to the already scheduled public hearing the Arkansas Pork Producers Association and its membership would like to request that an additional public hearing be scheduled in the permittee's local community. Public hearings should be scheduled in locations that make attending convenient for the permittee and the local community (i.e. the citizens of Newton County). There have been numerous public hearings over the past 5 years involving C&H Hog Farm and there has always been a hearing in Jasper or the surrounding area. These hearings have always been well attended by the public. The current scheduled public hearing that is schedule for 5:00 p.m. on Tuesday October 9, 2018 at your headquarters is not a convenient time for the public of Newton County. For the public to attend they will have to take a day off work and travel to North Little Rock. Please seriously consider this request and schedule another public hearing in Newton County.

Commenter: Arkansas Pork Producers Association

Response: A public hearing was held in Jasper, Newton County, Arkansas on October 16, 2018.

Comment: FNWR support ADEQ's findings in its proposed denial of the Reg 5 C&H and agrees with the ADEQ's positions as stated in Paragraph 8. "Basis for Permit Decision" pages 2 through 9 of ADEQ's "Statement of Basis". Deficiencies in the Geological Investigation: ADEQ's findings confirm the presence of karst hydrogeology at the C & H site and surrounding area which allows ground water to flow through interconnected underground fissures and cracks and into aquifers which are extremely vulnerable to contamination. Water Quality Issues: ADEQ's findings confirm two segments of Big Creek in Newton County and two segments of the Buffalo National River are now impaired due to the presence of pathogens and low levels of

dissolved oxygen. According to C&H annual reports to ADEQ, approximately 3 million gallons of untreated liquid hog waste have been sprayed on approximately 600 acres of pasture land each year for the past 4 to 5 years. This land is in the Big Creek and Buffalo National River watershed. Dye tracing also has documented that the underground streams which may be hydrologically connected to C&H activities have allowed residential water wells to be contaminated. FNWR believes sound science supports the permit denial and reaffirms the position of tens of thousands of concerned citizens dedicated to the protection of the Buffalo National River. Our members continue to see massive algal blooms in the Buffalo National River which are confirmed to include dangerous cynaotoxins. The presence of these algal blooms and related toxins are not only a threat to public health but are also a threat to the $70 million contribution the Buffalo National River provides to Arkansas's economy and in particular to those counties which border the river. FNWR fully supports ADEQ's position to deny the Reg 5 permit to C&H. Thank you for your consideration.

Commenter: Friends of the North Fork and White Rivers

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Comment: Hey everybody, I wasn't going to talk tonight but after hearing everybody I just felt like it was a good ideal. I am from Huntsville, that's where I went to High School and I went to College at Furman University where I got my Bachelors of Science Degree and so I just wanted to kind of address some of the things that I have analyzed scientifically while listening to you all, I don't know the families at the hog farm, you guys sound like good people I'm assuming you're over here because that's where everybody is looking when they talked about you, so I do feel sympathetic, however some of the science, like people are up here telling you not out emotion but out of facts they have studied, that they have been trained to studied it over the course of sequential years and mind you scientist don't paid a whole like by the way so I'm not getting paid to stand up here by any means. Somebody earlier said that this is the first farm to be denied and that sucks, however stakes are being raised around the world and around the Nation to make us more responsible to take care of the land that's around us so yes maybe you're one of the first people that's being denied because of this reason but you're not going to be the last. Everybody has to raise to these new standards we have to so that we can take care of our land and so that we can continue drink good water and you know farm good crops and all that good stuff. Another statement made was that families are going bankrupt and I just wanted to say, my sympathy, again I don't money I know what is like not to have money so I get it, but sometimes life sucks and you have to adjust and adapt and move forward and find something else to do. The other comment I heard was that water doesn't float up river. Technically this is correct, scientifically it is not correct, because the system of water is that is evaporates and then it condenses and then it rains and then it goes back to the river so this polluted water is going back up into the system and being redistributed in other areas so it does make a difference and so I

want to ask you guy, no I don't want you to be against people who have done these scientific studies because if you're not a scientist and I'm not saying I'm better than you this is just my area expertise. Who is a scientist here and if you're not that's okay but please be open to the ideal that there are fact out there you don't know and if you chose to understand those better then maybe we can help create better solutions together. And then the last thing I guess I want to say is that I do have marine biology experience so I do have experience with science and water and the facts of all sorts of stuff regarding that and then in Florida recently were I was living and doing these studies Red Tide was a huge deal. Did anybody hear about the Red Tide event that occurred recently in Florida? The Red Tide is a Algal Bloom that is affected by increasing heat and it's also affected by increased nutrients, now I don't know a ton about hog farming, but it is an influx of nutrients into the system and it just will make a difference it's just a fact of something that we have to accept and I'm just here to say this stuff as non-bias as I can because I care about people, so I hope that you all could open your minds a little bit and try to reach your hand across the aisle and shake them instead of turning your backs on one another. And that's all.

Commenter: Martha Robinson

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Comment: I'm Carol Bitting I live in Marble Falls (HC73 Box 182A) I shorten my seven (7) minutes as best I could. And I'm going to leave out a lot the history. But I'm going to say, I'm going to give you some information and if you want you can go on-line and you can look it up yourself because you all want to read the signs. In 2013 while we all in shock and in researching how C&H came about I begin to meet others around the community, my first stop was the ADEQ Office in Jasper, there I met three employees in shock. One of the NPDES permit writers for ADEQ was overwhelmed with grief that her prodigy had not informed her of the permit he was Orchestrating. John Bailey was a young ADEQ engineer in Little Rock and didn't converse with the experience in NPDES writer in one of the most protected and sensitive area of the State. He is now employed by Farm Bureau the corporation that's paying the attorney fees for C&H Hog Farms. In Jason Henson's deposition when asked why Farm Bureau is paying attorney fees he said because that's what Farm Bureau does it supports farmers. If that's the case then all farmers need to call Farm Bureau to represent them against this Ag. Farmers don't need permits, C&H is not a farm but instead an Industrial Producer of large amounts of waste and therefore a wastewater permit is required. In November of 2013 Dr. Bob Cross an engineer reported to Ryan Benefield of ADEQ the error of C&H Farms engineers calculations and ADEQ's permitting engineers oversight in a letter about the clay liners of the waste lagoons instead of using correct value and materials C&H and their engineers used material for allowing excess gallons of raw waste to seep daily from the lagoons. NPDES permits are not allow to discharge except during a 25 year storm event, this is the discharge and evidence in declining water quality and the extensive algae downstream of C&H Hog Farms. The same year my husband gave a talk at

Springfield Products, a younger women approached us after the meeting and told us that a Cargile Representative had just spoken to her Agri Hall. The rep told the class that if any (inaudible) given to the most sensitive area of the State, they have the Regs. of the State (inaudible) I had just been told by researcher from University of Arkansas that Big Creek was considered the most sensitive area of the State. To the most sensitive area of the State of Arkansas came on of the most devastating water polluting industry known around the world It separates families, friends, neighbors, and community, destroying physical and medical health, jobs and water quality. You want science? There is a website ADEQ. After C&H Hog Farms there is place call additional information and there are 16,000 pages of depositions, go there, you will see that the University of Arkansas Big Creek stream (inaudible bell going off) is one of the contributors of the scientific data that shows pollution to the Buffalo.

Commenter: Carol Bitting

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The prior permit issued under APC&EC Regulation 6 General Permit ARG590000 and the coverage under that permit tracking number ARG590001 are outside the scope of the current permitting decision. The initial Notice of Intent and the corresponding NMP for coverage under the prior APC&EC Regulation 6 permit tracking number ARG590001 were available for public comment during the 30-day public comment period beginning on June 25, 2012.

Seepage from waste storage ponds has the potential to pollute surface and ground water. The record included one recompacted permeability test that is insufficient to determine liner integrity. The necessary soil investigations including, but not limited to, percentage of fines and soil permeability evaluations, have not been performed at this facility in accordance with the AWMFH 651 Table 10-4 and Appendix 10D. Plasticity index analysis was performed on one sample of the in situ clay material in boring 2. The variability in the regolith expected in this geologic setting coupled with the insufficient data creates additional concerns about the siting and soil sources for the clay liner. The required number of borings were not advanced within the pool areas in accordance with AWMFH 651.0704(b)(4); these additional borings would have provided more data for assessment of clay source material. Proper soil investigations for the liner material are necessary to determine the suitability and location of the clay source material and to consider any additional geotechnical testing to confirm material properties, which will reduce the potential for downward and/or lateral seepage of the stored wastes.

Additionally, NRCS, in Appendix 10D of the AWMFH, indicates that special design measures are necessary where agricultural waste storage ponds are constructed in soils with high calcium content (BCRET Quarterly Report for October 2016 to December 2016, Table 10, page 71) or highly unfavorable geologic conditions, such as karst formations.

Comment: BRWA comments have already been submitted and tonight I'm speaking as an individual and I'd like to comment about the undue influence of Big Money special interests on this process, namely Arkansas Farm Bureau. - Over and over we keep hearing, base the permit decision on science not emotion. Well, BR W A submitted over 130 pages of comments based on regulations, facts and science. Many others did the same. Yet Farm Bureau posts slick videos of C&H based not on science but on emotion and invokes fear among supporters -telling them you're next, which of course is false and alarmist. This is about one facility in the wrong place, threatening the BNR. - They say ADEQ is "moving the goal posts" and "changing the rules midstream". That's not so. The rules were the same in 2012 as they are now. They just weren't properly enforced. A mistake in 2012 does not justify repeating that mistake now. -Let's go back to the beginning- when the public was first incensed by the lack of public notice when the C&H permit was issued, with no opportunity to object until it was too late. Why was there no public notice? Ask those lobbyists from special interests who helped craft the regulation back in 2011, including Butterball, Tyson, and Farm Bureau. If proper public notice had been provided the public would have made the same convincing arguments, insisting that the regs be followed, the permit would have been denied, and we wouldn't be here today. - FB and other special interest lobbyists helped create this problem and are making it worse by making C&H the poster child for "right to farm". The right to farm ends at the fencerow. When it crosses the fence and becomes a neighbors problem, or in this case a Nation's problem, that's not right at all. It's flat wrong. - FB claims to be the "voice of agriculture". They may speak for Big Ag like Cargill, Tyson or JBS, but they're not the voice of small farmers who are run out of business by the dozens every time they facilitate a CAFO like C&H. Here's a factoid: between 1980 and 2011, as CAPOs became the norm, the number of hog operations in the US dropped from 666,000 to 69,000 while the number of hogs sold remained the same. Concentration is the name of the game and small farmers are the losers. - FB helped create this mess. Now, if they really want to help farmers, instead of making it worse it's time they make it right. Stop obstructing ADEQ and take that money you're spending on lawyers and use it to help make the C&H owners whole.

Commenter: Gordon Watkins

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The prior permit issued under APC&EC Regulation 6 General Permit ARG590000 and the coverage under that permit tracking number ARG590001 are

outside the scope of the current permitting decision. The initial Notice of Intent and the corresponding NMP for coverage under the prior APC&EC Regulation 6 permit tracking number ARG590001 were available for public comment during the 30-day public comment period beginning on June 25, 2012.

Comment: See Attached: Carol Bitting

Commenter: Carol Bitting

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The prior permit issued under APC&EC Regulation 6 General Permit ARG590000 and the coverage under that permit tracking number ARG590001 are outside the scope of the current permitting decision. The initial Notice of Intent and the corresponding NMP for coverage under the prior APC&EC Regulation 6 permit tracking number ARG590001 were available for public comment during the 30-day public comment period beginning on June 25, 2012.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table

5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

> Algal blooms have, and continue to, cause concern on the Buffalo River. As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[1]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Pursuant to the Memorandum of Agreement between the Board of Trustees of the University of Arkansas System for and on behalf of the University of Arkansas System-Division of Agriculture and the Arkansas Department of Environmental Quality, the study performed by BCRET is being carried out for the use and benefit of ADEQ; however, the study shall be funded and conducted independently of ADEQ and shall meet the requirements of an independent study conducted by professionals in the field of water quality.

The Beautiful Buffalo River Action Committee (BBRAC) has been established for the purpose of addressing potential water-quality concerns throughout the Buffalo River Watershed and to protect the vitality of the Buffalo National River as a national, state, and local landmark. Governor Asa Hutchinson directed five agencies to develop an Arkansas-led approach to identify and address potential issues of common concern in the watershed. A key priority of BBRAC was to initiate the development of a Buffalo River Watershed Management Plan. The nine-element watershed management plan was developed for the Buffalo River Watershed, and the final plan was submitted and accepted by EPA in June 2018. Watershed management plans are recognized by EPA as comparable, state-led

management approaches expected to result in the attainment of water-quality standards.

Comment: There is a family farm at stake. If permit is not granted they are at risk of losing everything they own. At a minimum, the Dept. should allow a 20-day extension of the comment period per Reg. 8

Commenter: Evan Teague

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department granted an extension of the public comment period for the C&H Hog Farms, Inc. APC&EC Regulation 5 draft permitting decision until 4:30 p.m. on October 24, 2018.

Comment: I firmly support the Arkansas Department of Environmental Quality's decision to deny C&H Hog Farms request for a Regulation 5 permit. I base my decision on the strong technical data reported in the depositions by Dr. Robert E. Blanz (ADEQ), Mr. Thomas Aley (, Mr. David Mott (National Park Service, retired; USGS, retired), and in the documents that I have previously provided to you on which I was an author. These dealt with groundwater studies we conducted, and include the following peer-reviewed studies:

Brahana, Van, Bitting, Carol, Kosic-Ficco, Katarina, Turk, Teresa, Murdoch, John, Thompson, Brian, and Quick, Ray, 2017, Using fluorescent dyes to identify meaningful water-quality sampling locations and enhance understanding of groundwater flow near a hog CAFO on mantled karst—Buffalo National River, southern Ozarks: in Kuniansky, E.L., and Spangler, L.E., eds., U.S. Geological Survey Karst Interest Group Proceedings, San Antonio, Texas, May 19-23, 2017, U.S. Geological Survey Scientific Investigations Report 2017-5023, p. 147-160.

Brahana, V., Nix, J., Kuyper C., Turk, T., Usrey. F., Hodges, S., Bitting, C., Ficco, K., Pollock, E., Quick, R., Thompson, B., and Murdoch, J., 2016, Geochemical processes and controls affecting water quality of the karst area of Big Creek near Mt. Judea, Arkansas: Journal of the Arkansas Academy of Science, v. 70, p. 45-58.

Murdoch, John, Bitting, Carol, Brahana, John Van, 2016, Characterization of the karst hydrogeology of the Boone Formation in Big Creek Valley near Mt. Judea, Arkansas—Documenting the close relation of groundwater and surface water: Environmental Earth Sciences, v. 75;1160, 16 p. (DOI 10.1007/s12665-016-5981-y)

Data in these depositions and these reports strongly support the hydrogeologic interpretation that groundwater in the vicinity of C&H and their spreading fields is being contaminated by the feces and urine from the C&H hog waste, and is moving through underground karst voids and conduits

to tributaries to the Buffalo National River, and degrading the quality of that river. Please deny the Regulation 5 permit. Thank you.

Commenter: John Van Brahana

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Comment: First, a little about my qualifications. I have bachelor and master degrees in forestry from Clemson U. and a PhD in geosciences from the U. of Arizona, with a concentration in watershed management. I have spent my academic career teaching in the environmental sciences and doing research on paleoclimate and climate change through dendrochronology. I am an associate of the members of the Geosciences Dept. who are closely involved with watershed management such as Dr. Van Brahana.
In my training in forestry, I was taught that many valuable things could be gotten from a forest. Often the most valued but least valuable thing was timber. Often the most valuable but least valued "product" of a forested watershed was clean, abundant water delivered in a controlled manner (without flooding).
The decision to put a CAFO in the Buffalo R. watershed on karst terrain was criminal, quite literally. The original plan did not call for impermeable liners for the waste ponds, but specified that there would be a certain amount of leakage from the holding ponds. Spraying waste on a few fields is inadequate. It guarantees continuing pollution of groundwater. So this CAFO has been polluting the watershed from day one. How do you explain the decision to allow that? Perhaps it was a product of corruption?
It will take a long time for the pollution already introduced into the groundwater to clear, even if the pollution were stopped today. But it is continuing. What is the first maxim of policy-making? "When you are in a hole, stop digging." Wastes should be trucked out of the watershed, beginning immediately, and the CAFO should be shut down. That would require the state to make the owners whole, but since it was the state that blundered in permitting the operation in the first place, the state should do the right thing. The continuing losses from impaired recreation in the National River when the NPS has to shut down access to the river because of contaminant loads will cost the state far more than getting rid of this CAFO.
I urge the ADEQ to contact the Attorney General to start an investigation of the way the permitting process was conducted. I strongly suspect that there was collusion between private interests, ADEQ personnel and federal employees to sneak the initial permit in under the radar. An NPS employee stated publicly that he inquired if something were going on, but was kept in the dark.

Commenter: Malcolm Cleaveland

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The prior permit issued under APC&EC Regulation 6 General Permit ARG590000 and the coverage under that permit tracking number ARG590001 are outside the scope of the current permitting decision. The initial Notice of Intent and the corresponding NMP for coverage under the prior APC&EC Regulation 6 permit tracking number ARG590001 were available for public comment during the 30-day public comment period beginning on June 25, 2012.

Comment: See Attached: Carol Bitting (2)

Commenter: Carol Bitting

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The API, (Strategy 2 in AWMFH 651.0015) is a risk-based approach for assessment of phosphorus loadings as it regards surface runoff. The Statement of Basis for ADEQ's draft denial of the permit discusses the severe and unknown limitations for many of the application fields as well as the field phosphorus build-up and the legacy phosphorus (see pages 4 of 9, 7 of 9, and 8 of 9) issues.

The Statement of Basis does not address the alleged discrepancy in the number of swine at the facility among the various Design Reports and applications.

> Algal blooms have, and continue to, cause concern on the Buffalo River. As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[1]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.

The prior permit issued under APC&EC Regulation 6 General Permit ARG590000 and the coverage under that permit tracking number ARG590001 are outside the scope of the current permitting decision. The initial Notice of Intent and the corresponding NMP for coverage under the prior APC&EC Regulation 6 permit tracking number ARG590001 were available for public comment during the 30-day public comment period beginning on June 25, 2012.

The Department acknowledges the following statements from the Buffalo River Watershed-Based Management Plan dated May 22, 2018, regarding threatened and endangered species in the Buffalo River watershed:

> The Buffalo River and its tributaries are considered high quality water resources. The Buffalo River and its tributaries support over fifty (50) species of fish and over twenty (20) species of mussels. Portions of the Buffalo River have been designated critical habitat for the threatened Rabbitsfoot mussel, *Quadrula cylindrical cylindrical* (State/Federal Status: Endangered/Threatened, respectively). The watershed also includes important habitat for endangered bat species: Gray Bat, *Myotis grisescens* (State/Federal Status: Endangered); Indiana Bat, *Myotis sodalis* (State/Federal Status: Endangered); Ozark Big-eared Bat, *Corynorhinus townsendii ingens* (State/Federal Status: Endangered); and Northern Long-eared Bat, *Myotis septentrionalis* (State/Federal Status: Endangered/Threatened, respectively). Cave and other karst features in the Buffalo River watershed are important habitats for all of the protected bat species.[1]

However, the Department did not receive any comments during the comment period ending on October 24, 2018, regarding endangered or threatened species and their associated habitats from Arkansas Game & Fish Commission, Arkansas Natural Heritage Commission, or U.S. Fish and Wildlife Service.

The Department is actively engaged in developing an antidegradation implementation procedure to address the revision of 40 CFR § 131.12. The Department implemented 40 CFR § 131.12 in APC&EC Regulation 2 Chapter 2. As stated in APC&EC Regulation 2.203, it is not the intent of the regulation to dictate regulatory authority over private land within the watershed of an ERW, other than what exists under local, state, or federal law.

C&H Hog Farms, Inc. submitted an Emergency Action Plan to the Department on October 23, 2018. The Emergency Action Plan did not address possible failure of the liner resulting from potential damage, such as pumping and agitation, liner desiccation, or any other site-specific operational risks are not addressed, in accordance with AWMFH 651.0204(a), (b).

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require

the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Consideration of tourism is not within the Department's regulatory authority.

Comment: I am both a recreational floater and a retired engineer who has had to deal with issues in a complex regulatory environment. I know the beauty and economic value of the Buffalo due to tourism, but I also know the difficulty of getting professionals to agree on how to interpret complex regulations, and I know the importance of a stable regulatory environment where the interpretations are not changed to suit the political leanings of the day. I have been floating the Buffalo since the 1960's, and the changes in the river and water quality are dramatic and having a very negative impact on the recreational value of this public resource. The extent of algae blooms in the river in the summers of 2017 and 2018, while not "new", have been noted by many to be far in excess of what has been historically observed, and without a doubt the current level of algal growth is degrading the recreational experiences that this river provides and will have negative economic impact on the tourism industry of the region. That said, these changes did not begin suddenly after December of 2013 when C&H first began spreading on local fields. But this comment period is not about every potential influence on water quality – it is about one specific facility, so I will return to that: As was noted in ADEQ's draft permit denial, the latest draft 303(d) list clearly documents that water quality in Big Creek and associated reaches of the

Buffalo River is now "degraded". I agree that is an issue that needs to be considered in reviewing the permit application, as the farm is very likely one of the factors impacting water quality in Big Creek. ADEQ has admitted in writing that their own review was sharpened following the unprecedented level of public comments. ADEQ should enforce regulations and provide rigorous, science-based reviews that protect water quality independent of whether or not the public provides numerous comments on the matter at hand. If it is the determination of ADEQ using peer-reviewed science that any significant portion of this degradation is being caused by the Hog Farm, then ADEQ should deny the permit application. If evidence is not sufficient at this time to deny the permit on the basis of degrading water quality, then the permit should be approved but with additional stipulations as needed to protect water quality in the future. Since it is unlikely that there will ever be agreement among the experts as to what borings would eliminate doubts about pond leakage, I believe that the new requirements should include addition of a synthetic liner. Further, as more data becomes available there must be a rigorous process for revising the Nutrient Management Plan (NMP) as needed in response to scientific data from soil samples, water samples, and any other changes that may impact key NMP inputs such as changes in land use.

Commenter: Harmon Chadbourn

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen.

> Algal blooms have, and continue to, cause concern on the Buffalo River. As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[1]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused

on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Consideration of tourism and revenue is not within the Department's regulatory authority.

Comment: I fully support ADEQ's draft Regulation 5 permit denial for C & H Hogfarm at Mt. Judea, Arkansas. Please see my attached comments as an individual and my request that the comments submitted by The Ozark Society, are incorporated by reference, word for word. Since 1971, I have canoed the beautiful, spectacular waters, high bluffs, the flora and fauna and peace of the Buffalo National River. The wildlife - birds, otters, deer, bobcats, mink waterfowl have enchanted me, along with watching the light change on the bluffs, now there is unbelievable volumes of algae clogging the channels of the Buffalo. There is compelling scientific evidence that excess nutrients from C & H Hogfarm's concentrated animal feeding operation, is polluting the Buffalo River, as well as it's tributary, Big Creek. Comments attached.
Commenter: Alice B. Andrews

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Arkansas Department of Health did not submit a comment regarding C&H Hog Farms, Inc., AFIN 51-00164, during the public comment period ending October 24, 2018.

The Department is actively engaged in developing an antidegradation implementation procedure to address the revision of 40 CFR § 131.12. The Department implemented 40 CFR § 131.12 in APC&EC Regulation 2 Chapter 2. As stated in APC&EC Regulation 2.203, it is not the intent of the regulation to dictate regulatory authority over private land within the watershed of an ERW, other than what exists under local, state, or federal law.

C&H has applied for an APC&EC Regulation 5 Individual No Discharge permit. APC&EC Regulation 5.303 prohibits point source discharges from any part of the liquid animal waste management system.

ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in

APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Seepage from waste storage ponds has the potential to pollute surface and ground water. The record included one recompacted permeability test that is insufficient to determine liner integrity. The necessary soil investigations including, but not limited to, percentage of fines and soil permeability evaluations, have not been performed at this facility in accordance with the AWMFH 651 Table 10-4 and Appendix 10D. Plasticity index analysis was performed on one sample of the in situ clay material in boring 2. The variability in the regolith expected in this geologic setting coupled with the insufficient data creates additional concerns about the siting and soil sources for the clay liner. The required number of borings were not advanced within the pool areas in accordance with AWMFH 651.0704(b)(4); these additional borings would have provided more data for assessment of clay source material. Proper soil investigations for the liner material are necessary to determine the suitability and location of the clay source material and to consider any additional geotechnical testing to confirm material properties, which will reduce the potential for downward and/or lateral seepage of the stored wastes.

C&H Hog Farms, Inc. submitted an Emergency Action Plan to the Department on October 23, 2018. The Emergency Action Plan did not address possible failure of the liner resulting from potential damage, such as pumping and agitation, liner desiccation, or any other site-specific operational risks are not addressed, in accordance with AWMFH 651.0204(a), (b).

The Department acknowledges the following statements from the Buffalo River Watershed-Based Management Plan dated May 22, 2018, regarding threatened and endangered species in the Buffalo River watershed:

> The Buffalo River and its tributaries are considered high quality water resources. The Buffalo River and its tributaries support over fifty (50) species of fish and over twenty (20) species of mussels. Portions of the Buffalo River have been designated critical habitat for the threatened Rabbitsfoot mussel, *Quadrula cylindrical cylindrical* (State/Federal Status: Endangered/Threatened, respectively). The watershed also includes important habitat for endangered bat species: Gray Bat, *Myotis grisescens* (State/Federal Status: Endangered); Indiana Bat, *Myotis sodalis* (State/Federal Status: Endangered); Ozark Big-eared Bat, *Corynorhinus townsendii ingens* (State/Federal Status: Endangered); and Northern Long-eared Bat, *Myotis septentrionalis* (State/Federal Status: Endangered/Threatened, respectively). Cave and other karst features in the Buffalo River watershed are important habitats for all of the protected bat species.[1]

However, the Department did not receive any comments during the comment period ending on October 24, 2018, regarding endangered or threatened species and their associated habitats from Arkansas Game & Fish Commission, Arkansas Natural Heritage Commission, or U.S. Fish and Wildlife Service.

Rule-making regarding a permanent moratorium is outside the scope of this permitting decision.

Consideration of tourism is not within the Department's regulatory authority.

Comment: A public hearing to accept comments on the draft denial of C & H Hog Farms's Regulation 5 permit, Permit No. 5264-W, has been scheduled by ADEQ for October 9, 2018 at 5:00pm CT at ADEQ's North Little Rock office in Pulaski County, Arkansas. C & H Hog Farms feels it would be more appropriate for a public hearing to be held in the county in which the farm is located. Doing so will provide a better opportunity for residents of the county to make public comments. As such, C & H Hog Farms is requesting that ADEQ conduct a public hearing in Newton County, Arkansas.

Commenter: Jason Henson

Response: A public hearing was held in Jasper, Newton County, Arkansas on October 16, 2018.

Comment: We support the decision by ADEQ to deny the permit and have submitted 100+ pages of technical very technical information to support our position. But actually I want to talk about three things that are really sort of sociological in this meeting and it has to do with what most are urban or rural legends I guess, or rumors. One of them is that I think that we should have a technical team check out the possible impact of canoers and other recreations on water quality. The 2013/14 study by Stan Todd of Arkansas Game and Fish Commission and Sean Hodges of the Buffalo National River, give reasonably accurate estimates of yearly floater days but in fact only about 15% of visitors actually float. So there's a number floating around of about 2 million people or something, they are not all jumping in canoes and going down the river. The Health Department knows typical metabolic daily productions of nitrates in human urine and from that it is possible to deduce the maximum possible contribution to the yearly nitrate load from floaters. Even if all floaters peed in the river at every opportunity, only a small fraction of the nitrate load in the river actually comes from floaters. This can be documented and I think we have state agencies that can do it. my estimate, I'm a statistician mathematician, is that much less than 1% of the nitrate in that area comes from, could possibly come from floaters, period. And why is that? Well on any given day the farm animals in Newton County outweigh floaters by at least 400 to 1. I mean you can just total up the mass in the city. Floaters just don't have the capacity to out pee the farm animals and wildlife. Even if they were terribly irresponsible, which I hope they're not, I don't deny that the parks service should do a better job of informing and enforcing human problems there, but floaters aren't the main contributor even remotely close.

Second issue is feral hogs. Game and Fish people tell me that population estimates for feral hogs are very difficult and I don't doubt that. They're mobile. The only estimate I have seen in research papers is 4 feral hogs per square mile for the state, but this is unlikely to be accurate for the Buffalo River watershed. We know that, right? Eradication efforts as proposed by AR legislature need at least a 70% yearly kill rate in order to be of any effectiveness. So how do you know if you're getting a 70% kill rate if you don't know how many are there? So I propose that before money is invested in hog eradication in the Buffalo River watershed that Game and Fish, Agricultural Department, actually make a decent population estimate. A capture, recapture method using what's called a Peterson (that's not me) estimators might work in a restricted watershed like Big Creek. It should be done so you know where they are and what they are so there's an estimate of what damage that can be done. Then it's possible to generate a cost benefit estimate for controlling feral hogs. They should be controlled in some way but you need to know what you're talking about before you do it. And the third thing I want to discuss is drug resistance to staph and other bacterial infections. They're becoming an ever-growing problem in the US. Antibacterial drugs are no longer used in meat production to my knowledge, but the use of preventive antibacterial drugs on CAFOs have been linked to increased prevalence to resistant bacterial in nearby reservoirs. That's a non-trivial problem. Even restricting use of farm antibiotics to those not commonly used in humans does not solve the problem. The school children and the entire town of Mount Judea spend most of their day within several hundred yards of spread fields. I think it would be worthwhile to help the public to test these children and residents for abnormally high resistant bacterial counts. They can compare them to any place in the state of Arkansas. This would be a good voluntary project to reassure local parents if nothing is found, which would be the best result. But it would also improve health conditions if it's needed. Thank you.

Commenter: David Peterson

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Feral hog management is not within the Department's regulatory authority.

The Arkansas Department of Health did not submit a comment regarding C&H Hog Farms, Inc., AFIN 51-00164, during the public comment period ending October 24, 2018.

Comment: Please accept my comment on the draft regulation 5 swine waste permit denial for the C&H hog CAFO. I support the ADEQ decision to deny the permit based upon the points established in ADEQ's statement of basis for denial which I have included in my comments below. The presence of karst triggers additional considerations for siting and design as stated in the Animal Waste Management Field Handbook. It's inappropriate to site a CAFO like C&H in

karst. And especially with the hydrogeology that occurs connecting it to the Buffalo National River as evidenced in Professor Van Brahana's dye trace studies. ADEQ has identified karst at the site and the Big Creek research team reported that the core sample from the Harber drilling study had a calcium content of 382 176 mg/kg of soil at a depth of 25 ft. Epikarst serves as a conduit for liquids to travel through karst terrain. The Big Creek research extension team has documented an increase in nitrate near the facility. A ground monitoring flow direction study has not been performed. Increase in nitrate in both the ephemeral stream and the house well suggest that these systems may be hydrologically connected to areas where farm activities take place. Pond construction quality assurance is a real issue since the C&H record included only one recompacted permeability test. That single test is insufficient to determine liner integrity. The necessary soil investigations including but not limited to percentage of fines in soil permeability evaluations have not been performed at this facility in accordance with AWMFH. And I wanted to read a couple of comments from two Norwegian visitors at the park. One of them, Elsa Kobe, said "to preserve the Buffalo River is so important. Every visit every time we come to the United States we come to the Buffalo River." And Harold Kobe said "The Buffalo River is not only a historical interest as a national park, it is a special place that makes us come whenever visiting this part of the US. Preserve it for future generations." So I just wanted to read those because this is not just a Newton County issue, an Arkansas State issue, or I mean, it's a national park that people from all over the world visit and love and I think that says something about how wonderful it is and how Arkansas needs to protect it.

Commenter: Marti Olesen

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department acknowledges the commenter's statements that reiterate the Department's statements in the Statement of Basis.

Comment: I live on Bear Creek in Northern Boone County. When we have large rain events, more than 8" of rain in 3 days, the creek floods at levels 10' to 15' above normal. When truly catastrophic rain levels occur as has happened recently with hurricanes Harvey, Florence, and Michael, it is not possible to design holding ponds that will not overflow/breech and contaminate all areas downstream. This has recently occurred in the Carolinas with devastating effects on watersheds and human populations. Reports indicate that affected areas will be contaminated for years and may never return to pre-flood conditions. It is a near certainty that our area will be subject to such flooding events at more frequent intervals, possibly as offend as every 10 -15 years. In my career in the nuclear power industry, locating a plant where such obvious hazards exist would constitute a complete dereliction of duty. Similarly, permitting C&H Hog Farm (and others which will surely follow) in the Buffalo National River watershed constitutes a complete

abdication of the responsibility of ADEQ to protect our region from such obvious environmental hazards.

Commenter: Edward Proctor

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

ADEQ must follow its regulations. APC&EC Regulation 5 requires the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. The permit application record lacks the requisite information to evaluate the permit application for compliance with APC&EC Regulation 5. ADEQ cannot issue a permit when the permit application does not meet the requirements of the applicable regulation.

Comment: As someone who has been focused on the presence of a hog CAFO that was sited within the Buffalo watershed, from the beginning it was clear that this operation had been rushed into place to avoid adverse public reaction. Now, in reading through the depositions of many of those involved, it is clear that our suspicions about whether due diligence had been sacrificed in the haste to get the CAFO built were correct. I now know that an out-of-state engineer erred in how he used software designed to calculate the amount of nutrients that could be safely applied to the fields. Whether it was unintentional or deliberate, misusing the program allowed C&H to dump manure on fields far in excess of what the grasses could uptake. And no one in our state agencies noticed. Andrew Sharpley testified that plans to use equipment designed to measure subsurface flow was damaged by the flooding of the fields where the devices had been deployed. Why worry about what's happening under the field when Big Creek is washing over the top of the field, carrying away all the excess P in the ground due to over application? I also read about Jason Henson's practice of stirring or agitating the main waste pond to keep the solids from filling it up too fast, and in the process, changing the makeup of the slurry so that it was more potent in terms of nutrients.
I resent that as an Arkansas citizen, I am paying for the BCRET study that refused to focus on monitoring trends and instead has spent years gathering data but not doing the analysis that would show that tons of excess nutrients were being applied while at the same time, the Buffalo River was undergoing a rapid change from a beautiful recreational and natural resource to an algae stuffed, highly objectionable travesty that can hardly be called our state's crown jewel. Anyone who floated the river below Carver this last summer, and more so below Gilbert, likely found themselves swatting biting flies, swarms of them that weren't there before. An algae specialist explained that when algae mats cover large surface areas, they cause the water temps to rise. Warmer water attracts these biting flies who breed in warm waters. The ecosystem changes in ways large and small when humans abuse the watershed and put it out of balance. What humans do on the land ends up in the water. This in an inconvenient truth for those promoting

the growing of thousands of large mammals in metal sheds in an area where thin soils cover porous substrate. Now that there is many years worth of excess phosphorus in the ground surrounding Big Creek, will Farm Bureau and the Pork Producers step up to help clean up the mess they helped create?
I stand with ADEQ in their belated attempt to make this right. How does ADEQ plan to help heal this waterway? Will ADEQ advocate for a nutrient surplus designation within the watershed?

Commenter: Lin Wellford

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The prior permit issued under APC&EC Regulation 6 General Permit ARG590000 and the coverage under that permit tracking number ARG590001 are outside the scope of the current permitting decision. The initial Notice of Intent and the corresponding NMP for coverage under the prior APC&EC Regulation 6 permit tracking number ARG590001 were available for public comment during the 30-day public comment period beginning on June 25, 2012.

Pursuant to the Memorandum of Agreement between the Board of Trustees of the University of Arkansas System for and on behalf of the University of Arkansas System-Division of Agriculture and the Arkansas Department of Environmental Quality, the study performed by BCRET is being carried out for the use and benefit of ADEQ; however, the study shall be funded and conducted independently of ADEQ and shall meet the requirements of an independent study conducted by professionals in the field of water quality.

The Beautiful Buffalo River Action Committee (BBRAC) has been established for the purpose of addressing potential water-quality concerns throughout the Buffalo River Watershed and to protect the vitality of the Buffalo National River as a national, state, and local landmark. Governor Asa Hutchinson directed five agencies to develop an Arkansas-led approach to identify and address potential issues of common concern in the watershed. A key priority of BBRAC was to initiate the development of a Buffalo River Watershed Management Plan. The nine-element watershed management plan was developed for the Buffalo River Watershed, and the final plan was submitted and accepted by EPA in June 2018. Watershed management plans are recognized by EPA as comparable, state-led management approaches expected to result in the attainment of water-quality standards.

Comment: To ADEQ Decision Team: Decisions of this nature often bring with them many different political pressures. Often pushing the deciding team to be exposed to undue stresses. None the less, this particular issue about the potential of the Buffalo National River receiving excess contaminants is a rather significant one. Many times environmental agencies are faced with these important topics. I too, have been around similar decisions and seen the outcomes. In the end, it's impossible to please all parties to their utmost satisfaction. However, almost everytime a decision is made, it is possible to reach a compromise that touches aspects of each party's interests while still maintaining sound and environmentally safe operations. With that I would like you to think about the following alternative decision with rationale behind it. First, the ADEQ must make an environmentally safe decision about the operation of a large swine production facility within a popular and rather sensitive watershed. All the while, maintaining support from all interest groups to streamline future decisions made by ADEQ. Maintaining support from all groups will aid the department in the future by ensuring Arkansas citizens that honest, trustworthy decisions are being made that lookout for the best interest of everyone and not just one particular group. It is my experience that severe lop-sided decisions will only gain support from one side and in this case will rapidly increase the resentment of either interest group that sees themselves in a losing outcome. Future decisions will be appealed and lead to many more tax payer dollars being spent in litigation and lawsuits rather than important monitoring protocols in all the other sensitive water bodies in Arkansas. In some cases, individuals have been sued when they didn't dot all the i's and cross their t's. So please do what's best for everyone in the name of civility. Next, a decision in complete favor of C&H Hog Farms continuance of operations with no mitigations addressing the environmental concerns brought forward from groups like the BRWA will definitely leave their interest groups in total disarray and will eventually lead to more appeals and litigations where more and more tax payer dollars would be spent instead of important water quality studies in other water bodies of Arkansas. We, the people of Arkansas, depend on sound professionals from within ADEQ to maintain environmentally safe decisions by implementing logical scientific practices and monitoring protocol of all streams, reservoirs, watersheds, etc. When you spend your budget focusing more and more on litigation within one watershed, many others are being neglected. This leads to distrust from farmers and many others such as what we are seeing now. With that being said, BRWA wants a no operation decision. Would this ensure that C&H Hog Farms never contributed pollutants into the waters of the Buffalo River watershed? Sure it would! Do we all know that the waters within the Buffalo River watershed will still have pollutants if C&H never runs another pig through their facility? Sure we do. We're not all hydrology experts like the ones we depend on within ADEQ Division of Water Quality but we are intelligent enough to know that C&H is not the only potential pollutant to the watershed. Also, will ADEQ be finished when they issue a denial? No, they will be appealed by supporters of all types of farm operations within Arkansas and the department will lose the trust of many people. Will the department be at risk of more lawsuits? Sure they will. There is a strong farm base in Arkansas. At the same time, many small farms are afraid of "being next." We ask ADEQ to support all parties because we really do depend on your professionals to guide us in an environmentally safe manner while maintaining the highly productive agricultural economy Arkansas is known for. Therefore, in conclusion, we the supporters of all farming operations including C&H Hog Farms would like to propose that the operation of hog farming continue and to allow these hardworking families to

provide jobs and revenue for our small community. Due to the location of C&H hog facility within the sensitive Buffalo River watershed, the potential amount of waste produced, and because there have been no current findings of contributions of pollutants into the watershed from the hog facility; we would like ADEQ Division of Water Quality to address the concerns of pollution by developing monitoring protocol to mitigate the potential for any negative impacts caused by C&H operations. In response to the potential of negative impacts caused by excessive leaching of fertilizer, there can be action plans in place as to the restriction of timing on fertilizer applications to prevent excessive leaching of nitrogen, the amount of fertilizer to be applied per acre will be limited to ?? Dry tons/acre or ?? Liquid gal/acre. In an effort to address the concerns of the leakage of manure holding ponds, when monitoring determines pollutants are reaching unsafe depths below surface then C&H must cease all storage and remove manure until remedies can be applied to prevent potential contamination of ground water. In the event that C&H fails to comply with monitoring program and prevention plans, all permitted operations will be suspended until conditions are met. Setup control streams where there is nothing but nutrient byproducts of natural decomposition being added to the stream so people know for sure that the data is not skewed to fit the interests of one group. You're the experts we depend on!!! In the end, we depend on ADEQ to make decisions that will be of the best interests of all Arkansas residents; not just farmers and not just environmental groups. We all have a job to do and want to make a difference so let's make a difference for everyone involved. Keep it safe and keep it running! I SUPPORT C&H!!!

Commenter: Stuart Brasel

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Pursuant to the Memorandum of Agreement between the Board of Trustees of the University of Arkansas System for and on behalf of the University of Arkansas System-Division of Agriculture and the Arkansas Department of Environmental Quality, the study performed by BCRET is being carried out for the use and benefit of ADEQ; however, the study shall be funded and conducted independently of ADEQ and shall meet the requirements of an independent study conducted by professionals in the field of water quality.

ADEQ does not regulate all types of farming operations. The Department's permitting decision for this APC&EC Regulation 5 Individual No Discharge permit application pertains only to this individual permit application for a liquid animal waste management system, not all farming operations. Applications for Regulation 5 permits are evaluated according to Regulation 5 requirements.

ADEQ must follow its regulations. APC&EC Regulation 5 requires the designs and waste management plans for liquid animal waste management systems to be

in accordance with the AWMFH. The permit application record lacks the requisite information to evaluate the permit application for compliance with APC&EC Regulation 5. ADEQ cannot issue a permit when the permit application does not meet the requirements of the applicable regulation.

Comment: Denial of this permit is not only unfair, but is an affront to sound science. C&H has jumped through all the hoops you have asked, with no violations against them. It is unfair to change the rules without them getting the opportunity to provide response. Dept of interior removed access to restroom facilities on the Buffalo River, causing people to use sandbars and stream banks for their toilets, suppose that could be the source of the E.coli in the river? Need to allow good science to determine when a problem occurs, rather than some do gooder enviromental group. Arkansas Agriculture depends on fair treatment from regulators in order to function in our society. Might want to ask God to solve the problems, instead of man made unfair laws and rules governed with emotion.

Commenter: Charles Denver

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department has noted violations during its inspections of the C&H facility near Mt. Judea, Arkansas. However, those violations have not led to a formal enforcement action by the Department against C&H.

Consideration of tourism is not within the Department's regulatory authority.

ADEQ must follow its regulations. ADEQ cannot issue a permit if the permit application does not meet the requirements of the applicable regulation. APC&EC Regulation 5 requires the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. ADEQ has determined that a detailed geological investigation of the facility is required because karst includes highly permeable foundations with the associated potential for groundwater contamination and potential for sinkholes to open up with collapsing ground or cause differential settlement. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies, i.e. karst, that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section

651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. Additionally, ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of two segments of Big Creek and two segments of the Buffalo National River as impaired further illustrates the need for these detailed studies.

The Department considered all available scientific data and information from, but not limited to, BCRET, United States Geological Survey, University of Arkansas Department of Agriculture, and ADEQ in making this permitting decision.

Comment: I strongly urge you to deny the permit for the future operation of the C&H Hog Farm (CAFO) near Big Creek, West of Mt. Judea, in Newton County, Arkansas. I personally have a strong attachment to the Buffalo National River. My family and I have been canoeing and hiking on the Buffalo National River every year since 1972, when it was designated the first National River in the USA. Our children and grandchildren have grown up canoeing and hiking on the Buffalo River. The C&H Hog Farm Concentrated Animal Feeding Operation (CAFO) dumps millions of gallons of hog urine and feces each year into giant waste lagoons just a few miles from the Buffalo National River. That waste is then sprayed onto fields that are adjacent to Big Creek, a major tributary flowing into the Buffalo National River. That waste is already resulting in the serious pollution of the Buffalo National River. The Buffalo National River is the Crown Jewel of Arkansas, and draws visitors from across the nation and around the world. A new National Park Service report shows that there were 1,463,304 visitors to Buffalo National River in 2015, and they spent $62,243,200 in communities near the park. That spending supported 969 jobs in the local area and had a cumulative benefit to the local economy of $72,009,000. All of that enormous benefit to the people of Arkansas will be in jeopardy if the C&H Farm permit is not denied. I strongly urge you to deny the C&H Hog Farm permit due to lack of compliance with the Agricultural Waste Management Field Handbook (AWMFH). The specific reasons for this denial are the following
1. The failure to acknowledge the presence of karst and follow the subsequent requirements for a detailed geologic investigation (Chapter 7), 2. Application of waste in excess of agronomic need (Ch 2-3), 3. Failure to perform a "substantive evaluation of the impact of sudden breach or accidental release from waste impoundments" (Ch 2-14), 4. Failure to "develop an emergency action plan which should be considered for waste impoundments where there is potential for significant impact from breach or accidental release" (Ch 2-15), 5. Inability to comply with guidance regarding waste application on flood prone and sloping (8-15%) fields. Guidance recommends injection or incorporation which is impractical in this terrain, requiring those fields

be removed from the NMP (601.0504(f) and (m)), 6. Failure to account for proximity of a waste impoundment to sensitive groundwater areas or to investigate groundwater flow direction, especially the failure to identify the presence of an improperly abandoned hand dug well located less than 600 feet downgradient from the ponds. (651.0703 and 651.0702).
Commenter: Francis Millett

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information. The Department's basis for this permitting decision is detailed in the Statement of Basis located at https://www.adeq.state.ar.us/home/pdssql/p_permit_details_water_spb.aspx?AFINDash=51-00164&AFIN=5100164&PmtNbr=5264-W .

Consideration of tourism and revenue is not within the Department's regulatory authority.

Comment: See Attached: Eric Fleming

Commenter: Eric Fleming

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The prior permit issued under APC&EC Regulation 6 General Permit ARG590000 and the coverage under that permit tracking number ARG590001 are outside the scope of the current permitting decision. The initial Notice of Intent and the corresponding NMP for coverage under the prior APC&EC Regulation 6 permit tracking number ARG590001 were available for public comment during the 30-day public comment period beginning on June 25, 2012.

ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen.

> Algal blooms have, and continue to, cause concern on the Buffalo River. As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[1]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the

Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Data supplied from the C&H Hog Farms, Inc. 2014–2017 annual reports document an increase of soil test phosphorus (STP) from 20 ppm to 68 ppm in Field 17 to a more significant increase in Field 1, which increased from 45 ppm to 173 ppm. As stated in University of Arkansas Division of Agriculture Soil Phosphorus: Management and Recommendations FSA1029[3], "Arkansas scientists agree that there is no agronomic reason or need for STP to be greater than about 50 ppm (Mehlich-3 extraction)." However, "with the move from agronomic to environmental concerns with P, soil P testing has been used to indicate when P enrichment of runoff may become unacceptable. A common approach has been to use agronomic soil P standards, following the rationale that soil P in excess of crop requirements is vulnerable to removal by surface runoff or leaching" (FSA1029). "A large amount of research between 1985 and 2000, showed that as STP (Soil Test Phosphorous) increased, especially in the top 2–4 inches of soil, so did the concentrations of soluble P in runoff (Figure 1)" (FSA1029).

As of the C&H Hog Farms, Inc. 2017 Annual Report, results of all soil test phosphorus were greater than 50 ppm. Despite a reported increase of soil test phosphorus in waste application fields, pursuant to NRCS Code 590, the Arkansas Phosphorus Index may still allow application of swine waste because of other factors including phosphorus source potential, transport potential, and best management practice multipliers. FSA9516[2] states that the phosphorus index approach is most appropriate as it accounts for multiple risk factors and provides a better risk assessment of P loss in runoff.

Geotechnical investigations at all land application sites in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3 are necessary to ensure the efficacy of the API and demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River by rapid infiltration through highly permeable or thin soils.

[2] https://www.uaex.edu/publications/PDF/FSA-9516.pdf

[3] https://www.uaex.edu/publications/pdf/FSA-1029.pdf

Comment: I would like to thank you for the opportunity for the Arkansas Pork Producers Association (APPA) to comment on the C & H Draft permit (5264-W). The APPA would like to ask that the permit denial be reversed and approve the draft permit. C & H has been in operation

for the past 5 years and has been the most inspected facility in the history of pork production in Arkansas. They have never had a violation recorded against their operation (Regulation #6). It is one of the best if not the best operated Pork Production facility in the state. C & H has always worked with ADEQ to comply with the exceedingly extra burdens of the going the extra mile to try to satisfy public concerns that were unfounded. They agreed to the BCRET study on Big Creek. This study has been very comprehensive and has yet to show that C & H is impacting the water quality of Big Creek or the Buffalo River. They agreed to the Harbour Drilling study that proved their is not leakage coming from the holding ponds. It was quite evident at the recent public hearing in Jasper (October 16, 2018) that the citizens of the Mount Judea area are very supportive of C & H Hog Farm. For the most part the opposition are outsiders who are extreme activists that have a political agenda that is much more far reaching than C &H Hog Farm. The real truth of the matter is that the attitude from ADEQ to C & H changed somewhere in about November of 2017. The communication and working relationship changed between ADEQ towards C & H. ADEQ kept asking for more information that has never been asked of a Reg. 5 permit applicant in the past. C & H submitted the extra final information to ADEQ on December 29, 2017, they asked in an email if there was anymore information needed. ADEQ responded back that the application was complete only to find out this permit application was denied because there was more information needed. Never in the history of Reg 5 has a producer been held to a higher standard than C and H. The APPA and its members believe this permit denial has been politically motivated. C & H permit decision should be based off of their application not a moving target that is controlled by politics. The APPA would like to ask for a reversal on the current decision and allow C & H to work with ADEQ to supplement the record.

Commenter: Arkansas Pork Producers Association

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department has noted violations during its inspections of the C&H facility near Mt. Judea, Arkansas. However, those violations have not led to a formal enforcement action by the Department against C&H.

The prior permit issued under APC&EC Regulation 6 General Permit ARG590000 and the coverage under that permit tracking number ARG590001 are outside the scope of the current permitting decision. The initial Notice of Intent and the corresponding NMP for coverage under the prior APC&EC Regulation 6 permit tracking number ARG590001 were available for public comment during the 30-day public comment period beginning on June 25, 2012.

Pursuant to the Memorandum of Agreement between the Board of Trustees of the University of Arkansas System for and on behalf of the University of Arkansas System-Division of Agriculture and the Arkansas Department of Environmental

Quality, the study performed by BCRET is being carried out for the use and benefit of ADEQ; however, the study shall be funded and conducted independently of ADEQ and shall meet the requirements of an independent study conducted by professionals in the field of water quality.

Although the analytical data from the C&H Drilling Study did not indicate a leak at the borehole drilling location at the time of the sampling, the Study does not support the conclusion that there is not any leakage from the ponds.

ADEQ must follow its regulations. ADEQ cannot issue a permit if the permit application does not meet the requirements of the applicable regulation. APC&EC Regulation 5 requires the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. ADEQ has determined that a detailed geological investigation of the facility is required because karst includes highly permeable foundations with the associated potential for groundwater contamination and potential for sinkholes to open up with collapsing ground or cause differential settlement. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies, i.e. karst, that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. Additionally, ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed investigations.

Comment: Dear Permits Branch of the Arkansas Department of Environmental Quality: I am writing to you on behalf of the Arkansas Audubon Society, a statewide organization committed to fostering a greater knowledge of the natural history of Arkansas and promoting conservation of our natural resources. We strongly support the draft denial of C&H Hog Farm's application for Arkansas Pollution Control and Ecology Commission Regulation 5 Permit 5264-W, AFIN 51-00164. As feared, mounting evidence links the farm to degradation of the Buffalo River watershed. This permit denial is a positive step towards addressing this threat. ADEQ's statement of basis for the draft denial highlights several alarming pieces of evidence that

demonstrate the threat of the C&H Hog Farm. First, though C&H Hog Farm has claimed the site contains no karst terrain, studies suggest otherwise. A karst landscape means that waste from the farm has the capacity to spread further and faster, particularly during high water events. Operation of such a facility on this landscape would require significantly more environmental assessment and protections take place than currently exist. Second, data from the area suggest unacceptable levels of nutrients such as nitrogen and phosphorous in surrounding waterways and soils, respectively. Sections of Big Creek and the Buffalo River in this region have recently been proposed as impaired by ADEQ based on measures of pathogens and dissolved oxygen, levels of which can be affected by said nutrients. Thus, the evidence strongly suggests that declines in environmental quality are linked to the hog farm operation. In a 2016 comment period, we encouraged ADEQ to think proactively instead of reactively regarding the conservation of the Buffalo River Watershed. The denial of C&H Hog Farm's permit demonstrates an effort to act before it is too late, and we applaud this move. We hope the decision will remain as written in order to protect this natural resource that is so important to citizens of Arkansas and the United States. Thank you for considering our comments.

Commenter: Audubon Society

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at

all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen.

Data supplied from the C&H Hog Farms, Inc. 2014–2017 annual reports document an increase of soil test phosphorus (STP) from 20 ppm to 68 ppm in Field 17 to a more significant increase in Field 1, which increased from 45 ppm to 173 ppm. As stated in University of Arkansas Division of Agriculture Soil Phosphorus: Management and Recommendations FSA1029[2], “Arkansas scientists agree that there is no agronomic reason or need for STP to be greater than about 50 ppm (Mehlich-3 extraction).” However, “with the move from agronomic to environmental concerns with P, soil P testing has been used to indicate when P enrichment of runoff may become unacceptable. A common approach has been to use agronomic soil P standards, following the rationale that soil P in excess of crop requirements is vulnerable to removal by surface runoff or leaching” (FSA1029). “A large amount of research between 1985 and 2000, showed that as STP (Soil Test Phosphorous) increased, especially in the top 2–4 inches of soil, so did the concentrations of soluble P in runoff (Figure 1)” (FSA1029).

As of the C&H Hog Farms, Inc. 2017 Annual Report, results of all soil test phosphorus were greater than 50 ppm. Despite a reported increase of soil test phosphorus in waste application fields, pursuant to NRCS Code 590, the Arkansas Phosphorus Index may still allow application of swine waste because of other factors including phosphorus source potential, transport potential, and best

management practice multipliers. FSA9516[3] states that the phosphorus index approach is most appropriate as it accounts for multiple risk factors and provides a better risk assessment of P loss in runoff.

Geotechnical investigations at all land application sites in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3 are necessary to ensure the efficacy of the API and demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River by rapid infiltration through highly permeable or thin soils.

[2] https://www.uaex.edu/publications/pdf/FSA-1029.pdf
[3] https://www.uaex.edu/publications/PDF/FSA-9516.pdf

Comment: See Attached: National Park Service

Commenter: National Park Service

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two sections of Big Creek (Newton County) and two sections of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen.

NRCS's Web Soil Survey provides a general guide to soil characteristics and ground-truthing is necessary to confirm those soil characteristics. Walking the fields cannot provide the data necessary to evaluate the fields in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3. The ground penetrating radar studies[1] at Fields 1, 5, and 12 indicated that land application to those fields should be limited in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3. The ground penetrating radar studies suggest that these fields have characteristics identified in AWMFH 651.0504 (a)–(n) and Table 5-3, such as areas of higher permeability, thin soils of less than twenty (20) inches (see excerpts from the ERI Study below), and soils with a significant fractions of rock fragments preventing some soils samples from being taken. The limitations for land application sites

based on the above-referenced soil characteristics are part of the AWMFH with the purpose of preventing contamination of ground water. Geotechnical investigations of the land application fields are necessary to account for the soils characteristics that require limitations on animal waste application.
[1] As part of the BCRET study, USDA, NRCS conducted Ground Penetrating Radar (GPR) Surveys for Fields 1 and 5 in November of 2013 and Field 12 in April of 2014.

Field 5a exhibits average soil thicknesses of 0.5 to 4.5 meters (1.5 to 14.75 feet). Field 12 is a low-lying grazing area with low relief and an uneven topsoil surface. Field 12 exhibits similar average soil thicknesses at 0.7 to 4 meters (2.25 to 13 feet). Field 1 shows an average soil thickness of 0.5 meters (1.5 feet) determined from the ERI surveys and soil sampling. Field 1 has thinner and rockier soils than either Fields 5a or 12. In Field 12, there appears to be a large doline feature (a closed topographic depression caused by dissolution or weathering of underlying rock or soil) within the bedrock, approximately 61 meters (200 feet) across at the top of the feature, starting 8 meters (26 feet) below the land surface and extending 23 meters (75 feet) vertically downward.[2]
[2] Jon Fields and Todd Halihan, Electrical Resistivity Surveys of Applied Hog Manure Sites, Mount Judea, AR (2015).

Dye studies performed by Brahana et al. (2016, 2017)[3] and hydrologic studies by Murdoch et al. (2016)[4] in the Big Creek watershed indicate the connectivity of karst hydrology of the Boone Formation. Thomas Aley's May 24, 2018 expert report thoroughly explains karst geology and provides supporting evidence of the deficiencies of C&H Hog Farms, Inc.'s Regulation 5 application to address land application in karst topography.
[3] Brahana, V., J. Nix, C. Kuyper, T. Turk, F. Usrey, S. Hodges, C. Bitting, K. Ficco, E. Pollock, R. Quick, and others. 2016. Geochemical Processes and Controls Affecting Water Quality of the Karst Area of Big Creek near Mt. Judea, Arkansas. Journal of the Arkansas Academy of Science 70:45–58.
Brahana, V., C. Bitting, K. Kosic-Ficco, T. Turk, J. Murdoch, B. Thompson, and R. Quick, 2017, Using fluorescent dyes to identify meaningful water-quality sampling locations and enhance understanding of groundwater flow near a hog CAFO on mantled karst—Buffalo National River, southern Ozarks: *in* Kuniansky, E.L., and Spangler, L.E., eds., U.S. Geological Survey Karst Interest Group Proceedings, San Antonio, Texas, May 19-23, 2017, U.S. Geological Survey Scientific Investigations Report 2017-5023, p. 147-160.
[4] Murdoch, J., C. Bitting, and J. Van Brahana. 2016. Characterization of the karst hydrogeology of the Boone Formation in Big Creek Valley near Mt. Judea, Arkansas—documenting the close relation of groundwater and surface water. Environmental Earth Sciences 75:1160.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[5] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[5] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. A detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) including, but not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[5] Ground penetrating radar studies demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. Geotechnical investigations are necessary to demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[5] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

> Algal blooms have, and continue to, cause concern on the Buffalo River. As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[5]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused

on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.

The API, (Strategy 2 in AWMFH 651.0015) is a risk based approach for assessment of phosphorus loadings as it regards surface runoff. The Statement of Basis for ADEQ's draft denial of the permit discusses the severe and unknown limitations for many of the application fields as well as the field phosphorus build-up and the legacy phosphorus (see pages 4 of 9, 7 of 9, and 8 of 9) issues. Likewise the commenter's discussion of the waste storage pond vulnerabilities and the lack of geological and liner investigation (page 3 of 9 and 5 of 9) in the Statement of Basis is ample justification for denial of the permit.

The Arkansas Department of Health did not submit a comment regarding C&H Hog Farms, Inc., AFIN 51-00164, during the public comment period ending October 24, 2018.

The Department acknowledges the following statements from the Buffalo River Watershed-Based Management Plan dated May 22, 2018, regarding threatened and endangered species in the Buffalo River watershed:

> The Buffalo River and its tributaries are considered high quality water resources. The Buffalo River and its tributaries support over fifty (50) species of fish and over twenty (20) species of mussels. Portions of the Buffalo River have been designated critical habitat for the threatened Rabbitsfoot mussel, *Quadrula cylindrical cylindrical* (State/Federal Status: Endangered/Threatened, respectively). The watershed also includes important habitat for endangered bat species: Gray Bat, *Myotis grisescens* (State/Federal Status: Endangered); Indiana Bat, *Myotis sodalis* (State/Federal Status: Endangered); Ozark Big-eared Bat, *Corynorhinus townsendii ingens* (State/Federal Status: Endangered); and Northern Long-eared Bat, *Myotis septentrionalis* (State/Federal Status: Endangered/Threatened, respectively). Cave and other karst features in the Buffalo River watershed are important habitats for all of the protected bat species.[5]

However, the Department did not receive any comments during the comment period ending on October 24, 2018, regarding endangered or threatened species and their associated habitats from Arkansas Game & Fish Commission, Arkansas Natural Heritage Commission, or U.S. Fish and Wildlife Service.

Comment: See Attached: Ozark Society

Commenter: Ozark Society

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department refers the commenter to the Response to Comments dated September 17, 2018, regarding the commenter's restatement of their previous comments.

The Department acknowledges the resuscitations of facts and statements from information present in the permit application record including, but not limited to, inspection reports prepared by ADEQ, depositions, expert reports, and BCRET reports.

ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two sections of Big Creek (Newton County) and two sections of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section

651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two sections of Big Creek (Newton County) and two sections of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Consideration of tourism and the economy are not within the Department's regulatory authority.

Seepage from waste storage ponds has the potential to pollute surface and ground water. The record included one recompacted permeability test that is insufficient to determine liner integrity. The necessary soil investigations including, but not limited to, percentage of fines and soil permeability characteristics, have not been performed at this facility in accordance with the AWMFH 651 Table 10-4 and Appendix 10D. Plasticity index analysis was performed on one sample of the *in situ* clay material in boring 2. The variability in the regolith expected in this geologic setting coupled with the insufficient data creates additional concerns about the siting and soil sources for the clay liner. The required number of borings were not advanced within the pool areas in accordance with AWMFH 651.0704(b)(4); these additional borings would have provided more data for assessment of clay source material. Proper soil investigations for the liner material are necessary to determine the suitability and location of the clay source material and to consider any additional geotechnical testing to confirm material properties, which will reduce the potential for downward and/or lateral seepage of the stored wastes.

The API, (Strategy 2 in AWMFH 651.0015) is a risk-based approach for assessment of phosphorus loadings as it regards surface runoff. The Statement of Basis for ADEQ's draft denial of the permit discusses the severe and unknown limitations for many of the application fields as well as the field phosphorus build-up and the legacy phosphorus (see pages 4 of 9, 7 of 9, and 8 of 9) issues

mentioned in the comment. Likewise, the commenter's discussion of the waste storage pond vulnerabilities and the lack of geological and liner investigation (page 3 of 9 and 5 of 9) of the Statement of Basis is ample justification for denial of the permit. The Statement of Basis does not address the alleged discrepancy in the number of swine at the facility among the various Design Reports and applications.

Pursuant to the Memorandum of Agreement between the Board of Trustees of the University of Arkansas System for and on behalf of the University of Arkansas System-Division of Agriculture and the Arkansas Department of Environmental Quality, the study performed by BCRET is being carried out for the use and benefit of ADEQ; however, the study shall be funded and conducted independently of ADEQ and shall meet the requirements of an independent study conducted by professionals in the field of water quality.

Comment: See Attached: C&H Hog Farms, Inc.

Commenter: C&H Hog Farms, Inc.

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The case styled C&H Hog Farms, Inc. vs. Arkansas Pollution Control & Ecology Commission, 51-CV-18-58, filed in Newton County, Arkansas, is outside the scope of this permitting decision. ADEQ is not a party in the aforementioned matter.

Per the Rules of Arkansas State Board of Registration for Professional Geologists Sections 4-1 and 5-2 (Sections 21 and 27 (a) of Act 701 of the 1987 Regular Session):

> *"Each registrant under this Act, upon issuance of a certificate of registration, may purchase from a source approved by the Board a seal of such design as is authorized by the Board, bearing the registrant's name, the name of this State, and the legend "Registered Professional Geologist" or "Certified (sub-specialty) Geologist". All drawings, reports, or other geologic papers or documents involving the practice of geology, which shall have been*

> *prepared or approved by a registered geologist or a subordinate employee under his direction for the use of or for delivery to any person or for public record within this State shall be signed by him and impressed with the Seal provided for in this section or the seal of a nonresident practicing under this Act, either of which shall indicate his responsibility for them."*
> *"It shall be unlawful for any person other than a registered geologist, a registered certified specialty geologist, or a subordinate under the direction of one of the above to prepare any geologic plans, reports, or documents in which the performance is related to the public welfare or safeguarding of life, health, property, or the environment."*

The proposed work plan submitted for comment does not bear the signature and impression of the Seal of a professional geologist registered in the state of Arkansas. Additionally, this proposed work plan does not bear the seal of an engineer licensed in the state of Arkansas.

The applicant was previously granted coverage under an APC&EC Regulation 6 general permit. The prior permit issued under APC&EC Regulation 6 General Permit ARG590000 and the coverage under that permit tracking number ARG590001 are outside the scope of the current permitting decision.

The applicant submitted an application for an APC&EC Regulation 5 individual no-discharge permit. While the applicant may have styled the application as an administrative change, the Department does not have any available statutory or regulatory mechanism to administratively change the coverage issued pursuant to an APC&EC Regulation 6 general permit to an individual permit under APC&EC Regulation 5.

The Statement of Basis does not address the alleged discrepancy in the number of swine at the facility among the various Design Reports and applications.

The Department cannot issue a permit based upon the proposed work plan, as submitted. This proposed work plan does not contain adequate data and conclusions to inform the implementation and execution of a proposed work plan.

The author of the proposed work plan has failed to fully include the description provided for the Boone by McFarland (2004)[1]. In this description, it is also noted that "The Boone is well known for dissolution features such as sinkholes, caves, and enlarged fissures." This information is vital to the characterization and understanding of the local hydrogeologic setting.
[1] McFarland, J.D., 2004, Stratigraphic Summary of Arkansas (Information Circular 36). Arkansas Geological Commission. Little Rock, AR.

C&H has not performed the necessary borings within the pool area to demonstrate there are no large voids, solution channels, or fractures. The borings advanced at the C&H facility are not sufficient to meet the requirement of five (5) borings within the pool area in accordance with AWMFH 651.0703(b)(4). The proposed work plan submitted by Terracon, on behalf of C&H, does not provide for additional borings in the pool area to meet the requirements set forth in AWMFH 651.0703(b)(4). Without this essential geologic assessment, C&H has not demonstrated that its facility is not in a "very high" risk area. ADEQ has determined that a detailed geological investigation of the facility is required because karst includes highly permeable foundations with the associated potential for groundwater contamination and potential for sinkholes to open up with collapsing ground or cause differential settlement. AWMFH 651.0702(l). In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies, i.e. karst, that includes, but is not limited to, borings within the pool areas to ascertain the foundation of earth-filled structures and to rule out the presence of large voids in karst. AWMFH 651.0703(b)(4); AWMFH 651, Table 10-4.

The borings advanced by GTS, Inc., in May 2012, are not sufficient to meet the requirements of the geologic investigations required by APC&EC Regulation 5 and the AWMFH. Additionally, those borings were not allowed to stand open for the 24 hours as discussed in AWMFH 651.0704(b)(2) and necessary to determine the water table level at each boring location.

The three groundwater monitoring wells proposed for the groundwater assessment are not sufficient for the hydrogeologic setting and cannot adequately characterize the groundwater flow through the highly complex karst system. Groundwater flow within this region is complex, often exhibiting radial flow paths and unexpected flow direction when compared to slope of the land.

AWMFH 651.0703(b) Groundwater Flow Direction:

> *"**A desirable site for a waste storage pond or treatment lagoon is in an area where groundwater is not flowing away from the site toward a well, spring, or important underground water supply**. The direction of flow in a water table aquifer generally follows the topography, with lesser relief. In most cases, the slope of the land indicates the groundwater flow direction. In humid regions, the shape of the water table is a subdued reflection of surface topography. Unconfined groundwater moves primarily from topographically higher recharge areas down gradient to discharge areas. Lower areas serve as discharge points where groundwater rises and merges with perennial streams and ponds, drainage ditches, or flows as springs. Radial flow paths and **unusual subsurface geology can too often invalidate this assumption**. **Consider the case where secondary porosity governs the flow**. A common example is bedrock in upland areas where the direction of groundwater flow is strongly controlled by the trend of prominent joint sets or fractures. Fracture patterns in the rock may not be parallel to the slope of the ground surface. **Thus, assuming that groundwater flow is parallel to the topography can be misleading in terrain where flow is controlled by bedrock fractures."***

In karst settings groundwater flow is often governed by secondary porosity. The C&H Drilling Study performed by Harbor Environmental identified several features that are indicative of karst, including but not limited to potential voids, epikarst, and evidence of dissolution. Fractures and fracture zones were also identified at various depth intervals. These findings are consistent with McFarland's Stratigraphic Summary of Arkansas.[1]

This proposed work plan does not appear to take into consideration high permeability zones such as the location of conduits or fractures and the epikarst/soil-bedrock interface in the proposed groundwater assessment. Recent dye trace studies by Brahana et al. (2016, 2017)[2], which were relied upon by Dr. Sharpley, and hydrologic studies by Murdoch et al. (2016)[3] in the area indicate groundwater flow within this region is complex.

[2] Brahana, V., J. Nix, C. Kuyper, T. Turk, F. Usrey, S. Hodges, C. Bitting, K. Ficco, E. Pollock, R. Quick, and others. 2016. Geochemical Processes and

Controls Affecting Water Quality of the Karst Area of Big Creek near Mt. Judea, Arkansas. Journal of the Arkansas Academy of Science 70:45–58.
Brahana, V., C. Bitting, K. Kosic-Ficco, T. Turk, J. Murdoch, B. Thompson, and R. Quick, 2017, Using fluorescent dyes to identify meaningful water-quality sampling locations and enhance understanding of groundwater flow near a hog CAFO on mantled karst—Buffalo National River, southern Ozarks: *in* Kuniansky, E.L., and Spangler, L.E., eds., U.S. Geological Survey Karst Interest Group Proceedings, San Antonio, Texas, May 19-23, 2017, U.S. Geological Survey Scientific Investigations Report 2017-5023, p. 147-160.
[3] Murdoch, J., C. Bitting, and J. Van Brahana. 2016. Characterization of the karst hydrogeology of the Boone Formation in Big Creek Valley near Mt. Judea, Arkansas—documenting the close relation of groundwater and surface water. Environmental Earth Sciences 75:1160.

The proposed work plan references to soil survey data are insufficient and fail to address available data and other documented concerns. The proposed work plan does not include a comprehensive field reconnaissance of the operation area and associated land application areas to identify and evaluate geologic features. Due to the complexity of the sites, detailed field investigations to identify the location of springs, sinkholes and doline features, and other karst features and conclusive site-specific geotechnical information of the land application fields to account for the characteristics that limit application rates, are needed.

AWMFH 651.0704 states that:

> ***"The purpose of a detailed geologic investigation is to determine geologic conditions at a site that will affect or be affected by design, construction, and operation of an AWMS component."***

The proposed work plan makes no provisions for determining the possible presence of voids beneath the constructed ponds. The proposed scope of work makes no provisions for determination and characterization of high permeability zones, which may transport groundwater (and any leakage from the ponds).

The proposed work plan does not include data or other information to resolve the deficiencies in the permit application record regarding berm construction. Pursuant to AWMFH 651.0704(b)(4), borings are required in the embankment centerline of the berms as part of the detailed geologic investigation. Neither the as-built plans nor the proposed work plan provide data to demonstrate that the

berms were constructed in compliance with APC&EC Regulation 5 and the AWMFH. The C&H Drilling Study cannot satisfy the requirements of the AWMFH as the bore hole was not within the pool area or berm centerline.

The proposed work plan indicates the size of the excavation area for the pond and pond liner material. The information provided is insufficient to identify the mineral, structural, and hydraulic characteristics of the soil and rock materials. Additionally, a soil balance was never provided to quantify that the appropriate materials were available to construct the berms and clay liners.

AWMFH 651.0704(b)(2) states that:

> *"**During a geologic investigation, all soil and rock materials at the site or in borrow areas are identified and mapped.** From an engineering standpoint, a mappable soil or rock unit is defined as a zone that is consistent in its mineral, structural, and hydraulic characteristics and sufficiently homogeneous for descriptive and mapping purposes."*

Additionally, AWMFH 651.0704(b)(4) states that:

> ***"Borrow areas for embankment type structures and clay liners should be located, described, and mapped. Locate at least 150 percent suitable borrow of the required fill volume."***

Maps of soil and rock materials, both at the site and in the borrow area, have not been provided by the applicant previously, or in this proposed work plan. The previous submittals and the proposed work plan are insufficient to demonstrate that materials of appropriate quality and quantity were available and used during construction, adding additional concerns regarding the berm construction and clay liner integrity.

The proposed work plan proposed the installation of a synthetic liner to address the deficiencies related to liner integrity. The proposed design of the synthetic liner is inadequate. The technical information and drawing provided regarding the installation of a synthetic liner are insufficient to address the known and potentially unknown conditions at the site, such as compatibility with the existing liner material including the potential for puncture from large, angular rocks. The Department notes that the synthetic liner proposed in the comment submitted on

October 23, 2018, is less robust than the synthetic liner proposed previously on July 7, 2015.

As a result, additional information in response to potential deficiencies in liner integrity are still needed. The record included one recompacted permeability test that is insufficient to determine liner integrity. The necessary soil investigations including, but not limited to, percentage of fines and soil permeability characteristics, have not been performed at this facility in accordance with the AWMFH 651 Table 10-4 and Appendix 10D. Plasticity index analysis was performed on one sample of the *in situ* clay material in boring 2. The variability in the regolith expected in this geologic setting coupled with the insufficient data creates additional concerns about the siting and soil sources for the clay liner. The required number of borings were not advanced within the pool areas in accordance with AWMFH 651.0704(b)(4); these additional borings would have provided more data for assessment of clay source material. Proper soil investigations for the liner material are necessary to determine the suitability and location of the clay source material and to consider any additional geotechnical testing to confirm material properties, which will reduce the potential for downward and/or lateral seepage of the stored wastes.

Additionally, NRCS, in Appendix 10D of the AWMFH, indicates that special design measures are necessary where agricultural waste storage ponds are constructed in soils with high calcium content (BCRET Quarterly Report for October 2016 to December 2016, Table 10, page 71) or highly unfavorable geologic conditions, such as karst formations.

Substantial groundwater flow can occur at the soil bedrock interface or within the epikarst zone. However, these zones may not be continually saturated. A portion of the pond depth appears to be located within the epikarst zone, with only the clay liner separating the waste from this potentially highly permeable zone. The location of the epikarst zone and its unknown ground water flow and potential for voids, which causes stability concerns, coupled with the insufficient data necessary to demonstrate liner integrity further establishes the need for detailed geotechnical investigations at the facility.

The Environmental Assessment dated December 2015 is outside the scope of this permitting decision.

Scientists studying the Savoy Swine Facility have taken great efforts to conduct geologic investigations and have collected a large amount of data to demonstrate that there is very little leakage from the waste holding ponds and settling basin at the Savoy Swine Facility, which is not a CAFO.[4] University of Arkansas scientists conducted a karst inventory in the area of the Savoy Swine Facility to gain a better understanding of the ground-water system prior to sampling point selection and well drilling.[4] The interceptor trench installed at the Savoy Swine Facility extended to the bedrock surface to allow collection of lagoon leachate moving down-gradient from the waste lagoon after a storm event.[4]

A groundwater flow study has not been submitted to the Department for review. The Department has no knowledge of any groundwater studies that may have informed the placement of the interceptor trenches. The information on the interceptor trenches provided in the BCRET Quarterly Report for July 1 to September 30, 2014 is not sufficient to determine the appropriateness of the placement of the interceptor trenches for the purpose of monitoring leakage from the waste storage ponds. At this time, the Department does not have sufficient information to comment on the appropriateness of placement of the trenches or on the sufficiency of those trenches as a monitoring system for the waste storage ponds.

[4] Christopher M. Hobza, David C. Moffit, Danny P. Goodwin, Timothy Kresse, John Fazio, John V. Brahana, and Phillip D. Hays, 2005, Ground-Water Quality Near a Swine Waste Lagoon in a Mantled Karst Terrane in Northwestern Arkansas, U.S. Geological Survey Karst Interest Group proceedings, Rapid City, South Dakota, September 12-15, 2005: U.S. Geological Survey Scientific Investigations Report 2005-5160, p. 155-162.

The proposed work plan does not address the Department's concerns regarding the suitability of the land application sites. The ground penetrating radar studies[5] at Fields 1, 5, and 12 indicated that land application to those fields should be limited in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3. The ground penetrating radar studies suggest that these fields have characteristics identified in AWMFH 651.0504 (a)–(n) and Table 5-3, such as areas of higher permeability, thin soils of less than twenty (20) inches, and soils with significant fractions of rock fragments preventing some soil samples from being taken. The limitations for land application sites based on these soil characteristics are part of the AWMFH with the purpose of preventing contamination of ground water. Conclusive site-specific geotechnical information of the land application fields is

necessary to account for the soil characteristics that require limitations on animal waste application.

[5]As part of the BCRET study, USDA, NRCS conducted Ground Penetrating Radar (GPR) Surveys for Fields 1 and 5 in November of 2013 and Field 12 in April of 2014.

C&H Hog Farms, Inc. submitted an Emergency Action Plan to the Department on October 23, 2018. The Emergency Action Plan did not address possible failure of the liner resulting from potential damage, such as pumping and agitation, liner desiccation, or any other site-specific operational risks are not addressed, in accordance with AWMFH 651.0204(a), (b).

Comment: See Attached: Arkansas Farm Bureau

Commenter: Arkansas Farm Bureau

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

It is the applicant's responsibility to design its own liquid animal waste management systems in accordance with state laws and APC&EC Regulation 5. It is then the Department's charge to evaluate the proposed systems for compliance with state laws and APC&EC Regulation 5.

C&H has not addressed all concerns regarding the necessity of a directional groundwater flow study; studies by Brahana, et al. [1], [2] indicate the uncertainty of groundwater flow direction at this facility and thus the necessity for those studies. C&H has not demonstrated that groundwater does not flow away from the site toward a spring or important underground water supply, such as underground water that supplies surface waters. AWMFH 651.0703(b). C&H has only provided documentation that all wells located in the proximity of the lagoons have been properly closed. Because no groundwater flow direction study has been performed, the Department has relied upon the studies performed by University of Arkansas scientists that demonstrate that groundwater flows from C&H towards and ultimately into Big Creek and the Buffalo National River. A study of precipitation, water levels in wells, and water levels in streams in Big Creek Valley upstream from its confluence with the Buffalo National River demonstrate the interconnectedness of groundwater to surface water and the rapid water-level

response following precipitation onset.[2] Detailed geologic investigations, including a directional groundwater flow study, are necessary to determine that groundwater, and thus Big Creek and the Buffalo National River, are not influenced by the waste storage holding ponds, on-farm activities, or waste management practices.

[1] Brahana, V., J. Nix, C. Kuyper, T. Turk, F. Usrey, S. Hodges, C. Bitting, K. Ficco, E. Pollock, R. Quick, and others. 2016. Geochemical Processes and Controls Affecting Water Quality of the Karst Area of Big Creek near Mt. Judea, Arkansas. Journal of the Arkansas Academy of Science 70:45–58.

Brahana, V., C. Bitting, K. Kosic-Ficco, T. Turk, J. Murdoch, B. Thompson, and R. Quick, 2017, Using fluorescent dyes to identify meaningful water-quality sampling locations and enhance understanding of groundwater flow near a hog CAFO on mantled karst—Buffalo National River, southern Ozarks: *in* Kuniansky, E.L., and Spangler, L.E., eds., U.S. Geological Survey Karst Interest Group Proceedings, San Antonio, Texas, May 19-23, 2017, U.S. Geological Survey Scientific Investigations Report 2017-5023, p. 147-160.

[2] Murdoch, J., C. Bitting, and J. Van Brahana. 2016. Characterization of the karst hydrogeology of the Boone Formation in Big Creek Valley near Mt. Judea, Arkansas—documenting the close relation of groundwater and surface water. Environmental Earth Sciences 75:1160.

C&H has not performed the necessary borings within the pool area to demonstrate there are no large voids, solution channels, or fractures. Without this essential geologic assessment, C&H has not demonstrated that its facility is not in a "very high" risk area. ADEQ has determined that a detailed geological investigation of the facility is required because karst includes highly permeable foundations with the associated potential for groundwater contamination and potential for sinkholes to open up with collapsing ground or cause differential settlement. AWMFH 651.0702(l). In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies, i.e. karst, that includes, but is not limited to, borings within the pool areas to ascertain the foundation of earth-filled structures and to rule out the presence of large voids in karst. AWMFH 651.0703(b)(4); AWMFH 651, Table 10-4. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

The Department has noted violations during its inspections of the C&H facility near Mt. Judea, Arkansas. However, those violations have not led to a formal enforcement action by the Department against C&H.

The Department acknowledges Farm Bureau's statement that the necessary geologic investigations were not performed with the original application. The

Department is unaware of any investigations performed by FTN & Associates at the C&H facility. The investigations performed by BCRET, ADEQ, and Harbor Environmental and Safety are not sufficient to meet the requirements of the geologic investigations necessary to understand complex geologies as required by APC&EC Regulation 5 and the AWMFH, as amended.

On March 25, 2016, John Bailey, on behalf of ADEQ, sent a letter to C&H Hog Farms, Inc. notifying C&H that the requested modification to install a synthetic liner in both lagoons was approved and that the requested modification would expire after one year. Should C&H not install the liners within that one-year period, C&H would be required to resubmit plans and obtain a new approval from the Department. Mr. Bailey approved the installation of synthetic liners under the terms of the now expired General Permit ARG590000, tracking number ARG590001. Mr. Bailey's approval authorizing C&H to install the synthetic liners expired on March 25, 2017.

Seepage from waste storage ponds has the potential to pollute surface and ground water. The record included one recompacted permeability test that is insufficient to determine liner integrity. The necessary soil investigations including, but not limited to, percentage of fines and soil permeability characteristics, have not been performed at this facility in accordance with the AWMFH 651 Table 10-4 and Appendix 10D. Plasticity index analysis was performed on one sample of the in situ clay material in boring 2. The variability in the regolith expected in this geologic setting coupled with the insufficient data creates additional concerns about the siting and soil sources for the clay liner. The required number of borings were not advanced within the pool areas in accordance with AWMFH 651.0704(b)(4); these additional borings would have provided more data for assessment of clay source material. Proper soil investigations for the liner material are necessary to determine the suitability and location of the clay source material and to consider any additional geotechnical testing to confirm material properties, which will reduce the potential for downward and/or lateral seepage of the stored wastes.

Additionally, NRCS, in Appendix 10D of the AWMFH, indicates that special design measures are necessary where agricultural waste storage ponds are constructed in soils with high calcium content[3] or highly unfavorable geologic conditions, such as karst formations.
[3] BCRET Quarterly Report for October 2016 to December 2016, Table 10, page 71.

NRCS's Web Soil Survey provides a general guide to soil characteristics and ground-truthing is necessary to confirm those soil characteristics. Walking the fields cannot provide the data necessary to evaluate the fields in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3. The ground penetrating radar

studies[4] at Fields 1, 5, and 12 indicated that land application to those fields should be limited in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3. The ground penetrating radar studies suggest that these fields have characteristics identified in AWMFH 651.0504 (a)–(n) and Table 5-3, such as areas of higher permeability, thin soils of less than twenty (20) inches (see excerpts from the ERI Study below), and soils with a significant fractions of rock fragments preventing some soils samples from being taken. The limitations for land application sites based on the above-referenced soil characteristics are part of the AWMFH with the purpose of preventing contamination of ground water. Geotechnical investigations of the land application fields are necessary to account for the soils characteristics that require limitations on animal waste application.
[4] As part of the BCRET study, USDA, NRCS conducted Ground Penetrating Radar (GPR) Surveys for Fields 1 and 5 in November of 2013 and Field 12 in April of 2014.

Field 5a exhibits average soil thicknesses of 0.5 to 4.5 meters (1.5 to 14.75 feet). Field 12 is a low-lying grazing area with low relief and an uneven topsoil surface. Field 12 exhibits similar average soil thicknesses at 0.7 to 4 meters (2.25 to 13 feet). Field 1 shows an average soil thickness of 0.5 meters (1.5 feet) determined from the ERI surveys and soil sampling. Field 1 has thinner and rockier soils than either Fields 5a or 12. In Field 12, there appears to be a large doline feature (a closed topographic depression caused by dissolution or weathering of underlying rock or soil) within the bedrock, approximately 61 meters (200 feet) across at the top of the feature, starting 8 meters (26 feet) below the land surface and extending 23 meters (75 feet) vertically downward.[5]
[5] Jon Fields and Todd Halihan, Electrical Resistivity Surveys of Applied Hog Manure Sites, Mount Judea, AR (2015).

C&H Hog Farms, Inc. submitted an Emergency Action Plan to the Department on October 23, 2018. The Emergency Action Plan did not address possible failure of the liner resulting from potential damage, such as pumping and agitation, liner desiccation, or any other site-specific operational risks are not addressed, in accordance with AWMFH 651.0204(a), (b).

APC&EC Reg. 22 is not applicable to an APC&EC Reg. 5 permitting decision. While APC&EC Regulation 22 may not preclude the issuance of landfill permit coverage, it does require additional studies for landfills located in karst topography, just as APC&EC Regulation 5, through the AWMFH, requires additional studies for liquid animal waste facilities located in karst. Additional and more robust design elements are also required for facility design and construction. Relevant excerpts from APC&EC Regulation 22 are provided below.

Reg.22.102- Definitions

Karst terrains means areas where karst topography, with its characteristic surface and subterranean features, is developed as the result of dissolution of limestone, dolomite, or other soluble rock. Characteristic physiographic features present in karst terranes include, but are not limited to, sinkholes, sinking streams, caves, large springs, and blind valleys.

Unstable area means a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of the landfill structural components responsible for preventing releases from a landfill. Unstable areas can include poor foundation conditions, areas susceptible to mass movements, and Karst terranes.

Reg.22.407- Unstable Areas

(a) Applicability - Owners or operators of new units, existing units, and lateral expansions located in an unstable area must demonstrate that engineering measures have been incorporated into the unit's design to ensure that the integrity of the structural components of the unit will not be disrupted. The owner or operator must place the demonstration in the operating record, notify the Director that it has been placed in the operating record, and provide the demonstration to the Director for approval. The owner or operator must consider the following factors, at a minimum, when determining whether an area is unstable:

(1) On-site or local soil conditions that may result in significant differential settling;

(2) On-site or local geologic or geomorphologic features; and

(3) On-site or local human-made features or events (both surface and subsurface).

(b) For purposes of this section:

(1) Unstable area means a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of the landfill structural components responsible for preventing releases from a landfill. Unstable areas can include poor foundation conditions, areas susceptible to mass movements, and Karst terrain.

(2) Structural components means liners, leachate collection systems, final covers, runon/run-off systems, and any other component used in the construction and operation of the facility that is necessary for protection of human health and the environment.

(3) Poor foundation conditions means those areas where features exist which indicate that a natural or man-induced event may result in inadequate foundation support for the structural components of an solid waste unit.

(4) Areas susceptible to mass movement means those areas of influence (i.e., areas characterized as having an active or substantial possibility of mass movement) where the movement of earth material at, beneath, or adjacent to the municipal solid waste landfill unit, because of natural or man-induced events, results in the down slope transport of soil and rock material by means of gravitational influence. Areas of mass movement include, but are not limited to, landslides, avalanches, debris slides and flows, soil fluction, block sliding, and rock fall.

(5) Karst terrain means areas where karst topography, with its characteristic surface and subterranean features, is developed as the result of dissolution of limestone, dolomite, or other soluble rock. Characteristic physiographic features present in karst terrain include, but are not limited to, sinkholes, sinking streams, caves, large springs, and blind valleys.

Reg.22.425- Landfills In Boone and St. Joe Formations

(a) Applicability - The following are minimum design standards for Class 1 landfills that are located within the outcrop area of the Boone and St. Joe Formations. The design phase of a project must neutralize all limitations noted in the site characterization study through engineering modification or operating methods. The design of the containment structure must meet or exceed the minimum standards listed in these regulations.

(b) Separation Requirements -

(1) A minimum separation of ten (10) feet must be maintained between the bottom of the bottom liner system and the seasonal high water table surface.

(2) A minimum vertical separation of ten (10) feet must be maintained between the bottom liner and the highest point of the bedrock or pinnacles.

(3) All fill structures and operations must be above the one hundred (100) year flood elevation.

(c) Liner System -

(1) The minimum slope on the bottom liner must insure positive drainage of leachate after maximum loading and maximum expected strain.

(2) All bottom liner systems must consist of a double composite separated by a leak detection system. Each composite liner shall consist of an upper geomembrane liner (60 mil minimum thickness) directly overlying a low permeability soil layer, as described in Reg. 22.424(b).

(3) The soil and synthetic components of the composite liner must meet the requirements of Reg. 22.428.

(d) Leachate Collection System - The double composite liner system must have a leachate removal system directly overlying the upper composite liner. In addition to the requirements of Reg.22.429, the leachate collection and removal system must meet the following standards:

(1) The system must be designed such that leachate head above the primary composite liner does not exceed one foot under the most severe conditions anticipated.

(2) The drainage material must be free of organic and carbonate material, contain less than five percent (5%) by weight which passes the #200 sieve, have a minimum hydraulic conductivity of 1 x 10-3 and be a minimum of twenty-four (24) inches in thickness. Equivalent drainage nets or fabric may be used in lieu of the twenty-four (24) inch drainage layer provided a substitute protective layer is provided and the system provides an equivalent hydraulic conductivity to the twenty-four (24) inch layer.

(3) Leachate collection pipes must be incorporated into the drainage layer to convey liquid out of the landfill to storage tanks or a treatment system. The pipes must be a minimum of six (6) inches in diameter and must be chemically compatible with the leachate generated at the landfill and be structurally capable of supporting the maximum static and dynamic load anticipated from the overlying fill material and construction equipment.

(e) Leak Detection System - The double composite liner system must have a leak detection system located between the upper composite and the lower composite liners. The leak detection system must conform to the following standards:

(1) The minimum thickness of the coarse grained material must be 1 foot;

(2) Leak detection systems shall meet the standards for leachate collection system design and construction. A minimum hydraulic conductivity of 1 x 10-3 cm/sec must be obtained in the leak detection system material.

(3) An action leakage rate must be developed for the design and approved by the Department. If leakage rates exceed the action leakage rate, fill operations must cease and the Department must be notified. A written contingency plan must be developed for the facility which outlines steps and measures to be taken if the action leakage rate is exceeded.

(4) Daily records of fluid accumulation in the leak detection system must be maintained by the owner or operator.

(j) Alternative Designs - The Department may approve alternative designs proposals if determined by the staff to meet or exceed the minimum standards set forth above.

(k) Quality Assurance and Quality Control - A Quality Control and Quality Assurance Plan for liner and final cover construction must be developed in accordance with the requirements of Reg.22.428.

(l) Quality Assurance - The permittee shall employ a third party engineering firm to insure proper construction of each component of the containment structure in accordance with the requirements of Reg.22.428.

Reg.22.1101- General Requirements

The purpose of the geotechnical and hydrogeological site investigation is to thoroughly characterize all aspects of the property which may directly or indirectly affect the design, construction, operation or monitoring of the solid waste containment structure.

Reg.22.1102- Class 1 And Class 3 Landfills

(e) Boone-St. Joe Aquifer Of Northern Arkansas - Proposed landfills located within the outcrop area of the Boone or St. Joe Formations of Northern Arkansas, which will receive municipal solid waste or waste with a high potential for adversely impacting surface or ground water quality (Class 1 or Class 3), may be required to perform additional studies (i.e., in addition to the requirements under Reg.22.1101, Reg.22.1102(a) through (d) and (f), and Reg.22.1103) in order to adequately characterize the site. At a minimum, the additional studies will include:

(1) A detailed surface mapping of all karst features including, but not limited to, sinkholes, springs, loosing stream segments, caves, and dolines;

(2) A subsurface exploration program which consists of core drilling at a minimum spacing of one boring per one acre;

(3) A down-hole video log and/or a geophysical log, obtained by one of the methods under Reg.22.1102(c)(4)(vi), must be conducted for each boring; and

(4) A ground water dye trace study shall be performed to test the accuracy of the sites conceptual hydrogeologic model. The dye study methodology must be approved by the Department and shall consists of a sufficient number of monitoring locations, which will include wells/piezometers, streams, and springs.

APC&EC Regulation 5 requires a site-specific geologic investigation. Site characterizations of the Savoy Swine Facility are not applicable to the C&H facility because each facility must be evaluated independently. The composition of the Boone formation at the C&H facility differs from the composition of the Boone formation at the Savoy Swine Facility, and thus, it is difficult to draw parallels between the two facilities. University of Arkansas scientists conducted a karst inventory in the area of the Savoy Swine Facility to gain a better understanding of the ground-water system prior to sampling point selection and well drilling.[6] The interceptor trench installed at the Savoy Swine Facility extended to the bedrock surface to allow collection of lagoon leachate moving down-gradient from the waste lagoon after a storm event.[6] Additionally, in constructing the compacted clay liner at the Savoy Swine Facility, sieved native soil (clay) was used to ensure adequate compaction.[6] C&H has neither performed such detailed karst inventories to determine placement of wells and trenches nor sieved the clay soil to remove rocks from the clay liner soil to ensure adequate compaction. Scientists studying the Savoy Swine Facility have taken great efforts to conduct geologic investigations and have collected a large amount of data to demonstrate that there is very little leakage from the waste holding ponds and settling basin at the Savoy Swine Facility, which is not a CAFO.[6] C&H has not taken such efforts.

[6] Christopher M. Hobza, David C. Moffit, Danny P. Goodwin, Timothy Kresse, John Fazio, John V. Brahana, and Phillip D. Hays, 2005, Ground-Water Quality Near a Swine Waste Lagoon in a Mantled Karst Terrane in Northwestern Arkansas, U.S. Geological Survey Karst Interest Group proceedings, Rapid City, South Dakota, September 12-15, 2005: U.S. Geological Survey Scientific Investigations Report 2005-5160, p. 155-162.

The Department followed the 2018 Assessment Methodology[7] in its assessment of the State's water quality. The 2016 and 2018 Assessment Methodologies and the resulting assessments of the State's water quality are outside the scope of this permitting decision.

[7] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/final-2018-assessment-methodology.pdf

Pursuant to Ark. Code Ann. § 8-2-202, ADEQ administers an environmental laboratory accreditation program so that laboratories that submit data and analyses to the Department may be accredited by the Department as having demonstrated acceptable compliance with laboratory standards so that the validity of scientific data submitted to the Department may be further assured. All consulting laboratories performing analyses for which results are to be submitted to the ADEQ are required to obtain a laboratory accreditation through ADEQ's Environmental Laboratory Accreditation Program. Ark. Code Ann. § 8-2-206(a)(1)(A)(i). ADEQ's Environmental Laboratory Accreditation Program

ensures that data submitted for regulatory, planning, permitting, or other functions will be of acceptable quality.

The Department acknowledges that the dissolved oxygen (DO) data from the continuous monitoring in 2013 resulted in 528 violations out of 1131 sample points. The discreet data collected during the period of record (2012–2016) includes 15 violations out of 43 samples during the critical season meaning that 35% of the samples during the critical season exceeded the DO criteria during the period of record.

TMDLs for waters of the state of Arkansas are outside the scope of this permitting decision.

In the April 1 to June 30, 2018 Quarterly Report, BCRET presents data that documents a statistically significant increase of nitrate-N in the ephemeral stream (BC4) since 2014. However, BCRET notes that chloride, a conservative tracer, did not show a statistically significant increase. Four years of data also indicate a steady increase of geometric mean nitrate-N within the house well (W1) (BCRET April–June 2018, Figure 24). Increased nitrate-N in both the ephemeral stream and the house well does suggest that these systems may be hydrologically connected to areas where farm activities take place. APC&EC Regulation 5 requires the design and waste management plans for liquid animal waste management systems be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation to characterize and understand sites with complex geologies, i.e. karst, that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. Detailed geologic investigations, including a groundwater flow direction study, are necessary to determine that the ephemeral stream and house well are not influenced by the waste storage holding ponds, on-farm activities, or waste management practices.

BCRET data document that nitrate-N is variable; however, Figure 12 of the April 1 to June 30, 2018 BCRET Quarterly Report demonstrates that nitrate-N is higher downstream (BC7) than upstream (BC6). Chlorides and nitrates follow similar seasonal fluctuations in that they are higher during summer and autumn months when stream discharge is most influenced by groundwater. ADEQ reviewed Jim Petersen's May 31, 2018 expert report, which presents an analysis of temporal trends among nitrate-N and *E. coli* from January 2014–December 2017 at BC6 and BC7. Dr. Petersen's analysis presents decreasing trends of ammonia and chlorides and increasing concentrations of *E. coli* at BC6. Yet, increasing concentrations of nitrate-N were observed downstream at BC7. The conflicting temporal analysis prompted Dr. Petersen to further review trends upstream to downstream. By analyzing paired concentration data (collected same day) at BC6

and BC7 from January 2014 through December 2017, Dr. Petersen reports significant increases in total nitrogen, ortho-phosphorus, and chlorides, but non-significant changes in *E. coli* and nitrate-N. The significant increase of nitrate-N in the house well and ephemeral stream does correspond to increases of total nitrogen at BC7. Dr. Petersen's analysis illustrates the complexities of evaluating water chemistry in karst systems.

While no losing/gaining study has been performed to date on Big Creek between BC6 and the confluence with the Buffalo National River, BCRET notes seasonal dryness and rewatering between these two sites. Thomas Aley notes in his expert report of May 24, 2018, that "Big Creek also goes dry during much of the year where it passes over the Boone Formation near C&H Hog Farms." Dye studies performed by Brahana et al. (2016, 2017)[8], which were relied upon by Dr. Sharpley, and hydrologic studies by Murdoch et al. (2016)[9] in the Big Creek watershed identify potential confounding factors that make direct upstream to downstream comparisons difficult, particularly given the uncertainty that comes with the connectivity of karst hydrology. Groundwater upwelling can greatly influence ionic composition, nutrient concentration, and dissolved oxygen concentrations (Kresse et al. 2014, Cox et al. 2007, Soulsby et al. 2009, Robertson, et al. 2013, Justus et al. 2016).[10]

[8] Brahana, V., J. Nix, C. Kuyper, T. Turk, F. Usrey, S. Hodges, C. Bitting, K. Ficco, E. Pollock, R. Quick, and others. 2016. Geochemical Processes and Controls Affecting Water Quality of the Karst Area of Big Creek near Mt. Judea, Arkansas. Journal of the Arkansas Academy of Science 70:45–58.
Brahana, V., C. Bitting, K. Kosic-Ficco, T. Turk, J. Murdoch, B. Thompson, and R. Quick, 2017, Using fluorescent dyes to identify meaningful water-quality sampling locations and enhance understanding of groundwater flow near a hog CAFO on mantled karst—Buffalo National River, southern Ozarks: *in* Kuniansky, E.L., and Spangler, L.E., eds., U.S. Geological Survey Karst Interest Group Proceedings, San Antonio, Texas, May 19-23, 2017, U.S. Geological Survey Scientific Investigations Report 2017-5023, p. 147-160.
[9] Murdoch, J., C. Bitting, and J. Van Brahana. 2016. Characterization of the karst hydrogeology of the Boone Formation in Big Creek Valley near Mt. Judea, Arkansas—documenting the close relation of groundwater and surface water. Environmental Earth Sciences 75:1160.
[10] Kresse, T. M., P. D. Hays, K. R. Merriman, J. A. Gillip, D. T. Fugitt, J. L. Spellman, A. M. Nottmeier, D. A. Westerman, J. M. Blackstock, and J. L. Battreal. 2014. Aquifers of Arkansas—Protection, Management, and Hydrologic and Geochemical Characteristics of Groundwater Resources in Arkansas. U.S. Geological Survey Scientific Investigations Report 2014–5149.
Cox, M.H., Su, G.W. and Constantz, J., 2007. Heat, chloride, and specific conductance as ground water tracers near streams. Ground Water, 45(2), pp.187-195.

Justus, B. G., D. R. L. Burge, J. M. Cobb, T. D. Marsico, and J. L. Bouldin. 2016. Macroinvertebrate and diatom metrics as indicators of water-quality conditions in connected depression wetlands in the Mississippi Alluvial Plain. Freshwater Science 35:1049–1061.
Robertson, W.D., D.R. Van Stempvoort, D.K., Solomon, J. Homewood, S.J. Brown, J. Spoelstra, and S.L. Schiff. 2013. Persistence of artificial sweeteners in a 15-year-old septic system plume. Journal of Hydrology, 477, pp.43-54.
Soulsby, C., I. A. Malcolm, D. Tetzlaff, and A. F. Youngson. 2009. Seasonal and inter-annual variability in hyporheic water quality revealed by continuous monitoring in a salmon spawning stream. River research and applications 25:1304–1319.

ADEQ implements the applicable state and federal laws and regulations to protect waters of the state from pollution. Ark. Code Ann. § 8-4-101 *et seq.;* 33 U.S.C. § 1311 *et seq*.

The Department considered all available scientific data and information from, but not limited to, BCRET, United States Geological Survey, University of Arkansas Department of Agriculture, and ADEQ in making this permitting decision. The Department has no information to support the commenter's statement that this facility was designed, engineered, and constructed in accordance with APC&EC Regulation 5 and the AWMFH, as amended.

Comment: Any accident will contaminate the Buffalo River's pristine waters and critical habitat for endangered species, damaging the environment and adversely impacting tourism.

Commenter: Francie Bolter

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department acknowledges the following statements from the Buffalo River Watershed-Based Management Plan dated May 22, 2018, regarding threatened and endangered species in the Buffalo River watershed:

> The Buffalo River and its tributaries are considered high quality water resources. The Buffalo River and its tributaries support over fifty (50) species of fish and over twenty (20) species of mussels. Portions of the Buffalo River have been designated critical habitat for the threatened Rabbitsfoot mussel, *Quadrula cylindrical*

> *cylindrical* (State/Federal Status: Endangered/Threatened, respectively). The watershed also includes important habitat for endangered bat species: Gray Bat, *Myotis grisescens* (State/Federal Status: Endangered); Indiana Bat, *Myotis sodalis* (State/Federal Status: Endangered); Ozark Big-eared Bat, *Corynorhinus townsendii ingens* (State/Federal Status: Endangered); and Northern Long-eared Bat, *Myotis septentrionalis* (State/Federal Status: Endangered/Threatened, respectively). Cave and other karst features in the Buffalo River watershed are important habitats for all of the protected bat species.[1]

However, the Department did not receive any comments during the comment period ending on October 24, 2018, regarding endangered or threatened species and their associated habitats from Arkansas Game & Fish Commission, Arkansas Natural Heritage Commission, or U.S. Fish and Wildlife Service.
[1] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Consideration of tourism is not within the Department's regulatory authority.

Comment: This permit should have been denied years ago due to endangered species concerns as well as water quality issues. Deny the permit.

Commenter: Mitchell Wine

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department acknowledges the following statements from the Buffalo River Watershed-Based Management Plan dated May 22, 2018, regarding threatened and endangered species in the Buffalo River watershed:

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> habitat for endangered bat species: Gray Bat, *Myotis grisescens* (State/Federal Status: Endangered); Indiana Bat, *Myotis sodalis* (State/Federal Status: Endangered); Ozark Big-eared Bat, *Corynorhinus townsendii ingens* (State/Federal Status: Endangered); and Northern Long-eared Bat, *Myotis septentrionalis* (State/Federal Status: Endangered/Threatened, respectively). Cave and other karst features in the Buffalo River watershed are important habitats for all of the protected bat species.[1]

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[1] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Comment: Please remember the many biological species that depend on that river. As well as as the generations to come that will be able to enjoy the river if it's kept clean. I recommend that the permit be permanently denied to C&H Hog farm.

Commenter: Patty Hudgens

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department acknowledges the following statements from the Buffalo River Watershed-Based Management Plan dated May 22, 2018, regarding threatened and endangered species in the Buffalo River watershed:

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> Big-eared Bat, *Corynorhinus townsendii ingens* (State/Federal Status: Endangered); and Northern Long-eared Bat, *Myotis septentrionalis* (State/Federal Status: Endangered/Threatened, respectively). Cave and other karst features in the Buffalo River watershed are important habitats for all of the protected bat species.[1]

However, the Department did not receive any comments during the comment period ending on October 24, 2018, regarding endangered or threatened species and their associated habitats from Arkansas Game & Fish Commission, Arkansas Natural Heritage Commission, or U.S. Fish and Wildlife Service.

[1] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Comment: The Buffalo River is home to the endangered hellbender salamander. How many species have to go extinct before we realize the damage of altering these systems?

Commenter: Lori Monday

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department acknowledges the following statements from the Buffalo River Watershed-Based Management Plan dated May 22, 2018, regarding threatened and endangered species in the Buffalo River watershed:

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> features in the Buffalo River watershed are important habitats for all of the protected bat species.[1]

However, the Department did not receive any comments during the comment period ending on October 24, 2018, regarding endangered or threatened species and their associated habitats from Arkansas Game & Fish Commission, Arkansas Natural Heritage Commission, or U.S. Fish and Wildlife Service.

[1] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Comment: If there is even the slightest possibility that this farm will endanger the Buffalo River it must be denied. This River is a national treasure that is the habitat for many species.

Commenter: Ashley Henry

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department acknowledges the following statements from the Buffalo River Watershed-Based Management Plan dated May 22, 2018, regarding threatened and endangered species in the Buffalo River watershed:

> The Buffalo River and its tributaries are considered high quality water resources. The Buffalo River and its tributaries support over fifty (50) species of fish and over twenty (20) species of mussels. Portions of the Buffalo River have been designated critical habitat for the threatened Rabbitsfoot mussel, *Quadrula cylindrical cylindrical* (State/Federal Status: Endangered/Threatened, respectively). The watershed also includes important habitat for endangered bat species: Gray Bat, *Myotis grisescens* (State/Federal Status: Endangered); Indiana Bat, *Myotis sodalis* (State/Federal Status: Endangered); Ozark Big-eared Bat, *Corynorhinus townsendii ingens* (State/Federal Status: Endangered); and Northern Long-eared Bat, *Myotis septentrionalis* (State/Federal Status: Endangered/Threatened, respectively). Cave and other karst features in the Buffalo River watershed are important habitats for all of the protected bat species.[1]

However, the Department did not receive any comments during the comment period ending on October 24, 2018, regarding endangered or threatened species and their associated habitats from Arkansas Game & Fish Commission, Arkansas Natural Heritage Commission, or U.S. Fish and Wildlife Service.
[1] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Comment: The Buffalo National River has several unusual species that the National Park Service is bound by legislation to protect. Please keep hog farms away so my great-grandchildren may enjoy it the way my children have and my grandchildren are experiencing it.

Commenter: Gail Sears

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department acknowledges the following statements from the Buffalo River Watershed-Based Management Plan dated May 22, 2018, regarding threatened and endangered species in the Buffalo River watershed:

> The Buffalo River and its tributaries are considered high quality water resources. The Buffalo River and its tributaries support over fifty (50) species of fish and over twenty (20) species of mussels. Portions of the Buffalo River have been designated critical habitat for the threatened Rabbitsfoot mussel, *Quadrula cylindrical cylindrical* (State/Federal Status: Endangered/Threatened, respectively). The watershed also includes important habitat for endangered bat species: Gray Bat, *Myotis grisescens* (State/Federal Status: Endangered); Indiana Bat, *Myotis sodalis* (State/Federal Status: Endangered); Ozark Big-eared Bat, *Corynorhinus townsendii ingens* (State/Federal Status: Endangered); and Northern Long-eared Bat, *Myotis septentrionalis* (State/Federal Status: Endangered/Threatened, respectively). Cave and other karst features in the Buffalo River watershed are important habitats for all of the protected bat species.[1]

However, the Department did not receive any comments during the comment period ending on October 24, 2018, regarding endangered or threatened species

and their associated habitats from Arkansas Game & Fish Commission, Arkansas Natural Heritage Commission, or U.S. Fish and Wildlife Service.
[1] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Comment: I was born and raised on the headwaters of the Little Buffalo. Growing up, we received our drinking water directly from a spring. I know that many homes in Newton County get their drinking water this way. By concentrating sewage waste over fields in the area, many springs will be in the direct path of the sewage run off. There are many endangered plants and animals in close proximity to the Deer area that might not endure the extra insult caused by the swine waste and artificially high levels of phosphorus.

Commenter: Tasha Hudson

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department acknowledges the following statements from the Buffalo River Watershed-Based Management Plan dated May 22, 2018, regarding threatened and endangered species in the Buffalo River watershed:

> The Buffalo River and its tributaries are considered high quality water resources. The Buffalo River and its tributaries support over fifty (50) species of fish and over twenty (20) species of mussels. Portions of the Buffalo River have been designated critical habitat for the threatened Rabbitsfoot mussel, *Quadrula cylindrical cylindrical* (State/Federal Status: Endangered/Threatened, respectively). The watershed also includes important habitat for endangered bat species: Gray Bat, *Myotis grisescens* (State/Federal Status: Endangered); Indiana Bat, *Myotis sodalis* (State/Federal Status: Endangered); Ozark Big-eared Bat, *Corynorhinus townsendii ingens* (State/Federal Status: Endangered); and Northern Long-eared Bat, *Myotis septentrionalis* (State/Federal Status: Endangered/Threatened, respectively). Cave and other karst features in the Buffalo River watershed are important habitats for all of the protected bat species.[1]

However, the Department did not receive any comments during the comment period ending on October 24, 2018, regarding endangered or threatened species

and their associated habitats from Arkansas Game & Fish Commission, Arkansas Natural Heritage Commission, or U.S. Fish and Wildlife Service.
[1] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

The Arkansas Department of Health did not submit a comment regarding C&H Hog Farms, Inc., AFIN 51-00164, during the public comment period ending October 24, 2018.

Comment: The folks in North Carolina thought their manure pits were okay, too. We may not have a hurricane in our future, but there are too many things that could go wrong, given the geology of the region. https://www.usatoday.com/story/news/nation/2018/09/20/hurricane-florence-flooded-pig-poop-lagoons-threaten-north-carolina/1365984002/

Commenter: Steven Kopp

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. ADEQ has determined that a detailed geological investigation of the facility is required because karst includes highly permeable foundations with the associated potential for groundwater contamination and potential for sinkholes to open up with collapsing ground or cause differential settlement. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section

651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two sections of Big Creek (Newton County) and two sections of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Comment: I'm Jessie Green, I live in Harrison (P.O. Box 744) with such window of time for public comments let's not pretend. As we've seen that the intent of these hearings is anything other than just an opportunity to use a sounding board to vent our angst and aggression more than anything else. I here to talk to the community, I was going to ask for show of hands of those that are here in support of the Hog Farm but I thinks it's been clearly pointed out. For those of you that don't know me I'm your White River Water Keeper. And that include everyone in this room, I am your White River Water Keeper. If you don't know me then you also probably don't know that before I embarked on this endeavor. When I quit my job with ADEQ in the Water Division last year to start this non-profit. And I knowingly left my job as a senior ecologist just near months before pay raises kicked in, before receiving a bonus for an exceptional personnel review. I left my job at ADEQ because I wasn't allowed to let the science speak for itself. And was required to stick to the rhetoric supporting political agendas. I left my job that allowed me to spend over 50% of my time in the field the entire reason that I pursued a career in aquatic ecology, that's wasn't because I was bored, that wasn't because I felt that the work that I was going there wasn't meaningful it was, but it was controlled political agendas. I left my job because they desperately care about insuring Arkansan's have clean safe, fishable, swimmable and drinkable waters. I left because I was concerned about this polarizing divide that's growing in our State most of which could be attributed to the needs to pick a side related to where or not you are for or against C&H Hog Farm, and it's completely toxic. I left my job to start a non-profit because I thought it would be, I didn't leave because I thought it would be easier, I didn't leave because I thought it would require me to work fewer hours and certainly didn't leave because I thought that it would pay any better. I left because we can do better, I left because of whether you lived in an urban area or rural every one need and deserves access to clean water. Working against ourselves for the benefit of Corporations forcing rural farmers to buy into

industrial farming models because special interest control the free market, it doesn't benefit farmers, it doesn't protect our national resources for current and future generations and it doesn't benefit our communities and let's be perfectly honest the great scheme needs to be, has more to do with a 50 year old (thorn?) from the designation of the Buffalo River into the National Parks Service than it has to do with anything else. Special interest have capitalized on this deep root angst and used it to spread the "you're next" fear mongering and propaganda against Agriculture Communities. I support ADEQ denial of the Reg. 5 permit and I'll extend the same offer to anyone in this room as I extended to Jason Henson at a Quorum Court meeting in Marion County I will gladly sit down any time and explain the science and the rationale behind that decision to support the denial. To anyone who wants to know what else. Well I guess that's it, thank you.

Commenter: Jessie Green

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Comment: Over the past few decades, inhabitants of the region, including myself, have witnessed the negative impacts of overfarming, especially in lush environments. The Buffalo National River is no exception. Land conversion leads to habitat loss (when introducing non-native species), wasteful water consumption, soil erosion, degradation, and now harmful runoff which is polluting our waters. The Buffalo National River and Park has been a staple of the Ozark lands, and I wish to protect it at all costs. Please take this into consideration, and thank you for your time.

Commenter: Trae Pearce

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Comment: ADEQ, Thank you for your service and by the way I have flown also over the Bufflo and never saw any hogs but I have saw a lot of boulders.

Commenter: Earlene Edgemon

Response: This comment is outside the scope of this permitting decision.

Comment: It saddens me when people are fighting. When people have good will towards others, there are solutions to all problems. People can make a living farming, and our habitat can be protected. Both can be true. There is a way for hog farms and pristine rivers, to coexist. The best solutions are not be considered. Peace on Earth.

Commenter: Dennis Larson

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Comment: The error only exists on the mobile version of the site. I was able to use the full site version successfully. I hope you can fix the problem, so no commenter gets left out due to technology frustration. On Thu, Sep 20, 2018, 6:06 PM Robert Shingledecker > wrote: The form won't let me put my email in the email field... and of course you cannot submit your comment without the email address entered.

Commenter: Robert Shingledecker

Response: This comment is outside the scope of this permitting decision.

Comment: Thank you! On Sep 27, 2018 9:45 AM, "Water Draft Permit Comment" > wrote: The Department acknowledges the receipt of your electronic comment. Thank you.

Commenter: Rhonda Newton

Response: This comment is outside the scope of this permitting decision.

Comment: Dear Friends, I think there may be a problem with the form software - I've tried twice to comment, and it just grinds away indefinitely after I hit submit. Or maybe it's just me.

Commenter: Don House

Response: This comment is outside the scope of this permitting decision.

Comment: I have very little understanding of the technological way of communicating. I attempted to make my comment and was given CAPTCHA. I have no idea what I am do do although I would appreciate the opportunity to offer a comment on this extremely important issue. Thank you

Commenter: Nancy Garner

Response: This comment is outside the scope of this permitting decision.

Comment: The form won't let me put my email in the email field... and of course you cannot submit your comment without the email address entered.

Commenter: Robert Shingledecker

Response: This comment is outside the scope of this permitting decision.

Comment: There seems to be no ‘submit’ button. How do I know it has been accepted?

Commenter: Martha Sutherland

Response: This comment is outside the scope of this permitting decision.

Comment: Sent from Mail for Windows 10 ?????

Commenter: Margaret Lovell

Response: This comment is outside the scope of this permitting decision.

Comment: My self and several other people who are supporting the c&h farms are not able to leave comments and I'm reporting this to the Arkansas pollution control and ecology commission

Commenter: Brian Pruitt

Response: This comment is outside the scope of this permitting decision.

Comment: Why won’t the form accept my email address?

Commenter: Ed Hudnall

Response: This comment is outside the scope of this permitting decision.

Comment: After carefully filling out the form, I got a "oopsy, something went wrong" & can't figure out how to get past that. Maddening! Please help me get my comments in. Robert Bowker, tel. 870 499-5906, bowkerrg@ yahoo.com

Commenter: Robert Bowker

Response: This comment is outside the scope of this permitting decision.

Comment: Form does not appear to be allowing entry of an email address & subsequent submittal.

Commenter: Joe Payne

Response: This comment is outside the scope of this permitting decision.

Comment: I tried to submit my comment and when I click "continue", it does nothing.

Commenter: Rhonda Newton

Response: This comment is outside the scope of this permitting decision.

Comment: Sir/Madam: Thank you for the opportunity to provide comments asking the ADEQ to deny the CAFO permit for operation of a hog farm on the Buffalo River watershed. The previous permit was allowed with inadequate consideration of the damage resulting from such operations. I would like you to consider the letter I sent (copied below) on August 8, 2015, to the laboratory employed to prepare the original environmental assessment of the operation. There were many errors and omissions in that assessment. I didn't even receive an acknowledgement of my letter, and I assume it was ignored. I have moved to Tennessee since sending the letter, but I still ask you to consider my request to take actions in line with the well-being of the citizens of Arkansas and the proper stewardship of the environment. Please reject the placing of large hog farms in the watershed of our national river. Thank you.
Dear Sirs: Thank you for the opportunity to provide comments on the August 2015 Draft Environmental Assessment for C&H Hog Farms in Newton County, Arkansas. According to the "Notice of Availability" in Friday's (August 7, 2015) Arkansas Democrat Gazette, comments could be mailed to the above address. I hope these comments are helpful in your efforts to prepare the best possible final Environmental Assessment. While the draft EA contains helpful information, it fails to consider t groundwater supply that easily facilitates transfer to other sites. The karst formations in southern Missouri and northern Arkansas have been well known for this phenomenon. (See, for example,
http://geology.er.usgs.gov/eespteam/Midcontinent/Ozark_home/waterstudy.html.) The final EA surely should address this issue more carefully. p. 3-13 - "Most fecal pathogens from human and animal waste usually die very quickly. Two or three months is sufficient in most cases to reduce pathogens to negligible numbers once they have been excreted or land-applied in animal wastes." Besides the hedging here ("usually" and "most cases"), there is the obvious question of whether reapplication of waste will be done more frequently than every three months. If reapplication is more frequent, then a continual production of pathogens is assured. p. 3-13 - "All application areas receive application rates consistent with infiltration capabilities of the native soil such that there is no runoff into surrounding areas. Buffer strips (100 feet) are maintained . . . to prevent waste runoff into surrounding areas." The absence of a qualifier, such as "likely to be", and the use of the word "prevent" rather than "diminish" is notable. Is the author not familiar with the adage that "water runs downhill" (even through "buffer strips")? With the present wording, one

sees the draft EA as a promotional work, rather than an evaluative work. Options are listed for ways to address unexpected events leading to failure of the plan presented, but no mention is made of what would constitute a "tipping point" whereby any option is mandated. Later (p. 3-19), a "site-specific (NMP) plan" is mentioned, but its description includes the assertion that "[a]ll land application areas receive application at rates consistent with infilatration capabilities of the native soil such that there is no runoff to surrounding areas." That assertion is not given as a goal, but as a conclusion. The final EA surely will correct that. p. 3-14 through 3-16 - (Figures 3.2, 3.3, and 3.4) - The contrast between phosphorus concentration differences (downstream vs. upstream) and nitrate concentration differences begs two questions. What is the difference in mobility of nitrate and phosphate? And, what length of time would it take for any differences to appear? Phosphate is a much less soluble ion than nitrate, depending of course on pH and other factors, so it will initially be much less mobile than nitrate. The statement on p. 3-15, that "[n]o consistent differences in the trends in concentrations at the downstream site . . . compared with the upstream site were evident . . ." is incorrect (see Fig. 3.4), and it implies that such a concern can be dismissed. The EA should state that an increase in nitrate concentrations downstream from the CAFO is already detected (Fig. 3-4), and it is expected that phosphate concentrations downstream will increase when repeated application of manure to fields near Big Creek reaches the saturation point for the phosphate that the fields can hold. The phrase "seasonal variability" is inserted into the narrative here (p. 3-16). What is its purpose? Seasonal variability in measurements will be largely due to rainfall and temperature differences, and it is not in any way an explanation for the uniformly higher nitrate concentrations found downstream from the CAFO. I do appreciate the efforts made to predict what effects operations such as the CAFO might have on the environment. It is possible that reasonable predictions may indicate that the watershed may be able to accommodate the pollution that this CAFO alone may contribute, but the draft EA gives no encouragement that an impartial analysis is being conducted. p. 3-18 - "There are no data or other evidence to indicate that the [CAFO] is adversely affecting surface water quality." What about Figure 3.4 in the draft EA? (The point is not whether the current load of nitrate causes Big Creek to reach a eutrophic state, but whether the continued operation of the CAFO moves the stream in that direction.) Also, what about anecdotal evidence/complaints already given? Amazingly, the draft EA promotes the ". . . potential for improved water quality conditions . . .", as if to say this CAFO wouldn't be as bad as other options. Again, the draft EA conditions . . .", as if to say this CAFO wouldn't be as bad as other options. Again, the draft EA takes on the appearance of a promotional piece, rather than an objective analysis. p. 3-19 - "While it is highly unlikely, there could be a permitted discharge from the waste ponds should a 50-year or 100-year rainfall occur at a time when the ponds are at capacity." Consider this. If any pond is full and receives additional water, it overflows. It's not "unlikely". It will occur. Any body of water that is full is "full". Additionally, what is the hesitance to admit that a 50-year rainfall is likely to occur every fifty years? What is actually being admitted is that, statistically, a catastrophic pollution event will occur in the longer term. Also on p. 3-19, there are the statements, "There have been no consistent or significant differences in the concentrations of nutrients or bacteria between the upstream and downstream sites.", and, regarding such an event as an accidental discharge of waste, such an event ". . . would not result in long-term (chronic) or significant impacts to surface water quality." See above comments for pages 3-14 through 3-18. p. 3-20 - "There is no evident conduit for groundwater to reach surface water in the area." Did

the author mean, "There is no evident conduit for surface water to reach groundwater . . ."? Regardless, such an assertion would suggest that aquifers in the area aren't recharged by rainfall. Especially soluble nutrients, such as nitrates, are readily carried by surface and groundwater. (Consider the conflict regarding the elevated nitrate levels in the Illinois River entering Oklahoma from Arkansas. See the related article posted online by the Talequah Daily Press on January 29, 2015.) Additionally, the assertion that ". . . no nutrients are expected to leach into groundwater from the application of wastes to fields in the area." is just that, an assertion. (See above notes.) p. 3-37 - "No significant odor impacts are anticipated and no mitigation measures are required." The draft EA gives the impression that the "public commons" (environment shared by all) is relegated to a commodity to exploit, rather than a resource for which society is a steward. The draft EA fails to address adequately the destructive effects of this CAFO on the daily lives of its neighbors. Odor and flies might appear to be minor nuisances to those whose operation produce them or those who live farther away, but they can rob closer neighbors of the hope for a pleasant environment. The inclusion of sentences (p. 2-5) such as "[a] pesticide program is undertaken to control insects, if necessary . . ." and "[w]hen possible land application is downwind from residences . . ." don't adequately deal with this concern. The description that ". . . Arkansas' Right to Farm Law . . . protects farming operations from nuisance claims . . ." is not a justification for the assertion listed in the beginning of this paragraph. The final EA can include the description a farm can't be sued for flies or odors, but it can still acknowledge the damage to quality of life for neighbors. p. 3-41 (Sect. 3.8 Environmental Justice) - "There would be no effects to the . . . rest of the population in the Newton County." See previous paragraph. Thank you again for the opportunity to provide comments to the draft EA. I trust they will be helpful in developing a final EA.

Commenter: Michael Rapp

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The prior permit issued under APC&EC Regulation 6 General Permit ARG590000 and the coverage under that permit tracking number ARG590001 are outside the scope of the current permitting decision. The initial Notice of Intent and the corresponding NMP for coverage under the prior APC&EC Regulation 6 permit tracking number ARG590001 were available for public comment during the 30-day public comment period beginning on June 25, 2012.

The Environmental Assessment referenced in the comment is outside the scope of this permitting decision.

Comment: I agree that the current proposed C &H Hog farm permit should be denied. But if keeping the White River system pollution free is a priority I suggest you shut down the Norfork

National Fish Hatchery. The mass tonnage of trout waste they flush into the white river system seems to be above the law. Don't play favorites. You may wish to read the New York Times editorial below. https://www.nytimes.com/2015/04/11/opinion/the-cost-of-trout-fishing.html

Commenter: Bob Heine

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Trout farms are outside the scope of this permitting decision.

Comment: why do you let every confinement use earth dams to hold manure why can't they install a big storage tank and then dry the manure there is a market for that stuff for all the garden and flowers around the country

Commenter: Dale Zeimet

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

It is the applicant's responsibility to design its own liquid animal waste management systems in accordance with state laws and APC&EC Regulation 5. It is then the Department's charge to evaluate the proposed systems for compliance with state laws and APC&EC Regulation 5.

Comment: Say no to CAFO permit. The Buffalo National River is impaired. Stop further damage. Remove the swine factory. Objections: 1. Lack of written emergency environmental disaster plan. 2. Negative health impact on residents and tourists 3. Negative economic impact on Arkansas tourism industry. 4. Ark. Dept. of Environmental Quality failure in policy/procedure enforcement re geological site tests for the first permit and every permit application since. 5. Inhumane treatment of large animals. Look at the east coast States of Georgia N Carolina, S Carolina where disaster has left CAFOs and Chicken houses flooded which in turn has contaminated the rivers and ALL watersources for miles. A health catastrophe pending. Arkansas should end this recent agricultural experiment in confined feeding operations for large animals. Our water resources are more valuable than corporate feeding operations. Facts regarding this type of practice do not support claims regarding efficiencies. Arkansas should be a leader in agri industry not a follower of neighboring States with histories of disasters from CAFOs.

Commenter: Debbie Alexy

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

C&H Hog Farms, Inc. submitted an Emergency Action Plan to the Department on October 23, 2018. The Emergency Action Plan did not address possible failure of the liner resulting from potential damage, such as pumping and agitation, liner desiccation, or any other site-specific operational risks are not addressed, in accordance with AWMFH 651.0204(a), (b).

The Arkansas Department of Health did not submit a comment regarding C&H Hog Farms, Inc., AFIN 51-00164, during the public comment period ending October 24, 2018.

Consideration of tourism, economic impact, and animal husbandry are not within the Department's regulatory authority.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. ADEQ has determined that a detailed geological investigation of the facility is required because karst includes highly permeable foundations with the associated potential for groundwater contamination and potential for sinkholes to open up with collapsing ground or cause differential settlement. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in

Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Comment: https://www.facebook.com/69323601301/posts/10155804004846302/

Commenter: Delinda Mace

Response: Facebook posts are outside the scope of this permitting decision.

Comment: I would love to see the governing bodies in Arkansas care more about waterbodies in AR than they seem to care now. Not enough is done to ensure clean pure water for future generations. Risk of contamination, and tributaries already impaired are not taken seriously enough and that is not only sad, it is disturbing. Please deny C&H Hog Farm all hog operating permits. In addition, please stop letting water treatment facilities discharge treated liquids containing known carcinogen into Arkansas tributaries. Also, please fine violators. Not enough is being done to protect Arkansas water. Our government is dropping the ball on clean water in AR.

Commenter: Leora Hajek

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Comment: See Attached: Marti Olesen

Commenter: Marti Olesen

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department acknowledges the resuscitations of facts and statements from information present in the permit application record including, but not limited to, inspection reports prepared by ADEQ, depositions, expert reports, and BCRET reports.

Please refer to the Response to Comments for those individuals' or groups' comments which have been incorporated by reference into your comments.

The Department acknowledges the following statements from the Buffalo River Watershed-Based Management Plan dated May 22, 2018, regarding threatened and endangered species in the Buffalo River watershed.

> The Buffalo River and its tributaries are considered high quality water resources. The Buffalo River and its tributaries support over fifty (50) species of fish and over twenty (20) species of mussels. Portions of the Buffalo River have been designated critical habitat for the threatened Rabbitsfoot mussel, *Quadrula cylindrical cylindrical* (State/Federal Status: Endangered/Threatened, respectively). The watershed also includes important habitat for endangered bat species: Gray Bat, *Myotis grisescens* (State/Federal Status: Endangered); Indiana Bat, *Myotis sodalis* (State/Federal Status: Endangered); Ozark Big-eared Bat, *Corynorhinus townsendii ingens* (State/Federal Status: Endangered); and Northern Long-eared Bat, *Myotis septentrionalis* (State/Federal Status: Endangered/Threatened, respectively). Cave and other karst features in the Buffalo River watershed are important habitats for all of the protected bat species.[1]

However, the Department did not receive any comments during the comment period ending on October 24, 2018, regarding endangered or threatened species and their associated habitats from Arkansas Game & Fish Commission, Arkansas Natural Heritage Commission, or U.S. Fish and Wildlife Service.

[1] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

The Environmental Assessment referenced in the comment is outside the scope of this permitting decision.

ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. ADEQ has determined that a detailed geological investigation of the facility is required because karst includes highly permeable foundations with the associated potential for groundwater contamination and potential for sinkholes to open up with collapsing ground or cause differential settlement. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this

facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

Seepage from waste storage ponds has the potential to pollute surface and ground water. The record included one recompacted permeability test that is insufficient to determine liner integrity. The necessary soil investigations including, but not limited to, percentage of fines and soil permeability characteristics, have not been performed at this facility in accordance with the AWMFH 651 Table 10-4 and Appendix 10D. Plasticity index analysis was performed on one sample of the *in situ* clay material in boring 2. The variability in the regolith expected in this geologic setting coupled with the insufficient data creates additional concerns about the siting and soil sources for the clay liner. The required number of borings were not advanced within the pool areas in accordance with AWMFH 651.0704(b)(4); these additional borings would have provided more data for assessment of clay source material. Proper soil investigations for the liner material are necessary to determine the suitability and location of the clay source material and to consider any additional geotechnical testing to confirm material properties, which will reduce the potential for downward and/or lateral seepage of the stored wastes.

Additionally, NRCS, in Appendix 10D of the AWMFH, indicates that special design measures are necessary where agricultural waste storage ponds are constructed in soils with high calcium content (BCRET Quarterly Report for October 2016 to December 2016, Table 10, page 71) or highly unfavorable geologic conditions, such as karst formations.

C&H Hog Farms, Inc. submitted an Emergency Action Plan to the Department on October 23, 2018. The Emergency Action Plan did not address possible failure of the liner resulting from potential damage, such as pumping and agitation, liner desiccation, or any other site-specific operational risks are not addressed, in accordance with AWMFH 651.0204(a), (b).

The Department reviews all buffers to ensure that the applied buffers are in accordance with the buffer distances proscribed in APC&EC Regulation 5.406(D).

NRCS's Web Soil Survey provides a general guide to soil characteristics and ground-truthing is necessary to confirm those soil characteristics. Walking the fields cannot provide the data necessary to evaluate the fields in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3. The ground penetrating radar studies[2] at Fields 1, 5, and 12 indicated that land application to those fields should be limited in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3. The ground penetrating radar studies suggest that these fields have characteristics identified in AWMFH 651.0504 (a)–(n) and Table 5-3, such as areas of higher

permeability, thin soils of less than twenty (20) inches (see excerpts from the ERI Study below), and soils with a significant fractions of rock fragments preventing some soils samples from being taken. The limitations for land application sites based on these soil characteristics are part of the AWMFH with the purpose of preventing contamination of ground water. Geotechnical investigations of the land application fields are necessary to account for the soils characteristics that require limitations on animal waste application.

[2] As part of the BCRET study, USDA, NRCS conducted Ground Penetrating Radar (GPR) Surveys for Fields 1 and 5 in November of 2013 and Field 12 in April of 2014.

Field 5a exhibits average soil thicknesses of 0.5 to 4.5 meters (1.5 to 14.75 feet). Field 12 is a low-lying grazing area with low relief and an uneven topsoil surface. Field 12 exhibits similar average soil thicknesses at 0.7 to 4 meters (2.25 to 13 feet). Field 1 shows an average soil thickness of 0.5 meters (1.5 feet) determined from the ERI surveys and soil sampling. Field 1 has thinner and rockier soils than either Fields 5a or 12. In Field 12, there appears to be a large doline feature (a closed topographic depression caused by dissolution or weathering of underlying rock or soil) within the bedrock, approximately 61 meters (200 feet) across at the top of the feature, starting 8 meters (26 feet) below the land surface and extending 23 meters (75 feet) vertically downward.[3] Geotechnical investigations of the land application fields are necessary to account for the soils characteristics that require limitations on animal waste application.

[3] Jon Fields and Todd Halihan, Electrical Resistivity Surveys of Applied Hog Manure Sites, Mount Judea, AR (2015).

Data supplied from the C&H Hog Farms, Inc. 2014–2017 annual reports document an increase of soil test phosphorus (STP) from 20 ppm to 68 ppm in Field 17 to a more significant increase in Field 1, which increased from 45 ppm to 173 ppm. As stated in University of Arkansas Division of Agriculture Soil Phosphorus: Management and Recommendations FSA1029[4], “Arkansas scientists agree that there is no agronomic reason or need for STP to be greater than about 50 ppm (Mehlich-3 extraction).” However, “with the move from agronomic to environmental concerns with P, soil P testing has been used to indicate when P enrichment of runoff may become unacceptable. A common approach has been to use agronomic soil P standards, following the rationale that soil P in excess of crop requirements is vulnerable to removal by surface runoff or leaching” (FSA1029). “A large amount of research between 1985 and 2000, showed that as STP (Soil Test Phosphorous) increased, especially in the top 2–4 inches of soil, so did the concentrations of soluble P in runoff (Figure 1)” (FSA1029).

As of the C&H Hog Farms, Inc. 2017 Annual Report, results of all soil test phosphorus were greater than 50 ppm. Despite a reported increase of soil test

phosphorus in waste application fields, pursuant to NRCS Code 590, the Arkansas Phosphorus Index may still allow application of swine waste because of other factors including phosphorus source potential, transport potential, and best management practice multipliers. FSA9516[5] states that the phosphorus index approach is most appropriate as it accounts for multiple risk factors and provides a better risk assessment of P loss in runoff.

Geotechnical investigations at all land application sites in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3 are necessary to ensure the efficacy of the API and demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River by rapid infiltration through highly permeable or thin soils.

[4] https://www.uaex.edu/publications/PDF/FSA-9516.pdf

[5] https://www.uaex.edu/publications/pdf/FSA-1029.pdf

ADEQ evaluated total phosphorus concentrations in Big Creek according to the 2016 Assessment Methodology[6] and the 2018 Assessment Methodology[7]. For the 2016 assessment cycle, Big Creek (BUFT06, AU 11010005_020) mean total phosphorus and total nitrogen were 0.026 mg/L and 0.33mg/L, respectively. The assessment methodology for APC&EC Reg. 2.509 screens the monitoring station's mean total phosphorus and total nitrogen concentration to the 75th percentile for a given ecoregion for the assessment cycle period of record. Screening values for the Boston Mountain ecoregion for 2016 total phosphorus and total nitrogen were 0.036 mg/L and 0.46 mg/L, respectively. The 2018 screening values were 0.036 mg/L and 0.55 mg/L for total phosphorus and total nitrogen. The mean values for 2018 for BUFT06 were 0.028 mg/L total phosphorus and 0.297 mg/L total nitrogen. All mean total phosphorus and total nitrogen for Big Creek were below the Boston Mountain ecoregion 75th percentile. At this time, neither the Buffalo National River nor Big Creek have been identified as impaired for phosphorus based on the EPA-approved Assessment Methodology.

[6] https://www.adeq.state.ar.us/water/planning/integrated/assessment/pdfs/2016-assessment-methodology-draft-04apr16-305b.pdf

[7] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/final-2018-assessment-methodology.pdf

The prior permit issued under APC&EC Regulation 6 General Permit ARG590000 and the coverage under that permit tracking number ARG590001 are outside the scope of the current permitting decision. The initial Notice of Intent and the corresponding NMP for coverage under the prior APC&EC Regulation 6 permit tracking number ARG590001 were available for public comment during the 30-day public comment period beginning on June 25, 2012.

In the April 1 to June 30, 2018 Quarterly Report, BCRET presents data that documents a statistically significant increase of nitrate-N in the ephemeral stream (BC4) since 2014. However, BCRET notes that chloride, a conservative tracer, did not show a statistically significant increase. Four years of data also indicate a steady increase of geometric mean nitrate-N within the house well (W1) (BCRET April–June 2018, Figure 24). Increased nitrate-N in both the ephemeral stream and the house well does suggest that these systems may be hydrologically connected to areas where farm activities take place. APC&EC Regulation 5 requires the design and waste management plans for liquid animal waste management systems be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies, i.e. karst, that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. Detailed geologic investigations, including a groundwater flow direction study, are necessary to determine that the ephemeral stream and house well are not influenced by the waste storage holding ponds, on-farm activities, or waste management practices.

BCRET data document that nitrate-N is variable; however, Figure 12 of the April 1 to June 30, 2018 BCRET Quarterly Report demonstrates that nitrate-N is higher downstream (BC7) than upstream (BC6). Chlorides and nitrates follow similar seasonal fluctuations in that they are higher during summer and autumn months when stream discharge is most influenced by groundwater. ADEQ reviewed Jim Petersen's May 31, 2018 expert report, which presents an analysis of temporal trends among nitrate-N and E. coli from January 2014–December 2017 at BC6 and BC7. Mr. Petersen's analysis presents decreasing trends of ammonia and chlorides and increasing concentrations of E. coli at BC6. Yet, increasing concentrations of nitrate-N were observed downstream at BC7. The conflicting temporal analysis prompted Mr. Petersen to further review trends upstream to downstream. By analyzing paired concentration data (collected same day) at BC6 and BC7 from January 2014 through December 2017, Mr. Petersen reports significant increases in total nitrogen, ortho-phosphorus, and chlorides, but non-significant changes in E. coli and nitrate-N. The significant increase of nitrate-N in the house well and ephemeral stream does correspond to increases of total nitrogen at BC7. Mr. Petersen's analysis illustrates the complexities of evaluating water chemistry in karst systems.

While no losing/gaining study has been performed to date on Big Creek between BC6 and the confluence with the Buffalo National River, BCRET notes seasonal dryness and rewatering between these two sites. Thomas Aley notes in his expert report of May 24, 2018, that “Big Creek also goes dry during much of the year where it passes over the Boone Formation near C&H Hog Farms.” Dye studies performed by Brahana et al. (2016, 2017)[8] and hydrologic studies by Murdoch

et al. (2016)[9] in the Big Creek watershed identify potential confounding factors that make direct upstream to downstream comparisons difficult, particularly given the uncertainty that comes with the connectivity of karst hydrology. Groundwater upwelling can greatly influence ionic composition, nutrient concentration, and dissolved oxygen concentrations (Kresse et al. 2014, Cox et al. 2007, Soulsby et al. 2009, Robertson, et al. 2013, Justus et al. 2016).[10]

[8] Brahana, V., J. Nix, C. Kuyper, T. Turk, F. Usrey, S. Hodges, C. Bitting, K. Ficco, E. Pollock, R. Quick, and others. 2016. Geochemical Processes and Controls Affecting Water Quality of the Karst Area of Big Creek near Mt. Judea, Arkansas. Journal of the Arkansas Academy of Science 70:45–58.

Brahana, V., C. Bitting, K. Kosic-Ficco, T. Turk, J. Murdoch, B. Thompson, and R. Quick, 2017, Using fluorescent dyes to identify meaningful water-quality sampling locations and enhance understanding of groundwater flow near a hog CAFO on mantled karst—Buffalo National River, southern Ozarks: *in* Kuniansky, E.L., and Spangler, L.E., eds., U.S. Geological Survey Karst Interest Group Proceedings, San Antonio, Texas, May 19-23, 2017, U.S. Geological Survey Scientific Investigations Report 2017-5023, p. 147-160.

[9] Murdoch, J., C. Bitting, and J. Van Brahana. 2016. Characterization of the karst hydrogeology of the Boone Formation in Big Creek Valley near Mt. Judea, Arkansas—documenting the close relation of groundwater and surface water. Environmental Earth Sciences 75:1160.

[10] Kresse, T. M., P. D. Hays, K. R. Merriman, J. A. Gillip, D. T. Fugitt, J. L. Spellman, A. M. Nottmeier, D. A. Westerman, J. M. Blackstock, and J. L. Battreal. 2014. Aquifers of Arkansas—Protection, Management, and Hydrologic and Geochemical Characteristics of Groundwater Resources in Arkansas. U.S. Geological Survey Scientific Investigations Report 2014: 5149.

Cox, M.H., Su, G.W. and Constantz, J., 2007. Heat, chloride, and specific conductance as ground water tracers near streams. Ground Water, 45(2), pp.187-195.

Justus, B. G., D. R. L. Burge, J. M. Cobb, T. D. Marsico, and J. L. Bouldin. 2016. Macroinvertebrate and diatom metrics as indicators of water-quality conditions in connected depression wetlands in the Mississippi Alluvial Plain. Freshwater Science 35:1049–1061.

Robertson, W.D., D.R. Van Stempvoort, D.K., Solomon, J. Homewood, S.J. Brown, J. Spoelstra, and S.L. Schiff. 2013. Persistence of artificial sweeteners in a 15-year-old septic system plume. Journal of Hydrology, 477, pp.43–54.

Soulsby, C., I. A. Malcolm, D. Tetzlaff, and A. F. Youngson. 2009. Seasonal and inter-annual variability in hyporheic water quality revealed by continuous monitoring in a salmon spawning stream. River research and applications 25:1304–1319.

On March 25, 2016, John Bailey, on behalf of ADEQ, sent a letter to C&H Hog Farms, Inc. notifying C&H that the requested modification to install a synthetic liner in both lagoons was approved and that the requested modification would

expire after one year. Should C&H not install the liners within that one-year period, C&H would be required to resubmit plans and obtain a new approval from the Department. Mr. Bailey approved the installation of synthetic liners under the terms of the now expired General Permit ARG590000, tracking number ARG590001. Mr. Bailey's approval authorizing C&H to install the synthetic liners expired on March 25, 2017.

Although the analytical data from the C&H Drilling Study did not indicate a leak at the borehole drilling location at the time of the sampling, the Study does not support the conclusion that there is not any leakage from the ponds.

> Algal blooms have, and continue to, cause concern on the Buffalo River. As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[1]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.

The Arkansas Department of Health did not submit a comment regarding C&H Hog Farms, Inc., AFIN 51-00164, during the public comment period ending October 24, 2018.

The Department is actively engaged in developing an antidegradation implementation procedure to address the revision of 40 CFR § 131.12. The Department implemented 40 CFR § 131.12 in APC&EC Regulation 2 Chapter 2. As stated in APC&EC Regulation 2.203, it is not the intent of the regulation to dictate regulatory authority over private land within the watershed of an ERW, other than what exists under local, state, or federal law.

Consideration of tourism is not within the Department's regulatory authority.

Pursuant to the Memorandum of Agreement between the Board of Trustees of the University of Arkansas System for and on behalf of the University of Arkansas System-Division of Agriculture and the Arkansas Department of Environmental Quality, the study performed by BCRET is being carried out for the use and benefit of ADEQ; however, the study shall be funded and conducted

independently of ADEQ and shall meet the requirements of an independent study conducted by professionals in the field of water quality.

Summarized Comment: The following commenters provided comments supporting the Department's decision to deny the permit application due to air quality concerns including odor, airborne pathogens, and air pollution.

Commenters: Jeff Ingram, Nancy Baxter, Dorothy Walters, David Franks, Lynn Kidder, Cynthia Thiele, Rachel Henriques

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Air quality is outside the scope of this permitting decision.

Summarized Comment: The following commenters provided comments regarding algae in the Buffalo National River and Big Creek. Some commenters stated that the algae is a direct result of the facility operating, and that the algae has increased exponentially in the years following the construction and operation of the facility. Some commenters stated that there is no algae on Big Creek, and that the algae in the Buffalo National River has always been there.

Commenters: Jay Stanley, Eilish Palmer, Marilyn Masterson, Judy McCutcheon, Julann Carney, Kelly Olson, Laura Peach, Demaris Elkins, Chuck Smith, Virginia Hartnett, Dawn Stanley, Gary Fancher, Laura Bitting, Melinda Wylie, Jeannie Jones, Paula Bramlett, Frank Barton, Geral James, Tony Hilliard, Brian Pruitt, Julian Clark, Curtis Presley, Jan VanSchuyver, Barbara Turney, Carol Graham, James Wilcox, Curtis Semler, Robert Hornberger, Kim Bittle, Judi Nail, Robert Clay, Geoffrey Zahn, Angela Nichols, Janie Agee, Richard Crawford, Donald Campbell, David Pope MD, Tera Easter Short, Denice McMinn, Kelley Renard, Raymond Penick, Randall Hollenbeck, Carrie Harris, Marya McKee, Frank Barton, William Nipper, Marilyn Deese, Dick Lester, Judy Powell, Steve Singleton, Jerry Vartan, Marianne Black, Lawrence Ireland, Greg Kennedy, Nancy Baxter, Lisa Castellani, Andrea Moerman-Herzog, Linda Langer, Nicole Pope, Susan Gardner, Laykyn Rainbolt, Kriste Rees, Kenneth Smith, Brad Kohler, Brandon Baker, Mark Moore, Vivian Duncan, Bob Hill, Barbara Janke, John Creager, John Creager, John Creager, Jessica Luraas, John Creager, Alerha Tetterton, Heather Hudgens, Michael Jirka, Cindy Jetton, Shane Jetton, Sara White, Stacey Burnett, Jonathan Shoffit, Dean Castle, Daniel Lamping, Angela Koone, Dave Mcphail, Ashley Money, Sharon Robinson, Sam Whitlow, Melissa Knowlton, Philly Rains, Susan Robinson, Colleen Vollman, Bianca Armstrong, John Bouck, Brandon Bassett, Matt Horan, Caroline Hughed, Sarah Moss, Gordon Siggeman, Kerry Berger, Daniel Daugherty, T.A. Sampson, Don Shreve, Dorothy Walters, Robert Bowker, Nina Linn, Carol Wooten, Richard Crawford, Joellen Rosenquist, Abby Burnett, James Wise, Rickey Border, Tammy Decker, Alicoa Finch-McCastlai, Erika Brock Stolzer, Laura Herold, Bryon

Kelley, Joshua Janke, Lisa Swinford, Steven Roberts, Roxan Smith, Kenneth Pape, Taylor Shanks, James Cline, John Fritz, John Shore, Beth Barre, Stan Langley, Bob Morison, Gary Strain, Melinda Caldlwell, Cindy Majoros, Frank Keller, Sherry Clark, Larry Owens, Bonnie Jaeckle, Melissa Sunshine, Trish Hasenmueller, Joanne Vrecenak, Margaret Birdsong, Connor Schuman, Scott Yaich, Eileen Lenkman, Gaea Miller, Susan Leslie, Donald Campbell, Sandy Kapka, Keith Reeves, Toma Whitlock, Karen Hill, Julee Jaeger, Stephen Sims, Karen Tablish, Robyn Schaub, Ronald J. Doster, Roger Case, Tammy Calnan, Sandra Roerig, Elaine Nesmith, Sean Fletcher, David Harju, Janis Harju, Dorothy Bailey, Joe Love, Janice Peters, Nathan Pittman, Donnetta Wheeler, Barry Bryant, Amy Hazel, Gerald Weber, Kacy Forrester, Wes Craiglow, Nancy Miner, Denise Barton, Lillian Israel, David Alexander, Laura Timby, Steve Folkers, Robin Rumph, Ryan Sheffield, Charles Finch, Mike Richardson, Andrew Lee, Christy Tennant, Brandon ONeal, Cate Barnett, Dawn Kelly, Sean Stamm, Laura Brasel, Cindy Jetton, Alex Liles, kay fulton, Eddie Vollman, Tammy Jernigan, Teena Crabb, Emily Roberson, Rhon Reme, Terry Sutterfield, William Dark, Barbara DeChant, Richard Maxwell, Phil Wood, randy Jones, John Kelly, Erin Rains, Cindy Jetton, Kayden Rains, David Schisler, Ashley Campbell, Jeff Reddell, Sandra Avra, Danny Kelley, Robert & Cynthia Martin, Edith Stahl, Rel Corbin, Cynthia Jetton, Richard Williams, Brock Foster, Randy Carter, John Carter, Candace McGhee, Debbie Doss, Bruce and Susie Hibbs, Jeff Connole, Evelyn Mills, Kathy Downs, Andy McCutcheon, Bill Dark, Jared Wheeler, Kathy Downs, Brad and Diana Walpole, Gayle and Randy Teague

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

> Algal blooms have, and continue to, cause concern on the Buffalo River. As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[1]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Summarized Comment: The following commenters provided comments supporting the Department's decision to deny the permit application because the permit application fails to comply with the requirements set forth in APC&EC Regulation 5 and the AWMFH.

Commenters: Mike Masterson, Grant Scarsdale, Carolyn Shearman, Debbie Alexy, Robert Morgan, Greg Scharlau, Judy Eldridge, Harold Lacy, Rick Hale, Fay Knox, My Blue Heaven Cabin, Gerald Weber, Deborah Kitz, Mark Smith, William Dark, Ellen Corley, Brian Thompson, Bob Allen, Debbie Alexy

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. ADEQ has determined that a detailed geological investigation of the facility is required because karst includes highly permeable foundations with the associated potential for groundwater contamination and potential for sinkholes to open up with collapsing ground or cause differential settlement. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. Geotechnical

investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Summarized Comment: The following commenters provided comments in favor of the facility receiving a permit due to the applicant having gone above and beyond in providing all requested information to the Department. Some commenters raised concerns that the applicant was able to get an APC&EC Regulation 6 permit, but were denied an APC&EC Regulation 5 permit, and that the Department is following recommendations rather than requirements.

Commenters: Brandon Martin, Tammy Decker, Terance Middleton, Sharon Pierce, Michael Battenfield, Lemon Sharbrough, Gregory Smith, Bert Watson, Tad Huff, John Jones, Keith Kilbourn, Nathan Obryant, DeLana Shoemake, Charles Pridmore, Bill/Lois Willard, Kathy Martin, Martha Winnat, Austin Brown, Laura Smith, Kimberly Mefford, Janice Higgins, Brian Stoltze, John Crangle, Michelle Pass, Steven Hignight, John Moore, Jason Kaufman, Marcus Looney, Doug Baird, Brian Unruh, Amy Smith, Carla Vaught, Rosemary Faught, Amelia Bower, Bethaney Kent, Michelle Buchanan, Karen Edgmon, Joey Sample, Dan Wright, David Brown, Malcolm Farmer, Lillian Preddy, Randy Gibbins, Cassie Fisher, James Smith, Helen Griffin, Jane Ann Perry, Steve Barney, Libby Brasel, Martin Sims, Jennifer Cook, Libby Brasel, Linda Fortune, Jessica Wheeler, Kathy Morales, Kevin Flippin, Rick Casey, Jon Melton, Rona Cross, Kelly Ragland, Sam D. Cooke, Kevin Overholt, Dustin Cowell, Mike Richardson, Pam Grice, Michael Brotherton, Deanna Bohanan, Branda Swafford, Tammy Clark, Lavern Baughman, Charity Richardson, Teena Crabb, Jane Martin, Becky McAnulty, Nick Holt, Calvin Henry, Doug Miller, Carl Eggers, Carolyn Hambay, Thelma Ramsey, Dalton Bower, Amanda Drummond, Brad Doyle, Melissa Klipp, Debbie Peerce, Stephanie Ford, Donald Horton, Emilee Tucker, Ashley Campbell, Jack Boles, Jill Pierce Wilborn, James and Brenda Patton, Kason Knapp, Harlie Treat, Elliott Golmon, Doyle Smith, Janet Mathis, John Hamilton, Cathy Minor, Arlis Jones, Chuck Pridmore, Jerry Masters, Matt Heidersheidt

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The applicant was previously granted coverage under an APC&EC Regulation 6 general permit. The prior permit issued under APC&EC Regulation 6 General Permit ARG590000 and the coverage under that permit tracking number ARG590001 are outside the scope of the current permitting decision.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Summarized Comment: The following commenters provided comments supporting the Department's decision to deny the permit application due to the impairment of Big Creek and the Buffalo National River. Some commenters suggested that the Department list the streams as a Category 5 in the proposed 2018 ADEQ 303(d) list. The commenters believe that the facility is the source of impairment.

Commenters: Jay Stanley, Julann Carney, John Ritchey, Cheryl Luchin, Pamela Ellwood, Dewey Strode, Robert Steele, Valerie Hart, Richard Bishop, Laura McCarty, Hal Mitzenmacher, Carolyn Shearman, Martin Gallaher, Ellen Tate, Robert Richart, Mikki White, DeLynn Hearn, David Pope MD, Lucas Parsch, Debbie Alexy, Rebecca Shannon, Craig Gann, John Ray,

Theresa Brewer, Charles Steelman, Joseph D. LaFace, Robert Morgan, Linda Lewis, Benjamin Thompson, Arthur Evans, Kenneth Pape, Stacey Lochala, Margie Arens, Debbie Campbell, Barbara Dillon, Carolyn Di Santo, Melina Rikion, Mary Schlatterer, Steven Miller, Lesley Allen, My Blue Heaven Cabin, Elaine Nesmith, Craig Duffy, Sam D. Cooke, Mary Melissa Lee, Kay Fulton, Tom Thompson, Mark Smith, Tasha Hudson, Marti Olesen, Ellen Corley, Brian Thompson, Frances Dorough, Bill Pettit, Gayle Teague, Cynthia Mitchell

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen.

The Department followed the 2018 Assessment Methodology[1] in its assessment of the State's water quality. The 2018 Assessment Methodology and the resulting assessment of the State's water quality are outside the scope of this permitting decision.

[1] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/final-2018-assessment-methodology.pdf

Summarized Comment: The following commenters provided comments supporting the Department's decision to deny the permit application. The commenters believe that the facility applied for a permit to discharge waste to the Waters of the State.

Commenters: Donald Campbell, Jo Paulus, Ann Chitwood, Arlone Folkers, Andrew Lee, Anne Titus, Barbara Dillon, Becky Hauck-Brents, Charles Black, Carl Burd, Crescent Dragonwagon, Catherine Handley, Cece Hilliard, Calvin Wilson, Dan Clarke, Diana Danforth, Derrick Hartberger, David Jacobsen, David Kelley, Dustin Slaughter, Dylan Stith, Edward Downie, Jane Scroggs, Ellanorah Wilson, Frances Kulish, Guy Ames, Gary Johnson, Holli Hooten, Heather Huckeba, Homer Keys, Ian Shirley, Jeff Cordell, John Fritz, John Heringer, Jody Hughes, Jane Justus, Eileen Kelley, Joe Loman, Jefferie Renegar, Josh Sakon, Jan VanSchuyer, Jessica Walls, Jane Wenmok, John Wilson, Jacque Faubus, Jim Faubus, Kolt Burton, Kathy Cowherd, Kent Landrum, Keith Lewis, Kim Swepston, Lisa Hackman, Linda Komlos, Lauren Matlock, Lorenzo Otranto, Lynn Risser, Linda Stith, Mike Atkinson, Michael Daugherty, Michael de Buys, Misty Langston, Matthew Richardson, Mark Smith, Marthanne Squires, Mike Stith, Marion Tichenor,

Michelle Turberville, Mary Grace McCauley, Mary Lauren Wilson, Nancy Kahanak, Nan Loman, Penny Carroll, Paul Cromwell, Phyllis Head, Paula Matthews, Rebekah Brown, Rel Corbin, Robin Devine, Rebecca Ivey, Ramona Ladue, Steve Folkers, Sharon Keller, Scott Mashburn, Sarah Moore, Sydney Ripple, Sue Standefer, Susan Tinker, Susan Unger, Shari Withey, Terry Michaels, Tonia Squires, Virginia Hinterthuer, Victoria Lee, Wesley Booker, William Davis, William Kumpuris, William Smith, Norma Marshall, Kevin Williams, Kevin McKinnon, Robin Palculict, Carl Whittemore, Britta Morrison, Carol Shoup, Sharon Miller, Leah Simpson, Amy Thiele, Sandra Murray, Danny Smith, Legina Boswell, Frank Henry, Kathleen Lasar, Judith Matthews, Jett Moore, Jennifer Sterling, Jessica Winkleman, Kathryn Laurain, Margaret Blair, Mike Oglesby, Mark Pryor, Michael Pulfer, Patty Heller, Martha Falkenstien, Joyce Bunch, Diana Welch, Margaret Konert, Ginny Masullo, Patricia Mikkelson, Rita Benitez, Jeanie Wyant, Jeremiah Jennings, Becky Hauck-Brents, Parker Fiscus, Gena Pense, Thomas Mahaney, Jr., Rachel Huff, McKenzie Barnes, Michael Crane, Delaney Butler, Kasey Estes, Ellen Hoofard, Terry Layman, Catherine Sain, Holly Harper, Ken Muessig, Jennifer Cole, Melissa Daly, Anne Littell, Barbara Dillon, Robert Laurence, Sally Hunter, Susan James, Stella Keating, Stanley Lancaster, Sarah Matthews, Bayard Blain, Bayard Blain, Ryan Hartley, Betty Rowe, Brett Sterling, Damon Akin, Donald Hays, Doug Wallace, Elizabeth Cantwell, George Shelton, Heather Blair

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

C&H has applied for an APC&EC Regulation 5 Individual No Discharge permit. APC&EC Regulation 5.303 prohibits point source discharges from any part of the liquid animal waste management system.

Summarized Comment: The following commenters provided comments supporting the Department's decision to deny the permit application due to the lack of an emergency action plan that addresses overtopping, natural disaster, or other emergency discharge.

Commenters: Jay Stanley, Dale Anderson, Virginia Booth, Miranda Harrington, Bruce Petray, Charles Beavers, Debbie Alexy, Kenley Money, Lawrence Jackson, Steven Bonner, William Speer, Gerald Weber, Laura Timby, Gail Sears, Jacob Maris, Ellen Corley, Debbie Alexy, Judith Matthews, Jett Moore, Jennifer Sterling, Jessica Winkleman, Kathryn Laurain, Margaret Blair, Mike Oglesby, Mark Pryor, Michael Pulfer, Patty Heller, Margaret Konert, Ginny Masullo, Patricia Mikkelson, Rita Benitez, Jeanie Wyant, Jeremiah Jennings, Becky Hauck-Brents, Parker Fiscus, Gena Pense, Thomas Mahaney, Jr., Rachel Huff, McKenzie Barnes, Michael Crane, Delaney Butler, Kasey Estes, Ellen Hoofard, Terry Layman, Catherine Sain, Holly Harper, Ken Muessig, Jennifer Cole, Melissa Daly, Anne Littell, Barbara Dillon, Robert Laurence, Sally Hunter, Susan James, Stella Keating, Stanley Lancaster, Sarah Matthews, Bayard Blain, Bayard

Blain, Ryan Hartley, Betty Rowe, Brett Sterling, Damon Akin, Donald Hays, Doug Wallace, Elizabeth Cantwell, George Shelton, Heather Blair, Eddie Vollman, Steven Heye

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

C&H Hog Farms, Inc. submitted an Emergency Action Plan to the Department on October 23, 2018. The Emergency Action Plan did not address possible failure of the liner resulting from potential damage, such as pumping and agitation, liner desiccation, or any other site-specific operational risks are not addressed, in accordance with AWMFH 651.0204(a), (b).

Summarized Comment: The following commenters provided comments supporting the Department's decision to deny the permit application stating land application of liquid animal waste is not a viable method of waste disposal. The commenters raised concerns about the runoff from the land application of waste reaching the Waters of the State through surface runoff and subsurface geology. The commenters also commented on the amount of nutrients in the waste applied.

Commenters: Jay Stanley, John Taylor, Bruce Ehrman, Richard Grippo, Suzanne Barnes, John Ritchey, Ruby Molder, Virginia Booth, Mike Masterson, Laura McCarty, Tony Hilliard, Steve Crawshaw, Carolyn Shearman, Jeff Hood, Leah Childress, Rebekah Mize, David Pope MD, Diana Angelo, Virgil Duvall, Marya McKee, Ken Eastin, Robert Reed, Nancy Baxter, Ethel Simpson, Greg Manry, Linda Payne, Kenneth Smith, David Smith, Margaret Cameron, Joseph D. LaFace, Martha DeChant, Sharon Robinson, Lawrence Jackson, James Jones, Thomas Trigg, T.A. Sampson, Carol Percifull, Joe Neal, Terry Donohue, Bryan Signorelli, Mary Lightheart, Frank Sospenzi, Sherry Holden, Jim Spears, John Gunter, Keith Newton, Stan Langley, Chris Selby, Katheryn Walden, Lonnie Womack, Debbie Campbell, Barbara Dillon, Frank Keller, Melina Rikion, Charles and Janice Transue, Scott Yaich, Catherine Ross, My Blue Heaven Cabin, Virginia Evans, Sandra Roerig, Allison Nicholas, Shannon Gitchel, Laura Gocio, James Britt, Gerald Weber, Tom Holland, Sam D. Cooke, Rachelle Smith, PhD, Thomas Emerick, Eddie Vollman, Mark Smith, Rex Flagg, Terry Michaels, Craig Hull, Haley Lane, Ray Stahl, Brock Foster, John Carter, Candace McGhee, Bill Pettit, Rachel Henriques, Erin Yarrobino, Legina Boswell, Lucien Gillham, Anita Sawyer, Mark Corley, Faith McLaughlin, Vallie Graff

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Land application of liquid animal waste is an authorized method of disposal under APC&EC Regulation 5.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Summarized Comment: The following commenters provided comments supporting the Department's decision to deny the permit application. The commenters stated that the Buffalo National River should be accessible to everyone and be saved for future generations. The commenters stated that the farm should never have been built in its present location and that the farm is polluting the Buffalo National River. Commenters stated that the farm should be moved or bought out by the State and any pollution be cleaned up.

Commenters: Christy Lavely, Susann Walters, Deanne Mayer, Kevin Rawls, Ed Brocksmith, Save the Illinois River STIR, Greg Watkins, Dr. James Pagan, Rebecca Holden, Mary Jane Hickey, Jamie Causey, Michele Beasley, Gregory Merlino, Rick Milholen, Leonard Hankins, Clint Herrington, Gary Tombridge, Mary Gard, Michael McBroom, Drew Stephens, Pat Snyder, Phylis Allen, Thomas Neff, Denise Ritchey, Robert Smith, Martha Adams, Joe Hiryak, Hank van Rossum, Liz New, Chally Sims, Mark Burk, Julie Lanshe, Diane Newcomb, Emily Hartley, Andrew Fulkerson, Neil Pumford, Elaina Holcomv, Adam Schaffer, Virginia Carron, Paul Green, John Schmedeman, Thomas McCurdy, Tommy Allen, Dwayne Pratt, Richard Lancaster, Janelle McCann, Logan Pratt, Kelby Taylor, Kelly Franklin, Chris Davidson, Marcy Bujarski, Kenneth Jones, John Bomar, Hank Thompson, Robert Smith, Terrance Hill, Helen Smith, James Harmon Jr Smith, Steve Sitton, Jay Stanley, Sr, Kara McCarty, Paula Finch, Joe Rath, John Brown, Greg Watkins, Jane Aston, Steve Crawshaw, Tammy Knowles, Pam Floyd, Phil Milan, Charles Glasier, Vivian Doty, Michael Echols, Yates Phillips, Neil Collins, Samantha Dill, Allison Williams, Susan Fredrick, Sabrina Bradley, William Kumpuris, Norma Senyard, Gerald Toler, Lynn Phillips, Pattie Heitzman, Mark Heitzman, Ken Ackley, Lisa Orton, Barbara Fell, Cathy Leflar, Mike McMullin, Crystal Dore, Rita Caver, Roy Clinton, LaDonna Duncan, Jennifer Neill, Steve Hesse, Lisa Orton, John Goddard, Rodger Keesee, Kay Amos, Andrew Heinzelmann, Karen Anderson, Christine Sheldon, Angela Houser, Nancy Owens, Bettie Lu Lancaster, Judy McCune, Duane Curby, Stephanie Smith, Charles Carpenter, Helen Pounds, Sean Zupan, Greg Martin, Peter Curby, Dorothea Phillips, Debbie Billings, Jerilyn Nicholson, Renee Reed, Denise Brewer, Lori Marks, Ann Birge, Mary Langley, Janna Peters, Karen Thomas, Grimsley Graham, Cindy Baker, Margaret Johnson, Amy Garrett, Hugh Kincaid, Suzie Ridgley, Cloetta Annabel, Kyle Evans, Mary Jo Gover, Susan Fields, David Branscum, James Cummings, Kim O'Neill, Michael Harkey, Satah Kendrick, Cheryl Park, Stephanie Smittle, Isaac Tweeddale, Debbie Davis, Karen Seller, Dennis Moore, Jerrid Gelinas, Keith Warner, Judi Hart, Kori Turner, Carolyn Crook, Mika Nelson, Tammy Weaver, Mark Lawrence, Jann Bell, Jana Reid, Carolyn Banks, Mary Ann Holder, Beth Singley, Josey Humbert, Charles Davis, Charlie McGrew, Kelley Richardson, Frederic Short, Jana Jones, Gail Pianalto, Jan Ironside, Lindsey Rose, Marsha Ralph, Autumn Barrow, John Huff, Delayne Rushing, Pamela Fraim, Kenya Harbin, Jeannie Philpott, Rick Millard, Farris Bergant, Carolyn Ford, Brian Hardman, Beth Felton, Jennifer Zeck, Jay Clark, Donna Dowler, Randall Harness, Catherine D. Branch, John Mora, Casey Hook, Rachel Ward, John Langston, Michael Guidry, Ronnie Koons, Michael Wingo, Nathan Higgins, Janette Groves, Betony Weakley-Maringer, Danielle Nielsen, Karen Johnson, Jean Regina Nayga, Scott Coogan, Jody Zimmermann, Josh Rowden, Kim Emery, Kara Wise, Scott Swearingen, Roger Burke, Troy Ashmore, Jessica Brown, Adam Schaffer, Keith Merckx, Vanessa Jacky-Davis, Robert Boullester, Sheila Hettinga, Elaine Williams, Emma Boullester, Copeland Hughes, David Martinson, Heather Smith, Jaleta Boyd, Lindsay Pierce, Tom Watkins, Larkin Floyd, Randy Looper, Lisa Orton, Steve Stinnett, Sandy Kizer, Mike Brewer, Melissa Triplett, Douglas Horton, Cal Clark, David Mobley, Chelsea Jordon, Jeremy Holstead, Cindy Stinnett, Shelby Wahl, Valerie Core, Kayla Sapkota, Noah Moses, Valerie Allman, Richard Haff, Allison Groves, Hunter Woods, Elizabeth Yoder, Kathi Howard, Janet Jennings, William Thompson, Rob Poole, Mike Fick, Renee Farmer, Kyle Moppert, Gloria Elliott, Sonja Williams, John Hopper, Shirley Claypool, Annie Holmes, Polly Fricke, Christy Dablemont, Tammy Vanaman, Stacy Price, Larry Rehm, Linda Nolan, Paula Cannon, Margaret

Garland, Tim Holley, Brandon Wheeler, Tonia Spurlock, Vivien Lamb, Guy Knuth, Heather Graham, Monica Wingert, Lindsay Skinner, Joe Barrett, Bruce Jensen, Tim Crouch, Patrick Renee's Berry Garden (Ford), Kathy Prater, Will Larkin, Steven Zimmerman, Patricia McKeown, Hayden Walker, Marsha Crittenden, Kathy Thompson, David Childers, Mike Carron, Nicholas Boeddeker, Shanti Copeland, Ann Melero, Darrell Dougan, Carole Cimarron, Linda Rooney-Card, Michael Stoker, Lindi Criswell, Mary O'Shields, Kathy Pettigrew, Carmen Stephens, Chally Sims, Andrew Thompson, Adelia Kittrell, Andrew Gibbons, Lori Lemley, Michael Parks, Stacie Lake, Gene Reid, Lauren McCormick, Joan Philip, Tim Blair, Nancy Burton, Lynn Risser, John Pflasterer, Shana Tetuan, Donald Matt, Emily Harris, Luke Block, Bernie Reif, Amanda Duncan, Ricky Dye, David Martindale, Paula Breid, Tyler Anderson, Shannon Ingram, Margery Shore, MaryAnn Kahmann, Bobby Studnar, Ashley Denton, Michael C, Rita Johnson, Judi Richardson, Janet McMahon, Jeff Speak, Matthew Haygood, Darrell Lawrence, Dave Smith, Angela Barnett, Roger Taylor, Jeff Williams, Jimmie Thomas, Patrick S McKinney, David Davis, Ashleigh Fonte, Catherine Harvey, Tahya Taffar, Dalene Ketcher, Carl Bailey, Linda Chambers, Slater Corbin, Katherine Kennedy, Margaret Smith, John Erikson, Robert Loffler, Paul Taylor, Reva Stover, Mike Pryor, Suzy Dauphin, Debra Johnson, Stephen Bailey, Jacob Newman, Darren Dahle-Melsaether, Sean McGowan, Kathy Sutterfield, Cynthia Maurer, Lisa Orton, Eunice Millett, Terrie Martindale, Joyce Wilson, Jennifer Gregory, Joshua Pace, Ann Noland, Ray Balaster, David Barre, Jane Ray, Barry Martindale, Suzanne Sexton, Rebecca Harrison, Kirk Thompson, Stephanie Hyde, Bert Kell, Murray Harris, Linda Mann, Johnny Jacobs, Sherry Declerk, Kay Lewis, Bill DeClerk, Cary LeMaster, Douglas Bingham, Kyle Alexander, Capt. Glenn Jones, Arthur Bowie, Laura Fleetwood, Michelle Westfall-Edwards, Janet Atwood, Karan Freeman, Sherrie McIntyre, Harry Kiple, Doris Kiple, Susan Young, Sherrie Petersen, Laura Glaze, Herb Blount, Linda Macalik, Barbara Southerland, Del Heck, James Meinecke, Chuck Maize, E M, Barbara Johnson, Lenora Lohman, Kathleen G Glasgow Sparks, George Knight, Elizabeth Harness, Steven Ayers, James Cohea, Charles Olson, Liz Foster, Mary Wise, Elizabeth Keck, William Rosser, Janet Parsch, Janet Holman, William Johannesen, Gladys Tiffany, Andrew York, James McDonald, Corey Brady, Veronica Clarke, Ramey Moore, Deana Vickers, Linda Hancock, Jacque Alexander, Pat Sandlin, Shirley Womack, Stephen Grady, ted Spears, Bob Walker, Jillian Guthrie, Teresa Youngblood, Tammy Pack, Janet Robbins, Janet Nelson, Vivian Ireland, David Kuhne, Bryan Brewer, Billy Womack, Thomas Foti, Lenore Arent, Darlene Baker, Elizabeth Fletcher, Chuck Dudley, Bonnie Douglas, Don Castleberry, Francie Bolter, Brian Bolter, Don McCaskill, Rebecca Williams, Steven Booth, Charles Dudley, Ann Winters, Sondra Gordy, Robert Williams, Rick Davis, Carolyn Lee, Phillip Norris, John Slater, Paul Williamson, Linda Arnold, Terry Keefe, Kathleen Keefe, Clay Pearson, Dave Lay, Carol Phillips, Susan Frey, Rovetta Nodine, Rovetta Nodine, Ray Quick, Carolyn Quick, Mark Mccarroll, Patrick Hall, Rachel Townsend, Heather Hudgens, Barbara Birmingham, Charlotte Morris, Donald Poe, Claire Borroho, Don Stephens, Mark Burk, BreAnna Rhodes, Dennis W Wright, Susan Bennett, Suzie Ridgley, Richard Gray, James Stotts, Marvin Wilson, Lauri Porter, David Adams, Brenda Moreland, Steve Wilson, Jami West, Karen Doss, Larry Marcum, Stephanie King, Angie Russell, Jamie Rains, Dorothea Phillips, John Moore, DeAnn Blackard, Michele Mullins, John Fausett, Bonita Ouellette, Steve Davison, Dean Castle, Cathleen McAuliffe, James Loyd, Lyn Bowles, James Loyd, Ted Spears, Brady Carman, Kathy Madding, Rick Milner, Adam Black, Pam Harcrow, Rhonda Butler, Erica OBrien, Beth Singley,

James Loyd, Rob Uselton, Maggie Mouser, Debby Gwaltney, Tonya Smith, Jill Porto, Angela Wright, David Easley, Melody Keazer, Diane Easley, Kelly Stockman, Julia Schaap, Jon Wheeler, Kimberly Wallace, Kendra Bell, Michelle Lopez, Heather Alphord, Richard Spicer, Judith Levine, Kim Bennett, Diana Beaird, Donna Garden, Dennis Moore, Hannah Louise, Chris Brothers, Kelley Richardson, Robert Scott, Megan Carolan, Penny Manning, Shannon Hubanks, Ella McKinnon, Rachele Rhodes, Royce Jones, Lesa Otten, Laura Ball, Hank van Rossum, Stephanie Lewis, Helen Smith, Cheslea Harper, Brian Perry, Cheryl Matthews, Mark Hodge, C & F Christian, William Deese, Guy Knuth, Randall Pack, Josie Yerby, Jason Ashford, Steve Kirk, Beth Caldwell, Nicole Nichols, Mary Ford, Susan Starr, Gary Bivens, Gene Sparling, Michael Wingo, Janette Groves, Steve James, Joyce Ivy, Jenifer Williams, Tiffany Bewley, Carmen Tabor, Nazar Drani, Beth White, Stacy McEntarffer, Shanti Copeland, Teresa Gates, Julie Endsley, Ann Griffin, Leslie Tabor, Pamela Styles, Linda Eddings, Colleen Vollman, Edith Calaway, Diane Payne, Lisa Huff, Keith Owens, Marilyn Curry, Richard Morton, Dr & Mrs Greg Cothren, Lori Marks, Kevin Whaley, Margaret Collier, Matthew McClure, Jessica Cheval, Dena Dickinson, Connie Evans, Roger Pessa, London Sharp, Cindy Henley, Catherine Caldwell, LauraJo Smole, Jon Felker, Richard Hutchinson, Nona Dumas, David Vaughn, Hannah Snavely, Marc Hilden, Betsy Lundgren, Valerie Cops, Julie Cone, Joyce Tate, Jo Houser, Cherrie Widner, Alvin Thomas King, Linda Woods, Dan Coody, John Clayborn, Bruce Woods, Beth Ruddick, Lori Menichetti, Cyndi Smith, James Kent, Donna Park, Donna Hertlein, Autumn Robbins, Kim Smith, Tara Shrake, Cheryl Krock, Cale Hughes, Beverly Wright, Gretchen Hunt, Adrienne West, Mark Widder, Laura Doffitt, Natalia Chorew, Lorie McGeady, Philip Doyle, Jennifer Sieben, Ellen McLemore, Steven Wilson, Janet Trigg, Roy Coles, Ben Pittman, Jeanne Olson, Holly Basky, Amy Locke, Natalie Bourne, William Wimberly, Cristal McQuary, Leslie Moore, Sally Grace, Marcia Lux, Brenda Barnhill, Jason Lamar, Carol Ryan, Shawn Lorenzen, Sarah Weems, Shelley Rowan, Lee Wyman, Cornelia Sledge, Jan Buck, Darcy Foust, Robin Butler, Joel Nunneley, Elizabeth White, Dave Zucconi, Michael Koone, Stuart Reaves, Chris Koone, Amanda Echegoyen, Barry Swain, Carol Wallis, Joann Saraydarian, Kevin Breckenridge, Diane O Border, TR Smith, Thomas Rudolph, Heather Lawrence, Merrin Locke, Michael Overdorf, Rebecca Jeter, Chris Luckey, Brett Maguire, Stacey Lorenz-Mitchell, Rita Caver, Peggy Hill, Brenda Huber, Abigail Fryar, Kathleen Hess, Chally Sims, Dewayne Faulkner, Bettie Lu Lancaster, Marsha Havens, Dennis Sisson, Linda McCaskill, Carl Webb, Daryl Boles, Mary Fulk, Linda Nolan, Glenn Pickel, Jack Edwards, Jason Barr, Shannon Gayol, C Carter, Gwen Hoffmann, Julie Raines, Lewis Robinson, Renna Cothren, Katherine Weaver, Dereka Pedersen, Ruth Sampier, Jeff Rice, Wynne Waddell, Raymond Watts, Ashlee McCaskill, Janet Buss, Sally Wimberly, Wayne Stewart, Rose Hilliard, Malcolm Norman, Lane Phelps, James R. Few, Pam Chrisco, Linda Smith, Tim Mason, Kim Wilkinson, Amanda Cherry, Mary Hoffman, Rex Morris, Cynthia Adams, Melanie Sutton, Sandra Tedder, John Offutt, Michael Bellettiere, Elizabeth Foster, Sharon McGraw, Sherry Smith, Vivien Lamb, Patti Van Camp, Doug Vlastuin, Richard Quick, Mary Jane Hickey, Teresa Campbell, Lila McCauley, Kara Evans, Vicky Harvey, Michael Schwade, Kathleen Stanley, Robert Albrecht, Donna Muhollan, Dana Murdock Banks, Joe Trimble, Catherine Coffey, Donna McLaughlin, Jacqueline La Place, Mary Cole, Sherri Drzewiecki, Dian Williams, Frankie Jackson, Makenna Brennan, Sarah Myers, Jennifer Reed, Natalie Hobbs, Linda James, Ashley Knowlton, Kim Hinkle, Sonny Bell, Thomas Usher, John Cork, Julie Shelton, Alan Dougherty, Lea Ann Crisp, James McDonald, Emily Gintonio,

Stephen Spies, Mary Ann Guinn, Howard Aleshire, Debora Carpenter, Jeff Danos, Melissa Garrison, Dayna Enderson, Linda Bell, Jim Clark, Nicole Sagraves, Sandra Templeton, Crystal Ursin, Cay Miller, Carol McCutcheon, Darbi Blencowe, John Taylor, V Leland Sykes, Janalee Robison, Carly Marx, Kenneth L. Smith, Amanda Kennedy, Lauretta Richardson, Nancy Pierson, Marianne Bieker, David Franks, Katherine Murdock, Kim Hesse, Ed Nesbitt, Nan Lawler, Graham Gordy, Grant Nevill, Suzanne Kenward, Lorri Carter, Miles Janke, Roger Pyzocha, Hannah Janke, Sue Reynolds, Jason Thibodeaux, Joe Powell, Fletcher Smith, Kaye Clanton, Kaye Baskerville, Dan Clanton, Andrew LaGrone, Louise Halsey, Douglas Coppock, Christeen Kline, Noel Mays, Kathryn Martone, David Harper, Mary Droho, Becky Christenson, Douglas Lowrey, Cory Burbidge, Susan Jones, Martin Schaffer, Jana Fisher, Joseph Meyer, Thomas Dubois, Carroll Wesson, Julie Martin, Kerry Miller, Ruth Pianalto, Robert Burnett, Jerilyn Nicholson, Armilda McCormack, Frank Wait, Todd Parnell, Caroline Morgan, Clay Parton, Bryan Duncan, Grace Turley, Thomas Burroughs, Lila Gullick, Bryan Rupar, Wightman Harris, Ilene Powell, Suzanne Neal, Stuart Baer, Debbie King, John Hill, Donald Matt, Leon Alexander, Don Rottman, Judith A. Griffith, Leeann Whitlock, Melinda Burnette, Jay Shearer, Charles Faulkner, Stanley Gramling, Mitch LaGrone, George Wise, Rebeckah Koone, Randall Glenn, Lynn O'Toole, Robert Gillson, Mark Love, Karen Pope, Walter Coleman, Harriett Sisson, Norbert Delph, Julia Trecanao, Ray Templeton, Jesisica Camp, Peggy Mahurin, Terry Waldo, Maxwell Baldwin, Pam Herrington, Jan Robertson, Ann Chitwood, Allison Henry, Aaron Baldwin, Grace Brown is, Gregory O'Neal, Gail Brown, Cheryl Grey, Beverly Parkinson, Rhonda Smith, Justin Breland, Patricia Love, Vanessa Tomczak, Judy McNabb, Sharon Burnett, Gayle Teague, Steven Cherry, Connie Sedlacek, Andrea Matters, John Seymour, Donna Thompson, Susanne Roberts, Dimitri Harris, Reba Potee, Thomas Griffin, Dana Ward, Erin Jenkins, Susan Bryan, Gary Goeckerman, Pat Bates, Hunter LaTourette, Nancy Umiker, Don Matt, Troy Juzeler, David Prentice, Ron Griffin, Carey Blackwell, Frank Gianotti, Ronald Schneider, Sherry Johnson, Chynna Stipe, Anza Locke, Roy Golightly, Bob Sinclair, Rebecca Hartman, Sharrol Hardin, Donna Booth-Johnson, Leah Saffian, Carol McCorkle, Jackie Leatherman, Matt McQueen, Jim Delia, Barbara Dove, Judy Bearer, Ann Segura, Melissa Kelley, Arden Kate, Susan Blumreich, David Walton, David Crittenden, Jay Fulbright, Suzanne Sutherland, Amy Shafer, Mona Brown, Mark Hilleman, Dean Jansen, ME Vandergrift, Peg Obersto, Annonymous, Wanda Lindsey, Jenni Haughaboo, Charles Harper, Gresham Barnes, Jon Wellnitz, Sharon Ash, Charles Eubanks, Jerry Dorman, Jeff Trost, Paul Mitchell, Brad Morris, Mary Mitchell, Ed Loyd, Deborah Cromer, Roxanne Thompson, Penny Ellis, Jill Heath, Bev Taylor, Donna Danhauer, Cornelia McDaniel, David Hasenmueller, Kandice Blue, Charlotte Regennas, Ann Winters, Ryan Gray, Trish Pannell, James Lillis, Sheila Lamar, Brittany Nichols, Ed Brocksmith, Rebecca Heath, Stacie Smith, Tracy Tilley, Teton Back Country Horsemen, Marian Johnson, Margaret Johnson, Liam McMahon, Jimmie McKenzie, Ginny Storey, Cristal Messer, Aprille Kuder, Shannon Hays, Janette Groves, Hannah Davis, Glenda Lovett, Felicity Blanchard, Vicki Grisham, Hannah Hahn, Kendra Taylor, Terry Carson, Gail Robertson, Sheika Rowell, Phyllis Priddy, Daniel Nouguier, Rebecca Smith, Jin Brown, Tony Willmuth, James Hall, Wendy Jones, John Apel, Caleb Frazier, Mike Manion, Emily Buckthorpe, Rachelle Williams, James Bass, Lisa Huelle, Caren Robbins, Bonnie Laxton, Sandra Williams, Emily Graham, Heather England, Christy Spann, Paula Spitler, David Lamb, Sandra Jo Chandler, Steve Williams, Georgia James, Ashley Franz, Robin Norviel, Paul Vickers, Chris Harkins, Robin

Norviel, Dorothy Fincher, Dakota Thomas, Jason Singleton, Tara Sample, Karl Kent, Roberta Redburn, Steve Mahanay, Christine Sain, Jodie Gardisser, Cody Rudd, Erica Powell, Emma Hall, Misty Rowan, Amanda Zylowski, Amanda Bain, William Jeter, Sarah Croswell, Kathy Allen, Bradley McColey, Shane Henderson, Feleshia Hood, Mark Harper, Dustin Triebel, Joel Carr, Susan Jeter, Brandi Robertson, Charles Reid, Kassie Misiewicz, Leslie Harden, Robert Simmons, Marsha Hammond, David Bain, Amy Copelin, Steven Trulock, Joe Stephens, Skip Harris, Steve Middlekauff, Paula Breid, Spencer Mahan, Stacey Gregory, Pamela Price, Kelli Gilbert, Dave Hoffpauir, Polly Carter/White, Casey Gore, Traver Detras, Jeremy Walter, Tanya Hollifield, Lance Cockrum, Jared Davis, Mike Harvey, Dillon Halsted, Heather Harmon, James Brown, Jené Louviere, Robin McClellan, Keagan Snow, Jeff Clawges, Maria Troeger, Emily Myers, Jennifer Williams, Marsha Roach, Jacob Richardson, Susan Michaud, Jeff Henderson, Cliff Barnes, Seth Reeves, Judson Spillyards, Robin Killeen, Cody Moore, Mary Vancura, Cynthia Roberts, Tammy Roberson, Thomas Miller, Monica Ketchum, Thomas Powell, Lisa Peterson, Melinda Perceval, Gregory Snell, Justin Rhodes, Kerrie Turner, Mary Parks, Bailee Basinger, Erin Collier, Jason Moppin, Matthew Dickey, Shane Bruno, Matt Bretz, Bettye Ann Freeman, Meredith Hagan, Karen Hicks, Joseph Faught, Spencer Daly, Mary Phillips, Shawnda Caillouet, Terese Mountjoy, Ashley Henry, Shannon Givens, Jessica Wingler, Bill Chaffin, Meagan McClain, Craig Spears, Linda Higgins, Brandy Kinghorn, Kenton Cress, Matthew Marks, Willow Liebert, Cindy Scroggins, Jan Fletcher, Travis Powell, Nick Slagle, Gaye Bland, Susan Campbell, Richard Massey, Carla Weeks, Kristopher Kruger, Tinika Osborne, Ben Johnson, Tandy Weger, Andrew Pinkston, Carl McDaniel, Sandra Syphers, Mike James, Rebecca Low, Will Brand, Juli Braswell, James Crow, William Tranum, Vanessia Fletcher, Terry Ragsdale, Terri Williams, Shelley Smith, Michele Fay, McGeorge Caradine, Jack Low, Julie Furlow, Erica Ruble, Judy Brittenum, Jennifer Bradshaw, Judy White, Michelle Wilk, Ann Gordon, Lauren Murray, Jason Smith, Myron Putnam, Sammie Beaver, Chance Angelle, Chandra Rush, Tess Moody, Cindy Marckese, Dennis Marckese, Amy Bradshaw, Terri Glowe, Ted Porter, Tryphina Renz, Dana Niemann, Gregory Perceval, Anne Gonzalez, Angela Moppin, Lindsey Klebanoff, Calvin Smith, Lynn Warren, Elias Champagne, Robin Harris, Glynda McConnell, Isaac Szabo, Stephanie Krupka, Renita McDaniel, Kelly Hays, Meline Schaffer, Clay King, Shelia Mitchell, Robert Callans, Rachael Jones, Amy Ouchley, Martha Sharp, Wendy Clifton, Paige Crockett, Jackie Fliss, Hilda Ross, Michael LaTurno, Bill Jacksom, Janet Corley, Michelle Shoppach, Al King, Jennifer Smith, Sam Tobler, Dennis Gilliam, Christie Craig, Kelley Ferguson, Cynthia Howington, Nancy Harris, Andy Hawkins, Gaia So, Arthur Fent, Andrea Gonzales, Jennifer Rogers, Kristin Jones, Martha Gueringer, Robert Mahon, Alexis Burruss, Karen Fahrmeier, Carole Satterfield, Brian Chaisson, Jim Dunn, Ashley Harcrow, Lindie Landers, David Grimes, Warren Nelson, Shannon Darnold, Steve Poynter, Angel Crawford, Johnny Helwig, Joshua Albers, Polly Johnston, Shep Campbell, Hayne Begley, Abilyn Haase, Joe Hilliard, Alex Brady, Janie Mclane, Shelby Esry, Jorjanna Robinson, Connie Buller, Cicily Tubb-Warbington, Jalin Parry, Susan White, Brett Pittz, Shawn Moix, Serena Henderson, Aaron Kuder, Travis Gowin, April Price, Terri Johnson, Marjorie Watkins, Paula Martin, Jacob Achor, Teresa Huff, Angela Ward, Jean Strickert, Mark A. Ludlow, M D, Donette Boyett, Andy King, Suzanne Wasiluk, Denise Chai, Josh Reeves, Ruth Fissel, Adam Benzabeh, Sara Anderson, Courtney McNair, Laura Verwiebe, Joanna Bartle, Ashley Herrington, Amanda Ivy, Randi Passmore, Joel Ludford, Carla Koen, Phillip Freeman, Danny Mize, Scott Parson, Frankie Hart,

Joe Dupre, Candice Clay, Amanda Dewitt, Katherine Hudson, Mike Wiederkehr, Kelly Hitt, Armando Nelson, Michelle Swinford, Ben Goodwin, Martha Meenen, Margaret Peach, Kathryn Matchett, Dana Goodman, Lee Anne K Wiederkehr, Laura Stanley, Kristine Callahan, Paula Henry, Wallace Hattenhauer, Janis Mays, Morgan Gregory, Peggy Nabors, David Sewell, Richard Staton, Micah Szabo, Greg Lutz, Shirley Mccarley, Stefan Szabo, Christopher Curry, Marcel Slootheer, Beverly Belote, Holly Goff, John Collier, Alice Sorrells, Tyler Ehren, Ellen Turney, Tyler Meenen, Laci Embrey, Wesley Williams, Derek Yacoub, Luis Abadie, Janet Hall, Katie Murry, Spencer Watson, Lisa McDougal, Mark Judice, Cody Dalrymple, Dave Mathews, Gretchen Diegnau, William Murray, Judy Edwards Allen, Carol Chesser, Steve Blumreich, Wendy Ramsey, Richard Spicer, Carl Kimbro, Lisa Garrett, Tim Godfrey, Raymond Burks, Melissa Lee, Fran Deramus, Teresa Reddoch, Rachel Lyons, Holle Berg, Russell Babb, Ken Sutterfield, Kim Gullic, Gordon Williams, Sharon Boatright, Amy Morrow, Tara Harris, Kimberlee Jones, Kenn Young, Peri Doubleday, Denise Mecke, Brian Mitchell, Sally Smolich, Khandice Baldwin, Shelley Griffin, Sidney Wood, Kelly Carney, Travis Allen, Franklin Frederick, Matthew Corbello, Boyd Chitwood, Jane Winston, Marianne Estes, Matthew Levy, Sean Ronnau, Karen Murray, Bobbi Cauldwell, Jack Outlaw, Mike Roberts, Sierra Summers, Claudia Brigham, Janis Gregory, James Wright, Jordan Fila, L Henley, Leslie Pianalto, Martha Stanley, Nicole Pizzolato, Mary Holland, Katherine Cloud, Laney Laughlin, Bonnie Henson, Kimberly Fitzpatrick, Kathy Booher, Benjamin Diggins, Bryttani Bartlett, Kathy McAlister, Greg Banks, Tida Stocker, Jordan Haynes, Ambra Bruce, Pat McClelland, Tanna Feldman, James Rees, Robert Holt, Ann Chronister, Sherri Fryar, Emily Fletcher, Sharra Hampton, Karen Cron, Gordon King, Terri Huber, Heather Breen, Casey Jones, Jan Gaughan, Brandon Martin, Robert Baker, Joanna Gahr, Ashley Hudson, Ashley Havens, David Shipley, Stephen Swingle, Michael Broeg, Angela Huselton, Chris Wann, M Sanders, Kayla Denette, Allison Baker, Garry Brown, Allison Tucker, Susan Lovelace, Julie McClendon, Doug Wilson, Ashley Giannini, Charlie Hart, Sandy Walker, Michele Hughes, Margaret Chilton, Andy Sipes, Traci Lovell, Sandra Baker, Jason Throop, Gavin Mitchell, Katie Beck, Melinn Mitchell, Heather Pannitti, Ronald Sitton, Ed Daniel, Merideth McEntire, John Covey, John Gueringer, Deb Gilbert, Kyle Clifton, David Chance, Rebecca Ward, Heather Lancaster, Kaity Davis, Paula Stapleton, Sonya Warren, Dina Butler, Gary Woodward, Marilyn Fleder, Steve Thompson, Sherman Caldwell, Charles Jacob, Mary O'donovan, Dean Loos, JP Willis, Mary Overton, Judith Paz, Emily Davis, Nguyen Ly, Amber Brixie, Gary White, Zachary Herrick, Nancy Burris, Vicki Hill, Mike Koskoski, Matthew Martens, Elizabeth VanderStek, Jess VanderStek, Arlone Folkers, Lisa Martens, Gary Criglow, Mike Kobylinski, Sandra Hubbard, Gary Criglow, Patricia Sage, Janice Neville, Jonathan Jones, Mary Mahan, Jessica Bartnik, Gary Butler, Gail Pittman, Natalee Miller, Anna-Lee Pittman, Holly Robertson, Matt Foster, Deborah Haven, Ray White, William Moore, Mary Garmoe, Ellen Beeler, Kerin Smith, Lauren Trimble, David Finch, Kandy Jedlicka, Abby Nichols, Patrica Horn, Gina Drobena, David Moix, Scott Dupslaff, Steve Perry, Ann Southard, Mike Koger, Farar Rose, Mary Finsh, John Quint, James Burrow, Jack Barton, April Ambrose, Brandy Alcorn, Beth Key, Bridget Shelnut, James Savells, Alex No, Michael Tipton, Wanda Lock, Brian Crum, Jessica Botsford, Charles McFarlan, Katherine Winniford, Gina Pillow, Kelli Martin, Michael Cathey, David Sundin, Brandon Eidson, Talara Taylor, Pam Fowler, Annie Bekuhrs, William Wewers, Jennifer Wells, Rita Loucks, N Blades, Katy Campbell, Bethany Bates, Adam Maloof, Mac Weedman, Leonard Hyatt, Vikki Stefans, Susan

Linck, Jason Foitek, Cheryl Vincent, Jill Mcilroy, Catie Evenson, Missy Ishmael, Kurt Robinson, James McBryde, Theresa Hanacek, Annette Enderlin, Michelle Aquino, Mark Campbell, Wanda Evans, Meg Ryan, Tonja Hettinger, Debra Adams, April Scribner, Claudia Stevenson, Gay Certain, Karen Cockrum, Linda Liggett, Jenna Mosley, Wanda Medema, Breta Hauge, Ricky Russell, Angela Markell, Rebecca Funderburg, Oliver Williams, Beth Wiedower Jackson, Rachel Stripling, Kent Justus, Michelle Davis, Jean Horning, Michael Howell, George Linn, Mary Hughes, Mary Hughes, Neil Devine, Jennifer Walker, Mary Ulrich, Miriam Emerick, Marilyn Masterson, Skip Clemmons, Emily English, John Aquino, Ann Shoffit, Chris Conley, Freda White, Linda Poole, Susan Braswell, Susan Elms, Eva Riggs, George Anna Clark, Randy Riggs, Lori Sikes, Deanna Garretson, Shalann Boyce, Jessica Sheets, Fred Stumpf, Pierre Joubert, Bob Karr, Morris Voan, Barbara Chance, Richard Flinn, Richard Noel, Ann Fly, Amanda Willshire, Thomas Maly, Paul Stanley, Michael Mitchell, Doug Stanley, Megan Weatherford, Josh Self, Chris Werner, Kelly Robbins, Vern Berry, Kim Stanley, Melissa Clark, Mike McGowan, John Woodburn, Valerie McNee, Paul Young, Susan Wilson, Kristen Lassiter, Brad Weatherford, Kelly Pittman, Julie Lanshe, Brad Weatherford, Michelle Shellabarger, Kim Morris, Nancy Deisch, Karen Pitts, Kevin Christian, Will Branch, Victoria Bernal, Nancy Gore, Mandy Thomas, Cindy Strong, Charlie Mcgrew, Ann Birge, Kristina Pratt, Lisa Proctor, Mark Tew, Scotta James, Tyler Kappen, Marc Hirrel, Mary Hughes, Dee Hanson, Carl Reeves, Mandy Mooneyham, Sandra Withers, Wesley Kirk, Adam Day, Emily Babb, Margaret Nichols, J. Vincent Lague, Emma Baldwin, Sandra Baker, Derek Wood, Richard Baruch, Glenda Dean, Caitlin Young, Christopher Kunkle, Caleb Hennington, Michael Hildreth, David Eifling, Mahlon Maris, Ben Mooneyham, Robert Hagberg, Derek Linn, Chad Fisher, Anna Livengood, Lisa Hope, Julian Northway, clint ohara, Heather Knight, Gary Bongiovanni, Arlene Bongiovanni, Ken Harris, Melissa Thomas, James Lace, Kimberly Russell, Jazz Johnston, Laurence Collier, Dalton Rains, Nichole Atwell, Perry Hill, Joy Henson, Jessica McHugh, Louise Fitzgerald, Jerry Bratton, Maria Cortes, Shirley Emerson, Francine Heller, Marianne Lombari-Nelle, Michael Reilly, Christie Ison, Jacquelyn Hunter, Susann Crowell, Richelle Herron, Clarke Kappmeyer, Andrew Poor, Jan Liebert, Toby Slinkard, McKensey Flud, Frank King, Adam Willard, Mary Steele, Bryan Pinnell, Priscilla Stone, Tonda Oakes, Beth Price, Cole Miller, Patty Polster, Destiney Cameron, Debbie Moormann, Danielle Kling, Angela Madding, Felicity Moore, Brittany Thompson, Elyse Rucker, Paula Arnold, Donald Bearden, Susan Curtis, Kimberly Cheshier, Chloe Mims, Wes Moore, Sara Huddleston, Jennifer Thiele, Scott O'Kelley, Bethlyn Rooney, Kerri Garr, Christopher Baugh, Matthew Seaton, Tonita Taylor, Grace Anne Odom, Carly Squyres, Jake Pultro, Craig Jones, Jamie Mann, Lauren Crespin, Nicole Leonard, Rachael Crosby, Jordan Delling, Anita Gwatney, Carrie Crane, Deborah Howard, Katie Coffman, Abel Price, Adrianna Kennedy, Terry Michaels, Ronald Pollworth, Frances Scarborough, Jessica Myska, Colby Bostick, Lindsey Barber, Brendon Nickles, Skye Ansara, Shilah Molina, Waylon Steelman, Mabry Minton, Samantha Coble, Jacob Clayborn, Luis Contreras, Nicole Bax, David Finch, Brittney Owens Owens, Helen Wilson, Rheachel Hendricks, Matthew Anderson, Esther Heckmann, Robin Price, Sam Southerland, Paula Linder, Lynda Courtney, Helen Maringer, Oscar Jones, Greg Parker, Debi Ethridge, James Barrett, Haley Lane, Summer Stevens, Elizabeth Hancock, Zelma Murray, Christy Talley, Jeremy Lewno, Sarah Darnell, Mandi DeWulf, Kari Heuston, Justina Whitaker, Jim Heuston, Cynthia Jetton, Howard Umberson, Elaina Fouts, Christine DeMeo, Justin Callahan, Jean Evans, Sarah Peace, Marc Peace, Thomas Peace, Brian

Foster, Pauletta Browning, Taylor Bridges, Jan Allen, Brittney Karasek, Brian Stoltze, John St.hilaire, Holly Morgan, Clint Marshall, Tori Lamb, Straight outta Cotter -Arkansas, Christian Fregoso, Cindy Hill, Kellie Lindsay, Terri Estey, Matthew Photides, Christopher Selle, Mia Moon, Barry Smith, Melissa Luna, Mark Roberts, Cynthia Doffitt, Barbara Adams, Connie Walden, Beth DuVall, Timorhy Permenter, Joe Mckinney, Paul Dunn, KSuefarm and Carnahan Rentals, Regan Riser, Elita Caple, Tara Seely, Justin Hoover, Krystal Hoover, Frank Kelly, Carla Smith, Rebecca Waldschmidt, Steven Smith, Shelby Gonzales, Anne Greene, Kabrei Kilgore, Marcia Guffy, Mike Gavin, Nora Black, Janee Scroggs, Larry Price Price, Michael de Buys, Paula Matthews, Stephen Ballard, Shawn Porter, Shirley Graham, Kathleen Connole, Betty Harrison, Connie Sedlacek, Brenda Norsworthy, Terri Anderson, Daniel Barker, Charles Mullins, Kathleen Connole, Mike Harvey, Margaret Watson, James Pendergraft, Judy Smallwood, John Strickland, Kelly Quinn, Louis Jones, M. Leach, Oleta Gillean, Patti Kent, Nora Black, Chris Gal, James Binns, Elizabeth Keeling, Larry Olesen, Leslie Anderson, Shane Jetton, Jane Browning, Mary Olson, Cynthia Jetton, Cynthia Jetton, Carter Carrigan, Becky McCain, C.L. Kops, David Ford, Flarar Hunter, Frances Piercy, Grace Brown, Gladys Hambrick, Gary Westerman, Micki Houston, J.E. Caldwell, Betty Pullam

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Summarized Comment: The following commenters provided comments in favor of the applicant receiving a permit. The commenters stated that this facility has been treated differently by the Department, and that the denial of the permit will ruin the families that own the facility.

Commenters: Michaele Mcmillan, Heather High, Dwight Pierce, Kayla Kissel, Heath Holland, Amanda Standifer, John Gregson, Rhea Freeman, Ryan Crow, Duane Richey, Regina Tennison, Danielle Kitchens, Lesley Smith, Eddie Hendrix, Debbie Harris, Daniel Kitchens, Benjamin Vinson, Don Rainbolt, Rana Harding, Misty Dean, Marty Dean, Frank Higgins's, Holly Sisson, Nathan Stuart, Donna Chism, Michael Palmer, LaShell Turner, Melissa Stewart, Clara Greenhaw, Alice Willuams, Thomas Harrington, Brenton Richardson, Kyle Mcdonald, Glenda Young, Kevin Smith, Natasha Van Meter, Tina Byrd, Randy Byrd, Roberta Taylor, Shawn Long, Brenna Cannon, Rainey Yeager, Ashley Knapp, Don Rainbolt, B&W Auto Sales, Kallie Phillips, Preston Phillips, Pam Cannada, Starlinda Sanders, Patrick Sanders, Tamara Terherst, Roxanne Russell, Freda James, Candy Foster, Sarah Wilson, Alisha Martin, Rosie Campbell, Joe and Kathy Ricketts, Donna Bemis, Tracey Bemis, Janice Higgins, Patrick Walls, Wayne Kattner, Brittany Bower, Alex Fenton, Wade Edwards, Rusty Smith, Monty Bohanan, Doug Lowery, Garland Matlock, Robin Matlock, Shena Campbell, Doug Lowery, Robin Matlock, Garland Matlock, JR Butler, Suellen Butler, BJ Butler, Christopher Sanders, Laura Sanders, Brenda Napier, Julie Ann Campbell, Mike Middleton, Randy McCutcheon, Sue Campbell, Sharon Pierce

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal

Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

ADEQ must follow its regulations. ADEQ cannot issue a permit if the permit application does not meet the requirements of the applicable regulation. APC&EC Regulation 5 requires the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. ADEQ has determined that a detailed geological investigation of the facility is required because karst includes highly permeable foundations with the associated potential for groundwater contamination and potential for sinkholes to open up with collapsing ground or cause differential settlement. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies, i.e. karst, that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. Additionally, ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of two segments of Big Creek and two segments of the Buffalo National River as impaired further illustrates the need for these detailed studies.

Summarized Comment: The following commenters provided comments supporting the Department's decision to deny the permit application due to potential health risks and impact to waters of the state. The commenters raised concerns regarding algae and bacteria in the river and the adverse health impacts from the presence of liquid swine waste. Some commenters also stated that the adverse health impacts would negatively affect tourism.

Commenters: Michael Coleman, Melinda Wylie, Terry Karnes, Starlia Aubrey, Natalie Mannering, Ellis Gregory, Christina Day, Elizabeth Bainbridge, Michael Villines, Jill Fowler, Bobby Belote, Nancy Baxter, Debbie Alexy, Kriste Rees, Mary M. Smith, Gene Dunaway, Margaret Cameron, Betty Bradford, Jonathan Shoffit, Debra Holloway, Richard Taylor, Richard Taylor, Dorothy Walters, Thomas Ethridge, Jeff Montgomery, Susan Bolding, Gail Lee, Maria and Dave Smith, Jane Scroggs, Keta Kinard, Bonnie Files, Kelli Trickey, Michelle Murry, Libby Stewart, Jennifer Thompson, Carrie Harris, Helen Benefield, Olivia Powers, Gina Bird, Laura

Fout, Julie Mott, Laura Timby, Elizabeth Norton, Sheila Hellman, Cathy Joyce, Seth Howerton, Sean Adkins, Luis Contreras, Helen Wilson, Jeff Cumpston, Debbie Alexy, Judith Matthews, Jett Moore, Jennifer Sterling, Jessica Winkleman, Kathryn Laurain, Katherine Mendenhall, Margaret Blair, Mike Oglesby, Mark Pryor, Michael Pulfer, Patty Heller, Margaret Konert, Ginny Masullo, Patricia Mikkelson, Rita Benitez, Jeanie Wyant, Jeremiah Jennings, Becky Hauck-Brents, Parker Fiscus, Gena Pense, Thomas Mahaney, Jr., Rachel Huff, McKenzie Barnes, Michael Crane, Delaney Butler, Kasey Estes, Ellen Hoofard, Terry Layman, Catherine Sain, Holly Harper, Ken Muessig, Jennifer Cole, Melissa Daly, Anne Littell, Barbara Dillon, Robert Laurence, Sally Hunter, Susan James, Stella Keating, Stanley Lancaster, Sarah Matthews, Steve Blumreich, Bayard Blain, Bayard Blain, Ryan Hartley, Betty Rowe, Brett Sterling, Damon Akin, Donald Hays, Doug Wallace, Elizabeth Cantwell, George Shelton, Heather Blair

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Arkansas Department of Health did not submit a comment regarding C&H Hog Farms, Inc., AFIN 51-00164, during the public comment period ending October 24, 2018.

> Algal blooms have, and continue to, cause concern on the Buffalo River.
> As part of the USNPS aquatic invertebrate sampling program, the percentage of the sampling grid with filamentous algae is recorded. Of the monitored locations, the downstream locations tend to have more filamentous algae. The greater occurrence of filamentous algae at the downstream locations may be a response to higher nutrient levels.[1]

ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo National River.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Consideration of tourism is not within the Department's regulatory authority.

Summarized Comment: The following commenters provided comments supporting the Department's decision to deny the permit application citing negative impacts on tourism, recreation, revenue, property values, and local commerce in the Buffalo River Watershed.

Commenters: Jay Stanley, Joy Schaal, Eilish Palmer, Cheryl Ferendo, Jason Jacovelli, Marilyn Masterson, Julann Carney, Kelly Olson, Suzanne Barnes, Jules Carney, Cheryl Luchin, Jason Eaton, Matt Pope, Virginia Booth, Virginia Milan, Dawn Stanley, Joe Lavely, Jim Machen, Ron Cockmon, Kelly Franklin, Martha DeChant, Linda A. Stanley, Laura McCarty, Tony Hilliard, Kevin Ehemann, Travis Atwood, Channin Tacito, Michael Adelman, Jim Warnock, Jeff Ingram, Aleta Reed, Patricia Wyatt, Jessie Blevens, David Brewer, Trish Lopez, Martha Winnat, Hillary Moore-Brown, Jesse Edmondson, Janie Agee, Aidan Lawrence, Lonnie Myers, Marianna O'Dea, Jeannie Nicoli, Donald Campbell, Necia Parker-Gibson, Dennis McKinnie, James Treece, David Pope MD, Diana Angelo, Kathleen Trotter, Hal Mitzenmacher, Jeremy Moore, Martha DeChant, Amanda McCorkindale, Nathan Blanton, Barbara Jarvis, Waverly Walker, Jason Young, JL Titus, MD, Christine Graves, Jill Fowler, Douglas Shivers, Walter Dix, Linda Mays, Ellen Compton, Katherine Kersen, Lucas Parsch, Greg Kennedy, Jeff Williams, Ken Leonard, Elijah Virden, Bobby Belote, Casey Wyatt, Debbie Alexy, Ethel Simpson, Linda Langer, Greg Manry, Sean Duaine, Suzanne Poe, Greg Gorman, Mick Haven, Joel Emerson, Louise Mann, Donna Gail Leftwich, Kriste Rees, Mary Johnsey, Amanda Cabaniss, Janet Nye, Deb Bartholomew, Lowell Collins, Margaret Powell, Margaret Lonadier, Kim Smith, Gwen Bennett, Ricky Janke, Laurie Schuler, Karen Walls, Richard Rew, Kim Martin, Steven Heye, Francie Bolter, Maire Caverley, Mark Barre, Bob Hill, Anna Mathews, Chris Hankins, Leslie Oelsner, Jeremy Adams, Robert Morgan, Cindy Jetton, Shane Jetton, LaJuana Oswalt, Melissa Triplett, Martha DeChant, Carol Valbracht, Sara White, Susan Morrison, Jonathan Shoffit, Terri Allen, Katrina Mcclane, Robert Taylor, James Ulrich, Ashley Money, Angela Paradis, Envision Greatness, LLC, Casi Shanks, Jessica Goodman, Vanessa Liles, Carolyn Ford, Cindy Studer, Melissa Frederick, Lawrence Jackson, Kathleen (Katie) Deakins Deakins, Elizabeth Chabin, Stanley Doak, Mary Joe Morris, Scott Bennington, John Bouck, Pam Cash, Mary Ellen Hill, Barry Hughed, Clinton Marsh, Debbie Harris, Jessica Kibling, Susan Holmes, Ryan Loyd, David Randle, John Brooks, John Rankine, Richard Taylor, Richard Taylor, Dorothy Walters, Marie Langer, David Higgins, Donna Porter, Melissa Miller, Anne Wilson, Greg Spence, Brenda Lowe, Cary Quinney, Stan Allen, Tina Bradley, Joe Neal, Judy Stroope, Donna Thompson, Joanna Hanna, Cristie Donohue, Bryan Signorelli, Susan Bolding, Teresa DeVito, Mary Lightheart, Sharon Spurlin, Peter Ireland, Karen Granderson, Linda Owens, Nan DeVries, Bill Thomas, Pat Page, Mike Sommer, Bridget Cabibi-Wilkin, Amy Forbus, W. Burnetta Hinterthuer, Wendy Finn, Jeanmarie Mako, Nan Johnson, Marjorie Sullivan, Eve Agee, Susan vonGremp, Jennifer Golightly, Hunter Peterson, Ted Smith, Frank Keller, Penny Morris, Polly Fricke, Lynn Funge, Linda Lee, William Browner, Ryan Robb, Sandra Priest, Tammy Due, Jamison Atkiy, Laurie Gagne, Pamela Westerman, Antoinette Locke, Norman Vaden, Lloyd Halliburton, David Jones, Carol Wright, Rebecca Walker, Donnie Sneed, Michelle Winn, Scott Yaich, Sharon Wilson, Matt Cleveland, Jacob Jaggers, Gaea Miller, Myranda Callahan, Melissa Cady, Lynda Rogers, Donald Campbell, John Ruff, Maria Earls, John Barton, Craig Fox, Michael Reichert, Toma Whitlock, Kelby Ouchley, Rosie Bishop, Samantha Cockerham, Janet Richards, Tal Swicegood, Gary Speed, Jonathan

Mitchell, Dawn Nahlen, Jon Toburen, Aaron Mattix, Zachary Scheurich, Ryan Feero, Ironside Photography LLC, Rachael Rogillio, Kasey Licht, Karen Lee, Mike Hampton, Diane Keeter, Sandra Roerig, Jeannie Thrush, Clark Baldwin, Sean Fletcher, Rex McGill, Shannon Smith, Toni Newby, Rachel Ungar, Craig Duffy, Tabetha Holmes, Haley Nelson, Hilary Roberto, Janice Peters, Coreen Frasier, James Britt, Elizabeth Caldwell, Jay Shearer, Dana Steward, Nathan Pittman, Ashley Pinkard, Joshua Fout, Ashley Henry, Laura Fout, Ashley Pinkard, Gerald Weber, Randolph Haven, Pam Neal, Lillian Israel, Laura Timby, Steve Parsons, Steve Folkers, Hallroad Inc., Susan Day, Elizabeth Norton, Jacqueline Burgett, Whitney Foster, Julia Ramey, Pat Daly, Matthew Buie, James Lassiter, Peggy Moody, Kay Fulton, Lindsay Wilson, Debra Kuczek, Barbara DeChant, Ray Morris, Shayla Humble, Sheila Hellman, Jacob Maris, Richard Washburn, Carla Finch, Phil Wood, Jack Land, Cindy Jetton, Robert Olmstead, Robert Harris, Dianna Winters, Karen Bartle, Terri Hargrove, Danny Smith, William Anderson, Carol Auger, Jan Schaper, Brandi Smith, Cristy Karr, Ryan Brennell, Justin Keen, Abraham Hawkinson, Steve Fryar, Cynthia Jetton, Tim Permenter, Denise Pendergist, Edith Stahl, Rel Corbin, Cynthia Jetton, James Mott, Inez Young, Edd French, Rachel Henriques, Susan Parker, Debbie West, Evelyn Mills, Faith McLaughlin, Mary Weeks, Susan Siegele, Pat Rauls, Susan Segal, Cynthia Mitchell

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Consideration of tourism, revenue, local commerce, or property values is not within the Department's regulatory authority.

Summarized Comment: The following commenters provided comments supporting the Department's decision to deny the permit application due to the sensitive karst geology of the Buffalo River Watershed. The commenters stated that karst topography can be conduits for pollutants to enter groundwater and move to the Buffalo River Watershed. The commenters stated that liquid animal waste management systems should not be allowed in karst environments.

Commenters: Jay Stanley, David Gray, Cody Rankin, Lora Hamman, Adam Webb, Virginia Booth, David Dougan, Sharon Holladay, Janette Groves, Dewey Strode, Martha DeChant, James Norwood, Patricia Wyatt, James Wilcox, Jesse Edmondson, Richard Crawford, David Roberts, Annee Littell, Kenneth Carle, Hal Mitzenmacher, Jimmy Goff, Jeremy Moore, Kenny Teaster, Micheal Amos, Lawrence Ireland, Michael Sutton, Robert Walker, Bobby Belote, Mike Alexy, Nicole Pope, Kriste Rees, Janet Nye, Lowell Collins, Sheilah Roenfeldt, Kenneth Smith, John Ray, Gene Dunaway, Greg Van Horn, Raymond Herschend, Linda Vanblaricom, Kirsten Bartlow, Steven Heye, Francie Bolter, Thomas Nowlin, Nancy Paddock, Linda Lewis, Mo Elliott, Holly Pilgrim, Mary Joe Morris, David Tirpak, Thomas Trigg, Michael Johnson, Dorothy Walters, Audrey Weymiller, Gilbert Smith, Maryevelyn Jones, Joellen Rosenquist, Barry Stuart,

Kevin Brandtonies, Joe Neal, Daniel Smith, Bryan Signorelli, Mary Lightheart, Cindy Rimkus, Peter Ireland, Alisa Dixon, Evelyn Sammons, Annette Pettit, Stephen Driver, Kenneth Pape, Sue Lukens, Sharon Holladay, Nan Johnson, Marjorie Sullivan, Shelley Trost, James Nelson, Joanne Vrecenak, David Cooper, Antoinette Locke, Norman Vaden, Carol Wright, Gaea Miller, Will Swearingen, Gwen Walstrand, Michael Reichert, Sydney Rephan, My Blue Heaven Cabin, Ronald J. Doster, Elaine Nesmith, Kyra Wilk, Rebecca Russell, Tabetha Holmes, Bill Lord, Dana Steward, Hal Allen, David Neville, Jim Good, Teresa Neely, Laura Timby, Steve Parsons, Robin Rumph, Verna Rutledge, Connie Henshaw, Peggy Moody, Kay Fulton, Herbert Matthews, Mark Smith, Barbara DeChant, Tasha Hudson, Miranda Brewer, Edith Stahl, Claude Buckley, Debra Connor, Grant Scarsdale, Erin Yarrobino, Legina Boswell, Susan Parker, Frank Henry, Kathleen Hensley, Kathy Downs, Chuck Bitting, Laura Timby, Judith Duguid

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. ADEQ has determined that a detailed geological investigation of the facility is required because karst includes highly permeable foundations with the associated potential for groundwater contamination and potential for sinkholes to open up with collapsing ground or cause differential settlement. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table

5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. In the Buffalo River Watershed, four Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Summarized Comment: The following commenters provided comments in favor of the facility receiving a permit due to the facility having had no violations from neither the Department nor the EPA.

Commenters: Geral James, Doug Baird, Charles Pridmore, Andy McCutcheon, Dustin Riddle, Kari Holstex, Tony Taylor, Derek Gellerman, Lisa Smith, Michael Parish, Dan Wright, Roger Thompson, David Brown, Terry Laster, Clint Bowen, Sherry Clark, Bobby Craig, Susan Anglin, Cheryl McCutcheon, Steve Barney, Tessa Sparks, Brad Vines, Chrystal Willis, Jack Brasel, Judy Mallett, Lesley Ragland, Leketta Faught, Johnny Faught, Kassidy Dorrell, Danny Naegle, Alex Whitelaw, Steve Eddington, Emilee Tucker, Jason Keenom, Paul Gramlich, Jack Boles, Chad McCutcheon, Carla O'Neal, Sharon Pierce, William Wilborn, James and Brenda Patton, Mark Keaton, Elliott Golmon, Trent Dabbs, Janet Mathis, Kelly Woods, Cindy Creager, Johnny Faught, Matt Heidersheidt, Perry Hayes, James Widner

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department has noted violations during its inspections of the C&H facility near Mt. Judea, Arkansas. However, those violations have not led to a formal enforcement action by the Department against C&H.

Summarized Comment: The following commenters provided comments regarding the original APC&EC Regulation 6 General Permit ARG590001 coverage. The commenters stated that the permit should never have been approved, and commented that the process in which it was approved was done incorrectly. The commenters stated that the Public Notice procedure was

improper. The commenters were otherwise in favor of the Departments decision to deny the permit application.

Commenters: Jay Stanley, Danny Smith, Chuck Smith, Ruby Molder, Virginia Booth, Joe Lavely, Danny Smith, Raymond DeSalvo, Joe Golden, Jana Brady, Jeremy Grigg, David Pope MD, Denice McMinn, Denise Lanuti, G. McFarland, Randall Hollenbeck, Kenny Teaster, Ellen Compton, Lucas Parsch, Nicole Pope, Joel Emerson, Susan von Gremp, Rebecca Laster, Ellen Mitchell, Stevan Vowell, T.A. Sampson, Dorothy Walters, Maryevelyn Jones, Edward Fugatt, Joe Neal, David Franks, Stephen Driver, Kenneth Pape, Rick Thomas, Sydney Rephan, Sandra Roerig, Elaine Nesmith, Lady Kunkle, Terry Sutterfield, Kathy Sutterfield, Beyond Reality Ozark Cabin, Brian Thompson, Candace McGhee, Debbie Alexy, Frank Henry, Kathleen Hensley, Barbara Valuski, Chuck Bitting, Gordon Watkins, Phyllis Head

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

APC&EC Regulation 6 General Permit ARG590000 and the coverage (permit tracking number ARG590001) granted under the General Permit are outside the scope of the current permitting decision. The initial Notice of Intent and the corresponding NMP for coverage under the prior APC&EC Regulation 6 permit tracking number ARG590001 were available for public comment during the 30-day public comment period beginning on June 25, 2012.

Summarized Comment: The following commenters provided comments supporting the Department's decision to deny the permit application, and requested that the temporary moratorium in APC&EC Regulation 5.901 be made permanent.

Commenters: Pamela Ellwood, Fay Knox, Deborah Kitz, Bob Allen

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Rule-making regarding a permanent moratorium is outside the scope of this permitting decision.

Summarized Comment: The following commenters provided comments in opposition to a separate pending APC&EC Regulation 5 No Discharge permit application, Permit No. 5305-W.

Commenters: Robert Shingledecker, Dawn Stanley, Sophia Scalise, Jeremy Adams, Sean Mahan

Response: The permit application for Permit No. 5305-W is outside the scope of this permitting decision.

Summarized Comment: The following commenters provided comments supporting the Department's decision to deny the permit application due to issues regarding the waste storage pond at the facility. The commenters raised concerns about allowable leakage and unintentional leakage from the clay liner seeping into karst.

Commenters: John Taylor, Deborah Keene, Steve Crawshaw, Douglas Barton, Richard Rew, Greg Jones, Robert Walker, Nancy Swearingen, Mike Hampton, Sandra Roerig, Gerald Weber, Misako Ishimura, Eddie Vollman, Mark Corley

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Seepage from waste storage ponds has the potential to pollute surface and ground water. The record included one recompacted permeability test that is insufficient to determine liner integrity. The necessary soil investigations including, but not limited to, percentage of fines and soil permeability evaluations, have not been performed at this facility in accordance with the AWMFH 651 Table 10-4 and Appendix 10D. Plasticity index analysis was performed on one sample of the in situ clay material in boring 2. The variability in the regolith expected in this geologic setting coupled with the insufficient data creates additional concerns about the siting and soil sources for the clay liner. The required number of borings were not advanced within the pool areas in accordance with AWMFH 651.0704(b)(4); these additional borings would have provided more data for assessment of clay source material. Proper soil investigations for the liner material are necessary to determine the suitability and location of the clay source material and to consider any additional geotechnical testing to confirm material properties, which will reduce the potential for downward and/or lateral seepage of the stored wastes.

Additionally, NRCS, in Appendix 10D of the AWMFH, indicates that special design measures are necessary where agricultural waste storage ponds are constructed in soils with high calcium content (BCRET Quarterly Report for October 2016 to December 2016, Table 10, page 71) or highly unfavorable geologic conditions, such as karst formations.

Summarized Comment: The following commenters provided comments in favor of the facility receiving a permit due to infringement on an individual's personal property rights and their right to farm.

Commenters: Darryl Treat, Judy McCutcheon, Kayla Kissel, Sherry Campbell, Patrick Frachiseur, Betty Ruckman, Mark Halsted, Darren King, James Cline, Michelle Buchanan, Pam Woods, Mark Halsted, Susan Nichols, Tommy Park, Chrystal Willis, Cassidy Jasper, Luke Alston, Frank Higgins, Kayla Cowell

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Individual property rights are outside the scope of this permitting decision.

Summarized Comment: The following commenters provided comments in favor of the applicant receiving a permit. The commenters questioned the source of data relied upon by the Department. The commenters believe that the Department should use scientific evidence from the University of Arkansas and United States Geological Survey data and research as the basis for the decision, rather than the opinions, emotions, and ideas of outside sources. The commenters also question the amount of proof linking any pollution specifically to the facility.

Commenters: Carla ONeal, Ricky Dodson, Sharon Pierce, Leann Duncan, Paula Smith, Randy McCutcheon, Judy McCutcheon, Todd Parker, Jefferson Miller, Dora Payne, Geral James, James Jones, Brittany Jones, Cheryl Clayborn, Nickie Casey, Carla Richardson, Greg Norton, Kennetha McClelland, Masen McCutcheon, Dustin Riddle, Lori Dabbs, Terry Dabbs, Thomas Dawson, Cynthia Brotherton, Laykyn Rainbolt, Kari Holstex, Jan Harris, Shawn Smith, Chris Wyatt, Keith Kilbourn, Nathan Stuart, Terrell Davis, Steven Hignight, Rachel Bearden, David Morgan, Tony Suit, Tommy Thompson, Jason Kaufman, Hannah Bell, Nate Bell, Jason Keenom, Aurelie Morren, Kathryn Miller, Joe Stuart, Cindy Keenom, Andrew Campbell, Amy Adams, Roxan Smith, Jason Keys, Brad Troutt, Randall Robinson, Cody Harrington, Renee McCutcheon, Michelle Buchanan, Lisa Smith, Glenda Young, Mike Ragland, James Simpson, Michael Parish, Roger Thompson, David Brown, Jared Wheeler, Terry Laster, William Phelps, Lacie Audeoud, Betty Campbell, Tosha Gellerman, Jack W Norton, Brian Keys, Christina Merle, Bobby Craig, James Keys, Katherine James, Kirby and Betty Doane, Cassie Fisher, Derek Helms, Susan Anglin, John Parker, Cheryl McCutcheon, Wesley Sisco, Jane Ann Perry, Tommy Park, Brenda Smyth, Matt Palmer, Karla Bettis, Rebecca Richardson, Brenton Richardson, Calvice Casey, Kendall Wallace, Ron Cothran, Kayce Villines, Lauren Cannon, Barbara Hefley, Kellie Smith Davis, Dustin Cowell, Dustin Cowell, Brandon ONeal, Jimmy Holt, Laura Brasel, Karen Brasel, Johnny Faught, Randy Wheeler, Kassidy Dorrell, Teena Crabb, Harold Brasel, Danny Naegle, Josh Campbell, Steve Eddington, Donald Moss, Mary Wheeler, Robert Balentine, Emilee Tucker, Paul Gramlich, Jack Boles, Carla O'Neal, Angela Sullivan, James and Brenda Patton,

Mark Keaton, Jeremy Miller, Elliott Golmon, Trent Dabbs, Janet Mathis, Kelly Woods, Emily Ruff, Kara Smith, Peggy Ransom, Paige Clary, Andrea Smith, Alice Williams, Ed Hudnall, Betty Eddings, Ken and Virginia Hulsey, Rusty Butler, Cindy Creager, Jack Brasel, Jack Brasel, Kelly Woods, Starlinda Sanders, Andy McCutcheon, Dustin Cowell, Kelly Woods, LaBecca Brasel, Leslie Keene

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

The Department considered all available scientific data and information from, but not limited to, BCRET, United States Geological Survey, University of Arkansas Department of Agriculture, and ADEQ in making this permitting decision.

Summarized Comment: The following commenters provided comments expressing their concern that if the Department were to deny this applicant a permit, then all farmers within the State of Arkansas would be affected.

Commenters: Janice Higgins, Ricky Gunn, Kayla Kissel, James Jones, Brittany Jones, Cheryl Clayborn, Kathy Martin, Hannah Bell, Nate Bell, Marcus Looney, Jason Keenom, Aurelie Morren, Kathryn Miller, Amelia Bower, Cody Harrington, Betty Smith, James Simpson, Michael Parish, William Phelps, Sherry Clark, Susan Nichols, Helen Griffin, Steve Balloun, Steve Barney, Libby Brasel, Karla Bettis, Tammi Dickson, Ryan See, Dustin Cowell, Deanna Bohanan, Joseph Harrah, Mary Wheeler, Emilee Tucker, James and Brenda Patton, Kendra Dodson, Janet Mathis, Kelly Woods, Kara Smith, Paige Clary, Dustin Cowell, Tom Jones

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

ADEQ does not regulate all types of farming operations. The Department's permitting decision for this APC&EC Regulation 5 Individual No Discharge permit application pertains only to this individual permit application for a liquid animal waste management system, not all farming operations. Applications for Regulation 5 permits are evaluated according to Regulation 5 requirements.

Summarized Comment: The following commenters provided comments in favor of the applicant receiving a permit due to the facility not being the source of the impairments in the

watershed. The commenters stated that any impairment affecting the river is from the increase in tourism in the area, the abundance of feral hogs, and other unregulated farmers.

Commenters: Terance Middleton, Sharon Pierce, Kenny Tomasich, Michael Battenfield, Randy McCutcheon, Jack Boles, Gregory Smith, Malcolm Farmer, Geral James, James Jones, Brittany Jones, Robb Hulsey, Kassidy Dorrell, Brandon Johnson, DeLana Shoemake, Cheryl Clayborn, Angela Nichols, Dustin Riddle, Laykyn Rainbolt, Mark Halsted, John Creager, Barbara Foster, Charles Copeland, James Reynolds, Michelle Pass, Derek Gellerman, Rachel Bearden, David Morgan, Bryon Kelley, Jason Kaufman, Brian Unruh, Bonnie Cook, Jason Keys, James Cline, Renee McCutcheon, Glenda Young, Dan Wright, Jared Wheeler, Sherry Clark, Tosha Gellerman, Nathan Stuart, Crystal Ramsey, Larry Dilday, Christina Merle, Kirby and Betty Doane, Lillian Preddy, Elaine Waters, Susan Nichols, Cheryl McCutcheon, Tim Provencio, Brenda Smyth, Brad Vines, Makaela Burdine, Kathy Morales, Judith Murphy, Donnetta Wheeler, Jennifer Lewis, Kelly Ragland, Cindy Wyatt, Michelle Mitchell, Pam Grice, Jack Brasel, Judy Mallett, Laura Brasel, Kassidy Dorrell, Lavern Baughman, Teena Crabb, Becky McAnulty, Carl Eggers, Taylor Hefley, Ryan Pyszka, Libby Robinson, Sharon Pierce, Kendra Dodson, Keelin Baggs, Kelly Woods, Andrea Smith, Betty Eddings, Cindy Creager, Arlis Jones, Andy McCutcheon, Cheryl Clayborn, John Creager, Leslie Keene, Matt Heidersheidt

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

Consideration of tourism is not within the Department's regulatory authority.

Feral hog management is not within the Department's regulatory authority.

Comment: The following commenters provided comments by form letter that stated:

Please accept my comment on the draft Regulation 5 swine waste permit 5264-W, AFIN 51-00164 for the C&H Hog CAFO. I support the ADEQ decision to deny the permit based upon the points established in ADEQ's Statement of Basis for denial which I have included in my comments below.
1. There is now clear scientific evidence of a negative environmental impact to these streams attributable to nutrient overloading within the last few years. ADEQ has established its proposed 2018 impaired waterbodies list, and has placed four impaired Assessment Units (two sections of Big Creek (Newton County) and two sections of the Buffalo National River) as impaired waterbodies
2. C&H Hog Farm has not complied with requirements, especially those that pertain to karst locations, and this has increased the impairment of the Buffalo National River and its tributary, Big Creek, along which C&H is located.

3. The presence of karst triggers additional considerations for siting and design as stated in the Animal Waste Management Field Handbook (AWMFH).
4. Pond Construction Quality Assurance is a real issue since the C&H record included only one Recompacted permeability test.
5. C&H has not performed acceptable field Assessments of High-Risk Areas of Land Application Sites including all of the characteristics listed in A WMFH.
6. An adequate Operations and Maintenance Plan for the pond levee, including an inspection schedule and plan document, or an emergency plan were not included in the record.
7. The Buffalo River is home to at least four species of wildlife that are listed as endangered or threatened. The excess nutrient runoff from C & H Farm and the resulting disruption of the aquatic ecosystem are a serious threat to all Ozark wildlife and especially those species that are already in trouble.
I support the ADEQ denial of the C&H Hog farm permit. The proposed listing of Big Creek and the Buffalo National River as impaired waterbodies, the statistically significant increase of nitrate-N in the ephemeral stream and house well, and the increase of STP in all land application fields receiving waste further illustrate the need for the C&H Hog CAFO to be denied a permit to operate in the Buffalo National River watershed.
I agree with Governor Hutchinson that we must rely on the science as he stated: "My love for our state and my passion to protect our water compels me to ensure that the studies are scientific and impartial. The studies on which ADEQ bases its decisions are and will continue to be scientifically and environmentally sound."

Commenters: Jerry Harrison, Justin Holstead, Jacob Idec, Josh Kester, K.C. Larson, Kathleen Marleneanu, Kristine Patel, Kennith Wheetley, Lydia Bradshaw, Lezlie Douglas, Lynn Farr, Lacie Scott, Mya Aung, Mark Elrod, Maribeth Garrison, Myesha Logan, Olivia Eddings, Patsy Miller, David Malm, Gregory and Joyce Polus, Ann Taylor, Linda Bryant, Denise Dore, Jeff Ingram, Jean Whalen, Bill Lord, Kathryn Tomlinson, Vallie Graff, Craig Tomlinson, Heidi McLaughlin, Janie Traywick, , James Findley, Else Kobbe, Harald Kobbe, Philip Wanzer, Rebecca McMath, Sarai Brock, Sarah Henry, Stephanie Odom, Savannah Pelley, Samuel Pettit, Taylor Bridges, Tony Marleneanu, Zac Owens, Anna Holstead, April Lane, Alexa Shipp, Andrea Vanaman, Cassandra Bennett, Bethany Nelson, Calvin Rezac, Duane Nelson, Emily Lane, Fred Thessing, Jerry Bratton, J. Douglas Vanaman, Jackie Fliss

Response: The Department has made the permitting decision to deny issuance of Permit No. 5264-W in accordance with state laws and APC&EC Regulation 5, Liquid Animal Waste Management Systems and upon consideration of the submitted permit application, the public comments on the record, and other available and relevant data and information.

ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four

Assessment Units (two segments of Big Creek (Newton County) and two segments of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen.

Karst features in the Buffalo River watershed are associated primarily with the Boone Formation.[1] The karst geology present in the Buffalo River watershed makes exchanges between surface water and groundwater common in the watershed, and dye tracer studies have shown that there are areas in the watershed where infiltration of rainfall from the surface to groundwater occurs rapidly through sinkholes, faults, and existing solution channels.[1] The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation. While APC&EC Regulation 5 does not prohibit liquid animal waste management systems or associated land application from being located in karst, it does require the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. In accordance with the AWMFH, a detailed geologic investigation is necessary to characterize and understand sites with complex geologies (i.e. karst) that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. The karst geology of the area makes groundwater more susceptible to contamination resulting from activities on the land surface.[1] Ground penetrating radar studies performed in Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. The necessary geotechnical investigations have not been performed at all land application sites in accordance with AWMFH 651.0504(a)–(n) and Table 5-3. Geotechnical investigations are necessary and may help demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

[1] Buffalo River Watershed-Based Management Plan, May 22, 2018, https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Seepage from waste storage ponds has the potential to pollute surface and ground water. The record included one recompacted permeability test that is insufficient to determine liner integrity. The necessary soil investigations including, but not limited to, percentage of fines and soil permeability characteristics, have not been performed at this facility in accordance with the AWMFH 651 Table 10-4 and Appendix 10D. Plasticity index analysis was performed on one sample of the in situ clay material in boring 2. The variability in the regolith expected in this

geologic setting coupled with the insufficient data creates additional concerns about the siting and soil sources for the clay liner. The required number of borings were not advanced within the pool areas in accordance with AWMFH 651.0704(b)(4); these additional borings would have provided more data for assessment of clay source material. Proper soil investigations for the liner material are necessary to determine the suitability and location of the clay source material and to consider any additional geotechnical testing to confirm material properties, which will reduce the potential for downward and/or lateral seepage of the stored wastes.

C&H Hog Farms, Inc. submitted an Emergency Action Plan to the Department on October 23, 2018. The Emergency Action Plan did not address possible failure of the liner resulting from potential damage, such as pumping and agitation, liner desiccation, or any other site-specific operational risks are not addressed, in accordance with AWMFH 651.0204(a), (b).

The Department acknowledges the following statements from the Buffalo River Watershed-Based Management Plan dated May 22, 2018, regarding threatened and endangered species in the Buffalo River watershed.

> The Buffalo River and its tributaries are considered high quality water resources. The Buffalo River and its tributaries support over fifty (50) species of fish and over twenty (20) species of mussels. Portions of the Buffalo River have been designated critical habitat for the threatened Rabbitsfoot mussel, *Quadrula cylindrical cylindrical* (State/Federal Status: Endangered/Threatened, respectively). The watershed also includes important habitat for endangered bat species: Gray Bat, *Myotis grisescens* (State/Federal Status: Endangered); Indiana Bat, *Myotis sodalis* (State/Federal Status: Endangered); Ozark Big-eared Bat, *Corynorhinus townsendii ingens* (State/Federal Status: Endangered); and Northern Long-eared Bat, *Myotis septentrionalis* (State/Federal Status: Endangered/Threatened, respectively). Cave and other karst features in the Buffalo River watershed are important habitats for all of the protected bat species.[2]

However, the Department did not receive any comments during the comment period ending on October 24, 2018, regarding endangered or threatened species and their associated habitats from Arkansas Game & Fish Commission, Arkansas Natural Heritage Commission, or U.S. Fish and Wildlife Service.

[2] https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Buffalo River Watershed Alliance

Please find two PDF documents representing comments and appendix from BRWA.

Buffalo River Watershed Alliance Comments on C&H Reg 5 Permit Denial

Appendix to this document submitted separately

Position Summary 2

Part A - Permit risk 3

Part B - Application Fields 7

Part C - Geologic and Engineering Site Investigation 29

Part D - Degradation 62

Part E - Miscellaneous 69

Part F - *Additional Comments* added for recent proposed denial 93

Documents Referenced from this ADEQ link:

https://www.adeq.state.ar.us/home/pdssql/p-additional-information-5264-w.aspx

- Expert Opinions of Dr. J. Berton Fisher
- Expert Opinions of Dr. Michael D. Smolen
- Expert Opinions of Professional Geologist Thomas Aley
- Expert Opinions of Dr. David Peterson

Depositions Referenced:

- Hancock
- Blanz
- Henson (Jason)
- Keogh
- McWilliams
- Osborne
- Shafii
- Solaimanian
- Sharpley

Buffalo River Watershed Alliance
Comments on C&H Reg 5 Permit Denial

Position Summary:

In the 1960s there was a protracted ten year effort by ordinary citizens to prevent the U.S. Army Corp of Engineers from damming one of the last free flowing rivers in the continental United States. The Buffalo River was established as the nation's first "national river" on March 1st, 1972 by an act of Congress. The Buffalo was saved *for* Arkansans *by* Arkansans. It accommodates three wilderness areas and one wildlife management area. Images of its pristine waters backdropped by majestic painted bluffs adorn the state's maps and promotional materials. The Buffalo National River is iconic to the Arkansas identity.

The Buffalo River Watershed Alliance (BRWA) was formed after a large concentrated animal feeding operation (CAFO) was permitted and constructed in the watershed without adequate public notification. BRWA steadfastly opposes the location of this large CAFO due to the obvious risks it presents both environmentally and economically, but also because of the precedent it sets that would allow additional large CAFOs to be sited within the geologically sensitive watershed of a national river.

The following comments discuss the disproportionality of the risks, the lack of appropriate investigation, the weakness in the engineering, and the evidence of ongoing degradation in the Big Creek tributary.

It is the unequivocal position of the *Buffalo River Watershed Alliance* that the application for the Regulation 5 permit for this CAFO be denied and that a permanent moratorium on all such facilities be immediately established in the Buffalo National River watershed.

Part A - Permit risk: The high cost of consequences

Businesses that work with hazardous materials manage the possibility of contamination risks through technical planning every day. None the less, failures resulting in contamination occur at facilities where the engineering has been performed to lawful requirements. An example is the 2015 Animus River mine spill resulting from a berm failure where clean up efforts are currently estimated upwards of $28B. Another is the Duke Energy Coal Ash berm failure Feb 2nd, 2014 with clean up costs reaching upwards of $10B. Closer to home is the catastrophic collapse in May 2015 of a pond at the “Top of the Rock” Big Cedar golf course, located just 56 miles north of the C & H facility.



This page could easily be filled with similar examples. Below is a list of risks and a corresponding list of consequences as they pertain to potential failure for C & H farms:

Risks:

1. *Gradual degradation through spreading fields, several of which are in the flood plain of Big Creek. Degradation occurring through both surface and ground water.*
2. *Gradual degradation through pond leakage.*
3. *Damage through over-topping.*
4. *Sudden catastrophic damage through pond berm failure due to saturation/ overtopping.*

5. *Sudden catastrophic damage through pond floor collapse into an underground cavity typical of geologic karst formations in that area.*

Consequences of a failure:

1. *Whether the event is gradual or catastrophic, the Buffalo National River, an extraordinary resource water (ERW) could suffer permanent ecological damage from pollution.*
2. *A tourism economy worth $62.2M in 2015 supporting 910 jobs could be damaged or even destroyed depending on the nature of the failure.*
3. *A catastrophic failure could easily result in tens of millions in mitigative clean-up and economic relief.*

Comment A1 - This permit should be denied because preventive investigative measures are not proportional to the risk

A common theme of the most spectacular failures is that the efforts applied to address the risk were not proportional to the enormity of the consequential costs. For agricultural waste management facilities, the *Agricultural Waste Management Field Handbook* (AWMFH) provides the engineer with a broad selection of investigative and design suggestions, yet also allows latitude to choose whether or not to act on those suggestions. Engineering firms have a natural competitive incentive to minimize costs for clients and may be inclined to not exceed the basic requirements that satisfy the law. Yet engineering to minimal lawful requirements may not be proportional to the enormity of a failure. There is a remedy provided in the law that is intended to ensure that special circumstances with significant consequences are engineered appropriately, and that remedy lies within the latitude provided to the *Arkansas Department of Environmental Quality* (ADEQ) . ADEQ's capability to apply independent oversight is illustrated by the following quote on the water division web page:

> "***An individual permit is tailored specifically for each application and allows ADEQ to put specific conditions on each permitted facility or activity depending on its unique conditions."***

Without question, this permit application has "unique conditions" that ADEQ should recognize and in turn require additional investigative and engineering due diligence. By failing to acknowledge the enormous cost of possible

consequences, ADEQ is in effect abandoning its mission to "*protect, enhance and restore the natural environment for the well-being of all Arkansans*".

Comment A2 - This permit should be denied because compliance with detailed investigative requirements triggered by "*complex geologic conditions"* as suggested in AWMFH were ignored

Regulation 5.402(A) states:

> ***Designs and waste management plans shall be in accordance with this Chapter and the following United States Department of Agriculture Natural Resource Conservation Service technical publications:***
>
> 1. ***Field Office, Technical Guide, as amended***
> 2. ***Agricultural Waste Management Field Handbook, as amended***

The *Agricultural Waste Management Field Handbook* (AWMFH) 651.0704 *Site Investigations for planning and design* states the following:

> ***The intensity of a field investigation is based on several factors including:***
> 1. ***quality of information that can be collected beforehand***
> 2. ***Previous experience with conditions at similar sites***
> 3. ***complexity of the AWMS or site***

The Springfield Plateau and the known prevalence of karst geology is well understood and it is readily available background information typical of what is suggested in point #1 above. It is reasonable to assume that any experienced engineering firm will view complex karst geology as a risk factor to be carefully considered in the investigative process and that there is a corresponding likelihood of additional "detailed investigative" steps as described in AWMFH 651.0704(b). However, the presence of karst terrain in the vicinity of the facility and its application fields was not addressed in the investigation. That karst geology is not disclosed or even alluded to is an indication that the engineers who conducted the investigation either lacked sufficient prior experience with the complexities of karst environments, or that there was an intent to avoid additional investigative steps, otherwise the presence of karst and its attendant risks would have at least been mentioned if not directly addressed. As such, the quality of the geologic information collected and studied beforehand is suspect and was inadequate and not sufficiently reliable to meet the requirements of a *preliminary geologic investigation* per 651.0704(a) of the AWMFH. Karst terrain alone presents sufficient *"complexity of geology*" to the site, its waste management system, and the spreading fields that had it been acknowledged, a

detailed geologic investigation per 651.0704(b) would have been triggered and should have been conducted.

> **651.0704(b)** ***Detailed Investigation***
> ***"The purpose of a detailed geologic investigation is to determine geologic conditions at a site that will affect or be affected by design, construction, and operation of an AWMS component. Determining the intensity of detailed investigation is the joint responsibility of the designer and the person who has engineering job approval authority. Complex geology may require a geologist. Detailed investigations require application of individual judgment, use of pertinent technical references and state-of-the-art procedures, and timely consultation with other appropriate technical disciplines."***

Note that the components of a "detailed investigation" have the potential to significantly increase costs. Many of the following comments relate to the specifications of a detailed geologic investigation and show that, had a proper investigation been conducted, this site would have been found to be inappropriate and an alternative location would have been required or the permit denied.

Comment A3 - This permit should be denied because the economics of the risk is to be borne by the public, not the business. Financial assurances are lacking and, due to inordinate risk, should be required of the operator.

Looking beyond obvious ecological considerations, what would be the economic costs of a failure at C & H? In the case of a sudden catastrophic release of contamination, tourism would likely be severely curtailed. Affected businesses supported by tourism would request disaster relief. A year's worth of business losses would amount to $62.2M based on the 2015 estimate of economic output. Let's assume for the purposes of this example that a conservative relief package of one third that amount is approved. This would not include clean-up costs to restore the watershed, so let's assign a conservative figure of roughly $30M giving us a rounded amount of about $50M for total mitigation. Who would pay? The corporate integrator would immediately separate themselves from liability due to the fact that the facility itself is a contract operation. The scope of the costs would be well beyond that of the operator's resources and its owners would have little choice but to declare bankruptcy. At the end of the day, costs would fall on the backs of the Arkansas taxpayer.

The figures in this example might be debated, but the take-away is that the costs of a failure would be considerable and must be given serious consideration in the context of this permit. The operator feels strongly that he has an inherent right to make a living from his property, yet the businesses who depend on tourism have a similar lawful right, not to mention the public's right to enjoy a national river. To balance these rights, there is the option of insuring the operation with a policy specifically designed to cover environmental risk. Such policies are available for exactly these sorts of circumstances where the costs of environmental consequences are potentially very high. Rather than the taxpayer being the de facto insurer, the operator would assume the responsibility to insure against environmental damage of up to $50M or whatever the mitigation costs for potential damage would be estimated to be. The true economic cost of the risk-to-consequence equation would be determined by a professional actuary. Likewise, an environmental insurer would be motivated to provide constructive guidance for the the operator on how risks might be reduced. If the risks are truly low as the operator's advocates insist that they are, then the cost of the policy will be low as well. Monetizing the risk and having the business (the operator) shoulder the cost places the responsibility where it belongs and clarifies the discussion to that of a simple business case.

Part B - Application Fields

For a map of proposed spreading fields, see Appendix B1.

Comment B1 - This permit should be denied because the buffer zones are incorrectly designated. Buffers of spreading fields to Big Creek do not accommodate Extraordinary Resource Waters

On page 5 of the application *Nutrient Management plan*, the engineer recognizes the needs for buffers on intermittent streams of 100 ft as well as the buffer for extraordinary resource waters of 300 ft as stated in Regulation 5.406(D). The mappings of the various proposed application fields recognize all buffers near

water bodies to be 100 feet via blue crosshatching making the assumption that ERW buffers of 300 ft are not applicable.

BRWA contends that for the proposed spreading pastures the buffer should be 300 ft recognizing the integral role of Big Creek as a source for an extraordinary resource water (ERW). The rationale being that Big Creek is a water body that is hydrologically contiguous and is essentially *as of one* with the Buffalo National River which is a designated ERW. Regulation 2.302 on designated ERW uses says the following:

> "***Extraordinary Resource Waters - This beneficial use is a combination of the chemical, physical and biological characteristics of a waterbody and its watershed which is characterized by scenic beauty, aesthetics, scientific values, broad scope recreation potential and intangible social values."***

The uses as described above are directly impacted by the inflow and intermingling of homogeneous waters and therefore in the interest of maintaining said uses, they cannot reasonably be treated separately. One cannot declare that the water in the glass is superior to that of the pitcher. In addition, the phrase "*waterbody and its watershed"* as used above, implicitly includes Big Creek as a part of the Buffalo's ERW designation. As a result, all precautions required for an ERW must therefore apply to inflowing homogeneous waters contained within the ERW's watershed. An argument can be made that separate portions of a waterbody may be designated differently, and indeed this argument works for *downgrading* the status of a downstream segment. That argument is not applicable to Big Creek as its waters must be maintained to the standard of the ERW into which it flows and intermingles. These additional suggested precautionary buffers are ***directly proportional*** to the unique circumstances of this permit in regard to mitigating risk. The following fields should be buffered at 300 ft from the bank of Big creek. The maps should be corrected and the spreadable acreage recalculated.

- Field 5 9.7ac
- Field 7 64.3ac
- Field 7A 28.3ac
- Field 23 28.1ac
- Field 24 8ac
- Field 32 10ac
- Field 9 25.2ac
- Field 8A 1.4ac
- Field 10 14.1ac
- Field 10A 16.4ac
- Field 12 11.4ac
- Field 16 15.2ac

Comment B2 - This permit should be denied because the application methods proposed for flood prone soils do not conform to AWMFH and are not proportional to risk

The permit application proposes a large number of application fields in the Big Creek floodplain. The permit includes a "soils map overview" in which each of the fields is labeled with a number indicating a general soil type. The proposed fields in the floodplain adjacent to Big Creek are listed as the following soil types:

- 48 - Razort Loam, occasionally flooded
  - Field 5
  - Field 7
  - Field 7A
  - Field 23
  - Field 24
  - Field 32
- 50 - Spadra Loam, occasionally flooded
  - Field 9
  - Field 8A
  - Field 10
  - Field 10A
  - Field 12
  - Field 16

See Appendix B2 for mapping of soil types and photos of flooded spreading fields. A Water Resources Management Plan published by David Mott and Jessica Laurans of the National Park Service (2004), describes the effect of high precipitation events in the watershed:

> ***"Water levels in the Buffalo and its tributaries are considered 'flashy' ', with rapid rises and falls in the hydrograph on daily and monthly scales, as indicated in Figure 12. ...during heavy rains, the steeper slopes and shale bedrock result in faster-rising floods on the Buffalo River than in other Ozark streams."***

Reg 5.406 notes that:

> ***"Land application of waste/wastewater shall not be undertaken when soil is saturated, frozen, covered with ice or snow, or when significant precipitation is reasonably anticipated in the next twenty-four hours."***

The *Agricultural Waste Management Field Handbook* (AWMFH) on 651.0504(f) *Soil Characteristics* page 5-9 notes the following:

> "***Flooding events transport surface-applied agricultural wastes off the application site or field and deposit these materials in streams, rivers, lakes, and other surface water bodies".***

Part (f) goes on to define "occasionally flooded" (mentioned as the soil type above) as "5 to 50 times in 100 years". This is likely low as Big Creek as a wild tributary inundates fields nearly every spring (see photos Appendix B2). "Occasionally flooded" is noted as a "*moderate limitation*". The AWMFH then goes on to describe appropriate application methodology for these soil types:

> ***"Agricultural wastes should be applied during periods of the year when the probability of flooding is low. Liquid agricultural waste should be injected, and solid agricultural waste should be incorporated immediately after application. Incorporating agricultural wastes and applying wastes when the probability of flooding is low reduce the hazard to surface water."***

The proposed permit *Nutrient Management Plan* on page 5 under Operation and Maintenance notes the planned application methodology:

> ***"C & H Hog Farms, Inc. is requesting that manure and wastewater from either storage pond (Pond 1 or Pond 2) be transported via liquid tanker trucks or an irrigation system and applied to all fields included in this plan."***

Surface application via liquid tanker trucks or an irrigation system does not meet the application methodology requirement for soil types 48 and 50. Soil types 48 and 50 fall under the *moderate limitation* definition where liquids are to be injected and solids incorporated. "*Incorporation*" in regard to fertilizers means that material broadcast on the surface must then be incorporated via tillage or some other method to place the nutrients below the soil surface. However, injection or incorporation is problematic on these fields due to their shallow, rocky nature (see comment B4). As a result, it is not possible to reasonably comply with AWMFH guidance and these fields should be excluded from the nutrient management plan.

Comment B3 - This permit should be denied because the application methods proposed for slopes from 8 to 15% do not conform to AWMFH and are not proportional to risk

The permit application on page 4 of the *Engineering Plans and Review* notes in

regard to proposed application fields, the following regarding grades and slopes:

> "***Field Application Areas: Areas viewed were pasture and hay land that were either not subject to flooding or only subject to occasional flooding. Slopes, after buffering, are within specified limits of 15% or less."***

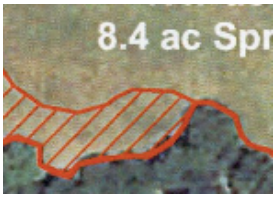
This 15% buffer corresponds with what is stated in Regulation 5.406:

> "***Waste/wastewater shall not be applied on slopes with a grade of more than fifteen percent (15%) or in any manner that will allow waste to enter waters of the State or to run onto adjacent property without the written consent of the affected adjacent property owner."***

The AWMFH 651.0504(m) *slope* page 5-12 concurs with Reg 5.406, but discusses additional limitations when spreading on slopes from 8 to 15%:

> ***"Slope is the inclination of the soil surface from the horizontal expressed as a percentage. The slope influences runoff velocity, erosion, and the ease with which machinery can be used. Steep slopes limit application methods and rates and machinery choices. Runoff velocity, soil carrying capacity of runoff, and potential water erosion increase as slopes become steeper."***

> ***"Limitations for the application of agricultural wastes are slight if the slope is less than 8 percent, moderate if it is 8 to 15 percent, and severe if it is more than 15 percent. Agricultural wastes applied to soils that have moderate limitations should be incorporated. This minimizes erosion and transport of waste materials by runoff, thus reducing the potential for surface water contamination."***



The permit application illustrates all sloped areas in the proposed spreading field maps that exceed 15% by red crosshatching. Slopes from 8% to 15% are not mapped as they are considered by the engineering plan (page 6) to be available for spreading. Reg 5 does not prohibit waste from being applied to slopes of 8 to 15% but it does direct the operator to follow the AWMFH guidelines which call for injection and incorporation for these soils to reduce runoff. The proposed permit *Nutrient Management Plan* on page 5 under Operation and Maintenance notes the planned application methodology:

> ***"C & H Hog Farms, Inc. is requesting that manure and wastewater from either storage pond (Pond 1 or Pond 2) be transported via liquid tanker trucks or an irrigation system and applied to all fields included in this plan."***

Surface application via liquid tanker trucks or an irrigation system does not meet the application methodology requirement for slopes that meet the *moderate limitation* of 8 to 15%.

AWMFH 651.0504(m) *slope* page 5-12 indicates that soils of *moderate limitation* require *incorporation* as part of the application methodology. "*Incorporation*" meaning that material broadcast on the surface must be incorporated via tillage or some other method to place the nutrients below the ground surface. The fields in question will tend to be upland with a lot of stone and chert that would make incorporation difficult and likely worsen erosion. As the AWMFH recommended application method is not a practical alternative to reduce runoff on fields from 8 to 15%, these slopes should be excluded from the nutrient management plan. Fields affected include but are not limited to the following where 15% grades are confirmed in the application mappings:

- Field 1
- Field 2
- Field 4
- Field 6
- Field 6A
- Field 11
- Field 13
- Field 13A
- Field 13B
- Field 14
- Field 15
- Field 15A
- Field 15B
- Field 20
- Field 21A
- Field 21B
- Field 22
- Field 34
- Field 35
- Field 36

The maps of the application fields should be modified to include all slopes from 8 to 15%.

Comment B4 - This permit should be denied because the soils of application fields are too thin for described waste application methodology according to AWMFH

An electrical resistivity survey commissioned by the Big Creek Research and Extension Team (BCRET) under the authorization of ADEQ was performed on three of the spreading fields under the Reg 6 General permit. As part of this study Dr. Todd Halihan's Oklahoma State University team performed a *Soil Structure Analysis.* The following discussion from the reporting results (6.2.1) Fields, Halihan (2016) will reference fields as they were numbered under their prior Reg 6 permit. An excerpt from the analysis:

"***The soil structure analysis consists of soil thickness and soil properties. Soil thicknesses for each site were picked and confirmed through hand dug borings on site conducted during previous University of Arkansas work on these fields. The borings were dug to refusal, or where the soil turns to epikarst (significantly weathered bedrock).***"

The following are excerpts from the soils analysis of the three distinct fields. The reader should take note of the thinness of soils particularly to references under 40" in depth and also under 20" in depth.

Field 5a analysis:

"***Field 5a is a low-lying grazing area with low relief and an uneven topsoil surface. Field 5a exhibits average soil thicknesses of 0.5 to 4.5 meters (1.5 to 14.75 feet). Soil thickness on Field 5a varies throughout. There is a significant resistivity difference between the highly to very resistive north and more electrically conductive southern portion (Figure 10). A broad topographic mound is situated northwest of the center of Field 5a; the soil thickness is thinner to the far north and far west of the field (see Appendix 3). This trend is consistent with the direction to which the alluvium would be deposited nearest to the stream. Soils on transects MTJ06 and MTJ07 (Figure 12A) are electrically conductive features, which thin to near zero soil thickness toward the far north.***"

Field 12 analysis:

"***Field 12 exhibits similar average soil thicknesses at 0.7 to 4 meters (2.25 to 13 feet). Soil thickness on Field 12 is not as variable as Field 5a, but there is a very resistive region of the site in the shallow soil area of the southwest portion of the investigation area (Figure 11). Field 12 is flatter and the soil thins to the west (see Appendix 3). MTJ12 (Figure 13A) shows thinning where the electrically conductive features become thicker as the image gets closer to the stream. This trend is consistent with the direction to which the alluvium would be deposited nearest to the stream. Areas where the soil profile is thinner on the images are consistent with the rocky soils encountered when electrodes were placed for data collection.***"

Field 1 analysis:

"***Field 1 is a grazing area situated on a hillside east of the stream. It has low to moderate relative relief and an uneven topsoil surface. Field 1 shows an average soil thickness of 0.5 meters (1.5 feet) determined from the ERI surveys of MTJ111 and MTJ112 (Figure 17) and soil sampling. Hand dug confirmation borings were not conducted on this field. This site was not studied extensively enough to determine differences in resistivity correlations across the entire field. Field 1 has thinner and rockier soils than either Fields 5a or 12.***"

The AWMFH 651.0504(d) *Soil Characteristics, depth to bedrock* states the following in regard to thin soils:

> ***"The depth to bedrock or a cemented pan is the depth from the soil surface to soft or hard consolidated rock or a continuous indurated or strongly cemented pan. A shallow depth to bedrock or cemented pan often does not allow for sufficient filtration or retention of agricultural wastes or agricultural waste mineralization by-products. Bedrock or a cemented pan at a shallow depth, less than 40 inches, limits plant growth and root penetration and reduces soil agricultural waste ad- sorptive capacity. Limitations for application of agricultural wastes are slight if bedrock or a cemented pan is at a depth of more than 40 inches, moderate if it is at a depth of 20 to 40 inches, and severe at a depth of less than 20 inches."***
>
> ***"Agricultural wastes continually applied to soils that have moderate or severe limitations because of bed-rock or a cemented pan can overload the soil retention capacity. This allows waste and mineralization byproducts to accumulate at the bedrock or cemented pan soil interface. When this accumulation occurs over fractured bedrock or a fractured cemented pan, the potential for ground water and aquifer contamination is high. Reducing waste application rates on soils that have a moderate limitation diminishes ground water contamination and helps to alleviate the potential for agricultural waste overloading. If the limitations are severe, reducing waste application rates and split applications will lessen overloading and the potential for contamination."***

Field 1's average depth falls into the *severe limitation* range. Field 5a has areas that include both *moderate* and *severe* limitations and field 12 has areas that fall under the *moderate limitation*. In addition, it is a serious concern that the point of refusal is epikarst which means that unabsorbed nutrients applied to thin soils will filter directly into fractured limestone pathways. The Oklahoma State study identifies epikarst beneath the soil layer for all three fields:

> ***6.2.2 Epikarst Structure***
>
> ***"The epikarst zone consists of the weathering profile of the underlying competent bedrock. Epikarst is visible on Field 5a (Figure 12), Field 12 (Figure 13), and Field 1 (Figure 17) as a more resistive to electrically conductive region below the base of the soil and above the highly resistive competent bedrock zones. No confirmation borings are available to evaluate rock properties in these zones on any of the sites. The thickness of the epikarst zone is highly variable (thicknesses range from 2 to 23 meters or 6.5 to 75.0 feet) throughout each field but averages 4 to 7 meters (13 to 23 feet) thick."***

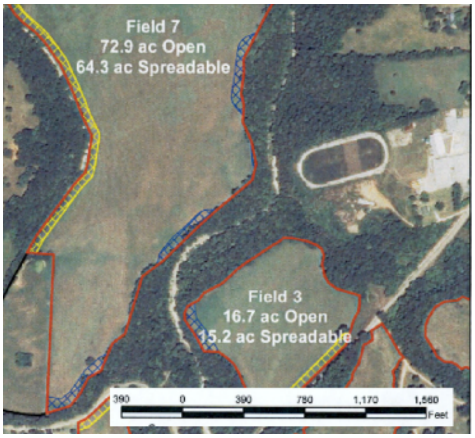
AWMFH 651.0703(2) page 7-15 *Factors affecting groundwater considered in planning* states the following regarding shallow soils over epikarst:

"Deeper soil increases the contact time a contaminant will have with mineral and organic matter of the soil. The longer the contact time, the greater the opportunity for attenuation. Very shallow (thin to absent) soil overlying permeable materials provides little to no protection against groundwater contamination."

Authors of the permit application must acknowledge the scientific soil analysis performed with public funds by the Oklahoma State team by mapping these three fields for light and split applications as recommended by the AWMFH 651.0504(d). Likewise, these limitations need to be specifically called out in the nutrient management plan and spreading areas limited and mapped accordingly.

Comment B5 - This permit should be denied because the application buffers for fields 7 and 3 do not sufficiently consider activity areas of nearby high school

The fields appear to be outside the 500 ft range of buildings as Reg 5 requires, however they are well within 400 feet of school property and the athletic track where children will be present.



Field 7 distance is 314 ft.



Field 3 distance is 389 ft



The seasonality and weather in which children are likely to be active corresponds with ideal conditions for spreading. ADEQ has the ability to apply conditions to a permit for unique situations like this where the health of children are a consideration.

The 500 foot buffer should not only accommodate children's outdoor activity areas at the high school, but ADEQ should exercise their legal prerogative to act on this as a special condition and expand the buffers to school property to 1,000 feet. The maps should reflect the expanded buffer with the spreadable acreage recalculated.

Comment B6 - This permit should be denied because the proposed fields do not have 100 foot buffers completely surrounding ponds

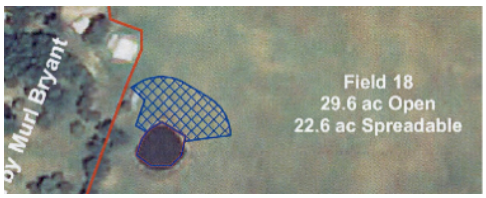
Regulation 5.406(D) states:

> ***"Application of waste/wastewater shall not be made within 100 feet of streams including intermittent streams, ponds, lakes, springs, sinkholes, rock outcrops, wells and water supplies"***

Buffers appear to be only partially applied around ponds. The engineer may be considering down gradients but Regulation 5 does not offer such exceptions. Ponds need to be fully buffered by 100 ft on all sides. Incomplete pond buffering occurs for the following fields which should be remapped and spreadable acreage should be recalculated:

- Field 1, 17.7 ac
- Field 6a, 17.5 ac
- Field 9, 29.6 ac
- Field 13A, 36.9 ac
- Field 13B, 15.5 ac
- Field 14, 15.1 ac
- Field 15B, 21 ac
- Field 15, 28.2 ac
- Field 18, 29.6 ac
- Field 19, 13.3 ac
- Field 20, two ponds, 24.8 ac
- Field 21, two ponds, 49.8 ac
- Field 33, 5.9 ac
- Field 35, 16.5 ac
- Field 36, 12.1 ac

Example:



Comment B7 - This permit should be denied because the geologic assessments of spreading soils are inadequate and not proportional to risks

The comments in Part A discuss the special circumstances of this permit in regard to the disproportionately high consequences of contamination. The degree of risk introduced by the permit calls for higher investigative due diligence. Comment B4 discusses the thin soils underlain by epikarst as outlined by the Oklahoma State University Electronic Resistivity Study (Fields, Halihan, 2016). Only three fields were checked in the study, yet two of them had soils falling into the *severe limitation* range and one of them had soils falling into the *moderate limitation* range. All three fields were determined to be underlain with highly porous epikarst. The AWMFH 651.0504(d) *Soil Characteristics, depth to bedrock* states the following in regard to thin soils:

> "***The depth to bedrock or a cemented pan is the depth from the soil surface to soft or hard consolidated rock or a continuous indurated or strongly cemented pan. A shallow depth to bedrock or cemented pan often does not allow for sufficient filtration or retention of agricultural wastes or agricultural waste mineralization by-products. Bedrock or a cemented pan at a shallow depth, less than 40 inches, limits plant growth and root penetration and reduces soil agricultural waste ad-sorptive capacity. Limitations for application of agricultural wastes are slight if bedrock or a cemented pan is at a depth of more than 40 inches, moderate if it is at a depth of 20 to 40 inches, and severe at a depth of less than 20 inches."***
>
> ***"Agricultural wastes continually applied to soils that have moderate or severe limitations because of bed-rock or a cemented pan can overload the soil retention capacity. This allows waste and mineralization byproducts to accumulate at the bedrock or cemented pan soil interface. When this accumulation occurs over fractured bedrock or a fractured cemented pan, the potential for ground water and aquifer contamination is high. Reducing waste application rates on soils that have a moderate limitation diminishes ground water contamination and helps to alleviate the potential for agricultural waste overloading. If the limitations are severe, reducing waste application rates and split applications will lessen overloading and the potential for contamination."***

AWMFH 651.0703(2) *Factors affecting groundwater considered in planning* page 7-15 states the following regarding depth of soil:

> ***"Deeper soil increases the contact time a contaminant will have with mineral and organic matter of the soil. The longer the contact time, the greater the opportunity for attenuation. Very shallow (thin to absent) soil overlying permeable materials provides little to no protection against groundwater contamination."***

As only three of 38 fields were tested, it is reasonable to expect that many if not most of the other proposed spreading fields will have similar thin soil limitations that need to be identified in the nutrient management plan. The upland fields will be especially prone. All fields should be inspected and tested via electronic resistivity by a qualified geologist. AWMFH 651.0202(c) *Inventory of resources*, page 2-8 states the following:

> ***"…variations in depth to bedrock or in soil depth, potential for sink- holes, and fractured or cavernous rock often eliminate use of some types of AWMS components. Geologic information, including depth to the water table and geologic reports, should be reviewed for any given site. Onsite geologic investigations with the assistance of a qualified geologist should be given a high priority…".***

In addition, the on site geologist should evaluate for "stoniness", particularly the upland fields. These should be assigned into one of the three classes as outlined in AWMFH 651.0504(g) *Fraction greater than 3 inches in diameter-Rock fragments, stones, and boulders*, page 5-10.

> ***"Rock fragments, stones, and boulders can restrict application equipment operations and trafficability and affect the incorporation of agricultural wastes. Incorporating agricultural wastes that have high solids content may be difficult or impractical where:***
>
> ***• Rock fragments between 3 and 10 inches in diameter make up more than 15 percent, by weight, (10 percent, by volume) of the soil***
>
> ***• Stones and boulders more than 10 inches in diameter make up more than 5 percent, by weight, (3 percent, by volume) of the soil***
>
> ***• The soil is in stoniness class 2 or higher***
>
> ***Because of this, agricultural wastes applied to these areas may be transported offsite by runoff and have the potential to contaminate the adjacent surface water. Local evaluation of the site is required to determine if the size, shape, or distribution of the rock fragments, stones, and/or boulders will impede application or incorporation of agricultural wastes."***

The survey for "stoniness" is particularly important for the fields mentioned in Comment B3 where fields contain grades between 8 and 15% and incorporation

is suggested but likely impractical. These limitations need to be identified, mapped, and planned for in the nutrient management plan.

Comment B8 - This permit should be denied because it allows application of waste in excess of agronomic need

Section 651.0201(d) of the AWMFH states:

> ***"If wastes are applied to agricultural fields, the application must be planned so that the available nutrients do not exceed the plant's need or contain other constituents in amounts that would be toxic to plant growth."***

Arkansas Regulation 5.405(a) states:

> ***"The waste management plan shall be developed in accordance with Reg. 5.402 and shall address the timing of land application of wastes with respect to the nutrient uptake cycle of the vegetation found on the land application site(s)…"***

Reg 5.402 referenced above is the requirement for compliance with the AWMFH. The regulation identifies the source of guidance in regard to agronomic "uptake cycle" and that guidance is clear about nutrient exceedance.

Current fields used under the existing permit ARG590001 have *"above optimum"* levels of phosphorus, based on the most recent soil tests performed in December 2015, and no additional applications of phosphorus are recommended. In addition, the fields proposed to be added under 5264-W have not been soil tested since April, 2014 and at that date many were also *"above optimum"* for P (phosphorus), with no further applications of P recommended. It is safe to assume that these new fields have likely received fertilizer applications since April, 2014 and at the least, new soil tests should be required for those added fields. Any applications of P will be in excess of the vegetation's nutrient uptake ability and will exceed agronomic need which will increase the risk of runoff and/or percolation into groundwater. Winter applications of waste, a modification approved by ADEQ, is clearly in excess of agronomic need as little if any plant uptake occurs during winter dormancy periods.

M.D. Smolen, PH.D. who has 35 years of experience in water quality management as affected by agricultural waste management states it this way in a report (Smolen, 2017). For the following, refer to Appendix B8, column: "P-Nutrient Status":

<u>Nutrient Management and Waste Disposal</u>

"The C &H Hog Farms nutrient management plan (NMP) is based on Nitrogen, resulting in excess Phosphorus application. This amounts to disposal of Phosphorus as most of the fields already have medium to very high soil test P levels. Table 1 shows the P-status of each field in the Permit Application with its most recent Soil Test Phosphorous (STP) and the Phosphorus (P2O5) fertilizer recommendation from the Arkansas Cooperative Extension Service. According to these recommendations these fields need very little or no P2O5. Note virtually all the fields included in the NMP, particularly those that were used previously have "Above Optimum" P-status."

"In my opinion, application of wastes to fields with P-Status higher than "Above Optimal" should be considered waste disposal, making them subject to storm water rules . Considering the number of fields at Optimal or Above Optimal STP, using a P-basis for nutrient management would severely reduce the amount of land available for waste application without additional BMPs".

The Arkansas Phosphorus Index (API) is intended to assess risk posed to waters of the state by excessive phosphorus applications, yet it inadequately accounts for soil tests for phosphorus and allows for applications in excess of agronomic need. The API is a waste disposal tool and its use is not appropriate when considering the risk factors as outlined in Part A.

Comment B9 - This permit should be denied because the Arkansas Phosphorus Index (API) fails to account for karst

As per the University of Arkansas Division of Agriculture document FSA9531 https://www.uaex.edu/publications/PDF/FSA-9531.pdf:

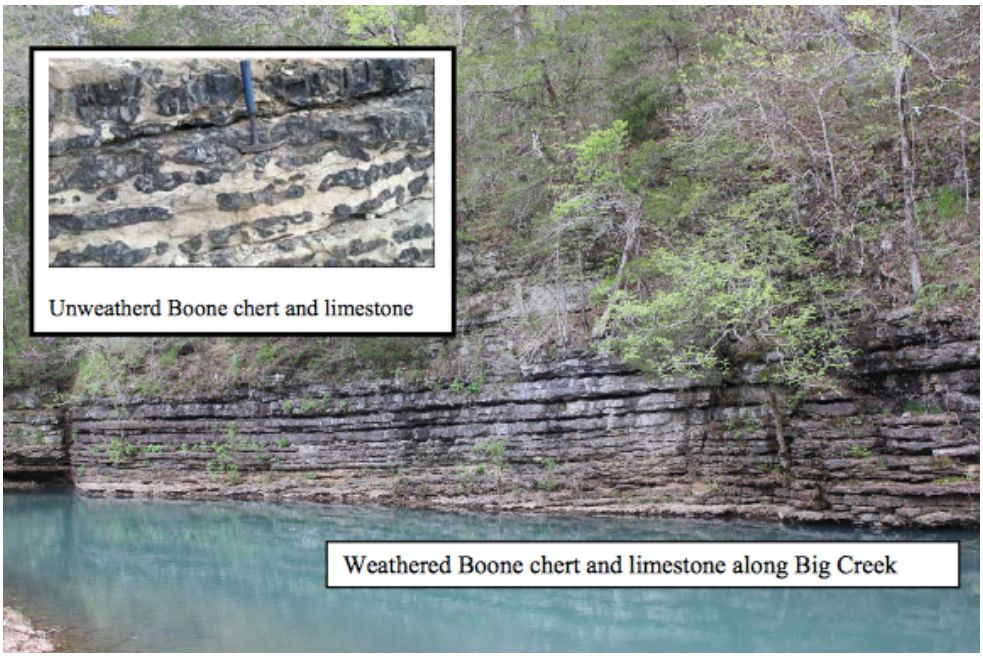
"The Arkansas Phosphorus Index (API) is used to assess the risk of phosphorus (P) <u>runoff</u> from pastures and hayland as part of farm nutrient management plan (NMP) development" (emphasis added)

The API addresses surface runoff *only* and does not consider risks to groundwater. A significant weakness of the API is its failure to consider karst or any subsurface geological risk factors when determining the risk of waste applications to waters of the state.

According to geologic maps of the area:

http://www.geology.ar.gov/maps_pdf/geologic/24k_maps/Mount%20Judea.pdf

C&H and the spreading fields are located in what is widely and scientifically accepted as a significant karst environment. The presence of karst is not subjective, but obvious to the casual observer from the weathered dissolution features in exposed formations throughout the Mt. Judea area.



For more in depth discussions and references to studies in regard to dye tracing, hydraulic subsurface flows relative to storm events, and evidence of karst see Comments: E2, C2, C11, C12. See also Mott, 2016 which states, "The waste storage ponds and land application sites are predominantly underlain by the Boone Formation; therefore, karst geohydrology." Further, a report titled "Surface-Water Quality In The Buffalo National River, 1985-2011" by the Watershed Conservation Resource Center, 2017 states:

> "***The Ordovician through Mississippian rocks [which characterizes the Buffalo River watershed geology] host a complex karst terrain where losing streams, sinkholes, springs, and caves dominate much of the landscape. Most of these rocks are carbonates, either limestone or dolomite. They are particularly susceptible to dissolution. These rocks are highly permeable to the movement of groundwater. Subsurface flow directions and rates of groundwater flow are difficult to predict and may rapidly change based upon the hydrologic events."***

Smolen (2017) had this to say in regard to limitations of the API in regard to various aspects including subsurface flows:

> ***Arkansas PI Shortcomings (API)***

"The API, as used in planning the NMP, has several severe shortcomings. First, although it purports to address risk of degrading water quality, it does not address some important factors affecting transport to the receiving waters. In reality it only compares the source term of the Index not the risk of polluting the receiving waterbody. The PI was derived from a series of rainfall simulator studies of runoff produced from application of a synthetic rainstorm on a small area of soil. This makes it very sensitive to application rate and characteristics of the waste, but not to many other physical factors such as karst, surface drainage, gravel bars, or management factors that affect delivery to the stream."

"Because it was developed from very short-term, micro-studies, it cannot address the larger- scale effects of season, groundwater pathways, or weathering, leaching, or eroding of enriched soils."

"The API does not address the risk due to increased runoff due to soil compaction from livestock hoofs or increased drainage efficiency due to subsurface gravel bars, karst geology, or increased drainage efficiency through surface or subsurface features."

Karst and fast moving ground water presents a significant risk factor which should be taken into account when assessing risk yet is altogether ignored by the applicable risk assessment tool; the API. If karst was properly factored into the API, it is highly likely that the risk categories for most if not all of the C&H fields would exceed that allowed under the terms of the permit.

Comment B10 - This permit should be denied because of the extreme difficulty of complying with the application buffer zones and because compliance is impractical to monitor or enforce

Many of the fields, particularly the upland ones, include buffer zones which are so fractured, convoluted and circuitous that the chances of applying waste outside the buffer areas are very high. Many of the fields, such as fields 13, 15, 16, and 21, are broken into multiple segments by the buffer zones. Fields 1, 2, 4, 6, 8, 10, 13, 14, 15, 19, 20, 21, 22, and 35 include multiple 50 and 100-foot buffers and some 500 foot buffers to avoid adjacent streams, drainage areas, ponds, steep slopes, rock outcroppings as well as adjacent homes and property lines. Flagging or other marking has not been observed demarcating any exclusion zones and, even if proper flagging was present, the logistics of navigating and applying swine waste from "honey wagons" to these fields is difficult at best and the risk of applying waste inside the buffer zones is

inordinately high. There are no provisions other than “self-reporting” to determine if waste is being applied in accordance with the buffer zones and the remote locations of the fields and lack of visible flagging makes it impossible for concerned citizens to observe and report any violations that might occur.

M.D. Smolen, PH.D. who has 35 years of experience in water quality management as affected by agricultural waste management states it this way (Smolen, 2017). Please refer to Appendix B8, column: “Suitability for waste Application”, and Appendix B10 - Unrealistic Buffer Zones:

> ***Suitability of Fields for Waste Application***
> ***“The last column of Table 1 also shows my assessment of each field’s suitability for waste application based on shape and steepness. Most fields in the NMP have reasonably good shape, with large open areas where a spray rig could maneuver easily to follow boundaries of buffer zones. Some, however, have few restricted areas, or at least areas that are easy to identify. Several fields, however, are so contorted, with buffer areas and steep slopes, it would be difficult or even impossible to follow. Examples of fields with severe limitations include fields 2, 4, 6A, 11, 13B, 20, and 21B. Figure 4 shows the example of Field 21A , where an operator would have difficulty. These six fields include 71.5 acres that should be removed from the permitted application area.”***

Comments submitted by the Arkansas Department of Health in regard to buffer zones https://www.adeq.state.ar.us/downloads/WebDatabases/PermitsOnline/NPDES/PermitInformation/5264-W_ADH%20Comment%20Letter_20170307.pdf state:

> ***“Permit requirements for best management practices and stream buffer zones should be strictly adhered to during the land application of swine wastes to prevent water-borne pathogens from leaving the sites.”***

As noted, strict adherence with the exclusion zones is unlikely and the odds of pathogens leaving the approved application sites are unacceptably high, therefore this permit should be denied.

Comment B11 - This permit should be denied because the nutrient management plan (NMP) proposed application rates are overly optimistic in regard to current forage management

M.D. Smolen, PH.D. who has 35 years of experience in water quality management as affected by agricultural waste management and other aspects of watershed management discusses some assumptions in the nutrient management plan (Smolen, 2017).

> ***"In writing the NMP, the planner used the API to set waste application rates that keep the PI in the Low to Medium range for each field. They analyzed only summer and spring seasons, although some winter application was reported each year under the previous permit, and winter application is the most Risk-prone season for waste application. The planner considered each field separately to set a maximum application rate for that field. This seems an acceptable approach to set upper limits for each field, but is not really a plan for distribution of waste."***
>
> ***"The API analysis presented in the Permit Application is based on the most recent waste analyses and the most recent soil tests (about 2 years ago). The planner assumed in the API that all fields would be managed as rotational grazing at the highest possible forage yield and the best ground cover condition possible for the area. Many of these assumptions are not correct and certainly do not represent a worst- case assessment."***

A definition of *"Managed intensive rotational grazing (MIRG)" reads as follows:*

> ***"Managed intensive rotational grazing (MIRG), also known as cell grazing, mob grazing and holistic managed planned grazing, describes a variety of closely related systems of forage use in which ruminant and non-ruminant herds and/or flocks are regularly and systematically moved to fresh rested areas with the intent to maximize the quality and quantity of forage growth."***
>
> ***"One primary goal of MIRG is to have a vegetative cover over all grazed areas at all times, and to prevent the complete removal of all vegetation from the grazed areas ('bare dirt')"***

Smolen confirms the above characterization of rotational grazing and comments on assumptions made in the NMP. Reference Appendix B11.

> ***<u>Conclusions Regarding Overall Planning of NMP</u>***
> ***"The assessment of an upper limits for waste application rates from each source on each field in two seasons of the year is a reasonable approach to setting guidelines for each field, but some of the choices for parameters are not correct. For example, under Regulation 5 soil testing is only required once in five years, but STP it is likely to increase drastically in that time. A glaring error is the designation of "Rotational Grazing" as the use of each pasture. This assumption is based on a very high level of grazing management, where cattle are moved frequently from paddock to paddock to assure the forage is harvested uniformly and has ample opportunity for regrowth before cattle are returned. It gives the lowest PI of all options in the PI spread sheet. Observations by local residents (Figure 5) indicate some fields are overstocked from time to time, and grass cover is not maintained in the most healthy, protective state at all times. An aerial view of Fields 2 and 3 (Figure 6) shows the eroded condition of these fields in mid-***

March 2016. In this case, Field 2 is among those that should not be included in the Permit."

Smolen's reference to "views" can be found as photos in Appendix B11. The photos show examples of poor management of forage production as well as evidence of "erodible conditions" from bare dirt. Smolen goes on to discuss API limitations from livestock use, soil compaction, and erosion:

> ***"The API does not address the risk due to increased runoff due to soil compaction from livestock hoofs or increased drainage efficiency due to subsurface gravel bars, karst geology, or increased drainage efficiency through surface or subsurface features. Another limitation is the API's treatment of erosion. Erosion is a very important mechanism for transporting Phosphorus. The P-content of eroded soil can be so high it can far exceed that predicted by the API. This is particularly important when assessing risk due to poor grazing management or overstocking."***

The examples in Appendix B11 are limited and not all of the fields have been examined to determine if best management practices regarding forage production have been in effect.

Smolen provides the following summary points regarding fields and forage management (2017):

- *Assumptions of forage production are too high for the area.*
- *Hay is not harvested from all fields so the nutrients are not removed efficiently.*
- *Assumptions of rotational grazing are not correct. In fact, grazing practices in the area are not as beneficial as planned, estimates of API are systematically low.*
- *A few fields get most of the waste as indicated by historical record.*
- *The effects of compaction, due to grazing are not recognized.*
- *the API does not account for erosion of pasture effectively - erosion is very effective in transferring P to receiving waters.*

Evidence of best management practices in regard to sound forage management should have a direct bearing on the evaluation of the permit. The fact that such a review is lacking and that optimal management is assumed speaks to the quality of the NMP in that it is not proportional to the risks described in Part A.

Comment B12 - This permit should be denied because the operation's swine waste is phosphorus-rich and current application rates will result in significant phosphorus build-up resulting in discharge into waters of the state

M.D. Smolen, PH.D. who has 35 years of experience in water quality management as affected by agricultural waste management and other aspects of watershed management discusses "nutrient imbalances" that can result from hog waste. From his report dated 2017.

> ***<u>The Problem of Nutrient Imbalance from applying Hog Waste to Agricultural Fields</u>***
> ***"The final stage of treatment of manure wastes is the application of waste to the land as fertilizer to utilize the nutrients in an actively growing crop. Hog manure is rich in Nitrogen, Phosphorus, and Potassium, which are all essential plant nutrients, and organic matter that is beneficial to the soil. There may be as much as 60% loss of soluble Nitrogen during storage in the pond due to volatilization of ammonia and denitrification (Chastain, 1999). Consequently, when the waste is applied to a hay crop, the waste is relatively high in phosphorus and low in nitrogen relative to crop needs."***
>
> ***"Because a hay crop needs fertilizer in a ratio of 8: 1: 1 (N: P: K), but the hog manure has a ratio of about 1: 1: 1, the crop leaves behind most of the P that is applied. With continued application of manure, the soil test P (STP) will increase rapidly. Studies have shown that on average STP increases about 20 lb for every 100 lb of excess fertilizer. Finally, it has been well documented that the concentration of P in runoff increases with STP, although the actual rate of increase depends on the soil (Vadas, 2005)."***
>
> ***"The effect of continued application of P-rich waste from 2012 through 2015 can be seen in the buildup of soil P in the C&H fields shown in Table 4 and in Figure 2 of the Appendix. In a three-year period, STP increased as much as 380%. The P-enriched soils will continue to be a source of P to the river for many years."***
>
> ***"The problem of Soil-P-buildup is virtually assured in these fields because the crop is only harvested by grazing, which removes very little P. Most of this nutrient is consumed by cattle then redeposited in shady lounging areas and riparian areas. This exacerbates the water quality issues, first because much of the manure is deposited in environmentally sensitive areas and second because the P distribution is not optimal for tor the crop. As can be seen by the STP results in Table 4, these fields have more than enough P for grazing."***

Where Smolen mentions "Table 1", refer to Appendix B8, column "P-Nutrient Status". The U.S. Geological Survey says this about phosphorus effects when there is too much of it:

> ***"Phosphorus is an essential element for plant life, but when there is too much of it in water, it can speed up eutrophication (a reduction in dissolved oxygen in water***

bodies caused by an increase of mineral and organic nutrients) of rivers and lakes."

As the waters of Big Creek are homogeneous and intermingled with the Buffalo National River, an "Extraordinary Resource Water" (ERW), phosphorus build-up will at some point result in a violation of Reg 2.202 regarding the *anti-degradation of high quality waters* which reads as follows:

> ***"Where the quality of the waters exceeds levels necessary to support propagation of fish, shellfish and wildlife and recreation in and on the water, <u>that quality shall be maintained and protected</u> unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State of Arkansas' Continuing Planning Process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located."***

The operation has received no review as per Reg 2.202 in regard to *"important economic or social development"* in the area in which the waters are located that would allow for an exception to the statute. The phosphorus build-up potential of the permit is clearly out of line and disproportional to the risk factors as described in Part A. For this reason alone, the permit should be denied.

Furthermore, Mott, 2016, states:

> ***"Soil phosphorus can be a potential source of contamination to surface water for both sediment-attached and soluble phosphorus in runoff (NRCS, 2012; Sharpley, 1993). Table 2 (below) was prepared from soil sample results contained in the NMP prepared for the NOI submitted prior to C and H Hog Farms conducting land application activities. Guidance from University of Arkansas states that fields are considered to be above the optimum level for phosphorus (P) when values exceed 50 pounds per acre (Espinoza et al., 2007). Only fields 12 and 15 were recommended by the University of Arkansas as needing additonal phosphorus. All other fields were recommended to receive zero pounds per acre for a "full-cycle system" (DeHann, Grabs, and Associates, 2012). Based on the soil test recommendations, out of the 630 acres permitted to receive land application, only 85 acres actually required additional P, and the total recommended P for these 85 acres equates to 3,391 pounds. Furthermore, when the acres are looked at in total, these 17 fields contain an above optimum surplus of 21,815 pounds of phosphorus already existing on the landscape."***
>
> ***"Long-term applications of organic P at rates that exceed the uptake rate of plants can result in saturation of the adsorption sites near the soil surface. This results in increased concentrations of both soluble and labile (easily altered) P. The excess soluble P can either leach downward to a zone that has more attachment sites, and then be converted to labile P or fixed P, or in karst environments, it could infiltrate conduits and subsurface drainage networks. Excess phosphorus can also be carried off the land in runoff water. If soils that***

Field Number	Usable Acres	Phosphous level	P_2O_5 lbs/field Recommended by University of AR	Concentration ppm (mg/L P_2O_5)	Existing lbs/acre P_2O_5	Excess P_2O_5 on landscape (pounds)*
1	15.6	Above Optimum	0	83	166	1810
2	17	Above Optimum	0	72	144	1598
3	13.6	Optimum	0	42	84	462
4	8.8	Optimum	0	50	100	440
5	23.8	Above Optimum	0	65	130	1904
6	34.5	Above Optimum	0	76	152	3519
7	74.3	Above Optimum	0	178	356	22736
8	15.5	Optimum	0	46	92	651
9	41.2	Above Optimum	0	52	104	2225
10	33.2	Above Optimum	0	69	138	2922
11	20.7	Above Optimum	0	57	114	1325
12	23.7	Low	1,659	19	38	-284
13	61.6	Optimum	0	48	96	2834
14	18	Above Optimum	0	52	104	972
15	61	Very Low	6,100	15	30	-1220
16	79.6	Optimum	0	48	96	3662
17	88.7	Optimum	0	50	100	4435
Total	630		7,759 (**3,391 lb P**)			49,989 (**21,815 lb P**)
* Calculated by: (Existing lb/ac – 50 pounds optimum) * # acres; P_2O_5 * 0.4364 = P						

Table 2: Soil test phosphorus results from the C and H Hog Farms nutrient management plan, analyzed in 2012 prior to application of swine waste.

have high labile P concentrations reach surface water as sediment, sediment particles will continuously desorb (release P in the soluble form) until equilibrium is attained. Therefore, sediment from land receiving animal waste at high rates or over a long period of time will have a high potential to pollute surface water (NRCS, 2012).”

“Sandy soils, such as those common to alluvial deposits in the Big Creek floodplain, may not effectively retain phosphorus (NRCS, 2012). If the ground water table is close to the surface, the application of waste at excessive rates, or at nitrogen-based rates, will likely contaminate the ground water beneath those soils. However, ground water that is below deep, clay soils is not likely to be contaminated by phosphorus because of the adsorptive capacity of the clay minerals. Almost half (291 acres) of the application fields used by C and H Hog Farms have alluvial soils, which commonly have a higher sand content than in-situ developed soils.”

“Because northwest Arkansas has a substantial CAFO industry, high phosphorus readings in pasture soils receiving animal waste is a common occurrence. Vast areas of the landscape could not accept phosphorus if soil test results and plant uptake requirements were the only criteria applied. To assist landowners and regulators with estimating the potential for phosphorus to impact waters of the State, Arkansas has developed the Arkansas Phosphorus Index (API) (Sharpley et al., 2010). This index uses various factors to estimate likelihood of phosphorus mobilization. However, this Index is not referenced in the NRCS (2012) guidance manual. Rather, the NRCS states “Waste must be applied in a manner that:

- ***Prevents runoff or excessive deep percolation of the wastewater,***
- ***Applies nutrients in amounts that do not exceed the needs of the crop, and***
- ***Minimizes odors from the waste being applied”***

"Estimated total waste water production was approximately 2.6 million gallons per year according to the 2014 and 2015 annual reports filed by C and H Hog Farms. The ongoing test results from the waste storage ponds and soils, and results from recalculations of the Arkansas Nutrient Management Planner with 2009 Phosphorus Index, confirm earlier projections that phosphorus is being applied at rates in excess of annual plant consumption. Several scientific papers are accessible at the BCRET website detailing how long-term application of excessive phosphorus in watersheds results in a slow but steady build-up of legacy phosphorus in soils and ground water. Once phosphorus outmigration from the watershed becomes measurable, it can continue for a long time with lasting environmental consequences (www.bigcreekresearch.org). "

Part C - Geologic and Engineering Site Investigation

A clarification on relative site elevations:

Harbor Environmental submitted a work-plan in August of 2016 for drilling a single bore hole to investigate Dr. Halihan's west transect (Oklahoma State ERI study). Although Harbor Environmental provided geographical coordinates for the planned hole, they failed to provide an elevation. As a result, Harbor later submitted an addendum on Jan 9th, 2017 with an elevation of the bore hole certified by licensed professional surveyor Johnny R. Tweedle. The original "as built" engineering plans also show the elevation of the bore hole (see Appendix C12). These "as built" plans were certified by licensed professional engineer Nathana Pesta on April 5th 2013. Mr. Tweedle's certified elevation is higher than Mr. Pesta's certified elevation by 16.31 feet. We are unable to identify any nearby elevations at the facility that are at the height that Mr. Tweedle states.

Several of the comments below discuss elevations of the bore hole relative to the pond floors and are based on the "as built" elevations. The "as built" drawings are a term of the permit and are required to show accurate contouring and relative depths. The "as built" drawings agree with relative depths described in the permit narrative and are the best and only source that is provided for examining relative elevations.

Comment C1 - This permit should be denied because facility plans do not account for proximity of a waste impoundment to sensitive groundwater areas as suggested by AWMFH

AWMFH *651.0703 Factors affecting groundwater quality considered in planning* page 7-15 describes a number of engineering considerations for siting and planning a facility. Under this on page 7-18(i) is *Proximity to designated aquifers, recharge areas, and well head protection areas* in which the following is stated:

> ***State water management and assessment reports and the following maps should be reviewed to ascertain the proximity of sensitive groundwater areas:***
> - ***sole source or other types of aquifers whose uses have been designated by the State***
> - ***important recharge areas***
> - ***Wellhead protection areas***

Location within the recharge area of a major tributary of a national river, a designated ERW, qualifies as *"a sensitive groundwater area"*. Such considerations not only apply to seepage but to the possibility of containment failure. The original NOI and the current Reg 5 application do not address this. Nor does the original NOI provide any evidence that this was seriously considered. Evidence of due diligence in regard to alternative sitings as suggested in AWMFH 651.0202 *Conservation Planning Process step 6: Evaluate Alternatives* would at least suggest that the investigators considered the sensitivity of the watershed. AWMFH 651.0801*Process* in Chapter 8: *Siting Agricultural Waste Management Systems* notes:

> ***"During the planning process, it is critical to arrange and locate the various AWMS components so they are functional and compatible with the surrounding land- scape."***

No such alternatives were provided or alluded to. Chapter 7 of the AWMFH does not require a review for sensitive ground waters, but the circumstances for which these suggestions are provided are clearly present. The lack of such a review suggests that there has not been adequate due diligence demonstrated in the permit application that is proportional to the significant risk factors described in Part A.

Comment C2 - This permit should be denied because facility plans do not investigate groundwater flow direction as suggested by AWMFH

AWMFH *651.0703 Factors affecting groundwater quality considered in planning* page 7-15 describes a number of engineering considerations for siting and planning a facility. On page 7-16(b) *Groundwater flow direction* reads as follows:

> ***"A desirable site for a waste storage pond or treatment lagoon is in an area where groundwater is not flowing away from the site toward a well, spring, or important underground water supply".***
>
> ***"The direction of flow in a water table aquifer generally follows the topography, with lesser relief. In most cases, the slope of the land indicates the groundwater flow direction."***

There are two improperly abandoned wells (no sealed liner) and one abandoned drilled well down gradient from the site. The first well is within 594 ft of the pond wall. The second (which we will refer to as B-39 in Brahana's study) is 1,710 ft. The drilled well (which we will refer to as B-40 in Brahana's study) is 2,066 ft. Although elevation shows a rise between the ponds and the wells for B-39 and B-40, the down gradient of flow will not be a straight line. See Appendix C2-A for well sitings and gradients. The original NOI notes the distance to the nearest watercourse in SECTION D: *SITE SPECIFIC INFORMATION*, but does not mention the wells. Likewise, a 2,000 ft radius map is provided in SECTION E: *FACILITY PLANS* (see Appendix C2-B), makes no reference to down gradient wells. 7-16(b) goes on to discuss alternative flow patterns:

> ***"Radial flow paths and unusual subsurface geology can too often invalidate this assumption. Consider the case where secondary porosity governs the flow. A common example is bedrock in upland areas where the direction of groundwater flow is strongly controlled by the trend of prominent joint sets or fractures. Fracture patterns in the rock may not be parallel to the slope of the ground surface. Thus, assuming that groundwater flow is parallel to the topography can be misleading in terrain where flow is controlled by bedrock fractures."***

As the Boone formation is the predominant geology, epikarst and karst evidenced by fractures and weathered limestone are the more likely drivers of groundwater flow direction in regard to this Reg 5 application. Evidence of alternative flows are discussed in a study published by Dr. John Brahana: August 3rd, 2016

"Characterization of the karst hydrogeology of the Boone Formation in Big Creek Valley near Mt. Judea, Arkansas documenting the close relation of groundwater and surface water". The study links rapid changes in well levels for B-39 and B-40 with precipitation events (see Appendix C2-A page 3). Note that the "hand dug well" in the appendix was not part of this study. Only wells B-39 and B-40 are referenced in the excerpt below.

> "***For the groundwater wells, time lag was essentially identical to the time lag of the surface- water stage, indicating that groundwater levels started rising no later than an hour after precipitation started. Rapid response of the groundwater level is an indicator that karst conditions facilitate rapid flow of precipitation into the ground. The magnitude of the water-level increases can be caused by several factors including: variation of permeability or porosity of the aquifer materials; variation in storage as the groundwater moves downgradient, variations in the epikarst (upper eroded zone) at the top of the Boone (BS-39); and variations in Big Creek alluvium and terrace deposits (BS-40) that directly overlie the Boone in Big Creek Valley (Braden and Ausbrooks 2003)."***
>
> ***"For the period of record, from May 1, 2015, through early June, 2015, 10 storms of varying intensity were recorded. Hydrograph records of the wells and streams indicate that water level rises rapidly after the onset of precipitation in Big Creek and contiguous basins, with little delay (less than an hour) between the wells and the streams (Figs. 13, 14, 15). This coincidence of the start of water- level rise in the hydrographs reflects the close relation of surface and ground water. The time to maximum crest of each hydrograph, however, indicates the duration the water takes to move laterally below ground through aquifers to the hydrologic drains. Variations in time-to-crest of each of the hydrographs indicate details of the rainfall intensity and variations in the underground flow system, including permeability, pre-storm water levels and hydrologic conditions, rainfall distribution, flow constrictions or constraints for intervening flow paths, and degree of karstification."***

This study and the corresponding hydrographs in Appendix C2-A page 3 suggest rapid subsurface water movement as evidenced by changes in down gradient well levels during storm events. This corresponds with the suggestion by AWMFH *"that secondary porosity can govern flows"* and that *"Radial flow paths and unusual subsurface geology can too often invalidate assumptions"*. Also see Watershed Conservation Resource Center, 2017, Brahana, et al, 2017, and Mott, 2016 regarding likely interbasin transfer of groundwater from one surface watershed to another.

The authors of the original NOI and the Regulation 5 permit application have not provided any evidence of due diligence in regard to groundwater flow direction for either of the down gradient wells or for karstic springs and seeps. Chapter 7

of the AWMFH does not require such an investigation, but the circumstances for which these suggestions are provided are clearly present. The lack of a groundwater flow investigation suggests that there has not been adequate due diligence demonstrated in this permit application proportional to the significant of risk factors in Part A.

Comment C3 - This permit should be denied because permeability determination for liner material does not include particle analysis as per AWMFH guidance

The AWMFH appended 10D under soil properties page 10D-5 describes the criteria for determining permeability.

> ***"The permeability of soils at the boundary of a waste storage pond depends on several factors. The most important factors are those used in soil classification systems such as the Unified Soil Classification System (USCS). The USCS groups soils into similar engineer- ing behavioral groups. The two most important factors that determine a soil's permeability are:***
> 1. ***The percentage of the sample which is finer than the No. 200 sieve size, 0.075 millimeters. The USCS has the following important categories of percentage fines:***
>   - ***Soils with less than 5 percent fines are the most permeable soils.***
>   - ***Soils with between 5 and 12 percent fines are next in permeability.***
>   - ***Soils with more than 12 percent fines but less than 50 percent fines are next in order of permeability.***
>   - ***Soils with 50 percent or more fines are the least permeable.***
> 2. ***The plasticity index (PI) of soils is another parameter that strongly correlates with permeability."***

To recap, point #1 is the particle analysis of the soil determining percent of "fines". Point #2 is the *plasticity index* (PI). To review some of the testing documents in the original NOI, reference Appendix C3. The information in Appendix C3 looks at the geologic soil testing process in the original NOI that resulted from drilling 3 holes: B1, B2, B3. Only B2 and B3 are in proximity to the ponds so only these samples are used to evaluate liner material (see Appendix C6). Note that the number of holes drilled does not conform to AWMFH guidelines (discussed in Comment C6).

First page of Appendix C3 shows *3. Geologic Investigation* page from the original NOI. The arrow pointing to the statement by the engineer regarding at what level

the liner material will be sourced from bore holes B2 and B3. The chart on the page shows the calculated *plasticity index* (PI) after it has been determined by lab analysis. The text identifies the unified soil classification system (USCS) designation as *CL - Fat Clay w/sand*.

Step 2: The boring log designates the sample numbers from the targeted depth of 7 to 11 ft where the liner material is to be sourced. The USCS designations are included here are all *CH - FAT CLAY*.

Step 3: The Plasticity Index(PI) is determined by the lab. For B2 sample 5 it is 55. The PI is one of the two suggested criteria (10D-5 above) for determining permeability.

Step 4: The unified soil classification system (USCS) designation is noted as determined visually.

Step 5: Note that the particle analysis has not been performed. All values in the *percent passing* column next to *sieve size* are listed as "N/A". Sieve and percent fine is the particle analysis and the 2nd of the two listed criteria (10D-5 above).

Step 6: Although an experienced engineer will likely do pretty well at determining the USCS visually, a precise determination is suggested by AWMFH via particle analysis. The USCS of CL in step 1 is different than the USCS of CH in the bore logs which suggests there are different people in the process making different estimations.

Conclusions: The engineer has determined only one of the two suggested criteria for permeability and that is the (PI) plasticity index. The engineer is also using his experience to estimate the USCS.

The lab determined PI of the samples between 7 & 11' which will be the depth of the material used in the liners:

1. Boring 2, sample 5, PI: 55
2. Boring 2, sample 6, PI: 41
3. Boring 3, sample 5, PI: 22
4. Boring 3, sample 6, PI: 37

AWMFH states that when the PI values are above 20, this suggests a flocculated (blocky) structure subject to high desiccation and shrinkage which also affects

permeability. This high PI suggests a USCS closer to CH in the type IV permeability group (see table 10D-4 in Appendix C3, page 5 (this document). For soil types III and IV the AWMFH appendix 10D page 10D-6 under *Permeability of soils* states:

> ***"Some soils in groups III and IV may have a higher permeability because they contain a high amount of calcium. High amounts of calcium result in a flocculated or aggregated structure in soils. These soils often result from the weathering of high calcium parent rock, such as limestone. Soil scientists and published soil surveys are helpful in identifying these soil types.***
> ***High calcium clays should usually be modified with soil dispersants to achieve the target permeability goals. Dispersants, such as tetrasodium polyphosphate, can alter the flocculated structure of these soils by replacement of the calcium with sodium. Because manure contains salts, it can aid in dispersing the structure of these soils, but design should not rely on manure as the only additive for these soil types."***

The facility is located atop the Boone formation which is karst limestone. The soil laboratory notes in the visual classification "chert fragments". There is a likelihood that high calcium limestone is the parent rock of this soil. However, no tests for calcium levels were mentioned in the geological investigation. The lack of the particle analysis or determination of calcium levels in the liner source material suggests weakness in the geological investigation that is not proportional to the significant of risk factors in Part A.

Comment C4 - This permit should be denied because the laboratory compaction analysis to determine hydraulic conductivity uses only one sample

Though the engineers did not perform the particle analysis suggested in AWMFH, they did perform a laboratory compaction to determine hydraulic conductivity. The one sample used is described as a "grab sample" (see page 6 of Appendix C3). The testing documents indicate it came from bore #2 from 7 to11 ft. There are several problems with using only a single grab sample.

1. **Hydraulic conductivity can vary from 7 to 11 ft.** We know the PI varies between from 41 to 55 in bore #2. Also, the level of calcium in soils can affect permeability, though no calcium testing was performed (Comment C3). As soil levels approach the soil-to-epikarst transition zone, chert

along with calcium levels will tend to rise. Tai Hubbard, the geologist who participated in the Harbor Environmental study suggested the epikarst zone starts at about 13.5 ft (see Comment C11):

> *"T**he highly weathered limestone bedrock and unconsolidated clay intervals observed between 13.8 and 28.0 ft.bgs. appeared to have the characteristics of epikarst. With the understanding that epikarst is the weathered zone found at the interface of unconsolidated soils and bedrock, the Site setting would support this characterization."***

A single grab sample from 7 ft could have different calcium content resulting in different hydraulic conductivity than a sample from 11 ft.

2. **Hydraulic conductivity can vary between bore hole locations.** First it should be mentioned that AWMFH suggests based on the area of the ponds that six bore holes should have been drilled (see comment C6). However, even with only two bore holes the samples have PI ranges that vary from 22 to 55. This PI variability can exhibit significantly different hydraulic conductivity.

In regard to the grab sample used, we don't know the exact depth from which it was taken and we don't know the calcium content. Likewise, the soils from Bore hole #3 which were also used in pond construction have very different PI readings which can result in variable hydraulic conductivity. M.D. Smolen, PH.D. who has 35 years of experience in water quality management as affected by agricultural waste management and other aspects of watershed management, had this to say in a report dated Jan 2nd, 2014:

> ***"The liner design was based on a single sample of in situ clay that was used as a liner. With only one sample, there is no way to determine how consistent this clay is, and whether or not the conductivity measured is representative of the entire stock pile. The inspection report from July 23, 2013 indicates that "gravel to cobble-sized coarse content" was observed in the clay liner (073447-INSP.pdf). This suggests the final clay liner could be quite different from the sample tested, which was supposed to be "fat clay." The presence of coarse particles can reduce the permeability of the liner. Cracks and rocks are visible in the photograph by ADEQ, Tony Morris 7/23/13, shown in Figure 1."***

See Appendix C5 for photos referenced above. The single grab sample was not sufficient to represent overall hydraulic conductivity. This was an engineering decision that was not proportional to the risks as described in Part A.

Comment C5 - This permit should be denied because type IV soils to be used for the liner suggest special considerations in AWMFH that were not addressed

Please review comments C3 and C4 for background. This discussion assumes that soils used for the liners were in or near the type IV soils group due to the high plasticity index (PI) determined by the laboratory analysis. There was no particle analysis performed to make an exact soil group determination. For soils types III and IV the AWMFH appendix 10D page 10D-6 under *Permeability of soils* states:

> ***"Some soils in groups III and IV may have a higher permeability because they contain a high amount of calcium. High amounts of calcium result in a flocculated or aggregated structure in soils. These soils often result from the weathering of high calcium parent rock, such as limestone. Soil scientists and published soil surveys are helpful in identifying these soil types."***
>
> ***"High calcium clays should usually be modified with soil dispersants to achieve the target permeability goals. Dispersants, such as tetrasodium polyphosphate, can alter the flocculated structure of these soils by replacement of the calcium with sodium. Because manure contains salts, it can aid in dispersing the structure of these soils, but design should not rely on manure as the only additive for these soil types."***

As the Boone formation is the predominant limestone geology in the region and evidence of chert is mentioned in the lab analysis, it is very possible that the soil has a high calcium content.

AWMFH suggests modification with soil dispersants to achieve permeability goals. More on dispersant recommendations discussed in AWMFH appendix 10-D page 10D-32:

> ***Design and construction of clay liners treated with soil dispersants***
> ***"Previous sections of this appendix caution that soils in groups III and IV containing high amounts of calcium may be more permeable than indicated by the percent fines and PI values. Groups III and IV soils predominated by calcium usually require some type of treatment to serve as an acceptable liner. The most common method of treatment to reduce the permeability of these soils is use of a soil dispersant additive containing sodium."***

Unfortunately no particle analysis was performed and calcium levels were not determined either. No mention of a dispersant modification in the geological investigation of the NOI.

Under appendix 10D: *Construction considerations for compacted clay liners* under *Soil Type* on page 10D-20:

> ***"The most ideal soils for compacted liners are those in group III. The soils have adequate plasticity to provide a low permeability, but the permeability is not excessively high to cause poor workability. Group IV soils can be useful for a clay liner, but their higher plasticity index (PI greater than 30) means they are more susceptible to desiccation. If clay liners are exposed to hot dry periods before the pond can be filled, desiccation and cracking of the liner can result in an increase in permeability of the liner. A protective layer of lower PI soils is often specified for protection of higher PI clay liners to prevent this problem from developing."***

The notation mentions plasticity levels > 30. Three sources of the liner material are over > 30. If used in equal parts the average PI will be 38.75.

1. Boring 2, sample 5, PI: 55
2. Boring 2, sample 6, PI: 41
3. Boring 3, sample 5, PI: 22
4. Boring 3, sample 6, PI: 37

There is no mention in the NOI engineering of a protective layer of lower PI soils as suggested in AWMFH. Note that high PI soils are generally highly flocculated (coarse granularity with clods). Although flocculation is suggested, we don't know for a certainty since there was no particle analysis. AWMFH Appendix 10D page 10D-23 states:

> ***Macrostructure in plastic clay soils***
> ***"Clods can create a macrostructure in a soil that results in higher than expected permeability because of preferential flow along the interfaces between clods. Figure 10D–13 illustrates the structure that can result from inadequate wetting and processing of plastic clay. The permeability of intact clay particles may be quite low, but the overall permeability of the mass is high because of flow between the intact particles."***

This permeability concern with type IV soil is reiterated in AWMFH Appendix 10D under *Permeability of soils* page 10D-6:

> ***"Soils in group IV usually have a very low permeability. However, because of their sometimes blocky structure, caused by desiccation, high seepage losses can occur through cracks that can develop when the soil is allowed to dry. These soils possess good attenuation properties if the seepage does not move through cracks in the soil mass."***

Desiccation, cracking, and coarse content consistent with type IV soils with suggested permeability risk is identified by an ADEQ inspector on July 23 2013. See Appendix C5 for accompanying photos:

> ***"3.) The wastewater pond liners were observed to have erosion rills, desiccation cracks and gravel to cobble-sized coarse content within the liner clay. If the liner is to be exposed for extended periods of time, it should be protected from deterioration by erosion and desiccation."***

On Jan 23rd, 2014 (six months later), a second ADEQ inspection noted that the liner desiccation continued to be a problem. See Appendix C5 for photos.

> ***"The holding pond embankments were not stabilized and erosion rills were found within the inside banks of the holding ponds. Stabilization of the embankments needs to occur to 1) prevent sediment from entering the holding ponds which may decrease the capacity of the holding ponds, and 2) ensure the integrity of the holding ponds are maintained. Please see Photographs 1 and 2."***

The inspector recognized deterioration characteristics consistent with type IV soils as an ongoing problem that should have been addressed immediately following construction as stated in this passage in AWMFH Appendix 10D under *Permeability of soils* page 10D-6:

> ***"High plasticity soils like those in group IV should be protected from desiccation in the interim period between construction and filling the pond. Ponds with intermittent storage should also consider protection for high PI liners in their design."***

The AWMFH also suggests construction techniques for high PI soils:

> ***Clods in borrow soil***
> ***"If borrow soils are plastic clays at a low water content, the soil will probably have large, durable clods. Disking may be effective for some soils at the proper water content, but pulverizer machines may also be required. To attain the highest quality liner, the transported fill should be processed by adding water and then turned with either a disk or a high-speed rotary mixer before using a tamping roller."***

The construction specification does not mention what techniques were used in laying down the clay liners. M.D. Smolen, PH.D. who has 35 years of experience in water quality management as affected by agricultural waste management and other aspects of watershed management, mentions that ponds will be subject to ongoing exposure issues that may have risk implications:

> ***"The storage ponds at C&H are designed to be pumped down very close to the bottom periodically (at least once every 6 months). Consequently much of the clay liner will be exposed for long periods. This will lead to cracks developing in the liner, reducing the effectiveness of the seal. [Note cracking has already been observed during a site inspection on July 23, 2013 (see item 3 in letter from Jason Bolenbaugh, ADEQ, to Jason Henson in reference 073447-INSP.pdf).] The NRCS recommends protecting the clay liner from cracking by applying a layer of lower PI material over the clay, not allowing the liner to dry out, or using a more specialized system with dispersants or bentonite added. If the ponds are pumped dry and cracking occurs at the bottom, consequences could be very serious."***

Conclusion: What is known for sure is that the material used in the liners has a very high plasticity index (PI) with chert suggesting the possibility of high calcium content. No testing for calcium was done. One grab sample was used to determine hydraulic conductivity for the entire range of material used in the liners though PI was variable. No dispersant modifications are mentioned. No protective layer of lower PI soils is mentioned. Inspections confirm desiccation, cracking, and coarse content consistent with type IV soils. No protection or maintenance for the liner for at least six months prior to filling as suggested in AWMFH. Exposure of liner floor to drying after pump down risks cracking. Construction technique is not mentioned in specifications. These issues are all suggestive of a low level of due diligence that is not proportional to the high cost of potential consequences discussed in Part A.

Comment C6 - This permit should be denied because the pond subsurface investigation does not conform to AWMFH guidance

Regulation 5.404 *Subsurface Investigation Requirements* states:

> ***"The subsurface investigation for earthen holding ponds and treatment lagoons suitability and liner requirements may consist of auger holes, dozer pits, or backhoe pits that should extend to at least two (2) feet below the planned bottom of the excavation."***

The AWMFH 651.0704(4) *Guide to detailed geologic investigation* page 7-21 goes further suggesting the following for sampling the subsurface where ponds

are planned. This is noted as to be particularly applicable for complex and inconsistent environments such as karst.

> ***"For structures with a pool area, use at least five test holes or pits or one per 10,000 square feet of pool area, whichever is greater. These holes or pits should be as evenly distributed as possible across the pool area. Use additional borings or pits, if needed, for complex sites where correlation is uncertain. The borings or pits should be dug no less than 2 feet below proposed grade in the pool area or to refusal (limiting layer)."***

The original NPDES Reg 6 NOI specifies pond area in section C2 "*design calculations"* as follows:

- Top of Waste Storage Pond 1 20,857 Square feet
- Top of Waste Storage Pond 2 35,262 Square feet

It should be noted that the Reg 5 permit application specifies different square footage areas for the two ponds than the original NOI. Likewise the application also specifies square footage for a total drainage area. None of these figures agree, but for the purposes of this comment they do not vary enough to make a difference.

The original NPDES Reg 6 NOI shows records for three borings in the *Geologic Investigation* document. These are numbered B-1, B-2, B-3. Only B-2 and B-3 were in the area of the ponds (see Comment C3). Using the guide from AWMFH page 7-21(4), there should have been at least 6 distributed borings if "pool area" is interpreted as encompassing both pools. More borings if "pool area" is interpreted as per pool. It is unclear how much latitude Chapter 7 provides the engineer regarding the detailed investigation. Certainly the risk factors were present to justify the AWMFH recommendations. The fact that the engineer recognized that drilling two holes was important but chose not to follow AWMFH guidance for the recommended number in the pond area suggests that the geologic investigation in this permit application is not proportional to the risk factors as discussed in Part A. The sensitivity of the watershed calls for the detailed geologic investigation to be revisited.

Comment C7 - This permit should be denied because the berm subsurface investigation was not performed as per AWMFH guidance

The AWMFH 651.0704(4) *Guide to detailed geologic investigation* page 7-21 specifies the following for sampling the subsurface where ponds are planned:

> ***"For foundations of earthfill structures, use at least four test borings or pits on the proposed embankment centerline, or one every 100 feet, whichever is greater. If correlation of materials between these points is uncertain, use additional test borings or pits until correlation is reasonable. The depth to which subsurface information is obtained should be no less than equivalent maximum height of fill, or to hard, unaltered rock or other significant limiting layer."***

The berm walls of the pits are on the opposite sides from the barn and come to roughly 335ft in length. There were no test borings recorded in the original NOI geologic investigation. There is a "core trench" noted in the *Engineering Plan Sheets* but this was a trench to be filled with material to reduce berm wall permeability; it was not a geological investigation. That the engineer chose not to follow the AWFMW detailed investigation guidance suggests that the geologic investigation in this permit application was not proportional to the risk factors as discussed in Part A. The sensitivity of the watershed calls for the detailed geologic investigation to be revisited.

Comment C8 - This permit should be denied as SPAW modeling for overtopping has not been made available for peer review

"SPAW" stands for *Soil-Plant-Air-Water* and it is a modeling technique that considers pond sizing, waste generation, waste usage, anticipated precipitation, and other factors to analyze the likelihood of the waste levels overtopping the pond containment system. M.D. Smolen, PH.D. who has 35 years of experience in water quality management as affected by agricultural waste management and other aspects of watershed management, discusses the specific SPAW modeling done for C & H in a report dated Jan 2nd, 2014:

> ***Review of SPAW Model Analysis***
>
> ***"As required in the AR rules, the designers have analyzed the likelihood of this waste system overtopping using the SPAW model. Their analysis uses 47 years of***

rainfall data from a nearby weather station. The data used are appropriate for this analysis. It is unlikely the result would be different if 100 years of historic data had been available.

SPAW analysis by DHG suggests the two-pond system will not overflow if the wastes are pumped out every six months. Their simulation shows annual maximum pond depth to range from 7.0 to 10.8 ft in Pond 2, with average maximum depth 8.99 ft. The maximum allowable depth in Pond 2 is 11.7 ft (Sheet 15 of DGH Plan sheets). Pages 8 – 25 of Certification and QA-QC Section show the SPAW printout. Area of the pond(s) used in the SPAW analysis is shown as 0.70 acres., but the "As-Built" drawings show the top area of Pond 2 as 0.76 acres and Pond 1 is about 0.5 acres for a total of about 1.2 acres. In addition there is also some contributing area from berms surrounding the two ponds that must be considered. Therefore, there should be something more like 1.5 acres considered for rainfall input to the system, or twice the area shown as model input. This is important because all model calculations of water balance are computed in volumes (acre-ft) that are sensitive to the area factor."

"Maximum volume used in SPAW is shown as 5.66 acre-ft (af), which isr approximately the volume of Pond 2 (about 5.32 af depending on the actual depths considered for full and empty). Total volume of both ponds should be about 7.40 af. At the end of the SPAW printout, total values for sections of the water balance are presented on an average monthly basis. The total of all precipitation inputs is shown as 1.33 af. If this is adjusted for area (0.7 acres), the precipitation amount would be about 22.8 inches, or about 1⁄2 the average annual precipitation for the area (43.7 inches at Marshall, AR). The model also considers water input from Bank Runoff, Seepage from Banks, and the waste input from the barns and the water losses from evaporation, seepage through the liner, and pump down every 6 months. The modeler may have adjusted some of these inputs and outputs to reflect the system accurately, but it is difficult to determine this from the information presented."

"The SPAW printout shows good water balance (this is an important check the model: on average water inflow must equal water outflow). According to the model, average annual input (precipitation plus wastewater) is about 10.45 a-f. Of this, 73% is pumped out and applied to fields, 11.7% evaporates, and 14.6% leaks."

Above, Smolen makes suggestions in regard to whether the SPAW model inputs were the best choices. Below is Smolen's recommendation regarding the model:

"I would recommend that the complete details of the SPAW simulation be requested to check the validity of the modeler's conclusion that the embankment will not be overtopped. The SPAW simulation is particularly important for two reasons; (1) it is used to determine if the waste storage ponds can overflow, and (2) the design assumes there will NEVER be an overflow event. If overflow occurs,

catastrophic failure of the embankment is likely, because the design does not include a stabilized emergency spillway."

Smolen (2017) notes the following in regard to the need to set a "higher bar" for this particular pond design:

"The waste holding ponds should be designed and operated to a higher standard than the NRCS Agricultural Waste Management Field Handbook (AWMFH) because Regulation 5 requires "no discharge." The C&H waste holding ponds are sized for discharge from a 25-yr 24-hr storm. This would be acceptable under a discharge permit like the Regulation 6 NPDES permit. Regulation 5, however, is a "No Discharge Permit" and should require a higher standard such as NOAA's Probable Maximum Precipitation. The high recreational value of the Buffalo River should be a basis for designing to a higher standard, such as the PMP, or at least 40 inches of stormwater and freeboard combined."

A peer review of the engineering details of the SPAW model are appropriate prior to the consideration of this Reg 5 permit. As Smolen mentions, incorrect assumptions in the model or flaws in the calculations have potentially serious consequence as it pertains to the risk level discussed in Part A.

Comment C9 - This permit should be denied because contingencies for storage pond overtopping are inadequate

AWMFH Appendix 10D, page 41 states the following:

"If overtopping can cause embankment failure, an emergency spillway or overflow pipe should be provided."

M.D. Smolen, PH.D. who has 35 years of experience in water quality management as affected by agricultural waste and other aspects of watershed management, has the following to say regarding overtopping contingencies in a report dated 1/02/2014:

"If the embankment of Pond 2 were overtopped due to unusual weather or poor management, there would be erosion of the embankment with possible catastrophic failure. The waste storage ponds are built on the side of a hill with 10% slope, making stability of the embankment structure critical."

Smolen elaborates in a later report dated 8/28/2015:

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

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

Smolen again mentions the overtopping risk in comments in 2017:

"Considering the lack of an emergency spillway and the experience of unusually high rainfall in the Ozarks, the operator should be encouraged to maintain more than the minimum storage at all times. A picture from the ADEQ inspection report from 12/30/2015, shows that WSP2 is operated close to the maximum level with about three months to go before a significant pumpdown is expected."

Photographer:	Jason Bolenbaugh	Date:	12/30/2015	Time:	
Witness:	Keith Waters			Photo #:	2
Description:	WPS #2 showing adequate amount of freeboard and the depth gauge which marks (red line) the Must Pump Down level.				



The far side is the top of the 10% slope mentioned that has no stabilized emergency outlet.

Assumptions that overtopping will never occur is an example of how the engineering of the storage ponds was not proportional to the risks as discussed in Part A.

Comment C10 - This permit should be denied because containment ponds are located within 600 ft of an improperly abandoned well

AWMFH 651.0702(n) *Presence of abandoned wells and other relics of past use* Page 7-15 states:

> ***"The site and its history should be surveyed for evidence of past use that may require special design considerations of the site relocation. If there is an abandoned well on the site, special efforts are required to determine if the well was sealed according to local requirements. An improperly sealed well can be a direct pathway for contaminants to pollute an aquifer."***

The AWMHB 651.1004(b) *Liquid and slurry manure* s*torage* on page 10-23 states the following regarding agricultural earthen waste storage ponds:

> ***"Earthen storage is frequently the least expensive type of storage; however, certain restrictions, such as limited space availability, high precipitation, water table, permeable soils, or shallow bedrock, can limit the types of storage considered. Table 10–4 provides guidance on siting, investigation, and design considerations."***

See Appendix C10-B shows a downgrade distance of 594 ft to a hand dug well.

AWMHB table 10-4 (Appendix C10) makes recommendations regarding AWMS storage ponds in proximity to improperly abandoned wells which can open an unlined column of water to geologic substrate. The table represents a "Vulnerability to Risk" matrix and clearly states that when planning AWMF waste storage, if it is within 600 feet of an improperly abandoned well, the vulnerability rating is ***Very High*** and that the planner should "***evaluate other storage alternatives*** or *properly seal well and reevaluate vulnerability".* The improperly abandoned well is not recognized in the SECTION D: *SITE SPECIFIC INFORMATION* of the original NOI. Likewise, a 2,000 ft radius map is provided in SECTION E: *FACILITY PLANS* (see Appendix C2-B), does not reference the well. AWMFH 651.0701 *Overview of geologic material and groundwater* page 7-2 states:

> ***"Many rural domestic wells, particularly in upland areas, derive water from fractures and joints in bedrock. These wells are at risk of contamination from waste impoundment facilities if fractured bedrock occurs within the excavation limits, within feedlots or holding areas, and in waste utilization areas. Fractures in bedrock may convey contaminants directly from the site to the well and significantly affect water quality in a local aquifer."***

The geology is predominantly karst (see Comments C11, E2). This suggests a weakness in the investigation in that the pond locations are too close to this well. The original NOI investigation does not suggest adequate due diligence proportional to the significant risk factors discussed in Part A.

Comment C11 - This permit should be denied because geologic karst is clearly identified beneath the facility in the Harbor Environmental single drill hole study

The *Water Resources Management Plan* for the Buffalo National River prepared by David Mott and Jessica Laurans for the National Park Service in 2004, says the following about the presence and behavior of karst in the Buffalo watershed:

> ***"Discrete recharge is a concentrated, rapid movement of water to the subsurface drainage network, most common in areas dominated by karst, which is typical in the Ozarks. Sinkholes and losing streams are examples of discrete recharge. Most sinkholes and losing streams (where a portion of the reach goes dry) are found to be underlain by the Boone formation in northwest Arkansas and most springs emerge in the Boone, as shown in Figure 19 (Aley, 1999). Groundwater pollution is most common in limestone and dolomite areas such as the Boone formation because discrete recharge does not allow for the effective filtration and absorption of pollutants. Faster travel rates provide less time for bacterial and viral die off as well. This is important for water quality management of the Buffalo River since almost 32% of the watershed is underlain by the Boone formation (Aley, 1982)."***

At the C & H facility, Harbor Environmental drilled a single bore hole to a depth of 120 ft as a result of an electronic resistivity study (ERI) performed by Dr. Todd Halihan of Oklahoma State University published 2016. The slides (Appendix C11) that resulted from Dr. Halihan's study suggested conductive zones consistent with high moisture content. The mixture of conductive and resistive zones suggests karst typical of the Boone formation. Bore holes were suggested by Dr. Halihan to "ground truth" the results of the ERI transects.

The Harbor Environmental report unfortunately does not speak directly to the ERI transects, but it does strongly detail karst features. Here is their overview of the geology:

> ***2.2.3 Geology***
> ***"The uppermost geologic formation below the site is the Mississippian-age Boone Formation (Haley, et al., 1993). The Boone formation consists of gray, fine- to coarse-grained fossiliferous limestone interbedded with chert. Some sections may be predominantly limestone or chert. The cherts are dark in color in the lower part of the sequence and light in the upper part. The quantity of chert varies considerably both vertically and horizontally. The sequence includes an oolite (Short Creek) member near the top of the Boone Formation in western exposures and the generally chert-free St. Joe Member at its base. The Boone Formation is well known for dissolutional features, such as sinkholes, caves, and enlarged***

fissures. Thickness of the Boone Formation ranges from approximately 300 to 350 feet in most of northern Arkansas (McFarland, 2004).”

Note in the following passage in the Harbor report that water used in the drilling process as a lubricant was lost in the 20 to 28.5 ft zone indicating the open space of a fracture or void. Note the terms “weathered and fractured and increased fracturing”. These are all indicative of karst.

Subsurface Conditions Encountered
“Yellowish red silty clay (CL) with chert and limestone fragments was encountered from the surface to a depth of 8 feet bgs. This material appeared to be fill soil placed during construction of the hog farm and adjacent waste ponds. Yellowish red fat clay (CH) was encountered from 8 feet to 13.5 feet bgs. Fine-grained, fossiliferous, gray limestone was encountered from 13.5 feet to 20 feet with a six-inch seam of fat clay as above occurring from approximately 18 feet to 18.5 feet bgs. Weathered and fractured, fossiliferous gray to buff limestone was encountered from 20 to 28.5 feet. The driller reported potable drilling water loss in this zone. Competent, fossiliferous gray limestone (consistent with the Boone Formation), with some minor fracturing and bedding planes was encountered at 28.5 feet bgs, which generally extended to the TD of 120 feet bgs. Zones of increased fracturing were encountered around 70 feet and 90 feet bags…”

The boring log selected entries are indicative of karst throughout:

-At 20 ft: “LIMESTONE, fine grained, weathered and fractured, gray (5Y 5/1) to buff, fossiliferous.”

-At 28 ft: “LIMESTONE, competent w/ some fracturing and bedding planes, gray (5Y 5/1) to buff, fossiliferous.”

-At 60 ft: “LIMESTONE, competent w/ some fracturing and bedding planes, gray (5Y 5/1) to buff, fossiliferous.”
At 65 ft: “Fractured”

-At 85 ft: “Increased fractures”

-At 100 ft: “LIMESTONE:, competent, interbedded with thin to medium bes of shaley limestone, gray (5Y 5/1) fossiliferous.”

The on-site geologist, Tai Hubbard, made this notation:

“The highly weathered limestone bedrock and unconsolidated clay intervals observed between 13.8 and 28.0 ft.bgs. appeared to have the characteristics of epikarst. With the understanding that epikarst is the weathered zone found at the interface of unconsolidated soils and bedrock, the Site setting would support this characterization.”

The indication of epikarst at 13.8 to 28 ft below ground level confirms porous weathered rock at a depth that is *<u>above</u>* the floor of the ponds with the pond #2 invert at 20 ft below the surface of where the bore hole was drilled (See Appendix C12 for elevations). The AWMFH table 10-D in Appendix 10D (Appendix C-10 of this document) notes the following regarding karst in the *Vulnerability to Risk* matrix when siting a facility: *"large voids e.g. karst, lava tubes, mine shafts) as a* ***very high*** *vulnerability suggesting that the engineer "****Evaluate other storage alternatives".*** No such alternatives were considered. As a result, this permit does not comply with AWMFH guidance.

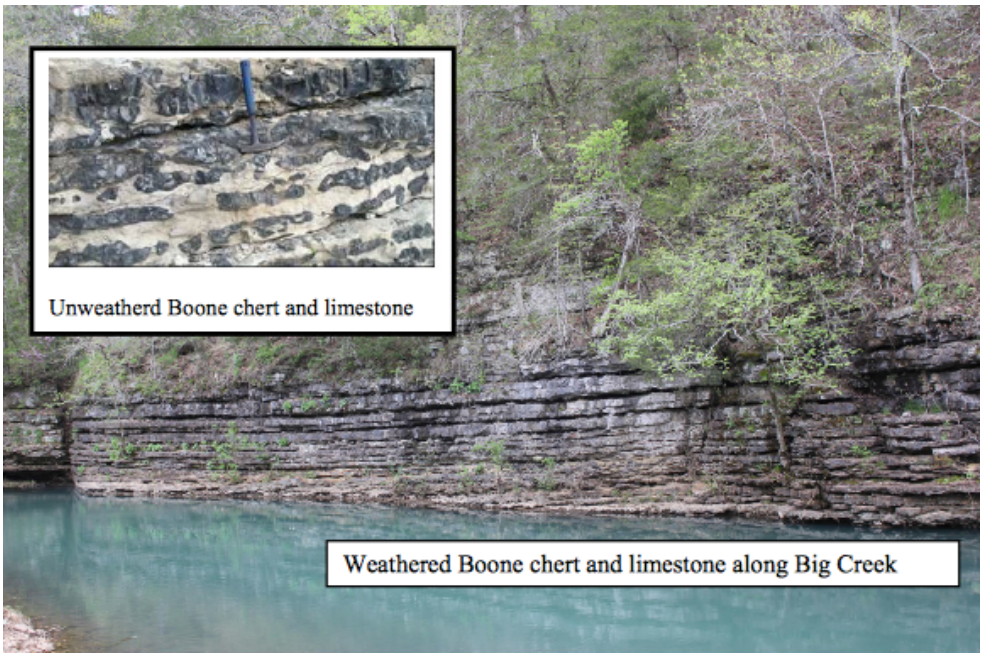
Comment C12 - This permit should be denied because containment ponds are located on a geologic foundation near voids and/or fractures

Harbor Environmental drilled a single bore hole to a depth of 120 ft as a result of an electronic resistivity study (ERI) performed by Dr. Todd Halihan of Oklahoma State University published in 2016. The transects that resulted from the study (Appendix C11) suggest conductive zones consistent with high moisture content. The concern that prompted the Harbor drilling exercise was possible leakage and/or fractures near the ponds. The comments and logs from the drilling process say on several occasions that "no voids were encountered". However, there were some very noticeable events in the process of drilling and filling the bore hole that the members of the Harbor drilling team did not address. In 3.2 *Subsurface conditions encountered* it states:

> ***"Weathered and fractured, fossiliferous gray to buff limestone was encountered from 20 to 28.5 feet. The driller reported potable drilling water loss in this zone."***

This loss of water is noted in the drilling log as well. The drilling process uses a 6" turning pipe with water pumped into the pipe and exiting around the sides. The water pumped in serves to a degree as a lubricant and it should all be recaptured as part of the process unless it is lost into an open subsurface space of some sort. The Harbor report does not indicate how much water was recovered vs how much was used, though it should have provided this as it is critically important. A large void will generally be noticeable during the drilling process, but not necessarily. A narrow fracture or cobble filled void that may be

of considerable volume may not be noticeable by the driller. An example of typical fractures in the Boone formation that would not easily be detected by a driller are illustrated in this cross section photo.



When filling the hole with cement there was a similar issue encountered discussed under 3.3 *Borehole Abandonment*:

> ***"After completion of the drilling and sampling operations and geophysical logging, the borehole was abandoned in accordance with the Arkansas Water Well Construction Commission Rules and Regulations (May 2016) and ADEQ Interim Policy 96-4. The borehole was grouted to the land surface via tremie method (from bottom up) using Portland cement (no bentonite). Due to fracture zones encountered in the subsurface, the borehole took more grout than calculated for its volume (see boring log in Appendix B). Borehole volume was estimated at 23.6 cubic feet (176 gallons). Total estimated grout placed in the borehole was approximately 280 gallons. The borehole was grouted on Friday, 9/23/16; however, the driller ran out of grout and was unable to grout the borehole to the surface."***

It is important to note that the loss of grout occurred in the same zone as the loss of water which was between 20 and 28.5' ("about 25' "). Experienced drillers will do a pretty good job at estimating the amount of grout to mix for filling a hole as they don't want to find themselves short. As described above, they pumped all that they had Friday afternoon and stopped for the day, hoping that the fracture(s) were narrow enough that the grout pumped would set and seal the

openings. On Monday, the fractures did apparently seal and they were able to finish the process. What should be noted is that the fractures may have taken quite a bit more grout Friday had they chosen to mix additional grout and continue pumping at that time. The amount of extra grout used before they ran out was determined to be 23.6 cubic ft, about the size of a small closet. It would be much more indicative of the size of this subterranean opening if we knew instead how much water was lost, which was not provided. Experts indicate that to come across an underground opening like this is generally unlikely with a single drill hole. This raises some concern in regard to the extent of possible subsurfaces openings that may exist around the ponds. In fact Tai Hubbard, the onsite geologist noted the limited scope of the Harbor study:

> ***"Evaluation of lithologic contacts and bed orientations are limited, both horizontally and vertically, due to the inability to correlate observations collected at a single location to any other bore holes."***

The extent of voids or fractures can't be known but to find one with only one bore hole suggests heightened risk. This indication of a subterranean opening tends to validate Dr. Todd Halihan's ERI transects which suggest fractures. What we know for certain is that there is at the very least 23.6 cubic ft area of subsurface open space at a depth of 20 to 28.5 ft where drilling water was lost and where the grout would not rise. The elevation of where the bore hole was drilled was about 914.3 ft (see Appendix C12 page 2) which means the subterranean opening occurred at an elevation between 894.3 and 885.8 ft (where water was lost) or 889.3 (where grout would not rise). The elevation of the floor of Pond #2 is 894.3 ft which places a clearly identified opening of some sort roughly even with the floor of pond 2 or a few feet below.

AWMFH table 10-4 (Appendix C10) that identifies *vulnerability to risk*, lists *"Large voids (e.g, karst, lava tubes, mine shafts) OR highest anticipated ground water elevation within 5 ft of invert"* as a "**Very high"** vulnerability and suggests **Evaluate other storage alternatives.**

In AWMFH Appendix 10-D under *When a liner should be considered* the following is stated:

> ***"Some bedrock may contain large openings caused by solutioning and dissolving of the bedrock by ground water. Common types of solutionized bedrock are limestone and gypsum. When sinks or openings are known or identified during the site investigation, these areas should be avoided and the proposed facility located elsewhere."***

The evidence of subsurface openings discovered so readily this close to the pond inverts suggests that the impoundment locations present risk that is disproportional to the surrounding environment as discussed in Part A. Note that ADEQ has approved a modification allowing for the installation of synthetic pond liners, but they have not yet been installed. Synthetic membranes are inadequate to address the risk identified in the Harbor drilling investigation (see Comment E1). Had an proper subsurface investigation been conducted prior to construction, AWMFH guidance table 10-4 would clearly have directed that *"these areas should be avoided and the proposed facility located elsewhere".*

Comment C13 - This permit should be denied due to evidence of perched groundwater close to pond inverts

Please review comment C12 regarding subsurface openings close to the Pond 2 invert.

The ERI transects resulting from Dr. Todd Halihan's study were compiled as a result of two separate visits. On the 2nd visit, Dr. Halihan's team produced ERI transects on field 1 and also generated four transects around the ponds. Note his description of the conditions that day:

> ***"Precipitation previous to and during the investigation resulted in both sites having moist to saturated soil conditions. The site soil of Field 1 was saturated."***

Three of the ERI transects from the study around the ponds noted several highly conductive zones indicative of moisture in the 13' to 28' range.

The bore hole drilled by Harbor Environmental was drilled Sept 21st through the 23rd during and following dry conditions. As this hole was only drilled near the middle of the west ERI transect, the following discussion is limited to that area. The Harbor Environmental report noted loss of water at 20 to 25' and they had difficulty grouting above 25'. We know for certain (Comment C12) that there is at least 23.6 cubic ft of subsurface open space at a depth of 20 to 28.5 ft. This corresponds with where the drilling water was lost and the grout would not rise.

Dr. Halihan's west transect indicates moisture at this depth. We know that conditions were very wet and that field 1 which he had tested earlier was described as "saturated". The conductivity in Halihan's west transect suggests

the possibility of perched groundwater in the same subsurface zone where Harbor Environmental lost water and grout. See Appendix C13. Dr. Halihan describes in his report the likelihood of perched ground water in epikarst:

> ***"In geologic settings like northern Arkansas, the epikarst zone is a significant source of water storage and transmission and many springs have been tapped to support local communities (Galloway, 2004). These types of groundwater systems can include perched water tables, which exist above regional water tables. These are called perched because they are places where low permeability soil or bedrock layers hold water above an unsaturated zone and often produce springs on the side of a bluff or sometimes in an open field if the relief is high enough to expose this feature."***

Tai Hubbard, the on-site geologist monitoring the drilling process for Harbor Environmental, described this exact zone as characteristic of epikarst which Halihan points out as a significant source of water storage:

> ***"The highly weathered limestone bedrock and unconsolidated clay intervals observed between 13.8 and 28.0 ft.bgs. appeared to have the characteristics of epikarst. With the understanding that epikarst is the weathered zone found at the interface of unconsolidated soils and bedrock, the Site setting would support this characterization."***

The Harbor Environmental drilling log confirms subsurface conditions suggesting that perched groundwater might be supported by consolidated material at the 28' level.

- ***At 20 ft: "LIMESTONE, fine grained, weathered and fractured, gray (5Y 5/1) to buff, fossiliferous."***
- ***At 28 ft: "LIMESTONE, competent w/ some fracturing and bedding planes, gray (5Y 5/1) to buff, fossiliferous."***

AWMFH 651.0701 *Overview of geologic material and groundwater* under *Aquifers* page 7-7 says this about perched aquifers:

> ***"A perched aquifer (fig. 7–8) is a local zone of unconfined groundwater occurring at some level above the regional water table, with unsaturated conditions existing above and below it. They form where downward-percolating groundwater is blocked by a zone of lesser permeability and accumulates above it. This lower confining unit is called a perching bed, and they commonly occur where clay lenses are present, particularly in glacial outwash and till. These perched aquifers are generally of limited lateral extent and may not provide a long-lasting source of water. Perched aquifers can also cause problems in construction dewatering and need to be identified during the site investigation."***

The elevation of where the bore hole was drilled was about 914.3 ft (see Appendix C12 page 2) which means the subsurface opening that likely contained perched groundwater during Halihan's ERI occurred at an elevation between 894.3 ft and 885.8 ft (where water was lost) or 889.3 ft (where grout would not rise). The elevation of the floor of Pond #2 is 894.3 ft which places a clearly identified open space of some sort (Comment 12) within 5 ft of elevation of the invert of pond #2.

AWMFH table 10-4 (Appendix C10) that identifies *vulnerability to risk*, lists *"Large voids (e.g, karst, lava tubes, mine shafts) OR highest anticipated ground water elevation within 5 ft of invert"* as a "**Very high"** vulnerability and suggests "**Evaluate other storage alternatives".**

The evidence of a subsurface opening combined with the saturated conditions during Halihan's ERI study and the conductivity shown in the west ERI transect suggest that the pond impoundment inverts are located within five ft of perched groundwater tables.

Comment C14 - This permit should be denied because the pond seepage limit in original NOI design is incorrect

In the original NOI for C & H, pond seepage was estimated for each pond (see chart below).

The soil proposed for the holding pond liner is Fat Clay w/sand and Fat Clay w/sand (CL) identified in the soils report at the depths of 7-11' feet in boring numbers 2-3.

Recompacted soil test were run to determine the Coefficient of Permeability using Darcy's Law. Results are included in this submittal.

Test Result	Test #1	Test #1
Test Location, (Pond/Basin)	Pond 1	Pond 2
Depth of Water at FB, (ft)	9.7	11.7
Thickness of Liner, (ft)	1.50	1.50
Coefficient of Permeability, (cm/sec)	5.0e-7	5.0e-7
Calculated Seepage Rate, (in./day)	0.13	0.15
Calculated Seepage Rate, (Gal/Acre/Day)	3,448	4,064

Currently it is recommended that the liner be constructed at 98% compaction +-2% Optimum Moisture to meet seepage requirements.
The seepage rate of any compacted liner that will be used will be less than the maximum allowable seepage rate of 5,000 Gallons/acre/per day as required by Arkansas Department of Environment Quality.

D-7

M.D. Smolen, PH.D. who has 35 years of experience in water quality management as affected by agricultural waste and other aspects of watershed management, had this to say regarding the calculated seepage rate in a report dated Jan 2nd, 2014:

> ***"The standard used by DHG for design of the waste storage pond clay liners at C&H was a seepage rate of 5,000 gal/acre/day, based on recommendation in the NRCS FOTG and AWMFH. As indicated earlier, these NRCS documents do not actually set standards but defer to state requirements. The NRCS AWMFH recommends, "In the absence of a more restrictive State regulation, assume an acceptable specific discharge of 5,000 gallons per acre per day."***

AWMFH states in Appendix 10-D under *Detailed Design Steps for Clay Liners,* page 10D-15:

> ***"If no regulations exist, a value of 5,000 gallons per acre per day may be used. If a designer feels that more conservative limiting Agricultural Waste Management Field Handbook seepage is advisable, that rate should be used in computations."***

Seepage levels calculated in the original NOI (above) are somewhat lower than 5,000 per acre per day. Unfortunately, the figures are based on a hydraulic conductivity test using one grab sample which is hardly representative of liner materials whose PI ranged from 22 to 55 and calcium levels that are likely variable but were not tested for (see comments C4, C5).

M.D. Smolen PH.D. describes his concern in a report dated 8/28/2015:

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

An important factor that allows seepage up to 5,000 gal per acre per day is the *manure sealing credit*. *Construction Guidelines for Impoundments Lined with Clay or Amendment-treated Soil*, page 10-D2 discuss the *manure sealing credit*:

"When credit for a reduction of seepage from manure sealing (described later in the document) is allowed, NRCS guidance considers an acceptable initial seepage rate to be 5,000 gallons per acre per day. This higher value used for design assumes that manure sealing will result in at least a half order of magnitude reduction in the initial seepage. If State or local regulations are more restrictive, those requirements should be followed."

"If State or local regulations prohibit designs from taking credit for future reductions in seepage from manure sealing, then NRCS recommends the initial design for the site be based on a seepage rate of 1,000 gallons per acre per day. Applying an additional safety factor to this value is not recommended because it conservatively ignores the potential benefits of manure sealing."

Dr. Smolen comments on the manure sealing credit on 1/2/2014:

"***NRCS recommendations allow up to one order of magnitude reduction in permeability due to clogging of liner material by solids from the manure. Credit for manure sealing is not recommended by NRCS in the most vulnerable situations, such as areas with karst geology or high seasonal water tables (see Appendix.) "***

Smolen refers to the *vulnerability to risk matrix* table 10-4 which can be found in Appendix C10 of this document. Below are the vulnerabilities we have identified in earlier comments that are listed in the above referenced table 10-4 which provides guidance for use of the *manure sealing credit.* Comment references are noted in parentheses on the right:

Very High Vulnerability

1. Voids (C12)
2. Karst (C11)
3. Highest groundwater within 5 ft of invert (C13)
4. <600 ft from improperly abandoned well (C10)

The recommendation for all risk options for very high vulnerability doesn't mention the *manure sealing credit* but simply states *Evaluate other storage alternatives.*

High Vulnerability

1. Bedrock (assumed fractured) within 2 ft of invert (C11,C12).
2. Highest anticipated groundwater elevation is between 5 and 20 ft of invert (C13).
3. 600 to 1,000 ft of an improperly abandoned well (C10)

The recommendation for all risk options for high vulnerability is *No manure sealing credit*

Moderate Vulnerability

1. Flocculated or blocky clays (typically associated with high Ca) (C5)
2. Highest anticipated groundwater elevation is between 21 and 50 ft of invert (C13).
3. 600 to 1,000 ft of an improperly abandoned well (C10).

The “Moderate Risk” selection applies here as the ponds are within 600 to 1,000 ft of an abandoned well. Recommendation is <u>*No manure sealing credit*</u>

Table 10-4 *vulnerability to risk* is clear that for this facility, the *manure sealing credit* should never have been used. That being the case “*NRCS recommends the initial design for the site be based on a seepage rate of 1,000 gallons per acre per day”*.

Smolen also noted on 8/28/2015:

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

See Comment E1 on synthetic membranes - special risk factors.

Comment C15 - This permit should be denied because the pond liner leakage rate permitted in Arkansas is lax compared with other state standards making it particularly inappropriate for a location in geological karst

Smolen (2017) states the following regarding the Arkansas leakage standards compared to those of other states:

> ***<u>Comparison of leakage rate with the rate allowed in other states.</u>***
> ***“The leakage rate allowed in Arkansas is higher than many other states. I reviewed eight state standards, and the “10-State Standard” for comparison. This analysis (see Appendix C15) showed that most of these states hold animal waste structures to a higher standard than Arkansas. In this comparison I looked at***

leakage rate based on a 6-foot depth. Ohio's standard generally allows a leakage rate of 277 gal/ac/day, but restricts leakage further in a karst area. Missouri restricts leakage to 500 gal/ac/day in a basin where potable groundwater might become contaminated, Oklahoma restricts leakage to 462 gal/ac/day and requires installation of monitoring wells. The 10-state standard restricts leakage to 500 gal/ac/day."

That the Arkansas standard allows ***ten times*** the leakage of the *10-state standard* is excessive under any circumstances, but to apply the Arkansas standard in a geologically sensitive karst environment is nothing less that irresponsible, particularly when considering the disproportionate risk factors as discussed in Part A.

Comment C16 - This permit should be denied because of the failure to adequately evaluate the impact of breach or accidental release or to provide an emergency action plan

AWMFH Section 651.0204(a) states:

"A substantive evaluation of the impact of sudden breach or accidental release from waste impoundments should be made on all waste impoundments."

No such evaluation has been provided. Pond 2 lacks an emergency spillway or reinforced embankment and should the pond overtop due to excessive rain, rapid erosion of the pond bank could occur leading to catastrophic failure (Comment C9). This contingency should have been addressed as part of a substantive evaluation of the waste impoundments.

AWMFH Section 651.0204(a) further states:

"Development of an emergency action plan should be considered for waste impoundments where there is potential for significant impact from breach or accidental release."

Smolen (2017) notes that in a situation where the ponds need to be pumped down quickly: *"In an emergency it would be very difficult to operate tank sprayer equipment"*, in that the pump-down process would be slow, and the vacu-tanker would be impractical for disposing it into saturated fields.

Due to the proximity of Big Creek, and the corresponding risk to the Buffalo National River, there clearly is the potential for significant impact should a breach or accidental release occur. Such an emergency action plan was not provided

suggesting a low level of due diligence not proportional to the risks described in Part A.

Comment C17 - This permit should be denied because the original permit, ARG590001, was improperly issued

Failure to issue a construction permit

C & H obtained a discharge permit (NPDES General Permit ARG590001) but failed to obtain a construction permit. Arkansas law requires that a person seeking to construct and/or operate a disposal system that discharges industrial waste or sewage into waters of the State must apply for a state construction permit. § 8-4-201(4), Ark. Code. C & H Hog Farm is a “waste disposal” facility and “sewage” includes animal wastes, and “waters of the state” include underground waters. § 8-4-102, Ark. Code. Arkansas Regulation 6, which contains Arkansas NPDES regulations governing the permitting of C & H, requires a state construction permit for operation of wastewater facilities. Ark. Reg. 6.202(A). ADEQ must approve the application, and a permit be issued and effective before the activity applied for can begin. Ark. Reg. 6.202(A). The state permit is not an NPDES permit. Ark. Reg. 6.202(B). It is intended to ensure a satisfactory design and review of the treatment facility which must meet the basic design criteria set forth in the "Ten States Standards” unless an exception to those standards is justified. Ark. Reg. 6.202(B). Those standards are intended to protect both surface waters and ground waters. In its original application, C&H stated that it was applying for a permit for a new facility and for a construction permit,(NOI Form 1, p.2), and describes its treatment system , (NOI Form 1, p. 5, 13) as required by Ark.. Reg 6.202(A). However, no state construction permit was ever noticed or issued. C&H’s NPDES permit ARG590001 authorizes only discharges, not construction. C & H therefore has been operating without a state construction permit in violation of § 8-4-201(4), Ark. Code. Neither C&H’s application for a Regulation 5 no-discharge permit, nor ADEQ’s draft approval of permit 5264-W includes any reference to a construction permit and makes no effort to correct the aforementioned deficiency. Permit ARG590001 was improperly issued and therefore this permit, 5264-W, should be denied.

Failure to require a review by staff geologists

Comments on draft permit 5264-W have been submitted by Gerald Delavan who, until retirement in February 2014, worked for 30 years as a Geologist and

Professional Geologist on staff with ADEQ. His comments are incorporated here by reference and state in part:

> ***"The initial C&H permit application for a Regulation 6 General Permit was never reviewed by any of the Professional Geologists working in the Water Division or by any other ADEQ staff geologists, prior to the permit being issued...The C&H permit application was reviewed and approved exclusively by the ADEQ Engineers working in the Water Division. Consequently, any potential problems concerning the release of liquid waste into the local groundwater supplies from the manure holding ponds at C&H were never discussed or evaluated by ADEQ Geology staff. In addition, the potential for waste contaminated surface water runoff to be discharged into Big Creek and the potential for the infiltration of waste contaminates into ground water from the land application sites through <u>the underlying karst limestone geology was never discussed or reviewed by any ADEQ Geology staff, prior to issuance of the C&H Farm's initial permit</u>...Given the sensitive geologic nature of this proposed hog farm location, the appropriate thing to do would have been for ADEQ Water Division to expand he permit application review process to include the ADEQ Professional Geologist staff in the review process...If ADEQ had given its Geologists an opportunity to review and comment on C&H's permit application, it is highly unlikely any of the Professional Geologists performing the review would have signed off on or approved the proposed permit for the C&H holding ponds locations without requesting additional geologic data be gathered about the proposed holding pond locations and proposed land application sites."***

The fact that no ADEQ Geology staff were required to review the original C&H application, especially given the sensitive location in karst terrain and in the watershed of the Buffalo National River, reflects a lack of due diligence on the part of ADEQ when reviewing the application. Permit ARG590001 was improperly issued and therefore this permit 5264-W, which relies almost entirely on the previous permit review, should be denied.

Part D - Degradation of Big Creek noted by State and Federal Agencies

Comment D1 - This permit should be denied because Big Creek Research & Extension Team (BCRET) testing of Big Creek immediately downstream of the facility shows degradation for nitrates

Nitrates are being measured by the *Big Creek Research and Extension Team* (BCRET) of the *University of Arkansas Division of Agriculture* both upstream and downstream of the facility and nearby spreading fields Figure 1.

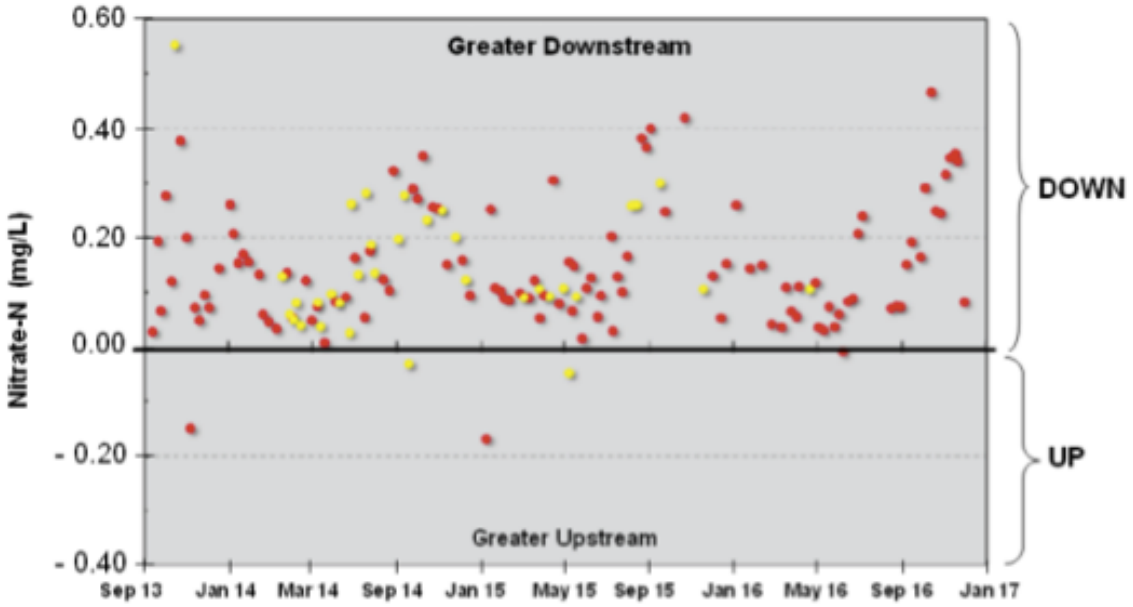


Figure 1. Difference in NO_3^-N concentration in Big Creek up- and downstream from the C&H CAFO. Following the "upstream vs. downstream" comparative criterion that is the basis of the BCRET study, the data clearly indicate that the C&H CAFO is contaminating Big Creek with nitrate. From BCRET (2017a; note that explanation was not given for the yellow versus red color-coding).

Regarding this data illustration, Burkholder (2017) states:

> ***"The data clearly indicate that the C&H CAFO is contributing swine waste pollution to adjacent public trust waters. The nitrate levels downstream from this CAFO commonly are levels that have been shown in other research to be toxic to sensitive aquatic life (Camargo et al. 2005, Guillette et al. 2005). The nitrate signal is stronger than the $E. coli$ signal because nitrate does not adsorb to sediment particles and settle out (Stumm and Morgan 1996); instead, nitrate is highly soluble and is transported rapidly from swine CAFOs to receiving surface and groundwaters (Evans et al. 1984, Stone et al. 1998, Ham and DeSutter 2000, Mallin 2000, Krapac et al. 2002), the latter problem being exacerbated in underlying karst geology (Mellander et al. 2012, Knierim et al. 2015) which is characteristic of the region that includes the C&H CAFO (Hudson et al. 2001, 2011)."***

Reg. 2.202 on anti-degradation of high quality waters reads as follows:

> ***"Where the quality of the waters exceeds levels necessary to support propagation of fish, shellfish and wildlife and recreation in and on the water, <u>that quality shall be maintained and protected</u> unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State of Arkansas' Continuing Planning Process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located."***

There has been no such finding of economic or social development "*accommodation"* published by ADEQ or APC&EC. The statute does not specify a minimum level of acceptable *degradation*, so technically the above data which reports a periodic and consistent finding of increased nitrates downstream of the facility indicates a violation of the statute. See also Mott, 2016 regarding further interpretation of BCRET data showing elevated nitrates. Burkholder (2017) goes on to say:

> ***"Nitrate concentrations at the downstream site have been consistently higher than at the upstream site on nearly all BCRET sampling dates since swine waste applications from the C&H CAFO began (BCRET 2014a-d, 2015a-d, 2016a-d) (Figure 1). During January – November 2016, for example, paired upstream/ downstream data showed that nitrate was substantially lower at the upstream station than at the downstream station on 40 of 41 sampling dates; concentrations were comparable on the remaining one date. Elevated nitrate levels near swine CAFOs are commonly used as an indicator of swine waste discharge; the wastes initially are high in ammonia, but over short distances during transport the ammonia is oxidized to nitrate (Dewi et al. 1994). Nitrate***

levels at the downstream site typically have been two- to three-fold higher than at the upstream site; sometimes the difference has been as high as 25-fold"

As elevated nitrates are very likely due in whole or in part to discharge from C & H, this permit should be denied.

Comment D2 - This permit should be denied because Big Creek Research & Extension Team (BCRET) testing of Big Creek immediately downstream of the facility shows degradation for *E.coli*

In a report prepared for BRWA titled, *"Assessment of Environmental Data and Draft Regulatory Changes Regarding the C&H CAFO, Including the Present Draft Permit, JoAnn M. Burkholder, Ph.D., 27 March 2017"* Dr. Burkholder, an expert in water pollution assessment and water quality monitoring and research in freshwaters and estuaries with more than 30 years of experience in research on nutrient pollution and its effects on aquatic ecosystems, including peer-reviewed publications on the impacts of concentrated (confined) swine and poultry feeding operations (CAFOs) on surrounding natural resources, states:

"…considering BCRET data from January through November of 2016 (BCRET 2016d), the median of excessive E. coli densities at the upstream station was 986.7 (n = 8). During the same year, the median of excessive E. coli densities at the downstream station was much higher, 1,732.9 colonies/100 mL (n = 7). Fecal bacteria such as E. coli tend to adsorb ("stick") to sediment particles and, thus, settle out of the water column to the bottom sediment as the water moves downstream (Burkholder et al. 1997 and references therein). Thus, if the only source of E. coli to the downstream station was contamination upstream from the C&H CAFO, the median of excessive E. coli densities would be much lower at the downstream site than at the upstream site. Instead, the median of excessive E. coli densities at the downstream site is nearly double that of the upstream site. These data indicate that the C&H CAFO is discharging E. coli bacteria which are contributing to the pollution of Big Creek in the CAFO area and downstream waters. "

Elevated *E.coli* introduces a health risk into a tributary that is intermingled and homogenous with an extraordinary resource water (ERW). In the interest of public health and safety, this permit should be denied.

Comment D3 - This permit should be denied because the National Park Service has notified ADEQ of Big Creek Impairment

In a letter dated October 6, 2015, Kevin Cheri, Superintendent for the National Park Service (NPS) to Director Keogh of ADEQ noted the following (excerpt):

> ***"NPS has also been monitoring the United States Geological Survey (USGS) sites collecting dissolved oxygen data on tributaries to the Buffalo River. Two of these sites have chronically been below the allowable limits in Regulation 2.505. These are Bear Creek near Silver Hill (USGS Site 07056515) (ADEQ site- BUFT12) (Figure 2) and Big Creek at Carver (USGS Site 07055814) (ADEQ site- BUFT06) (Figure 3). These streams have had minimum dissolved oxygen values of 3.9 and 4.5 mg/L, respectively, well below the standards."***
>
> ***"As dissolved oxygen is very important for aquatic life, particularly for species such as freshwater mussels, and such species are part of the suite of scenic and scientific resources Congress expected to be conserved when the Buffalo National River was established, NPS needs the assistance of ADEQ in determining the sources of low dissolved oxygen and reducing or eliminating these sources. We feel that both of these streams should be placed on the "Impaired Waterbodies" list pursuant to Section 303(d) of the Clean Water Act."***

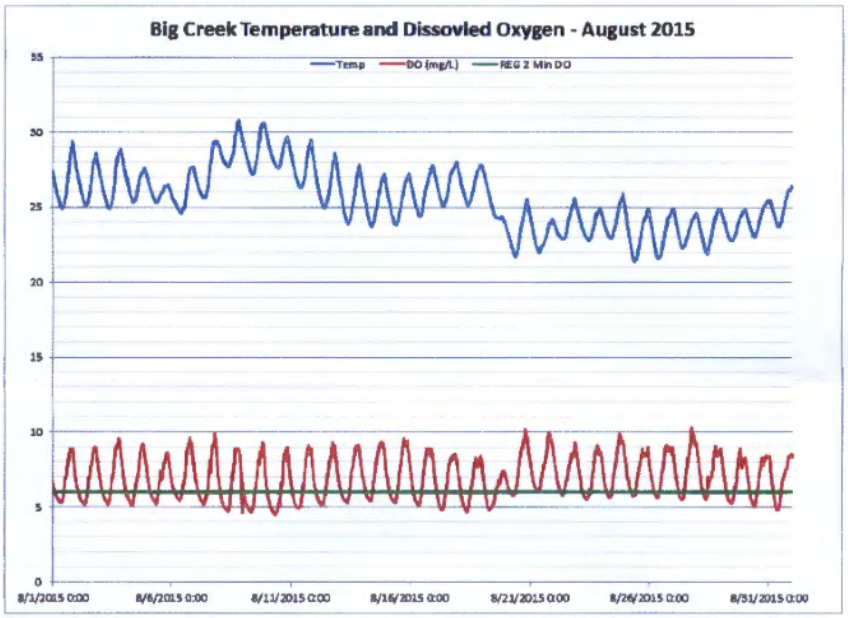


Figure 3: Dissolved Oxygen data for Big Creek (BUFT06) during August of 2015. (Source USGS)

In a letter dated February 25, 2016, Kevin Cheri, Superintendent for the National Park Service (NPS) to Director Keogh of ADEQ noted the following (excerpt):

> ***"On October 6, 2015 I sent a letter (Attachment 2) to Arkansas Department of Environmental Quality (ADEQ) asking that you consider placing three tributaries of theBuffalo River on the Impaired Waterbodies List pursuant to Section 303(d) of the Clean Water Act. To date, I have not received any formal correspondence relative to my request. My staff has reviewed the draft 303(d) streams list published on your website (ADEQ,2016) and see that these three streams are not in the draft list. I would like to receive documentation explaining why these streams were not listed in the draft 303(d) list."***

The above two letters focus on low dissolved oxygen levels as the justification for an impairment listing. An additional letter was sent on March 16, 2016 to director Keogh where there is a concern expressed in regard to *E. coli (excerpt):*

> ***"Assuming that Big Creek is not part of an Extraordinary Resource Water, Ecologically Sensitive Waterbody, or Natural and Scenic Waterway (ERW, ESW, or NSW) the upper E. coli limit is 410 colonies per 100 ml (410 col/100ml). Data from BCRET (Big Creek Research & Extension Team), during the primary contact period in 2014, shows E. coli exceeded 410 col/100ml in six of twenty-two samples for a 27% exceedance. According to Regulation 2.507, for assessment of ambient waters as impaired by bacteria, the E. coli standard shall not be exceeded in more than 25% of samples in no less than eight samples taken during the primary contact season."***

The full March letter can be found in Appendix D3. In summary, NPS has pointed out impairment evidence in regard to both low dissolved oxygen as well as elevated E. coli.

Since the submission of the above letters, the National Park Service has commissioned a report, *"Permitted Concentrated Animal Feeding Operation Assessment Buffalo National River, Arkansas"* by David N. Mott November 2016. This report includes extensive discussion of impairment of Big Creek, and potentially the Buffalo National River, due to elevated nutrients and bacteria in Big Creek.

Considering that Big Creek waters are contiguous and intermingled with waters of a designated ERW, the high level of ecological and economic risk as discussed in Part A justifies a delay of a requested Reg 5 permit until the degradation issues in regard to Big Creek are fully resolved. Full compliance with Reg. 2.202 on anti-degradation of high quality waters should be enforced. If

it is determined that C & H contributes in whole or in part to the impaired status of Big Creek, the permit should be denied.

Comment D4 - This permit should be denied because the Arkansas Game and Fish Commission concurs with National Park Service recommendation of Big Creek impairment

Chris Racey, Chief - Fisheries Division, Arkansas Game and Fish Commission wrote to Jim Wise of ADEQ on March 16, 2016 (excerpt):

> ***"AGFC Biologists are also concerned with the Dissolved Oxygen levels of Big Creek, a Buffalo River tributary in Newton County near Gene Rush Wildlife Management Area. Summer algal blooms, likely caused by excess nutrient levels, appear to be impairing this creek. Smallmouth bass require 6.0 mg/L DO for optimal growth, and this water quality standard is not being met for several months of the year, per the USGS gage station at Big Creek. We concur with the recommendations of the National Parks Service that Big Creek should be considered for the list of 303(d) streams."***

Comment D5 - This permit should be denied because the U.S. Geological Survey study indicates impairment of Big Creek

On December 15th, an *Assessment Methodology* session was sponsored by ADEQ at their N Little Rock headquarters to review with selected stakeholders the process for producing the 303(d) list. During this meeting, Billy Justus and Lucas Driver of the *U.S. Geological Survey (USGS) Lower Mississippi-Gulf Water Science Center* presented a slide presentation entitled: *An Evaluation of Continuous Monitoring Data for Assessing Dissolved-Oxygen in the Boston Mountains.* Big Creek was one of five waterbodies reviewed in the presentation. Notable was the slide listed in Appendix D5 showing dissolved oxygen at 20.5% of unit values below 6mg/L. The exceedance level over which impairment is indicated is 10% at 20 degrees centigrade. These USGS statistics show a clear indication of impairment.

Considering that Big Creek waters correspond to waters of a designated ERW, the high level of ecologic and economic risk as discussed in Part A justifies a delay of a requested Reg 5 permit until the impairment issues on Big Creek are fully resolved. Reg. 2.202 on anti-degradation of high quality waters must be given precedence over this permit. If it is determined that C & H contributes in whole or in part to the impaired status of Big Creek, the permit should be denied.

Part E - Miscellaneous Concerns

Comment E1 - This permit should be denied because synthetic flexible membranes for ponds can no longer be safely installed and they present a special set of risks for the circumstances of this particular permit

On June 5th, 2014, ADEQ approved a modification to permit the retrofit of a synthetic membrane liner which the operation owners hoped would assuage public concerns. That modification for a retrofit, yet to be implemented, carries a unique set of risks. They are as follows:

1. Once the liquid is removed, fecal sludge must also be removed from the pond floors before liners can be installed. Sludge removal will inevitably disturb the existing clay liners and likely the underlying soil and groundwater increasing the possibility of subsurface contamination.
2. When the liners are installed over the clay which contains embedded residual organic waste, decomposition can produce methane and other gasses. This gas accumulation beneath the liner can cause it to displace and float to the surface. This can result in rupture, seam failure, or leakage.
3. Seam failure, punctures, and mechanical damage have caused liners to fail and leak. Once liners are in place there is no way to tell if they have been compromised and leaks could occur for years without detection.
4. Retrofitting liners over actively used ponds is an entirely different and more complex challenge than installing them in a newly constructed pond. This has never been attempted in the state of Arkansas and it is likely there are few qualified personnel that could ensure a successful result. Tom Aley, a licensed Arkansas geologist and karst expert states that: “inadequate preparation of the ponds for liners will compromise the leakage integrity of the synthetic liners even if they are well installed”.
5. There is evidence of epikarst close to the ponds above the pond inverts, and fractures and/or voids with evidence of perched groundwater within a depth of five ft of the inverts.

The points illustrate clear technical differences between installing a liner on a freshly constructed impoundment, as opposed to a retrofit which has never been done in the state of Arkansas. The *Technical Field Guide for Arkansas* as identified in Reg 5.402 identifies under the *USDA-Natural Resources Conservation Service, Practice 521A - Pond Sealing or Lining, Flexible Membrane* identifies the estimated costs and needed skills for installing a synthetic membrane, but the standardized nature of these estimates imply that they are applicable to newly constructed pits. Retrofitting a synthetic membrane

over fecal saturated clay liners presents an entirely different set of technical challenges not to mention additional costs. There are no known installers in Arkansas that have performed this uncommon operation, and there is no identified best practice in the *Technical Field Guide for Arkansas* references for performing this kind of retrofit.

The approved pond liner retrofit is of notable concern as it is possible that ADEQ will view this as a solution to the comments in Part C regarding geological issues, and also Part D regarding degradation. Unfortunately, not only does a synthetic liner at this stage present unique risks, it would not satisfy the very serious vulnerabilities identified by comments: C10, C11, C12, and C13. It has been *subsequent* to the pond liner modification approval that indications of subsurface karst, epikarst, voids, fractures, and perched groundwater have been revealed by Dr. Halihan's ERI transects and validated by the Harbor Environmental drilling exercise. These risks were unknown at the time ADEQ approved the synthetic liner permit modification in June of 2014. When the circumstances of each of these four comments (C10 thru 13) are applied to the AWMFH Appendix 10D *vulnerability to risk matrix* (Appendix C10 of this document) the vulnerability is identified as "***very high"*** and the recommendation is: ***-"Evaluate other storage alternatives".*** The 10D *vulnerability to risk matrix* is not suggesting mitigation of the impoundment, but that it never should have been constructed at that location based on the risk factors present.

The take-away is that ADEQ's approved synthetic liner modification is now outdated because of what has come to light in recent studies. The approval of the pond liner modification should be rescinded.

If this was a new facility in a different location, BRWA would contend that synthetic membranes should be a required term of the permit, not merely an allowed modification. However, given what is now known about the location, a synthetic membrane will not address the risk factors identified, not to mention that the technology presents its own unique risks in regard to the challenges of a retrofit. Synthetic liners are not appropriate at this stage when considering the risk in Part A. For this reason alone, the permit should be denied.

Comment E2 - This permit should be denied because karst as a predominant and well known geological risk factor in the

Springfield Plateau and topographic vicinity of the facility and its spreading fields, is not recognized or investigated adequately in either the prior or current permit application

The AWMFH devotes the entirety of Chapter 7 to guidance around *"Geologic and Groundwater Considerations".* AWMFH 651.0702 *Engineering Geology Considerations in Planning* states the following under Part (I) Topography:

> ***"Karst topography is formed on limestone, gypsum, or similar rocks by dissolution and is characterized by sinkholes, caves, and underground drainage. Common problems associated with karst terrain include highly permeable foundations and the associated potential for groundwater contamination, and sinkholes can open up with collapsing ground. As such, its recognition is important in determining potential siting problems."***

The original Environmental Assessment (EA) with a finding of no significant impact submitted by the Farm Services Agency (United States Department of Agriculture) on Sept 26th 2012, does not discuss any topographic concerns. The words "karst" and "groundwater" are conspicuously absent. Neither does the original permit or the new permit application mention karst as a risk factor. The original EA of 2012 was challenged as insufficient and a court order was filed 12/2/2014 by U.S. District Judge D.P. Marshall finding that Farm Services Agency (FSA) and Small Bus Administration (SBA) violated the provisions of the National Environmental Policies Act (NEPA) and the Endangered Species Act (ESA) and that they "arbitrarily and capriciously guaranteed the loans" to C & H Hog Farms. The court required the agencies to re-do their "cursory and flawed" Environmental Assessment.

A new Environmental Assessment was submitted by FSA in August of 2015. The rewritten EA provided responses to concerns regarding the original EA, one of which was that the original EA did not consider karst. The response of the 2015 EA on the subject of karst topography was as follows (excerpt page 22 under "Karst"):

> ***"As stated in Section 3.3 of the EA, the soluble nature of limestones gives rise to karst terrain in the southern Ozarks region. Highly soluble conditions in certain areas of the Buffalo River watershed, distant from the C&H Farms, including the western and north-central parts of the watershed, have produced pervasive occurrence of karst features, including caves, sinkholes, springs, and sinking streams (Hudson et al. 2001 and Soto 2014). However, the C&H Hog Farms site***

and vicinity do not exhibit strongly developed karst landforms as demonstrated by a review of the Mt. Judea USGS 7.5 Minute Topographic Quadrangle Map and aerial photograph information. Our topographic and aerial photography review indicates that limited numbers of karst ponds are located on upper reaches of floodplains, where a separation of shallow perched groundwater in alluvial and epikarst (Hudson et al. 2013) from deeper groundwater in the Boone Formation may explain development of sinkhole ponds in overburden, due to dewatered secondary porosity in the underlying bedrock."

Expert testimony specifically directed to this topographic overview in the 2nd EA was provided on 8/27/2015 by Tom Aley, a professional licensed geologist specializing in karst in Arkansas as well as in the Mt. Judea area (the EA writers were not licensed in AR):

"In karst areas the adjective "Dry" is commonly applied to streams and valleys where the proportion of surface water lost to the groundwater system is exceptionally great. The vicinity of the C&H Hog Farm is characterized by an exceptionally large proportion of the surface water being lost to the groundwater system as illustrated by the following:

- ***Dry Creek, a stream with a topographic basin of 7.23 square miles, is located along the southern margin of the hog farm operations. Three of the manure disposal fields (Fields 15, 16, and 17) are topographically tributary to Dry Creek.***
- ***Dry Branch, a steam tributary to the Left Fork of Big Creek at a point 11,600 ft west of Field 5.***
- ***Dry Branch, a northward flowing stream tributary to Big Creek. The small community of Mt. Judea is on the ridge between Dry Branch (to the east) and Big Creek (to the west) and roughly parallels Big Creek. Dry Branch is within 2200 ft of of Field 1 and is 3,500 to 6,100 feed from Fields 5,6,7,9, and 10.***

The hog farm operation is bordered on the west, south, and east by streams named Dry Creek and Dry Branches. The hog farm operation is on the Mt. Judea 7.5 minute topographic quadrangle map. There are few if any other 7.5 minute quadrangle maps in the karst areas of north Arkansas that a have three separate streams with the adjective "Dry" in the name. The hog farm is clearly in the middle of a well developed karst area."

Dr. Todd Halihan of Oklahoma State University who performed an Electrical Resistivity Study (ERI) on three of the facility spreading fields entitled: *Electrical Resistivity Surveys of Applied Hog Manure Sites, Mount Judea, AR (2016).* Dr. Halihan characterized observations of the three fields in the *Executive Summary* of his report*:*

Several datasets were collected and the following observations were made from the ERI data:

- ***ERI provided delineation of boundaries between soil, epikarst, and competent bedrock.***
- ***The potential for rapid transport pathways in the underlying bedrock as joints or potential karst features were observed as conductive electrical features in a resistive background.***
- ***Soil depth was measured to range from 0.5 to 3.5 meters (1.5 to 11.5 feet). On Fields 5a***
- ***and 12, the thickness of soil increases moving toward the stream and thins towards higher elevations. This is consistent with the thickening of the alluvium as it is deposited closest to the stream.***
- ***The average epikarst thickness is highly variable, ranging from 2.0 to 23.0 meters thick (6.0 to 75.0 feet).***

Tai Hubbard, the on-site geologist monitoring the drilling process for Harbor Environmental, described a specific zone as characteristic of epikarst between the barns and the holding ponds:

> ***"The highly weathered limestone bedrock and unconsolidated clay intervals observed between 13.8 and 28.0 ft.bgs. appeared to have the characteristics of epikarst. With the understanding that epikarst is the weathered zone found at the interface of unconsolidated soils and bedrock, the Site setting would support this characterization."***

Likewise the Harbor Environmental drilling log uses geologic terminology to describe features encountered at increased depths; terms that include: "fractures", "increased fracturing", "weathered fractures", and "bedding planes", all terms indicative of karst. M.D. Smolen, PH.D. who has 35 years of experience in water quality management as affected by agricultural waste and other aspects of watershed management, had this to say (2017):

> ***"Recent electrical resistance study by Halihan and Fields suggested, and follow-up drilling by Harbor Environmental confirmed, that the ponds and the application fields are all underlain by Boone Formation limestone. This limestone, clay, and chert geology is noted for fractures and karstic groundwater features. Although leakage from the ponds has not been confirmed to date, <u>any seepage or direct leakage from the ponds would be transmitted to groundwater and ultimately to the Buffalo River</u>. The fact that Harbor Environmental did not confirm any ground water contamination is not conclusive because they only drilled one hole."***

David Mott in a 2016 report for the National Park Service states:

> ***"The waste storage ponds and land application sites are predominantly underlain by the Boone Formation; therefore, karst geohydrology".***

Further, a report titled “Surface-Water Quality In The Buffalo National River, 1985-2011” by the Watershed Conservation Resource Center, 2017 states:

> ***"The Ordovician through Mississippian rocks [which characterizes the Buffalo River watershed geology] host a complex karst terrain where losing streams, sinkholes, springs, and caves dominate much of the landscape. Most of these rocks are carbonates, either limestone or dolomite. They are particularly susceptible to dissolution. These rocks are highly permeable to the movement of groundwater. Subsurface flow directions and rates of groundwater flow are difficult to predict and may rapidly change based upon the hydrologic events."***

Dr. Van Brahana produced a peer reviewed report (in press 2017) entitled: “*Utilizing Fluorescent Dyes to Identify Meaningful Water-Quality Sampling Locations and Enhance Understanding of Groundwater Flow Near a Hog CAFO on Mantled Karst—Buffalo National River, Southern Ozarks”.* Dr. Brahana’s dye tracing results can be observed topographically in Appendix E2. In this appendix illustration the swine facility and many of the primary spreading fields lie directly in the path between the dye introduction point and the corresponding dye detection points. Dr. Brahana’s conclusions were as follows:

> ***Based on the results of the dye tracing described herein, the following observations of groundwater flow in the Boone Formation in the Big Creek study area can be used for designing a more reliable and relevant water-quality sampling network to assess the impact of the CAFO on the karst groundwater and to gain further understanding of the karst flow.***
>
> 1. ***Although the study area is mantled karst, subsurface flow is very important, and forms a significant part of the hydrologic budget.***
> 2. ***Groundwater velocities in the chert/limestone portion of the middle Boone Formation were conservatively measured to be in the range of 600-800 m/d.***
> 3. ***Conduits in pure-phase limestones of the upper and lower Boone have flow velocities that can exceed 5000 m/d.***
> 4. ***Groundwater flow in the Boone Formation is not limited to the same surface drainage basin, which means that anomalously large springs should be part of the sampling network (Brahana, 1997).***
> 5. ***Because the Buffalo National River is the main drain from the study area, and the intensive contact of the river water by uses such as canoeing, fishing, swimming, and related activities, large springs and high- yield wells should be included in the sampling network.***
> 6. ***Maximum potential transport times of CAFO wastes from the land surface appear to be greatest during and shortly after intense precipitation events. Minimum groundwater flow occurs during droughts. Sampling should accommodate these considerations.***

The history of both the old and new permit applications and the corresponding EA (both old and new) appear to have avoided the discussion of karst as a risk factor and have only acknowledged it vaguely when forced to respond directly,

despite the fact that the AWMFH devotes extensive guidance on its recognition as it pertains to risk factors and design considerations. This failure to acknowledge even the possibility of the presence of karst suggests a low level of investigative due diligence that is not proportional to the high cost of potential consequences discussed in Part A.

Comment E4 - This permit should be denied because an increase in the permitted number of swine at the facility violates the moratorium as defined in Regulation 5.901(D)

Reg 5.901(D) states, "*A permit renewal, permit modification, or new permit issued pursuant to Reg. 5.901(C) shall not increase the number of swine permitted at a facility*." The current C&H NPDES permit allows for 2,500 sows and 4,000 pigs. The new draft permit includes 2,672 sows, an approximately 7% increase in gestating and lactating sows. But the number of pigs has been reduced from 4,000 to only 750, based on the estimated average present at any time. However, annual production is more meaningful and common sense indicates that an increase in the number of sows will result in an increase in the number of pigs (in this case 78,000 per year) and consequently the amount of waste produced annually. According to "The National Hog Farmer", http://www.nationalhogfarmer.com a gestating sow on average will have 2.6 litters per year and produce 29.1 piglets per sow per year surviving through weaning. Weaning takes up to 24 days, producing a weight of around 14 pounds. Using these numbers, the average number of piglets on the farm at any one time would be 4,309 and the total number of swine would be 6,987. This is calculated as follows:

6 boars @ 450 lbs = 2,700 lbs

2,252 gestating sows @ 425 lbs = 957,100 lbs
420 lactating sows@400 lbs = 168,000 lbs
4,309 nursery pigs @ 14 lbs = 60,326 lbs

Total = 1,188,126 lbs

This represents an increase from the original authorized number by 7.4%.

Relative to weight of pigs this represents an increase of 18.9%. By volume of manure produced this is an increase of 17.4%. This increase violates both the spirit and the letter of the moratorium as described in Reg 5.901(D) and this permit should be denied.

Comment E6 - The Harbor Environmental study does not provide scientific support for this permit and in fact yields evidence that it should be denied

Harbor Environmental drilled a single bore hole to a depth of 120 ft as a result of an electronic resistivity study (ERI) performed by Dr. Todd Halihan of Oklahoma State University in 2015. The transects that resulted from the Halihan study (Appendix C11) suggest conductive zones consistent with high moisture content. The concern that prompted the Harbor drilling exercise was possible leakage and/or fractures near the ponds. The Harbor Drilling Study work plan described the following as its "goals":

- ***Evaluate the lithology/geology below the waste storage ponds; and***
- ***Assess potential subsurface impact from the waste storage ponds.***

It is possible that ADEQ may consider the Harbor Environmental study as supportive of the applied regulation 5 permit. To that end, the BRWA expresses the following concerns (A, B, & C):

A) The Harbor Study was scientifically limited

These are some, but not all of the concerns with how the study was conducted from a scientific standpoint:

1. Several experts suggested that at least three holes be drilled in order to arrive at a supportable conclusion regarding subsurface conditions. Dr. Tai Hubbard the on site geologist stated the limitation as follows: "*Evaluation of lithologic contacts and bed orientations are limited, both horizontally and vertically, due to the inability to correlate observations collected at a single location to any other bore holes."*
2. The drilling method damaged the rock core extracts, inhibiting the ability to examine fracturing that would have shed light on subsurface

karst formations. Dr. Tai Hubbard the on site geologist stated a similar concern as follows: "*The drilling method employed during this investigation consisted of a rotosonic drill rig without a high speed rotation implement used for typical rock coring. This limitation resulted in poor rock core quality, preventing the calculation of Rock Quality Determination (RQD) as proposed."*

3. The rotosonic drilling process used a 6" turning pipe with water pumped into the pipe and exiting around the sides. The water pumped in served to a degree as a lubricant and it was recaptured and stored in barrels as part of the process. A noticeable volume of water was lost at about 25' indicating open subterranean space near the ponds, which suggests a significant risk factor (see Comment C12). The volume of water lost (pumped vs recaptured) was critical information for determining the total cubic footage of a confirmed subterranean void that Harbor did not provide.
4. Chlorinated municipal drinking water was pumped in during the drilling process. Chlorine and other chemicals are used specifically to eliminate *E. coli* and other contaminants. As *E. coli* was one of the elements being examined, chlorinated water could have significantly influenced the results. There were two other drilled wells located on the site which could have been accessed to provide untreated water for the drilling process.
5. When Harbor Environmental provided an initial report on Dec 1st, 2016 the presentation was attended by the public, geologists, hydrologists, and others who had a professional interest in reviewing the results. No interactive questions were accepted. Interactive questioning which is considered part of the normal scientific protocol in vetting technical studies was not permitted by Harbor or ADEQ. All questions were directed to be submitted in writing with answers to be returned in summary form.

B) The Study does not serve as a means to satisfy Reg. 5.404

Regulation 5.404 *Subsurface Investigation Requirements* reads as follows:

"The subsurface investigation for earthen holding ponds and treatment lagoons suitability and liner requirements may consist of auger holes, dozer pits, or backhoe pits that should extend to at least (2) feet below the planned bottom of the excavation."

Likewise, Reg. 5.402 *Design Requirements* states the following:

Designs and waste management plans shall be in accordance with this Chapter and the following United States Dept of Agriculture Natural Resources Conservation Service Technical Publications:
(1) Field Office Technical Guide, as amended
(2) Agricultural Waste Management Field Handbook (AWMFH), as amended

Review of the AWMFH identifies the following shortfalls in the subsurface investigation which the Harbor Environmental drill study will not satisfy:

1. Comment C2 - Facility plans do not investigate groundwater flow direction as suggested by AWMFH.
2. Comment C6 - Pond subsurface investigation does not conform to AWMFH guidance. *"For structures with a pool area, use at least five test holes or pits or one per 10,000 square ft of pool area, whichever is greater".*
3. Comment C7 - Berm subsurface investigation was not performed as per AWMFH guidance. *"for foundations of earth fill structures, use at least four test borings or pits on the proposed embankment centerline, or one every 100 ft."*
4. Comment C3 - Permeability analysis for liner material does not include particle analysis as per AWMFH guidance.
5. Comment C4 - Laboratory compaction analysis to determine hydraulic conductivity uses only one sample.
6. Comment C5 - Type IV soils to be used for the liner, suggest special considerations in the AWMFH that were not addressed

C) Risk factors identified by the study support permit denial

The Harbor Environmental single drill hole study in conjunction with the Oklahoma State University ERI study by Dr. Todd Halihan's team have turned up geological anomalies since the date in which first Regulation 6 permit was granted. These anomalies suggest that the Regulation 5 permit should now be denied.

1. Comment C11 - ADEQ single bore hole investigation provides information that confirms the facility is located over geologic karst
2. Comment C12 - Containment ponds are located on a geologic foundation near voids and/or fractures

3. Comment C13 - Evidence of perched groundwater close to pond inverts.

Comment E7 - This permit should be denied because it does not include An Expiration Date

The proposed Permit does not contain an expiration date. Under Regulation 6, the permit would be required to have a fixed term not to exceed five years. While Regulation 5 does not have a stated time for the effective life of a permit issued under that Regulation, there is nothing in Regulation 5 that would prohibit ADEQ and the Commission from including an expiration date in the permit even if ADEQ persists in using Regulation 5 as its authority.

There are numerous sound policy reasons for requiring a termination date, requiring the permittee to apply for the renewal of the permit. The fact that the permit will be subject to renewal in a stated period of years would be a motivating factor for the permittee to strictly adhere to the terms and conditions of the permit, and to address problems on their own volition. In addition, requiring periodic renewal gives ADEQ and the public an opportunity to review the operations of C&H and for the public to be heard on the quality of those operations and their effect on the environment. Also, periodic renewal allows for the consideration and use of new technology to remedy or prevent problems that may be affecting the public and the environment. These are among the reasons why NPDES permits are subject to periodic renewal.

Smolen (2017) notes risk of STP buildup:

> ***"…under Regulation 5 soil testing is only required once in five years, but STP it is likely to increase drastically in that time."***

Considering the potential for serious environmental harm from swine CAFO operations, a Reg 5 permit limited to an effective period of three (3) years should be required for such facilities.

Comment E8 - The permit should be denied because criteria for location of a CAFO in karst geology are not adequately developed or implemented

The standards that are being applied to the location of the C&H facility are the same as those that would be applied to any location in Arkansas. The standard ignores the fact that the C&H facility is located in a karst geology, which greatly exacerbates the potential for migration of any contaminants that are or may be released from the facility, and the difficulty of containing or even locating any such contaminants, once released.

The AWMFH provides the entirety of Chapter 7 as guidance to the engineer regarding karst and groundwater as a risk factor, and yet the engineering documents do not acknowledge or allude to fast moving ground water as a concern, though the circumstances identified in Chapter 7 regarding karst geology were certainly present.

ADEQ did not conduct or require *an enhanced geological and hydrological assessment of the facility site***.** It is important to know the nature and extent of the geology; the degree to which the underlying rock formations have been fractured; the potential routes of migration of contamination in the event of a release; the environmentally-sensitive areas that might be affected from a surface or sub-surface release due to groundwater flow direction; and other related facts. ADEQ has the legal authority and the mandate to require additional conditions or investigations where special risk factors are present, yet they chose not do so for this permit application in the sensitive geologic watershed of a national river.

The fact that private and public institutions have *both failed* to recognize the need for a higher standard of investigation in a karstic rapid groundwater environment indicates that there is a need for a *legal delineation of standards designed specifically for permits that are proposed for geologic karst locations*. This delineation is particularly important in the state of Arkansas as a large portion of the state is underlain by karst geology. Simply put, karst geology and hydrology present an entirely different set of risks than south Arkansas Mississippi bottom land soils.

This permit should be denied as the current standards are inadequate in that they do not take karst into consideration.

Comment E9 - This permit should be denied as experts agree that Big Creek is a “losing stream” in that it loses significant water volume into groundwater

David Mott, an engineering geologist, former hydrologist with NPS, former regional hydrologist with the U.S. Forest Service, and having held various leadership positions with the USGS, produced a report entitled *“Permitted Concentrated Animal Feeding Operation Assessment, Buffalo National River, Arkansas”* dated: November 2016. In the report’s Executive Summary Mott mentions the following data sources:

> ***“Water quality and stream discharge information were analyzed from the in-park monitoring station on Big Creek at Carver, located 4-miles downstream from the BCRET sampling site below the CAFO and 1⁄2 mile above the confluence with the Buffalo River. These data came from BNR, USGS, and special studies being conducted by the University of Arkansas Geosciences Department and Ouachita Baptist University.”***

Among other results listed, Mott points out that the data show that Big Creek is a “losing stream” (page 11):

> ***“Discharge data from the USGS gaging stations at Big Creek near Mt. Judea and Big Creek at Carver revealed the intervening reach is a losing stream segment. It is likely that water entering the subsurface karst conduits in this losing reach of Big Creek resurfaces in the Buffalo River channel in a previously identified gaining reach below the confluence of Big Creek and the Buffalo River.”***

A “losing stream” is one that loses significant water volume into groundwater as it flows downstream. Mott, 2016 states:

> ***“...the discharge at Big Creek at Carver was sometimes less than the discharge at the upstream USGS gage, Big Creek near Mt. Judea, AR...In 2003 USGS staff conducted a flow gain and loss study and water quality sampling run along the length of the Buffalo River, including measuring flow and water quality at tributaries (Moix and Galloway, 2004). When examining flow patterns in the Buffalo River below Carver, USGS found discharge increased by 35 percent (7 cubic feet per second) in a 3-mile reach (Figure 34). Conductance also increased in this reach, and water temperature decreased, indicating ground water was discharging directly to the main channel of the Buffalo River. One possible source of this ground water recharge is the losing reach of Big Creek located between the two USGS gaging stations. This implies water with high nitrate concentration as observed at the BCRET sampling site downstream of the NMW could be entering the karst bedrock of either the Ordovician aged Fernvale/***

> ***Plattin Limestone, or the Everton Formation, or both (Braden and Ausbrooks , 2003). Once in the subsurface drainage network, the water could travel through conduits and discharge directly to the Buffalo River main stem, bypassing the Big Creek at Carver sampling site."***

Losing streams are sources of groundwater recharge and are characteristic of karst environments. See comments E2, C2, C11, C12 regarding karst. Also refer to Comment C1 regarding critical recharge areas. AWMFH *651.0703 Factors affecting groundwater quality considered in planning* page 7-15 describes a number of engineering considerations for siting and planning a facility. Under this on page 7-18(i) is *Proximity to designated aquifers, recharge areas, and well head protection areas* in which the following is stated:

> ***State water management and assessment reports and the following maps should be reviewed to ascertain the proximity of sensitive groundwater areas:***
> - ***sole source or other types of aquifers whose uses have been designated by the State***
> - ***important recharge areas***
> - ***Wellhead protection areas***

Waters lost from “losing streams” often re-enter surface flows via springs and can also affect residential wells and water sources which are common in this rural area. The fact that Big Creek is a “losing stream” corroborates the overwhelming evidence of karst and the presence of rapid groundwater flows. The presence of numerous springs throughout the area confirms this characterization. Chapter 7 of the AWMFH does not require a review for sensitive ground waters, but the circumstances for which these suggestions are provided are clearly present. That this “losing stream” is not considered in the permit demonstrates a lack of investigative due diligence that is not proportional to the significant risk factors described in Part A.

Comment E10 - ADEQ should deny C&H a permit because the conditions put in place by ADEQ in the 1992 moratorium have not been met

ADEQ imposed a moratorium for Regulation No. 5 permits in the Buffalo River watershed in 1992 (see Mott 2016, Appendix A). This moratorium specifically mandated the completion of site specific studies, and the use of those studies to inform regulatory changes to protect the watershed prior to the moratorium being

lifted. C&H was designed and is managed in a similar manner to the previous swine CAFOs studied by ADEQ from 1994 – 2002, but the operation functions on a much larger scale. Not only did ADEQ fail to complete the requirements of the previous moratorium, the agency never provided public notice that the 1992 moratorium was to be lifted. ADEQ did not disclose the modifications and corrections it made, if any, based on the results of its own studies and investigations. Because lifting this moratorium would have been a major environmental decision with potential to impact the Buffalo National River, and the outstanding national resource designation by the State of Arkansas, public notice and analysis of this decision was warranted.

By not announcing that it was lifting the moratorium, ADEQ effectively circumvented public participation in protecting and maintaining the water quality of the Buffalo National River. ADEQ should deny this permit because it has yet to fulfill the mandates of the moratorium. ADEQ has not yet gone through the public notice and public comment process, nor has the agency explained to concerned citizens of the state of Arkansas how it addressed the requirements of the moratorium. The goal of this effort as stated in the moratorium was to adjust the regulatory, mitigation, and evaluation requirements of Regulation No. 5 permits issued in the Buffalo River watershed. Until ADEQ addresses the concerns identified in its own studies, ADEQ is in violation of the 1992 moratorium.

Comment E11 - BCRET monitoring program is not effectively measuring or reporting on water quality problems in their study of the C&H facility and therefore misleads decision makers and the public.

In 2014, a panel of experts reviewed the operational and monitoring activities taking place at C&H and analyzed BCRET's study design and implementation (https://bigcreekresearch.org/project_reports/docs/Review%20Panel%20Report%20- %20May%2019%202014.pdf). In their Summary of Findings the panel stated "The complexity of the landscape and the farming operation presents a challenging task for the Team." They began their review by noting that conclusively demonstrating the impact of C&H on water quality is made difficult by "the fact that limited data on water quality are available prior to the onset of the farming operations. Additionally, within the Big Creek watershed there are a number of other ongoing land management and land use activities that can impact water quality."

The panel immediately recognized the significance of monitoring storm events and stated “extreme events are often the driver of hydrologic responses to environmental stressors and **we recommend that more effort be directed at sample collection during high-flow events**.” The panel also “recognized three major potential threats to water quality associated with C&H. These include: 1) leakage from the two onsite waste storage ponds, 2) contamination of surface and subsurface water due to land application of the wastes, and 3) potential long-term buildup of soil nutrient levels (primarily soil phosphorus) due to application in excess of crop needs and removal.”

Following is a list of specific recommendations made by the panel, and an assessment of the actions BCRET has taken in response to panel concerns:

1. A short-term, detailed water balance study should be conducted to determine the actual seepage rate of the storage ponds.

    - A water balance study has not been undertaken and pond seepage rates/volumes remain unquantified.

2. Water quality samples should continue to be collected from the house well on a routine basis. In addition, the Panel recommends that the detailed well driller’s log be obtained and that a slug test, pump test, or both be conducted on this well to determine characteristics of the aquifer from which water is drawn.

    - Water samples continue to be collected from the well but it was not apparent that aquifer testing was conducted. Well sample results showed problems with bacteria contamination and nitrate values are higher than in surface water samples.

3. A detailed walking survey of the slope down gradient from the waste ponds should be conducted to identify potential seeps and springs from perched aquifers. If perched aquifers are noted based on the driller’s log or by the identification of hillside seeps, one or more shallow monitoring wells should be installed to the depth of the perched aquifer within as short a distance as feasible from the storage ponds. If springs or seeps are noted on the hillside, these should be monitored on a routine basis to establish baselines and trends in water quality.

    - Not able to verify walking survey, no monitoring wells were installed. Because BCRET installed trenches below the pond, it might be assumed that seeps were found below the ponds during prolonged dry weather indicating perched water. In karst environments the pond seepage could be migrating vertically through solutionally enlarged fractures to the

subsurface drainage network, and then discharge to springs and or surface streams. BCRET has not provided a peer reviewed report describing their trench study methods and results.

4. An inventory of the entire reach of Big Creek between the upstream and downstream sampling points with geo-referenced notes made on any significant changes in water flow due to tributaries or major springs. This inventory should include karst features located within the contributing area.

    - A karst inventory of the pond and spreading field areas could be useful, however the work of Halihan and Fields (2014) clearly shows the mature karst just below the spreading fields and near the ponds, and the fractures and conduits normally associated with karst terrain, and directly supports the AWMFH concerns for citing CAFOs in such terrain. The recommended seepage runs in #6 below is a superior way to quantify and assess “changes in water flow” in Big Creek.

5. A detailed land use map that identifies all land uses within the contributing area of the watershed. This should include surveys of farmers to gauge land management practices, with particular emphasis on animal stocking practices, fertilization, and manure applications.

    - A land-use analysis has been conducted for the contributing watersheds to support the BCRET study objectives (bigcreekresearch.org). The analysis used GIS and remote sensing acquired sources. Unfortunately, the watershed boundary assumptions may be in error in this karst settings. A detailed inventory and survey of farmers as suggested by the panel would be expensive and time consuming and more appropriate to developing a stand-alone water quality model.

6. A seepage survey to include stream profile measurements and estimations of discharge. The stream survey should be repeated under high (if feasible), medium, and low flow conditions to capture the potential variability in groundwater recharge and discharge to the riparian zone, valley alluvium, and karst features (if present).

    - Sometimes referred to as a gain and loss flow study, seepage surveys are a critical recommendation. A seepage run in this karst setting would yield quantifiable and reproducible results concerning ground water/surface water interactions. Seepage study design should incorporate water quality measurements and sample collection. A seepage survey has been performed on the entire length of the Buffalo River (Moix and Galloway, 2004). Completion of a seepage run by BCRET was not identified.

- Karst influence on surface flow is pronounced in Big Creek as this stream channel is often dry where it passes the C&H's spreading fields and waste storage ponds during base flow conditions. It is dry during these times because, as commonly happens, the karst drainage network in the Boone Formation has pirated surface flow. By the time Big Creek reaches the upstream sampling site it has flowed across the Boone Formation for two miles. It is likely significant stream flow has already been lost to the subsurface drainage network before it reaches the upstream sampling site. This is confirmed by the times in the BCRET sampling record when the upstream site is dry while the downstream site is still flowing.

- At the downstream site, it is likely karst hydrology is having the opposite effects on stream flow. The downstream site is located near the base of the Boone Formation. In the Big Creek valley, the lower Boone contains a relatively high quantity of chert (Braden and Ausbrooks, 2003). Chert is composed mainly of silica, and therefore is insoluble. Chert also interacts in complicated ways with the soluble limestone in which it is inter-bedded to affect hydrologic ground water flow processes (Brahana et al., 2016). At the downstream sampling site, it is likely these chert layers form a continuous aquitard of undefined spatial distribution, disrupting the subsurface drainage network and forcing flow back into Big Creek's surface channel. Instead of losing flow as happens at the upstream site, the downstream sampling site is likely capturing water from other basins, such as Dry Creek east of Mt. Judea, for example (bigcreekresearch.org).

7. Develop rating curves between water level and discharge at both the upstream and downstream sites.

    - This recommendation reflects the importance of being able to match water quality results to stream discharge and calculate loads or flow-weighted concentrations. Rating curves allow stream stage to be converted to stream discharge. A stream gage has been installed by the USGS at the BCRET downstream site. The upstream site lacks a rating curve, stream gage, and discharge measurements. This lack of discharge information is uncommon for such studies and will be discussed at length in association with panel recommendations #11 and #15.

    - Discharge data for the BCRET upstream site has not, and is not currently being collected. Even when BCRET technicians are on-site collecting water quality samples, they do not measure discharge.

    - At sampling sites lacking discharge data, storm loads cannot be developed. Only the BCRET downstream sampling site, co-located with

the USGS gage at Big Creek near Mt. Judea, will have the requisite flow data to allow loads to be calculated. The lack of discharge at the upstream site in this upstream/downstream study of the effects of agricultural runoff is not a typical study design.

- The use of the watershed area ratio to estimate flow and loads at the upstream site is likely not applicable because the flow relationship between the two sites is not linear due to karst surface water/ groundwater interactions affecting surface flow. Without discharge at the upstream site, verification of the accuracy of the watershed ratio method, or development of nonlinear relationships between flow at the upstream and downstream sites, is not possible.

8. Conduct traces with multiple dyes. The first set of traces should be qualitative to identify the potential connections between points of recharge and discharge. Once established, quantitative traces should be conducted with both conservative and non-conservative dyes to establish travel times and dispersion characteristics. Results of the traces, for example from the sinkhole in Field #1 to the spring downslope, may help revise the area for manure application.

    - Dye tracing studies have not been conducted by BCRET. Dr Van Brahana has attempted to partially fill the need identified by this recommendation, but is not receiving funding from BCRET to assume what is their responsibility, and his studies were limited. His results and interpretations are currently in press. BCRET states that dye tracing through the waste storage pond liners is not considered feasible.

    - BCRET has used GIS techniques to delineate the watersheds contributing to their monitoring sites. These estimates are likely in error because this simplistic view of watersheds often does not apply to karst basins with extensively developed subsurface drainage networks (Aley, 1982; Aley and Aley, 1989; Aley, 1999; Aley and Aley, 2000; Mott et al., 2000). This is especially applicable to the BCRET downstream sampling site. The actual recharge area for the upstream and downstream sampling sites, and Left Fork of Big Creek, should be delineated using common dye tracing techniques.

    - BCRET has not delineated the recharge area for the spring they are monitoring. Information from this spring is telling us what about the C&H use of the nearby pasture as a waste application site? What else is happening in the recharge area of this spring? What is the spatial extent of this recharge area? Is this spring pirating an upgradient surface stream? Does the spreading field even contribute recharge to this

spring? Basic questions like these should have been answered prior to sample site selection and the start of sample collection.

9. The Dry Creek watershed includes an estimated 1/3 of the proposed land area approved for manure application from C&H. An automated sampling and gauging station should be installed as close to the confluence with Big Creek.

    - Between November, 2014, and May, 2015, Dry Creek was sampled seven times.

10. The Panel recognizes the need to monitor surface runoff and recommends that more emphasis be placed on a sampling protocol to better capture flow-weighted samples during runoff events.

    - The BCRET sampling strategy does not appear to have changed in any notable way to increase emphasis of surface runoff sampling. There is limited surface runoff data from three flumes. Only two of the fields draining to the flumes receive swine waste.

    - See discussion in #15.

11. Use commonly available geophysical techniques to characterize the subsurface conditions that could potentially contribute to preferential flow of water and contaminants from fields receiving swine waste applications. If these procedures document significant subsurface features that can affect water flow, subsurface investigations (i.e., drilling) should be conducted to confirm these observations.

    - Ground penetrating radar and electrical resistivity methods have been employed by BCRET collaborators. Follow-up investigations of karst features using borehole investigations at the spreading fields showed many profiles dominated by sand and gravel. One borehole was drilled near the waste storage ponds, this borehole confirmed the presence of a karst preferential flow path (a solutionally enlarged fracture).

    - The electrical resistivity surveys identified concerns related to preferential flow paths in the subsurface karst, as discussed previously. Identified concerns based on karst hydrology were not used by the permit planner or the draft permit approver to appropriately condition waste storage and application as required by the AWMFH (NRCS, 2012).

12. If buildup of soil phosphorous levels is noted, the results of the manure solids and liquid separation trials that are being conducted as part of the project may offer an opportunity to better match waste applications to specific crop and soil fertility needs. In general, the manure solids will have a lower N:P ratio than the liquid fraction. Ideally, the dryer solid fraction could be applied to fields where soil P levels are low or transported out of the watershed altogether. In light of C&H's use of additives to enhance the function of the waste storage ponds, a regular sampling of storage ponds is important to understand the effects of the additives and to determine variability in nutrient concentrations.

    - Buildup of phosphorus levels in soils has been noted by BCRET in recent years (bigcreekresearch.org)

    - ADEQ studies of CAFO facilities in the Buffalo River watershed in the 1990s and early 2000s identified sludge build up and disposal as the most significant concern at Regulation No. 5 permitted facilities.

    - Dr. Sharpley's efforts to study ways to ameliorate high P levels in the waste stream have been abandoned.

    - The current NMP and permit do not address sludge buildup or waste stream treatment, or the need to refine NMP calculations based on "as applied" testing results.

13. Source tracking of nutrients and bacteria. While this is time consuming and can be prohibitively expensive to conduct on a routine basis, if elevated contaminant levels are noted at the downstream site relative to the upstream monitoring locations, source tracking using isotopic or PCR methods may provide additional information needed to establish whether activities associated with C&H are a contributing factor.

    - No evidence was found that any source tracking methods have been employed by BCRET even though their data shows statistically significant increases in several parameters at the downstream site (Mott, 2016).

14. Supplemental chemical parameters. The study of watershed hydrology and geochemistry is regularly enhanced by combining a multi-parameter approach. For example, the use of multiple water quality parameters may provide additional information on flow paths, residence times, and sources that may otherwise be difficult to interpret on limited sources of data. Therefore, the Panel recommends that the Team consider, if practical, the following additional analytes: - Principal ions - Alkalinity - Appropriate trace

metals - Environmental isotopes (including C/N ratios) - Ammonia, Nitrite, and Nitrate fractions of total N - Emerging contaminants (caffeine, hormones, antibiotics, etc.).

- Several parameters were added based on the review team's recommendations. However, some obvious parameters are still lacking such as dissolved oxygen and quantification of discharge concurrent with sample collection.

- The base flow database BCRET has developed is substantial and lab reports reflect high standards of quality. Unfortunately, the other short comings of the study design and execution limit the intended use of the base flow data to interpret the impacts of C&H.

15. Storm event sampling. Wide-ranging studies of watershed processes and contaminant transport demonstrate the importance of storm events. In this particular investigation, the transport of waste offsite may be strongly correlated to periods of overland flow on application fields. While the Panel is encouraged to see instrumentation specifically designed to capture this overland flow, it would be beneficial to capture more than a single composite sample, particularly for long lasting storms.

    - The Big Creek sampling strategy employed by BCRET primarily utilizes an upstream of C&H activities and below C&H activities (upstream/ downstream) approach. Their stated purpose of this monitoring is to assess potential declines in water quality occurring in the intervening reach where the production facility, swine excrement holding ponds, and swine excrement land application fields are located (bigcreekresearch.org). Samples are collected on a set weekly basis independent of hydrograph considerations. In agricultural basins, it is well known that nonpoint source contamination is rainfall generated, and transport to surface streams is primarily in conjunction with storm hydrographs, as the review panel noted. In a report prepared for the EPA looking at studies from across the country (https:// www.bae.ncsu.edu/programs/extension/wqg/issues/loadestimation.pdf) the relationship between parameter concentrations and storm loading is discussed.

      "Especially for particulate pollutants of non-point origin, the flux varies drastically over time, with fluxes during snowmelt and storm runoff events often several orders of magnitude greater than those during low flow periods. It is not uncommon for 80 to 90% or more of the annual load to be delivered during the 10% of the time with the highest fluxes, as is illustrated in Table 1. Clearly it is critical to sample during these periods, if an accurate load estimate is to be obtained."

Table 1. Delivery of pollutants in Lake Erie tributaries, during selected periods of time with the highest fluxes. Data from Baker (1988).

Parameter	Percent of time	Percent of annual load delivered				
		Raisin	Maumee	Sandusky	Rock	Cuyahoga
Suspended solids	0.5	17.8	17.3	24.3	42.7	28.3
	1.0	26.9	27.1	36.4	59.5	38.1
	10.0	79.6	81.6	87.7	97.6	81.5
	20.0	91.2	93.9	95.4	99.0	90.9
Total Phosphorus	0.5	14.8	9.8	14.8	30.9	13.2
	1.0	23.9	17.2	22.8	47.2	18.0
	10.0	67.9	67.5	77.3	93.9	51.3
	20.0	81.3	85.6	90.2	97.2	64.8
Nitrate + Nitrite	0.5	5.3	5.0	6.9	17.9	3.0
	1.0	9.5	8.7	12.3	28.8	5.2
	10.0	54.2	52.2	56.7	81.0	25.9
	20.0	76.4	75.4	77.2	91.4	40.5

- Table 2 compares base flow median instantaneous loads (flux) at BCRET's downstream sampling site compared to flux during a period of storm flow at the same site. The results show the critical nature of analyzing storm flow loads as prescribed by the expert panel, EPA, USGS, and other researchers is very applicable to the study of C&H. It is literally tens, hundreds or even thousands of times as important to accurately quantify the storm loads as compared to the base loads. BCRET collects approximately 80 percent of its stream samples from periods of base flow water quality, and 20 percent of its samples are collected from storm runoff periods (bigcreekresearch.org). BCRET prepares quarterly update reports based on these data and presents this information on their website (bigcreekresearch.org), but there is no analysis of loads presented. Not only is it critical to sample during times of storm runoff, the data collection and analysis must be conducted in a specific manner to calculate accurate, scientifically accepted, loads (Haggard et al., 2003;
    - https://toxics.usgs.gov/pubs/of-2007-1080/methods.html
    - https://pubs.usgs.gov/tm/2005/tm4A5/pdf/508final.pdf;
    - https://pubs.er.usgs.gov/publication/sir20115172).

	Ortho-P mg/s	TP mg/s	NO3 mg/s	TN mg/s	TSS mg/s
Median Base-flow flux	5.43744	15.40608	151.7952	165.1056	1019.52
May 11, 2015 flux	1870	31970	4283	67560	16739244
Increase (times)	344	2,076	28	409	16,411

Table 2: Comparison of median base-flow flux values to storm flow flux values at BCRET downstream sampling site (Ortho-P = orthophosphorus; TP = total phosphorus; NO3 = nitrate+nitrite-N; TN - total nitrogen; TSS = total suspended solids; mg/s = milligrams per second).

After 3.5 years of monitoring, BCRET has not subjected their data or interpretations to independent peer review. ADEQ has not asked BCRET to prepare such an analysis prior to making its permit decision. The BRWA believes a peer review of the BCRET study would reveal that:

- *BCRET and USGS should coordinate sampling and prioritize storm event data collection and analysis with the goal of quantifying the offsite impacts of C&H on the water quality of Big Creek, the Buffalo River, and the karst aquifer.*

- *Does BCRET plan to compare their load estimates at the downstream site to the USGS loads at Carver? How will these loads be comparable if USGS uses different sampling techniques and load development procedures?*

- *BCRET is not planning to sample storm event runoff in Big Creek at intervals throughout the rising and falling limbs of a storm hydrograph(s) to allow for integration analysis.*

- *BCRET flags storm and base flow samples in their databases. These flag sometimes contradict behavior of the USGS hydrograph at Mt. Judea gage.*

- *BCRET data may show increasing nitrates in base flow over time. This result has not been detected or reported by BCRET in their quarterly reports. BCRET should use more commonly accepted and refined water quality assessment techniques and peer review processes to interpret data and state conclusions.*

- *E. coli concentrations are not measured from storm samples collected with ISCO samplers.*

BRWA is concerned by the findings of the expert review panel, as the review appears to show the water quality monitoring approach being employed by BCRET missed many fundamentally important aspects of a carefully designed study tailored to “the complexity of the landscape and the farming operation.” BRWA has reviewed the BCRET data and the BCRET sampling activities and concluded that BCRET has not adequately responded to the recommendations made by the expert review panel and others to focus on Big Creek and karst aquifer monitoring, especially during storm flow periods. ADEQ should deny the C & H permit until a proper scientific assessment of its impact is designed, conducted, and reported on through acceptable scientific peer review processes. This would allow ADEQ to make an informed decision regarding the level of water quality impacts to Big Creek, the Buffalo River, and the karst aquifer caused by C&H.

Part F - Additional Comments Added for Recent Proposed Permit Denial

Comment F1 - This permit should be denied as experts have identified highly porous features including gravel lenses and sinkholes in the three spreading fields reviewed by Halihan and Fields

Berton Fischer, Ph.D. serves the Buffalo River Watershed Alliance with expert opinion on the matters of geology in regard to the C&H facility. His opinions have been included in a separate document in conjunction with these comments. Dr. Fischer's opinions provide detail and corroboration of many points made in previous comments. However, an additional concern that he discusses is the presence of highly permeable features in the spreading fields. Below is an excerpt from Dr. Fisher's opinions in which he provides interpretation of Dr. Halihan's electronic resistivity images in fields 1, 5A, and 12.

> ***"Water quality and stream discharge information were analyzed from the in-park monitoring station on Big Creek at Carver, located 4-miles downstream from the BCRET. Each of these fields showed non-homogenous subsurface conditions. Some GPR transects from each of two fields (1 and 5A) displayed a wavy and irregular boundary between soil and bedrock that was interpreted by BCRET as resembling the dissolution features in cutter and pinnacle karst (EXHIBIT IX-a-b). Two fields (5A and 12) displayed GPR transects there were interpreted as channelized deposits of coarse fragments or "gravel bars". Subsequent geophysical work (electrical resistivity imaging; see EXHIBIT X-a-i)[1] identified a***

[1] Fields, J. and T. Halihan. 2015. Preliminary electrical resistivity surveys of Mount Judea alluvial sites. Oklahoma State University Boone Pickens School of Geology, 24 pp.; Fields, J. and Halihan, T. 2016. Electrical Resistivity Surveys of Applied Hog Manure Sites, Mount Judea, AR, Final Report. Oklahoma State University Boone Pickens School of Geology. 49 pp.

large, buried sinkhole[2] in Field 12 (see EXHIBIT X-c and X-e) and strong epikarst development in Field 1 and Field 5A (EXHIBIT X-b, X-d, X-f and X-h). The sinkhole found in Field 12 feature is large (~200-ft long and ~75-ft deep). Although surface expression of this feature is obscured, this feature has the hydrogeologic function of a sinkhole; it provides a more direct pathway for the movement of fluids from the surface to the subsurface. Notwithstanding, C&H Hog Farms' Regulation 5 permit application did not recognize, and was not modified to recognize, the presence of this feature; a 100-ft buffer was not established around this feature as required under Regulation 5.[3] The discovery of a large sinkhole, cutter and pinnacle karst and apparent channeled permeability in the subsurface of a very small sampling of the total area of Fields strongly suggests that other waste application fields described in the C&H Hog Farm permit application would also possess subsurface features that must be considered in designing an animal waste management plan for the C&H Hog Farm, but the C&H Hog Farms' permit application is silent regarding these features, the need to assess Fields for the presence of these features or accommodations for these features; no investigations of subsurface karst or sedimentary conditions were made or recognized in the C&H Hog Farms' permit application."

Likewise, professional geologist Thomas Aley who has provided expert opinion to the Ozark Society reached similar conclusions:

"Geophysical work by Fields and Halihan (2015) has identified a large, but obscured sinkhole (called a doline by the authors) in Field 12. This sinkhole is about 200 feet long and about 75 feet deep. While its surface expression has been obscured by human activities and natural processes, there is no reason to not expect it to hydrologically function as a sinkhole. As a result, it must be viewed as a sinkhole under Reg 5.406. There are undoubtedly many similar features in the C&H Hog Farms manure application fields where geophysical profiles are lacking."

Regulation 5.406(d) states:

"*Application of waste/wastewater shall not be made within 100 feet of … sinkholes…".*

Regulation 5.402(A) states:

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[2] The authors term this feature a doline. The term "sinkhole" is generally interchangeable with the terms cenote, sink, sink-hole, shakehole, swallet, swallow hole, or doline – all of these terms refer to a depression or hole in the ground caused by some form of collapse of the surface layer.

[3] 5.406 (d)

> ***Designs and waste management plans shall be in accordance with this Chapter and the following United States Department of Agriculture Natural Resource Conservation Service technical publications:***
>
> 1. ***Field Office, Technical Guide, as amended***
> 2. ***Agricultural Waste Management Field Handbook, as amended***

The *Agricultural Waste Management Field Handbook* (AWMFH) 651.0202 *Conservation planning process* under a.(9) *Geology* states the following:

> ***The geology of a site plays an important part in select- ing an appropriate AWMS. For this reason, the geology of the area in which the AWMS will be located must be evaluated. The groundwater table, variations in depth to bedrock or in soil depth, potential for sink- holes, and fractured or cavernous rock often eliminate use of some types of AWMS components.***

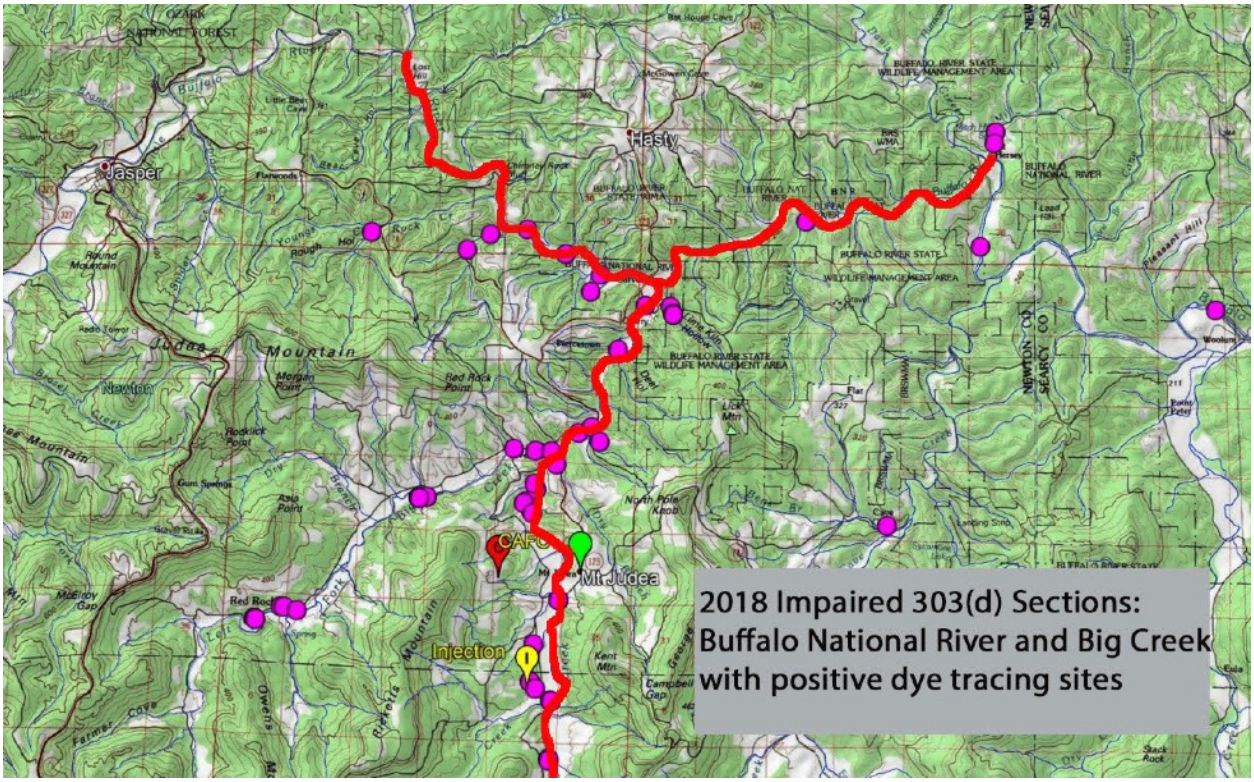
As noted in Comment A2, a detailed investigation regarding the fields should have been triggered by complex geologic conditions, primarily the widely recognized presence of the karstic Boone formation in the Springfield plateau. As noted in 651.0704(b) *Detailed Investigation, "Complex geology may require a geologist".*

As per the deposition of Monica Hancock, it was her responsibility to survey the fields for geologic conditions. Ms. Hancock is certified by the Arkansas Natural Resources Commission to write nutrient management plans and she has some college experience. She is not a geologist. Ms. Hancock surveyed the fields "many times" with the operator and also Karl Vandevender. Mr. Vandevender is an agricultural engineer who works closely with the Agricultural Extension Service who assists farmers. Mr. Vandevender is not a geologist, nor is the operator. Ms. Hancock, Mr. Vandevender, nor Mr. Henson recognized the above mentioned geological risk factors as they were not equipped or qualified to do so.

That a limited sampling revealed highly porous and permeable geological features in all three of the fields surveyed, implies that most if not all of the other spreading fields will have similar geological risk factors. That the widely understood presence of karst did not trigger a "detailed investigation", and that obvious geological anomalies were so readily identified by a limited study, speaks to the limits of the investigation in that it was not suitable or proportional to the risks described in Part A.

Comment F2 - This permit should be denied as ADEQ has proposed listing portions of Big Creek and the Buffalo as impaired, and C&H has been determined to be contributing at minimum, a portion of those nutrients

ADEQ's 2018 proposed 303(d) list of impaired waterbodies include Big Creek and 14.32 miles of the Buffalo National River. The Buffalo shows impairment both upstream and downstream of Big Creek's confluence. In regard to how C&H might be implicated as a source, the following illustration from the peer-reviewed study, *"Using Flourescent Dyes to Identify Meaningful Water Quality Sampling Locations And Enhance Understanding Of Groundwater Flow Near A Hog CAFO on Mantled Karst, Buffalo National River, Southern Ozarks. Dr. Van Brahana, et al."* shows impaired segments correlate closely with the dye trace study conducted by Dr Van Brahana. Dye injected at Mt Judea, in close vicinity of the C&H spreading fields, makes its way into the Buffalo, not just at the mouth of Big Creek, but a considerable distance both upstream and downstream as well. This clearly shows the possibility that a single waste source of a large size in a karst location, such as C&H Hog Farms, could very well impair waters throughout the impacted area.



Dr. Andrew Sharpley, head of the Big Creek Research and Extension Team (BCRET) which is monitoring C&H Hog Farms has stated that he considers Dr. Brahana an expert to whom he would defer in dye tracing and whose studies provide an indication of groundwater flow from the area of the hog farm. [*Sharpley Deposition, May 25, 2018, pg. 87*]

ADEQ describes the proposed impairment of Big Creek and the Buffalo in the following response to comments on the Regulation 5 permit from January:

> **"ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two sections of Big Creek and two sections of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Based on data for submitted by USGS for the 2018 303(d) list, ADEQ proposes listing Big Creek (AR_11010005_022) as impaired for dissolved oxygen."**

It is important to note that Big Creek was showing early signs of impairment in 2016, but ADEQ chose not to include Big Creek on the 303(d) list at that time because the data was not within a 5 year period of record – 4/1/12- 3/31/2015. C&H has now been operational since 2013 spreading millions of gallons of waste in the Big Creek watershed. There have been no other significant sources of nutrients identified as having been added during that time period to which the current impairment could be attributed.

It has been noted in Comment D1 that Big Creek Research & Extension (BCRET) data illustrates degradation for nitrates between the upstream and downstream monitoring stations. Nitrates as a nutrient could certainly result in dissolved oxygen exceedences as noted by ADEQ. This has since been acknowledged by ADEQ after reviewing statistical data interpretation by Dr. David Petersen:

> **"-BCRET data document that nitrate-N is variable; however, Figure 12 of the April 1 to June 30, 2018 BCRET Quarterly Report demonstrates that nitrate-N is higher downstream (BC7) than upstream (BC6). Chlorides and nitrates follow similar seasonal fluctuations in that they are higher during summer and autumn months when stream discharge is most influenced by groundwater. ADEQ reviewed Petersen's May 31, 2018 expert report, which presents an analysis of temporal trends among nitrate-N and E. coli from January 2014–December 2017 at ---BC6 and BC7. Mr. Petersen's analysis presents decreasing trends of ammonia and chlorides and increasing concentrations of E. coli at BC6. Yet, increasing concentrations of nitrate-N were observed downstream at BC7. The conflicting temporal**

analysis prompted Mr. Petersen to further review trends upstream to downstream. By analyzing paired concentration data (collected same day) at BC6 and BC7 from January 2014 through December 2017, Mr. Petersen reports significant increases in total nitrogen, ortho-phosphorus, and chlorides, but nonsignificant changes in E. coli and nitrate-N. The significant increase of nitrate-N in the house well and ephemeral stream does correspond to increases of total nitrogen at BC7. Mr. Petersen's analysis illustrates the complexities of evaluating water chemistry in karst systems. "

Although evidence indicating C&H as the primary contributor of nutrients to the proposed impaired segments of Big Creek and the Buffalo cannot be established without source tracking, the above data and acknowledged interpretation firmly establishes that at a minimum, it is a contributor and therefore discharging in violation of its permit. For this reason alone, the permit should be denied.

Comment F3 - This permit should be denied as the presence of widespread nuisance algae has steadily increased during the period of C&H operation, correlates with proposed impaired waters, and presents health risks to recreational users

Like most rivers in Arkansas the Buffalo National River periodically experiences some algae in late summer. However, residents began to notice particularly heavy algae blooms in the summer of 2015. Algae amounts can be highly variable from year to year and are influenced by multiple factors including weather conditions, flow volumes, and nutrients. The 2015 algae was not seen at that time as a serious concern directly attributable to C&H. However, with each successive year, the algae has appeared to become more prevalent. The areas of concern appear to begin near Carver close to the Big Creek confluence and continue downstream where it is especially heavy in low flow areas, particularly between Gilbert and Maumee.

In 2018, algae volume was recognized by state and federal agencies as having significantly increased, and although estimates are subjective, the length of river affected was said to increase from 20 to 70 miles. The increase was significant enough for the National Park Service to issue public warnings in a new release on July 27th, 2018 (excerpt below).

"The Buffalo River continues to experience significant algal growth this summer as hot and dry conditions persist. Most algae is harmless, but certain types can make people and pets sick if they swim in or drink water in close proximity to the

algae. This year a species of blue-green algae (also called cyanobacteria) has been identified within the river. This species has the potential to produce cyanotoxins, which can be harmful to humans and pets. Unfortunately, you cannot tell if the algae would produce cyanotoxins just by looking at it."

"A few visitors have reported illnesses after swimming in areas with algae this month. The National Park Service (NPS) has been working closely with the US Public Health Service (USPHS) and the Arkansas Department of Health (ADH) to determine the causes of the reported illnesses. The testing conducted so far has not identified a pathogen directly linked to algae; however, we are continuing to explore more extensive testing options with the Centers for Disease Control and Prevention (CDC)."

ADEQ also has recognized "the rapid expansion" of nuisance algae as seen in this excerpt from their response to public comments submitted in January 2018:

"ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo River"

On August 3rd, 2018 the Arkansas Department of Health (ADH) issued the following public warning to veterinarians with the subject: *Harmful algal blooms and toxin poisoning dogs.* The following is an excerpt:

"Harmful algal blooms (HAB) from blue-green algae (cyanobacteria) may be intermittently present in parts of the Buffalo River National Park, specifically the lower river region. These algae can produce toxins, such as microcystins and anatoxins, that affect people, pets, and livestock that swim in and drink from algae-contaminated water. Buffalo River National Park manages multiple high-use recreational swim/float areas where people frequently recreate with their dogs. Though we have received only a few reports of human illnesses possibly associated with HABs, we want to inform you of the current situation and provide additional resources should a potential case present at your clinic.

Oddly, ADH did not issue a similar warning related to the Buffalo directed to Arkansas physicians who might encounter people with such symptoms.

Multiple types of algae have been identified in the Buffalo, and in addition to the varieties that can be harmful, filamentous varieties that grow and bubble into solid surface coverage, will significantly heat the water in pool areas. This can result in an exponential growth of subsurface bacteria which also presents a significant risk to recreational users (or dogs) with cuts or abrasions. Symptoms from such bacterial infections will not likely be recognized as the result of algal

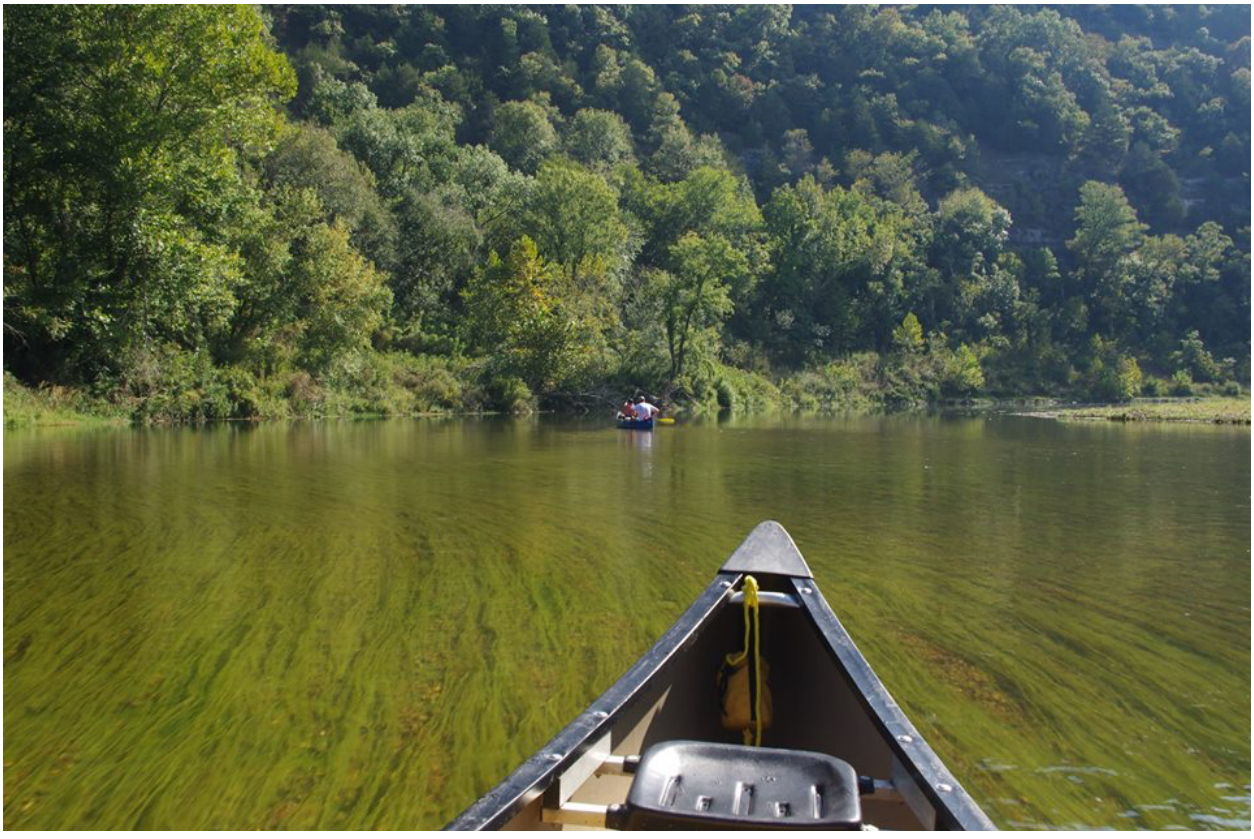
growth and such illnesses will likely be overlooked in any data sets regarding algal risk factors.



At this time, Arkansas does not have standards for measuring or recognizing changes in algal growth. West Virginia in response to algae on the Shenandoah River has an easily applied standard that looks at the amount of algae coverage from bank to bank at a given point along the river. If there are three such consecutive points at intervals along the river's length that are 80% covered by algal growth from bank to bank, then that part of the river is declared "*recreationally impaired*". The three lengthwise intervals correspond to the river width. "*Recreationally impaired*", indicates unsuitability for swimming, fishing, or even boating and raises health concerns. If Arkansas were to measure the 2018 algae on the Buffalo between Gilbert and Maumee using such a standard, that entire section would meet the West Virginia measure of "*recreationally impaired".* In West Virginia this would trigger actions to determine nutrient sources.

ADEQ has proposed adding Big Creek and 14.32 miles of the Buffalo National River above and below the Big Creek confluence to the 303(d) list of impaired waterbodies (see Comment F2). The Buffalo segment is proposed as impaired for low dissolved oxygen which is frequently a result of excessive algae and affects fish and biota. Excessive algae, in turn, is frequently influenced by excessive nutrient loads. It has been recognized by ADEQ that C&H is adding nitrates between monitoring stations (Comment F2), and this does not include reliable storm flow data which is when most nutrients are moving. As a result, it is not a huge leap of the imagination to conclude that increasing algae volumes are being influenced by C&H operations.


Buffalo National River
Gilbert-S Maumee
09/18/2018



Arkansas Regulation 2.301 defines *Extraordinary Resource Waters* as follows:

> **"(A) Extraordinary Resource Waters - This beneficial use is a combination of the chemical, physical and biological characteristics of a waterbody and its watershed which is characterized by scenic beauty, aesthetics, scientific values, broad scope recreation potential and intangible social values. (For specific listings, refer to Appendices A and D)**

The Buffalo National River is designated as an *extraordinary resource water* and as this is the highest designation, it incorporates uses of all lower designations such as this one that describes physical contact:

> **"(D) Primary Contact Recreation - This beneficial use designates waters where full body contact is involved. Any streams with watersheds of greater than 10 mi2 are designated for full body contact. All streams with watersheds less than 10 mi2 may be designated for primary contact recreation after site verification.**

The level of algal growth is a threat to ALL characteristics described above, including physical contact. The algal growth over time corresponds to the period of operation of C&H. The area of growth corresponds to downstream segments from C&H and the problem area is inclusive of the portion of the Buffalo that has been proposed as impaired. The evidence correlating C&H nutrients to the increase in algal growth is strongly compelling to the degree that this permit should be denied.

Comment F4 - There is a significant risk to endangered species from impairments and algae that are a likely result of C&H nutrients

The Buffalo River watershed is home to three species of endangered bats; the Gray bat, the Indiana bat, and the Ozark Big-eared bat. These insectivores are vital components of the Ozark ecosystem and any further threats to their stability should not be tolerated. These bats roost and live in a variety of known and unknown habitat near the Buffalo River and they feed and drink directly from the river. The presence of widespread algae blooms on the Buffalo River as reported this summer by ADEQ, the National Park Service and the USGS and the detection of toxic Blue-green algae in the river, present a clear and direct threat

to these endangered animals as demonstrated by multiple scientific papers.
"Mortality of Little Brown Bats (Myotis lucifugus carissima) Naturally Exposed to Microcystin-LR" Journal of Wildlife Diseases, 55(1), 2019, pp. 000–000 Ó Wildlife Disease Association 2019

The Rabbitsfoot mussel is threatened throughout its rapidly shrinking range. The continued presence and vitality of this filter feeding mollusk is critically important to the restoration and health of the Buffalo River. Its habitat must be protected from excess nitrogen and phosphorous running off from agricultural over application. The Buffalo River has been designated "critical habitat" by the Department of Interior for the Rabbitsfoot mussel *Theliderma cylindrical.*

Federal Register/Vol. 80, No. 83/Thursday, April 30, 2015/Rules and Regulations

Reference: "Survey of Threatenedand Endangered Bat Species on Big Creek by James W. Gore" Link:
https://buffaloriveralliance.org/Resources/Documents/Ex%203%20-%20Gore%20FINAL%20-%20truncated%20version,%20reduced%20size.pdf

Reference: "Survey of Threatenedand Endangered Bat Species on Left Fork of Big Creek by James W. Gore" Link:
https://buffaloriveralliance.org/Resources/Documents/Bat%20Survey%20Left%20Fork%20Final-2.pdf

Comment F5 - We include by reference the expert report and opinions prepared for BRWA by Dr. Michael Smolen, Lithochimeia, LLC

Dr. Smolen holds a Ph. D. in Environmental Science and Engineering and has worked since 1975 on agricultural water quality and agricultural pollution control and is knowledgeable about agricultural nutrient management. He is properly credentialed to provide expert opinions on this matter (Smolen Report, pg 1).

We support ADEQ's denial of the C& H permit based on statements included in the expert report prepared for BRWA by Dr. Michael Smolen, Lithochimeia, LLC, dated June 1, 2018, including but not limited to the following:

- **"Dr Smolen agrees with the "Blanz memo" that the lack of an acceptable Emergency Action Plan is a substantial deficiency, especially considering the catastrophic impact a pond failure could have on the Buffalo National River (Pg 2)**

- **Dr Smolen's opinion is that the waste storage ponds are improperly designed to assure "no-discharge" and provide inadequate freeboard to accommodate storm events. (Pg 3)**

- **Dr. Smolen states that no groundwater flow direction study was done to determine the directional flow(s) from any waste storage ponds or waste application sites which is essential to determine their potential impact on nearby drinking water wells. (Pgs 4-5)**

- **Dr. Smolen states that C&H failed to follow guidance of AWMFH 651.0703(b) regarding geologic assessments. (Pg 5)**

- **Dr. Smolen states that there were inadequate berm integrity assessments of the pond embankments, particularly in light of the known presence of underlying karst as verified by the Hallihan ERI studies as Harbor drilling. (Pg 5)**

- **Dr. Smolen states that there was inadequate pond construction quality assurance due to only one recompacted permeability test that is insufficient to determine liner integrity. (Pg 4)**

- **Dr. Smolen states that waste holding ponds should be designed and operated to a higher standard than the NRCS AWMH because Regulation 5 requires "no discharge". (Pgs 4-5)**

- **Dr. Smolen comments extensively on the inadequate field assessment for land application sites, especially due to the use of the Arkansas Phosphorus Index as the sole basis for assessing risk, neglecting any assessment of subsurface pathways in this known karst terrain. (Pgs 6-15)**

- **Dr Smolen concludes by agreeing with ADEQ's decision to deny the C&H permit:** ***"Overall Opinion: I concur with the decision of ADEQ to deny the Regulation 5 permit because the design of the animal waste storage and handling system fails to meet the requirements. The permit application fails to consider the influence of karst geology underlying the waste storage ponds and the proximity of the facility and its waste disposal areas to the Buffalo River, an Extraordinary Resource Waterbody (Arkansas Pollution Control and Ecology Commission Regulation No. 2, As Amended. (August 25, 2017) … It seems the waste storage ponds and the waste disposal system were designed for an area with no significant environmental concerns. Clearly this should not be acceptable for siting a hog farm in the Buffalo River Watershed. Numerous field studies conducted since 2012 show the entire area is underlain by karstic geology and most of the waste disposal areas have either steep slopes or highly conductive soils, that directly contribute to pollutants to groundwater and to the Buffalo River."*** **(Pg 16)**

- **Additional statements by Dr. Smolen which provide the basis for the above opinions are found in his report and are hereby incorporated in their entirety by reference.**

Comment F6 - We include by reference the expert report and opinions prepared for BRWA by Dr. Bert Fisher, Lithochimeia, LLC

Dr. Fisher has worked on technical environmental matters regarding the disposal of animal wastes deriving from geologic, hydrologic and hydrogeologic circumstances for more than 20 years. Dr. Fisher holds a Ph.D. and M.S. in Earth Sciences from Case Western Reserve University and a B.S. in Geology and Geophysics from Yale University. Dr. Fisher is a Certified Professional Geologist and a Registered Professional Geoscientist in the State of Texas.

We support ADEQ's denial of the C& H permit based on statements included in the expert report prepared for BRWA by Dr. Bert Fisher, Lithochimeia, including but not limited to the following:

- **"Dr. Fisher states that C&H is located on karst terrain which carries attendant risks and requirements which were not followed. (Pg 6)**
- **Dr. Fisher states that determining groundwater flow direction is a permitting requirement which was not met; there were inadequate investigatory bore holes; and no geologist was retained by C&H. (Pgs 7-8)**
- **Dr. Fisher states there was an inadequate evaluation of waste application sites but what limited evaluation that was done revealed the presence of epikarst, a sinkhole, indicating the likelihood of preferential pathways. (Pg 8)**
- **Dr Fisher states that because C&H failed to conduct adequate field assessments, including appropriate and required geological investigations, it did not meet the requirements to obtain a permit. (Pg 9)**

- **Dr. Fisher concludes: *"C&H Hog Farms' failure to conduct an appropriate field assessment of all land application sites contemplated in C&H Hog Farms Regulation 5 permit application, including, but not limited to, soil thickness and water capacity alone would have been sufficient grounds to deny issuance of a Regulation 5 permit to C&H Hog Farms. As a consequence of C&H Hog Farms' failure to conduct appropriate and required geological investigations the record developed by C&H Farms in support of their Regulation 5 permit application lacked necessary and critical information to support granting C& H Farms a Regulation 5 permit. The requirements to obtain a permit under Regulation 5 are minimum standards. The permit application submitted by C&H Hog Farms did not meet the minimum standards required by Regulation 5. ADEQ properly denied issuance of a Regulation 5 permit to C&H Hog Farms."***

- **Additional statements by Dr Fisher which provide the basis for the above opinions are found in his report and are hereby incorporated in their entirety by reference. (Pgs 10-18)**

Comment F7 - We include by reference the expert report and opinions prepared for BRWA by Tom Aley #1646, President and Senior Hydrogeologist: Ozark Underground Laboratory, Inc.

We support denial of the C&H permit based on statements included in the expert report of Arkansas licensed Professional Geologist Tom Aley, on May 24, 2018, "Hydrogeological Conditions in and Around C&H Hog Farms...." including but not limited to the following statements:

> **pp. 3-5 We agree with Professional Geologist Tom Aley's summary statements that C&H did not submit Reg 5.402 required information for investigations of groundwater flow direction and rates from waste storage pond sites and application fields, subsurface water tables, or adequate application field soil variation depths, and other subsurface karst features such as sinkholes, pinnacles, epikarst zones. We also concur that though promised by Andrew Sharpley of the BCRET, no dye trace studies were ever conducted by the team and that this lack has thwarted gaining accurate groundwater to surface (and vice versa) information. Professional Geologist Tom Aley states in Summary Opinion 9 that such a study would reveal that the operation sits on a losing stream karstic landscape that recharges liquids into the channel of the Buffalo River between Carver and Lick Creek. We agree with Aley's summary statements that C&H did not submit satisfactory Reg 5.402 required information for geotechnical investigation into the location of waste ponds in karst and that information submitted was inadequate for the AWMFH:**

Summary Opinion 13. It is my opinion that water samples from both Trenches 1 and 2 (downslope of the waste storage ponds) have demonstrated leakage from one or both of the waste storage ponds. The magnitude and severity of leakage from the ponds cannot be determined since neither the applicant for the Reg. 5 permit nor Big Creek Research and Extension Team (BCRET) has conducted groundwater tracing studies to identify groundwater discharge points for water from the waste storage ponds or developed water balance data.

pp. 8-9 BRWA concurs with Professional Geologist Tom Aley that a major recharge of groundwater discharge into the Buffalo River below Carver indicates karstic springs in the Big Creek subwatershed. As Big Creek is a major losing stream often going dry near the C&H operation, the recharge of the Buffalo from its karstic groundwater systems falls within the Big Creek topographic basin.

There are three surface watercourses shown on the Mt. Judea 7.5 minute topographic quadrangle map that have the word "dry" in their names. They are:

- Dry Creek. It is adjacent to C&H Hog Farms land application field 16.
- Dry Branch. It is about a mile east of several of the land application fields.
- Dry Branch. It is a tributary to the Left Fork of Big Creek about 2.3 miles west of some of the land application fields.

The existence and close proximity of these Dry Creeks and Dry Branches south, east, and west of C&H Hog Farms operation demonstrates that losing streams are a dominant karst feature in the vicinity of the hog farms and that the hog farms region is characterized by large amounts of groundwater recharge.

p. 17 BRWA agrees with Professional Geologist Tom Aley's epikarstic zone analysis that significant water storage and transport are known to occur in the epikarst zone of weathered bedrock characterized by extreme fracturing , vadose percolation and enhanced solution. This zone appears under some of the application fields as gravel lenses through which liquids can move rapidly to groundwaters.

pp. 25-26 BRWA agrees with Professional Geologist Tom Aley's opinion that Reg 5.406(C) and (D) apply to the seepage and leakage from C&H Hog Farms operations and field applications, and that they have provided insufficient information to show that waste is not entering waters of the state:

pp. 27-29 BRWA agrees with Professional Geologist Tom Aley's notation that an onsite professional geologist should be given high priority for selecting and evaluating an appropriate AWMS site as stated in the AWMFH. No professional geologist was used in the DeHaan C&H's site selection. *"Site geology information is clearly information that the operator needs to know long before he spends money on engineering design, permitting, and construction. The Reg 5. permit application (Bass et al., 2016 including information from DeHaan et al.,2012)*

almost totally ignores this requirement. The operator needs to understand that this is a karst site where approximately 65% of the annual water reaching the Buffalo River from the site will have moved into and through the groundwater system… The geological and hydrological requirements in Chapter 2 of the AWMFH are both reasonable and prudent. These requirements were essentially ignored in the application prepared by DeHaan et al.(2012) which was used in the subsequent Reg 5 permit application. As a result, the application is clearly not in compliance with the AWMFH as required under Reg 5".

Aley discusses the NRCS the required information that C&H, Bass and DeHaan failed to provide to "assure that the designated water use is protected" and that is required when planning an AWMS. Since the Buffalo National river is a "Primary Contact", "Outstanding Resource Water", an "Extraordinary Resource Water", our nation's *first* river to become a national park, Arkansas' prized recreational jewel, protected by the antidegradation policy, it is wholly unacceptable that there is no plan that assures or addresses this designated water use. The only acceptable plan would be to locate the C&H CAFO out of its present site in the prime BNR watershed.

pp. 2-9 As Aley reiterates from AWMFH Appendix 7A, the scientifically established fluorescent method of dye tracing for a groundwater flow directions and subsurface connectivity is standard. That it was proposed and then dropped with no explanation by Andrew Sharpley, leader of the taxpayer funded BCRET, despite an expert panel peer review that recommended it, has now become a glaring omission of the substantial information required for this permit. With the BNR being the receiving water of the Big Creek subwatershed, the highest priority of water quality must be ensured.

The Bass DeHaan C&H application failed to address the designated water use requirements for protection at all. Professional Geologist Tom Aley believes that the Buffalo River is already suffering now from the discharges that have gone unregulated because this operation's failure to supply adequate information:

p. 29-30 BRWA agrees with Professional Geologist Tom Aley that AWMFH Chapter 10 and Table 10-4 describe that waters used for primary human contact such as the Buffalo River have a high vulnerability for risk from CAFO liquid manure storage facilities.

p. 31 We agree with Aley's statement that the NRCS ground penetrating radar studies done in 2013-14 in application fields showed karst dissolution features of cutters, pinnacles, and sinkholes under the fields that drain surface water to groundwater, and that such a terrain is highly unsuitable for locating a CAFO.

pp. 31-32 BRWA concurs with Professional Geologist Tom Aley's analyses, and especially that: *"Given the abundance of karst features beneath the land application fields, it is my opinion that, if waters of the state are to be protected from manure contamination, then the fields associated with the C&H Hog Farms are not suited to land application of liquid hog manure".*

BRWA agrees with Professional Geologist Tom Aley that the geology of a site must be investigated and that a proper current groundwater table study was not submitted in the C&H application. Reg 5.402 requirements have not been met. The AWMFH p. 2-8 states that a qualified geologist should be given high priority to assess the application and facility sites. Since Aley is such a highly qualified geologist and experienced expert on karst, his assessment of the location must be taken into account.

P. 38 BRWA agrees with Professional Geologist Tom Aley when he refers to the AWMFH (p. 2-8) that states that an onsite professional geologist would have determined that the location of a CAFO and its waste storage ponds is highly unsuited for the site C&H chose to build upon without consulting the hand book first.

We concur with Professional Geologist Tom Aley that the AWMFH (p. 2-8) requires that investigations into groundwater must be made to map and determine direction of flow and receiving stream locations, as well as hydraulic gradient. (Appendix 7A)

pp. 41-42 BRWA agrees with Professional Geologist Tom Aley's assessment that discrepancies in the depth to bedrock borings reported by the DeHaan engineer and the boring log recorder show that such a hasty and unchecked process does not meet the AWMFH requirements for a site investigation beneath the waste storage ponds. Aley suggests that instead of a site investigation into the karst suitability for siting a facility, this was merely a probe to find suitable clay soils to be used in constructing the liners. He also states that the borings did nothing to confirm they had delved 10 feet into bedrock, that instead of ascertaining bedrock, the auger could very well have encountered a large rock or pinnacle, as is common in epikarst.

Table 9. Reported depths of borings in the vicinity of the waste storage ponds and buildings. Boring logs from GTS Inc. Boring locations and depths as shown on DeHaan et al. (2012) Sheet 3, detailed proposed site plan.

Boring	Total depth as shown on boring logs	Total depth as shown on DeHaan et al. Sheet 3.
Bore Hole 1	13.5 ft.	13.5 ft.
Bore Hole 2	18.5 ft.	23.5 ft.
Bore Hole 3	11.5 ft. Auger refusal	18.5 ft.

pp. 43-44 BRWA asks that ADEQ evaluate carefully Professional Geologist Tom Aley's assessment of the Harbor Drilling Report's explanation of its boring process at the C&H CAFO. Aley disagrees with the explanation as follows from the data reported in Table 10:

the data in Table 10 it is reasonable to conclude that:

- The "clay seam" between 18 and 18.5 feet was a filled solutional opening that took little if any water.
- That there was a water loss zone at about 25 feet.
- That there was a larger water loss zone between 28 and 38 feet as indicated by the fact that the driller lost circulation.
- That there was another water loss zone at about 59 feet.
- That there are one or more permeable zones between 98.5 and 120 feet.

At the end of the drilling I cannot find any record of a measurement made of the static depth to water in the well.

He goes on to explain that the refilling of the hole with grout required 59% more grout than the crew had estimated. We agree with Aley's determination that this grout filled "solutionally enlarged openings", not fractures. He states that this investigation does not show that the waste storage ponds do not leak or that they are not a threat for collapse. We know that such openings are typical in the karst geology and are difficult to map. They allow liquids to travel in unpredictable routes beneath the surface to groundwater.

pp. 45-48 We agree with Professional Geologist Tom Aley's response to the DeHaan analysis of the clay liner composition. Instead of the fatty clay the firm describes, the results from the boreholes used to determine the suitability of the clay for liner material reports clayey gravel with sand and chert fragments. There were no sieve size measurements so the chert and gravel amounts are unknown in the clays used from this source.

pp. 49-51 Aley describes the initial erosion and attempts to control it that C&H performed. His analysis reveals that because of rills, desiccation, and piping that takes place in the depths of the pools, there is likely discharge occurring, and since there have been no water balance or pumping data records or measures taken to discount this evaluation, the permit must be denied. No credible measuring device for leakage was ever installed at this site.

pp. 52-53 Professional Geologist Tom Aley examined a study done by Dave Mott (former BNR , USGS, Army Corps of Engineers hydrologist) that tested the BCRET trenches for nutrients and ammonia in the spring of 2017. It appears that waste storage pond 2 is likely leaking waste since the nutrient numbers were greater in its trench than in the WSP 1 trench. If no leakage were occurring then the numbers should have been relatively equal. In the WSP 1 trench there was a spike of ammonia two to three times in magnitude greater than background conditions. Ammonia commonly develops in such anaerobic states as the depths of waste storage ponds.

Aley also references James Petersen's analysis of BCRET water quality data that shows contamination of the wells near the house and waste storage ponds as evidence that Reg 5 requirements for no discharge have not been met by the information submitted by C&H in its application for a permit.

Comment F8 - We include for reference all of the following responses made by ADEQ to January 2018 comments regarding the Reg 5 permit

In addition to ADEQ's Statement of Basis for denying the C&H permit, BRWA also includes for reference the following statements by ADEQ contained in its revised responses to public comments received during Public Comment Period beginning on February 15, 2017, and ending on April 6, 2017 . These additional responses, based on new information received by ADEQ since initial responses were prepared, further support the justification for denying the permit.

> **-The Department amends its previous response. Upon consideration of the submitted permit application, the public comments on the record, and other subsequently available and relevant data and information, the Department denies issuance of the permit.**
>
> **-The preparation and technical review of this permit application were conducted by the Office of Water Quality staff with support from other resources within ADEQ including the Office of Law and Policy and the Office of Land Resources. The review team was led by Dr. Robert Blanz, Ph.D., P.E., Chief Technical Officer for ADEQ**
>
> **-A facility located in a sensitive geologic area must have an Emergency Response Plan to address any failure of the waste containment system. Section 651.0204(a) of the AWMFH requires facilities with waste impoundments with embankments to consider the risk to life, property, and the environment should the embankment fail. Pursuant to Section 651.0204(b) of the AWMFH, a thorough geologic investigation is essential as a prerequisite to planning seepage control for a waste impoundment. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH.**
>
> **-The Department received a comment from the Arkansas Department of Health regarding C&H Hog Farms, AFIN 51-00164, ADEQ Permit No. 5264-W that stated, "Permit requirements for best management practices and stream buffer zones should be strictly adhered to during the land application of swine wastes to prevent water-borne pathogens from leaving the sites."**
>
> **-APC&EC Regulation 5 requires the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. The AWMFH requires a detailed geologic investigation for complex geologies, i.e. karst, that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The**

proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed studies.

-The permit application proposed the following numbers of swine: 6 boars, 2,252 gestating sows, 420 lactating sows, and 750 nursery pigs. The number of nursery pigs (pigs less than 55 lbs.) given in the Reg. 5 application is less than the number of pigs less than 55 lbs. in the applicant's NOI for coverage under ARG590000 (Expired on October 31, 2016).

-The Department acknowledges that C&H Hog Farms, Inc. is located in the Boone Formation, an area known to have karst. Ground penetrating radar studies at Fields 1, 5, and 12 demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3. Geotechnical investigations are necessary to demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed investigations.

-APC&EC Regulation 5 requires liquid animal waste management systems and associated land application to be in the designs and waste management plans for liquid animal waste management systems to be in accordance with the AWMFH. The AWMFH requires a detailed geologic investigation for complex geologies, i.e. karst, that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D.

-The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. Additionally, ground penetrating radar studies demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3. Geotechnical investigations are necessary to demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed investigations.

-ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two sections of Big Creek and two sections of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Based on data for submitted by USGS for the 2018 303(d) list, ADEQ proposes listing Big Creek (AR_11010005_022) as impaired for dissolved oxygen.

-BCRET data document that nitrate-N is variable; however, Figure 12 of the April 1 to June 30, 2018 BCRET Quarterly Report demonstrates that nitrate-N is higher downstream (BC7) than upstream (BC6). Chlorides and nitrates follow similar seasonal fluctuations in that they are higher during summer and autumn months when stream discharge is most influenced by groundwater. ADEQ reviewed Petersen's May 31, 2018 expert report, which presents an analysis of temporal trends among nitrate-N and E. coli from January 2014–December 2017 at ---BC6 and BC7. Mr. Petersen's analysis presents decreasing trends of ammonia and chlorides and increasing concentrations of E. coli at BC6. Yet, increasing concentrations of nitrate-N were observed downstream at BC7. The conflicting temporal analysis prompted Mr. Petersen to further review trends upstream to downstream. By analyzing paired concentration data (collected same day) at BC6 and BC7 from January 2014 through December 2017, Mr. Petersen reports significant increases in total nitrogen, ortho-phosphorus, and chlorides, but nonsignificant changes in E. coli and nitrate-N. The significant increase of nitrate-N in the house well and ephemeral stream does correspond to increases of total nitrogen at BC7. Mr. Petersen's analysis illustrates the complexities of evaluating water chemistry in karst systems.

-In the April 1 to June 30, 2018 Quarterly Report, BCRET presents data that documents a statistically significant increase of nitrate-N in the ephemeral stream (BC4) since 2014. However, BCRET notes that chloride, a conservative tracer, did not show a statistically significant increase. Four years of data also indicate a steady increase of geometric mean nitrate-N within the house well (W1) (BCRET April–June 2018, Figure 24). Increased nitrate-N in both the ephemeral stream and the house well does suggest that these systems may be hydrologically connected to areas where farm activities take place. APC&EC Regulation 5 requires the design and waste management plans for liquid animal waste management systems be in accordance with the AWMFH. The AWMFH requires a detailed, geologic investigation for complex geologies, i.e. karst, that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. Detailed geologic investigations are necessary to determine that the ephemeral stream and house well are not influenced by the waste storage holding ponds, on-farm activities, or waste management practices. A dye tracing study may be necessary to understand the movement of groundwater in this complex geologic system.

-Data supplied from the C&H Hog Farms, Inc. 2014–2017 annual reports document an increase of soil test phosphorus (STP) from 20 ppm to 68 ppm in Field 17 to a more significant increase in Field 1, which increased from 45 ppm to 173 ppm. As stated in University of Arkansas Division of Agriculture Soil Phosphorus: Management and Recommendations FSA10292, "Arkansas scientists agree that there is no agronomic reason or need for STP to be greater than about 50 ppm (Mehlich-3 extraction)." As of the C&H Hog Farms, Inc. 2017 Annual Report, results of all soil test phosphorus were greater than 50 ppm. FSA95163 states that the phosphorus index approach is most appropriate as it accounts for multiple risk factors and provides a better risk assessment of P loss in runoff. Despite a reported increase of soil test phosphorus in waste application fields, the Arkansas

Phosphorus Index may still allow application of swine waste because of other factors including phosphorus source potential, transport potential, and best management practice multipliers. However, "with the move from agronomic to environmental concerns with P, soil P testing has been used to indicate when P enrichment of runoff may become unacceptable. A common approach has been to use agronomic soil P standards, following the rationale that soil P in excess of crop requirements is vulnerable to removal by surface runoff or leaching" (FSA1029). "A large amount of research between 1985 and 2000, showed that as STP (Soil Test Phosphorous) increased, especially in the top 2–4 inches of soil, so did the concentrations of soluble P in runoff (Figure 1)" (FSA1029). Geotechnical investigations at all land application sites in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3 are necessary to demonstrate that this facility is contributing to water quality impairments of Big Creek and the Buffalo National River.

-"A large amount of research between 1985 and 2000, showed that as STP (Soil Test Phosphorous) increased, especially in the top 2–4 inches of soil, so did the concentrations of soluble P in runoff (Figure 1)" (FSA1029). Geotechnical investigations at all land application sites in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3 are necessary to demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River.

-While no losing/gaining study has been performed to date on Big Creek between BC6 and the confluence with the Buffalo National River, BCRET notes seasonal dryness and rewatering between these two sites. Thomas Aley notes in his expert report of May 24, 2018, that "Big Creek also goes dry during much of the year where it passes over the Boone Formation near C&H Hog Farms." Dye studies performed by Brahana et al. (2016)7 and hydrologic studies by Murdoch et al. (2016)8 in the Big Creek watershed indicate the connectivity of karst hydrology of the Boone Formation. Thomas Aley's May 24, 2018 expert report thoroughly explains karst geology and provides supporting evidence of the deficiencies of C&H Hog Farms, Inc.'s Regulation 5 application to address land application in karst topography.

-Although the analytical data from the Harbor Drilling Study did not indicate a leak at the borehole drilling location at the time of the sampling, the Study does not support the conclusion that there is not any leakage from the ponds.

-The AWMFH requires a detailed, geologic investigation for complex geologies, i.e. karst, that includes, but is not limited to, groundwater flow direction studies, borings in the pool areas, berm integrity assessment, pond construction quality assurance, and assessment of high-risk areas of land application sites. Detailed geologic investigations are necessary to determine that the ephemeral stream and house well are not influenced by the waste storage holding ponds, on-farm activities, or waste management practices. A dye tracing study may be necessary to understand the movement of groundwater in this complex geologic system.

-ADEQ is working to support a collaborative study with the Arkansas Game and Fish Commission, US Geological Survey, and the National Park Service focused on the distribution and causation of the rapid expansion of filamentous algae in the Buffalo River

-Seepage from waste storage ponds has the potential to pollute surface and ground water. The record included one recompacted permeability test that is insufficient to determine liner integrity. The necessary soil investigations including, but not limited to, percentage of fines and soil permeability evaluations, have not been performed at this facility in accordance with the AWMFH 651 Table 10-4 and Appendix 10D. Plasticity index analysis was performed on one sample of the in situ clay material in boring 2. The variability in the regolith expected in this geologic setting coupled with the insufficient data creates additional concerns about the siting and soil sources for the clay liner. The required number of borings were not advanced within the pool areas in accordance with AWMFH 651.0704(b)(4); these additional borings would have provided more data for assessment of clay source material. Proper soil investigations for the liner material are necessary to determine the suitability and location of the clay source material and to consider any additional geotechnical testing to confirm material properties, which will reduce the potential for downward and/or lateral seepage of the stored wastes.

-Pursuant to Appendix 10D of the AWMFH, it is the position of NRCS that special design measures are necessary where agricultural waste storage ponds are constructed in soils with high calcium content or highly unfavorable geologic conditions, such as karst formations.

-Jason Henson described the equipment used for agitation of the waste storage ponds in his deposition of May 15, 2018. Dr. Sharpley, in his deposition of May 25, 2018, briefly discussed agitation of the waste storage ponds. (p. 464)

-A groundwater flow study has not been submitted to the Department for review. The Department has no knowledge of any groundwater studies that may have informed the placement of the interceptor trenches. The information on the interceptor trenches provided in the BCRET Quarterly Report for July 1 to September 30, 2014 is not sufficient to determine the appropriateness of the placement of the interceptor trenches for the purpose of monitoring leakage from the waste storage ponds. At this time, the Department does not have sufficient information to comment on the appropriateness of placement of the trenches or on the sufficiency of those trenches as a monitoring system for the waste storage ponds.

-The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. Additionally, ground penetrating radar studies demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3. Geotechnical investigations are necessary to demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National

River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed investigations.

Comment F9 - We support denial of the C&H permit based on statements included in the deposition transcript of Caleb Osborne on May 17, 2018, Associate Director for the Office of Water Quality, ADEQ including but not limited to the following:

Mr. Osborne agreed with Dr. Blanz about the decision to deny the permit, since underlying the decision was, "Can we defend the permit?"p. 76, lines 3-7: He stated that the director charges Osborne with the "importance of issuing defensible permits."

Mr. Osborne stated that *"A schedule of compliance was considered but the limitation of the information we needed was so fundamental to our ability to permit this site to make a sound, technical, scientific justification for permitting decision for C&H to continue operating, that tool just wouldn't really work correctly.... It was considered but ultimately determined to just not be workable... and the denial was the appropriate decision.*"

We agree that ADEQ has the authority to reverse its draft decision for approval based on the fact that the C&H Hog CAFO Reg 5 application for was for a new permit, not an existing one. p. 85 lines 1-5

Mr. Osborne: *"This was a new -- from the standpoint of Reg 5, it was a new permit.... subject to all the requirements of Reg 5. There was no exemption or exclusion on the basis of previous coverage."* p. 86 lines 1-18

Mr. Osborne confirmed that he had answered Henson's question about "existing farm" with the need for C&H to comply with the requirements of Reg 5.

Comment F10 - We support denial of the C&H permit based on statements included in the deposition transcript of ADEQ Director Becky Keogh, Chemical Engineer, on May 25, 2018, including but not limited to the following:

Director Keogh states that permit decisions include consideration of questions that arise through the comment period. Her statement indicates that public

comments may influence and inform the final decision made on a permit by bringing up pertinent data and information that ADEQ had not considered previously in its draft decision. This supports the ADEQ decision to deny the C&H Reg 5 permit. (p. 18, lines 4-7)

When asked about consideration of alternatives to a denial of the C&H Reg 5 permit application, Director Keogh recalls team discussion about the possibility of using a conditional permit with a *"Schedule of Compliance"* that listed detailed information that could be submitted by the applicant. ADEQ made the decision not to utilize this alternative because the record of information was too incomplete to demonstrate compliance with Reg 5. (pp. 21-24)

In a meeting with Governor Hutchinson about the C&H Reg 5 denial decision prior to issuing it, Director Keogh relates that her administrative superior, the Governor, was aware and supported the decision to deny the permit. (pp. 27-28)

BRWA supports the ADEQ decision to deny this permit that was reviewed by the Governor before it was issued, including the explanation of the reasons the permit application record was incomplete. (p. 32)

Director Keogh was questioned about when the so called "Blanz memo" was made available to C&H. BRWA agrees with the ADEQ that the decision to deny the permit was based on the terms of Regulation 5 and that applicants have the responsibility to adhere to the regulation and the AWFH and the Technical Guide that Reg 5 includes, and to submit the information required for the ADEQ to consider when evaluating an application. (pp. 58-59

Comment F11 - We support denial of the C&H permit based on statements included in the deposition transcript of Katherine McWilliams, engineer, at Arkansas Department of Environmental Quality (ADEQ) on May 16th, 2018, including but not limited to the following:

Katherine McWilliams is an ADEQ Engineer (not professional), no discharge permit section, Reg 5, and holds a B.S. in biological engineering and biology

BRWA points out that many concerned individuals took the time and effort to read the entire Regulation 5, and the AWMFH and technical guide it relies upon in order to see if the C&H permit application satisfied the Reg 5 liquid swine waste conditions. The C&H owners and/or the engineers and experts they relied upon for making sure their permit would be in compliance with the regulation could certainly have done the

same. As Katherine McWilliams confirmed in her deposition, the AWMFH and technical guide are comprehensive.

McWilliams reviewed the Nutrient Management Plan (NMP), and served as a primary reviewer of the C&H Reg 5 application, preparing the initial draft document. She explained that administrative completeness is filling out and signing forms and that technical completeness is what's included in the NMP to see if it complies with Reg 5 requirements. When both are reviewed and determined to be complete pending public comments, then it goes out for public comments.

> **p. 15: BRWA agrees with McWilliams statement that the Reg 5 permit is an individual permit in the state of Arkansas and that Reg 5 permits rely upon the site specific conditions in the AWMFH and the technical guide. When asked about Dr. Blanz's added conditions, she responded: "So it's an individual permit (Reg 5) there were some individual conditions, specific conditions added... for the facility."**
>
> **pp. 41-43: McWilliams confirms that based on comments ADEQ received, they (questions about the technical completeness of the permit) could not be adequately answered without additional information, which had not been provided by C&H. She explains that additional information would have been from the geologic investigation from the handbook.**
>
> **pp. 46-48: When asked about a groundwater flow direction study and waste storage pond, McWilliams says it referred to the AWFMH, Chapter 7, and would have been included as part of the geologic investigation information for the site which was requested by ADEQ.**
>
> **pp. 53-54: When asked about the compaction test and permeability analysis of the pond liner, McWilliams says it was part of the "as built" supplemental information requested by ADEQ.**

Comment F12 - We support denial of the C&H permit based on statements included in the deposition transcript of Jason Henson, President of C&H Hog Farms, on May 15, 2018 including but not limited to the following:

> **Several statements are made describing how waste is removed from the holding ponds. It is mentioned that Pond #1 is always agitated prior to removal of waste (pages 47-58, 188) Mr Henson says the only way they monitor the amount of sludge is by manure analysis reports. Higher nutrients reflect higher amounts of sludge. (page 189) The NMP which dictates application rates for each field is based in part on manure samples taken by Dr VanDevender. (page 59) These**

samples are drawn from different levels of the pond and then composited into a single sample (page 59, 60) No mention is made of agitation prior to sampling and presumably the pond is not agitated during sampling. There seems to be an assumption that a composited sample is equivalent in nutrients to an agitated pond. Dr Sharpley, in his deposition (Sharpley deposition, pages 122-123) states that ponds should NOT be agitated prior to removing waste but that the sludge should be allowed to accumulate and be removed in a separate procedure due to the high nutrient content. It is possible that the waste actually being applied from Pond #1 is higher in nutrients than what the samples indicate. There is no measure in place to ensure that applications are being done in compliance with the NMP.

Mr Henson believes that the BCRET quarterly reports, the GPR and ERI studies, and Harbor drilling study constitute "geological site investigations" (pages 136-138). However, he also says he did not provide the GPR reports to Monica Hancock, the nutrient planner (page 190). These limited studies clearly do not meet the requirements of the AWMFH for locations in complex geologies such as karst, including such things as groundwater flow direction studies, borings in the pool area, berm integrity assessment, and BCRET studies limited to 2 fields, one of which includes a doline (sinkhole) do not come close to meeting the requirements for evaluation of site-specific conditions of waste application sites of 17 permitted fields. As pointed out in the ADEQ Statement of Basis, the Harbor drilling investigation indicates unequivocal presence of karst and the GPR data, limited as it is, indicates soils which require additional geotechnical investigations to assure their suitability for waste applications.

There are 2 *"house wells"* at the C&H barns. The first well was drilled at time of construction (pg 197). The second was drilled *"after the first one"* to assure adequate water supply (pg 199). The second well pumped into a cistern and comingled with water from the first well. BCRET samples well #1 but not well #2. They are both pumped into and used from the same holding tank. Well #1 is sampled out of a hydrant outside before water goes into the tank. (pg 201). E.coli showed up in Well #1 in early BCRET testing and it was determined that the contamination was coming from the cistern. BCRET then began sampling directly from a faucet on Well #1. When E. coli became undetectable it was assumed that the cistern or waterlines were somehow contaminated, not the groundwater. Because Well #2 also supplies the cistern it could be that it is the source of contamination. However, no further information has been provided to explain the source of contamination and BCRET claims it does not have the resources to sample Well #2. The ADEQ Statement of Basis states that "increased nitrate-N in both the ephemeral stream and house well [well #1] suggests that these systems may be hydrologically connected to areas where farm activities take place". It is also possible that E.coli is present in well #2 and may be the result of the same hydrological connection and may be another indicator or the source of impairment of Big Creek.

Comment F13 - We support denial of the C&H permit based on statements included in the deposition transcript of Dr. Jamal Solamanian on May 16 and 17, 2018, including but not limited to the following:

Dr. Solamanian's credentials with regards to review of the C&H permit are clear. He holds a PhD in biological engineering, is the ADEQ Engineering Supervisor, and was described as an expert witness in the Blanz deposition, specifically regarding regulations, permitting and engineering. (Deposition Vol. 1, page 6)

> **ADEQ has the authority to reverse its draft decision based on valid public comments. "If the public comments bring to our attention, if they have enough scientific reason, facts that show that this facility will have potential impact to the environment that's when we start evaluating other aspects" (V1, pg. 22)**
>
> **Compliance with the AWMFH is a requirement, not an option: "Plans are supposed to comply with AWMFH" (V 1, pg 28)**
>
> **Dr Solamanian agrees that Waters of the State includes groundwater and no waste is allowed in groundwater. (Volumn 2, pg 107) and agrees that if there is evidence of seepage or leakage to groundwater occurring under one permit, it will continue under another. (V 2, pg 109)**
>
> **Dr Solamanian agrees that most fields are on karst (V2, pg 116)**
>
> **Dr Solamanian agrees that no geologist or hydrogeologist was involved in the permit design (V2, Pg 123)**
>
> **Dr Solamanian agrees that no study of groundwater flow direction was done (V2, pg 125)**
>
> **The public comments provided grounds for denial of the permit. Dr Solamanian states that if "somebody presents sufficient scientific data or facts which show that a facility as built or exists is causing an environmental impact, that is grounds for denying a permit." and he agrees that such information was provided through public comments. (V2, pg 127,128)**
>
> **The C&H permit as written is legally indefensible. Dr Solamanian agrees with the statement in Dr Robert Blanz's deposition, "We did not feel we could defend the permit as written given the public comments we received" (V2, pg 131)**
>
> **There is the potential of catastrophic impact to Big Creek and the Buffalo National River. Dr Solamanian agrees that it is "likely" that, if the pond levees fail, waste will flow into Big Creek and the Buffalo. (V2, Pg 132) He agrees that the Buffalo, as a National Wild and Scenic River and Outstanding Resource Water is afforded the**

highest level of protection of any water body possible. (V2, pg 133) [Such a catastrophic event would violate A.C.A 8-4-217 (2).]

Dr Solamanian states that karst pathways can serve as conduits or hydrogeological connections to surface waters and points to the importance of studying underground flow paths: "it's very difficult to know the underground flow direction in karst. Eventually it recharges through springs back into surface waters" (V2, pg 134)

Dr Solamanian acknowledges that nutrients which enter surface waters can lead to excessive growth of aquatic vegetation and lead to Biological Oxygen Demand and ultimately low dissolved oxygen resulting in impairment (V2, pg 135)

All of the above statements by a qualified expert, when considered in light of the inclusion of Big Creek and the Buffalo in the 2018 Draft 303(d) List of Impaired Waterbodies, provide a strong basis for concluding that discharges from C&H holding ponds and application fields are entering Big Creek and the Buffalo and that C&H is a major contributor to impairment of these streams. The C&H permit should be denied.

Comment F14 - We support denial of the C&H permit based on statements included in the deposition transcript of Dr. Robert Blanz in May, 2018, including but not limited to the following:

Dr. Robert Blanz has a PhD in civil engineering from Texas A & M. Dr. Blanz has been in the field of environmental regulation/protection for over 40 years. Dr. Blanz, Chief Technical Officer of the Arkansas Department of Environmental Quality (ADEQ), has been selected to serve on the Environmental Protection Agency's (EPA) Science Advisory Board (SAB) and Board of Scientific Counselors (BOSC).

Dr. Blanz's main expert opinion relates to the content of the record as it relates to the requirements of the regulation, primarily having to do with the geological and hydrogeological information, as well as some of the engineering construction requirements for part of the berm, as well as the field investigation for the application fields. (p. 22)

In Dr. Blanz's opinion, a complete geologic investigation includes both the subsurface geology, and in this case, the questionable integrity from a hydraulic standpoint; "*the determination that there may be voids underneath those ponds; questions about the stability of the levees as based to the geology.*" The BCRET study does not qualify in any regard as a geologic investigation. It's a water quality

study. (p. 89)

Big Creek Research Extension Team-ADEQ wanted to continue to monitor interceptor trenches as evidence of seepage from the lagoons after the Extension Service project is over. Since then, the Extension Service project has been extended, but, at some point, ADEQ believes they "*still need to monitor for seepage even after the Big Creek project is over with.*" (pgs. 37-39)

The Harbor Drilling study. Dr. Blanz: "*…was an intrusive geologic investigation…. it's only one boring, and you don't get a full picture of the geology with one boring*". (pgs. 90-91)

AWMFH Table 10-4 Criteria for Siting Investigation and Design of Liquid Manure Storage Facilities. Borings within the pool areas, per Dr. Blanz: "*if you go into the upper left-hand column on vulnerability, you'll see large voids, for example, karst, lava tubes or mine. Well, we know we have karst. And then you go across, and you'll see some risk associated with that, and then you'll also see that in karst, the recommendation is evaluate other storage alternatives". … "The water height anticipated on the left-hand column, the second block down, height anticipated to groundwater elevations between five to 20 feet below the invert"… "The significance of the range five to 20 in Table 10-4 ". You still need the borings for a couple of reasons. … "I've personally seen liners fail when the groundwater elevation comes up below the inverted liner. So you don't want that to happen. So you need to know where the groundwater elevation is."* (pgs. 91-96)

AWMFH Table 10-4 of the handbook - Per Dr. Blanz: "*...evaluate other storage alternatives or properly seal well and recalculate vulnerability. That means evaluate other storage alternatives, a waste lagoon - liquid manure storage facility, an earthen- is not appropriate in areas with large voids or karst topography and it should look at other alternatives".* (pgs. 160-161)

Groundwater Assessment a groundwater flow directional study, 651.0703 7-15 Factors affecting groundwater quality considered in planning-Refers to planning the construction of the waste management system. There was a determination made that what was there already at the time of the Reg 5 permit did not meet the Reg 5 requirements. Dr. Blanz: "*The decision was made by the review teams. The location of the lagoons is on a very steep slope in the epikarst environment. ADEQ doesn't know where the leakage was going, how fast it was going, what the hydraulic conductivity is. ADEQ doesn't know anything about the subsurface permeability or the flow direction, which in karst is very difficult to determine. So the question is which way is the groundwater going and in what speed and what amount, and given the environment there, it could very well be impacting the surface water".* 651.0703(b), (b) is on 7- 16 is not required by the handbook but Dr. Blanz thinks it's just a good engineering practice. There is absolutely judgment of the planner. Dr. Blanz does not recall if C & H was specifically told that they needed to do a groundwater flow direction study before the permit application was denied. ADEQ's position was that the regulation says it should be done and the consideration was given that they're in the handbook and no consideration was given. (pgs. 85-89)

Dr. Blanz is aware that there are 3 borings, not all in the pool area. One of them was in pond number one, one of them was in the west levee of pond number two,

and the other one was underneath one of the houses. To make that determination, he reviewed the engineering design. [Exhibit 10 As Built Engineering Plan Sheets] [Exhibit 11 QA/QC Soil testing results April 12, 2013] Dr. Blanz reviewed the As Built Engineering Plans and the QA/AC Soil testing results, which were submitted with C & H's Reg 5 application, when ADEQ was drafting the Reg 5 permit. For the geologic assessments, Dr. Blanz thinks it was a combination of the data that was information available to him in the application as well as the handbook, not the As Built and the QA/QC. The invert of the ponds is the lowest elevation, the bottom of the liner. The highest invert means you have an invert, for example, a pipe, and it's draining this way, and then the highest portion of the invert is up on the upper end. Purpose of borings under geologic assessment - the handbook suggests borings to be taken periodically, again to determine what the subsoil is and to determine what the groundwater elevation is. It's really multi-purpose. If Pond area excavation does not go below the bottom of the pond, it won't give same information as a boring. Harbor drilling identified depth to groundwater. At that boring, they hit groundwater at about 120 feet, somewhere in that range. The drilling did not provide information that Blanz is trying to ascertain in first bullet point-geologic assessment. Dr. Blanz stated: *"not in that kind of geology, not in karst geology. He can't be sure that there's not a solution channel or epikarst or some other geologic feature under the pond unless he drills under the pond"*. Borings that are required would have to be under the pond floor-the basin. Pond has to be emptied to get equipment in there. (pgs.99-112)

<u>Borings within the pool area</u> to ascertain the foundation of earth filled structures 7-21. Dr. Blanz is looking for the characterization of the substrate of the ponds. Per Dr. Blanz: *"There are several things. First of all, how are you going to compact it with the liner if there are any voids in the karst -- epikarst underneath the pond? That could cause it to fail"*. These borings would be like the ones referred to in the bullet point [see Blanz memo] above that you'd have to drain the pond and then do the borings- 651.0704(b)(4). Part (a) is on page 7-19 and refers to preliminary investigation. Part (b) refers to a detailed investigation. If you look in (a), it says a detailed investigation must be scheduled if reliable information for design cannot be obtained with the tools available during the preliminary investigation. Is is a complex geological site, and it needed a more detailed investigation than what Dr. Blanz was able to find in the record. If you look down at the last sentence, Blanz says you can accomplish all three of these bullets with the same borings. Ponds would have to be drained and then the borings would be taken within the pool area. Same borings could be used to comply with 3(a), (b) and (c). "*In the epikarst area, you can have voids and solution channels, and if you have a pond sitting there on top of that and the pond is leaking, which the design calculations say that it was, then it can only enlarge those void areas, and your chance of failure are greater*". (pgs. 112-116)

There were handwritten calculations based on the permeability and the depth of the water, what they calculated the leakage rate in terms of gallons per acre per day. Dr. Blanz thought it was in Exhibit Number 11, but this is a different version than Dr. Blanz was looking at, but it had to do with the permeability test, and then it had a sheet in there with the calculations. Exhibit 11 is some background information on the compaction used in the nuclear density. It has the one remote permeability test, Proctor test, and the rest of it is the data on the compaction. Dr. Blanz assumes it's compaction of the levees. The Reg 5 permit specifically refers to the handbook in terms of the construction, the planning, everything that goes into the facility. Dr. Blanz is an engineer, not a geologist, but reading the geologist logs

in the Harbor drilling report, it is clearly a karst area from the from how geologists logged it, the voids they found, the solution channels, those kinds of things. There was one void right at the 120 foot mark, right when Harbor stopped drilling, they found groundwater (pgs. 116-122)

<u>Berm integrity assessment</u> - borings are required in the embankment centerline of the berms. 651.0704(b)(4) 7-21. Dr. Blanz notes: *"It has to do with just borings for foundations of earthen structures. These four test borings or pits on the proposed embankment centerline or one every 100 feet"*. Drawing number 13, the bottom profile- *"you'll see that there's a standard depiction, it's not a depiction of this drawing because the outside slope is not the proper scale, but if you look at Zone 1, and the way that is keyed -- the Zone 1 is keyed into the existing ground, it says that -- particularly one-third of the berm height, but not less than one foot below the stripped ground. But there is no dimension given there as to how deep that — I call it a key, the berm key, the Zone 1. There's no mention of how deep that was into the substrate, and, as far as he knows, there were no borings along that centerline"*. They did have some nuclear density re-compaction readings, but he did not see any borings in the centerline. No borings in the record. There's no evidence that there are calculations on the stability, slope stability. There's no information, as-built drawings. So Dr. Blanz can't tell from the information he has whether it was constructed using good engineering practice or not. Dr. Blanz has no information that the ponds or the area around the ponds were not constructed according to the plans. Dr. Blanz does not have an opinion that ponds are defective. He does have an opinion that he doesn't know if they're defective or not. He does not know if there is actual leakage. The information in Dr. Blanz memo is the basis for determination that the plans used for pond construction that were submitted for Reg 5 were inadequate. It's a combination of the plans and the specifications, not just the plans. Exhibit 11 is not complete. (pgs. 123-128)

<u>Pond construction quality assurance and recompacted permeability test</u> - Dr. Blanz notes that if you're going to put in a clay liner and compact it, "*…you need to have more information than one test, particularly since that area -- the clay is high in calcium"*. *…"There is not necessarily the quality assurance, but the Table 10-4 says in these high risk areas and very high risk areas, which includes karst topography, that you would look at an alternative storage"*. The criteria that would require a synthetic liner are listed under the vulnerabilities and the risk. *"There's a combination of things. If you've only got one permeability test, you don't know how competent your liner is"*. *… "So the alternative of that is put in a synthetic liner or do more tests. That's just common engineering practice"*. Number of tests: *"varies with the site. It depends on whether you're going to use borrow area for the liner or if you're going to use in situ soils or how you're going to do it, and it depends on the what you find and what's the range of test results that you get"*. *… "The recompacted permeability test tells you what optimum moisture is for your compaction of the liner to get the permeability that's required, 10 to the minus seven centimeters per second"*. Table 10-4 does not say anything about how many tests are required. Other pages in Exhibit 11 QA/QC are results of the nuclear density testing. It appears to be along the berm centerline but it's difficult to tell that. Nuclear density checks the density and the moisture content, and you can take that back and determine what your compaction is-wet density and dry density. Common engineering practices determined that more was needed than the one test. (pgs. 129-135)

There was not enough information provided in the application to know if the ponds were built properly. (p. 166) ADEQ felt like liners were necessary based on the design and calculations for the lagoons. There are some seepage rate calculations in those. Because of karst geology, ADEQ needed to be sure that the liners weren't leaking from the bottom of the pond. Becky Keogh and Dr. Blanz as Chief Technical Officer had an interest in this one. (pgs. 40-41)

AWMFH 10E is about liner construction. Jason Henson had submitted a permit modification to install synthetic liners and it was never built. If a liner was installed, that was favorable to ADEQ. Dr. Blanz: "*If you go by Table 10-4 and you look at some of the issues there, if you're trying to answer these questions about the integrity of the liner or whether it's a high risk, low risk, medium risk, you're going to want more information. If you don't have the information, then the safest thing to do is to put in a synthetic liner*". C&H has submitted a modification to install a liner under Reg 6, but it hasn't been installed and Dr. Blanz doesn't have the information to say that what's in there is satisfactory, then he thinks it's a basis of denial. Dr. Blanz has no knowledge that the clay liners that were in place in the ponds were actually leaking because there is no monitoring. The installation of synthetic liners would eliminate some of the other issues in the Blanz memo. It still wouldn't answer the question about a void underneath the liner because that could also make a synthetic liner fail. Synthetic liner would eliminate the bores-geologic assessment, but not the groundwater assessment or the berm integrity assessment. Ponds would have to be drained to install synthetic liners. Per Blanz: "*You've got to dry out what's in there to get your equipment in there, but, essentially, you'd have to move the equipment down into the pond*". (pgs. 135-140)

Assessment of high risk areas of land application sites - Per Dr. Blanz: "*…there was some testing done on some of the fields, but if you'll look at the Newton County soil survey, you'll see that a number of these soils have severe limitations according to the survey, that either the depth of the soil, the cation-exchange capacity, the water capacity, those kinds of things vary among the fields, and in some cases, they severely restrict the application of animal waste*". Dr. Blanz has not looked at EC Farms' fields. 651.0504 Chapter 5, 5-8 available water capacity, bulk density and cation-exchange capacity, depth to water, depth to bedrock, , soil pH, salinity. Reg 5 requires use of the handbook. There has been some work done by the university, but, it didn't look at all the fields and it didn't have all the parameters. There's some information that the university takes when they do their soil sampling annually and it's in the nutrient management plan or the field management plan. (pgs. 140-142)

Pond levee integrity and assessment - there might have been a statement that they were going to be visually inspected from time to time. Dr. Blanz: "*You can either look at them yourself or you can have an engineer come in there and survey them or have an engineer -- geotechnical engineer look and see if there's any slope failure*". NRCS Conservation Practice Standard Number 359 - There is a section on operation and maintenance and the things that should be looked at. It appeared that this is inclusive, but given the site and the length of that slope on the east side, it would seem to Dr. Blanz that would need to have a little extra care than would normally be called for in a plan. It's a steep slope, it's a long slope, and it's more prone to fail than if the ponds were located on level ground. They would need to be surveyed from time to time. One might consider monitoring wells down

gradient. Record keeping requirements - when you do an inspection, you take notes, and you take and make a record of it, and you take pictures and the investigator signs it and dates it. The issue is telling how often you're going to do it and then do it and have a record of it. Audits/reviews of inspections results - you have somebody that is doing the routine inspection and taking notes and going by a checklist. Then it's good practice to have someone else, another set of eyes come and look at that and review the records and see if, in fact, the inspections were done according to the frequency and if there was a deficiency if it was repaired. Any people at the farm are all knowledgeable about lagoons and operations, you need just another set of eyes. (pgs. 143-147)

Emergency Response Preparedness – refers to a breach of the levee, lagoon levees. 651.0204(a) 2-13 of the handbook, 204(a) is entitled Potential risk from sudden breach of embankment or accidental releases of waste impoundments. What the handbook in large does is raise the issues that should be considered. And this issue is raised and should be considered, and given the location and proximity of that facility, Jason should have considered it as having a safety plan. (pgs. 82-85)

Assessment of high risk areas of land application - Per Dr. Blanz "*There was some testing done on some of the fields, but if you'll look at the Newton County soil survey, you'll see that a number of these soils have severe limitations according to the survey, that either the depth of the soil, the cation-exchange capacity, the water capacity, those kinds of things vary among the fields, and in some cases, they severely restrict the application of animal waste*". Dr. Blanz has not looked at EC Farms' fields. 651.0504 Chapter 5, 5-8 available water capacity, bulk density and cation-exchange capacity, depth to water, depth to bedrock, , soil pH, salinity. Reg 5 requires use of the handbook. There has been some work done by the university, but, it didn't look at all the fields and it didn't have all the parameters. Blanz notes: "*There's some information that the university takes when they do their soil sampling annually and it's in the nutrient management plan or the field management plan*". (pgs. 140-142)

Manure sealing of clay liners - Dr. Blanz would not expect after this many years of operation that seepage would be at 5,000 gallons/day, but there would still be seepage. It could be as much or as little of 10% of the handbook, 500 gallons. Dr. Blanz does not know where seepage is going without a groundwater study. In karst terrain, it is likely that it is going into surface water. (pgs. 154-157) The seepage calculations are in the application and the manual calls for seepage. Dr. Blanz: "*The seepage, of course, is the same as a leak, but a leak could be also from when the pond is pumped down periodically to remove the waste and get the solids. There was not enough information provided in the application to know if the ponds were built properly*". (p. 165)

Comment F15 - We support denial of the C&H permit based on weaknesses in the Big Creek Research & Extension Team study supported by the deposition transcript of Dr. Andrew Sharpley in May, 2018, including but not limited to the following:

Dr. Sharpley has overseen the work of the Big Creek Research and Extension Team that was assigned by the University of Arkansas Agricultural Department to monitor the area around Big Creek near the C&H facility. Dr. Sharpley's team produces a quarterly report entitled "***Monitoring the Sustainable Management of Nutrients from C&H Farms in Big Creek Watershed***". Dr. Sharpley considers himself an expert in the use of the Animal Waste Management Field Handbook in designing a CAFO in karst terrain with respect to risks of nutrient management on surface water quality using the API. (p. 14).

> **Hydrogologic work - Dr. Sharply considers the BCRET work a hydrogeologic investigation in that the BCRET is evaluating water flows within the watershed in the area upstream/downstream of the C & H operation. BCRET is collaborating with USGS. Dr. Sharpley defers to USGS as the experts in terms of hydrology or hydrologic investigation in that area (p. 23). When asked if he has ever performed a hydrogeologic investigation, Dr. Sharpley responds that *"he has not"*. Dr. Sharpley agrees that what he is monitoring is probably groundwater that has been recharged in the Buffalo. (p. 24) Dr. Sharpley does not have load data before C & H came into operation. USGS site downstream was not operational; flows were not available at the time. Dr. Sharpley assessed a change from concentrations prior to land application of slurry - 3 to 4 month period of data. (p. 30)**
>
> **Watershed Comparison - When asked about other watersheds and he might use for comparison, Dr. Sharpley states: *"We would use other watersheds within the Buffalo River, within the White River, within the Illinois River which have karst features only".* When asked if the land use within the Illinois River watershed was similar to the Buffalo, Dr. Sharpley states: *"It is not".***
>
> **Evaluation of spreading fields - Dr. Sharpley's reference to sinkholes and similar type karst features would be areas that get rapid movement of water, anything that might be in it, to some place you're not sure about. (p. 18) The presence of sinkholes would be mapped. Dr. Sharpley would refer to a geological survey map or the nutrient planner would be planning the site for the presence of them. (p. 18) The mapping is beyond Sharpley's expertise. (p. 19) Dr. Sharpley defers to experts, e.g. Van Brahana, Dr. Hays, others with expertise, with regard to buffering and mapping the sinkholes at C & H. (p. 21)**
>
> **Arkansas Phosphorus Index - In reference to the Arkansas Phosphorus Index formula for application of nutrients designed by Dr. Sharpley, regarding subsurface infiltration, Dr. Sharpley states: *"Subsurface infiltration would be under different guidelines, not the API, it is not relevant".* (p. 20) Then, Dr. Sharpley states: *"The timing of application in terms of rainfall amounts would be affected by the presence of karst"… "if we were within several days of expected rainfall, then you would likely get movement of water through to some karst features that would accentuate nutrient maybe transport"*. (p. 20)**
>
> **Waste Management Recommendations - Dr Sharpley's waste management recommendations directly contradict C&H's actually practices. In his deposition, Jason Henson states that the waste storage ponds are always agitated prior to waste removal for field application (J. Henson deposition pgs 47-58, 188). This**

directly contradicts what Dr Sharpley recommends and could result in nutrient applications far in excess of allowable limits in violation of the NMP and could in part explain the "above optimum" levels of phosphorus now occurring in all C&H fields. According to his deposition Dr. Sharpley presumes that BCRET manure samples from the ponds are used by C & H in its API calculations. Samples are taken shallow, middle and deep. The waste is not being agitated when samples are taken. The values would be lower if the pond was agitated to mix the solids. Less phosphorus at top, more at bottom. If you agitated the solids mixed them in – phosphorus would go down in concentration. If you compared it to the bottom, it would go down. If you compared it with the top, it would go up. Bottom sample is in the solids. Agitating the solids from the bottom of the ponds would counteract what the solids are supposed to do on the bottom of the ponds. By agitating the solids that would defeat the purpose of trying to get them to separate and self seal. That would be one reason not to do it. The other reason would be that you reduce the capability to collect samples that more closely mirror what those crops need, because you have much more phosphorus. If you're agitating you're getting more phosphorus out. If you keep it there and don't agitate, you're getting less phosphorus applied with that slurry. (p. 183-186)

Study design discussion points

- USGS does not have an upstream monitoring station in the vicinity of BC-6. (p. 37) BCRET is restricted to the local conditions to estimate flux or flow from the downstream site. BCRET hand collects samples, which does not give BCRET a continuous record. (p. 38)
- BCRET is developing a rating curve for the upstream site based on data collected at the downstream site. (p. 39) BCRET is collecting instantaneous flow measurements, cross-sectional measurement of the stream channel at the upstream site. The data is not recorded. (p. 39)
- There is now a sampling site. There are no stream flow values for B-C-6 reported in the BCRET data. (p. 41)
- Dr. Sharpley has not done a gain/loss survey as recommended by the expert panel to determine if there is minimum variability. (p. 41)
- There is no rating curve for BC-6. (p. 43)
- Dr. Sharpley does not know whether or not nutrients, specifically phosphorus, are accumulating in the fields. (p. 49)
- There are periodic increases in the house well. [Ed] Gbur does the statistical analysis –nonpaired T tests, ANOVA studies, general comparisons of different sets of data. Dr. Sharpley is not an expert in statistical analysis. (p.54-55)
- Dr. Sharpley and BCRET have had discussions with regard to house well data with Jim Petersen, David Petersen, and Bob Cross. (p. 55-56)

- **BCRET has provided raw data but has not done an analysis on concentrations or fluxes-calculations of loads in streams. (p. 58-62)**

- **Per expert panel recommendation for a water balance study, Dr. Sharpley and BCRET tried to calculate the amount of leakage at C & H and found it was not possible. (p. 75-76)**

- **The purpose of monitoring the house well is to give BCRET an indication of nutrients. Mainly, nitrates, chloride conductivity, various elements in that deep water—actually 300 feet below the ground; it is what BCRET would think of as deeper groundwater in that area reflective of the trench. It was suggested by the expert panel to put in more bore wells, holes. BCRET felt that was not appropriate. BCRET used a trench, a french drain, basically below the holding ponds that had been used by Dr. Brahana and Phil Hays at Savoy. Same situation-also karst. It was chosen above drilling numerous other bore wells as to be indicator of whether material might be leaking from the base of those lagoons. (p. 76-77)**

- **The trenches are to indicate if there might be leakage. They are not quantitative, they're totally qualitative. BCRET does not know totally where that water is coming from that they see in the trench but given its position below the base of the ponds and its proximity, BCRET feels if there was some leakage, BCRET would see it. (p. 77)**

In Conclusion:

The Buffalo River Watershed Alliance reiterates our position that this Regulation 5 permit for this CAFO should be denied and that a permanent moratorium on all such facilities should be immediately established in the Buffalo National River watershed.

These comments are submitted on behalf of the Buffalo River Watershed Alliance. The Buffalo River Watershed Alliance also incorporates by reference all current and past comments of the National Parks Conservation Association, the Arkansas Canoe Club, the Ozark Society, the Arkansas Public Policy Panel, National Parks Service, Friends of the North Fork and White Rivers, Dane Schumacher, Marti Olesen, Carol Bitting, Jessie J. Green, Teresa Turk, John Murdoch, Chuck Bitting, Gerald Delavan, and any other person or entity who opposes the proposed C&H Hog Farm permit that is the subject of these comments.

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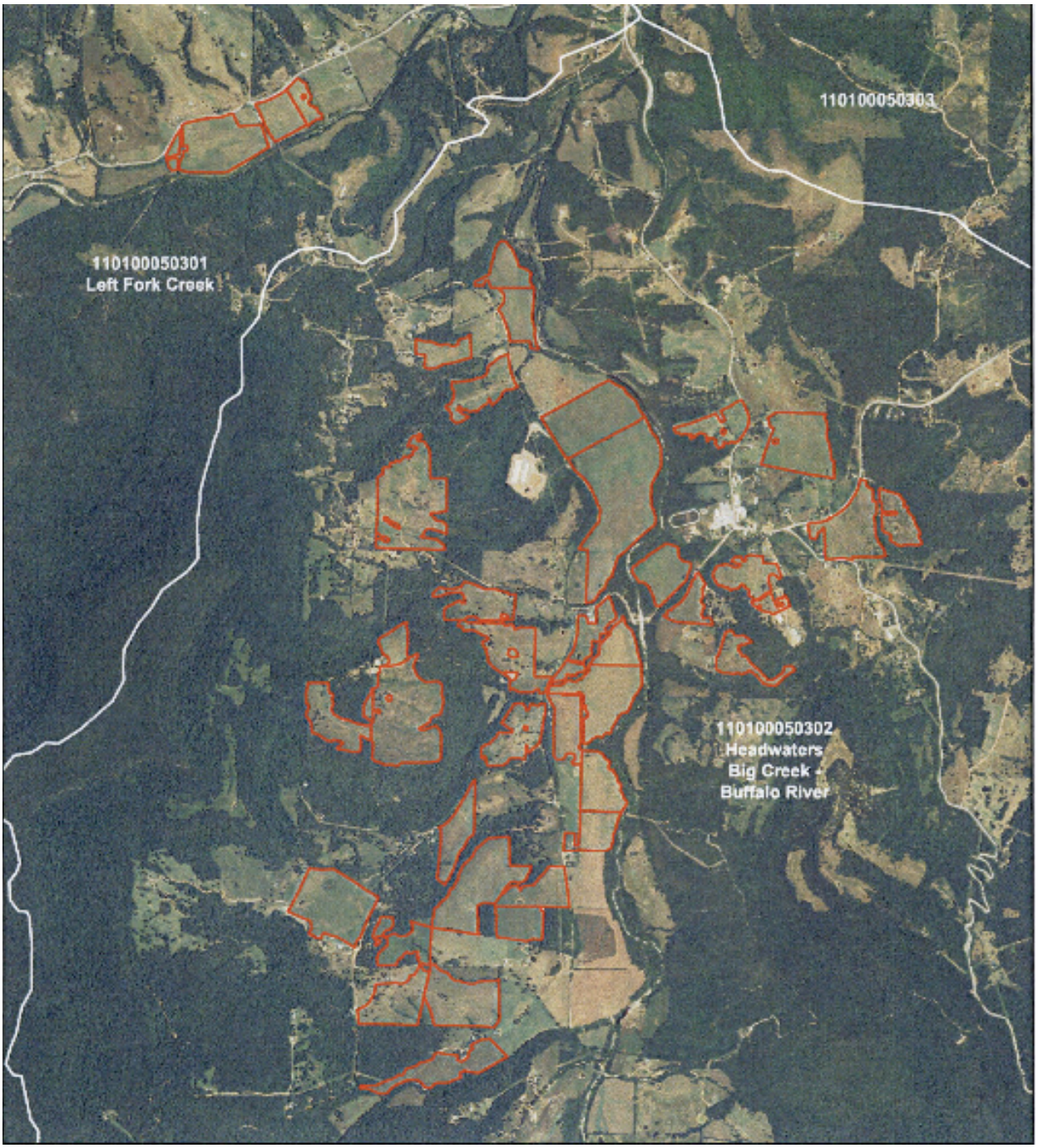
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Reg 5 Comment Appendices

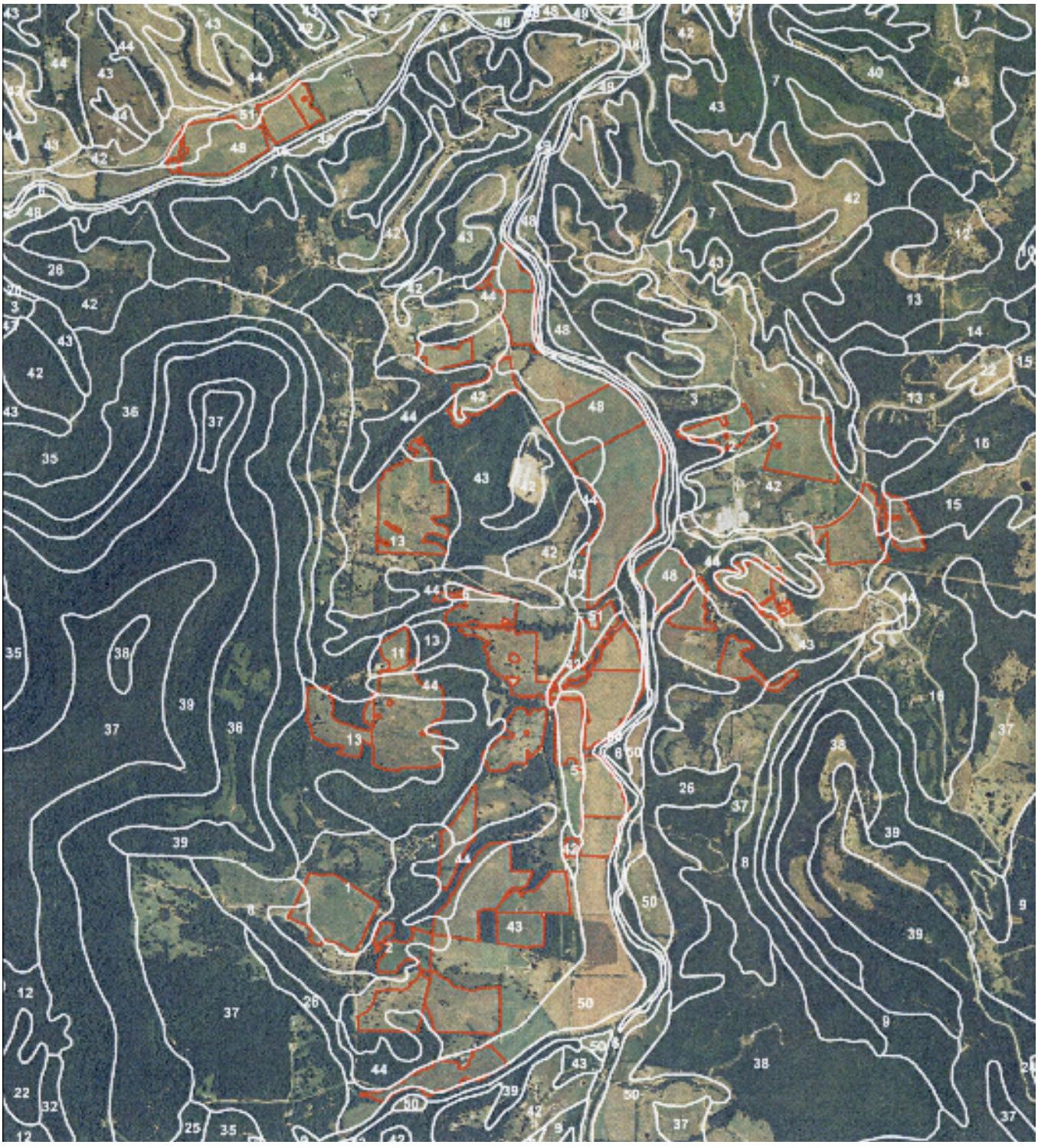
Appendix B1

Map of proposed spreading fields:



Appendix B2 - Soil types, flood plains 1 of 3

Map of soil types:



Appendix B2 - Soil types, flood plains Page 2 of 3

Soil types:

SYMBOL	NAME
1	Arkana very cherty silt loam, 3 to 8 percent slopes
2	Arkana-Moko complex, 8 to 20 percent slopes 1/
3	Arkana-Moko complex, 20 to 40 percent slopes 1/
4	Britwater gravelly silt loam, 3 to 8 percent slopes
5	Ceda cobbly loam, frequently flooded
6	Ceda-Kenn complex, frequently flooded
7	Clarksville very cherty silt loam, 20 to 50 percent slopes
8	Eden-Newnata complex, 8 to 20 percent slopes 1/
9	Eden-Newnata complex, 20 to 40 percent slopes 1/
10	Eden-Newnata-Rock outcrop complex, 40 to 60 percent slopes 1/
11	Enders gravelly loam, 3 to 8 percent slopes
12	Enders gravelly loam, 8 to 20 percent slopes
13	Enders stony loam, 3 to 20 percent slopes
14	Enders stony loam, 20 to 40 percent slopes
15	Enders-Leesburg stony loams, 8 to 20 percent slopes 1/
16	Enders-Leesburg stony loams, 20 to 40 percent slopes 1/
17	Estate-Lily-Portia complex, 8 to 20 percent slopes 1/
18	Estate-Lily-Portia complex, 20 to 40 percent slopes 1/
19	Leadvale silt loam, 3 to 8 percent slopes
20	Lily-Udorthents-Rock outcrop complex, 8 to 20 percent slopes 1/
21	Lily-Udorthents-Rock outcrop complex, 20 to 40 percent slopes 1/
22	Linker loam, 3 to 8 percent slopes
23	Linker gravelly loam, 3 to 8 percent slopes
24	Linker-Mountainburg complex, 3 to 8 percent slopes
25	Linker-Mountainburg complex, 8 to 20 percent slopes
26	Moko-Rock outcrop complex, 15 to 50 percent slopes 1/
27	Mountainburg gravelly fine sandy loam, 3 to 8 percent slopes
28	Mountainburg very stony fine sandy loam, 3 to 8 percent slopes
29	Mountainburg very stony fine sandy loam, 8 to 20 percent slopes
30	Mountainburg very stony fine sandy loam, 20 to 40 percent slopes
31	Nella gravelly loam, 3 to 12 percent slopes
32	Nella gravelly loam, 12 to 20 percent slopes
33	Nella stony loam, 8 to 20 percent slopes
34	Nella stony loam, 20 to 40 percent slopes
35	Nella-Enders stony loams, 8 to 20 percent slopes 1/
36	Nella-Enders stony loams, 20 to 40 percent slopes 1/
37	Nella-Steprock complex, 8 to 20 percent slopes 1/
38	Nella-Steprock-Mountainburg very stony loams, 20 to 40 percent slopes 1/
39	Nella-Steprock-Mountainburg very stony loams, 40 to 60 percent slopes 1/
40	Nixa very cherty silt loam, 3 to 8 percent slopes
41	Nixa very cherty silt loam, 8 to 12 percent slopes
42	Noark very cherty silt loam, 3 to 8 percent slopes
43	Noark very cherty silt loam, 8 to 20 percent slopes
44	Noark very cherty silt loam, 20 to 40 percent slopes
45	Peridge silt loam, 3 to 8 percent slopes
46	Portia sandy loam, 3 to 8 percent slopes
47	Portia sandy loam, 8 to 12 percent slopes
48	Razort loam, occasionally flooded
49	Riverwash, frequently flooded
50	Spadra loam, occasionally flooded
51	Spadra loam, 2 to 5 percent slopes
52	Steprock gravelly loam, 3 to 8 percent slopes
53	Wideman loamy fine sand, frequently flooded

Appendix B2 - Soil types, flood plains Page 3 of 3

Photo uses Reg 6 NOI field numbering





TABLE 1 SOIL P-STATUS, FERTILITY RECOMMENDATION, AND SUITABILITY FOR WASTE APPLICATION BASED ON STEEPNESS AND SHAPE OF APPLICATION AREA

Field	spread-able ac	STP	P-Nutrient Status	Recommendation P2O5 lb/ac	Suitability for waste application
Field 1	8.4	95	Above Optimum	0	Fair – contorted
Field 2	6	108	Above Optimum	0	Poor – Steep, contorted
Field 3	15	89	Above Optimum	0	Good
Field 4	7.2	75	Above Optimum	0	Poor – steep, contorted
*Field 5**	9.7	63	Above Optimum	0	Good
*Field 6**	5.6	116	Above Optimum	0	Good
Field 7	64	89	Above Optimum	0	Good
Field 8	7.2	82	Above Optimum	0	Good
Field 9	25	82	Above Optimum	0	Good
Field 10	14	72	Above Optimum	0	Good
Field 11	14	62	Above Optimum	0	Poor - contorted
Field 12	11	88	Above Optimum	0	Good
Field 13	12	86	Above Optimum	0	Good
Field 14	8.1	75	Above Optimum	0	Fair - steep
Field 15	23	72	Above Optimum	0	Good
Field 16	15	66	Above Optimum	0	Good
Field 17	32	86	Above Optimum	0	Good
*Field 6A**	7.9	111	Above Optimum	0	Poor - contorted
*Field 7A***	28	38	Optimum	45	Good
*Field 8a***	1.4	82	Above Optimum	0	Good
*Field 9a***	10	57	Above Optimum	0	Good
*Field 10A***	16	100	Above Optimum	0	Good
*Field 13A***	31	75	Above Optimum	0	Good
*Field 13B***	8.5	61	Above Optimum	0	Poor – steep, contorted
*Field 15A***	10	18	Low	80	Fair - contorted
*Field 15B***	15	66	Above Optimum	0	Poor – contorted, steep
*Field 18**	23	42	Optimum	45	Good
*Field 19**	11	66	Above Optimum	0	Good
*Field 20**	22	63	Above Optimum	0	Good
*Field 21**	20	12	Very Low	120	Very Poor – contorted, steep
*Field 21A**	6	21	Low	80	Fair - steep
*Field 21B**	6	38	Optimum	45	Very Poor - contorted
*Field 22**	36	38	Optimum	60	Good - steep
*Field 23**	28	56	Above Optimum	0	Good
*Field 24**	8	45	Optimum	45	Good
*Field 32**	10	57	Above Optimum	0	Good
*Field 33**	4	52	Above Optimum	0	Good
*Field 34**	14	56	Above Optimum	0	Good
*Field 35**	18	40	Optimum	45	Good - contorted
*Field36**	9.3	20	Low	110	Fair - contorted

*Fields newly designated in this plan

**Fields created by subdividing fields used in previous plans

Example:

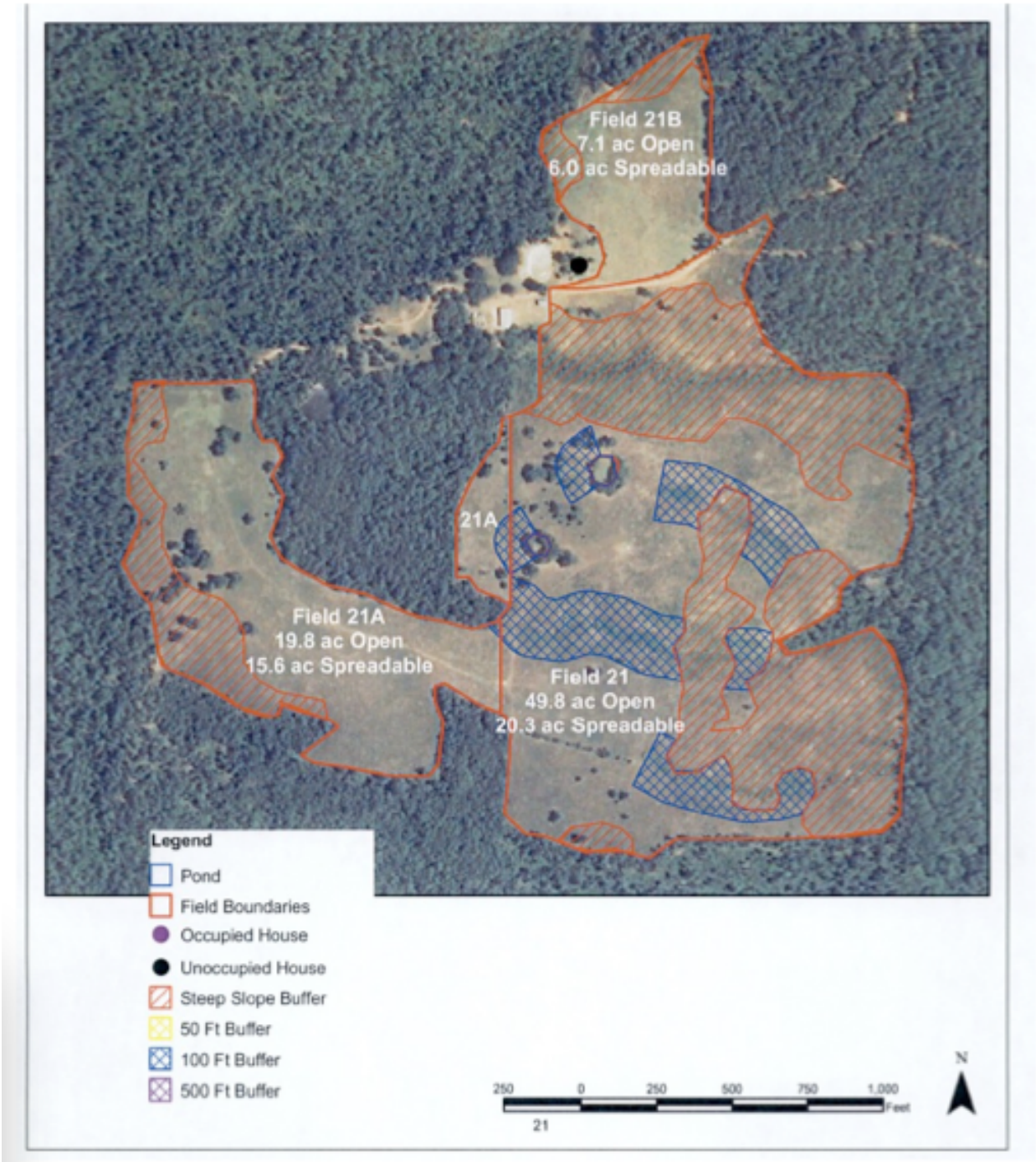


FIGURE 1 EXAMPLE OF A FIELD 21A, WHICH IS CONTORTED AND INAPPROPRIATE FOR WASTE APPLICATION



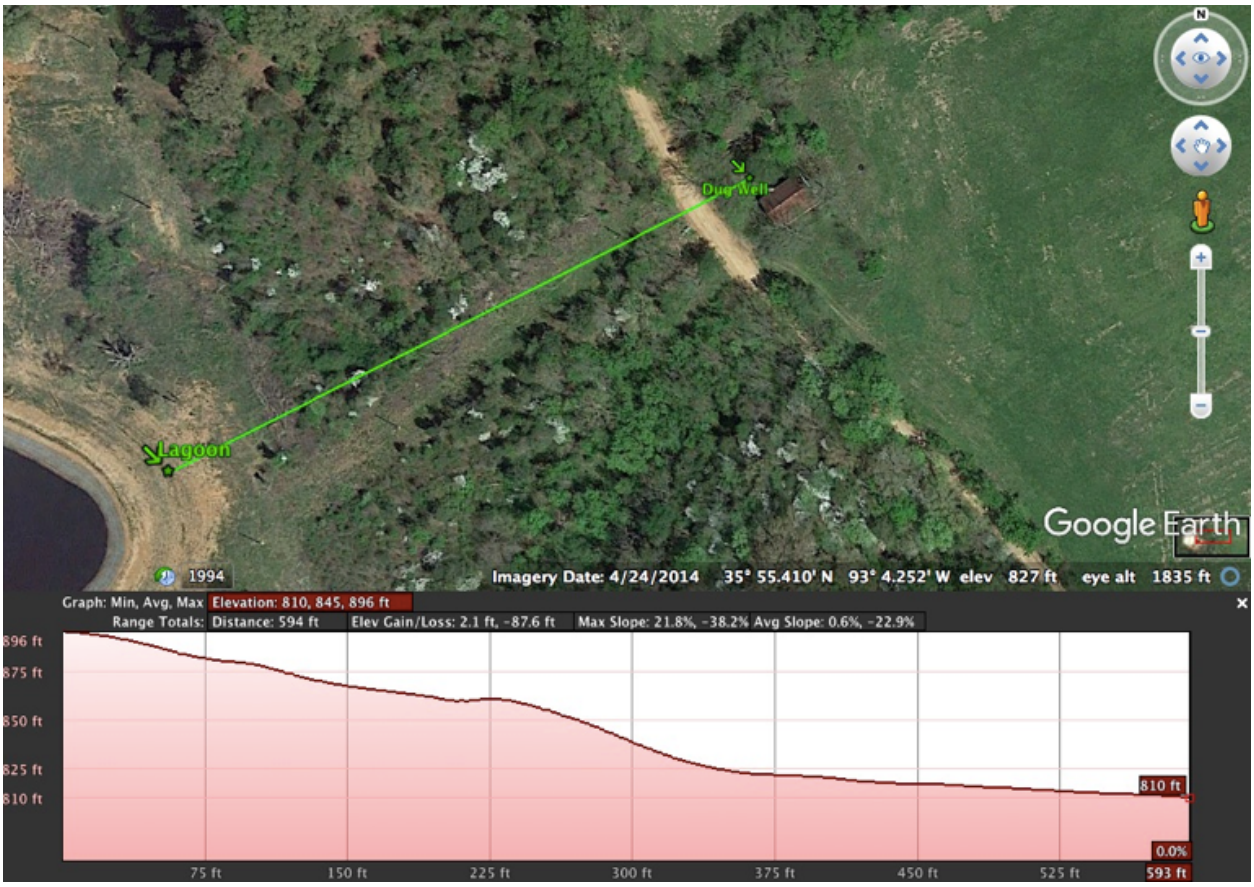
FIGURE 2 PHOTOGRAPH OF FIELD 2 SHOWING POOR MANAGEMENT OF FORAGE PRODUCTION AND GRAZING. PHOTO BY BRWA TAKEN FEBRUARY 17, 2017.



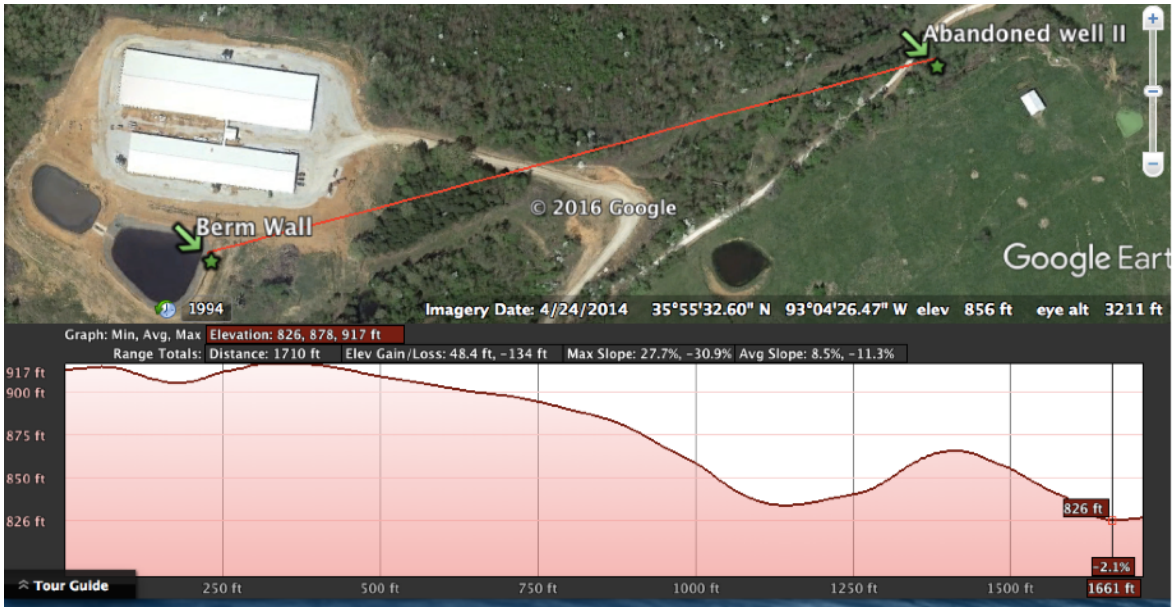
FIGURE 3 AERIAL VIEW OF FIELDS 2 AND 3 SHOWING COW TRAILS AND OTHER EVIDENCE OF ERODIBLE CONDITIONS.

Appendix C2-A Nearby Wells Page 1 of 3

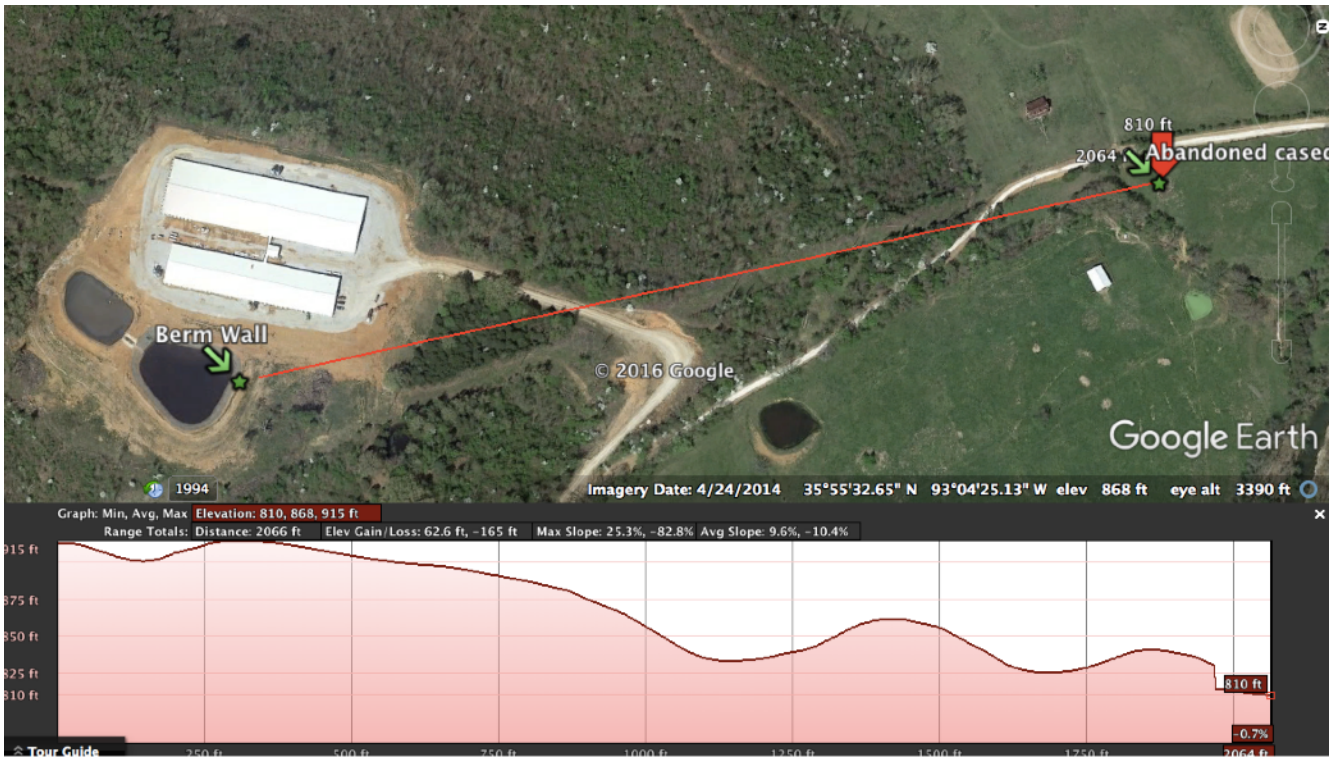
Hand dug well with distance and gradient:



B39 - Wheeler well with distance and gradient:



B-40 Drilled Well



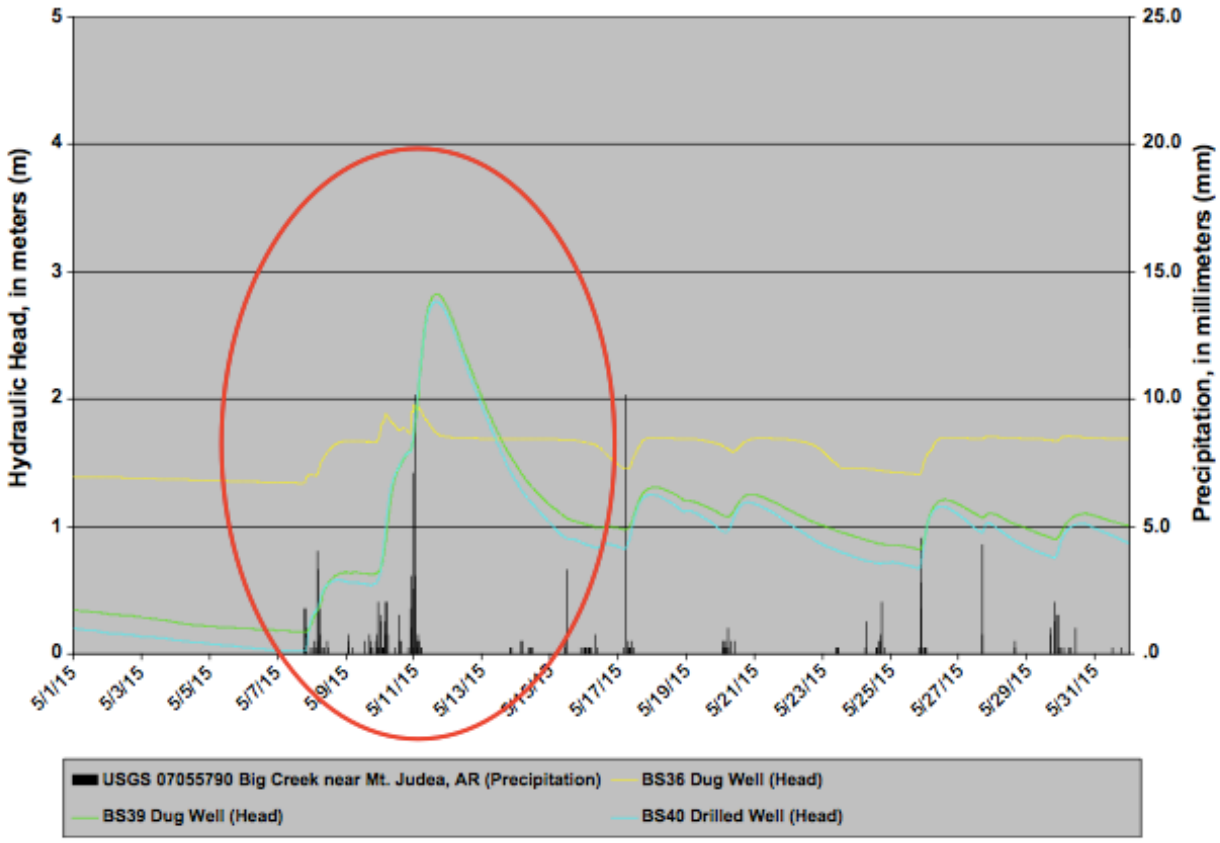
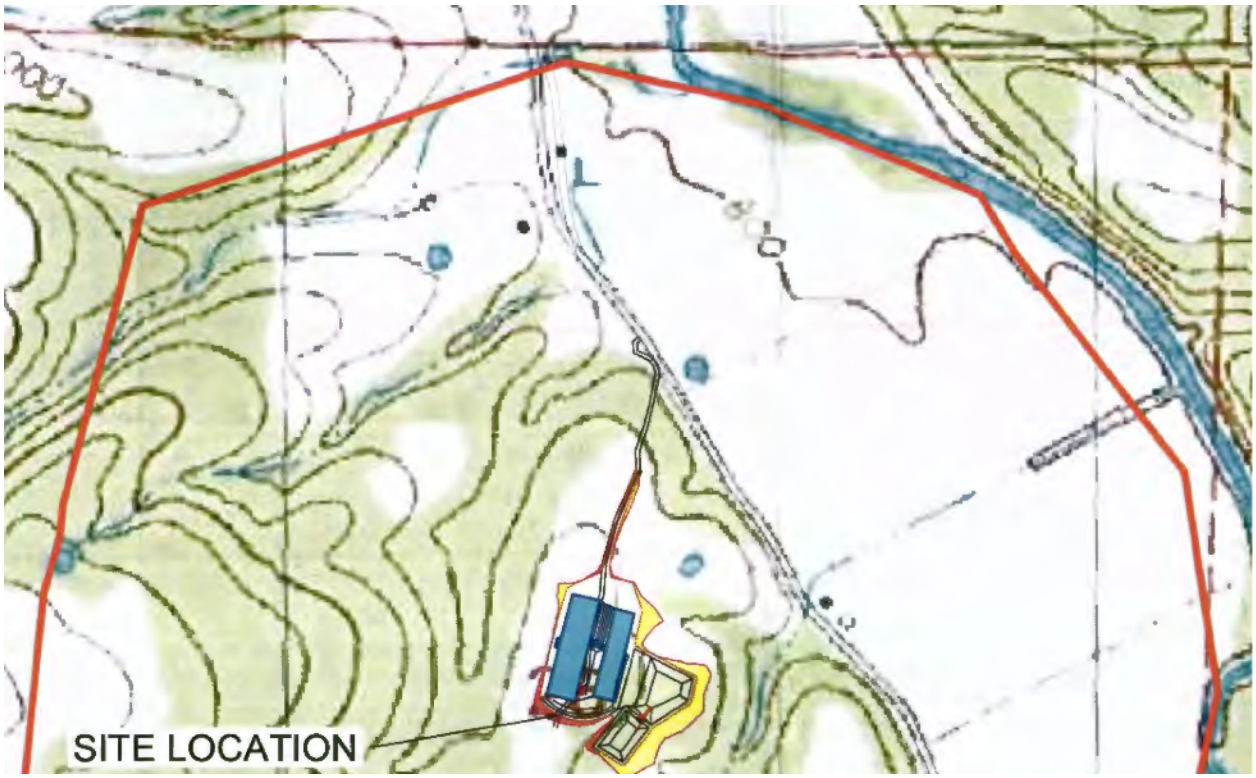


Fig. 13 Hydrographs of three groundwater wells, BS-36, BS-39, and BS-40 for the month of May 2015. The hydrographs show the groundwater level (rise and fall) on the *vertical axis* plotted against time on the *horizontal axis*. As in Fig. 12, precipitation is shown by the *vertical lines* and the scales for the figures are presented in the same locations. The timing of the causes (precipitation) and effects (groundwater-level response) can be subtracted, and is called the lag time. In this case, the time lag was essentially zero, indicating that groundwater levels started rising as soon as the precipitation started. The magnitude of the water-level increases is a reflection of the change in storage as the groundwater moves downgradient, and varies for different hydrologic settings in the Boone Formation (BS-36), the epikarst at the top of the Boone (BS-39), and the Big Creek alluvium and terrace deposits (BS-40) that lie above the Boone in Big Creek Valley

Appendix C2-B 2,000 ft radius from facility



Appendix C3 - Review of permeability determination

3. *Geologic Investigation*

The USDA Soil Survey predicts that the soil in the location of the storage structures is primarily a Noark very cherty silt loam, 3 to 8% slopes, (42). The soil profile for 42 from 0 to 14 inches is very gravelly silt loam, from 14-43 inches is very gravelly silty clay, and from 43-72 inches is very gravelly clay.

The holding ponds will be constructed with an 18-inch thick liner.

Geotechnical & Testing Services conducted laboratory tests on some of the samples. Atterburg limits were run on the soil samples for the sandy lean clay. The results were as follows:

Boring #	Depth (ft)	Description	LL	PL	PI
2	3.0– 4.5'	Silty Lean Clay	38	22	16
2	4.5 – 6.0'	Sandy Lean Clay	44	24	20
2	7.0 – 8.5'	Fat Clay w/sand	93	38	55
2	9.5-11'	Sandy Fat Clay	64	23	41
3	7-8.5'	Fat Clay w/sand	58	36	22
3	9.5-11'	Clayey Gravel with Sand	81	44	37

The soil proposed for the holding pond liner is Fat Clay w/sand and Fat Clay w/sand (CL) identified in the soils report at the depths of 7-11' feet in boring numbers 2-3.

Recompacted soil test are currently being run to determine the Coefficient of Permeability using Darcy's Law. Results will be forwarded on once they are completed by the testing lab.

Currently it is recommended that the liner be constructed at 95% compaction +-2% Optimum Moisture to meet seepage requirements. This may change based off results from the Recompacted Permeability.

The seepage rate of any compacted liner that will be used will be less than the maximum allowable seepage rate of 5,000 Gallons/acre/per day as required by Arkansas Department of environment Quality.

1) Here is where they will get the liner material.

Appendix C3 - Review of permeability determination

LOG OF BORING NO.B-2

Proposed Pond and Building Pads
Mt. Judea, Arkansas

GTS, Inc.
Geotechnical & Testing Services
Fayetteville, AR

Project No.: 12-15049 Location: Shown on Boring Location Diagram

DEPTH, FT	SYMBOL	SAMPLES	SAMPLE No.	RECOVERY (in.)	DESCRIPTION OF MATERIAL	USCS	%<#200	HAND PENETROMETER, TSF ■ / LAB. COHESION, TSF ▲ (0.4, 0.8, 1.2, 1.6) / WATER CONTENT, % ● (PL — LL; 20, 40, 60, 80)	BLOWS PER FT
0			1	13	SILT, with sand medium dense, brown with organics	SM			25
2.5			2	15	CLAYEY GRAVEL, with sand dense, red and tan with chert fragments	GC			30
			3	18	CLAYEY SAND / SANDY LEAN CLAY dense, very stiff, red and tan with extremely weathered sandstone fragments and chert fragments	CL			30
5			4	18		SC			26
7.5			5	18	FAT CLAY, with sand very stiff, light gray, red and orangish tan	CH			22
10			6	17	SANDY FAT CLAY very stiff, light gray, red and orangish tan	CH			25
12.5			7	15	GRAVELLY FAT CLAY very stiff, light gray, red and orangish tan with chert fragments	CH			65
15			8	18	FAT CLAY, with gravel very stiff, light gray and tan with chert fragments	CH			34
17.5					FAT CLAY very stiff, tan with ferrous nodules	CH			

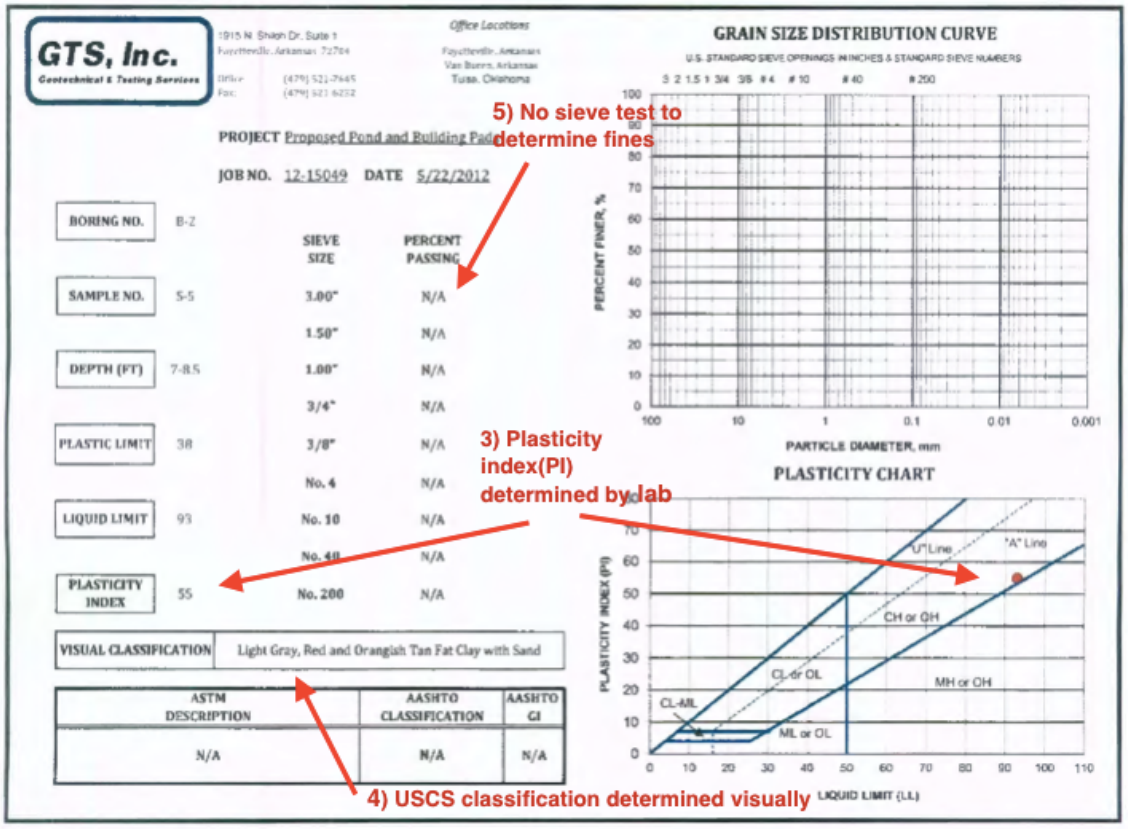
COMPLETION DEPTH: 18.5 ft.
DATE: 5/15/2012
RIG: Diedrich D-50

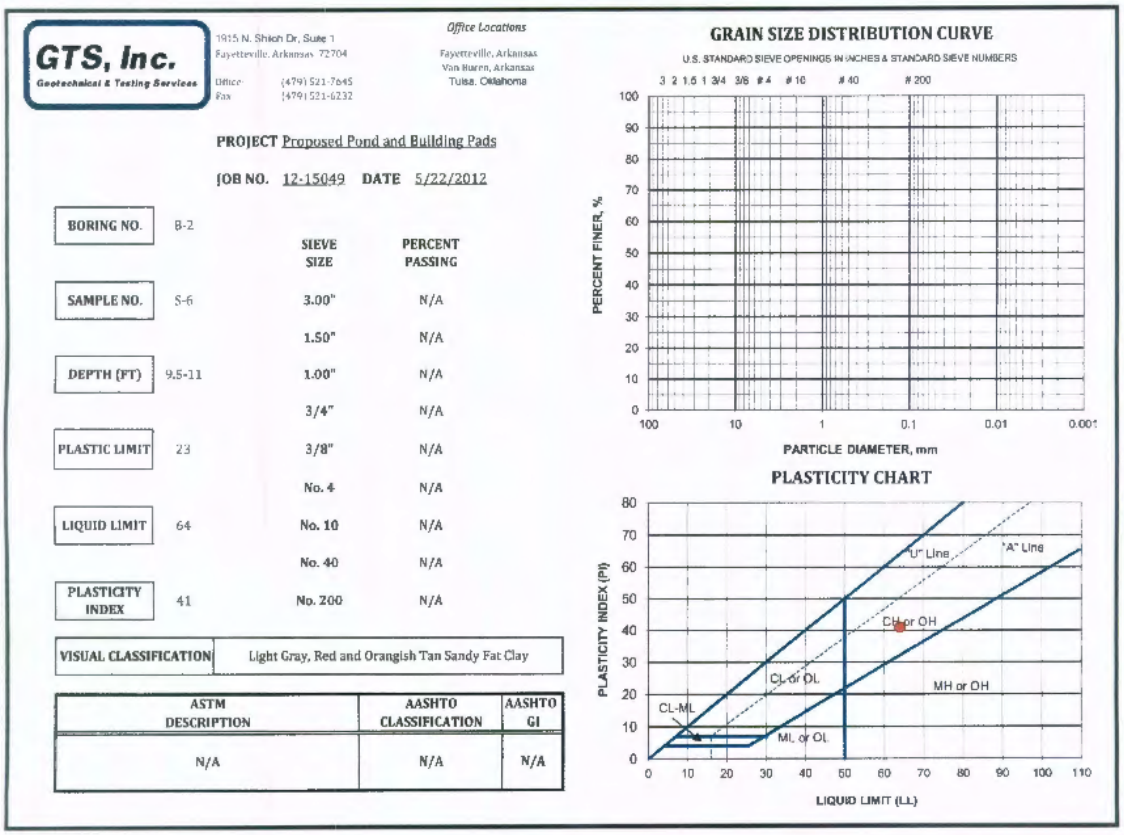
DEPTH TO WATER: DURING DRILLING: DRY
AT COMPLETION: DRY
AT 24 HOURS: N/A

Page 1 of 2

2) Samples 5 & 6 from Boring No B-2. B-3 samples 5 and 6 are also used but not shown here. USCS designations are not determined yet.

Appendix C3 - Review of permeability determination





6) Unified soil classification system (USCS) classification is based on sieve

Symbol chart [edit]

Major divisions			Group symbol	Group name
Coarse grained soils more than 50% retained on or above No.200 (0.074 mm) sieve	gravel > 50% of coarse fraction retained on No.4 (4.75 mm) sieve	clean gravel <5% smaller than No.200 Sieve	GW	well-graded gravel, fine to coarse gravel
			GP	poorly graded gravel
		gravel with >12% fines	GM	silty gravel
			GC	clayey gravel
	sand ≥ 50% of coarse fraction passes No.4 (4.75 mm) sieve	clean sand	SW	well-graded sand, fine to coarse sand
			SP	poorly graded sand
		sand with >12% fines	SM	silty sand
			SC	clayey sand
Fine grained soils 50% or more passing the No.200 (0.074 mm) sieve	silt and clay liquid limit < 50	inorganic	ML	silt
			CL	clay of low plasticity, lean clay
		organic	OL	organic silt, organic clay
	silt and clay liquid limit ≥ 50	inorganic	MH	silt of high plasticity, elastic silt
			CH	clay of high plasticity, fat clay
		organic	OH	organic clay, organic silt
Highly organic soils			Pt	peat

Visually determined USGS group →

Table 10D–4 Unified classification versus soil permeability groups 1/

Unified Soil Classification System Group Name	Soil permeability group number and occurrence of USCS group in that soil			
	I	II	III	IV
CH	N	N	S	U
MH	N	S	U	S
CL	N	S	U	S
ML	N	U	S	N
CL–ML	N	A	N	N
GC	N	S	U	S
GM	S	U	S	S
GW	A	N	N	N
SM	S	U	S	S
SC	N	S	U	S
SW	A	N	N	N
SP	A	N	N	N
GP	A	N	N	N

1/ ASTM Method D–2488 has criteria for use of index test data to classify soils by the USCS.

A = Always in this permeability group

N = Never in this permeability group

S = Sometimes in this permeability group (less than 10 percent of samples fall in this group)

U = Usually in this permeability group (more than 90 percent of samples fall in this group)

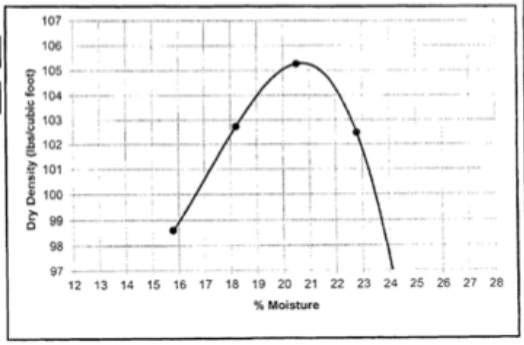
B-2 Bulk Grab Sample

GTS, Inc.
Geotechnical & Testing Services

LABORATORY COMPACTION CHARACTERISTICS OF SOIL

CLIENT: DeHaan, Grabs & Associates, LLC DATE: 6/14/12 SAMPLE LOCATION: B-2, Bulk Grab Sample LL= 64
PROJECT NUMBER: 12-15049 LAB NO. 1 SAMPLE DESCRIPTION: Red with Light Gray Streaks PL= 23
PROJECT NAME: Proposed Pond and Building Pads TEST METHOD: ASTM D698 AASHTO CLASS.: N/A PI= 41
VISUAL CLASSIFICATION: Fat Clay, with Sand

Maximum Dry Density (lbs./cubic foot)	105.2
Optimum Moisture (percent)	20.7



1915 North Shiloh Drive, Suite 1
Fayetteville, Arkansas 72704
Office: (479) 521-7645
Fax: (479) 521-6232

GTS, Inc.
Geotechnical & Testing Services

Hydraulic Conductivity Test Procedures Performed In Accordance With ASTM D 5084 Method C (Flexible Wall - Falling Head - Rising Tail)

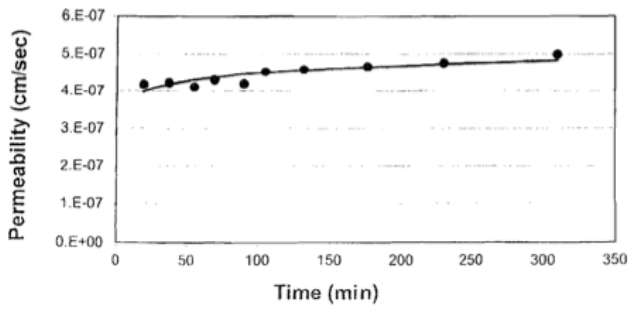
HYDRAULIC CONDUCTIVITY TEST RESULTS

PROJECT: Mt. Judea - Proposed Pond and Building Pads
BORING: B-2
DEPTH (ft): 7 - 11

PROJECT NUMBER: 12-15049
SAMPLE: N/A
SAMPLE TYPE: Recompacted

Hyrdraulic Conductivity, k (cm/s): 5.E-07

Test Parameters	*Initial Sample Data*	*Final Sample Data* (after consolidation and testing)
Cell Pressure (psi): 8	Diameter (in): 2.57	Diameter (in): 2.55
Inflow Pressure (psi): 4	Length (in): 4.58	Length (in): 4.54
Outflow Pressure (psi): 3	Moisture Content: 21.3%	Moisture Content: 25.3%
Back Pressure (psi): 3	Wet Unit Weight (pcf): 125.2	Wet Unit Weight (pcf): 130.3
Confining Pressure (psi): 4	Dry Unit Weight (pcf): 103.2	Dry Unit Weight (pcf): 103.9
	Initial Hydraulic Gradient: 5.29	Final Hydraulic Gradient: 5.03



Notes: Sample was recompacted at 98.1% of MDD at a moisture content of 21.2% (at OMC +0.5%)

Appendix
C5 - ADEQ inspection photos

Arkansas Department of Environmental Quality
CONCENTRATED ANIMAL FEEDING OPERATION (CAFO) INSPECTION REPORT

Water Division NPDES Photographic Evidence Sheet

Location:	C&H Hog Farm, Newton County						
Photographer:	Tony Morris			**Witness:**	Phillip Campbell		
Photo #	5	**Of**	6	**Date:**	07/23/13	**Time:**	12:03
Description:	Rill erosion in Settling Basin liner; large rocks in liner. Signs of liner deterioration.						



Photographer:	Tony Morris			**Witness:**	Phillip Campbell		
Photo #	6	**Of**	6	**Date:**	07/23/13	**Time:**	17:21
Description:	Rill erosion and desiccation cracks in Holding Pond liner due to extended exposure.						



Appendix C5 - ADEQ inspection photos

Water Division Photographic Evidence Sheet					
Location:	C&H Hog Farms				
Photographer:	Jason Bolenbaugh	Date:	1/23/2014	Time:	12:02
Witness:	John Bailey, Jason Henson			Photo #:	1
Description:	Inside of Holding Pond 2. Note erosion rills and unstabilized banks. Holding Pond Must Pumpdown elevation is indicated in red on the Must Pumpdown gauge.				



Photographer:	Jason Bolenbaugh	Date:	1/23/2014	Time:	12:16
Witness:	John Bailey, Jason Henson			Photo #:	2
Description:	Inside of Holding Pond 1. Note the unstabilized banks. Waste water is not currently running over the spillway into Holding Pond 2.				



Appendix C6 - Original NOI bore holes

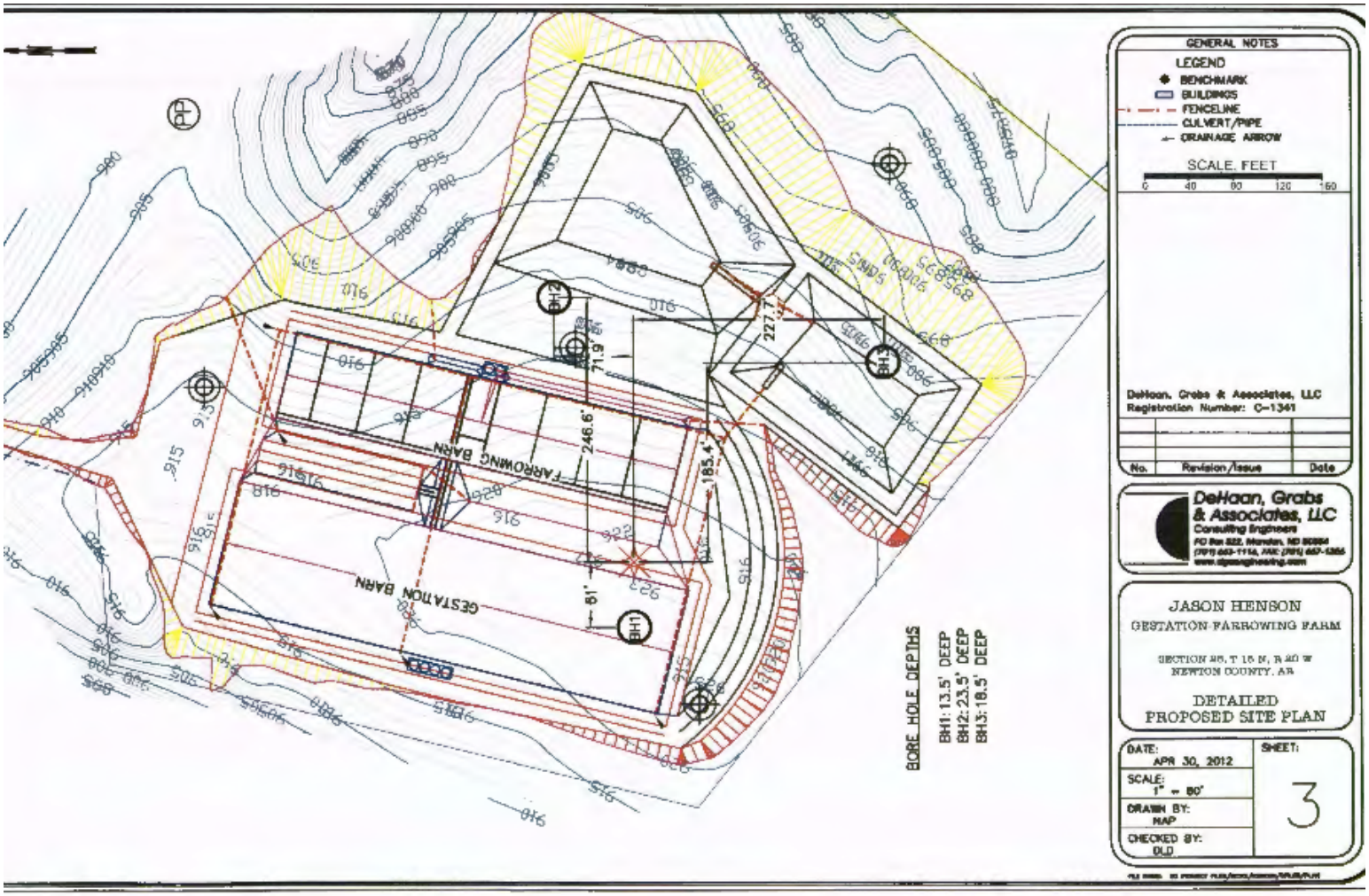
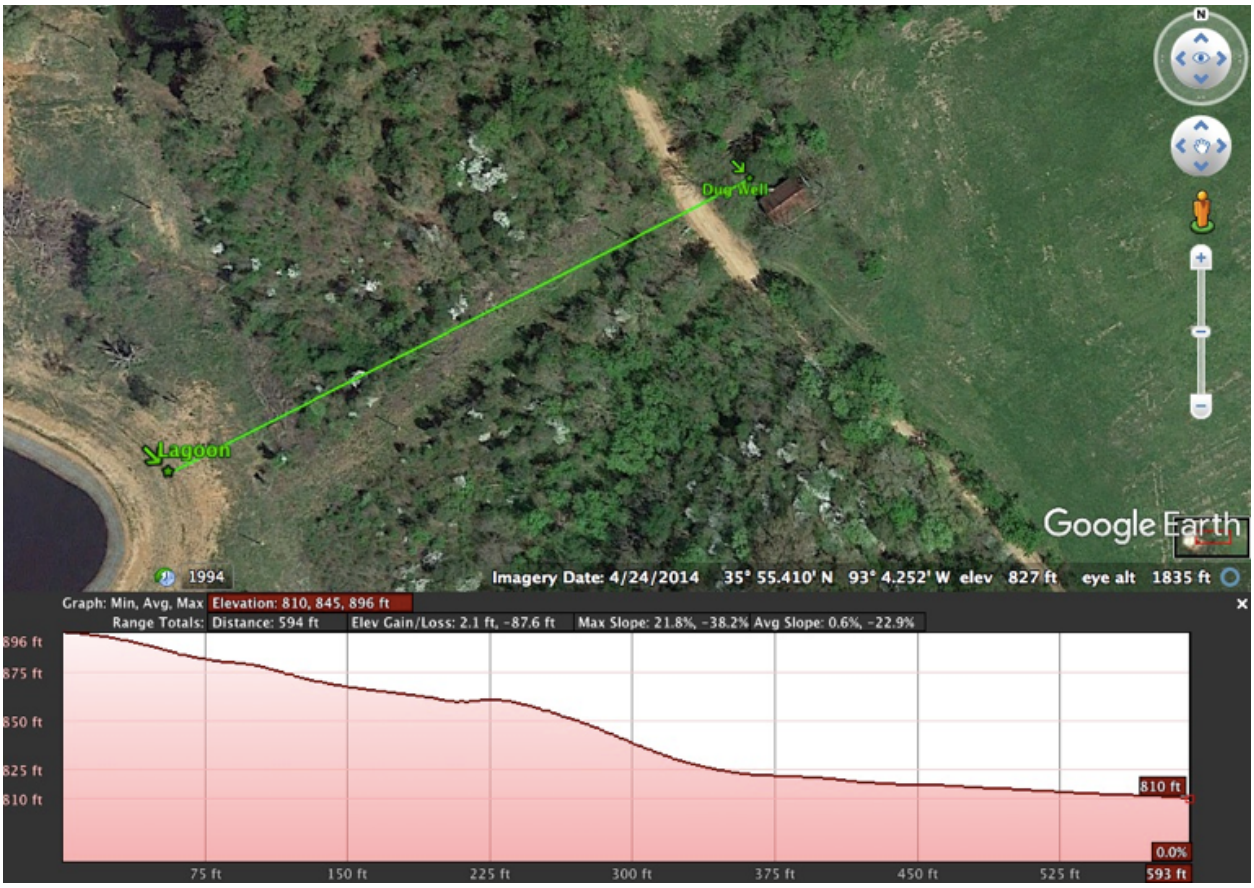


Table 10–4 Criteria for siting, investigation, and design of liquid manure storage facilities

Vulnerability ↓ / Risk →	Very high <1,500 ft from public drinking water supply wells; **OR** <100 ft from any domestic well or Class 1 stream	High Does not meet Very High Risk criteria; **AND** Recharge areas for Sole Source aquifers; **OR** 100 to 600 ft from unconfined domestic water supply well (or where degree of aquifer confinement is unknown) or Class 1 stream	Moderate Does not meet High Risk criteria; **AND** 600 to 1,000 ft from unconfined domestic well (or where degree of aquifer confinement is unknown) or Class 1 stream; **OR** <600 ft from unconfined nondomestic water supply well (or where degree of aquifer confinement is unknown) or Class 2 stream	Slight Does not meet Moderate Risk criteria; **AND** >1,000 ft from unconfined domestic well (or where degree of aquifer confinement is unknown) or Class 1 stream; **AND** >600 ft from unconfined nondomestic water supply well (or where degree of aquifer confinement is unknown) or Class 2 stream
Very high Large voids (e.g., karst, lava tubes, mine shafts); **OR** Highest anticipated ground water elevation within 5 ft of invert; **OR** <600 ft from improperly abandoned well*	**Evaluate other storage alternatives** * (or properly seal well and reevaluate vulnerability)	**Evaluate other storage alternatives** * (or properly seal well and reevaluate vulnerability)		
High Does not meet Very High Vulnerability criteria; **AND** Bedrock (assumed fractured) within 2 ft of invert; **OR** Coarse soils/parent material (Permeability Group I soils as defined in AWMFH, always including GP, GW, SP, SW); **OR** Highest anticipated groundwater elevation is between 5 to 20 ft below invert; **OR** 600 to 1,000 ft from improperly abandoned well*	**Evaluate other alternatives or synthetic liner as allowed** Local regulations may apply Consult with area engineer	**Synthetic liner required** * (or properly seal well and reevaluate vulnerability) No additional site characterization required	**Liner required** * (or properly seal well and reevaluate vulnerability) Specific discharge $\leq 1 \times 10^{-6}$ $cm^3/cm^2/s$ No manure sealing credit Earthen liner design includes sampling and testing of liner material (Classification, Standard Proctor compaction, Permeability)	**Liner required** * (or properly seal well and reevaluate vulnerability). Specific Discharge $\leq 1 \times 10^{-6}$ $cm^3/cm^2/s$ No manure sealing credit Earthen liner design includes sampling and classification testing of liner material Published permeability data and construction method specifications may be used
Moderate Does not meet High Vulnerability criteria; **AND** Medium soils/parent material (Permeability Group II soils as defined in AWMFH, usually including CL-ML, GM, SM, ML); **OR** Flocculated or blocky clays (typically associated with high Ca); **OR** Complex stratigraphy (discontinuous layering); **OR** Highest anticipated ground water elevation is between 21 to 50 ft below invert; **OR** 600–1,000 ft from improperly abandoned well*		**Further evaluate need for liner** Specific discharge $\leq 1 \times 10^{-6}$ $cm^3/m^2/s$ No manure sealing credit Earthen liner/no liner design includes sampling and testing of liner/in-place material (Classification, Standard Proctor compaction/in-place density, Remolded/ Undisturbed sample Permeability)	**Further evaluate need for liner** Specific discharge $\leq 1 \times 10^{-6}$ $cm^3/cm^2/s$ No manure sealing credit Earthen liner/no liner design includes sampling and testing of liner/in-place material (Classification, Standard Proctor compaction/ in-place density, Remolded/Undisturbed sample Permeability)	**Further evaluate need for liner** Specific discharge $\leq 1 \times 10^{-6}$ $cm^3/cm^2/s$ No manure sealing credit Earthen liner/no liner design includes sampling and classification testing of liner/ in-place material + in-place density Published permeability data and construction method specifications may be used
Low Does not meet Moderate Vulnerability criteria; **AND** Fine soils/parent material (Permeability Group III and IV soils as defined in AWMFH, usually including GC, SC, MH, CL, CH); **AND** Highest anticipated ground water elevation is >50 ft below invert		**Further evaluate need for liner** Specific discharge $\leq 1 \times 10^{-6}$ $cm^3/cm^2/s$ No manure sealing credit Earthen liner/no liner design includes sampling and testing of liner/ in-place material (Classification, Standard Proctor compaction/ in-place density, Remolded/ Undisturbed sample Permeability) Scarify and recompact surface to seal cracks and break down soil structure as appropriate	**Liner not required** Specific discharge: $\leq 1 \times 10^{-6}$ $cm^3/cm^2/s$ Field classification and published permeability data may be used Construction method specifications may be used Scarify and recompact surface to seal cracks and break down soil structure as appropriate	

*See local regulations

Appendix C10B - Improperly Abandoned well

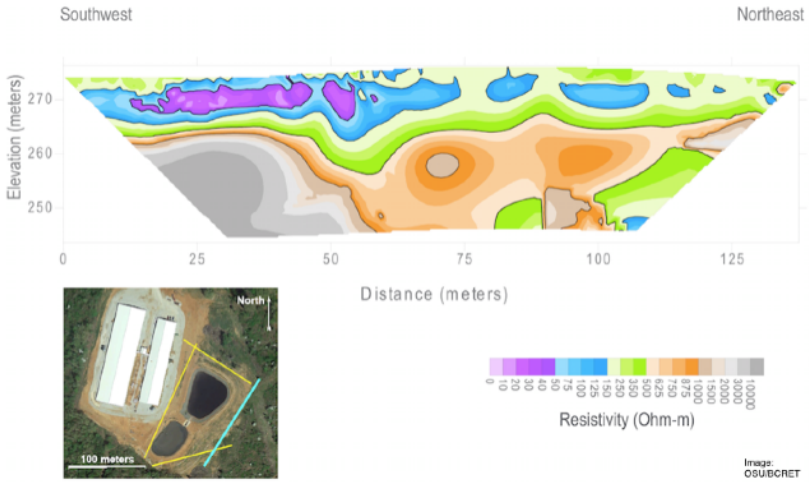


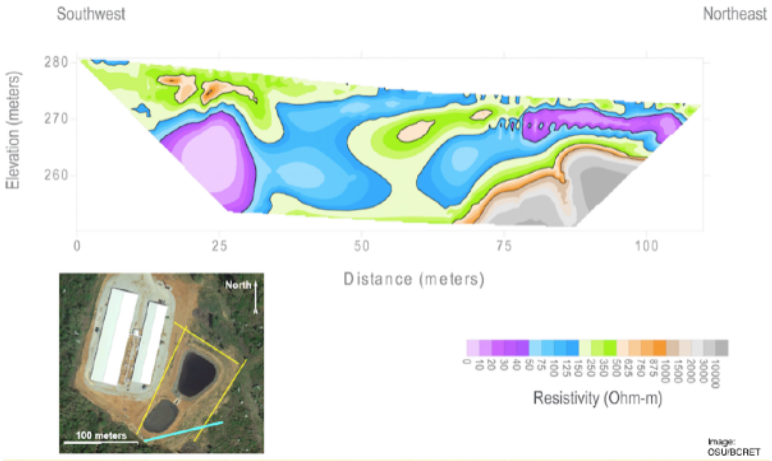
Appendix C10B - Improperly Abandoned well

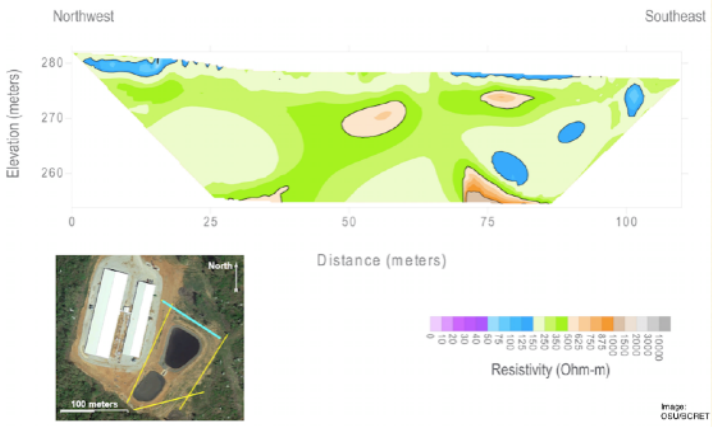


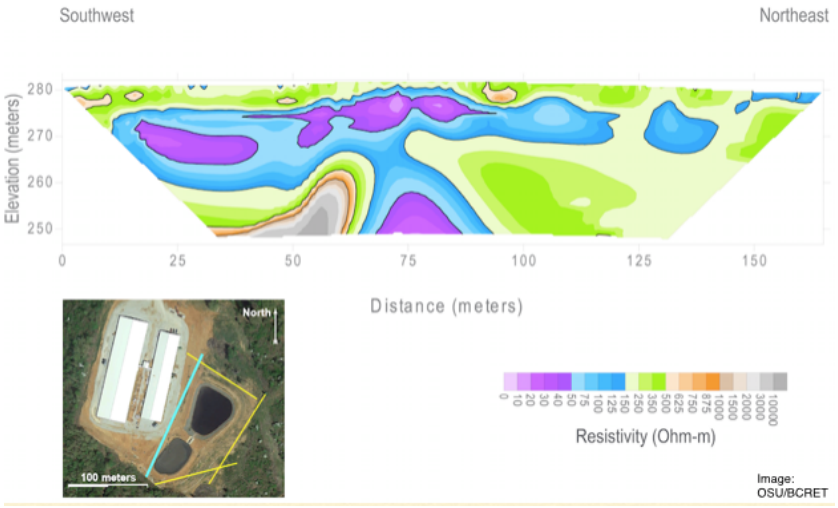


Appendix C11 - OK State Resistivity Study Transects





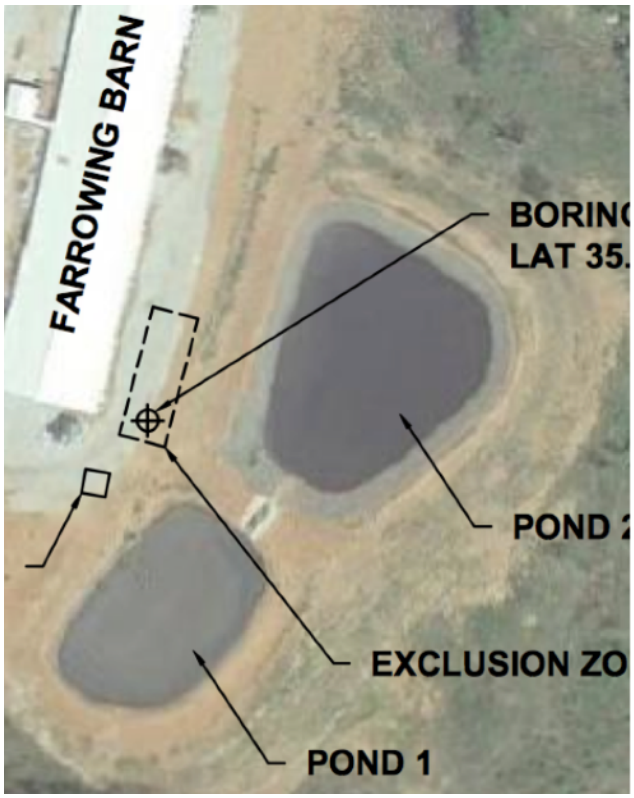


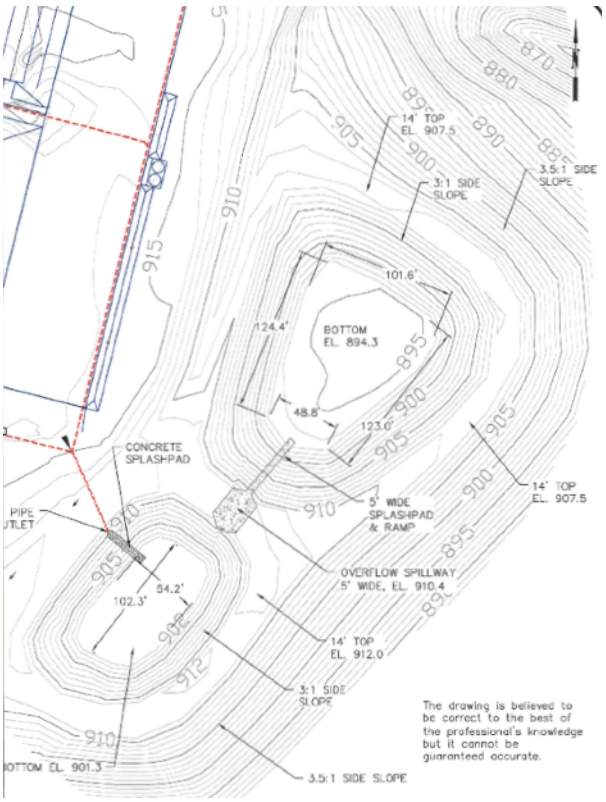


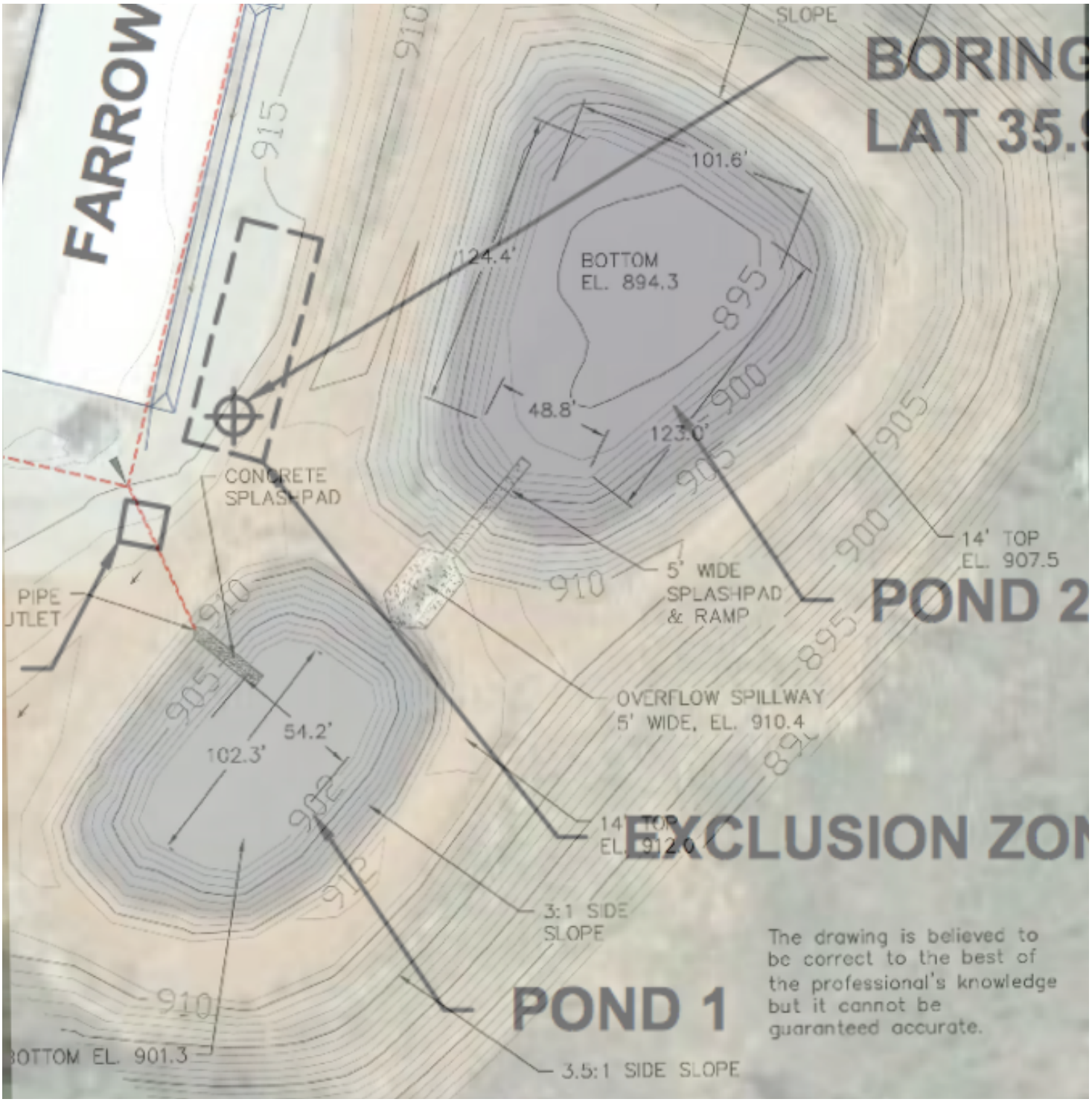
Appendix C12 - Determination of Elevations

Photo is from the Harbor Environmental Study: FIGURE 2 C & H Hog Farm - Site Layout map

2nd item is the AS BUILT elevations - Engineering Plan Sheets April 12, 2013

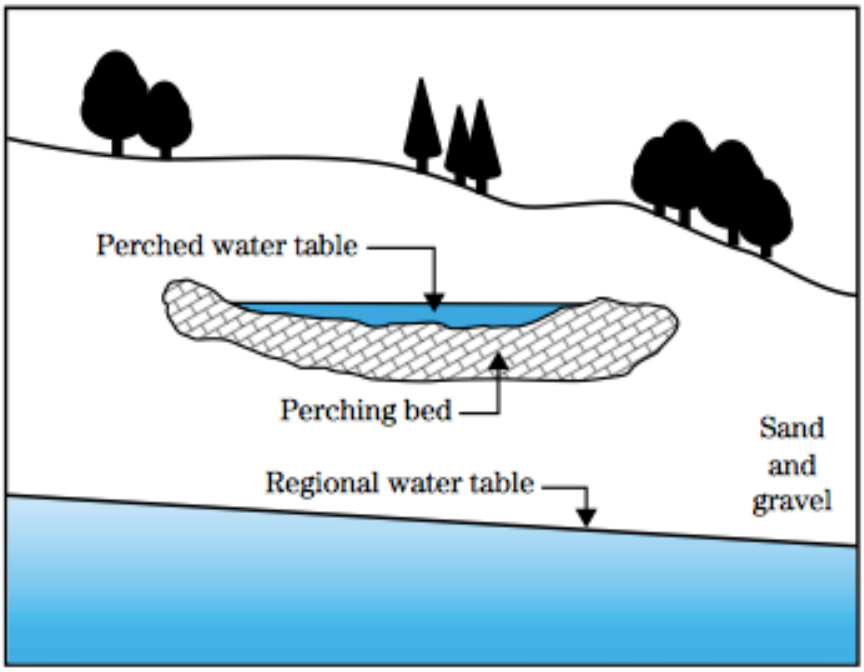


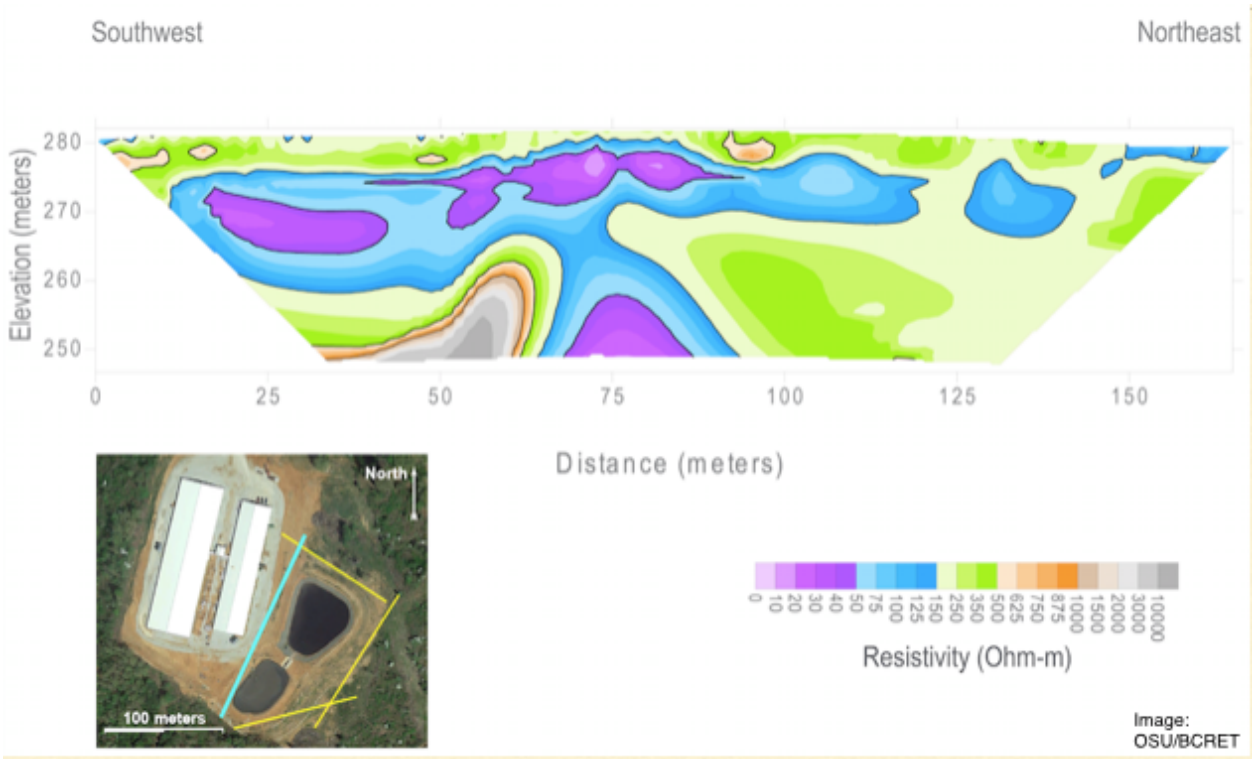



FARROW
915
910
SLOPE
BORING
LAT 35.
101.6'
124.4'
BOTTOM
EL. 894.3
895
48.8'
123.0'
900
905
CONCRETE
SPLASHPAD
14' TOP
EL. 907.5
5' WIDE
SPLASHPAD
& RAMP
POND 2
PIPE
UTLET
910
905
895
OVERFLOW SPILLWAY
5' WIDE, EL. 910.4
54.2'
102.3'
EXCLUSION ZON
3:1 SIDE
SLOPE
The drawing is believed to
be correct to the best of
the professional's knowledge
but it cannot be
guaranteed accurate.
POND 1
910
OTTOM EL. 901.3
3.5:1 SIDE SLOPE

Appendix C13 Evidence of perched groundwater.

Figure 7–8 Perched aquifer





Appendix C15 - Leakage Standards - Other States

Table 1 Comparison of state liner design rules for selected states

State	Year	Rule*	Seepage at 6 ft depth
Georgia	2002	391-3-6-21. maximum of 1/8 inch per day (3.67 x 10-6 cm/sec). (or if) located within significant ground water recharge areas must be provided with either a compacted clay or synthetic liner such that the vertical hydraulic conductivity does not exceed 5 x 10-7 cm/sec	3394 gal/ac-day Or 1108 gal/ac-day
Iowa	2006	327 IAC 19-12-5. (a) maximum specific discharge of 1/16 in /day (1.8x10 -6 cm/ sec).	1697 gal/ac/day
Ohio	2010	901:10-2-06. A minimum of three feet of *in situ* soils with a hydraulic conductivity of 1 x 10-7 cm/sec or (b) soil liners designed and constructed using procedures in section 651.1080 of the USDA, Ohio NRCS FOTG CP Standard 521 D. (10) (a) Manure storage ponds or manure treatment lagoons may be constructed within a karst area provided that the facility is designed to prevent seepage of manure to groundwater.	277 gal/ac/day
Missouri	2012	CSR 20-8.300. A. The design permeability of the basin seal shall not exceed 500 gallons per acre per day in areas where potable groundwater might become contaminated or when the wastewater contains industrial contributions of concern. Design seepage rates up to 3,500 gallons per acre per day may be considered in other areas where potable groundwater contamination is not a concern	500 gal/ac/day Or 3,500 gal/ac/day
Iowa	2000	IAC 65.15(11) . The percolation rate shall not exceed 1/16 inch per day at the design depth of the structure.	1,697 gal/ac/day
Nebraska	2000	130-8-007. materials and construction methods so that percolation does not exceed 0.13 inches per day (3.82 x 10-6cm/sec).	3,530 gal/ac/day
Oklahoma		35:17-4-11. Hydraulic conductivities of no greater than I x 10-7 cm/sec. ...(B) At least four (4) representative undisturbed core samples, one from each corner of the waste retention structure bottom Minimum thickness of one and one half (1.5) feet. For Maximum hydrostatic head of 10.5 feet	462 gal/ac/day
North Carolina	2006	15A NCAC 02T .1005 . (IF) less than four feet above bedrock shall have a liner with a hydraulic conductivity no greater than 1 x 10^{-7} centimeters per second.	462 gal/ac/day
NRCS FOTG PART 651 Chapter 10* (Table 10-4)	2010	**VERY HIGH RISK - VERY HIGH VULNERABILITY (KARST) –** evaluate other alternatives **HIGH RISK AREA – HIGH VULNERABILITY.** – synthetic liner required (or seal and reevaluate vulnerability) **HIGH RISK AREA – MODERATE VULNERABILITY** – specific discharge 1 x 10-6 cm/sec (no manure sealing credit)	no discharge no discharge 6500 gal/ac/day with no credit for manure sealing
10 State Standard**	2005	seal shall not exceed the value derived from the following expression where L equals the thickness of the seal in centimeters. k = 2.6 x 10-9L the "k" obtained by the above expression corresponds to a percolation rate	500 gal/ac/day

* Extracted from Table 10-4 (page 10-26) Criteria for siting, investigation, and design of liquid manure storage facilities, based on Risk and Vulnerability.
**Recommended Standards for Wastewater Facilities. 2004 Edition. Health Research Inc.

United States Department of the Interior
NATIONAL PARK SERVICE
Buffalo National River
402 N. Walnut, Suite 136
Harrison, AR 72601

IN REPLY REFER TO
1.A.2

March 16, 2016

Becky Keogh
Director
Arkansas Department of Environmental Quality
5301 Northshore Drive
North Little Rock, AR 72118-5317

REFERENCE: Arkansas 2016 list of impaired streams, 303(d) list

Dear Director Keogh:

Natural resource staff at Buffalo National River has recently conducted an analysis of the Big Creek Research and Extension Team (BCRET) water quality data. Two stations of particular interest are on the main stem of Big Creek, Newton County, above its confluence with the Left Fork of Big Creek. Analysis of this data indicates that this reach of stream, Headwaters Big Creek, [12-digit Hydrologic Unit Code (HUC12) 110100050302] was impaired for *Escherichia coli* (*E. coli*) bacteria based upon Regulation 2.507 during the primary contact period of May 1 to September 30, 2014. According to the Arkansas Water Information System, this HUC12 has an area of approximately 45 square miles, making this segment of Big Creek a Primary Contact Stream. The BCRET sites BC 6 and 7 (Figure 1) are located on the main stem of Big Creek within this segment, topographically upstream and downstream, respectively, of the C&H Hog Farm, Inc. facility and manure spreading fields.

Assuming that Big Creek is not part of an Extraordinary Resource Water, Ecologically Sensitive Waterbody, or Natural and Scenic Waterway (ERW, ESW, or NSW) the upper *E. coli* limit is 410 colonies per 100 ml (410 col/100ml). Data from BCRET, during the primary contact period in 2014, shows *E. coli* exceeded 410 col/100ml in six of twenty-two samples for a 27% exceedance. According to Regulation 2.507, for assessment of ambient waters as impaired by bacteria, the *E. coli* standard shall not be exceeded in more than 25% of samples in no less than eight samples taken during the primary contact season.

The regulations enacting the Federal Clean Water Act appear to take a more conservative approach to Outstanding National Resource Waters (ONRW) [40 CFR§131.12(a)(3)] which streams are analogous to ERW, WSW, and NSW streams. Buffalo National River certainly meets the criteria as an ONRW. 40 CFR indicates that the watershed of ONRWs is part and

parcel with the ONRW itself, and strongly encourages watershed protection for maintenance and protection of the ONRW. Taking this more conservative approach to *E. coli*, the standard for Big Creek should be 298 col/100ml for an individual sample and 126 col/100ml for a geometric mean of at least five samples over a 30-day period.

During the primary contact period of 2014, BCRET Station BC 6 exceeded 298 col/100ml in eight of twenty-two samples for a 36% exceedance. Also, during the primary contact period there were three periods when the geometric mean was exceeded. These were: May 13 through June 9, 2014 when the geometric mean was 339 col/100ml; June 19 through July 15, 2014 when the geometric mean was 783 col/100ml; and August 20 through September 18, 2014 when the geometric mean was 146 col/100ml.

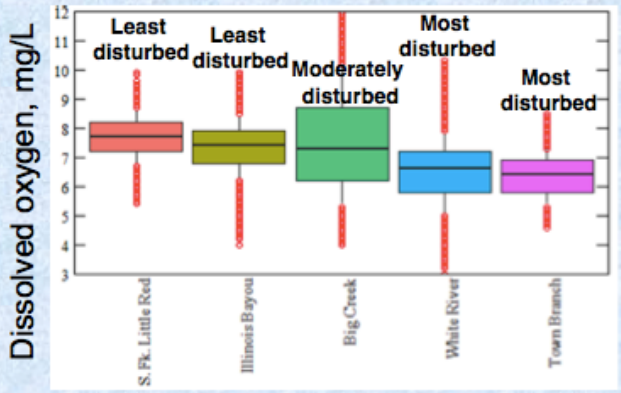
BCRET BC 7 is a station on the main stem of Big Creek downstream of the C&H Hog Farm, Inc. facility and manure spreading fields. During the primary contact period in 2014, the stream exceeded 410 col/100ml in seven out of twenty-two samples for a 32% exceedance of the standard. The stream exceeded 298 col/100 ml in seven out of twenty-two samples for a 32% exceedance of the ERW standard. The stream had two periods where the ERW geometric mean was exceeded. These were: May 13 to June 9, 2014 with a geometric mean of 283 col/100ml and June 24 to July 23, 2014 with a geometric mean of 697 col/100ml.

To further corroborate the BCRET observations from the Headwaters Big Creek hydrologic unit further down the system at ADEQ monitoring site BUFT06, data were collected by Buffalo National River within the park's boundary. *E. coli* concentrations were also elevated during the primary contact period in 2014, similar to the BCRET observations. Geometric means (five samples within a 30-day period) of *E. coli* concentrations observed two months above 126 col/100ml during that same time (Figure 2). Although the causality linkages between the *E. coli* concentrations at the BCRET sites and within the park are not fully documented, the similarity in timeframe and exceedingly high concentrations of *E. coli* at all sites during this primary contact period clearly shows the connectivity of the watershed, and what happens within the headwaters directly impacts the quality of water further downstream, in this case within the Buffalo National River. Please give this evidence strong consideration when evaluating any site within Big Creek (BUFT06) for 303(d) listing.

Data from the BCRET researchers indicate that Big Creek is indeed impaired for *E. coli* upstream of the Left Fork. Impairment of that segment can also lead to impairment within the national river as shown in our data for *E. coli* at BUFT06. *E. coli* contamination of the Buffalo River and its tributaries adversely and directly impacts the public's ability to enjoy water-based recreation within Buffalo National River.

On a final note, during a number of email exchanges between Aquatic Ecologist Faron Usrey of my staff and Craig Uyeda and Sarah Clem of ADEQ, we noted depressed dissolved oxygen values in Big Creek. The dates of these emails are July 23 and 27, 2013 and August 6 and 27, 2013. The data and information in these emails should be added to the dataset for determination of impairment for Big Creek.

Continuous DO statistics indicated a strong connection between the nutrient and land-use indices and DO concentrations



Stream name	Site no.	No. of unit values	No. of unit values < 6 mg/L	Percent of unit values < 6 mg/L
South Fork Little Red River	07075250	21,715	75	0.03
Illinois Bayou	07257500	27,986	1,046	3.7
Big Creek	07055814	14,623	2,992	20.5
White River	07048600	11,007	2,976	27.0
Town Branch	07048495	7,488	2,494	33.0

USGS

Preliminary Information—Subject to Revision. Not for Citation or Distribution

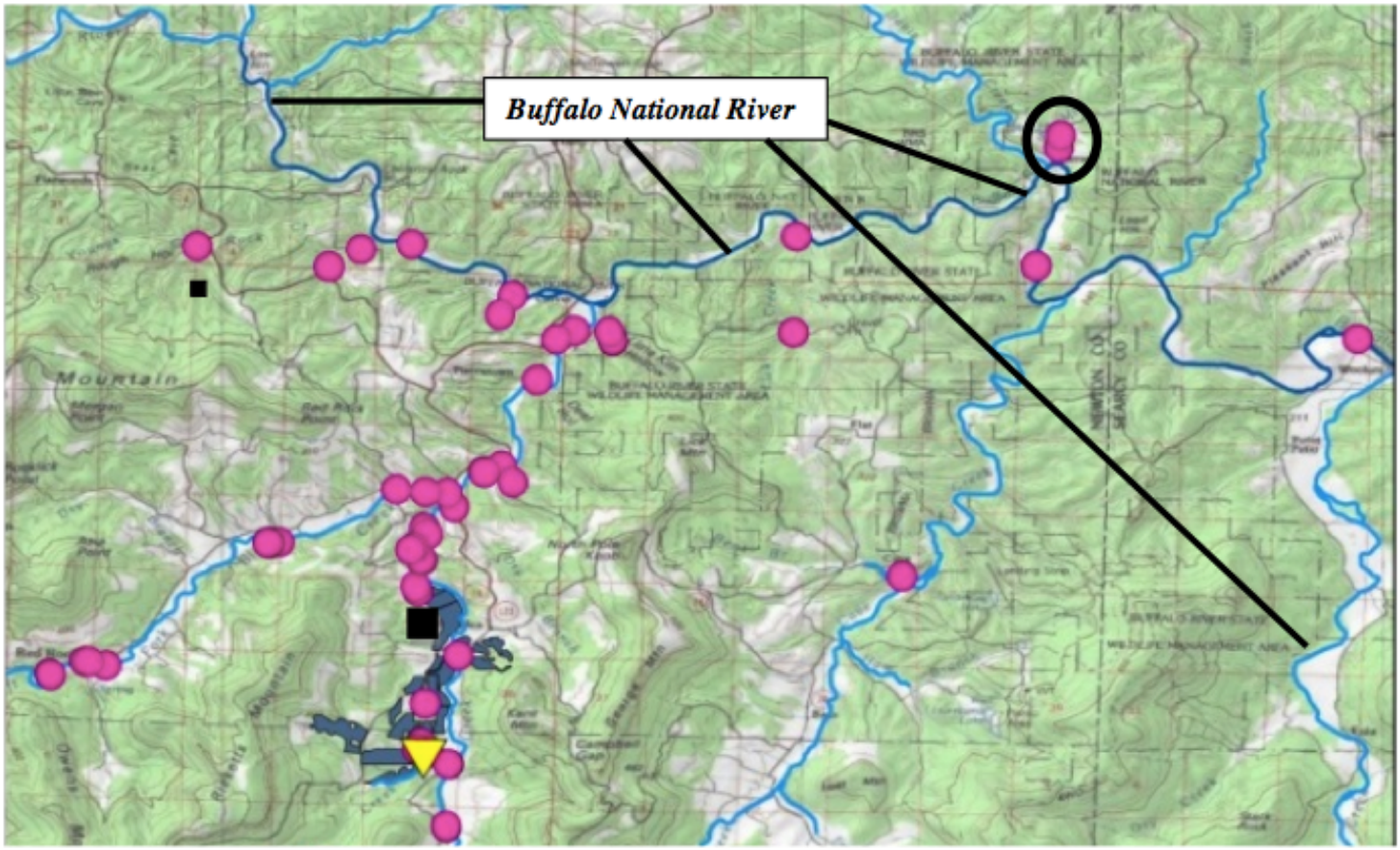


Figure 9. Flow from BS-36 where eosin input was positively traced to outflow springs and streams. This trace shows the full dispersive extent of karst flow in the subsurface into other surface water basins, the Buffalo National River, and even beneath the river to Mitch Hill Spring, identified by the black circle in the northeast quadrant. The yellow triangle is dye input well BS-36, blue shapes are hog-waste spreading fields, and the black rectangle is the CAFO. The Buffalo Nation River is the blue irregular sinuous feature that extends from the northwest to the southeast corner of the map. Pink circles are positive dye detections, five of which were retrieved from the rivet

October 16, 2018

Public Comments on denial of 5264-W C&H HOG FARMS Regulation 5 permit.

My name is Carol Bitting and I live in Marble Falls. This is my home.

In 1972 Congress designated the Buffalo River as the first national river. It gave authority to the National Parks to buy, trade and preserve the lands and oversee the protection of the 99,000 acres and the 150 miles of river against industrial pollution while preserving for future generations an experience of a free flowing stream with high quality waters containing unique, scientific and scenic values.

Anger and resentment flows here in certain communities and an 'us against them' continues, but this is only by a few. Most realize and know that the river and the lands are available to all and enjoy the scenic views and creative ways while prospering. Many hunt, fish, hike and canoe living quiet simpler lives because that is what we as land owners living rural seek.

Many folks are proud to have contributed their homesites in a way of preserving them so they are always accessible. One Mt Judea resident told me someone dumped dead hogs into a sink hole upstream of Mt Judea and the community well was contaminated and now water is piped from Bull Shoals Lake. This is the lake that flooded the lands of many generations so that Mt Judea and C&H Hog Farms could have access to drinking water when pumps stop working and wells run dry or become contaminated. We are communities relying on each other and we all contribute to each other somehow.

I realize that a force of its own exploded lifting the flat surface of the earth into mountains and bluffs and then eons of waters eroded away leaving behind what is here today not just for me but for all. Students come from all over the world to study this unique area and as a land owner I'm a part of this and I'm mixed with those generations whom left behind paintings, tools, flint works and histories of hardships and love. I've helped record this information and been proud to preserve it so that whomever walks behind me experiences it as an adventure and a re-creative experience similar to my own.

In 2013 while we were all in shock and researching how C&H came about I began to meet others around the community (Newton County). My first stop was the ADEQ office in jasper where I met 3 employees, also in shock. One was the NPDES permit writer for ADEQ who was over whelmed with grief that her prodigy had not informed her of the permit he was orchestrating. Imagine, John Bailey a young ADEQ

engineer in LR, didn't call and converse with the experienced NPDES writer in one of the most protected and sensitive areas of the state this man is now employed by Farm Bureau, the corporation paying attorney fees for C&H Hog Farms. In Jason Henson's deposition he says when asked why FB is paying attorney fees he says because that's what Farm Bureau does. If that is the case then all farmers need to call Farm Bureau to represent them against big Ag. Farmers don't need permits, C&H is not a farm but instead an industrial producer of large amounts of waste and therefore a waste water permit is required.

I have reason to be angry. Nov of 2013 Dr. Bob Cross, an engineer reported to Ryan Benefield of ADEQ the error of C&H Hog Farms engineer's calculations and ADEQ's permitting engineer's oversight in a letter about the clay linings of the waste lagoons. Instead of using the correct values and materials C&H and their engineers used materials allowing excessive gallons of raw waste to leak daily from the lagoons. NPDES permits are not allowed discharge except during a 25 year storm event. This is a discharge as evidenced in declining water qualities and in the extensive algae downstream of C&H Hog Farms. **The use of these lagoons should be stopped immediately and those responsible fined.**

The same year, 2013, my husband gave a talk at the Springfield Grotto (caver organization). A young woman approached us after the meeting and told us that a Cargill Representative had just spoken to her agri class. The rep told the class that if industry can get into the most sensitive area of a state they have the rest of the state easy. I had just been told by a researcher from the U of A that Big Creek was considered the most sensitive area of the state.

To the most sensitive area of the state of Arkansas came one of the most devastating water polluting industries known around the world. It separates families, friends, neighbors and communities destroying physical and mental health, jobs and water quality.

Reading the depositions and expert reports listed under C&H Hog Farms 'Additional Information'. I am angry and disappointed at the lack of integrity and the involvement that continues to allow destruction of the Buffalo River by our state agency's, the University of Arkansas' BCRET team, Governor Beebe, Governor Hutchinson, Farm Bureau, The Pork Producers, Cargill, C&H Hog Farms, C&C Hog Farms, EC Farms and on down the line. It is no wonder that a state representative told me, the truth has been hard to get to about the CAFO and the Buffalo River.

Lying, hatred and forgetfulness will not restore the Buffalo National River. It will take many many years for the incorrectly figured amounts of phosphorous waste to be flushed from the karst

and will only begin when the waste lagoons are closed and the permit denied.

The livelihood of the citizens that live here and other downstream counties is another matter and the longer the decision held the larger the burden others shoulder.

The Karst Hydrology of the Buffalo River was a group formed as a result of the CAFO in Big Creek. This team included Dr. John Van Brahana, Dr Joe Nix, John Murdoch, Ray Quick, Teresa Turk, Brian Thompson, Katarina Kosick, myself and many students. WE produced 5 peer reviewed papers and one of those was a very extensive dye trace.

We came together as volunteers and we were welcomed into the Big Creek area by most residents including waste spreading field owners and onto lands that BCRET says they were denied permission to access. What happened to this community was greed, it was deliberate and unfortunate because it has hardened hearts and has torn gashes deep into family roots. I have been there I have heard their stories and listened as they gave hidden quiet support to our team to restore what they and their forefathers found so special in this community surrounded by National Forest, Arkansas Game and Fish and the National Parks.

I am proud of the studies and all the volunteers that have come together as we have recorded to the best of our abilities the fact based science surrounding the 'death of the Buffalo National River'. I am hopeful that closing this operation will allow myself and colleagues an opportunity to help restore integrity to our state agencies and regulators and take priority in restoring the Buffalo National River to what Congress set aside for all.

I support the denial of C&H HOG FARMS permit 5264-W in the Buffalo National River watershed.

Carol Bitting
HC 73 Box 182 A
Marble Falls, Ar 72648



This photo is a spring to the east of Big Creek in the Cave Creek area. It is questionable as to why it is boiling a brown turbid water. Local people collect drinking water from this spring. Could this be a recipient of lagoon waste discharge? Though a few cattle are near the spring has deteriorated over the last 6 yrs.

P. O. Box 1Eb
Fayetteville, AR 72702

November 4, 2013

Mr. Ryan Benefield
Deputy Director
Interim Chief, Water Division
Arkansas Department of Environmental Quality
5301 Northshore Drive
North Little Rock, Arkansas 72118-5317

Subject: Comments on Pond Liner for Waste Holding Ponds, C&H Hog Farms

Dear Mr. Benefield

C&H Hog Farms filed an NOI with ADEQ on June 14, 2012 for coverage under General Permit No. ARG590000. The NOI was accepted as complete on June 25, 2012 and after the 30-day public comment period, coverage under the general permit was granted on August 3, 2013 with a permit number of ARG590001.

As part of the NOI, C&H was required to submit ADEQ Form 1 with plans and specifications for the construction of the waste ponds. I have reviewed these plans and specifications and wish to bring to your attention certain mistakes that were made by C&H as well as by ADEQ in the general permit process. In this discussion I will treat C&H and the engineering firm that they hired, DeHaan, Grabs & Associates as one entity and even if the mistake was made by DeHaan, Grabs, I'll refer to it as C&H. I have also reviewed subsequent events in April, 2013 when the as-built plans of C&H were reviewed by ADEQ and the facility was approved for production. I found additional problems during that time period and inferred from some of the correspondence that ADEQ was aware of some of the inaccuracies but chose not to bring them to the attention of the public.

The mistakes relate to the clay liners for the waste ponds. It was stated in the NOI that the ADEQ specification for leakage was no more than 5,000 gallons per acre per day. However, APCEC Regulation 6, the regulation that governs the ADEQ administration of NPDES permits, states that specifications for liners for waste ponds shall be based on the 10 States Standards, i.e.,

Paragraph 93.422 of the Standards states:

> "Ponds shall be sealed such that seepage loss through the seal is as low as practicably possible. Seals consisting of soils, bentonite, or synthetic liners may be considered provided the permeability, durability, and integrity of the proposed material can be satisfactorily demonstrated for anticipated conditions. **Results of a testing program which substantiates the adequacy of the proposed seal must be incorporated into and/or accompany the engineering report. Standard ASTM procedures or acceptable similar methods shall be used for all tests.** (Please note this underlined and highlighted passage; I will refer to it again.)
>
> To achieve an adequate seal in systems using soil, bentonite, or other seal materials, the hydraulic conductivity (k) in centimeters per second specified for the seal shall not exceed the value derived from the following expression where L equals the thickness of the seal in centimeters
>
> $$k = 2.6 \times 10^{-9} L$$
>
> The "k" obtained by the above expression corresponds to a percolation rate of pond water of less than 500 gallons per day per acre [4.7 $m^3/(ha \cdot d)$] at a water depth of 6 feet (1.8 m) and a liner thickness of 1 foot (0.3 m), using the Darcy's law equation."

Thus the specification is not even close to 5,000 gallons per acre per day. The actual specification is given in terms of the hydraulic permeability, k, but as stated above Darcy's Law can be used to calculate the specification in gallons per acre per day using the actual liner thickness and liquid depth in the ponds. In Attachment 1 I have done just that for the two C&H ponds. Thus Pond 1 having a liner thickness of 18 inches and a maximum liquid depth of 9 feet would have a specification of 660 gallons per acre per day and Pond 2 having a liner thickness of 18 inches and a maximum liquid depth of 12.2 feet would have a specification of 895 gallons per acre per day. This is a far cry from the 5,000 gallons per acre per day given in the NOI.

The other problem with the NOI related to the pond liner is that the laboratory testing results for the soil to be used for the liner were not included. Only a statement was provided saying "tests are currently being run to determine the coefficient of permeability using Darcy's Law. Results will be forwarded once they are completed." Thus the requirement in the 10 States Standards and highlighted above that the "results of a testing program which substantiates the adequacy of the proposed seal must be incorporated into and/or accompany the engineering report" was not met. I would also read the requirement in the general permit requiring construction plans and specifications for the ponds to be in the NOI to mean that the properties of the soil to be used as the clay liner should be in the NOI.

Therefore, there are two problems with the NOI—an incorrect pond liner specification and not including laboratory test results of soil to be used for the pond liner. The NOI should not have been accepted by ADEQ on June 25, 2012.

The public was denied their right to review and comment on the pond liner design and specifications.

We now fast forward to April 8, 2013 when in a letter from C&H to ADEQ (Ref. 1) the results of the soil testing program were finally reported, over 9 months after they were "currently being run". This letter was sent as part of the information that was sent to ADEQ to obtain approval for C&H to start production. In this letter it is reported that the value of k, the coefficient of permeability (or the hydraulic conductivity of Darcy's Law) for the clay liner material is 5.0E-7 cm/sec. C&H then used Darcy's Law to calculate the seepage rates for Pond 1 and Pond 2 and finds them to be 3,448 and 4,218 gal/acre/day, respectively. They go on to say that these numbers are less that the 5,000 gal/acre/day as established by "Part 651 National Engineering Field Handbook". It's actually Part 651 Agricultural Waste Management Field Handbook . The name they used is not correct. However, as pointed out above 5,000 gal/acre/day is an incorrect specification and the Agricultural Waste Management Field Handbook is the wrong reference; it should have been the 10 States Standards.

Someone, perhaps someone at ADEQ, recognized that the wrong specification had been used, and on April 12, 2013, four days after the previous letter, C&H sent another letter to ADEQ (Ref. 2) giving the same lab results with the 5.0E-7 cm/sec permeability coefficient. In this letter they pointed out correctly that the 10 States Standards specifies that the permeability coefficient shall not exceed 1.2E-7 cm/sec for an 18-inch liner but they failed to mention the rest of the specification given above that the "**specification must be substantiated by the testing program.**" They should have pointed out that their clay liner material had a permeability 4.2 times higher (420 percent) than the specification. Instead they threw in a smoke screen by referencing an appendix of the Agricultural Waste Management Field Handbook again and stating that Appendix 10D of the Handbook gives an estimated future reduction of the permeability of ½ order of magnitude by manure sealing of the liner and thus the 10 States Standard requirement would be met. However, stated another way the 10 States Standard specification doesn't rely on what happens in the future; it must be substantiated by the testing program. Furthermore, there is no reference that I can find to the Agricultural Waste Management Field Handbook in the general permit or in Regulation 6. To make the numbers somewhat more meaningful I will use the lab result of k=5.0E-7 cm/sec to calculate the seepage rate in units of gal/acre/day. As noted in Attachment 1 the value would be 2,775 gal/acre/day for Pond 1 and 3,761 for Pond 2. These numbers are somewhat lower than those calculated by C&H (see above). Since they didn't show their calculations in their April 8, 2013 letter, I don't know where their error was. As expected, the values given, 2,775 and 3,761 are 4.2 times higher than the specifications given above and in Attachment 1.

Then in an undated letter (but listed as April 15, 2013 on the ADEQ website) (Ref. 3) from John Bailey to Jason Henson of C&H, ADEQ accepted the construction certification of C&H with no comment and approved the initiation of operations. This is inexplicable in light of the failure of C&H to meet the clay liner specification.

In summary the following problems are outlined in this letter:

- the specification for the waste pond clay liner in the NOI was not correct,
- lab testing results for soil to be used as the liner were not included in the NOI,
- ADEQ accepted the NOI with the errors stated with the public being mislead about the clay liner specification and not being able to review the soil properties for the clay liner construction,
- lab testing results showed the soil used for the clay liner had a permeability 420 percent higher than the specification,
- ADEQ approved the out-of-specification results,
- the waste ponds are now being used with liners that don't meet specifications.

I would appreciate your comments on the information in this letter.

Sincerely,

Robert Cross

President, Ozark Society

Research Professor Emeritus
Ralph E. Martin Department of Chemical Engineering
University of Arkansas

Cc: Ms. Teresa Marks, Director, ADEQ

Attachment

References: To find the references, go to the ADEQ web site:

and then enter ARG590001 in the search field and select "Search" twice. When the list of items comes up, Ref. 1 is entitled "Certification and QA-QC Section and Updated SPAW Calculations, 2013-04-08". Ref. 2 is entitled "QA-QC Soil Testing Results, 2013-04-12". Ref. 3 is entitled "Approval of Construction Certification and WNMP Revisions Minor Mod, 2013-04-14".

Attachment 1

Calculations Using Darcy's Law

Darcy's Law is usually written as:

$$Q = \frac{kA\Delta h}{L} \qquad (1)$$

where Q = volumetric flow rate, $cm^3/_{sec}$

k = permeability coefficient (or hydraulic conductivity), cm/sec

A = flow area, cm^2

Δh = liquid head, cm

L = length of flow path, cm

This equation can be written as:

$$\frac{Q}{A} = \frac{k\Delta h}{L} \qquad (2)$$

The 10 States Standards gives the specifications for pond liners in terms of the permeability, k, i.e.,

$$k = 2.6 \times 10^{-9} \text{ L} \qquad (3)$$

where L = the thickness of the liner in cm.

Thus for the C&H ponds that have liner thicknesses of 18 inches (1 inch = 2.54 cm), the specification is:

$$k = 2.6\times10^{-9} \text{ x } 18 \text{ x } 2.54 = 1.19\times10^{-7} \text{ cm/sec} \qquad (4)$$

While the specification is given in terms of the permeability, k, it may be easier to visualize its meaning by using equation (2) to calculate a corresponding seepage rate for the two C&H ponds, i.e. Pond 1 and Pond 2.

For Pond 1:

the liquid depth Δh is 9 ft (or 9 x 30.48 cm/ft = 274.3 cm)

the liner thickness, L = 18 in. or (18 x 2.54 cm/in = 45.7 cm)

then using Equation (2)

$$\frac{Q}{A} = \frac{k\Delta h}{L} = \frac{1.19x10^{-7}\times 274.3}{45.7} = 7.143\times10^{-7}\,\frac{cm^3}{cm^2.sec} \qquad (5)$$

Converting to the English units commonly used the calculated specification seepage rate for Pond 1 would be:

$$\frac{Q}{A} = 660\ \text{gal/acre/day} \qquad (6)$$

For Pond 2 the same method would be used but now with a liquid depth of 12.2 ft. This would result in a calculated specification seepage rate of:

$$\frac{Q}{A} = 895\ \text{gal/acre/day} \qquad (7)$$

The laboratory engaged by C&H, GTS, Inc., tested the soil used by C&H for the liners by ASTM D 5084 Method C as required by the 10 States Standards and found the permeability, k, to be 5.0×10^{-7} cm/sec. As previously pointed out the value exceeds the specification by a factor of 4.2 (420%). It can be used to calculate a seepage rate for the two ponds. Using this value of k with the liner thickness and liquid depth of Pond 1 and Pond 2, the seepage rate would be 2,775 gal/acre/day and 3,761 gal/acre/day, respectively. As expected, these numbers exceed the specification seepage rates given in Equations (6) and (7) by a factor of 4.2 (420%).

ROBERT A. CROSS

Ralph E. Martin Department of Chemical Engineering
University of Arkansas

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P.O. Box 145
Fayetteville, AR 72702
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EXPERIENCE:

UNIVERSITY OF ARKANSAS, Fayetteville, AR, 2008-Present
Emeritus Research Professor, Ralph E. Martin Department of Chemical Engineering
Research projects and part-time teaching.

UNIVERSITY OF ARKANSAS, Fayetteville, AR, 1995-2007
Research Professor, Ralph E. Martin Department of Chemical Engineering
Co-Director, Center for Membrane Separations
Teaching membrane technology and chemical engineering process design courses. Directing the Membrane Separations Center to coordinate membrane-related research and to serve as a focal point for obtaining government and corporate support.

CUNO INCORPORATED, Norwood, MA 1991-1994
Vice President and General Manager (and Technical Director), Separations Systems Division
Full P&L responsibility for this Cuno division which took over the business and facilities of Bioken Separations. Developed new products and expanded business into drinking water, pharmaceutical processing, beverage clarification and waste treatment. Obtained the first contracts from US E.P.A. to provide membrane systems for drinking water treatment to meet new turbidity and microbiological standards. Launched marketing effort to sell packaged drinking water systems to small towns.

BIOKEN SEPARATIONS INC., Norwood, MA, 1989-1991
CEO and Chairman (and Technical Director)
General Management responsibility for this startup company. Developed a leading position in the ultrapure water field by developing spiral ultrafiltration cartridges manufactured in a clean room under strict quality control standards. Sold installations to major semiconductor companies including SEMATECH, Motorola and Digital Equipment. Became the sole supplier to several leading OEM's selling laboratory water systems.

ROMICON, INC., Woburn, MA, 1972-1988
President, 1974-1988
Full P&L responsibility for this high technology $14,000,000 company with 120 employees that developed, manufactured and marketed membrane ultrafiltration, microfiltration and reverse osmosis systems for waste and water treatment and for chemical, food and pharmaceutical processing. Direct sales in North America and parts of Europe plus twenty distributors in Europe, the Eastern Bloc, Latin America and the Pacific Basin. Romicon was independently incorporated but all stock was owned by the Rohm and Haas Company, a $4.0 billion specialty chemical company.
Vice President, Research and Development, 1972-1974
Managed membrane and cartridge development, process development, product development, quality control, technical service, selling joint process development programs to industry and the government, and patent administration.

AMICON CORPORATION, Lexington, MA, 1963-1972
Director, Process Research, 1970-1972
Responsible for the technical and administrative direction on contract and in-house development programs, primarily in the biomedical area. This included responsibility for securing new research contracts. Program areas were artificial kidneys, membrane oxygenators, blood and tissue compatible materials, desalination membranes, pilot production of hollow fiber ultrafiltration modules.
Assistant Director of Research, 1968-1970 **Manager, Film Products,** 1966-1968
Project Manager, 1964-1966 **Senior Project Engineer,** 1963-1964

EDUCATION:	M.S.Ch.E.	Massachusetts Institute of Technology	1959
	B.S.Ch.E.	University of Arkansas	1957

MILITARY SERVICE: USAF, Materials Command, Wright-Patterson Air Force Base, Ohio
1959 – 1962, Last attained rank: Captain

PUBLICATIONS AND PRESENTATIONS:

1. "Properties Required for Collector Surfaces of Solar Powered Thermal Systems," by R. A. Cross, *Solar Energy,* VII(3), pp. 152-155 (July-September 1963).

2. "Effects of Water-Dispersible, Ether-Containing Polymeric Feed Additives Upon the Salt-Rejection Efficiency of Cellulose Acetate Reverse Osmosis Membranes," by H. J. Bixler and R. A. Cross, San Diego OSW Conference, February, 1967.

3. "Utilization of Polyelectrolyte complexes in Biology and Medicine," by L. Markley, H. J. Bixler and R. A. Cross, *American Chemical Society Division of Organic Coatings and Plastics Chemistry,* 27 (2) p. 21 (September 1967).

4. "Synthetic Antithrombogenic Surfaces from Polyelectrolyte Complexes," by R. A. Cross, L. Markley Nelsen, H. J. Bixler, M. Fadali and V. L. Gott, Philadelphia Materials Conference of the AIChE, April 1968.

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12. "Asymmetric Hollow fibers for Ultrafiltration and Dialysis," by R. A. Cross, *AIChE Symposium Series* 68(120), pp. 15-20 (1972).

13. "Structure, Properties, and Biocompatibility of Polyelectrolyte Complexes," by A. S. Michaels and R. A. Cross, IUPAC Meeting, Boston, MA, July 1971.

14. "Barrier Separation Processes," by R. A. Cross and H. Strathmann in *An Introduction to Separation Science*, Barry L. Karger, Lloyd R. Snyder and Csaba Horvath, eds., Wiley, New York, 1973.

15. "Hollow Fiber Ultrafiltration for By-Product Recovery in the Food Processing Industry," by B. R. Breslau, A. J. Testa and R. A. Cross, 168th National Meeting of the American Chemical Society, September 1974.

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18. "Production of a Crystal Clear Bland Tasting Protein Solution from Cheese Whey," by B. R. Breslau, J. Goulet and R. A. Cross, 70th Annual Meeting of the American Dairy Science Association, June 1975.

19 Lecturer on Membrane Separations, Biochemical Engineering Summer Course, University College London, 1981, 1983, 1985 and 1987.

20. "Purification of Drinking Water with Ultrafiltration" by R. A. Cross, The 1993 Eleventh Annual Membrane Technology/Separations Planning Conference, Newton, Massachusetts 1993.

21. "Evaluation of Spiral-Wound Ultrafiltration Cartridges for Large-Scale Water Applications" by R. A. Cross, R. J. Hardiman, O. A. Chu and J. T. Greene, American Water Works Association, Membrane Processes Conference, March 1991.

22. "Ultrafiltration and Reverse Osmosis for Vinegar Processing" by R. A. Cross, The Vinegar Institute, West Palm Beach, Florida, 1994.

23. "Ultrafiltration: One Answer to the Surface Water Treatment Rule? by I. Sabran, R. A. Cross, D. R. Libby, J. Goodrich and B. Lykins, Jr., *Water Conditioning and Purification* (December 1992).

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26. "The Separation Center at the University of Arkansas" by R. A. Cross, The 1996 Fourteenth Annual Membrane Technology/Separations Planning Conference, Newton, MA, October, 1996.

27. "Workshop--Membrane System Design & Applications in the Food and Pharmaceutical Industries" by R. A. Cross and H. S. Muralidhara, North American Membrane Society Tenth Annual Meeting, Cleveland, Ohio, May, 1998

28. "Seminar--Optimization of the Process Design for Ultrafiltration and Microfiltration Systems," by R. A. Cross, University of Twente, The Netherlands, July, 1998

29. "Optimum Process Designs for UF and Crossflow MF Systems," by R. A. Cross, International Congress on Membranes and Membrane Processes, Toronto, Canada, June, 1999.

30. "Optimum Process Designs for Ultrafiltration and Crossflow Microfiltration Systems," by R. A. Cross, AIChE Annual Meeting, Dallas, Texas, November, 1999.

31. "Workshop--Membranes for Pharmaceutical Applications" by R. A. Cross, North American Membrane Society Twelfth Annual Meeting, Lexington, Kentucky, May, 2001

32. "Removal of Red Grape Polyphenoloxidase (PPO) by Ultrafiltration," by L. Song and R. A. Cross, North American Membrane Society, Thirteenth Annual Meeting, Long Beach, CA, May 2002

33. "Optimum Process Designs for Ultrafiltration and Crossflow Microfiltration Systems," by R. A. Cross, *Desalination* 145, 159-163 (2002)

34. "Optimum Process Designs for Ultrafiltration and Crossflow Microfiltration Systems," by R. A. Cross, International Congress on Membranes and Membrane Processes (ICOM), Toulouse, France, July 7-12, 2002.

35. "Comparison of UF and MF Membranes for Bacteria and Virus Removal in Drinking Water Applications," by R. A. Cross, J. Teo, and P. Wang, AIChE Annual Meeting, November, 2002, Indianapolis

36. "Optimization of UF and MF Process Designs for Concentration and Purification of High-Value Products," by R. A. Cross, AICHE Annual Meeting, November, 2002, Indianapolis

37. "Methods of Process Design for Ultrafiltration and Crossflow Microfiltration Systems," (Invited Tutorial), by R. A. Cross, AICHE Annual Meeting, November 2003, San Francisco

38. "Air Pollution and Greenhouse Gas Effects of Drilling in Shale Areas," by R. A. Cross, Fayetteville Shale Symposium, United States Geologic Service and and University of Arkansas Water Resources Center, Fort Smith, AR, March 20-21, 2012

LIST OF PATENTS:

U.S. 3,475,358 Antithrombogenic Material
U.S. 3,514,438 Antithrombogenic Material
U.S. 3,607,377 Electroconductive Paper
U.S. 3,691,068 Dialysis Membrane and Its Use
U.S. 3,775,176 Method of Forming an Electroplatable Microporous Film

Carol Bitting

Here is the 2nd submittal to my comments.

Thank you,

Carol Bitting

Engineer Permits Branch, Office of Water Quality
5301 Northshore Drive
North Little Rock, Ar 72118-5317

October 6, 2018

My comments are in support of ADEQ's draft denial of C&H Hog Farms (C&H) permit 5264-W AFIN51-00164 and for a denial decision with immediate closure so that the streams this facility contributes degradation to and remediation begin immediately to restore the Extraordinary Resource Waters, Ecologically Sensitive Waters and Natural or Scenic Waterways as protected by Congress.

I will attach prior comments to this denial and my position is still a denial of the permit and all permits in the Buffalo River watershed until the State of Arkansas has determined stream nutrient criteria and agronomic soil rates for the natural, unique and scenic qualities of the karst area of the Buffalo National River.

I have searched sites such as the Regulation 6 permit ARG590001[1] the CAFO is operating under at this time. Original permit states 4,000 nursery pigs and 5264-W states 750. Reducing these numbers to 750 nursery pigs averaging 10 lbs each reduces waste to 7,500 lbs verses 40,000 lbs in 2012. This becomes concerning when you are figuring how much waste is being produced, stored and spread on the fields already saturated with phosphorous.

5264-W permit increases the number of sows from previous permit of 2500 sows to 2672. 2018 USDA reports a sow will average between 27-29 pigs a year. So if you increase the sows from 2500 to 2672 you will be increasing the number of pigs the cafo is producing. Increasing the size, waste and spreading output of the operation. This would violate *Regulation 5.901 (d) A permit renewal, permit modification or* ***new permit issued pursuant to Reg 5.901 shall not increase the number of swine at a facility.***[2]

December of 2013 after beginning operation in June, C&H Hog Farm's lagoon's were near pump down markers. They sought a winter nutrient management plan to apply[3]. This was a winter day and yet application was made to field 15 where all plants were dormant.

The 2013 annual report[4] states they had 2160 swine over 55 lbs and 1289 under 55 lbs and produced 2,786,908 gallons of waste. To change the calculations would err the storage needed in the lagoons requiring more waste application and create more runoff to the streams when plants are dormant.



The turbidity of Big Creek entering the Buffalo National River is apparent in this upper photo.

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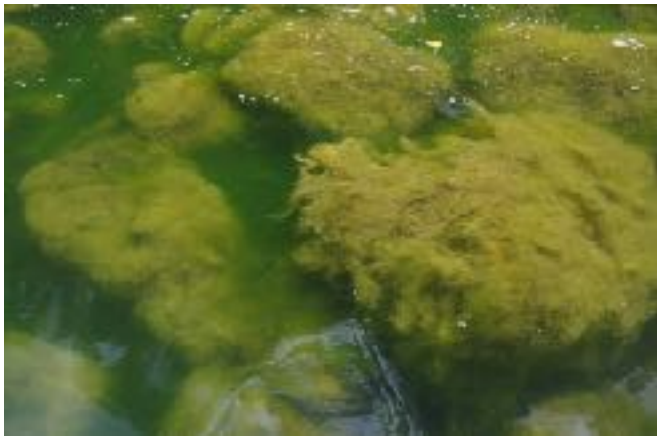
[1] https://www.adeq.state.ar.us/downloads/WebDatabases/PermitsOnline/NPDES/PN/ARG590001_Modiifcation%20of%20NMP_20140218.pdf

[2] https://www.adeq.state.ar.us/regs/files/reg05_final_150918.pdf

[3]https://www.adeq.state.ar.us/water/bbri/c-and-h/pdfs/2018-09-17/Deposition%20Hancock%20with%20Exhibits.pdf

[4] https://www.adeq.state.ar.us/downloads/WebDatabases/PermitsOnline/NPDES/PermitInformation/ARG590001_2013%20Annual%20Report_20140127.pdf

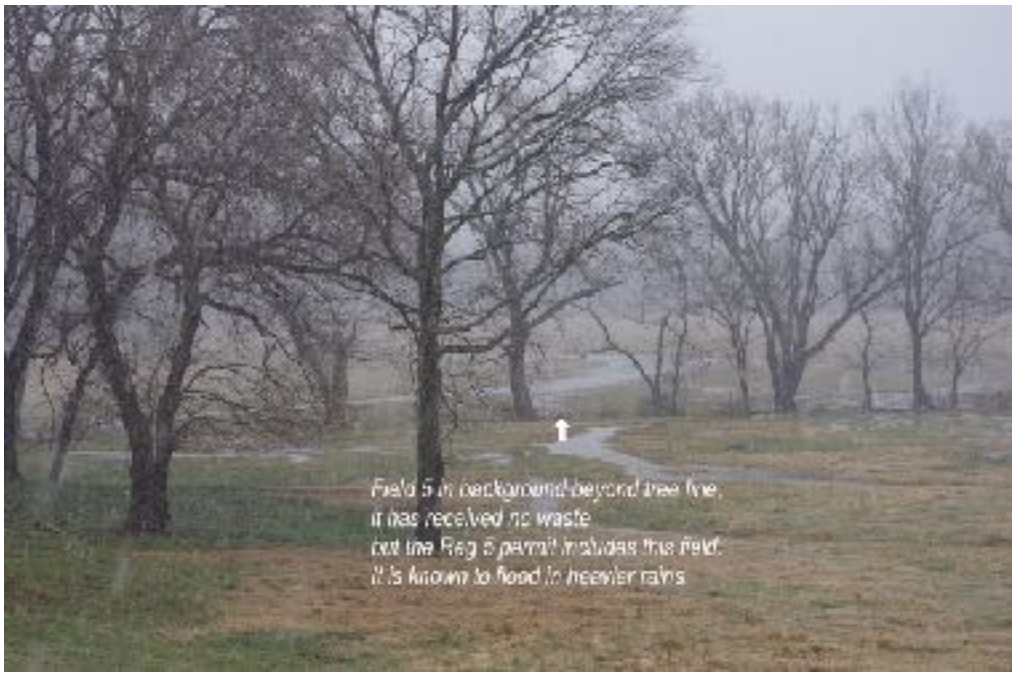
The photo on the right is of the increased algal bloom and periphyton on the Buffalo River stream bottom downstream of the hog CAFO.



Honey Wagon's (waste hauler trucks) utilize state highways to get to spreading fields around the county. No placards or license or owner information is on these trucks.



For future consideration this photo shows rainwater flow across Field 5. There is no mention of 'highly erodible land conservation and wetland conservation' (HEL) included with the nutrient management plan but I think this is extremely important to be added so that fields that are already under contract are declared and the NM Planner can adjust for phosphorus and nitrogen runoff. Since the USDA Farm Service Agency may have made determinations on many of these permitted fields it would be a good practice to include this in the NMP.[5] In NM planner Monica Hancock's deposition it appears little is known or translated to a NMP about karst, highly erodible lands or excess phosphorus. This is disastrous to high quality waters due to excess algae growth by the runoff.



[5]https://www.adeq.state.ar.us/water/bbri/c-and-h/pdfs/2018-09-17/Deposition%20Hancock%20with%20Exhibits.pdf

Please also take into consideration that C&H Hog Farm is a corporation, not an individual therefore it is important to have disclosure information.

There are many technical reports in the 'Additional Information' under the 5264-W permit information. Many of these reports verify the leakage of the lagoons and the addition of nutrients to Big Creek and the Buffalo River. I will not list them but provide footnote access to their location.[6]

I continue to believe we have common goals to provide a future for generations continuing enjoyment of the Buffalo National River as designated by Congress in 1972. Agencies and citizens have become complacent to the importance of preserving previous environmental standards that it takes to maintain high quality waters when money drives the heart. The untold state and local $'s spent on this one cafo since the permitting of ARG590001 will continue to rise as the waters of this state continue to be contaminated with the excess phosphorus runoff for years to come.



Let this be a lesson that we remember and don't hesitate to implement standards to be more environmental than standards that allow degradation to our streams and soils leaving behind superfund sites that can't be undone.

I will attach my previous comments and concur with Jessie Green, White River Waterkeeper, Buffalo River Watershed Alliance, the Ozark Society, NPS, John Murdoch, Van Brahana, Ray Quick and many others for the denial of this permit.

Sincerely,
Carol Bitting
HC 73 Box 182A
Marble Falls, Ar 72648

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[6]https://www.adeq.state.ar.us/home/pdssql/p-additional-information-5264-w.aspx

To ADEQ, 06/02/2016

In reference to a Regulation 6 General Permit #ARG590001 requesting Regulation 5 individual permit under #5264-W I would like these comments to go on record.

The ARG590001 permit was placed in a newspaper in Pulaski County under a name unknown to any local or Arkansas resident, this permit went unnoticed by Newton County residents and most Arkansas taxpayers. There was no mention of the Buffalo National River (BNR) and no mention of Big Creek. Only a few ADEQ staff & a few residents were aware of the filing of this large confined animal feeding operation application in Mt. Judea, Ar.

Now that C&H has been in operation under a National Pollutant Discharge Permit and is up for renewal they have asked for an individual Reg 5 permit with no renewal attachments. Regulation 5 permits at the time of the original filling had a much more stringent public notice requirement than the Regulation 6 General Permit. This regulation has since been revised to include more stringent notification, but only after a large cafo was permitted in the BNR watershed.

The ARG590001, NPDES permit is under the federal supervision of the Environmental Protection Agency as well as the state supervision, Arkansas Department of Environmental Quality . This cafo with its high potential to pollute water was placed on karst in the watershed of the First National River, an Extraordinary Resource Water, therefore surveillance should be at the highest level to protect the waters of this state described in Regulation 2.

C&H Hog Farms, ARG590001, by design and all visual appearances is discharging into the waters of this state. The lagoons, as so stated, are allowed to leak according to the NPDES permit over 7,000 gallons daily. Due to this discharge factored into the original permit and no proof there is not leakage, C&H owners are knowingly discharging while seeking a Regulation 5 “no discharge” permit.

The presence of a large swine cafo in a tributary to the Buffalo National River with funding from the state of Arkansas (BCRET) to monitor the impacts to the Buffalo River has shown that Big Creek is impaired for e-coli and the USGS & NPS data show Big Creek is impaired for dissolved oxygen (see data presented to ADEQ prior to the State’s 303-D impaired waters listing by the NPS & BCRET). Due to the visual appearance of Big Creek and the BCRET, NPS and USGS data results it appears there is discharge into the streams, springs and waters of the state. I ask you to deny this application change to a Regulation 5 individual permit due to discharge and or the lack of evidence they are not discharging.

If ADEQ director, Becky Keogh, approves this new application of a large confined animal feeding operation in the Buffalo River watershed I request a public hearing.

Sincerely,
Carol Bitting
HC 73 Box 182 A
Marble Falls, Ar 72648

From:	McWilliams, Katherine
To:	Deardoff, Amy
Subject:	FW: ARG590001_5264-W
Date:	Monday, June 06, 2016 8:29:56 AM
Attachments:	ARG590001_5264_W Comments.pdf

5264-W

Thanks.

From: McWilliams, Clark
Sent: Friday, June 03, 2016 7:30 AM
To: McWilliams, Katherine
Subject: FW: ARG590001_5264-W

From: Carol Bitting [mailto:lcbitting@gmail.com]
Sent: Thursday, June 02, 2016 8:22 PM
To: McWilliams, Clark
Subject: ARG590001_5264-W

Katherine,
Please find attached my comments to the request for a new swine application in the Buffalo River Watershed. Let me know if you have trouble opening the attachment.
Carol
We will Win, or We ALL LOSE....Save the Buffalo River Watershed.

Katherine McWilliams
Engineer Permits Branch, Office of Water Quality
5301 Northshore Drive
North Little Rock, Ar 72118-5317

April 4, 2017

In Reference to ADEQ's Draft Decision to Approve C&H Hog Farm Application Permit 5264-W; AFIN 51-00164,

We, citizens, have submitted many expert reports and comments since ADEQ permitted this point source large confined swine feeding operation in the Buffalo River Watershed with no public notice, without informing the National Park Service, Arkansas Game & Fish or the National Forest Service of the General Permit of 2012, without stream data TMDL's or even mention of Big Creek or the Buffalo National River and without utilizing the permit designed for these type of operations, such as the NPDES Individual CAFO Permit.

There is nothing like hogs stinking up the scenic beauty of the sensitive area of the Buffalo River or Big Creek Valley, where Sam's Throne, a popular natural climbing area is located, resort cabins, a community store, restaurant, a school, churches, rural homesteaders and one of Arkansas' curviest roads (a favorite to motorcycle riders). Nor is there anything that quiet describes the community's lack of confidence at speaking out due to intimidation and close relations.

There is nothing like flies covering the eves of houses and puking in the mornings as you try to tend to your chores. How about the asthma illness' and the kids who have to go outside on the playground while hog waste is being spread around their school? Have you heard one classmate to another say, "hogs are stinking up the air?" What about a comment made by a teacher to her students when they remarked the hogs stink and they can't stand to play outside, "that's the smell of money"? Whose going to tell those children that C&H and ADEQ have now permitted fields in all directions of the school, not just south and west? Whose going to tell those children the headaches, runny noses, asthma and illness' they experience are creating immune issues that will slowly break down their health?

Whose going to tell the children the Buffalo River is no longer a place to swim or fish and that recreation is limited to staying out of the water and throwing back your catch? This year I was on a canoe trip, two days into the trip my husband and I both became extremely ill. In our 25 years together we have never been so ill nor have we ever had the same issue at the same time. We both believe we contracted something from a swim at a favorite spring below Big Creek, possibly we licked the water from our lips and exposed our systems to "rage". I also received a phone call from a high school friend telling me of 2 of their youth whom on a June, 7 day Buffalo River canoe trip became so ill they still don't know if both will survive. How many others are out there we don't know of? No agency wants to tell the public the Buffalo River is a hazard and that 6500 hogs (equivalent to a 15,000 town of people) waste is being applied to thin soils with rapid transport to the streams, creeks, wells and aquifer of this state. No one wants to take responsibility, do you?

The April 4, 2001 report by Dr. William Weida, Department of Economics, the Colorado College, Colorado Springs, CO Nutrient Management Problems defines many of the issues with stream and groundwater near cafo's.
"The pathogens present in hog manure are not found in inorganic chemicals. These pathogens could be transported to ground water supplies through improperly sealed wells or other naturally occurring pathways. Studies released since 1999 have found that:

(a) *Swine herds are a potential animal reservoir for Swine Hepatitis E Virus and this virus is present in fields to which manure has been applied and in water waste from these fields. Swine Hepatitis E Virus may persist in the environment for at least 2 weeks and possibly longer.15*

(b) *(b) A broad profile of chemical and microbial constituents are present in both ground and surface water proximal to large-scale swine operations--chemical (pesticides, antibiotics, heavy metals, minerals, and nutrients) and microbial (Escherichia coli, Salmonella sp., Enterococcus sp., Yersinia sp., Campylobacter sp., Cryptosporidium parvum) contaminants were present.*

(c) Antibiotics are present in waste generated at confined animal feeding operations and may be available for transport into surface and ground water.17

These data directly contradict the contention the risk of groundwater contamination from hog manure is no different than that from inorganic fertilizer. In fact, the use of animal manure for fertilizer carries with it not only all the contamination issues associated with inorganic fertilizers but also a large number of additional pollution and health concerns.

Hog waste from a large confined feeding operation is a waste application permit. Hog and humans can transfer bacteria and pathogens back and forth. Applying more than the agronomic amounts results in scours in calves and even death of the animals, kidney and liver failures, weedy fields, excessive nutrient runoff (Reg 5.303), and algae growth in streams, loss of aquatic life such as the small mouth bass, muscles, and insects that bats and fish feed upon.

Here (Photo on right) below Gilbert the waters are choked with algae on the impaired stretch of the Buffalo River. The algae was reported for over 30 miles of river. I witnessed at 11.





ADEQ did you take the endangered species into account? After all the lagoons are still permitted to leak and there is a Gray Bat maternity cave near the mouth of Big Creek on the Buffalo River. There are Indiana Bats on Left Fork Big Creek and scattered throughout the area. The cave above is a Gray Bat maternity colony site and a positive dye trace to the spreading fields of C&H Hog Farm. (Brahana Dye Study 2014).

Regulation 2.201 states: Existing in stream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected. I have seen no data verifying this is being maintained on the contrary the opposite appears true. Can you please verify this regulation is upheld.

Note the Regulation 5 permit plan and review dated September 1, 2015, by engineers. In a karst environment many things can happen. Did you check the pits below the pigs for leakage? Is there any way to determine if the concrete lined pits are leaking? Can you please list all other ADEQ employees and their qualifications whom reviewed this permit? It appears very minimal for Regulation 5 in karst geology.

There is no plan for spills yet the terrains are steep, roads are windy and narrow crossing many tributaries, sink holes with heavy laden fast moving trucks in a hurry to get the next load of waste dumped. Very important is the financial ability of C&H to support a disaster in the event of “at fault accidents”.

There is no consideration for the tourist whom are seen wandering the National Forest sightseeing or hiking. Nor economic considerations for the many whom make a living from rental property.

The proper procedures for a Regulation 5 permit are stated on the ADEQ website https://www.adeq.state.ar.us/water/permits/pdfs/reg_5_permit_procedures.pdf

Page 6 of the Statement of Basis; ADEQ left out the following sources for proper permitting procedures. Why weren’t the following used for this permit in a most sensitive karst environment and the First National River, an Outstanding Resource Water with the highest protection, when they are included in proper permitting procedures? https://www.adeq.state.ar.us/water/permits/nodischarge/individual.aspx

Here are 4 of the sources that are omitted from proper permitting procedures;

- APC&EC Regulation 2,
- The USDA Natural Resources Conservation Service Technical Publications
- (a) Field Office Technical Guide and
- (b) Agricultural Waste Management Field Handbook

Omitted under part 3 Technical Requirements
3.a,

- ✳ each field should have distance to stream and highways, each stream should be named and marked for easy reference to the waterways
- ✳ A permit with this liability should have a topo map that is readable

Page 5, Operation and Maintenance, Land Management, Spreader Calibration , Soil & Swine Fertilizer Sampling the word fertilizer has been substituted for manure or waste application. This is a waste application permit, not a fertilizer permit. Hog manure from a concentrated animal operation is waste management.

Regulation 5.201 defines the "Waste Management Plan means a plan prepared by the United States Department of Agriculture Natural Resource Conservation Service (NRCS), an Arkansas Natural Resources Commission water quality technician, the University of Arkansas Cooperative Extension Service, or a professional engineer registered in the state of Arkansas detailing the management and disposal of liquid wastes generated in a confined animal operation."

Why have you changed the wording to fertilizer? it is liquid animal waste, so operation and maintenance section is unacceptable and the permit should be denied. The operator cannot manage proper calculations of waste when the Nutrient Management Plan has been altered beyond acceptable definition. There are up to 6500 hogs living within the confines of 2 buildings. This is waste management. Reg. 5.301 states, No confined animal operation using a l**iquid animal waste disposal system** shall be constructed or operated unless the owner has first obtained a permit from the Department. Please explain to the operator the difference in fertilizer and waste management and the health conditions related to waste verses fertilizer. This facility and spreading fields are rock throwing distance to a community and school.

NMP Section 1, page 5; Soil & Swine Fertilizer Sampling Soil samples are to be taken once every five years or **when the nutrient management plan is revised**. Dated 3/2/2016 by Monica Hancock and signed by engineers Pat Bass and Dennis Carmen.

Soil samples once every 5 years for a permit in the watershed of an ORW? C&H ARG590001 is required to sample yearly, these samples are not available and many of the fields are dated 2014. These are outdated for an NPDES permit and a large CAFO in the Buffalo River watershed and outdated for a Nutrient Management Plan dated 2016. Will you continue to permit a large cafo that is already out of NMP compliance with their permit? Again this appears C&H has been allowed a modification not a new permit and the oversight of the industrial hog factory is to lax.
In an inspection by Jason Bolenbaugh dated 1/23/2014, owner, Jason Henson is reminded **soil samples for Nitrate-N and Phosphorus shall be taken no less than annually.** https://www.adeq.state.ar.us/downloads/WebDatabases/InspectionsOnline/075752-insp.pdf

> **Per Section B.3.c.4 of your NMP, soil samples for Nitrate-N and Phosphorus shall be taken no less than annually. This differs from Part 4.2.1.3 of your permit. Please ensure you continue to abide by the requirement of your NMP.**

D Section 651.0201(d) of the AWMFH states:
"If wastes are applied to agricultural fields, the application must be planned so that the available nutrients do not exceed the plant's need or contain other constituents in amounts that would be toxic to plant growth."

It is apparent there is a problem when you look at the 2016 Annual Report and you see that 15 of the 17 C&H soil samples are above optimum and the waste is still being spread on them. This is a violation of the Regulation 6 NPDES permit.
https://www.adeq.state.ar.us/downloads/WebDatabases/PermitsOnline/NPDES/PermitInformation/ARG590001_2016%20Annual%20Report_20170126.pdf

Below are excerpts from the NMP prepared by Monica Hancock for the Regulation 5 permit.

NMP dated 3/2/2016 by Monica Hancock Section 1;
Soil and Swine Fertilizer Sampling states, " Soils samples are to be taken once every 5 years or "*when the nutrient management plan is revised."*
Looking through the soil samples I see outdated soil samples such as
Field JH 1, JH 4 JH 2, FD11,CC 13, CC13A, CC13B, C1C15B, BH16,
is dated 12/04/2015 and *above optimum for P & K*
Field CC 3, EGC7, CH35, CC8, CC8A, CC9, CC9A, FD10, BC10A, RF 12, CC 14, C1C15, JC 17, GN23, HC32, HC33, RC34 is dated 12/04/2015 and *above optimum for P*
Field GR 5,RC20, EGC7A is dated *04/01/2014* and above optimum for P *(definitely outdated)*
Field SR 6, GR 6A is dated *04/01/2014* and above optimum for P & K (*definitely outdated)*
Field CH36, dated 12/04/2015; above optimum for K
Field C1C15A, MB1B, MB19, RC21, RC21A, RC21B, KC22, DH24, is dated *04/01/2014 (outdated)*
According to C&H NMP dated 5/24/2012 B. Nutrient Utilization Plan Page 3 (3) a. Composite base-line soil test …. will be taken at least annually. See page 43-83 of 5264-W permit for outdated soil test.

Section 2 ; Application for Regulation 5 Permit Engineering Plans and Review Sept 1,, 2015;

I could understand an engineer would be needed to go over the building plans, but when it comes to application fields I would think ADEQ would request a geologist and with the sensitive nature of this CAFO in the Buffalo River Watershed I would expect a hydrogeologist, the best in the state. I would also expect that Regulation 2, and Regulation 22 would be taken into account due to the karst terrain and high probability of fast transport of pollutants to the Buffalo River. There is no mention of the karst terrain presented in the ERI by BCRET that identify field 5 and 12 karst. I did not find any reference to the leakage allowed by the lagoons and due to the low permeability of the lining feel this should have been explored more thoroughly. BCRET and ADEQ have had time to install and require monitoring of the daily levels of the lagoons, yet when requested, this information is unavailable. One bore hole, again, is below standard.

> **At the time of the inspection you could not verify the exact number of swine on site that were above 55 lbs. and below 55 lbs. On January 27, 2014 you confirmed there were 2,499 sows (> 55 lbs.) and 700 nursery pigs (< 55 lbs.) on site. Your NMP states there will be no more than 2,500 swine (> 55 lbs.) and 4,000 swine (< 55 lbs.) on site. Please ensure you are maintaining an actual head count at all times so you do not exceed the given number of swine.**

Page 6, 2nd paragraph increases the number of boars and sows and violates Regulation 5.901 (d) A permit renewal, permit modification, or new permit issued pursuant to Reg. 5.901(C) shall not increase the number of swine permitted at a facility.

2012, ARG590001 design calculations section C2 (b) to determine minimum storage requirement it is the sum of the animal waste produced, plus the spillage and wash water, plus the pit recharge produced in 180 days.

These following figures are estimates not exact numbers, but if these were accurate you would see this permit increases the sows, boars, pigs and the number of pounds of hogs raised at C&H over the year increasing waste production.

ARG 590001 NMP Section C2: Design Calculations Waste Production A. (3) 3 boars @ 450 lbs, 2,100 Gestating sows @ 375; 400 lactating sows @ 425 lbs, 4,000 pig @ 10 lbs

ARG 5900001 weekly average of hog weight by annual report 2012-2016 = total hog # ÷ 4 years =average # × pounds = total hog weight

boars 3 @ 450 = 1,350.00 pounds of hog weight

Gestating Sows 2011.75 @ 375 = 754,406.24 pounds of hog weight

Lactating Sows. 400 @ 425 = 170,000.00 pounds of hog weight

pigs 856 @ 10 = 8,560.00 pounds of hog weight

total 934,316.25 total hog pounds a week

5264-W (Regulation 5 revised, modified numbers)

boars 6 @ 450 = 2,700

Gestating Sows 2252 @ 425 = 957,100

Lactating Sows 420 @ 400 = 168,000 weight has decreased by 25 lbs per hog in 2016 NMP

pigs 750 @ 14 = 10,500 pounds (permit states average 1,500 shipped weekly) this figure was Section 2 P. 6.

total 1,138,300 weekly hog pounds for 5264-W

This is a difference of 203,983.75 pounds of hog weight per week increase. With lagoon and nutrient management plans relying on hog weight for calculations this will increase the waste output and the storage limits and increase the need for more application fields. This will also increase the impact to the water quality by increasing the output on the already phosphorus saturated fields.

I also would suggest refiguring the pig output. If 2,412 sows produce an average of 856 pigs weekly over 4 years then 2672 sows (an increase of 260 sows a year at the facility) will increase pigs, not reduce them as written in this permit. Will you please explain how you came about reduced figures by increasing sows and boars?

ARG 590001 Section C2; Design calculations "Liquid manure storage is measured by unit waste production (UWP) in cubic feet per day per 1,000 pounds of animal"

Do you see anything in my calculations or reasoning that appears wrong or that there will be less waste due to increase in sow numbers? When sows and boars are increased pigs are increased. The average number of pigs in the last 4 annual reports average 856 yet 5264-W states only 750. Can you clarify this for me?

I could find no water quality TMDL's for Big Creek or water quality data referenced for permitting of large cafo in already impaired stream (Big Creek) as per documents from list in the public comments for the 303 (d) listing. These agencies including NPS, USGS, and BCRET data show Big Creek to be impaired. Regulation 2.201 states Existing in stream water uses and the level of water quality necessary to protect the existing uses shall be maintained. Regulation 2.30 states….any stream with watersheds of greater than 10 mile square are designated full body contact. Reg 2.301 states….**the criteria to protect the most sensitive use shall be maintained**. Reg 2.304 ….the department may require an evaluation of all practicable alternatives to the project including; an environmental assessment of the impacts of each alternative, an engineering and economic analysis and a socio-economic evaluation of the project in the local area. Dr. Sharpely's study may not be completed until 2019 but that doesn't have anything to do with Regulations and the permitting of C & H Hog Farms. Dr Sharpely's BCRET study has already shown increased e coli and nitrates since the permitting of C&H. The trends have already been done by ADEQ.

Condition #27 page 4 of part 2, states minor modification with Reg 5.306 can incorporate all fields that are permitted to receive waste from the permittee. Does this mean that the *EC Farm fields that are in appeal are allowed to be a minor modification? Does it mean the missing field numbers are permitted and going to be allowed as minor modification? What exactly does this mean? We saw that EC Farms added 600 plus acres stating they were being pro active with the environment and sidestepping all the requirements of a new permit and now we see the language built into C&H's permit. This doesn't take into account the publics point of view and shows ADEQ to be capricious and arbitrary presuming the outcome of the appeal or another plan unbeknownst to the public.*

Condition #28; "alterations to the design, plans or specifications may be approved as a minor modification in accordance with Reg 5.306". Here it appears ADEQ has other plans to make modifications to this permit prior to its approval and are predetermining the need to modify C&H Hog Farms again. This information has not been released for public review and to preset conditions not allowing for public participation is capricious and arbitrary.

A Regulation 5 permit is a non point source permit. EPA definition, "**Non point source pollution** generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification. Non point source (NPS) pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters and ground waters. How can ADEQ even consider allowing this when downstream impairment exist?

I am not stating I am in agreement with either permit, I am not. This is the wrong place for an industrial operation of hogs and this factory should be denied any permit in the Buffalo River watershed. Unless this is done the continued trespassing on the community and the nation will continue.

According to the EPA under definition of non point source it says, States report that **nonpoint source pollution** is the leading remaining cause of water quality problems. The effects of non point source pollutants on specific waters vary and may not always be fully assessed. **However, we know that these pollutants have harmful effects on drinking water supplies, recreation, fisheries and wildlife."**

The term "non point source" is defined to mean any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act. That definition states:
The term "**point source**" means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, **concentrated animal feeding operation**, or vessel or other floating craft, from which pollutants are or may be discharged.

40 CFR 122.23 Discharge of a pollutant means: a) Any addition of any "pollutant" or combination of pollutants to "waters of the United States" from any "point source,"….

C&H discharges waste to a pipe, where the flow creates a surface water of over 1 acre called lagoons or ponds, these lagoons collect rainwater as well as piped hog waste from the barns, they then use a pipe to remove this waste to a tank truck where it is then spread via pipes over sink holes and thin sandy gravelly soils, with discrete fissures to waters of the state. There is no natural animal to ground transport of the waste, all the waste is manipulated from the time it leaves the animal body. See Waste Management Plan requirements https://www.adeq.state.ar.us/water/permits/nodischarge/individual.aspx
The terms of point source includes every means that C&H uses to get the waste out of its lagoons and transferred to fields and by discrete fissures to the waters of the state. In a karst environment unless you do a full ERI study of all application fields and rule out the presence of discrete fissures you must presume they are there.
In this email below the AHD and ADEQ know…."the system flushes well after a rainfall". Is this the reason for throwing out the storm flow data?

From: Terry Paul [mailto:Terry.Paul@arkansas.gov]
Sent: Friday, November 06, 2015 2:39 PM
To: Carpenter, Ellen
Cc: Bailey, John; Clem, Sarah
Subject: RE: Big Creek at confluence of Buffalo River

Mrs. Ellen,

It is pretty basic at this point but I am attempting to get ADH data assembled. The only thing really evident at this point is the system flushes well after a rainfall event. I will get that information over to Sarah in the next week, or as soon as I can.

Thanks Again,

Terry Paul

In May of 2012 C&H applied for a General Permit, this general permit did not include public notification requirements that the Regulation 5 individual permit did at that time. May 10, 2012 Mr. Jason Sutherland of Forman, Ar #3604-WG-AG-2 was told ADEQ would no longer reissue the Generñl Permit and he was required to get an individual permit. This information is on the ADEQ website. On the ADEQ site the specific instructions still do not require state general permits to undergo the same notifications as a Regulation 5 permit. Public notification and interagency communications would have saved the C & H Hog Farm owners, the state and all stakeholders many millions of dollars. This permit should be denied as the public was unable to participate in the permit at that time and it appears to be treated as a modification not a new permit at this time.

In accordance with APC&EC Regulation 8.204 (B) all applicants for the issuance (new, Modification, and renewal or transfer of any permit under the environmental law of Arkansas shall submit a "Disclosure Statement" to the Department. This one is blank and due to a new permit and the risk involved why isn't this section completed? There were millions of dollars borrowed against the facility in 2012 see Farm Service Agency and Small Business Association documents. There may be other debts accumulated over the last few years. One stipulation is the full name and business address of any legal entity in which the applicant holds a **debt** or equity interest of at least 5% or that is a parent company or subsidiary of the applicant and a description of the ongoing organizational relationships as they may impact operations within the state; https://www.adeq.state.ar.us/ADEQ_Disclosure_Statement.pdf

Reg. 5.102 's purpose is to establish the minimum qualifications, standards and procedures for issuance of permits for **confined animal operations** using liquid animal waste management systems within the state and for the issuance of permits for land application sites within the state. By definition from Reg 5 C&H Hog Farm is a CAFO. A CAFO requires an NPDES permit because it is a point source pollution.

40 CFR 122.23
(a) Concentrated animal feeding operations (CAFOs), as defined in paragraph (b) of this section or designated in accordance with paragraph (c) of this section, are point sources, subject to NPDES permitting requirements as provided in this section. Once an animal feeding operation is defined as a CAFO for at least one type of animal, the NPDES requirements for CAFOs apply with respect to all animals in confinement at the operation and all manure, litter, and process wastewater generated by those animals or the production of those animals, regardless of the type of animal.

Could you please tell me where fields 25 thru 31 are? and or explain the skip in numbering?



Page 3 of Part II; Condition #22, whose going to ship waste and are there specific requirements for shipping waste? Is C&H qualified to ship waste? Would specific skills be needed for shipping waste? Can this waste be shipped out of the County? State? Country? What type container should hog waste be shipped in? Is there a specific placard for the shipping container? Would you please expand an explanation of what this means. Regulation 22 might need to apply here.

Condition # 26. It doesn't appear that the past has made facilities more responsible with time. In fact facilities such as these become outdated quickly. To allow less observation and frequency of monitoring with time seems backwards. Can you explain how with years there will be less likely hood of pollution and levee breeching? See the ADEQ study done in the 1990's that explains the problems with older facilities and lagoons that were full of solids that no longer held the liquid waste but it flowed over the levees into the streams.

Condition # 27. Could you elaborate? How can ADEQ submit a minor modification proposing to add fields to this permit? Wouldn't it be more proactive to do that now? Why would a permit already be requesting modification? Is there a known problem already? Are you considering EC Fields or are they the missing numbers 25-31? This condition should be struck form the permit. Regulation 5.302, Regulation 5.305 and Regulation 5.306 should be cited here not a predetermined minor modification. I object to any approval of unknown modifications.



Condition # 28. If ADEQ is already expecting this permit appealed does it seem that the agency should rethink the permitting of a large swine cafo in the Buffalo River watershed? Is the agency taking the public comments and expert reports and the water quality criteria into consideration? Has the department predetermined it is going to approve this permit regardless of any and all scientific data, public resistance, or recommended council? Please supply answers.

Page 2 Part III, 5. Be sure Oil and Hazardous Substance Liability pertains to this permit. I'm not sure about oil but if you consider hog waste hazardous then we need to include that in the transportation of hazardous substance. If a disclosure statement is included a better determination is whether C&H is financially or mechanically responsible to handle a crisis of a hazardous substance. I think it important to note CDL's, spill training, qualifications, etc. Will you please explain?

#10 (A) Are all these facilities located at these coordinates Latitude 35 55' 30.47"N Longitude 93 4'18.42"W?

#11 This is a no discharge permit….there is no discharge not even a 25 year 24 hour storm event, neither can there be any pollution from application fields. ADEQ considers runoff from application fields as pollution. See full answers under ADEQ's General Permit Fees_Economic_Impact_Environmental_Benefit_Analysis.pdf Below is an excert:
4. What risks are addressed by the proposal and to what extent are the risks anticipated to be reduced?

NPDES permitting for CAFOs **will require the CAFOs to implement waste management practices that reduce the amount of pollutants that may enter waters of the State from waste storage and land application.**

#12 Discarded or land applied? I'm not sure this is what you mean. Could you please define "removed substances" as relating to a waste management plan? This condition starts off with "solids removed" and Regulation 22, page 1-8 under *solid waste* definition includes "agricultural operations". According to definition of Liquid Waste Management System in Regulation 5 chapter 2; Definitions it means a system used for the collection, storage, distribution or disposal of **animal waste in liquid form** generated by a confined animal operation. ARG590001 states Condition 7.6 of the permit does talk about removed substances but I can only assume somewhere there are management practices to follow, here are from

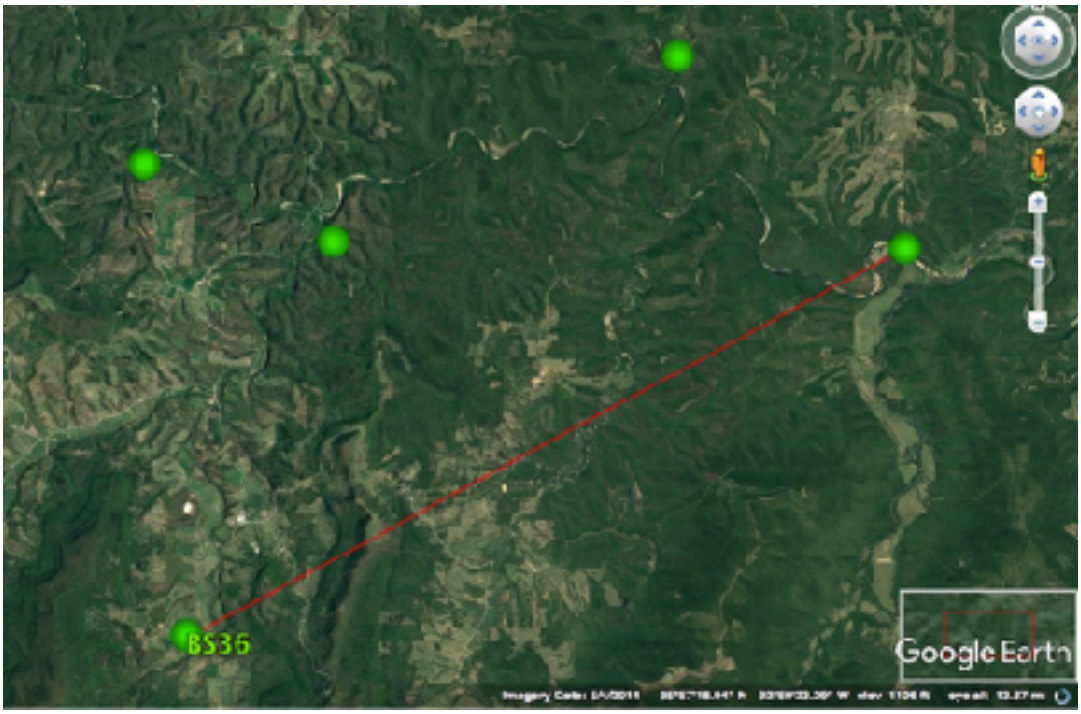
previous ARG590001 permit. *Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of waste waters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering the waters of the State. Written approval for such disposal must be obtained from the ADEQ Director, unless management of the material is contemplated by the Nutrient Management Plan.*

#13. In a karst terrain 24 hours could be too late to capture the pollutant from making it to the streams. Spills, leaks, or any discharge must be handled immediately. See Terry Paul, ADH comment "The only thing really evident at this point is the system flushes well after a rainfall event." See Arkansas State Geology road guide for description of the area of Big Creek and surrounding spreading fields. http://www.geology.ar.gov/pdf/Roadside%20Geology%20Series%2001.pdf The Confederate Fault may help understand why the section of the Buffalo River is impaired at Tyler Bend. See http://buffaloriveralliance.org/resources/Pictures/scanned%20reprints%20GWSW%20Big%20Creek%20karst.pdf also; http://buffaloriveralliance.org/resources/Pictures/Brahana%20JAAS%20Article.pdf See Regulation 5.402, Chapter 7, Part 651-Geologic and Groundwater Considerations

Did you know in 2008 there were two Segments of the Buffalo River impaired for water quality? ADEQ is using the 2008 data and these segments are downstream of C&H 21 miles by river and 18 miles by air. This segment is shown here in these 2016 photos as impaired.

In the inpress, 2017 USGS Scientific Investigation report "Utilizing Fluorescent Dyes to Identify Meaningful Water-Quality Sampling Locations and Enhance Understanding of Groundwater Flow Near a Hog CAFO on Mantled Karst—Buffalo National River, Southern Ozarks Dr. Brahana states, "One positive trace to Mitch Hill Spring on the opposite side of the Buffalo River from injection reflected how complex the karst flow system is and how far flow from the study area could be measured. "

Here a map showing injection at BS36 and dots at positive dye receptors within the Buffalo National River. The spreading fields surrounding this injection are the most heavily spread. The red line indicates 11.4 approximate miles to Woolum from injection. I have only noted 4 receptors and of these, 3 are springs. From Woolum (green dot at end of red line) to Tyler Bend Campground is less than 9 miles. It would be easy to visualize the fast transport of swine waste downstream and through underground conduits, settling in the deeper pools downstream as the finer particles are absorbed by the rocks and soils creating breeding grounds for pathogens, over loading of nutrients and algae blooms such as last summer.



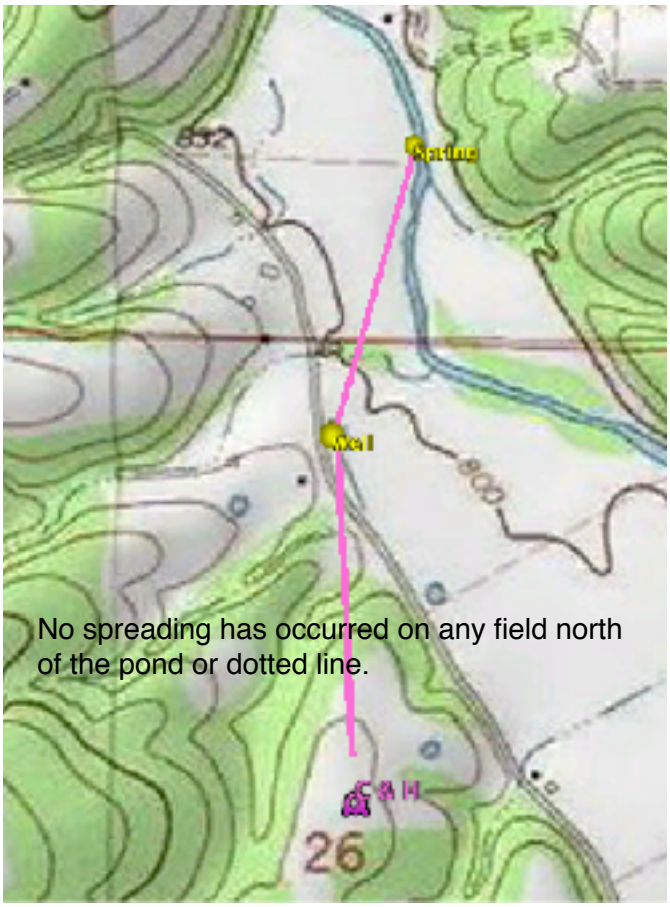
303(d) water body – Under section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These impaired waters do not meet water quality standards that states, territories, and authorized tribes have set for them. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters.

Specifically stated in Regulation 2.203; Outstanding Resource Waters, Where high quality waters constitute an outstanding state or national resources, such as those waters designated as extraordinary resource waters, ecologically sensitive or natural and scenic waterways, those uses and water quality for which the outstanding waterbody was designated shall be protected by (1) water quality controls (2) maintenance of natural flow regime, (3) protection of in stream habitat, and (4) encouragement of land management practices protective of the watershed.

The stream to the right is below C&H Hog Farm. It is below a plugged well that at one time was Mt. Judea's water supply until it was contaminated after dead hogs were thrown into a sink hole upstream. (prior dating to C&H)
Big Creek goes dry and resurges just upstream of this photo. Above this area the closest spreading field is 6270 feet by Big Creek stream.



In 2014 Dr. Van Brahana put dye into a well (map below). The well is approximately 1,600' from C&H Hog Barns and approximately 1,600' from the spring it emerged in 31 hours later in Big Creek. The emergence of the dye was visually apparent under the ledge in the stream (see photo). 1,200' downstream of the spring is a deep pool and 1,200' further is another on Big Creek and both used for swimming.



No spreading has occurred on any field north of the pond or dotted line.

BigCreek is considered a primary contact stream and flows into the campground at Carver on the Buffalo River. E coli monitoring results show Big Creek as impaired…

see C & H All data in the 2016 303 (d) impaired waters comments on theADEQ website. See 2013 Arkansas



Department of Health concern for ….pathogens such as e coli and cryptosporidium from the proposed land application sites….. https://www.adeq.state.ar.us/downloads/webdatabases/permitsonline/npdes/permitinformation/arg590001_adh%20comment%20letter_20130321.pdf

If C&H is given a Regulation 5 permit, a non point source permit, then according to the definition of non point source and the pollution increased risk of non point source and a karst topographical setting, along an Outstanding Resource Waterway and the first National River the potential for poor water quality will continue escalating.

In a recent interview of Dr. Andrew Sharpely, University of Arkansas states, **"you cannot expect cheap food and clean water at the same time"** https://youtu.be/0lvkRwXpZYY
The Buffalo National River is downstream of Dr. Sharpely's, University of Arkansas, Division of Agriculture's study of C&H Hog Farm in Big Creek.

To my knowledge the owners were not aware of the fragile ecosystem in which they have been raised and lived. They understand the beauty, the hunting, the easy availability to all the scenic sports they enjoy and wanted to work in their community, but they may not have had an idea of the impact they created or will continue creating without Dr Sharpely, ADEQ, Pork Producers & Farm Bureau showing them the facts. They have put their trust in these agencies and these agencies are at fault for allowing the continued degradation of the waters and the community by continuing to support the wrongful permitting of this cafo and not informing the owners and the community of the science that supports these statements of degradation.

One person in tourism told me if we don't talk about it people won't know. Does this mean if we ignore it, it will go away? I doubt it and I found the comment an insult to those whom I know that work so hard to keep this part of Arkansas for the enjoyment of all. I want people to come back or share a wonderful view of our beloved state and its people. We are the host to an industry that we the people of these counties along the Buffalo River have developed. We are responsible for the needs of the million plus visitors and the sensitive Buffalo River. It is our responsibility as residents to protect her having survived and built our own successful business' with her influence. This market is open to everyone with initiative in the 5 counties that line her borders and we are the largest stakeholders. C & H and all stakeholders have shown that an industry such as the hog CAFO industry isn't sustainable in this area. It is time to make decisions based on all facts.

The federal and state agencies have increased the wages of hundreds of county residents over the years and contributed to many added incomes and retirements. Those who live here sacrifice to live here. We treasure our solitude, the scenic beauty and we at times enjoy the simplest lives because we can. We are blessed and at this time we are battling our state and industry for what we know is the livelihood of millions of people and the future of a river. I can't even imagine how many jobs or recreational values will be lost when the Buffalo River is no longer a river that is treasured for what Congress designated. I can't imagine that the algae experienced last summer will choke the life out of all her miles. But I know that if the cafo's of this state continue to haul their waste to the poor, rocky, hillsides and continue to force chicken and hog waste down her throat, she will suffocate and all the while ADEQ refuses to admit wrong doing ignoring the very value they represent as taken from their website "**The Arkansas Department of Environmental Quality (ADEQ) is the state's main environmental protection agency, charged with protecting, enhancing, and restoring the environment for Arkansans**."

Sincerely,

Carol Bitting
HC 73 Box 182 A
Marble Falls, Ar 72648

The Difference Between Animal Manure and Inorganic Fertilizer

Statements that manure application by subsoil injection at agronomic rates has a risk of groundwater contamination that is no different than inorganic fertilizer ignore the non-nutrient content of animal manure. A large number of diseases are present in animal manure. These diseases are not present in inorganic fertilizers. Table 2 shows that the potential presence of 25 different diseases in animal manure make this form of fertilizer very different from the inorganic chemicals that are used as crop fertilizer.

Table 2, Diseases and organisms spread by animal manure

Disease	Responsible organism	Disease	Responsible organism
Bacterial		Viral	
Salmonella	Salmonella sp	New Castle	Virus
Leptospirosis	Leptospiral pomona	Hog Cholera	Virus
Anthrax	Bacillus anthracis	Foot and Mouth	Virus
Tuberculosis	Mycobacterium tuberculosis Mycobacterium avium	Psittacosis	Virus
Johnes disease	Mycobacterium paratuberculosis	Fungal	
		Coccidioidomycosis	Coccidoides immitis
Brucellosis	Brucella abortus	Histoplasmosis	Histoplasma capsulatum
	Brucella melitensis	Ringworm	Various microsporum and trichophyton
	Brucella suis		
Listerosis	Listeria monocytogenes	Protozoal	
Tetanus	Clostridium tetani	Coccidiosis	Eimeria sp.
Tularemia	Pasturella tularensis	Balantidiasis	Balatidium coli.
Erysipelas	Erysipelothrix rhusiopathiae	Toxoplasmosis	Toxoplasma sp.
Colibacilosis	E.coli (some serotypes)		
Coliform mastitis Metritis	E.coli (some serotypes)	Parasitic	
		Ascariasis	Ascaris lumbricoides
		Sarcocystiasis	Sarcocystis sp.
Rickettsial			
Q fever	Coxiella burneti		

6

Source: Agricultural Waste Management Field Handbook, United States Department of Agriculture Soil Conservation Service, April, 1992, p. 3-13, 3-14.

The pathogens present in hog manure are not found in inorganic chemicals. These pathogens could be transported to ground water supplies through improperly sealed wells or other naturally occurring pathways. Studies released since 1999 have found that:

(a) Swine herds are a potential animal reservoir for Swine Hepatitis E Virus and this virus is present in fields to which manure has been applied and in water waste from these fields. Swine Hepatitis E Virus may persist in the environment for at least 2 weeks and possibly longer.[15]

(b) A broad profile of chemical and microbial constituents are present in both ground and surface water proximal to large-scale swine operations--chemical (pesticides, antibiotics, heavy metals, minerals, and nutrients) and microbial (Escherichia coli, Salmonella sp., Enterococcus sp., Yersinia sp., Campylobacter sp., Cryptosporidium parvum) contaminants were present.[16]

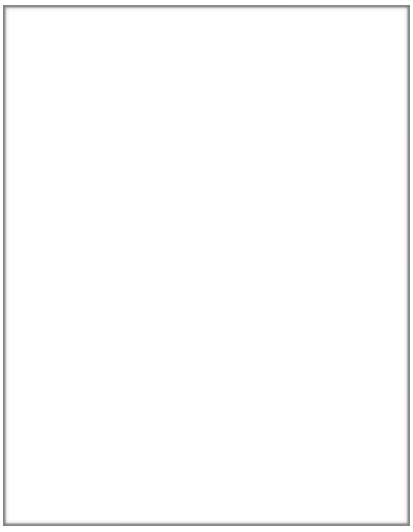
(c) Antibiotics are present in waste generated at confined animal feeding operations and may be available for transport into surface and ground water.[17]

These data directly contradict the contention the risk of groundwater contamination from hog manure is no different than that from inorganic fertilizer. In fact, the use of animal manure for fertilizer carries with it not only all the contamination issues associated with inorganic fertilizers but also a large number of additional pollution and health concerns.

As the populations increase so does man's demand on the resources. We can practice sustainability, but Dr. Sharpely does not have a sustainable plan for C & H Hog Farm or the owners. We do not need to feed the world, that is not our responsibility. One only has to consider what happens when there is no electricity, no water in the well, no antibiotics etc to know this is not sustainable.

Save the river…for the future of all generations.





From:	Carol Bitting
To:	Water Draft Permit Comment
Subject:	[BULK] Permit 5264-W Comments
Date:	Wednesday, April 05, 2017 11:31:29 PM
Attachments:	20170405 5264-W Carol Comments.pdf

I have included my public comments as an attachment to this email. Would you please verify you have received them?
Thank you,
Carol Bitting



Katherine McWilliams
Engineer Permits Branch, Office of Water Quality 5301 Northshore Drive
North Little Rock, Ar 72118-5317

April 4, 2017
In Reference to ADEQ's Draft Decision to Approve C&H Hog Farm Application Permit 5264-W; AFIN 51-00164

I am using exerts from my comment in the 2016 303 (d) impaired waters listing to be reviewed along with the C&H 5264-W Regulation 5 permit. This large swine CAFO has added degradation to the streams surrounding it's spreading fields, including the photo above which is on Left Fork Big Creek near a spring that resurges and positive dye trace from a well near the C&H highly used spreading fields on Big Creek.

It appears ADEQ has lost sight of its goal to *"Protect, Enhance and Restore* the *Natural Environment for the well being of all Arkansans"*. Over the years ADEQ has seen a departure of conscientious employees qualified to understand the duty the agency has to the citizens of Arkansas. Many people like myself were under the impression ADEQ was watching out for the environmental well being of our state. The nonchalant permitting of a large swine CAFO in the watershed of America's First National River, an Outstanding National Resource Water has placed tremendous burdens upon our state.

There are 3 streams the National Park Service has asked to be included and I recommend they be included. All three streams are greater than 10 square miles therefore are categorized as primary contact water within the Buffalo River Watershed. These streams are Mill Creek of Newton County, Big Creek of Newton County and Bear Creek of Searcy County. This region is within ADEQ's Integrated Water Quality Monitoring Assessment Report Section 305 (b) and 303 (d) of the Federal Pollution Control Act submitted biennial.

Page 373 states; In cooperation with the US Parks Service, approximately 60 monitoring stations on the Buffalo River, **its tributaries, and watershed springs** are routinely monitored. Page 31 states: Extraordinary Resource Waters (ERW) This beneficial use is a combination of the chemical, physical, and biological characteristics of a **waterbody and its watershed** which is characterized by scenic beauty, aesthetics, scientific values, broad scope recreation potential, and intangible social values.
Unless the watershed is included the Buffalo River cannot maintain Extraordinary Resource Waters (ERW), Ecologically Sensitive Waterbody (ESW) or Natural and Scenic Waterway (NSW) status.

I begin with Big Creek, Newton County due to ADEQ's permitting of an NPDES large swine CAFO on an already at capacity stream without use of documentation or historical stream data information. In other words you did not utilize your own research and data prior to the permitting of a General Permit. Below Regulation 2.304 states you must provide documentation that there will be **no degradation** to the Extraordinary Resource Water, Ecologically Sensitive Waterbodies or the Natural and Scenic Waterways. The NPS and USGS data report there has been degradation therefore you are in violation of state regulations and you have not provided proof that the permitted facility is not degrading the water of the tributary and the river.

Algae growth in Big Creek has continued to rise over the last few years with the increased application of millions of gallons of untreated waste. This waste is spread thru out the year even when there are no plants to uptake the nutrients. The lower 2 miles of Big Creek are within the boundaries of the National Park. The above photo of the stream choked with algae is 6 miles upstream Big Creek. Big Creek is impaired for dissolved oxygen according to USGS & NPS data, data you have been accepting since the 1970s.

According to Reg 2.30 (below) these streams are full body contact streams and therefore when sampling bacterial data from these streams during May 1-Sep 30 a geometric mean of 126 colonies per 100 ml is the standard.

These streams are within the watershed of the Buffalo National River and must be maintained as Reg 2.01 states to prevent the degradation of the Buffalo River.

Reg. 2.01 states; Existing in-stream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.

Reg 2.203 states; Where high quality waters constitute an outstanding state or national resource, such as those waters designated as Extraordinary Resource Waters, Ecologically Sensitive Waterbodies or Natural and Scenic Waterways, those uses and water quality for which the outstanding waterbody was designated shall be protected by (1) water quality controls, (2) maintenance of natural flow regime, (3) protection of in-stream habitat, and (4) encouragement of **land management practices protective** of the **watershed.**

Reg 2.30 (d)states; Primary Contact Recreation - This beneficial use designates waters where full body contact is involved. Any stream with watersheds of greater than 10 mile square are designated for full body contact.

Reg 2.301 states: Substantially all the waters of the State have been designated for specific uses as shown in Appendix A. In those instances where waters are classified for multiple uses

and different criteria are specified for each use, **the criteria to protect the most sensitive use shall be applicable.**

Below is a regulation that states you must provide documentation that there will be no degradation to the ERW, ESW or the NSW.

Reg 2.304 states; Significant physical **alterations** of the habitat within Extraordinary Resource Waters, Ecologically Sensitive Waterbodies or Natural and Scenic Waterways **are not allowed**. **In other waters**, where significant physical alterations of the habitat are proposed, the Department must be assured that **no significant degradation of any**

existing use or water quality necessary to protect that use will occur. In order to make such determinations, the Department may require an evaluation of all practicable alternatives to the project including: an environmental assessment of the impacts of each alternative, an engineering and economic analysis, and a socio-economic evaluation of the project in the local area.

ADEQ is empowered to enforce and administer all laws and regulations relating to pollution of the waters of the state and the Commission is authorized to promulgate rules and regulations relating to pollution of waters of the state. Ark. Code Ann. § 8-4-201. Because "waters of the state" include "...all bodies or accumulations of water, surface and underground...," the Commission is authorized under state law to develop standards for the protection of groundwater.

Please add Mill Creek, Bear Creek and Big Creek to the 303 (d) impaired waters list. It is visibly and data apparent these tributaries are impaired due to some type of pollution within the watershed. The source of the impaired criteria does not come from the Buffalo River itself but from the tributaries that are the sources of the waters of the river.

It is very important when visiting an ERW with your children or immune compromised individual that people are aware when the water quality has degraded and harmful bacteria can enter the body causing kidney failure in young children or bacterial infections on the skin. Children love to splash and play in the water and they should not have to worry about raw sewage. They deserve the protection, the enhancement and the restoration of their environment.

I look forward to watching Arkansas become a leader in Environmental Quality. Not just a rubber stamped leader, but a real quality leader.

Sincerely,
Carol Bitting

From:	Carol Bitting
To:	Water Draft Permit Comment
Subject:	[BULK] 5264-W 2nd Comment
Date:	Thursday, April 06, 2017 7:26:35 AM
Attachments:	20170406 5264-W Carol Comments.pdf

Please accept the attached comment letter to include as Comment # 2.
Thank you.
Carol Bitting

DOI: 10.7589/2018-02-047

Journal of Wildlife Diseases, 55(1), 2019, pp. 000–000
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Mortality of Little Brown Bats (*Myotis lucifugus carissima*) Naturally Exposed to Microcystin-LR

Marcos Isidoro-Ayza,[1,3,6] Lee Jones,[2] Robert J. Dusek,[3] Jeffrey M. Lorch,[3] Jan H. Landsberg,[4] Patrick Wilson,[4] and Stephanie Graham[5] [1]Department of Pathobiological Sciences, School of Veterinary Medicine, University of Wisconsin, Madison, Wisconsin xxxxx, USA; [2]Wildlife Health Office, Natural Resource Program Center, US Fish and Wildlife Service, Bozeman, Montana xxxxx, USA; [3]US Geological Survey, National Wildlife Health Center, Madison, Wisconsin xxxxx, USA; [4]Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, St. Petersburg, Florida xxxxx, USA; [5]Field Office, US Fish and Wildlife Service, West Valley City, Utah xxxxx, USA; [6]Corresponding author (email: isidoroayza@wisc.edu)

ABSTRACT: We describe a die-off of little brown bats (*Myotis lucifugus carissima*) associated with acute intoxication with microcystin-LR in 2016 at Scofield Reservoir in Utah. High levels of this cyanotoxin in water from the reservoir and gastrointestinal content of bats supported this diagnosis.

Cyanobacterial blooms are an increasing problem in natural and man-made aquatic habitats. Cyanotoxins such as microcystins produced during these blooms can result in human and animal intoxications (Valério et al. 2010). A mass die-off of bats (*Myotis* sp. and *Lasiurus cinereus*) exposed to high levels of the neurotoxin anatoxin-a in Alberta, Canada is the only reported cyanobacterial bloom-associated bat mortality (Pybus et al. 1986). More recently, Woller-Skar et al. (2015) detected microcystins in feces of apparently healthy little brown bats (*Myotis lucifugus*) from a roost in Michigan adjacent to a lake experiencing seasonal *Microcystis aeruginosa* blooms. Exposure of bats to cyanotoxins can be indirect, through ingestion of microarthropods harboring the toxins (Woller-Skar et al. 2015), or direct, by drinking contaminated water (Pybus et al. 1986).

Between 30 August and 1 September 2016, during sampling work conducted in relation to a cyanobacterial bloom at Scofield Reservoir, Carbon County, Utah, USA (39°47′21.4152″N, 11°7′45.8652″W), we found 27 dead and one moribund bat (*Myotis* sp.) scattered along 50 m of shoreline, within 5 m of the water. Several bats were covered in viscous, bright green scum consistent with cyanobacteria. For disease response, US Fish and Wildlife Service personnel humanely euthanized the moribund bat by cervical dislocation. They then collected and refrigerated eight of the carcasses (including the euthanized bat) in individual plastic bags and shipped them overnight to the US Geological Survey–National Wildlife Health Center (USGS-NWHC), Madison, Wisconsin, USA for cause-of-death determination. The remaining carcasses were in advanced state of decomposition and considered unsuitable for postmortem examination.

On 29 August 2016, we collected and submitted water samples from six points of the reservoir to Region 8 Laboratory–US Environmental Protection Agency, Golden, Colorado, USA for cyanotoxin analysis (Table 1). Enzyme-linked immunosorbent assay (ELISA) for total microcystin detection yielded values between 22.2 to over 50 µg/L (report limit [RL]=1.5 µg/L). Subsequent congener-dependent quantification of cyanotoxins by liquid chromatography–tandem mass spectrometry (LC/MS-MS) yielded levels of microcystin-LR (MC-LR) ranging from 4.33 to 1,890 µg/L (RL=0.5 µg/L). Microcystin-RR was detected at low concentrations (0.13–17.5 µg/L, RL=0.05 µg/L) in four of the water samples. Microcystin-YR, anatoxin-a, and cylindrospermopsin were not detected (RL=0.05 µg/L for each cyanotoxin). On 31 August 2016, we collected and sent water samples from five points of the reservoir (including four of the areas previously sampled) to GreenWater Laboratories, Palatka, Florida, USA for total microcystin, cylindrospermopsin, and saxitoxin quantification using an ELISA with a broader range of quantification, which yielded microcystin levels from 14.4 to 60,000 µg/L (RL=0.15 µg/L) in every

TABLE 1. Total microcystin concentration (μg/L) by enzyme-linked immunosorbent assay, microcystin-LR and -RR concentrations by liquid chromatography–tandem mass spectrometry in environmental water, and microcystin-LR concentration in pooled gastrointestinal contents of five little brown bats (*Myotis lucifugus carissima*) found dead at Scofield Reservoir, Carbon County, Utah in 2016.

	Microcystin concentration				
	μg/L				ng/g Dry weight
Sample	Total[a]	Total[b]	Microcystin-LR[a]	Microcystin-RR[a]	Microcystin-LR[c]
Water 1	46.4[d]	ND[e]	4.33	<0.05	NA[f]
Water 2	22.2	329	6.99	<0.05	NA
Water 3[g]	>50[h]	60,000	349[h]	1.22	NA
Water 4	>50[h]	14.4	1,890g	17.5[i]	NA
Water 5	>50[h]	17.8	11.5	0.13[i]	NA
Water 6	>50[h]	ND	43.3	0.29[i]	NA
Water 7	ND	30.4	ND	ND	NA
Gastrointestinal contents	NA	NA	NA	NA	5,700

[a] Region 8 Laboratory–US Environmental Protection Agency; sampling date was 29 August 2016.
[b] GreenWater Laboratory; sampling date was 31 August 2016.
[c] D1612253 Laboratory of the California Animal Health and Food Safety Laboratory System.
[d] Estimated value; sample temperature outside of criteria.
[e] ND=not done.
[f] NA=Not applicable.
[g] Water sample closest to bat mortality.
[h] Estimated value; above the range of quantification.
[i] Estimated value; continuing calibration verification recoveries above criteria.

sample. Neither cylindrospermopsin (RL=0.10 μg/L) nor saxitoxin (RL=0.05 μg/L) was detected (Table 1).

On 2 September 2016, we conducted complete necropsies of seven of the eight bats submitted to the USGS-NWHC (Table 2). The remaining carcass was unsuitable for postmortem investigation given its very poor postmortem preservation state when reassessed at arrival. All necropsied bats were male adults and were identified as little brown bats (*Myotis lucifugus carissima*) on the basis of a combination of external morphologic features (Rodhouse et al. 2008) and mitochondrial DNA sequencing (GenBank accession numbers MG851797-MG851820) (Vonhof et al. 2015). The fur of two bats was partially covered with bright green dusty material consistent with dry cyanobacteria. All bats were in good body condition, and three bats had abundant green material (presumptive cyanobacteria) in their stomachs, suggesting acute death after ingestion. All bats presented apparently normal intestinal contents and no evidence of trauma. Histopathologic examinations of formalin-fixed and paraffin-embedded organs from each prosected bat revealed no major microscopic changes besides nonspecific antemortem agonal changes (i.e., severe pulmonary congestion) or those caused by mild to moderate autolysis. When present, the gastrointestinal content consisted of partially digested arthropods. Bacterial culture from aseptically collected lung and liver samples from three bats yielded mixed growth of environmental bacteria, likely postmortem tissue invasion. Brain tissue from three of the prosected bats was negative for rabies by direct fluorescence antibody test performed at the Wisconsin State Laboratory of Hygiene, Madison, Wisconsin. We sent 5 g of pooled gastrointestinal contents from five of the prosected bats to the California Animal Health & Food Safety Laboratory System, Davis, California to test for cyanobacterial

TABLE 2. Physical measurements, necropsy findings, and ancillary test results of eight adult male little brown bats (*Myotis lucifugus carissima*) found dead at Scofield Reservoir, Carbon County, Utah submitted for necropsy. All bats were in good body condition and all were in fair postmortem preservation state except for bat 2 (very poor) and bat 4 (poor). All necropsied bats had diffuse, acute, and severe pulmonary congestion and apparently normal intestinal contents.

Bat ID	FAL (mm)[a]	Body weight (g)	Microcystin-LR[b]	FAT[c]	Additional necropsy findings
1	37.56	5.4	Yes	ND[d]	Empty stomach
2	38.91	5.3	ND	Negative	ND
3	38.99	8.8	Yes	ND	Ventral and dorsal fur of the body, head and wing membranes diffusely covered with green dusty material; abundant green content in stomach microscopically identified as partially digested arthropods.
4	37.62	7.6	ND	Negative	Abundant green content in stomach.
5	36.54	5.8	Yes	ND	Fur of the ventral body diffusely covered with green dusty material; abundant green, finely granular content in stomach.
6	39.16	6.0	ND	Negative	Abundant green, finely granular content in stomach.
7	37.67	6.2	Yes	ND	Small amount of green, finely granular content in stomach.

[a] FAL=forearm length.

[b] MCLR= detection of MCLR by liquid chromatography–tandem mass spectrometry from pooled gastrointestinal content of five bats at D1612253 Laboratory of the California Animal Health & Food Safety Laboratory System.

[c] FAT=fluorescence antibody test for rabies lyssavirus detection in fresh brain at Wisconsin State Laboratory of Hygiene.

[d] ND=Not done.

toxins by LC/MS-MS (RL=10 ng/g), and MC-LR was detected at a concentration of 5,700 ng/g dry weight (Table 1).

On the basis of the exclusion of other causes of acute death (i.e., rabies lyssavirus infection, bacterial septicemia, or trauma) and the high levels of MC-LR detected in the gastrointestinal contents of prosected bats and in the water from the reservoir, we considered acute MC-LR intoxication as the most likely cause of mortality.

Microcystin-LR synthesized by the cyanobacterium *M. aeruginosa* is the most common cyanotoxin detected in freshwater cyanobacterial blooms (Hitzfeld et al. 2000). Microcystin-LR is a cyclic heptapeptide hepatotoxin that induces centrilobular hepatocyte rounding, dissociation, and necrosis due to inhibition of protein phosphatases (Runnegar et al. 1993). Although we observed no major hepatic lesions in the submitted bats, mild to severe autolysis present in the histologically examined tissues may have obscured minor hepatic changes. Furthermore, there are no descriptions of acute and peracute toxic effects of MC-LR in bats.

We report the potential risk for bats to be exposed to high doses of microcystins and the first strong epidemiologic and toxicologic evidence of a bat mortality event after exposure to microcystins. Although more information is needed on the deleterious impact of microcystins to bats, they might represent a health risk not previously assessed for bats in North America, especially for species that forage over, or regularly drink from, water bodies prone to cyanobacterial blooms.

We thank Benjamin Holcombe, Brady Bradford, Jodi Gardberg, and Scott Hacking

(Utah Department of Environmental Quality) for collecting and shipping water samples for toxicologic analysis; Tina Laidlaw and William Batschelet (US Environmental Protection Agency) for the toxicologic analysis of water samples; and Calvin Black, Scott Gibson, and Justin Hart (Utah Department of Wildlife Resources) for fieldwork. Use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the US Government.

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Submitted for publication 19 February 2018.
Accepted 26 April 2018.

Arkansas Department of Health

4815 West Markham Street ● Little Rock, Arkansas 72205-3867 ● Telephone (501) 661-2000
Governor Asa Hutchinson
Nathaniel Smith, MD, MPH, Director and State Health Officer

3 August 2018

Dear Veterinarian:

Subject: Harmful algal blooms and toxin poisoning in dogs

Harmful algal blooms (HAB) from blue-green algae (cyanobacteria) may be intermittently present in parts of the Buffalo River National Park, specifically the lower river region. These algae can produce toxins, such as microcystins and anatoxins, that affect people, pets, and livestock that swim in and drink from algae-contaminated water. Buffalo River National Park manages multiple high-use recreational swim/float areas where people frequently recreate with their dogs. Though we have received only a few reports of human illnesses possibly associated with HABs, we want to inform you of the current situation and provide additional resources should a potential case present at your clinic.

Though this notice is specific to HAB activity within the lower Buffalo River region, it is important to note that HABs are an issue for many lakes, ponds, and possibly rivers nationwide, and their incidence is on the rise. Please consider water exposure and travel history as elements of a patient's medical history.

Clinical Signs and Diagnosis

Signs of cyanobacterial toxin poisoning depend on the type of toxin (hepatotoxin, neurotoxin, or dermatoxin), toxin concentration, amount consumed, size of the animal, and exposure route. The majority of exposures result in no or self-limiting clinical signs, but ingestion of large amounts of toxin can result in serious illness and presentation for emergency care. Common signs of hepatotoxin poisoning (e.g. microcystins) include vomiting, diarrhea, anorexia, jaundice, abdominal tenderness, and dark urine. Death can occur within days after exposure due to liver failure. Neurotoxins (e.g. anatoxin-a) cause excessive drooling, disorientation, seizures, and respiratory failure. Death follows within minutes to hours after exposure from respiratory paralysis. Additionally, cyanobacteria may produce dermatoxins, which result in rash, hives, or an allergic reaction in the exposed animal.

Diagnosis is based primarily on history of recent exposure to cyanobacteria, clinical signs of poisoning, and necropsy findings. Diagnostic methods include analysis of stomach and fecal content and liver histopathology.

Treatment

Untreated, cyanobacterial toxin poisonings may be fatal in animals. Prompt veterinary care is critical for patients showing hepatic or neurologic symptoms and should include supportive care.

There are no antidotes to these toxins, but experimentally, oral cholestyramine has shown promise for treatment in dogs. Inducing vomiting within the first two hours of ingestion may minimize absorption of ingested toxins. Activated charcoal slurry may be of benefit to bind toxins in the gut if cholestyramine is not available. Pet Poison Hotlines may be consulted for additional treatment advice.

To report an illness: contact Arkansas Department of Health at adh.zoonotic@arkansas.gov or 501-280-4136.

To report suspect nuisance or harmful algal blooms: contact Arkansas Department of Environmental Quality at https://www.adeq.state.ar.us/complaints/forms/nuisance_algae_complaint.aspx or https://www.adeq.state.ar.us/complaints/forms/harmful_algae_complaint.aspx or 501-682-0923.

For additional information:
Laura Rothfeldt, DVM, DACVPM
State Public Health Veterinarian
Arkansas Department of Health
Zoonotic Disease Section
Office: 501-280-4136
Laura.Rothfeldt@arkansas.gov

http://www.merckvetmanual.com/mvm/toxicology/algal_poisoning/overview_of_algal_poisoning.html?qt=cyanobacteria&alt=sh

http://www.mdpi.com/2072-6651/5/6/1051/htm

http://www.health.state.mn.us/divs/idepc/diseases/hab/vet/index.html

http://www.dec.ny.gov/docs/water_pdf/habspets.pdf

https://www.nps.gov/buff/learn/news/buffalo-river-water-quality.htm

Engineer Permits Branch, Office of Water Quality 5301 Northshore Drive
North Little Rock, Ar 72118-5317

To support the Denial of 5264-W.

Seems I never get by with just one comment submission but I think it very important to include the information listed here.

August 3rd, 2018 the Arkansas Department of Health posted letter concerning human and animal exposure to algae and that a dog exposed to certain cyanobacteria can die within 2 hours. (ADH letters attached)

This photo was taken Sept 18 2018 and ask you to consider trickle down effects due to the pollution and death of the river and its effects on the wildlife that I so enjoyed years ago. On this trip I did not see a single turtle and the wildlife was very sparse. Very few



frogs were along the banks but instead many flies and biting insects.

The tourist drive thru and eat at our restaurants, sleep in our motels and cabins. They come to see elk, deer, turkey, eagles, the pileated wood pecker, scenic beauty, etc. but there's something smaller here, such as bats and herps and they require quality water for river habitat and visitors come to see that too.

The bats have suffered an immune deficient disease called White Nose Syndrome. Because of that the caves were closed to allow them to recover but what about the importance of their drinking water, the insects they eat and their habitat? How will we manage that?

I read a study 'Mortality of Little Brown Bats (Myotis lucifugus carissima) Naturally Exposed to Microcystin-LR'. (attached)

In this report bats were found dead within 5 m of the water and all autopsied bats had diffuse, acute, and severe pulmonary congestion and apparently normal intestinal contents.

Going through photographs taken while employed as a bio tech for AGF & NPS in a herpological study in the BR watershed I remembered the sensitive species. As I flipped thru the photos I wondered about the abundance of these animals during 2002-2003. The turtles, cricket frogs, peepers, bullfrogs and snakes lined the river banks. In the evenings the gravel bars were alive with tiny frogs croaking, peeping and rattling about. It was a natural experience that still can be heard when I quiet myself and listen.

Carol Bitting

HC 73 Box 182 A

Marble Falls, Ar 72648

This photo taken in 2003 by me and is one of the larger species that would be tangled in algae and probably die.



ARKANSAS DEPARTMENT OF HEALTH

NEWS RELEASE

Meg Mirivel, MA
Public Information Officer
Office of Health Communications
501-280-4768, margaret.mirivel@arkansas.gov

For Immediate Release:
August 1, 2018

Tips to prevent Recreational Water Illness (RWI) this summer

Little Rock, Ark. – The Arkansas Department of Health (ADH) encourages Arkansans to take some simple steps to stay healthy and prevent Recreational Water Illnesses (RWIs) while relaxing at the state's rivers, lakes, streams, and ponds. RWIs are caused when people swallow water that is contaminated with common germs or bacteria, such as E. coli. People can also become sick when swimming during a harmful algal bloom (HAB).

To stay healthy while enjoying the water:

- Do not swallow water.
- Avoid swimming in algae.
- When in doubt, stay out.

You should avoid entering or playing in bodies of water that:

- Smell bad.
- Look discolored.
- Have foam, scum or algal mats on the surface.
- Contain dead fish or animals or if they are nearby (for example, do not enter a body of water if dead fish have washed up on its shore or beach).

Water quality can change quickly. In general, there is a higher risk of getting sick after a rainfall event or in cloudy water. Rainfall can wash contaminates into the water. Cloudy water due to runoff can contain contaminates that may be harmful. Not all of the contaminates can be seen by the naked eye.

Not all algae are harmful but some algae produce toxins that can make people and animals sick. It is not possible to tell if algae are producing toxins just by looking at the water. The size of the bloom is not related to the amount of toxins that could be present. Children and pets are at the greatest risk from swimming or drinking water when algae are present. You should never drink water when algae are present, even if you have filtered it first. Personal filter equipment and treatment options do not eliminate the risks associated with HABs. Never drink, cook or try to filter water affected by HABs.

Symptoms for RWIs include vomiting and diarrhea. If you believe you have gotten sick from recreational water use, contact the ADH Communicable Disease Nurses at 501-537-8969.

The Arkansas Department of Health (ADH) routinely tests designated swim beaches for E. coli levels in the summer months and recommends closure when E. coli levels are too high. Swim beach closures can be found at both the ADH (https://www.healthy.arkansas.gov/programs-

services/topics/arkansas-swim-beach-program) and Corp of Engineers (https://www.swl.usace.army.mil/) websites.

###

October 10, 2018

Re: Regulation 5 Permit Denial – C&H Hog Farm

These may be considered comments on my APPROVAL of ADEQ denying C&H hog farm a Regulation 5 permit.

My name is Eric Fleming. I was the Inspection Branch Manager in the Water Division of ADEQ when the original C&H CAFO was permitted. It would have been the task of my branch to keep this facility inspected and in compliance. We would also be responsible for responding to all citizens' complaints. I worked in the Inspection Branch for 22 years. My name is on the ADEQ permit approval letter which authorized C&H to begin operation. I was allegedly cc:'d a copy of this letter when it was sent. I never saw this letter. I was told about this CAFO by another person, after it was already permitted. When I found that we had just permitted a large CAFO in the Buffalo River Watershed, I realized the damage that would ultimately occur to the Buffalo River and the headache this would cause our agency for years. After I discussed this with those that permitted this CAFO, I turned in my 2 weeks noticed and left the agency I worked so hard for…for so long. This was the straw that broke the camel's back. It broke my heart.

A little background. Besides having a Degree in Water and Wastewater Treatment Technology, I have worked in this field for 36 years. I have received numerous awards in this industry over the years including the 2018 Outstanding Achievement Award in the Water Industry in the State of Arkansas. I grew up in Wisconsin, on a chicken farm…a dry litter operation. I land applied chicken litter as fertilizer on our cropland. I grew up learning about uptake rates, and how to apply the litter to get maximum utilization of the nutrients. I learned about over application. I am very pro farm. I grew up in the dairy state for god sake, surrounded by dairies. Lots of my friends were farmers.

My first job in the water industry was as an operator at a wastewater plant. It was a small activated sludge package plant. One of my duties was to drive the sludge truck and land apply the waste sludge as fertilizer on permitted pastureland. So I know a little bit about the land application of beneficial use solids.

The initial permitting of this facility was screwed up from day 1. Not a single person who had ever been to a hog farm, much less a 6500 head CAFO, looked at this application when it came in. It changed hands and was rubber stamped by everyone involved. No questions were asked of anyone who had knowledge of hog farms and their operation. If someone would have asked ONE question of any of my Inspectors or me, this CAFO would have never been permitted in the first place, because we KNEW the damage that a CAFO can do, and the non compliance history of hog farms. Because no one asked THAT question, we are now stuck with this CAFO that will continually degrade the Buffalo River until it is

no longer an Extra Ordinary Resource Water (ERW). I am not going to go through all of the debate of analytical data and how the facility was built without proper permits and required information. The evidence shows that the permitted fields can no longer take wastes from the hog operation due to the concentration in the soil already exceeds limits. That's why they are looking for additional land for land applying. One of the points that the pro farm community and Farm Bureau makes is that the contaminants are also present in the Buffalo River UPSTREAM from the Big Creek confluence. If the contamination is present upstream from Big Creek, the source can't be the hog farm because water can't flow upriver. Sounds good..initially. The C&H farm sits at an elevation of 915 feet above sea level. The Big Creek confluence with the Buffalo River is 712 feet above sea level. A drop of 200 feet. Shit flows downhill. The HWY 7 crossing on the Buffalo is at the Pruitt Access. The elevation of the river at Pruitt is 780 feet above sea level. So the elevation of the Buffalo River, 11 miles upstream is 135 below the elevation of the hog farm. Shit rolls downhill, remember. Between the hydrostatic pressure in the waste lagoons and the karst geology under the farm it is most likely that the wastes from the C&H farm are in some manner entering the Buffalo upriver from the Big Creek confluence. Dye studies have confirmed this.

Having worked fishkills for 22 years, I find it surprising that we have been able to avoid a large diurnal fishkill. To simplify…When there is a very large amount of algae present in a water body, algae "creates" dissolved oxygen during the day. At night, the algae consume oxygen in the water, to the point where fish cannot survive. Can you imagine the public outcry when fish start dying in the Nations First Scenic River?

When I canoe, I cannot help but look for macroinvertebrates along the stream bottom. The last few times I floated through Erbie, I noticed a healthy, diverse macro population. It wasn't hard to turn over a few rocks and find "critters" crawling all over the rocks. Erbie is upstream of the Big Creek confluence. Then you go downstream of Big Creek and turn over a few rocks on the Buffalo and look. What do you find??? Nothing….the main indicator sign of a healthy stream begins with a healthy macroinvertebrate population. It looks grim folks.

We have known for years that problems exist on the tributaries of the Buffalo. ADEQ has documented this over the last 30 years. These "other sources" of pollution have not changed and have remained a constant since C&H was permitted. (See my report on Marble Falls / Dogpatch to Deputy Director Ryan Benefield for example). These "other pollution sources" are NOT causing the degradation which is now occurring on the Buffalo River.

ADEQ has been running water tests on samples from the Buffalo River, which were collected by NPS employees. We have 30 plus years of monthly analytical data that we can look at to see when the degradation began.

My friends at The Farm Bureau are doing all they can “To protect the hog farm”…..I would love to take these people for a trip down the river and show them the results of the great job that they are doing for the Farm Bureau, at the cost of the river and the people who enjoy it…or should I say, used to enjoy it.

I love the outdoors. I have 3 kayaks and a canoe. I try to be on the water as often as possible. I used to have a large group of friends who used to do multiple trips on the Buffalo River several times a year. Over the past 4 years we have been on the Eleven Point River, Jacks Fork, and Current River multiple times and have loved it. We now go to the spring river a few times a year. We avoid the Buffalo now. We take our money into Missouri where we can enjoy their beautiful clear clean water. It’s painful, when you can’t cast your fishing line without it getting snagged up in algae, when you can’t camp on the river without battling flies that are reproducing in the dead stinking algae which lies above the waterline when the water level drops. When you can no longer look down through the crystal clear water and see the beautiful cobble bottom and see darters and small fish shoot underneath you as you pass by them. It hurts when you see something die. It’s like watching someone with cancer die. It’s a slow process, but you know how it is going to eventually end. You can only hope for a miracle cure. The only way to correct this problem is to take all of the money that is being wasted by these so called Research teams (it’s all manipulated data) and use that taxpayer money to buy that WRONGLY permitted farm and pay the owners, who were foolish enough to put this farm there, to either go away or to build them another bigger CAFO in a better, less environmentally sensitive area. Remember I am a farmer, always will be, and am pro agriculture, but also pro-environment.

Compared to last year, I can tell you that the algae are more prevalent this year than last. The three types of algae which are causing the most problems are the genus Cladophora, Oedogonium, and Lyngbya, (all three are green filamentous), and the invasive aquatic plant Chara. All four are thriving due to an excess of nutrients present in the water.

United States Department of the Interior
NATIONAL PARK SERVICE
Buffalo National River
402 N. Walnut, Suite 136
Harrison, AR 72601

IN REPLY REFER TO
1.A.1 (BUFF)

ELECTRONIC CORRESPONDENCE ONLY

October 24, 2018

Becky Keogh, Director
Arkansas Department of Environmental Quality
5301 Northshore Drive
North Little Rock, AR 72118-5317

Comments Submitted Electronically: Water-Draft-Comment@adeq.state.ar.us

Dear Director Keogh:

Thank you for the opportunity to provide comments on the draft permit denial for C&H Hog Farms, Inc., application # AFIN-51-00164, Permit #5264-W.

I am the superintendent at Buffalo National River (BNR), a unit of the National Park Service (NPS). The BNR was created pursuant to the Buffalo National River Enabling Act of 1972 (P.L. 92-237). It was the first national river designated as a park unit, in recognition of its free-flowing condition and its scenic, scientific, recreational and fish and wildlife habitat values. The NPS is charged with protecting BNR values for the benefit and enjoyment of present and future generations in accordance with Federal law.

The NPS has reviewed the draft permit denial for the facility, and agrees with all points in ADEQ's Statement of Basis for Denial. While the facility is located outside of the boundaries of the BNR, it is within the greater Buffalo River Watershed and its proximity to the river presents a defined risk of contamination to BNR resources. Due to the karst environment throughout the area, there is a demonstrated hydrologic connection between the facility's operations and the Buffalo River. Please consider the following comments as you make a final decision on denying this permit.

General Comments:

- The NPS continues to have serious concerns about the impacts from the operation of C&H on the waters of Big Creek and the BNR. These concerns are confirmed by the ADEQ 2018 draft 303d listing of the Buffalo River and the section of Big Creek

adjacent to the facility and its spreading fields for *E.coli*, and lower Big Creek for dissolved oxygen impairment. As the hydrologic base level of the watershed, the Buffalo River assimilates pollutants from diverse sources within the watershed. The operation of the facility inevitably introduces nutrients and other pollutants into ground and surface waters that are critically important to the continued well-being of the river and the health and safety of those who enjoy its recreational values.

- The Buffalo River is classified as an Outstanding National Resource Water (ONRW), Extraordinary Resource Water (ERW), and Natural and Scenic Waterway (NSW). This makes the watershed a poor setting for the placement of a high volume liquid animal waste storage facility under an NPDES (Regulation 6) or State non-discharge permit (Regulation 5). Karst conditions present persistent waste storage pond leakage and irreversible infiltration of waste products into the groundwater from spreading fields.

Specific Comments:

1. Deficiencies in the Geological Investigation:

The NPS agrees with ADEQ that there are significant deficiencies in the Geologic Investigation of the Facility location and the Waste Application Field locations.

The area where the C&H barns and waste storage ponds sit is on the Boone Formation, a Mississippian-age limestone. The Boone Formation is widespread in northwest Arkansas and is a southern extension of several limestone formations present in Missouri. Anywhere the Boone Formation outcrops should be considered to have a very high likelihood of karst development. Within Buffalo National River, 39% of the caves are found in the Boone Formation, which comprises only 31% of the surface geology. In addition to caves, there are countless sinkholes, sinking streams, and springs present in this karst-intensive geologic formation.

The Animal Waste Management Field Handbook (AWMFH) is based on decades of experience by the Natural Resource Conservation Service, working in diverse landscapes and geologic settings across the United States. Karst areas are locations that present unique challenges to construction, waste pond design, and waste disposal. The AWMFH is an appropriate beginning place to design a facility and its operation in an environment such as the Buffalo River Watershed. The dye tracing performed by Dr. Brahana and his team[1] showed dye travelling long distances from the injection point near spreading field 15 to numerous points along Big Creek and the Buffalo River, both upstream and

[1] Brahana J.V., C. Bitting, K. Kosic-Ficco, T. Turk, J. Murdoch, B. Thompson, and R. Quick. Utilizing fluorescent dyes to identify meaningful water-quality sampling locations and enhance understanding of groundwater flow near a hog CAFO on mantled karst – Buffalo National River, southern Ozarks. 2017. 26 pp.

downstream of Big Creek. This shows there is a high likelihood of pollutants flowing from the facility to the BNR.

Electrical Resistivity Imaging (ERI) by scientists from Oklahoma State University[2] in waste application fields and around the waste storage ponds showed signatures indicating karst features below the soils in the fields as well as below the waste storage ponds. A drilling test by Harbor Environmental[3] indicates areas of lost drilling fluids, highly weathered rock with features consistent with karst development, and loss of grout near the level of the pond invert. This study provided a single data point that appears to validate the Fields and Halihan ERI survey of the waste storage pond area. Ground Penetrating Radar (GPR) studies were conducted for Big Creek Research and Extension Team (BCRET) in November 2013 at two fields. The GPR surveys noted anomalies in the profiles that were indicative of karst features directly beneath the mantle of sediments in fields 1 and 5.

Data from the USGS gaging stations on Big Creek, specifically the gage established below the CAFO and the gage at BUF-T06 indicate the section of Big Creek between these two stations loses discharge during base flow conditions, despite the fact that Left Fork of Big Creek and several smaller tributaries enter the mainstem of Big Creek in this reach. Combine this with the USGS gain-loss survey of the Buffalo River[4] which shows that the Buffalo River gains more than 8 cfs flow from groundwater sources between Big Creek and Lick Creek, about 4 miles downstream, all indications are that any leakage from the waste storage ponds and any downward percolation of contaminants from the waste application fields are highly likely to re-emerge in the channel of the Buffalo River below Big Creek. Water flowing through karst conduits does not get filtered effectively and is not exposed to sunlight. Consequently, there is no attenuation of pollutants. This can expose park visitors to increased risk, cause problems with algal growth, including cyanobacteria or Harmful Algal Blooms (HABs), and adversely impact aquatic fauna through eutrophication and disruption of the physical habitat.

A thorough geologic and hydro-geologic investigation of the facility is required. Without such a review, it is not possible to conduct an Antidegradation Review as required by 40 CFR 131.12(a)(2) as laid out in the EPA Water Quality Handbook, Chapter 4 – Antidegradation, as amended.

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[2] Fields J. and T. Halihan. Electrical resistivity surveys of applied hog manure sites, Mount Judea, Arkansas. 2016. 55pp.

[3] Harbor Environmental and Safety. Drilling Study Report. 2016. 542pp.

[4] Moix M.W. and J.M. Galloway. Base flow, water quality, and streamflow gain and loss of the Buffalo River, Arkansas, and selected tributaries, July and August 2003. United States Geological Survey, Scientific Investigations Report 2004-5274. 2004. 44pp.

2. Water Quality Issues

The National Park Service agrees with ADEQ that there are significant water quality issues associated with the operation of this facility.

The particular waste pollutants from this facility are providing an extensive load of phosphorus, nitrogen, and *E. coli* to the watershed. The Nutrient Management Plan, and Arkansas Phosphorus Index upon which it is based, allow for manure slurry to be applied to fields at rates designed to meet nitrogen needs. This means that the phosphorus is over applied by a large factor with each application. Over time, this phosphorus builds up in the soil bank, becoming what is known as "legacy phosphorus".

Best Management Practices (BMPs) are enacted at agricultural facilities to help limit their direct impact to receiving waters; however, current research (Hamilton 2011[5]; Meals et al. 2010[6]) suggest a lag-time response of many streams (and no response in others) from implementation to measurable results. One paper of particular interest (Jarvie, et al. 2013[7]) notes that long-term monitoring, measured by decades, will likely be necessary to capture the responses (both water quality and ecologically) to the implementation of BMPs. Of particular interest to the current permit is an article by Jarvie, et al. 2014[8] measuring the retention and remobilization of phosphorus in karst terrain. The authors report that the karst terrain of an experimental watershed in northwest Arkansas has the ability to retain high amounts of phosphorus within the karst drainage (noted as a phosphorus sink); however, they also caution once this source is remobilized, it may become a long-term source of legacy phosphorus to surface waters. The lack of a response of water quality or biota to the current nutrient loading of C&H may not indicate that a problem does not exist (even though 4 stream sections are being proposed as impaired in the 2018 Integrated Water Quality Monitoring Report); however, it might be a sign that the soil and karst environments have not been saturated to allow excess nutrients (mainly nitrogen and phosphorus) to begin leeching to surface water. If this is allowed to occur, given the above-mentioned articles, recovery may take decades, or worse, create an irreversible altered state (Carpenter et al. 1999[9]). Waiting for data to

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[5] Hamiliton, S.K. Biogeochemical time lags may delay responses of streams to ecological restoration. Freshwater Biology. 2011 DOI:10.1111/j.1365-2427.2011.02685.x

[6] Meals, D.W., S.A. Dressing, and T.E. Davenport. 2010. Lag time in water quality response to best management practices: a review. J. Environ. Qual. 39:85-96.

[7] Jarvie, H.P, A.N. Sharpley, P.J.A. Withers, J.T. Scott, B.E. Haggard, and C. Neal. 2013. Phosphorus mitigation to control river eutrophication: murky waters, inconvenient truths, and "postnormal" science. J. Environ. Qual. 42:295-304.

[8] Jarvie, H.P., A.N. Sharpley, V. Brahana, T. Simmons, A. Price, C. Neal, A.J. Lawlor, D. Sleep, S. Thacker, and B.E. Haggard. Phosphorus retention and remobilization along hydrological pathways in karst terrain. Environ. Sci. Technol. 2014. Dx.doi.org/10.1021/es405585b

[9] Carpenter. S.R., D. Ludwig, and W.A. Brock. 1999. Management of eutrophication for lakes subject to potentially irreversible change. Ecol. Appl. 9:751-771.

show degradation of the environment to begin remediation does not fit with the purpose of the Clean Water Act or the Antidegration Policy in Regulation 2.

3. Aquatic Threatened and Endangered Species Issues

Buffalo National River provides habitat for the Threatened Rabbitsfoot mussel (*Quadrula cylindrica cylindrica*) and the Snuffbox mussel (*Epioblasma triquetra*). The Buffalo River from the mouth of Cove Creek near Erbie to the U.S. Route 65 crossing at Grinder's Ferry is Critical Habitat for the Rabbitsfoot mussel. Nutrient loading of streams is one of the primary threats facing the Rabbitsfoot mussel[10] Nutrient loading is exacerbated by the addition of Zinc (Zn) and Copper (Cu) in swine rations to increase growth rates. The application of effluent enriched in these plant micro-nutrients can cause accumulation in sandy soils.[11] Up to 95% of the Cu ingested by swine is passed through and excreted, with much of it being in a readily soluble form.[12] Juvenile freshwater mussels are particularly sensitive to Cu enrichment of water.[13]

4. Terrestrial Threatened and Endangered Species

BNR is home to four species of bat listed as Threatened or Endangered. The Gray bat (*Myotis grisescens*) was first listed in 1976. The Gray bat utilizes subterranean habitats year around for roosting, hibernation, and rearing of young. One of the sites where the bat roosts is John Eddings Cave, which was also a location where fluorescent dye from one of the groundwater traces conducted by Brahana et al. was detected. The Gray bat specializes in capturing emergent aquatic insects from streams and large ponds and lakes. The Buffalo River is an undammed 152 mile resource for this species. Contamination of the roost cave with waste from the CAFO has the potential to have impacts upon this confined space. Contamination of the Buffalo River has the potential to have even greater impacts upon this species' survival. An additional Gray bat cave is located along Big Creek, not far from the confluence with the Buffalo River. *Ephemeroptera*, *Plecoptera*, and *Tricoptera* are very important to the diet of Gray bats[14] Pollutants can

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[10] Butler RS. 2015. Status assessment report for the Rabbitsfoot, *Quadrula cylindrica cylindrica*, a freshwater mussel occurring in the Mississippi River and Great Lakes Basin. Research April 2015. DOI: 10.13140/RG.2.1.3065.4883. 208 pp.

[11] Novak J, AA Szogi, and DW Watts. Copper and zinc accumulation in sandy soils and constructed wetlands receiving pig manure effluent applications *in* Trace elements in animal production systems. pp. 45 - 54

[12] Schwarz MS, KR Echols, MJ Wolcott, and KJ Nelson. 2004. Environmental contaminants associated with a swine concentrated animal feeding operation and implications for McMurtrey National Wildlife Refuge. United States Fish and Wildlife Service. 98 pp.

[13] Wang N, CG Ingersoll, IE Greer, DK Hardesty, CD Ivey, JL Kunz, WG Brumbaugh, FJ Dwyer, AD Roberts, T Augspurger, CM Kane, RJ Neves, and MC Barnhart. 2007. Contaminant sensitivity of freshwater mussels: Chronic toxicity of copper and ammonia to juvenile freshwater mussels (*Unionidae*). Environmental Toxicology and Chemistry, V26, N10, pp2048-2056.

[14] Brack Jr. V and RK LaVal. 2006. Diet of the gray Myotis (*Myotis grisescens*): Variability and consistency, opportunism, and selectivity. Journal of Mammalogy V87, N1. pp. 7-18.

reduce species richness of taxa from these three groups, potentially resulting in adverse impacts to the Gray bat. This is an impact that is additional to the impacts from climate change and White Nose Syndrome (WNS). BNR is close to the southern edge of the range for the Gray bat, changing climate is likely to push this range northerly where it may be difficult for the species as a whole to find adequate numbers and distribution of suitable roost sites. WNS is a disease that effects cave dwelling bats. At the current time, it does not seem to be adversely impacting the Gray bat in Arkansas, but reductions in diet variety and abundance may change the current equation.

5. Primary Contact Recreation and Impairment of Scenic Values

Pollutants flowing down Big Creek and reaching the Buffalo River via groundwater pathways have apparently impaired the Buffalo River for *E. coli*. In addition the 'unique scenic and scientific features' which the national river was established to conserve have been negatively impacted by algae production in the river. The long-term impact of nutrients washing off the fields at C&H Hog Farm, particularly nitrogen and phosphorus compounds, have the potential to become chronic additions to the soil surface leading to continued impairment of adjacent stream segments and the length of time the impairment will last.

The NPS agrees with the actions of ADEQ to deny this permit. We have a continuing interest in working with you to ensure that there are no negative impacts to the water and air quality of BNR, a resource of great concern. It is critical that BNR receive the utmost consideration and permanent protection from activities determined to threaten this exceptional water resource. Should you have any questions, please direct them to Mark Foust, Superintendent, at 870-365-2732, or mark_foust@nps.gov.

Marilyn Kreps

Attached are the Comments of the Ozark Society concerning C&H Hog Farms, Inc.'s permit denial.

Marilyn Kreps

Paralegal

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October 16, 2018

Via Email Water-Draft-Permit-Comment@adeq.state.ar.us

Arkansas Department of Environmental Quality
ATTN: C&H Draft Denial
5301 Northshore Drive
North Little Rock, Arkansas 72118-5317

Re: Draft Denial of Liquid Animal Waste Management System Permit
Applicant: C&H Hog Farms, Inc., HC 72 Box 2
Vendor, AR 72683
Permit Number 5264-W; AFIN 51-00164

Dear Sir or Madam:

I represent the Ozark Society, Inc., Dr. Alan Nye, Dr. David Peterson and Robert Cross. The Ozark Society is a non-profit corporation formed pursuant to the laws of Arkansas. The attached comments (Attachment "1") in support of ADEQ's decision to deny the permit application of C&H Hog Farms, Inc. are submitted on behalf of the Ozark Society, Dr. Alan Nye, Dr. David Peterson and Robert Cross (referred to as the Ozark Society commenters). We support ADEQ's proposal to deny a permit that would allow C&H Hog Farms, Inc. to operate a large CAFO near the Buffalo River in perpetuity.

The Ozark Society was founded in 1962 by Dr. Neil Compton of Bentonville and a group of associates for the immediate purpose of saving the Buffalo River from dams proposed by the U.S. Army Corps of Engineers. Society founders, working with elected officials, helped get the National Park Service to survey the Buffalo River area and then began to campaign for the creation of the "Buffalo National River" as an alternative to the dams. It took ten years, but Congress passed legislation to create our nation's first "national river" in 1972 and it is now one of mid-America's most outstanding river-oriented attractions. Since its designation as a National River, the Ozark Society has worked to preserve its pristine water quality and wild and scenic nature from all threats: agricultural and human waste, unneeded or poorly designed road building, haze, odors, and other air quality issues, fracking intrusion, overdevelopment and over

use in the park itself. The Ozark Society has a three-fold mission of conservation, education, and recreation. The Ozark Society has approximately 1,008 dues paying members, approximately 80% of whom are from Arkansas. Members of the Ozark Society enjoy all forms of recreation allowed on the Buffalo River.

Dr. Alan Nye is a toxicologist who resides at 12 Platte Drive, Maumelle, AR 72113. His telephone number is 501-258-7137. Dr. Nye is an adjunct faculty member of the UAMS Fay W. Boozman College of Public Health. Dr. Nye has been a member of the Ozark Society for over 30 years and is immediate past president of the Ozark Society. Dr. Nye and his wife own a residence in Gilbert, Arkansas (61 Frost Street, Gilbert, AR 72636) near the Buffalo River. Dr. Nye has canoed the Buffalo River on many single-day and multi-day trips with his family and friends since the late 1980s, and has also day hiked and backpacked many times on the Buffalo River Trail. Dr. Nye enjoys and seeks to preserve the unique characteristics of the Buffalo River, including recreational and aesthetic values associated with this Outstanding National Resource Water. Water quality of the Buffalo River is of paramount importance to Dr. Nye.

Robert Cross is an Emeritus Professor of Chemical Engineering at the University of Arkansas in Fayetteville. He resides at 315 N. Fletcher Ave. in Fayetteville, AR 72701 and his telephone number is 479-466-3077. He was previously a Research Professor of Chemical Engineering at the UofA and before that was the President and Technical Director for many years of Romicon, Inc., a subsidiary of the Rohm and Haas Co., located in Boston. He was involved in the development, manufacture, and sale of advanced separations equipment including membrane technology for water and waste treatment. He is currently working on the development of more economical and reliable process to produce drinking water for households in third-world countries. His education includes a B.S.Ch.E. from the UofA and a M.S.Ch.E. from M.I.T. He has been a member of the Ozark Society for 20 years and has served as Vice President for six years and President for six years. He is currently a State Director for Arkansas. He has hiked for many years in the Buffalo Nation River as well as the Upper and Lower Buffalo National Wilderness and has canoed most sections of the Buffalo River.

Dr. David Peterson is a retired math professor from UCA, who lives at 56 Ridge Drive, Greenbrier, AR 72058. His telephone number is 501-679-2935. He and his family have been involved with the Ozark Society since 1978. Dr. Peterson is the immediate past president of the Pulaski Chapter of the Ozark Society and currently is president of the Ozark Society. He and his wife Donna have hiked and canoed the entire length of the Buffalo River, and explored many tributaries as well. As an avid fisherman, Dr. Peterson admires the native smallmouth bass in the watershed and realizes that water quality is paramount in preserving this resource. Given his avocation as a statistician, he has spent many hours modeling nutrient flow in the Buffalo River, its tributaries, and Big Creek in particular.

In support of permit denial, we adopt and incorporate by reference the entire record before ADEQ on this matter that is viewed at the following link:

https://www.adeq.state.ar.us/home/pdssql/p_permit_details_water_spb.aspx?AFINDash=51-00164&AFIN=5100164&PmtNbr=5264-W). This includes, without limitation:

Public comment submitted during the previous public comment period on this permit application, including comments of the Ozark Society, Robert Cross, David Peterson and Alan Nye submitted in opposition to ADEQ's initial permitting decision dated April 6, 2017, the Buffalo River Watershed Alliance, the Arkansas Canoe Club, Gordon Watkins and Marti Olesen;

Expert reports in connection with C&H's permit appeal (18-001-P):

Thomas Aley dated May 29, 2018;

James C. Petersen dated May 31, 2018 and revised October 15, 2018 (Attachment "2" hereto);

Dr. Lee J. Florea, P.G. dated June 4, 2018;

Dr. Michael Smolen dated June 1, 2018;

Dr. J. Berton Fisher dated May 27, 2018;

Robert Cross; and

David Mott;

All deposition testimony taken in connection with C&H's earlier permit appeal (18-001-P) including, without limitation:

Deposition of Dr. Andrew Sharpley;

Deposition of Jason Henson;

Deposition of Tana Henson;

Deposition of Monica Hancock;

Deposition of Dr. Robert Blanz; and

Deposition of Dr. Jamal Solaimanian;

Subpoena to Dr. Andrew Sharpley and Response thereto;

Materials contained in Docket No. 18-001-P; and

BCRET reports and the "Expert Panel" Report dated May 19, 2014.

In addition to the comments we are submitting, we adopt by reference, as if stated word for word herein, all other comments submitted in support of permit denial, including, without

limitation, comments submitted by the Buffalo River Watershed Alliance, the Arkansas Canoe Club, or its members.

For the reasons set forth in our comments and others supporting permit denial, we respectfully request that ADEQ deny the permit.

Thank you.

Sincerely,

Samuel E. Ledbetter

SEL/

Enc.

Attachment "1" – Detailed comments of the Ozark Society concerning ADEQ's public notice to deny a Regulation No. 5 (Reg. 5) "no discharge" permit for C&H Hog Farms (C&H)

These comments are submitted on behalf of the Ozark Society, Dr. David Peterson, Robert Cross and Dr. Alan Nye (hereafter "OS") in response to Arkansas Department of Environmental Quality's (ADEQ) September 2018 Statement of Basis for its decision to deny the application of C&H for a Reg. 5 permit.

Permit History/Activity. On April 6, 2017, OS submitted comments to ADEQ during the initial public comment period for draft permit 5264-W (hereafter referred to as "OS 2017 p. ___"). Those comments urged denial of draft permit 5264-W and address C&H's Reg. 5 permit application and accompanying material contained in the permitting record at that time. Those comments are incorporated by reference herein as if repeated word for word. In addition to commenting on the earlier draft permit decision in support of permit denial, OS intervened in C&H's appeal of ADEQ's January 10, 2018 permit denial. OS has sought to intervene in an appeal related to coverage under C&H's expired Regulation 6 General Permit. These comments focus on the Statement of Basis (SOB) dated September 17, 2018, as well as new information since our earlier comments of April 6, 2017, including without limitation, the record developed in connection with Docket No. 18-001-P and materials contained on ADEQ's website under 5264-W titled "Additional Information 5264-W," which is adopted by reference and incorporated in our comments to the extent it provides additional support for permit denial. *See*, https://www.adeq.state.ar.us/home/pdssql/p-additional-information-5264-w.aspx

Facility Location. C&H is located on the karstic Boone Formation less than 5-miles from Buffalo National River. C&H should never have been authorized to construct and operate a Liquid Animal Waste Management System (also known as an Animal Waste Management System or AWMS) to dispose of waste from a large swine Concentrated Animal Feeding Operation (CAFO) at this location. The hydrogeologic properties of the karst aquifers in the Buffalo River watershed and the state and national significance of the Buffalo River combine to create a valuable Arkansas resource very susceptible to the contaminants in swine manure. The Buffalo River is unique, possessing a combination of attributes unmatched in our state, and arguably the nation:

- The Buffalo River has both Extraordinary Resource Waters (ERW) and Natural and Scenic Waterways (NSW) designations under Clean Water Act and State regulations.
- The Buffalo River is the primary natural resource and recreational element of the Buffalo National River - America's first National River.
- The watershed contributing flow to the Buffalo River is mostly underlain by karst.
- The Buffalo National River is one of Arkansas's tourism hotspots, with over a million visitors per year coming to experience the clean, clear waters of a large karst river.
- Numerous dye tracing studies have shown the complicated and rapid transport of groundwater through the region's karst drainage networks.

For these general reasons and the specific reasons listed in the following comments and references herein, C&H should not receive a permit. Any large swine CAFO constructed in the Buffalo River watershed, on karst, and on a major tributary to a National River, must be held to higher environmental standards than a facility built in an area characterized by rich homogenous soils and non-karst geology. There are literally thousands of suitable locations in Arkansas where the downstream receiving water is not a crystal clear karst river of national significance, critical to the local tourism economy, and susceptible to nuisance algae blooms.

Given the location of this CAFO, it is reasonable to expect that:

1) A professional geologist would be involved with the planning and design of such a facility, although none was;

2) The design engineers would closely examine and account for the karst geology and yet the presence of karst is not mentioned in the application;

3) The applicant would collect and analyze technical information required by Regulation 5 and the Agricultural Waste Management Field Handbook (AWMFH), but again this didn't happen; and

4) There would be an independent review and assessment of all the required data and facts, and yet there wasn't.

We submit that a qualified team of planners utilizing appropriate guidance would conclude the present location next to Big Creek is a poor/unsuitable location for a large AWMS and explain this fact to a reasonable operator in the first planning meeting. The AWMFH states "Location of a facility is an extremely important consideration during the planning process to minimize exposure to vulnerability and risk." AWMFH 651.1000 (4). This CAFO should never have been built in its current location and is only there because of a failure to properly assess site-specific concerns in the original "general" permitting process.

Waterbody Evaluation. This section of the SOB states "Surrounding areas were evaluated to determine if any Extraordinary Resource Waters (ERWs), Natural or Scenic Waterways (NSWs), or waterbodies in the 2016 or the proposed 2018 list of impaired waterbodies in the State of Arkansas are near the proposed land application sites." While the ensuing discussion focuses on impairment of both Big Creek and the Buffalo River, it fails to mention that the Buffalo River is designated as both an ERW and NSW. OS 2017 p. 7 discusses the need to recognize the resource sensitivity of the area and make the potential impacts to the existing water quality of the Buffalo River part of the design considerations and permit review. C&H is contributing nutrients, bacteria and suspended solids to the Buffalo River, as documented in the previous comments and references contained therein, the expert reports/opinions, and deposition testimony taken in connection with permit appeal 18-001-P, and the recent impairment designations. Data collected since the beginning of operations at C&H shows water quality impairment exceeding Arkansas's water quality criteria. By definition, the existing water quality of the Buffalo River is not being maintained, and this facility is causing or contributing to water quality degradation in an Outstanding National Resource Water (ONRW) in violation of the

Clean Water Act and the AWMFH. Reg. 2.203 states "Where high quality waters constitute an outstanding state or national resource, such as those waters designated as Extraordinary Resource Waters, Ecologically Sensitive Waterbodies or Natural and Scenic Waterways, those uses and water quality for which the outstanding waterbody was designated shall be protected by (1) water quality controls, (2) maintenance of natural flow regime, (3) protection of instream habitat, and (4) encouragement of land management practices protective of the watershed.

OS supports ADEQ's decision to list Big Creek and the Buffalo River as impaired and to associate these impairments to recent animal waste disposal activities at C&H. Our previous comments note both the elevated pathogen levels in Big Creek and the Buffalo River, and the dissolved oxygen water quality violations at the USGS sampling station at Big Creek near Carver (OS 2017 p. 13 and 14). Granting a permit to C&H would violate 2.203 by continuing to allow water quality to decline, constituting a land management practice that is not protective of the watershed.

Big Creek at Carver is within ½ mile of the confluence of Big Creek and the Buffalo River. Within the Buffalo River channel downstream from this confluence is a large spring identified by a USGS flow gain and loss study discussed in detail in Aley 2018. It is very likely that groundwater discharged from the Big Creek aquifer flows directly to the Buffalo River. This location presents complex challenges. The minimal engineering protections that characterize the planning, design, construction and operation of this CAFO under the expired general permit (which were performed by a firm from North Dakota lacking appropriate knowledge and expertise) is unacceptable.

Big Creek Research Extension Team (BCRET) sampling has identified statistically significant increases in nutrient concentrations in the local aquifer and in surface water during base flow conditions. However, BCRET sampling is neither designed nor conducted in a manner that provides quantitative storm loading estimates. In his deposition, Dr. Sharpley (p. 13 – 14; found at https://www.adeq.state.ar.us/water/bbri/c-and-h/pdfs/2018-09-17/Deposition%20Sharpley%20with%20Exhibits.pdf) stated that he does not consider himself an expert in karst hydrology and has never designed, conducted, or led any similar watershed-scale water quality study. Previous studies (as referenced in the OS's previous comments and the expert reports prepared on our behalf as well as on behalf of Buffalo River Watershed Alliance (BRWA)) show that swine CAFOs such as C&H are a major contributor to nutrient loads in receiving streams and these loads are dominantly transported during storm events. Dr. Sharpley also testified (p. 42) "If we were concerned with fluxes in terms of amounts of nutrients coming out, we would be concerned with high flows." Storm event water quality conditions and loads remain unassessed, but the weight of the evidence supports our position that the ONRW designation and accompanying antidegradation policy are being violated by runoff and groundwater inputs related to the operation of C&H's liquid animal waste disposal system. This point is discussed and detailed below.

Applicant Activity – The applicant's activity should be placed in a more representative context. For example, this facility is categorized as a large swine CAFO under CWA definitions and is the largest CAFO ever constructed and operated in the Buffalo River watershed. It is located in a

karst landscape in a sensitive area. This type and size of facility has long been a source of environmental concern, leading ADEQ in 1992 to place a moratorium on Regulation 5 permits in the Buffalo River watershed (OS 2017 p. 57 – 59). This application must be reviewed with the potential impacts to the Buffalo River and its ONRW values as a primary concern. The applicant fails to demonstrate that it understands the hydrologic and socio-economic consequences of its actions or that it has devised acceptable strategies to avoid measurable contamination of Waters of the State, first and foremost being the Buffalo River.

Facility Type and Size

C&H's permit application seeks to increase the number of swine from 6,503 to 6,878. Reg. 5.901(D) prohibits an increase in the number of swine at this facility. Three hundred and seventy five swine may not seem like a lot, but that is the size of the typical permitted hog farm in the Buffalo River watershed prior to the construction of C&H. Even a 300 to 400 sow facility can cause measurable water quality degradation as evidenced by the 1992 ADEQ moratorium on Regulation 5 permits in the Buffalo River watershed. As an additional basis for permit denial please see OS 2017 p. 55 – 56. This issue is discussed below under the "Additional Bases for Denial."

Basis for Permit Decision

The OS concurs with ADEQ's denial decision and its determination that the record lacks necessary and critical information to support granting a permit and contains information that the operation of this facility may not only be affecting water quality in the area, but also contributing to water quality impairments in Big Creek and the Buffalo River. We also offer additional Bases for Denial items:

1. **C&H has not evaluated, designed, constructed or operated in compliance with Reg. 5.102 and Reg. 5.402**
2. **C&H is discharging to waters of the State in violation of 5.102.**
3. **C&H is contributing to declining water quality in the Buffalo River in violation of Regulation No. 2, the Clean Water Act (see APC&EC Reg. 2, Chapter 2: the Clean Water Act § 303 (33 U.S.C. § 1313) and 40 CFR § 131.12), and AWMFH 651.0202 C (17).**
4. **The number of swine at the facility has increased in violation of the 2016 APC&EC moratorium Reg. 5.901(D).**

OS 2017 listed many of the information shortcomings of C&H's Reg. 5 application and established that the application, as stated in the SOB, lacked the "necessary and critical information to support granting of the permit, and the record contains information that the operation of this facility may be contributing to water quality impairments of water of the state." This prevents ADEQ from evaluating the permit under both Reg. 5.102 and 5.402 (OS 2017 p. 18 – 55). In connection with C&H's appeal of ADEQ's earlier denial, we engaged Mr. Tom Aley to review the permit application, environmental setting, and compare the geotechnical requirements of the AWMFH to the information provided by the applicant. See,

https://www.adeq.state.ar.us/water/bbri/c-and-h/pdfs/2018-09-17/Expert%20Report%20Aley.pdf (hereafter referred to as Aley 2018)

Mr. Aley's opinions include:

- C&H is sited on the karstic Boone Formation
- The Boone Formation has a high infiltration rate and the Arkansas Phosphorus Index does not account for nutrient transport to groundwater
- Polluted groundwater from C&H could migrate directly through the karst groundwater network to the Buffalo River
- The permit application fails to provide the requisite technical information or a credible explanation of how operation of C&H will be able to comply with Reg. 5.406 (C) in this sensitive location
- The waste storage ponds and their clay liners are inadequate for waste storage in karst

In support of denial, OS adopts and incorporates herein by reference Mr. Aley's report and the opinions contained therein. OS also engaged Dr. Lee Florea, a hydrogeologist and member of the expert panel that reviewed the BCRET study. Dr. Florea has visited the area to review karst water quality related concerns. His opinions reinforce those expressed by Aley. *See*, https://www.adeq.state.ar.us/water/bbri/c-and-h/pdfs/2018-09-17/Expert%20Report%20Florea.pdf hereafter referred to as Florea 2018. Dr. Florea's opinions are incorporated herein in support of permit denial.

In its 2017 comments, the OS presented detailed discussions of water quality concerns which are summarized as follows:

- Waste holding ponds are leaking to groundwater and the actual leakage rate has not been determined even though this is a simple process.
- Waste holding ponds are constructed on karst and the bottom of the ponds are likely constructed within the epikarst zone.
- Excess phosphorus is accumulating in application fields. A legacy phosphorus situation is developing.
- The Buffalo River is susceptible to nuisance algae blooms and C&H produces, stores, and surface applies a large amount of the nutrients that drive these algae blooms.
- Downstream sampling of Big Creek shows elevated nutrients, chloride, total suspended solids, and total coliform bacteria compared to the upstream site.
- More nitrogen and phosphorus is being imported into the Big Creek watershed by C&H than is being exported in agricultural products. Most of the surplus nutrients are eventually transported to surface and groundwater.
- There is no credible water quality baseline representing pre-C&H conditions.
- Buffalo River water quality is degrading as a result of increased agricultural activity in the watershed and C&H is contributing to this water quality decline.
- Water quality declines are a violation of the ONRW status and the designated uses applicable to ERW and NSW waters.

- Primary transport of nutrients, pathogens, and other contaminants of concern from C&H to the Buffalo River remains unquantified. 80 to 90 percent of this transport occurs during storm runoff conditions. The BCRET study lacks the necessary design and implementation measures required to assess, quantify and compare storm loading.
- The BCRET "study" is poorly designed and implemented. The BCRET "Team Leader" (Dr. Sharpley) inaccurately represents BCRET's findings and results in a number of respects. Dr. Sharpley is not an expert in the fields of hydrogeology, watershed science, and in-stream water quality data collection and analysis. While there may be members of BCRET who could offer expert opinions in these areas, Dr. Sharpley cannot. Moreover, the BCRET study, results and findings have not been peer reviewed. OS submits that BCRET's work would not withstand peer review due to numerous flaws, including, without limitation, data gaps, flaws in QA/QC, data collection and analysis protocols (or lack thereof) that render the study unreliable.
- Dye-tracing to date indicates groundwater moves great distances at high rates of speed and may be discharging directly to Buffalo National River's springs and streams.
- USGS continuously recording nitrate sensor at Carver shows slugs of nitrate moving into the Buffalo River in conjunction with storm events. Time of travel estimates place the source of these slugs upstream at a distance consistent with the distance from C&H to the Carver sensor. Based on literature and previous studies, total nitrogen and phosphorus, sediment, pathogens, and other constituents of concern are likely being loaded into the Buffalo River at even greater magnitude than shown for nitrate.
- BCRET field flumes show runoff from C&H is much higher in phosphorus and nitrogen then the receiving stream, Big Creek, and that much of the phosphorus is in dissolved form and immediately available for plant stimulation.
- Bacteria levels often exceed state numeric water quality standards in both Big Creek and the Buffalo River.
- BCRET data is only useful in characterizing base flow water quality conditions. Within the BCRET database, flags characterizing samples as base flow or storm flow are often wrong.
- BCRET has no discharge data for the upstream site, therefore accurate flux and load comparisons between the upstream and downstream sites cannot be made. Seasonal and annual stream loads contributed by C&H cannot be accurately calculated.
- BCRET uses automated samplers in an effort to collect storm runoff samples. However, their operational design and implementation lacks any pre-planning or quality control documentation. This method has failed to capture the vast majority of storm flow events and for those events it has captured, critical data needed to assess storm flows is missing or not gathered. The data collected by these automated samplers has not been interpreted or subjected to peer review. As such, storm flow data critical to understanding the impact C&H is having on the receiving stream, is not available.
- Trends in nitrate and total nitrogen appear to be increasing with time downstream of C&H but not upstream.

- USGS dissolved oxygen data from Carver clearly shows water quality numeric criteria are being violated.
- Nitrate values are significantly elevated in groundwater near C&H as compared to Big Creek. Groundwater is being loaded with nitrate and discharging via the karst drainage network to Big Creek and the Buffalo River.
- A large spring is located in the channel of the Buffalo River downstream from the confluence of Big Creek. This spring could be a direct conduit for groundwater flow from the Big Creek basin to the Buffalo River.
- Soil phosphorus levels are high and increasing in most of the spreading fields leading to elevated phosphorus in runoff waters and a legacy phosphorus situation is developing.
- Soil type, characteristics, and thickness in the area are mostly inadequate to provide the waste assimilation capacity mandated in the AWMFH.
- High nitrate values were detected in the BCRET monitored spring, house barn well, and trenches and OS recommended a trend analysis be performed on these data.
- The increased levels of nutrients in surface and groundwater near C&H, and in the Big Creek valley below C&H, are causing low dissolved oxygen values at Carver.
- Increasing nutrient levels transported from C&H spreading fields to the Buffalo River is likely contributing to nuisance algae blooms in the Buffalo River.
- Water quality deterioration in the Buffalo River (as well as the perception of the public regarding risks associated with primary contact in the river this CAFO has created) threatens the tourism economy in the area.
- The AWMFH requires application of nutrients at levels that match plant needs, and in a resource sensitive area such as this, to apply only at agronomic rates, not at rates that result in use of soils as phosphorus disposal sites.
- Waste application rates are "haphazard" and the actual nutrient application rates at C&H may be far different from the recommendations (guestimates) in the Nutrient Management Plan.
- C&H is not following Dr. Sharpley's (or the AWMFH's) recommendations for storage pond management or waste spreading.
- C&H has not implemented any of Dr. Sharpley's recommendations to modify the waste stream to remove excess phosphorus and/or improve the ratio of nitrogen and phosphorus in the applied waste.
- Applying the lessons ADEQ learned from studies conducted in response to the 1992 moratorium on swine CAFOs in the Buffalo River Watershed supports permit denial.
- As soil phosphorus levels increase, so do levels of phosphorus in surface and groundwater leaving the field.
- BCRET mostly ignored the review comments of the expert team sent to evaluate its work. Even a simple gain and loss study to understand the basics of karst groundwater/surface water interactions has not been conducted.
- A number of significant problems with the BCRET study were identified by the expert panel. In summary the BCRET study fails to meet the design and QA/QC requirements

necessary for the collection of meaningful and accurate data that allows for a complete interpretation of impacts.

- Dye tracing indicated the upstream "control" site may also be receiving recharge from application fields located in the Dry Creek basin.
- Waste application records indicate waste is not being spread evenly or consistently on application fields.

The Buffalo River and Big Creek have recently been designated impaired under the Clean Water Act. Permitting the largest swine CAFO in the entire Buffalo River watershed would continue to exacerbate this impairment. In OS 2017 p. 14 – 17, we noted that data collected by the USGS at Carver reflected that Big Creek was not meeting State standards for dissolved oxygen. The violation of State water quality standards due to low dissolved oxygen values is most probably due to nutrient eutrophication and/or assimilation processes taking place in lower Big Creek. It is a fact that C&H is the largest generator of nutrients in the Big Creek watershed (in fact it is the largest generator of nutrients in the entire Buffalo River watershed).

Deficiencies in the Geological Investigation:

The OS concurs with ADEQ's determination that C&H is located on karst, a fact that cannot be disputed and which is supported by Dr. Sharpley and his collaborators (Sharpley deposition p. 90). The statements made by Terracon and Carmen demonstrate they are at best uninformed and at worse biased and thus these statements cannot be given credibility. In the SOB, ADEQ acknowledges that this facility is "located in a sensitive geologic area." SOB p. 4. ADEQ further acknowledges that this permit must be evaluated based on site-specific conditions and in full compliance with the AWMFH.

The SOB refers to and discusses 651.0503 and 651.0504 of the AWMFH, and reviews the recommended methods for determining soil suitability for waste application. Highly permeable soils, often thin and overlying karst formations in the watershed of Buffalo National River by definition are in the "severe" limitation category. The AWMFH requires a careful and comprehensive examination of soil and numerous other site conditions and the AWMFH supports ADEQ in that "The presence of karst triggers additional considerations for siting and design. An example of how this AWMS would have to be redesigned to comply with the AWMFH concerns waste application rates. In sensitive areas, the AWMFH cautions against using manure management planning such as provided by the Arkansas Phosphorus Index (API) which is the equivalent to Strategy 2 listed below (651.1105(c)).

> Two strategies can be used for manure utilization: management for maximum nutrient efficiency, and management for maximum application rate of manure.
>
> **Strategy 1 —Management for maximum nutrient efficiency.** This strategy best realizes the value of the nutrients in the manure. The rate of application is based on the nutrient available at the highest level to meet the crop's needs. This element is often phosphorus. The manure rate is calculated to meet the requirement of phosphorus, and additional amounts of nitrogen and potassium are added from other sources (generally commercial fertilizers). This rate is most conservative and requires the greater

supplement of fertilizer, but applies nutrients in the quantities that do not exceed the recommended rates for the crop.

Strategy 2—Management for maximum application rate of manure. This is the strategy employed when the land available for application is limited, and it fails to fully realize the value of the nutrients in the manure. The most abundant element in the manure, generally nitrogen, is used to the greatest extent possible. The manure rate is calculated to meet the nitrogen need of the crop. Often the crop is chosen to maximize the nitrogen uptake. This maximizes the application rate of manure, but will overapply phosphorus and potassium for the crop's requirement. **Over the long term, this will lead to an undesirable accumulation of phosphorus in the soil. Once a phosphorus threshold is reached, another strategy will need to be employed and manure will need to be applied elsewhere.** (emphasis added)

C&H's use of the API (Strategy 2) application rates is causing phosphorous concentrations to increase in the C&H waste application fields as noted in previous comments, by Dr. Sharpley in his deposition, and now by ADEQ. Use of the API does not account for karst as stated by Dr. Sharpley (deposition p. 18), and in fact the API does not even consider infiltration of nutrients to groundwater. Aley opines that on average 65 percent of the water delivered to the Buffalo River from karst areas of the watershed travels through the karst groundwater network (Aley 2018). In his deposition at p. 90, Dr. Sharpley agreed that infiltration can be the dominant pathway for nutrients to enter karst. The use of the API to calculate waste application rates to develop the NMP for C&H is causing groundwater contamination with nitrate and elevated nitrogen and phosphorus in soils and surface runoff. Dr. Sharpley agreed in his deposition that testing results indicate a legacy phosphorus condition is developing at the C&H fields he monitors (p.183). This location is not appropriate for a large CAFO no matter how it is designed. The obvious cost-effective and environmentally responsible alternative is to locate such operations in a setting more consistent with the recommendations of the AWMFH.

Karst is given particular attention in the AWMFH. Discussions of karst issues are in comments submitted in the previous public comment period. We have supplemented the record with additional expert opinions. Karst issues were ignored in the Reg. 5 permit application. The Dr. Florea provides two pertinent examples of cases where failing to plan karst complexity yielded negative environmental consequences (Florea 2018). All C&H buildings and waste storage ponds, and all of the land application fields except for part of Field 17 and a very small part of Field 4, are underlain by the Boone Formation. In a number of the land application fields the Boone Formation is overlain by a veneer of highly permeable alluvium. The Boone Formation is a major karst aquifer in Arkansas, Missouri, and Oklahoma (see OS 2017; Aley 2018, p 7 – 24; and Florea 2018 for a detailed and accurate description of the OS's concerns related to the region's karst hydrogeology).

The SOB correctly states "The presence of karst triggers additional considerations for siting and design as stated in the…AWMFH." There are additional issues presented by the presence of karst as discussed in the AWMFH. An entire chapter of the handbook is titled "Geologic and Groundwater Considerations", and karst is discussed repeatedly as a major design and operational concern. While concerns about catastrophic events, such as in the example text cited

in the SOB, are valid and fully supported by OS, probable water contamination is the dominant theme of the AWMFH's discussion of karst. OS 2017 p. 36 – 55 discusses karst concerns as presented in the AWMFH and applicable to C&H Hog Farms:

- A detailed planning and analysis of the AWMS has not been conducted. If the information submitted with the permit application is to be considered C&H's AWMS plan, it lacks many important considerations defined in the AWMFH.
- A NRCS Conservation Plan is required and has not been developed.
- A "complete systems approach" was not followed and this led to numerous incorrect decisions including the ongoing disposal of excess phosphorus in soils.
- The AWMS must be designed with maintenance or improvement of surface and ground water quality as a priority.
- Alternative construction and operation scenarios have not been developed for the AWMS. Specific measures to reduce contaminated runoff and infiltration in a karst landscape have not been assessed.
- The required site evaluation criteria have not been collected or analyzed, including the many sources of data and information that have become available since operation commenced.
- Appropriate experts such as geologists, water quality specialists, and NRCS staff, were not utilized in planning and construction.
- The original NOI and construction planning documents did not include a recognition or assessment of the area's karst geology or its karst aquifer. The result is a facility design not compatible with the AWMFH.
- The use of waste storage ponds with synthetic or clay liners is not allowed in karst settings in recognition of numerous commonly acknowledged risks such as leaching or soil piping through the clay liner, rips and tears in a synthetic liner, and subsequent risk to water quality and the potential for catastrophic failure.
- The disposal of nutrients from the swine wastes to waste application fields at rates that exceed plant uptake and soil test-based agronomic recommendations is not justified for sensitive areas such as karst near Buffalo National River.
- The firm that prepared the original Notice of Intent (NOI) did not assemble the team of professionals required. It did not involve a geologist or geohydrologist, a water quality specialist, or NRCS specialists. In fact, the original NOI developers were located in North Dakota, and did not even mention the site's karst geology or its proximity to the Buffalo River.
- Topography includes karst and since the Arkansas Geological Survey Map for the Mt. Judea area shows Boone Formation underlying the C&H's waste application fields, karst is undoubtedly present as the top layer of the bedrock. As outlined above in Chapter 5(d), the depth to bedrock should be determined for each waste application field as well as for the pond area. The "Topography" section on page 7-14 discusses the importance of mapping the karst terrain. For the waste application fields this may require test pits and/or ground penetrating radar and the services of a geologist. The karst as the top layer of the bedrock in areas of shallow soil may rule out some waste application fields or areas of some waste application fields for use. Quoting from the AWMFH:

"When designing any agricultural waste management component, it is important to know what type(s) of aquifers are present and at what depth"

"Sinkholes or caves in karst topography or underground mines **may disqualify a site for a waste storage pond or treatment lagoon.** Sinkholes can also be caused by dissolving salt domes in coastal areas. The physical hazard of ground collapse and the potential for groundwater contamination through the large voids are severe limitations…"

"Karst topography is formed on limestone, gypsum, or similar rocks by dissolution and is characterized by sinkholes, caves, and underground drainage. Common problems associated with karst terrain include highly permeable foundations and the associated potential for groundwater contamination, and sinkholes can open up with collapsing ground. **As such, its recognition is important in determining potential siting problems."** (Emphasis added)."

- Table 10-4 categorizes C&H as an AWMS that meets the "very high vulnerability" criteria and requires the planner to "Evaluate Other Storage Alternatives" because of the karst geology and associated ground water contamination, leakage, and collapse potential. The "Other Storage Alternatives" include all alternatives with the exception of storage ponds with synthetic or clay liners.
- The choice of a waste storage system must also consider potential waste treatment options. The planner is to develop waste treatment options based on "a total system design" which properly accounts for the karst environment, soil and waste nutrient levels, and environmental sensitivity.

OS 2017 p. 36 – 55 describes the lack of any geological investigation of this facility. Dr. Blanz's deposition (at p. 20) establishes that it is the applicant's responsibility to submit the appropriate information to support permitting decisions. (https://www.adeq.state.ar.us/water/bbri/c-and-h/pdfs/2018-09-17/Deposition% 20Blanz%20with%20Exhibits.pdf). The three borings used to characterize the soils near the barns and storage ponds **do not** even meet the minimum of six borings as required in the AWMFH (regardless of site sensitivity) for this specific data collection activity. The AWMFH also lists many other data collection (and analysis by a qualified specialist) requirements which have not been conducted. Mr. Aley's evaluation supports ADEQ's conclusion that the applicant has failed to submit the type of geotechnical information required, and thus, beyond the lack of required information, there is nothing to comment on.

We agree with ADEQ's concerns that both the physical properties and thicknesses of the soils in the land application sites are insufficient to assimilate large volumes of swine waste in this karst setting, and that the application rate is excessive given the ease with which karst ground water and surface runoff can become contaminated. The last paragraph of this section is critically important and makes it clear ADEQ recognizes the need to use relevant site-specific data and engineering to redesign this facility and revise operations to comply with the AWMFH. The OS agrees that "The ultimate aim of APC&EC Reg. 5 and the AWMFH is that pollutants are not being released from the facility to waters of the state." SOB p. 7.

Water Quality Issues:

Our 2017 comments presented detailed assessments of water quality conditions and conclude that pollutants are being released from C&H to aquifers, karst drainage networks, Big Creek and the Buffalo River. A summary of our findings was presented earlier. Since April of 2017, more information has emerged supporting this conclusion. We engaged Mr. James C. Petersen to analyze and interpret the water quality data collected by BCRET. Mr. Petersen is a respected expert whose career with the USGS in Arkansas includes work in the fields of water quality and aquatic biology in Ozark streams.

Mr. Petersen's revised report accompanies these comments. It is adopted by reference and incorporated herein and referred to as "Petersen 2018." His major points are:

- The waste storage ponds are leaking to groundwater which eventually discharges to surface water and private wells. Nitrate levels, along with other parameters, are increasing in the well and ephemeral stream near the waste storage ponds. The monitored trenches below the ponds show evidence of contamination, and the Harbor Drilling study showed anomalously high phosphorus levels in the aquifer below the ponds.
- Nitrate, total nitrogen, dissolved phosphorus, and chloride levels are increasing downstream of C&H but not upstream.
- BCRET data are not sufficient to generate annual or seasonal load estimates, a major shortcoming of the study but only one of many shortcomings pointed out by the expert review panel.
- Aquatic communities are being impacted by high nutrient levels and low dissolved oxygen.

The OS also concurs with ADEQ's concerns regarding soil phosphorus build up at the already high in phosphorus land application sites. BCRET's Dr. Sharpley has researched the effects of phosphorous build up in soils and employs the term "legacy P." A legacy P problem should not be the goal of nutrient management planning efforts. Waste management for a large CAFO generating millions of gallons of swine waste every year is a tremendous responsibility. Waste storage, removal, agitation, sludge management, application, testing and disposal operations should be aligned to a plant utilization model of nutrient management, as clearly required by the AWMFH. Phosphorus should not be allowed to build in soils until it exceeds the agronomic needs of the crops because both runoff and infiltration concentrations of nutrients increase as soil test phosphorus levels increase. Dr. Sharpley has shown how long-term buildup of phosphorus in soils can lead to legacy phosphorus conditions, as is currently taking place on most C&H waste application fields (Sharpley deposition p. 183). These conditions may take decades (perhaps as long as a century) to correct. Our previous comments regarding C&H's waste management, soils, and phosphorus remain valid and can be found at OS 2017 p. 21 – 29. Our analysis of geotechnical assessment requirements and AWMFH guidelines for soils can be found at OS 2017 p. 40, 44 – 47 and at Aley 2018 p. 19, 26-27, 33-36.

In its SOB, ADEQ states that it needs "C&H to provide the appropriate geotechnical data to demonstrate this facility has been constructed in accordance with the AWMFH." Appropriate geotechnical data is only the first step in assessing and designing an AWMS. The AWMFH requires the geotechnical data to be collected and analyzed by appropriate professionals and used in the design, construction and permitting process so that ultimately an AWMS can be located, assessed, designed, constructed and operated in an environmentally sound manner (a manner consistent with Reg. 5). This facility was not designed and constructed in compliance with the AWMFH. Pollutants are being discharged from the AWMS to waters of the State. C&H's permit application must be denied because this facility is designed to discharge to waters of the state and is not in compliance with the AWMFH - primarily because there are no modifications that reflect the karst terrain the facility is sited on, nor the sensitive resource concerns associated with receiving waters such as those within Buffalo National River.

Finally, the OS offers the following four comments as additional reasons for denial:

1. C&H Hog Farms not evaluated, designed, constructed or operated in compliance with Reg. 5.102 and Reg. 5.402

Reg. 5.102 states:

> The purpose of this regulation is to establish **minimum** qualifications, standards and procedures for issuance of permits for confined animal operations using liquid animal waste management systems within the state and for the issuance of permits for land application sites within the state. (Emphasis added).

Thus, the regulation contemplates more stringent "qualifications, standards and procedures for issuance of [CAFO] permits" where circumstances require them. This is consistent with other guidance for siting large swine CAFO's and with our position that there are certain areas in the State where large swine CAFOs should not be sited. The C&H CAFO generates more than three times as much phosphorous as the entire human population of Newton County, is the largest CAFO in the Buffalo River Watershed, and is located in an area of karst geology less than 5 stream miles upstream of the Buffalo National River, America's First National River and perhaps the most important tourism destination in Arkansas. Yet, the qualifications, standards and procedures proposed by C&H in its permit application are no more stringent than those for any other swine CAFO in Arkansas. This means C&H engineers designed this CAFO the same as any similarly sized CAFO anywhere else in Arkansas, instead of one located in one of the most sensitive areas of the State and directly upstream from our most pristine river.

At a "minimum," Regulation 5 permits require facilities to be assessed, designed, constructed and operated in compliance with the AWMFH. Section 5.402 of Reg. 5 states:

> (A) Designs and waste management plans shall be in accordance with this Chapter and the following USDA Natural Resource Conservation Service technical publications:
>
> - Field Office Technical Guide, as amended
> - Agricultural Waste Management Field Handbook, as amended. (Emphasis added).

The AWMFH provides the requisite guidance to operators and planners to characterize, assess, understand, plan, site, design, and operate an AWMS and is especially relevant to liquid animal waste disposal systems. Recommendations are intended to establish systems that will generally function adequately in a variety of settings. The recommendations are not designed or intended to outline ideal or best management practices. Even if fully complied with, the guidance provided in the AWMFH is not adequate for designing systems that will function adequately in very high risk and very high vulnerability locations. The AWMFH recommends avoiding very high risk and very high vulnerability locations and, since the handbook authors must presume that farmers do not wish to pollute groundwater or cause other environmental problems, they do not identify all actions that should be taken for the design of an AWMS in karst landscapes.

Table 10-4 at page 10-25 of the AWMFH is a table that lists criteria for siting, investigation, and design of liquid manure storage facilities. It uses a matrix with risk on the horizontal scale and vulnerability on the vertical. Vulnerability is "Very High" because of the presence of large voids (karst). The table demonstrates that where there is Very High vulnerability that storage alternatives other than lagoons and waste ponds must be evaluated. Risk is also Very High because of a karst groundwater system that multiple regional studies have shown transports water underground for distances of thousands of feet at rates of hundreds to thousands of feet per day. This transport ultimately discharges water to Buffalo National River (a National Park Service unit) where waters are designated as ERW/NSW. These waters are routinely used by many people for whole body contact. The table demonstrates that where there is Very High Risk other storage alternatives must be evaluated. It is totally inconsistent with the AWMFH that the liquid waste storage at the site is in waste storage ponds lined with native soils with documented liner damage.

The AWMFH requires planning, design, and operation of an AWMS that fully recognizes and accounts for the environmental sensitivity of the area to be impacted. (AWMFH 651.0202 C (17)). C&H co-owner/operator Mr. Jason Henson explained in his deposition that he did not investigate anything prior to purchasing the property and it was therefore critical for the design engineers to explain to the operator the area's special site considerations (p. 127 – 128 at https://www.adeq.state.ar.us/water/bbri/c-and-h/pdfs/2018-09-17/Deposition%20Henson,%20Jason%20with%20Exhibits.pdf). While this topic is of great importance, the application prepared by Bass et al. (2016) including information from DeHaan et al. (2012) and used in the subsequent Reg. 5 application failed to: 1) evaluate this topic, and 2) make the sensitivity of receiving waters part of the decision process. In reality, the hydrogeologic conditions at the waste storage ponds and the land application sites are such that there is no reasonable chance that the facility is not already discharging wastes to groundwater and via groundwater to the Buffalo River. The permit application is thus not in compliance with the AWMFH as required under Reg. 5. C&H was not and is not planned, designed, or operated in compliance with Reg. 5.402.

Specific requirements of the AWMFH and the major shortcoming of the current AWMS, permit application, are listed above and will not be repeated here. The AWMFH requires the planner to

complete a site evaluation as part of the waste management plan and consult with the decision-maker (the AWMS operator) regarding the findings. Section 651.0200 states:

> "Planning an [AWMS] involves the same process used for any type of natural resource management system, such as an erosion control system. Each system includes a group or series of practices planned, designed, and installed to meet a need. However, different resource concerns, management requirements, practices, environmental effects, and economic effects must be considered.
>
> Planning an AWMS requires the collaboration and combined efforts of a team of people. The decision-maker for the property involved, NRCS specialists and conservationists, county agricultural extension agents, and other professionals often make up the team. Specialists include engineers, geologists, soil scientists, and agronomists."

The firm that prepared the original Notice of Intent (NOI) did not assemble the team of professionals required. It did not involve a geologist or hydrogeologist, a water quality specialist, or NRCS specialists. In fact, the original NOI developers were located in North Dakota, and did not even mention the site's karst geology or its proximity to the Buffalo River. Failure to consider these important factors leads one to conclude that the original NOI planners never understood the complexity of the site. C&H failed to submit a complete site evaluation with its original NOI, and has failed to submit one with its current permit application.

The permit application record does not satisfy the requirements of the AWMFH for C&H's location. The fact that the location drives the selection of the most protective design elements of the AWMFH is ignored. Because C&H is having a measurable impact on aquifers, surface water, and the Buffalo National River, the decision to deny the permit due to the ongoing water quality degradation resulting from this facility is correct.

2. C&H is discharging to waters of the State in violation of 5.102.

The SOB states "The ultimate aim of APC&EC Reg. 5 and the AWMFH is that pollutants are not being released from the facility to waters of the state." The "Harbor Drilling Report" indicates that the waste holding ponds sit atop karst features. Karst features provide a mechanism for rapid transport of wastes that leak from the waste ponds to ground and surface waters. The waste holding ponds were designed and constructed to permit significant waste leakage to "Waters of the State." In the construction certification documents laboratory testing results were given for the compressed soil used for the pond liners. These tests indicated that the initial leakage rates would be 3,448 gal/acre/day for Pond 1 and 4,218 gal/acre/day for Pond 2. The difference is a result of the differing depths of the two ponds. Then estimates were given of the leakage after "manure sealing" –540 gal/acre/day for Pond 1 and 1,008 gal/acre/day for Pond 2. Since Pond 1 has a size of 0.463 acres and Pond 2 has a size of 0.756 acres, leakage per year would be 552,600 gallons. Even though this would be a very significant discharge, multiple lines of evidence suggest that actual leakage from the waste ponds could be much greater than the estimate made by C&H's own engineers. These include the following facts in the record:

1) Only a single analysis was performed to determine whether the soil liners are sufficiently impermeable;

2) There are a large number of chert cobbles present in the native soil liners as discussed in the deposition of Jason Bolenbaugh found at https://www.adeq.state.ar.us/water/bbri/c-and-h/pdfs/2018-09-17/Deposition%20Bolenbaugh.pdf;

3) Erosion rills and desiccation cracks began developing shortly after the ponds were completed, thus compromising the liners;

4) Efforts to repair erosion rills and desiccation cracks, by C&H's own admission (See Ex. 7 to Jason Henson's deposition), resulted in "heavy machinery . . . used to eliminate the erosion rills" (without engineering oversight or review by ADEQ) further compromised the compacted soil liners and liner thickness; and

5) C&H's repeated use of a homemade "agitator" (See J. Henson deposition) to repeatedly stir up solids in pond 1 during waste removal has likely impacted the utility of the native soil liner and any sealing that might occur due to manure solids. (See Sharpley deposition pp. 121-123). Neither pond liner was built to withstand agitation or other methods to remove accumulated solids.

Moreover, sampling from the nearby "house well," trenches, and ephemeral stream confirms significant volumes of waste is seeping into groundwater. Nitrate levels downstream from C&H are more than double upstream values, are highest during low flow periods indicating a groundwater source, and are increasing with time (Petersen 2018). Nitrate slugs have been shown to move past the USGS gaging station at Carver and into the Buffalo River and "time of travel" estimates indicate the source is in the vicinity of C&H (OS 2017 p. 7 – 13). Big Creek has been designated as impaired due to low dissolved oxygen readings resulting from excessive nutrients.

Swine waste leaching into the karst aquifer or washed from surface application fields, and subsequently transported to receiving streams is a probable cause of these declining water quality observations (OS 2017, Petersen 2018, Aley 2018). ADEQ appears to agree based on the statement that "Four assessment units on close proximity to the ongoing operations of the applicant, C&H Hog Farms, Inc., failed to meet the standards in APC&EC Regulation 2 (two sections of Big Creek (Newton County) and two sections of the Buffalo National River)). The assessment units impaired for pathogens and dissolved oxygen and other related water quality data indicate that this facility may be contributing to the water quality impairments observed in Big Creek and the Buffalo National River." SOB p. 8.

In summary, multiple lines of evidence indicate that the prohibition in Regulation 5 against discharging wastes to "Waters of the State" is currently being violated by C&H. That the facility is discharging wastes to Waters of the State is plain both from the current permit, the Regulation 5 permit application and the results of the work done by BCRET, USGS, and the NPS. Furthermore, it cannot be disputed that waste discharges to Waters of the State will

continue to occur unless the permit is denied. As mentioned previously, installation of synthetic liners is not a solution to this problem in a karst setting.

3. C&H is contributing to declining water quality in the Buffalo River in violation of Regulation No. 2, the Clean Water Act (see APC&EC Reg. 2, Chapter 2: the Clean Water Act § 303 (33 U.S.C. § 1313) and 40 CFR § 131.12), and AWMFH 651.0202 C (17).

The OS has provided evidence in the form of expert opinions that C&H is having the following impacts on the Buffalo National River:

- Large quantities of nutrients, bacteria, and suspended solids are transported from C&H waste disposal fields to the Buffalo National River with storm event driven surface runoff.
- Groundwater in the Big Creek aquifer near C&H is high in nitrates and likely discharges to a large spring in the Buffalo River's channel.
- Eutrophication and/or assimilation processes driven by agriculturally derived nutrient stimulation has resulted in water quality standards violations and an impairment designation for lower Big Creek within the boundaries of Buffalo National River. This impaired water discharges into the Buffalo River within minutes of passing the USGS Carver sampling station.
- Nutrient loading of the Buffalo River is contributing to nuisance algae blooms, a violation of Regulation No. 2 and aesthetically degrading the visitor experience.
- Pathogen levels in the Buffalo River and Big Creek are now determined to present an elevated risk of water-borne illness to visitors recreating in close proximity to C&H.

OS has shown by a preponderance of the evidence that swine waste is leaching into the karst geology of Big Creek combined with episodic discharge from application fields during storm events, which is all subsequently transported to Buffalo National River (OS 2017, Petersen 2018, Aley 2018, ADEQ Draft 2018 Impaired Water Bodies 303(d) List). The SOB states that "Four assessment units in close proximity to the ongoing operations of the applicant, C&H Hog Farms, Inc., failed to meet the standards in APC&EC Regulation 2 (two sections of Big Creek (Newton County) and two sections of the Buffalo National River). The assessment units impaired for pathogens and dissolved oxygen and other related water quality data indicate that this facility may be contributing to the water quality impairments observed in Big Creek and the Buffalo National River." SOB p. 8. We agree.

The Buffalo National River is designated an ONRW. The CWA established an "Antidegradation Policy." The antidegradation policy is currently being violated because the existing C&H facility contributes significant nutrient and pathogen loads to the Buffalo River, and the river's pre-existing water quality has been degraded – a violation of the CWA and the AWMFH provision to assure that the designated water use (in this case ONRW, ERW and NSW) is protected. (AWMFH 651.0202 C (17).

The CWA also requires establishment of "Designated Uses" for waterbodies. Designated uses include such categories as Public Water Supply, Fishable/Swimmable, and Outstanding National

Resource Waters. Water quality standards are established based on designated use. Under the Antidegradation Policy, waterbodies will not be degraded with pollutants such that they no longer meet their most restrictive designated use. CFR 40 § 131.12 states:

> (a) The State shall develop and adopt a statewide antidegradation policy. The antidegradation policy shall, at a minimum, be consistent with the following:
>
> (1) Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.
>
> (2) Where the quality of the waters exceeds levels necessary to support the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State's continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully. Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control (emphasis added).
>
> (i) The State may identify waters for the protections described in paragraph (a)(2) of this section on a parameter-by-parameter basis or on a water body-by-water body basis. Where the State identifies waters for antidegradation protection on a water body-by-water body basis, the State shall provide an opportunity for public involvement in any decisions about whether the protections described in paragraph (a)(2) of this section will be afforded to a water body, and the factors considered when making those decisions. Further, the State shall not exclude a water body from the protections described in paragraph (a)(2) of this section solely because water quality does not exceed levels necessary to support all of the uses specified in section 101(a)(2) of the Act.
>
> (ii) Before allowing any lowering of high water quality, pursuant to paragraph (a)(2) of this section, the State shall find, after an analysis of alternatives, that such a lowering is necessary to accommodate important economic or social development in the area in which the waters are located. The analysis of alternatives shall evaluate a range of practicable alternatives that would prevent or lessen the degradation associated with the proposed activity. When the analysis of alternatives identifies one or more practicable alternatives, the State shall only find that a lowering is necessary if one such alternative is selected for implementation.
>
> (3) Where high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of

exceptional recreational or ecological significance, that water quality shall be maintained and protected. (emphasis added).

C&H's AWMS component planning, design, and management was not undertaken in a manner that assures the designated water uses of Big Creek and the Buffalo River are protected. Planning requirements as stated in the AWMFH were not followed. These planning requirements not only mandate the additional geotechnical data as outlined in the SOB, but also the ultimate design and operation of a facility that has "minimum" water quality impacts. The AWMFH states:

> The sensitivity of lakes, streams, or groundwater aquifers to contaminants in the agricultural waste should be evaluated and made part of the decision process of whether to allow discharge. Receiving water sensitivity must also be considered when establishing the intensity of management and level of efficiency needed to avoid or minimize accidental spills and **to assure that the designated water use is protected.** (AWMFH 651.0202 C (17). (emphasis added).

The Buffalo River deserves the highest protection of any receiving stream in the State. We outlined this position in our previous comments noting its ONRW status (OS 2017 comments p.7) of the Buffalo River and the accompanying antidegradation policy. We also discussed the importance of Buffalo National River as an economic and tourism resource for the State in our 2017 cover letter and comments (OS 2017 p. 36 – 55).

Permit denial is appropriate. Issuing a permit to C&H would violate Regulation 5 and the CWA. C&H is contributing to water quality declines and stream impairment. This has resulted in the Buffalo River and Big Creek no longer meeting their designated uses as ERW/NSW and fishable/swimmable.

4. The number of swine at the facility has increased in violation of the 2016 APC&EC moratorium Reg. 5.901(D).

The NOI submitted by C&H on June 25, 2012 for coverage under the general NPDES permit, ARG590001, described C&H as a "2,500 head farrowing farm." It also stated that the barns would have a "maximum capacity of 6,503 head of swine weighing an average 150 lbs." (Section C: "*Design Report*," p. C-1) The breakdown was:

> 3 Boars @ 450 lbs.
> 2,100 Gestation Sows @ 375 lbs
> 400 Lactating Sows @ 425 lbs
> 4,000 Nursery Pigs @ 10 lbs

Section C2: "*Design Calculations*," p. C-3.

It appears the 4,000 "Nursery Pigs" was estimated by assuming that a nursing litter would be 10 piglets per sow being weaned. The weaning process requires 23 to 24 days (www.nationalhogfarmer.com/health-diseases/0615-producing-quality-pigs.) The 4,000 estimate

is an average but this number will be relatively constant because as sows give birth to new litters, litters are weaned and then shipped off-site.

Reg. 5.901(D) states that "A permit renewal, permit modification, or new permit issued pursuant to Reg. 5.901(C) shall not increase the number of swine permitted at a facility." However, the "Application Packet" submitted by C & H on April 6, 2016 in support of its request for a Reg. 5 permit (these numbers are repeated in the SOB) and it states C&H Hog Farms now seeks a permit for:

> 6 Boars @ 450 lbs
> 2,252 Gestating Sows @ 425 lbs
> 420 Lactating Sows@ 400 lbs
> 750 Nursing Pigs @ 14 lbs.

C & H Hog Farms, Inc., "*Application for Regulation 5 Permit, Engineering Plans and Review*," p. 6.

In contrast to its 2012 NOI, in its Reg. 5 permit application C & H defines "Nursery Pigs" as pigs that have completed the weaning process. The "750" is arrived at as the average of 1,500 weaned pigs on the farm before the weekly shipment and the zero number on the farm just after the shipment. *Id.* at pp. 5-6. This ignores pigs in the weaning process that weigh from 3 to 5 pounds at birth and 14 pounds or more when weaned. (www.nationalhogfarmer.com/health-diseases/0615-producing-quality-pigs.) The weaning period is from 23 to 24 days. (*Id.*) In order to ship 1,500 pigs at a given time, there must be over 4,000 pigs being weaned at the time of the shipment.

If C & H's Reg. 5 permit application had used the same method for determining the number of "Nursery pigs" as in the original NOI, the numbers would currently be:

> 6 Boars @ 450 lbs
> 2,252 Gestating Sows @ 425 lbs
> 420 Lactating Sows @ 400 lbs
> 4,200 Nursing Pigs @ 10 lbs

Thus, the original approved NOI is being violated since there are now approximately 6,878 pigs on the farm instead of the original 6,503. If approved, the new Regulation 5 permit would violate Reg. 5.901(D).

Comparisons of pounds of swine and waste permitted in the original NOI and the current permit application further confirms these estimates. In the NOI (DeHaan, Grabs & Associates, 2012), C&H was permitted to raise 998,850 pounds of swine producing 1.5 million gallons of waste. The permit application lists 1,138,000 pounds of swine (Hancock et al., 2016) producing 1.9 million gallons of waste (February 2017 SOB p. 3).

In addition, the waste calculations in the permit application are incorrect. Along with the boars and sows, waste volumes should have been based on 4,200 pigs weighing 10 pounds instead of 750 pigs weighing 14 pounds. This means the volume of waste will be significantly greater. The permit application violates Reg. 5.901(D).

Expert Report

C&H Hog Farms Hearing

Analysis of Water Quality, Groundwater Hydrology, Surface Water Hydrology, and Aquatic Biology

May 31, 2018

Revised October 16, 2018

James C. Petersen

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Attachment 2

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1.0 Introduction

I have prepared this report to present information, data, and opinions concerning the water quality and aquatic biology in and around the Big Creek watershed near Mt. Judea, Arkansas, and the potential effects of operation of C&H Hog Farms on water quality, groundwater hydrology, surface water hydrology, and aquatic biology in the region. Because of issues with the storm data and to address a lack of previous consideration of the karst geology and its effect on groundwater hydrology, I have chosen to focus on samples from groundwater and on samples from streams collected at times when the streamflow was likely to have been dominated by contributions from groundwater. Much of the data collected near C&H Hog Farms has been collected by the University of Arkansas Big Creek Research and Extension Team (BCRET) (https://bigcreekresearch.org/). BCRET sampling sites are shown on figure 1. This report has been prepared at the request of Mr. Sam Ledbetter with McMath Woods.

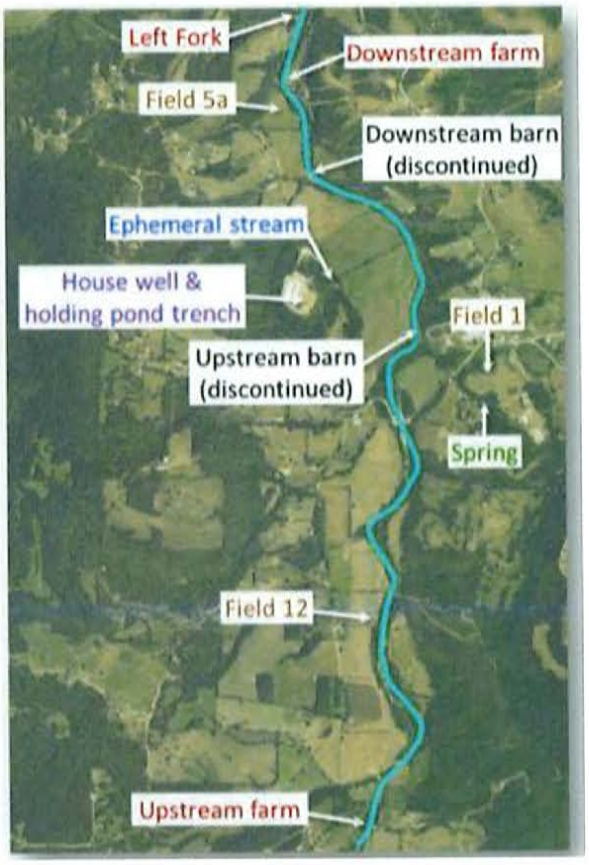


Figure 1. Location of BCRET water-quality sampling sites (from the BCRET January-March 2018 Quarterly Report)

2.0 Qualifications and Experience

I am an aquatic biologist and a water-quality hydrologist and worked for more than 36 years with the U.S. Geological Survey Arkansas Water Science Center (later part of the Lower Mississippi-Gulf Water Science Center). During much of that time I was responsible, either individually or as part of a study team, for conducting several studies of surface-water and groundwater quality and aquatic biology in the Ozarks of Arkansas, Missouri, and Oklahoma. See appendix A for a more detailed curriculum vitae.

3.0 Summary of Opinions

The following is a summary of my opinions. These opinions are described in greater detail in later sections of this report:

(1) The karst topography and geology of the area near C&H Hog Farms, including part of Big Creek located upstream from BCRET monitoring site BC6 and downstream to the Buffalo River, present issues for agricultural activities and the collection of data used for hydrologic studies. These issues are not applicable, or not applicable to the same degree, in areas without karst. Karst-specific attributes include rapid movement of groundwater (up to thousands of feet to miles per day; Brahana and others, 2017), little decrease of contaminants, relatively common movement of groundwater beneath surface elevation divides, loss of surface water from streams to groundwater, and gain of groundwater to streams. Studies or data required to determine specific groundwater flow pathways and loads for contaminants of concern were not available prior to the operation of C&H Hog Farms. Lack of pre-development baseline water-quality data and a basic understanding of the karst hydrology of the Big Creek watershed impede efforts to analyze and interpret water quality results. New hydrologic information gathered since that time has answered some questions, yet many significant questions remain that can only be resolved through alteration of the BCRET study design and collection of systematic dye tracing studies. These include questions about groundwater movement, gaining and losing reaches of Big Creek, and measurement of storm flow concentrations and loads in a manner that transport of nutrients and other constituents out of the Big Creek watershed and into the Buffalo River can be quantified.

(2) As is most often the case in similar situations, environmental sampling and testing adequate to define pre-existing conditions prior to the operation of this facility did not occur. Several scientific investigations could have been conducted after operation began or could be conducted in the future that would provide information about the hydrology and geology of the vicinity. The recommendations of the expert review panel (https://bigcreekresearch.org/project_reports/docs/Review%20Panel%20Report%20-%20May%2019%202014.pdf) provide some examples of appropriate investigations that are lacking. These include a seepage survey along Big Creek, streamflow and a rating curve for BC6, source tracking using isotopic methods or analysis of emerging contaminants such as antibiotics, and better sampling of storm events.

(3) The absence of representative data associated with storm flows precluded the analysis of storm data and accurate estimation of seasonal or annual loads (for example the pounds of nitrogen moving past a site in a year). Because much of the mass of sediment and nutrients is transported during storm events, **this is a critical shortcoming of the available dataset**. This was pointed out by the expert review panel but their concerns remain unresolved. As a result, an estimated 80 to 90 percent of the nutrient transport and fate processes remain unassessed.

(4) My analysis of water-quality data collected by BCRET focused on base flow conditions when streamflow is dominated by groundwater input. Results from sites BC6 (upstream from C&H Hog Farms facilities and associated waste ponds and slurry spreading fields) and BC7 (downstream) indicate that the operation of the currently permitted Animal Waste Management System is having a negative effect on the water quality of Big Creek during base flow.

(5) The frequency and seasonal persistence of dissolved oxygen concentrations of Big Creek at Carver that are often substantially below the state standard may be causing detrimental effects on aquatic species and fish and macroinvertebrate (aquatic insects, etc.) communities of Big Creek and the Buffalo River. The proximity to the Buffalo River and the applicable anti-degradation policy are another immediate concern.

(6) Increasing trends in some nutrients, dissolved organic carbon, and *E. coli* in samples from site BC4 (Ephemeral Stream) indicate that inputs of these constituents to Big Creek are increasing and potentially affecting water quality of Big Creek near the hog farms and downstream from the confluence of this stream with Big Creek. If concentrations are increasing in base flow samples it is likely that concentrations in storm water also are increasing—and concentrations are almost certainly higher in the storm water than in base flow.

(7) Comparison of concentrations of total nitrogen and total phosphorus at BC7 to biological thresholds for nutrients in wadeable Ozark streams indicates that existing concentrations are approaching (total nitrogen) or have exceeded (total phosphorus) concentrations affecting periphyton (attached algae), macroinvertebrate (aquatic insects, etc.), and fish communities.

(8) Increasing trends in concentrations of three nitrogen constituents in samples from the BCRET House Well site indicate contamination of the shallow groundwater aquifer. The steadily increasing pattern observed for several parameters indicates a constant input to the local aquifer feeding the well. Results at BC7 also indicate a strong correlation between increasing nitrate concentrations and time (i.e., date) during low flow periods characterized by increased groundwater discharge.

(9) Water-quality from a trench downslope from the two waste holding ponds indicates that the contents from both ponds are seeping into the downslope trench.

Much of the above information can be summarized in the following tabulation of pertinent results indicating existing conditions and water-quality trends.

Table 1. Summary of most pertinent results indicating existing conditions and water-quality trends

Constituent or attribute	Impact	p-value
Ammonia	Increasing at House Well	<0.001
Nitrate	Increasing at BC7	0.07
Nitrate	Increasing at Ephemeral Stream	0.002
Nitrate	Increasing at House Well	<0.001
Total nitrogen	BC7 minus BC6 increasing	0.095
Total nitrogen	Increasing at Ephemeral Stream	<0.001
Total nitrogen	Increasing at House Well	<0.001
Dissolved phosphorus	BC7 minus BC6 increasing	0.091
Dissolved phosphorus	Increasing at Ephemeral Stream	0.011
Dissolved organic carbon	Increasing at Ephemeral Stream	0.01
E. coli	Increasing at Ephemeral Stream	0.08
Chloride	Decreasing at BC6 but no trend at BC7	0.03
Chloride	BC7 minus BC6 increasing	0.04
Nutrient Management Watershed pasture yields (compared to BC6 watershed)	Nitrate, total nitrogen, and chloride significantly higher	
	Total nitrogen decreasing, no trends for nitrate and chloride	
Trench data	Several constituents indicate leakage from ponds	
Biology data	Total phosphorus exceeding threshold of community impact	
DO data	DO standard already exceeded 50-60 days per year at Carver	

4.0 Bases for Opinions

In preparing this report I used Big Creek Research and Extension Team (BCRET) data and information supplied by Dr. Andrew Sharpley or contained in BCRET quarterly reports, and:

(1) Other information from the BCRET website (https://bigcreekresearch.org/)
(2) U.S. Geological Survey streamflow and water-quality data (available from their website)
(3) Permitted Concentrated Animal Feeding Operation Assessment, Buffalo National River by David N. Mott (2016)
(4) A March 19, 2018 visit to parts of the Big Creek watershed including BCRET sites BC6, BC7, and Ephemeral Stream and the U.S. Geological Survey sites at Carver and Mt. Judea
(5) A National Park Service/Arkansas Department of Environmental Quality water quality dataset for several sites on the mainstem of the Buffalo River and its tributaries.

(6) Several reports and journal articles cited and listed below
(7) My professional experience and expertise, see appendix A for additional information.

5.0 Location, Environmental Setting, and Karst Topography and Geology

C&H Hog Farms is located in Newton County, Arkansas about 0.7 mile northwest of the community of Mt. Judea and 0.4 mile west of Big Creek. Mt. Judea has a population of less than 460 (457 people live in the 72655 zip code area which includes Mt. Judea; 2010 census) (https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml?src=bkmk).

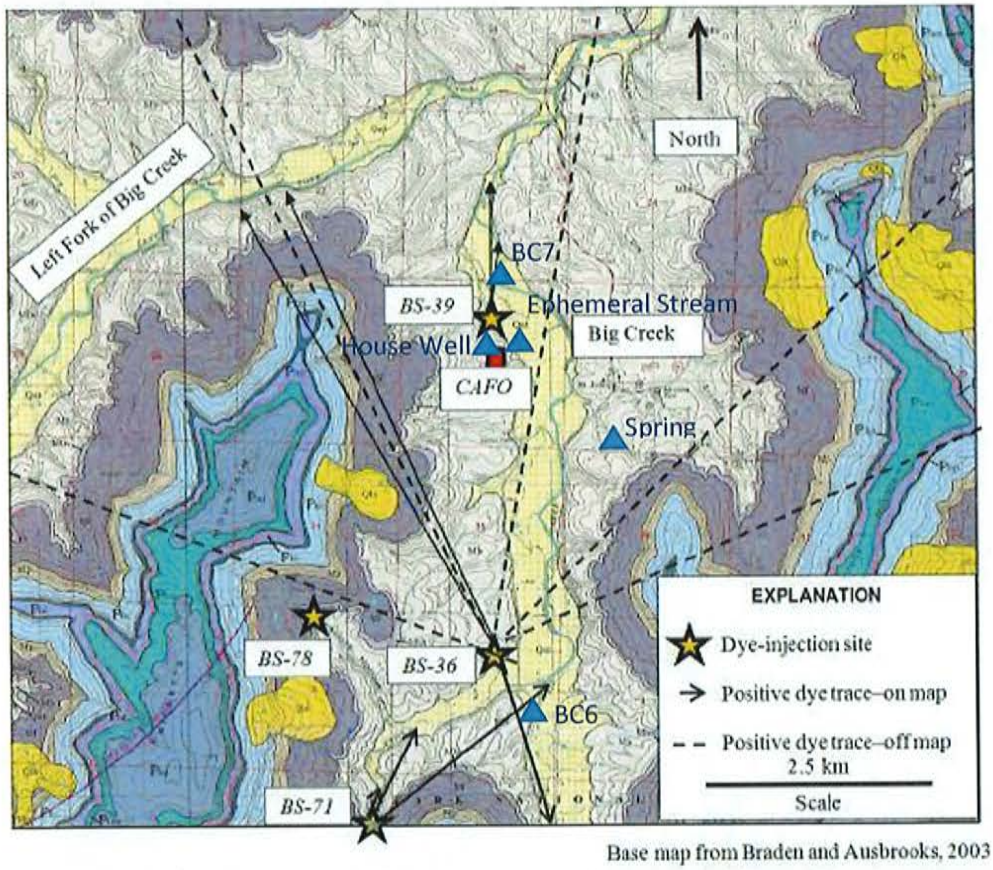
Big Creek flows northward, east of the hog farm and west of Mt. Judea. It has a watershed area of approximately 89.8 square miles at its confluence with the Buffalo River, which is part of the Buffalo National River (Watershed Conservation Resource Center, 2017). The land use within the watershed is approximately 82.2 percent forest, 15.3 percent agriculture/grass, and 2.5 percent other (Watershed Conservation Resource Center, 2017).

The Buffalo River is listed as an Extraordinary Resource Water and Natural and Scenic Waterway in the Arkansas Pollution Control and Ecology Commission's Regulation 2 (Arkansas Pollution Control and Ecology Commission, 2017).

Big Creek and nearby reaches of the Buffalo River are considered to be within the Boston Mountains ecoregion by the Arkansas Pollution Control and Ecology Commission (Regulation 2; Arkansas Pollution Control and Ecology Commission, 2017). Near Mt. Judea, Big Creek flows through alluvial deposits overlying the Boone Formation, a karstic limestone formation with interbedded chert. The Boone Formation extends upstream along Big Creek to about 3 miles south of Mt. Judea (which is about 1 mile upstream of BC6, the site upstream from C&H Hog Farms monitored by BCRET).

In my opinion, the karst topography and geology of the area near C&H Hog Farms, including part of Big Creek located upstream from BCRET monitoring site BC6 and downstream to the Buffalo River, present issues for agricultural activities and the collection of data used for hydrologic studies. These issues are not applicable, or not applicable to the same degree, in areas without karst. These karst-specific attributes include rapid movement of groundwater (up to thousands of feet to miles per day; Brahana and others, 2017), little decrease of contaminants, relatively common movement of groundwater beneath surface elevation divides, loss of surface water from streams to groundwater, and gain of groundwater to streams. Studies or data required to determine specific groundwater flow pathways and loads for contaminants of concern were not available prior to the operation of C&H Hog Farms. Lack of pre-development baseline water-quality data and a basic understanding of the karst hydrology of the Big Creek watershed impede efforts to analyze and interpret water quality results. New hydrologic information gathered since that time has answered some questions, yet many significant questions remain that can only be resolved through alteration of the BCRET study design and collection of systematic dye tracing studies. These include questions about groundwater movement, gaining and losing reaches of Big Creek, and measurement of storm flow concentrations and loads in a manner that transport of nutrients and other constituents out of the Big Creek watershed and into the Buffalo River can be quantified.

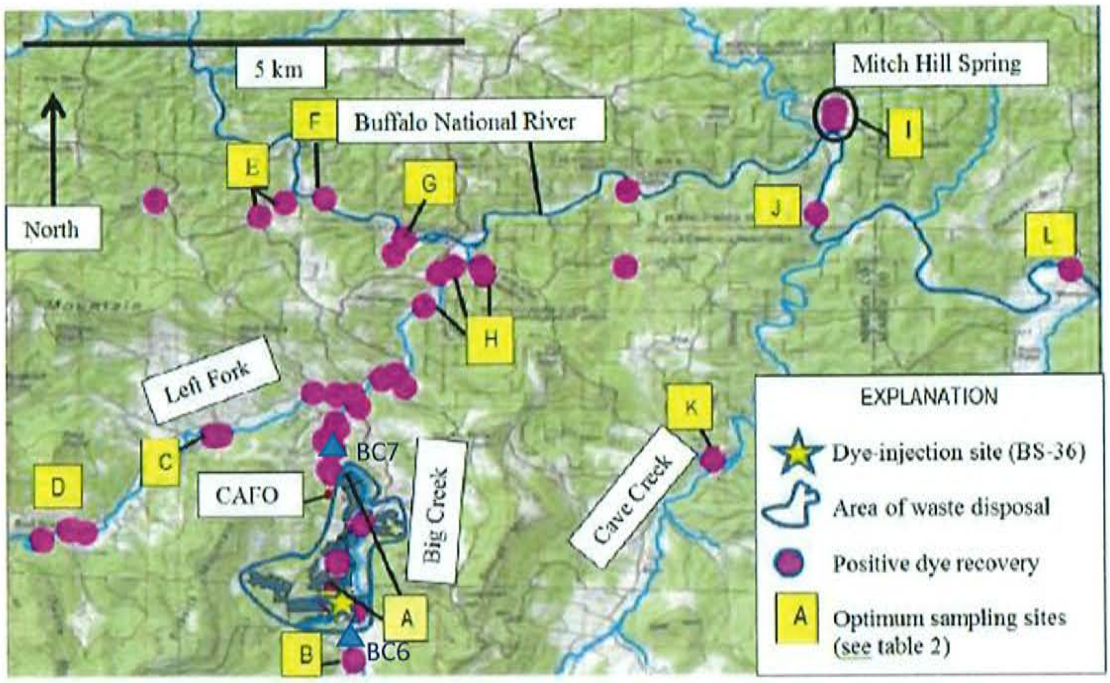
The dye tracing results shown in figures 2 and 3 (Brahana and others, 2017) suggest that BC6 may not be an appropriate "control" site because of the possibility of south flowing groundwater moving from one of the fields receiving hog waste to Big Creek upstream from BC6. The dye traces (figs. 2 and 3) also show the potential for wide ranging movement of contaminants from the area of the application fields to locations in the Big Creek watershed, Cave Creek watershed, and in Buffalo National River (including Mitch Hill Spring on the opposite side of the Buffalo River).



Base map from Braden and Ausbrooks, 2003

Geologic map showing point-to-point dye-tracing results in the area of the CAFO and its spreading fields. Solid arrows that emanate from the injection points show the locations of groundwater recovery sites on the map. Dashed lines from injection well BS-36 extend beyond the area shown on this map, with the full observed extent shown on figure 9. Actual flow paths in the subsurface are substantially more complex than the straight lines show. Tracing results shown here are groundwater-level dependent.

Figure 2. Dye tracing injection and recovery sites and selected BCRET sampling sites (modified from Brahana and others, 2017)



. Flow from BS-36 during high flow after eosine injection on May 12, 2014. Dye was positively traced to 36 sites (springs and streams). Letters (yellow squares) show recommendations for sites to sample for evaluating contamination in the future. The dye-trace results show the full dispersive extent of karst flow in the subsurface into other surface-water basins, the Buffalo National River, and even beneath the Buffalo River to Mitch Hill Spring, identified by the black circle. Dark green rectangular patterns within area outlined around dye-injection site (yellow star) represent waste spreading fields. Five positive dye traces were recovered from the Buffalo National River during this test.

Figure 3. Dye recovery sites associated with a single injection site near BCRET site BC6 (blue triangle) (modified from Brahana and others, 2017)

Much of the middle section of Big Creek is underlain by the Boone Formation, while its headwaters and the tributaries originate in geologic formations composed primarily of sandstone and shale (Braden and Ausbrooks, 2003; Brahana and others, 2017). The Boone Formation is a relatively thick (approximately 120 to 400 feet) limestone with locally variable amounts of interbedded chert (chert is a relatively impervious rock composed of silicon dioxide). Chert layers can impede the movement of water through the Boone Formation.

Chert layers are common in the streambed of Big Creek just upstream from BC7 and are likely forcing groundwater of unconfirmed origin back into the stream channel. The section of stream between BC6 and BC7 contains reaches that lose surface water to the groundwater and that gain streamflow from the groundwater (these are referred to as "losing" and "gaining" reaches). Big Creek between the two sites can go dry while both the upstream and the downstream sites are still flowing. The upstream site can also go dry while the downstream site is still flowing. Therefore, the reach of Big Creek from above the upstream site to just above the downstream site is a losing reach. The downstream site has not gone dry since monitoring began, and the section is gaining water from groundwater inflow. It is not uncommon for BC6 to be dry or not flowing when the streamflow at BC7 is less than about 3 cubic feet

per second. Most, if not all, of the BC7 flow at these times is groundwater that has flowed from the Boone Formation into Big Creek. The recharge area for the spring(s) feeding Big Creek upstream from BC7 has not been delineated.

Continuous streamflow data from USGS gages at BC7 and about 4 river miles downstream near Carver (Big Creek at Carver) suggest that the section of Big Creek between these two gages is losing water to the Ordovician aged limestones underlying the Boone Formation, although some water may be flowing through gravel bars near the gage rather than flowing into underlying limestones. During periods of low flow at Carver (less than 6 cubic feet per second) it is not uncommon for streamflow at Carver to be less than streamflow at BC7. This water lost to the karst formations may resurface in the Buffalo River downstream of the confluence with Big Creek. In a July 2003 study of gaining and losing reaches of the Buffalo River, a reach just downstream from Big Creek gained a substantial volume of water. It gained approximately 8.5 cubic feet per second more than could be attributed to inflow from Big Creek (Moix and Galloway, 2005).

A seepage study of Big Creek to determine gaining and losing reaches of the stream followed by additional dye trace studies would provide insight into the pathways of nutrients from Big Creek to the Buffalo River. In the July 2003 study about one-third (the surface water inflow from Big Creek plus the approximate 8.5 cubic feet per second gain) of the flow at the end of the gaining Buffalo River reach was potentially from the Big Creek watershed. This is important because groundwater in the area of C&H Hog Farms (House Well) could have average concentrations more than seven times higher than average nitrate concentrations in the Buffalo River at Hasty (Watershed Conservation Resource Center, 2017).

6.0 Limitations of Existing Water-Quality Data

In my opinion, as is most often the case in similar situations, environmental sampling and testing adequate to define pre-existing conditions prior to the operation of this facility did not occur. Several scientific investigations could have been conducted after operation began or could be conducted in the future that would provide information about the hydrology and geology of the vicinity. The recommendations of the expert review panel (https://bigcreekresearch.org/project_reports/docs/Review%20Panel%20Report%20-%20May%2019%202014.pdf) provide some examples of appropriate investigations that are lacking. These include a seepage survey along Big Creek, streamflow and a rating curve for BC6, source tracking using isotopic methods or analysis of emerging contaminants such as antibiotics, and better sampling of storm events.

If site specific groundwater and geologic data had been collected prior to the operation of the hog farm much more would be known regarding karst groundwater flow and subsurface contaminant pathways. Water quality data should have been collected prior to the operation of the hog farm given the magnitude of concerns. The fact that it was not is beyond the control of BCRET. Nonetheless, new information about the hydrology and geology of the Big Creek area would provide helpful insight. Studies/needs include installation of a streamgage at BC6, a seepage study of Big Creek to determine gaining and losing reaches of the stream, additional dye traces of the area to better determine

groundwater pathways, subsurface water quality investigations below the spreading fields to quantify infiltration of contaminants to shallow karst groundwater, and isotope studies to better determine sources of nutrients in Big Creek. These are among the recommendations of an expert panel formed to review the current and planned BCRET monitoring program (https://bigcreekresearch.org/project_reports/docs/Review%20Panel%20Report%20-%20May%2019%202014.pdf). The additional information would add to the validity of interpretations based on the existing water-quality data.

In my opinion, the absence of representative data associated with storm flows precluded the analysis of storm data and accurate estimation of seasonal or annual loads (for example the pounds of nitrogen moving past a site in a year). Because much of the mass of sediment and nutrients is transported during storm events, this is a critical shortcoming of the available dataset. This was pointed out by the expert review panel but their concerns remain unresolved. As a result, an estimated 80 to 90 percent of the nutrient transport and fate processes remain unassessed.

Because reliable monitoring of stormflow has not been performed, my analysis of water-quality data from streams was limited to samples collected during conditions when streamflows were primarily base flow (base flow is input or effluent from groundwater; specifically, samples that I identified as "base" samples after looking at the "base" or "storm" designation in the BCRET database and USGS 15-minute streamflow values for BC7—see below for more details). Hereafter, in most cases I will refer to streamflow associated with these "base" samples as base flow.

A very large percentage of the constituent loads (mass per unit time, a function of the multiplication of concentrations and streamflows) and streamflows typically occurs during a few days of the year. Therefore, to get a complete description of the water quality of a stream it is important to measure streamflow and to collect representative water-quality samples not just during periods of low flow, but also during periods of runoff-induced high streamflow (i.e., during storm events). Concentrations of constituents (particularly those associated with suspended particles) are not uniformly distributed vertically or horizontally in a stream cross-section because of localized inflows and the spatial variability of water velocity in a cross-section. Collecting representative samples during these periods of high streamflow is a difficult and expensive endeavor. At one end of the storm event sampling-method continuum would be collecting grab samples at a single time during a few events. At the other end of the continuum would be collecting several integrated samples from the entire depth of several vertical transects during a number of storm events; supplementing this information with samples collected using automatic samplers is also beneficial. Automatic samplers are helpful because they can sample during an entire storm event, however, they pull their samples from a discrete point in the stream and this may or may not yield samples representative of the entire stream cross section. The procedure (U.S. Geological Survey, 2006) for U.S. Geological Survey sampling of flowing waters (waters with velocities of greater than 1.5 feet per second) is to use one of two sampling methods (Equal Width Increment, EWI; or Equal Discharge Increment, EDI). The most common, because of ease of use, is the EWI method. The method requires use of an isokinetic (collecting water in proportion to the water velocity), depth-integrating sampler lowered from surface to full depth at multiple verticals across a stream cross section. The samples from the individual verticals are then composited and divided by a splitter into

required bottles for laboratory analysis to maintain the representativeness of the water placed in each laboratory bottle.

The BCRET sampling relied on grab samples exclusively during base flows and a combination of grab samples and auto-collected samples during storm flows. These samples are not likely to be representative except during times of low water velocities. They are not representative during storm events or during base flow times with higher velocities. The BCRET samples collected with ISCO brand automatic samplers were collected from discrete points in the stream. The representativeness of these storm samples cannot be confirmed and I did not include storm data in my analyses for the following reasons:

- Edwards and Glysson (1999) describe considerations for use of automatic samplers--including advantages and disadvantages, optimum criteria, placement of sampler intake, orientation of sampler intake, and substantial time for post-collection data analysis. I have seen no documentation and I am not aware of these items being considered or implemented.
- Martin and others (1992) found that concentrations of dissolved constituents were not consistently different among grab samples and integrated samples. However, concentrations of suspended sediment and total phosphorus were significantly lower in surface-grab samples than in integrated samples. Harmel and others (2010) in a study of grab and integrated samples from storm waters at sites with drainage areas similar to the Big Creek sites found grab sample concentration errors (relative to integrated sample concentrations) of more than 5 percent in 52 percent of the nitrate samples, 74 percent of the ammonia samples, and 81 percent of the dissolved phosphorus samples. For the constituents associated with suspended materials, errors of more than 5 percent for 68 percent of the total phosphorus samples and 71 percent of the suspended sediment samples were reported. It was not uncommon (in 7 to 32 percent of comparisons) for these for constituents to have greater than a 30 percent error between the two sampling procedures. Unfortunately, much of the difference between concentrations of water-quality variables that include a suspended component (such as total nitrogen, total phosphorus, total suspended solids, bacteria) would occur between samples collected during the elevated streamflow conditions associated with storms.
- In addition to samples needing to be representative of the stream profile, the sampling design must be representative of all flow conditions throughout the study period. Much of the streamflow and much of the transport of nutrients and other constituents occurs during a few days each year. Based on USGS streamflow data at BC7 (Big Creek near Mt. Judea, station 07055790) for calendar years 2014-2017, 25 percent of the total flow occurred during only 1 percent of the days (11 days) (fig. 4). Water-quality samples were collected at BC7 on only 2 of these 11 days. Samples were collected the following day for 4 of the 11 days.

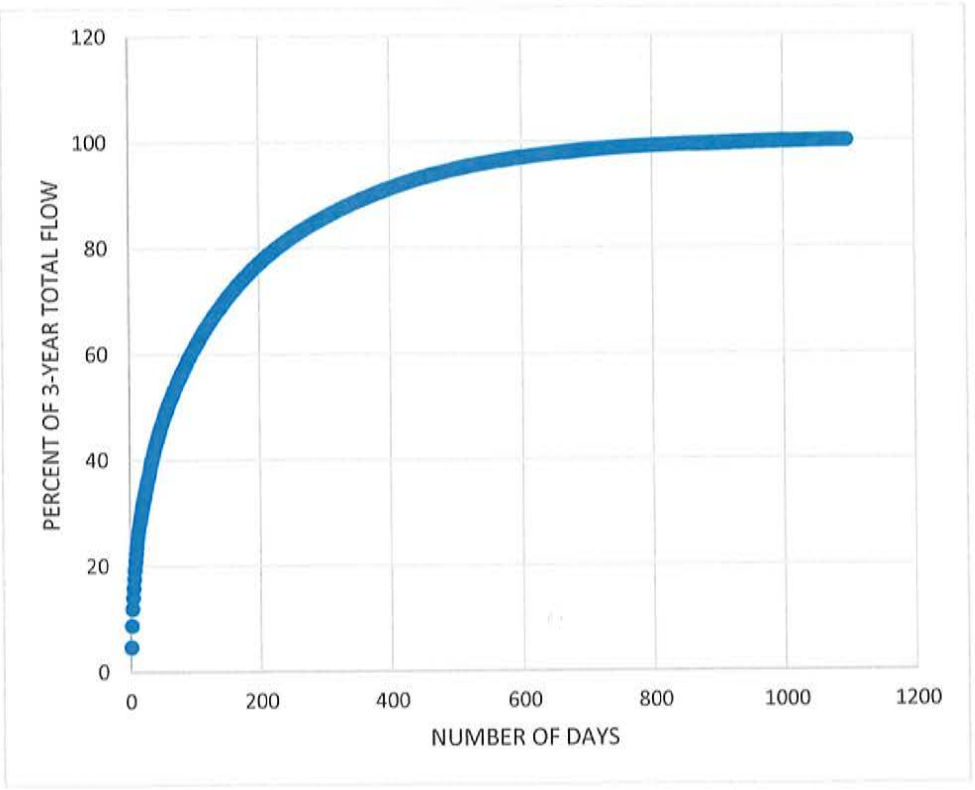


Figure 4. Cumulative streamflow for USGS site 07055790 (colocated with BC7) for calendar years 2014 through 2017

- Storm events were not consistently sampled. In 2017 some substantial stormflows were not sampled (fig. 5; blue dots show 15-minute streamflow value at time of sampling). Calendar year 2017 was typical of the total sampling period.
- In addition to the potential errors in characterization of water quality that can be attributed solely to collecting grab samples (versus integrated samples or ISCO samples), there are potential errors resulting from differences in ISCO sampling frequency at BC6 and BC7. The number of ISCO samples at the two sites was substantially different—5 at BC6 and 15 at BC7, through December 2017 (table 2). The ISCO sampling dates at BC6 ranged from June 27, 2014 to May 8, 2015 while the sampling dates at BC7 ranged from October 14, 2014 to June 6, 2017; **2 years of ISCO sampling occurred at BC7 with no ISCO samples being collected at BC6**. Only on one occasion (and these samples were collected a day apart) were a pair (one from BC6 and one from BC7) of ISCO samples collected during the same storm event.

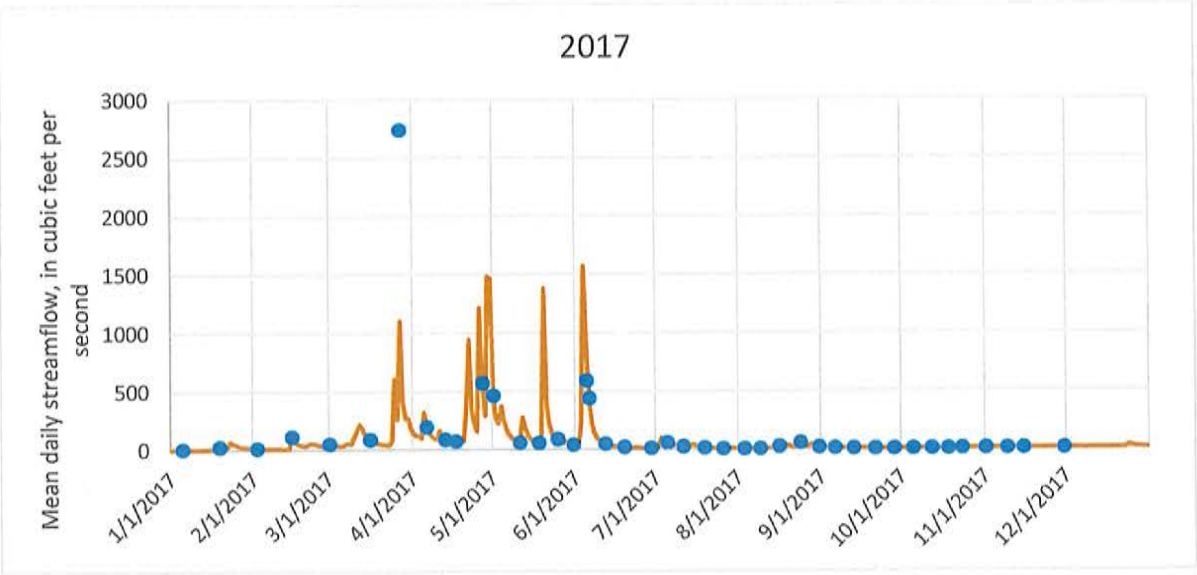


Figure 5. Sampling dates (blue dots) and associated mean daily streamflow at USGS site 07055790 (colocated with BC7)

Table 2. Comparison of ISCO automatic sampler collections and collection dates (through December 2017)

	BC6	BC7
Number of ISCO samples	5	15
First sample date	6/27/2014	10/14/2014
Last sample date	5/8/2015	6/6/2017
Number of dates with ISCO samples at other sites	1*	1*

*one day apart

- I visited the two sites on March 19, 2018. At both sites the intake tubing for the ISCO sampler was lying loose on the stream bottom without any protective housing to keep it stable during elevated streamflows. This would limit the ability of the sampler to collect representative samples.

- Lack of standard quality assurance and quality control checks for automated samplers are also a concern. A comparison of concentrations of dissolved phosphorus, total phosphorus, ammonia, nitrate, total nitrogen, total suspended solids, and dissolved organic carbon for five paired storm samples (four "storm, ISCO" with "storm, grab"; one "storm, ISCO" with "base, grab") indicated that ISCO and grab sample concentrations were not comparable. Relative percent differences for pairs of dissolved phosphorus samples ranged from -21 to 156 percent, total phosphorus

from -94 to 172 percent, ammonia from -200 to 129 percent, nitrate from -192 to -17 percent, total nitrogen from -18 to 155 percent, total suspended solids from -31 to 198 percent, and dissolved organic carbon from -31 to 128 percent. While some of these differences are undoubtedly because of differences in the timing of the sample collection, a properly designed quality assurance plan would have identified issues that at this point appear unresolvable. The ISCO samples are composites--presumably spanning the rising limb, peak, and part of the falling limb of the storm hydrograph (i.e. when the water levels in the stream are rising, peaking, and falling) while the "storm,grab" samples that were paired with ISCO samples were collected at the time when the ISCO samples were "collected." The time shown in the BCRET water-quality database for "storm,grab" samples closely corresponds to the time shown for the ISCO samples and therefore the ISCO time apparently does not refer to the time when the water was pumped from the stream because the grab sample is collected when the technician arrives at the site to collect the ISCO sample from the ISCO shelter (inferred from written communication from Andrew Sharpley, March 30, 2018). Therefore, we are comparing a composited sample with a grab sample collected (presumably) on the falling limb of the hydrograph. Nevertheless, the comparison indicates that ISCO and grab samples are not comparable.

Collection of representative storm samples requires specialized equipment and training, as well as time and money that may not have been available in the budget provided to BCRET. Manual sampling of storm water, including wading into the centroid of flow during storm events, can be difficult and dangerous. The bridge at BC6 is only about 3 feet above the water at low flow and may be submerged during many storms. Installation of a cableway and subsequent water sampling would solve this problem. There is no bridge at BC7 but Big Creek can be sampled about 0.6 river mile downstream at Highway 123; sampling from a highway bridge during inclement conditions presents its own set of safety problems.

The length of time I used for most trend analyses was 4 years. Analysis of water-quality trends for time periods of less than 5 years is not recommended (Schertz and others, 1991). However, this is a case where some exploratory analysis of data is warranted and specific efforts were taken to evaluate factors that might affect the validity of the trend analysis for a slightly truncated period of analysis. Nonetheless, the limitation of the data and associated results were considered. Variation in weather-related factors such as seasonal/annual precipitation, air temperature, and streamflow are sources confounding influences on water quality that can be reflected in water-quality trends (see figures 6-9 for streamflow and precipitation comparisons by year). Trend analysis (Spearman's rho) of 15-minute streamflow values at BC7 measured at the time of water-quality sampling at BC7 did not indicate a trend in streamflow ($p=0.43$) (fig. 6). Annual variation in streamflow (annual and streamflows less than 80 cubic feet per second—the 90th percentile of streamflows for base samples at BC7 (figs. 7 and 8) did not indicate trends in streamflow from 2015 through 2017. The annual precipitation at Harrison (approximately 24 miles north of Mt. Judea) was greatest in 2015 and least in 2016 but did not indicate a consistent trend in precipitation from 2014 through 2017 (fig. 9). Using values that compare differences of concurrently collected values between sites or watersheds (BC7 minus BC6

concentrations, for example) for trend analysis help to minimize effects of annual or seasonal influences of weather and streamflow on trends.

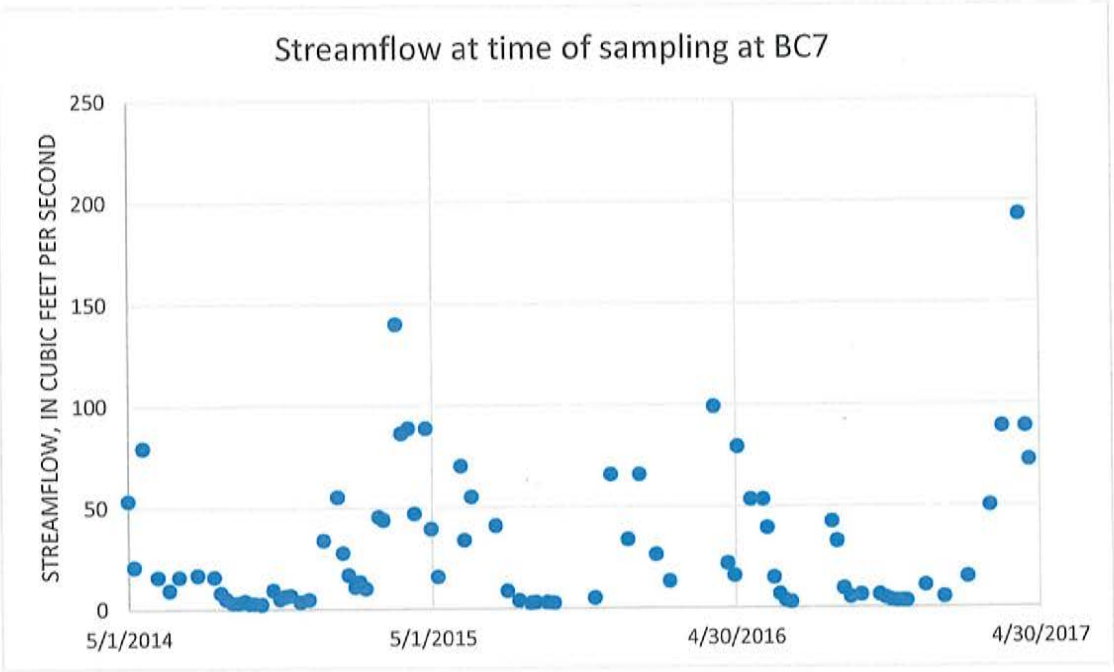


Figure 6. Streamflow values at USGS site 07055790 (colocated with BC7) at time of sampling at BC7. These are base samples only and do not include storm samples

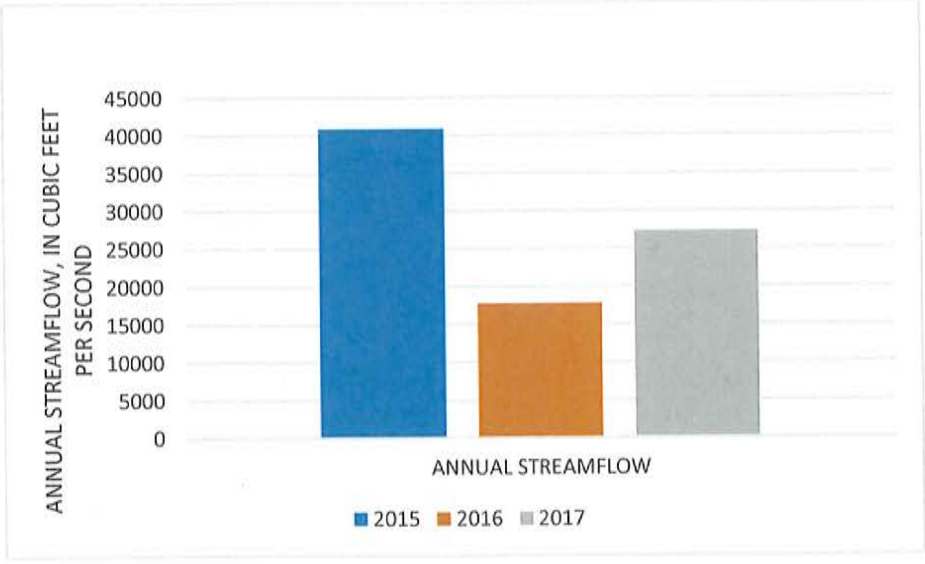


Figure 7. Annual mean streamflow at USGS site 07055790 (colocated with BC7)

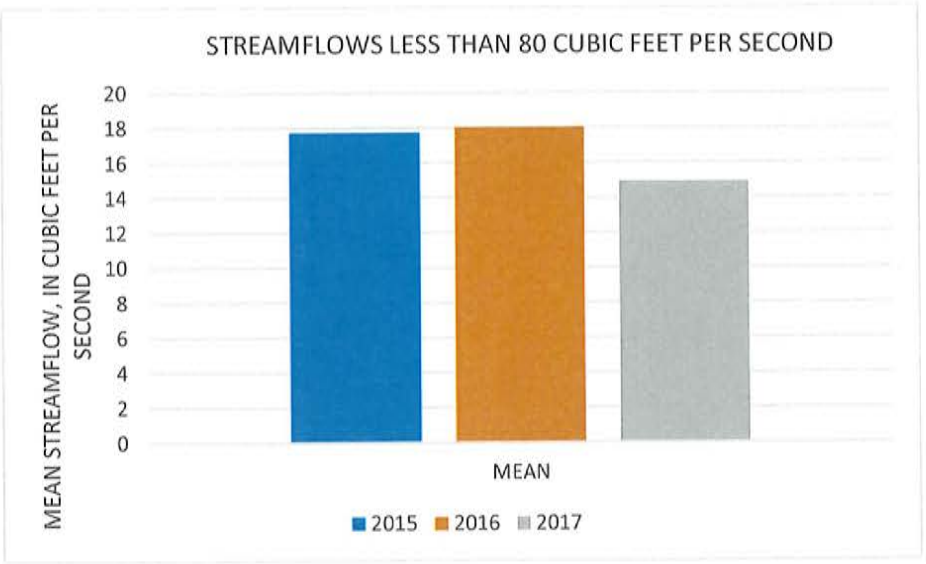


Figure 8. Annual mean streamflow when less than 80 cubic feet per second at USGS site 07055790 (colocated with BC7)

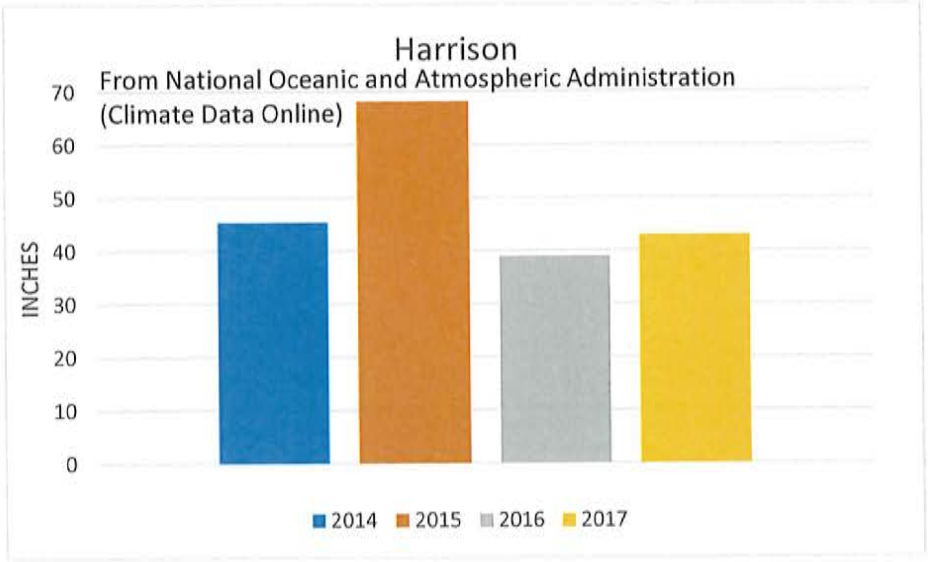


Figure 9. Annual precipitation for Harrison, Arkansas

Despite these limitations of the data, base flow water-quality data for Big Creek upstream and downstream of the farm and slurry receiving fields, and all data from a well near the hog barn, a spring on the east side of Big Creek, and two trench sites just downslope from two waste ponds suggest that water quality of Big Creek and groundwater of the Boone Formation is being impacted by operation of the hog farm. The hydrology and geology of the karstic Boone Formation, along with the water quality of Big Creek, suggests that the water quality and biota (the animal and plant life) of the Buffalo River and other parts of Buffalo National River potentially are being affected.

7.0 Water Quality of Big Creek

My analysis of water-quality data collected by BCRET focused on base flow conditions when streamflow is dominated by groundwater input. In my opinion, results from sites BC6 (upstream from C&H Hog Farms facilities and associated waste ponds and slurry spreading fields) and BC7 (downstream) indicates that the operation of the currently permitted Animal Waste Management System is having a negative effect on the water quality of Big Creek during base flow. Statistical analyses of the data indicated increasing trends in concentrations of chloride and some nutrients at BC7 when compared to BC6 concentrations.

Nitrogen (medians of 1,043 to 5,078 mg/L total nitrogen), phosphorus (medians of 114 to 5,070 mg/L total phosphorus), organic carbon (395 and 844 mg/L total organic carbon; Harbor Environmental and Safety, 2016), and chloride (medians of 338 to 532 mg/L) are among the contaminants found in hog waste (manure and urine) (median values from BCRET October-December 2016 Quarterly Report). Using multiple approaches, concentrations of several of these potential contaminants to Big Creek were analyzed to look for differences in concentrations and to look for temporal trends during the relatively short time that data have been collected by BCRET and others. Approaches included trend analysis at individual sites, trend analysis of differences between sites, comparisons of concentrations at sites, comparison of dissolved oxygen concentrations to associated factors and to water-quality standards, and analysis of inputs to Big Creek from the Nutrient Management Watershed pastures.

In addition to simply limiting my analysis to samples designated as "base/grab" within the BCRET-provided dataset, I examined the dataset to try to improve the accuracy of the designations. Based on information such as total suspended solids (TSS) concentrations, bacteria concentrations, and 15-minute streamflow data from the USGS site co-located with BCRET site BC7 I changed several base/storm designations for a revised dataset that I used for my data analysis.

During the first few months of sampling (which was before the first applications of hog waste slurry in January 2014) concentrations of most constituents from BC7 (downstream site) and BC6 (upstream site) generally were either higher downstream or were similar at both sites (figs. 10-12 for nitrate, total phosphorus, and dissolved organic carbon).

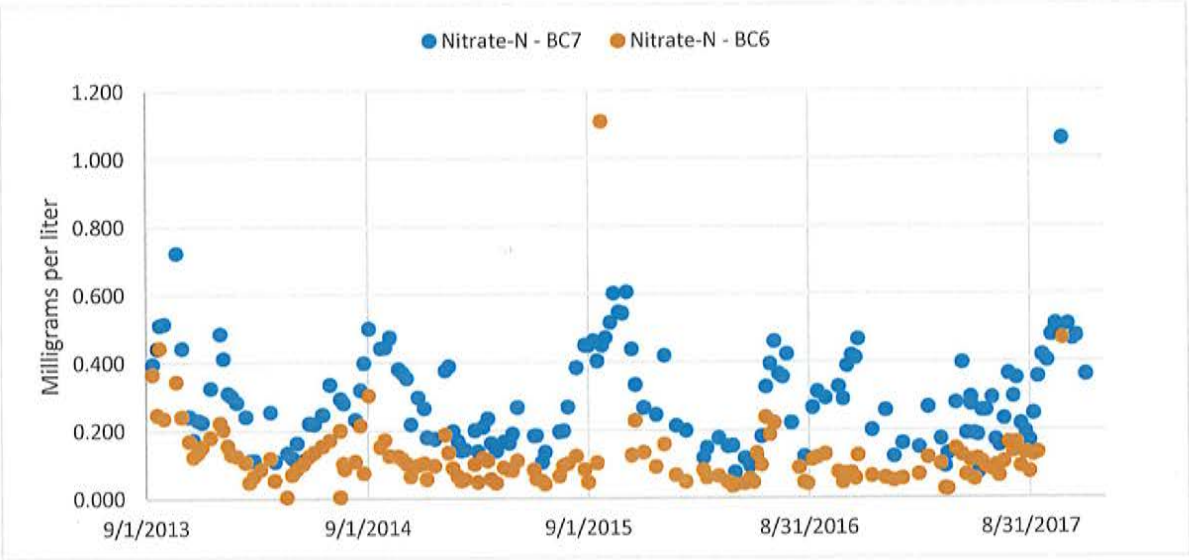


Figure 10. Nitrate concentrations from September 2013 through August 2017 at sites BC6 and BC7

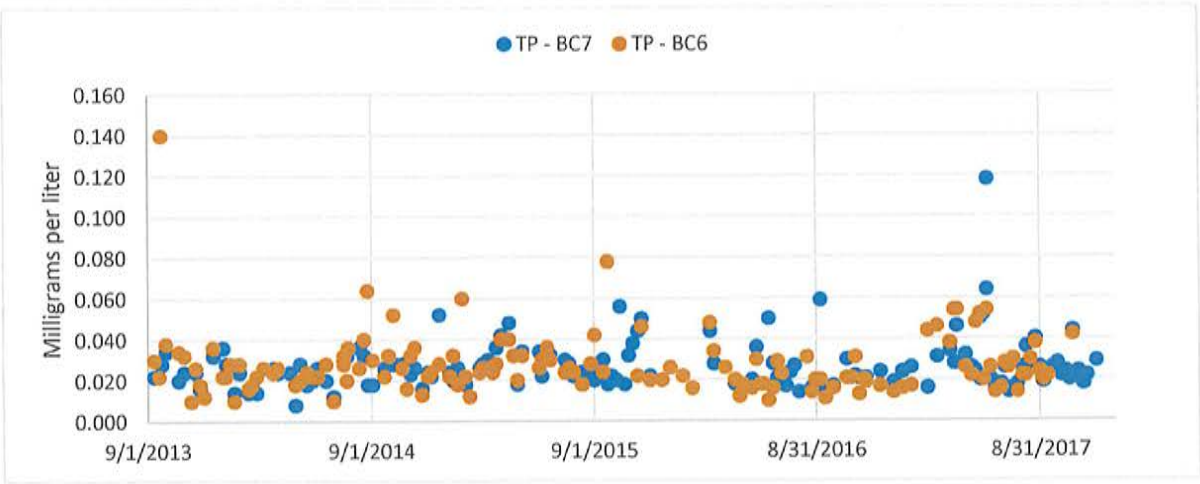


Figure 11. Total phosphorus concentrations from September 2013 through August 2017 at sites BC6 and BC7

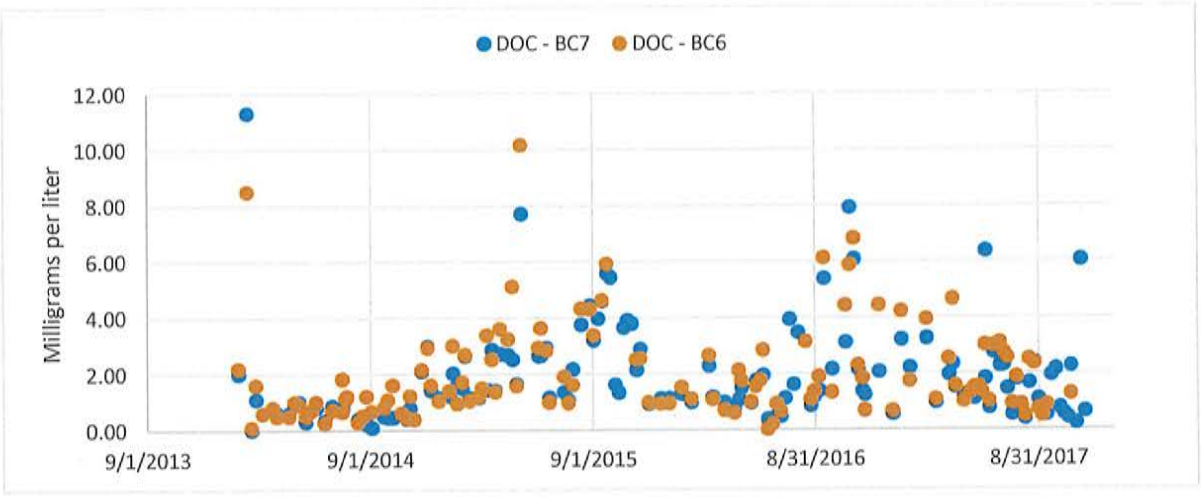


Figure 12. Dissolved organic carbon concentrations from September 2013 through August 2017 at sites BC6 and BC7

To evaluate changes during the period following the applications, a trends analysis of base flow data from January 2014 through December 2017 was conducted using Spearman's rank correlation of date with concentration (table 3). The first three months of data (October-December 2013) were not included because many of these constituents vary seasonally and inclusion of an uneven distribution of seasons could bias trend results. Statistical significance was set at $p<0.10$. This analysis indicates that nitrate (NO3) and chloride inputs were increasing between BC6 and BC7. For nitrate, concentrations were increasing at BC7 but were not increasing at BC6, indicating an increasing input from the part of the watershed between the two sites. For chloride, concentrations were decreasing at BC6, but were not decreasing at BC7, again indicating an increasing input from the part of the watershed between the two sites. Conversely it indicates that dissolved organic carbon (DOC), total suspended solids (TSS), and *E. coli* inputs were decreasing at BC7 relative to BC6. In either case, further analysis was warranted.

Table 3. Temporal trends for selected constituents at sites BC6 and B7

Temporal trends from January 2014 through December 2017

	BC6		BC7	
	Direction	p value	Direction	p value
NH3	Decreasing	<0.001	Decreasing	0.02
NO3	Not significant		Increasing	0.07
TN	Not significant		Not significant	
OP	Not significant		Not significant	
TP	Not significant		Not significant	
Chloride	Decreasing	0.03	Not significant	
DOC	Increasing	0.04	Not significant	

TSS	Increasing	0.05	Not significant
E. coli	Increasing	0.02	Not significant

To further analyze differences between the two sites, paired concentrations (those collected on the same day) at BC6 and BC7 were analyzed for temporal trends using the same methods used to analyze trends at the individual sites (table 4). Trends in BC7 concentration minus BC6 concentration (△ concentration) were analyzed. This approach has advantages over trend analysis for a single site because many factors that might confound trend analyses (for example, annual or seasonal variation in precipitation) are relatively consistent in effect on nearby sites (Dressing and Meals, 2005). Total nitrogen (TN), dissolved phosphorus (OP), and chloride △ concentrations increased between the two sites from January 2014 through December 2017 indicating increasing inputs of these constituents between the two sites. The area between the two sites is known as the Nutrient Management Watershed.

Table 4. Temporal trends in the difference between concentrations at sites BC6 and B7 for selected constituents

Temporal trends from January 2014 through December 2017

	BC7 minus BC6 concentration	
	Direction	p value
NH3	Not significant	
NO3	Not significant	
TN	Increasing	0.095
OP	Increasing	0.091
TP	Not significant	
Chloride	Increasing	0.04
DOC	Not significant	
TSS	Not significant	
E. coli	Not significant	

To isolate the response of pasture base flow discharge from the Nutrient Management Watershed (the area downstream of BC6 and upstream from BC7 where hog waste is surface applied to pastures, fig. 13), estimates of the yield of nitrate, dissolved phosphorus, and other constituents from pasture were calculated (see Appendix B for detailed methods). The calculations used water-quality, streamflow, land use, and watershed size data from BC6, BC7, Buffalo River, Richland Creek, and Beech Creek.

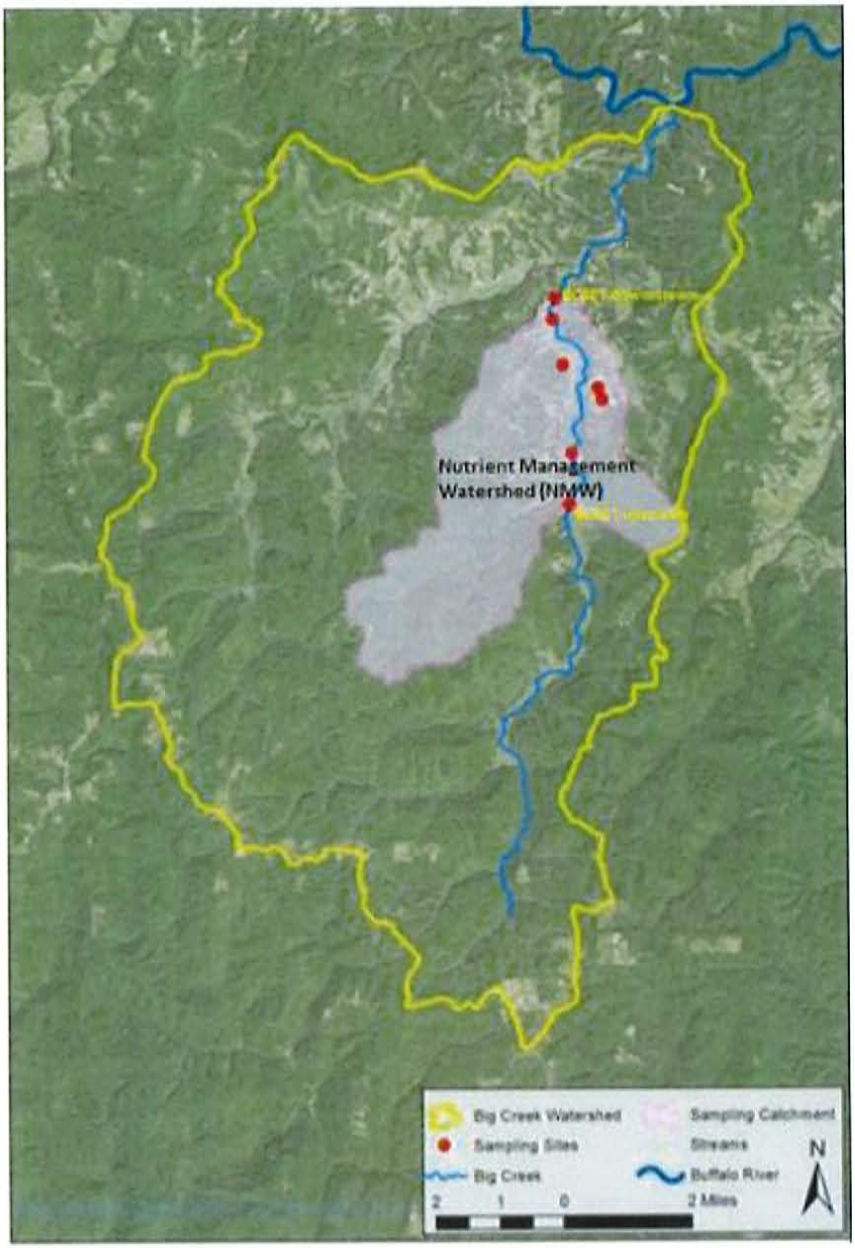


Figure 13. Location of Nutrient Management Watershed (purple), BC6 (upstream), and BC7 (downstream). Modified from BCRET October-December 2014 Quarterly Report.

To estimate the flux (an instantaneous load, calculated as the product of the concentration of an individual sample and the 15-minute streamflow), yield (calculated as the flux divided by the drainage area), and concentrations for waters flowing from the pasture areas of the BC6 watershed and the Nutrient Management Watershed, a multi-step process was used to examine nitrogen, phosphorus, dissolved organic carbon, chloride and *E. coli* data. The process included estimation of streamflow at BC6 (which by definition introduces errors in subsequent calculations not introduced by methods focused solely on concentration differences), estimation of concentrations in water from forests, and

use of two-component mixing models. The primary goal of this process was to estimate the yield (mass per second per square mile) and concentration of nitrate and total phosphorus from areas of pasture land use in the Nutrient Management Watershed and the BC6 watershed. The individual pasture yields from the BC6 and Nutrient Management Watershed watersheds were compared using the Wilcoxon Signed Rank Test and trends were analyzed using Spearman's rank correlation. For trend analysis the data were restricted to October 1, 2014 to September 30, 2017 to avoid a bias caused by including data that do not represent multiples of 12-month periods. Many water-quality constituents naturally vary from one season to another, so it would not be proper to begin a trend analysis period at a time when concentrations are naturally lower and end the analysis period at a time when concentrations are naturally higher. The trend analysis was performed on the difference (△ yield, Nutrient Management Watershed yield minus BC6 watershed yield) between the two watersheds. This process is described in more detail in Appendix B.

Derived (calculated) concentrations of nitrate, total nitrogen, and chloride from the Nutrient Management Watershed pastures were substantially higher than concentrations from the BC6 watershed pastures. The mean nitrate concentration of water discharging from pasture land in the NMW watershed was 2.2 times the concentration of water discharging from pasture land in the BC6 watershed (fig.14). The mean concentration of total nitrogen from pasture land in the Nutrient Management Watershed was 2.5 times that of the mean concentration from pasture land in the BC6 watershed and the mean concentration of chloride was approximately 1.4 times higher than the mean concentration from pasture land in the BC6 watershed (not shown).

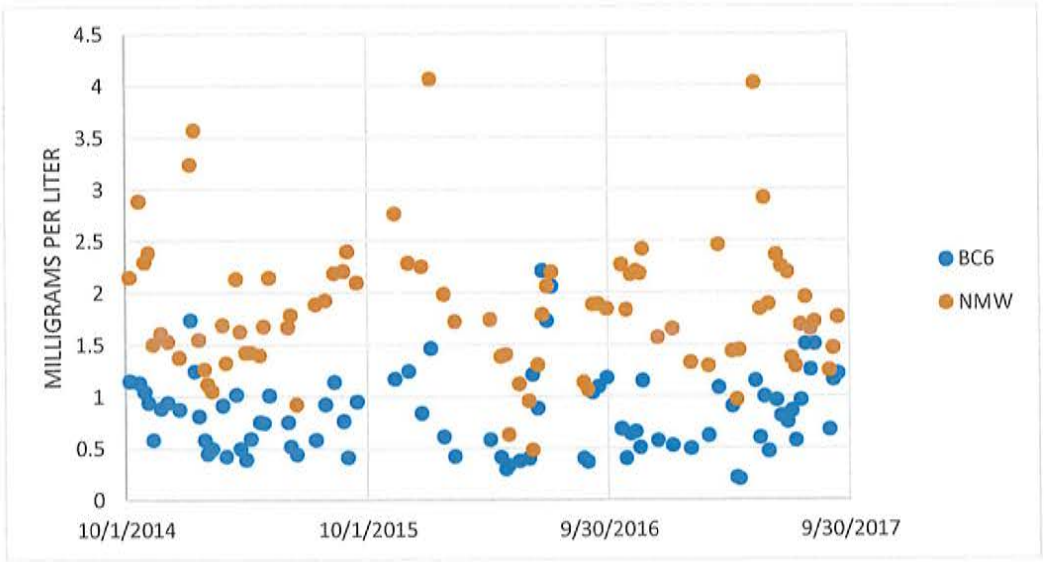


Figure 14. Derived concentrations of nitrate coming from pasture land in the BC6 and NMW watersheds

Trend analyses of concentrations were performed for the three constituents with significantly higher yields from the NMW watershed (table 5). No trends (upward or downward) were detected in concentrations of nitrate or chloride from pastures in either watershed or in the differences (NMW

watershed minus BC6 watershed) between concentrations for pastures in the two watersheds (not shown). Statistically significant downward trends in total nitrogen were detected in the NMW pasture concentration (p=0.04, not shown) and the difference between NMW and BC6 watershed concentrations (p=0.09; not shown).

The derived yield (milligrams per second per square mile) of nitrate from pasture land in the Nutrient Management Watershed was almost three times that of the yield from pasture land in the BC6 watershed (fig. 15). The yields were significantly different (Wilcoxon signed rank test, p<0.001) than the yield from pasture land in the BC6 watershed yield (table 5). Total nitrogen and chloride yields were significantly higher from the NMW watershed pasture than from the BC watershed pasture (table 5). No trends were detected other than a downward trend in the difference between total nitrogen NMW pasture yields and BC6 watershed pasture yields (table 5).

No trends (upward or downward) were detected in yields of nitrate from pastures in either watershed or in the differences (NMW watershed minus BC6 watershed) between yields for pastures in the two watersheds (table 5).

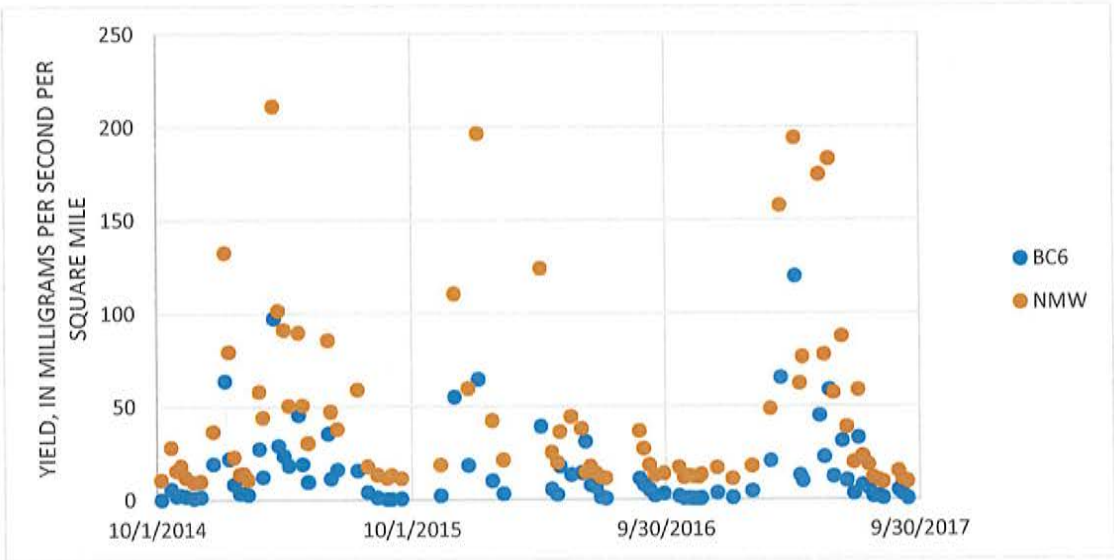


Figure 15. Derived yields of nitrate coming from pasture land in the BC6 and NMW watersheds

Table 5. Statistical analysis of difference between yields from pastures at BC6 and NMW watersheds and of trends in yields from pastures in the NMW watershed and the difference in yields from pastures in the BC6 and NMW watersheds

	Wilcoxon two-tailed test of differences between yields	NMW watershed yields	Spearman correlation	NMW minus BC6 yields	Spearman correlation
	p-value	Trend direction	p-value	Trend direction	p-value
Diss. phosphorus	NS	Not tested**	Not tested*	Not tested**	Not tested**
Total phosphorus	NS	Not tested**	Not tested*	Not tested**	Not tested**
Ammonia	NS	Not tested**	Not tested*	Not tested**	Not tested**
Nitrate	<0.001***	NS	NS	NS	NS
Total nitrogen	<0.001***	NS	NS	Decreasing	0.04
Diss. organic carbon	NS	Not tested**	Not tested*	Not tested**	Not tested**
Chloride	<0.001***	NS	NS	NS	NS
E. coli	NS	Not tested**	Not tested*	Not tested**	Not tested**

NS is not significant (at p=0.10)

**Trends were not tested because the yields for BC6 watershed were higher than for NMW watershed

***Higher for the NMW watershed

The significantly higher concentrations and yields from the pasture land in the NMW watershed and the lack of any temporal trends suggests one of three scenarios. One--agricultural practices preceding the operation of C&H Hog Farms in the NMW watershed have resulted in a source of nitrate that is greater than the source in the BC6 watershed. Two—the application of hog waste has resulted in a rapid (within the 9 months from January to October 2014) and substantial increase in nitrate concentrations and yields but that initial increase has not continued to increase in magnitude since October 2014. Or three—some combination of the first two scenarios.

Also, there are inherent errors in using watershed ratios to estimate the discharges from BC6, the BC6 watershed, and the pasture and forest components of the discharge from the BC6 and NMW watersheds. These errors would affect the derived concentrations and yields from the pasture and forest of the BC6 and NMW watersheds.

Derived concentrations and yields from May 2014 (the earliest date that NMW concentrations and yields could be calculated because of absence of flow data prior to May 2014) were visually compared to the later data and no difference in values was apparent. This makes the second scenario less likely.

Yields and concentrations for the BC6 and NMW watersheds also were derived for total phosphorus, dissolved phosphorus, ammonia, dissolved organic carbon, and *E. coli.* Concentrations and yields of these constituents from the BC6 watershed were higher than from the NMW watershed indicating that the NMW watershed pastures are contributing less of these constituents than BC6 watershed pastures

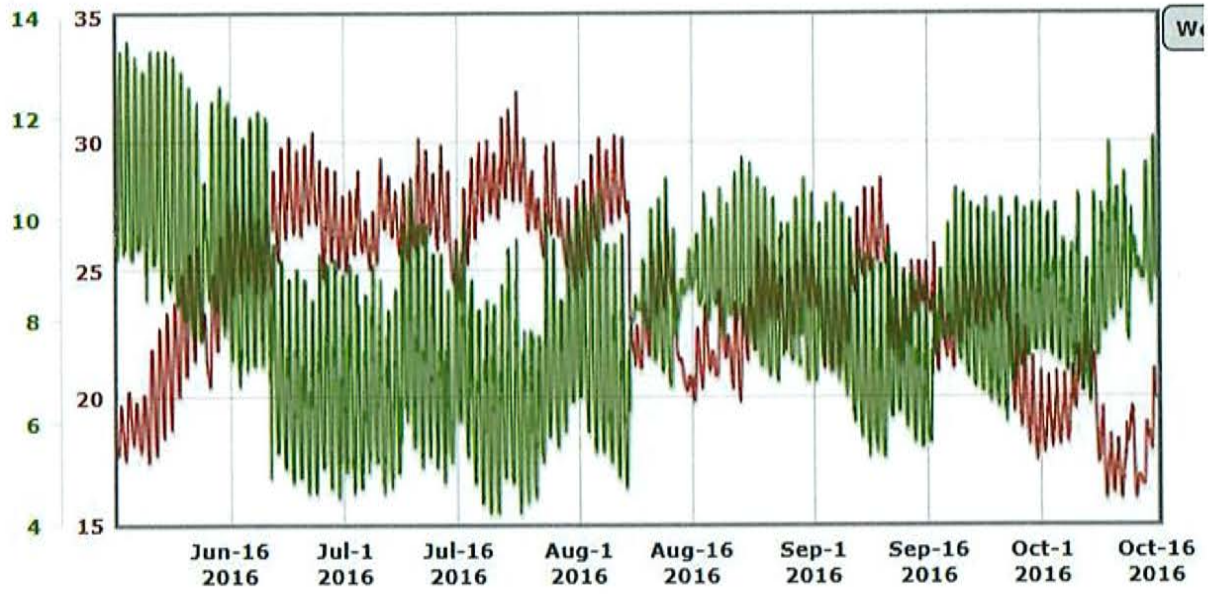
are contributing. Therefore, additional statistical analyses were not performed for these constituents (table 5). **It is important to remember that these analyses are based only on base samples, those not associated with storm events, and that phosphorus, total nitrogen, sediment, and *E. coli* would be expected to be transported primarily in the storm runoff.**

In my opinion, the frequency and seasonal persistence of dissolved oxygen concentrations of Big Creek at Carver that are often substantially below the state standard may be causing detrimental effects on aquatic species and fish and macroinvertebrate (aquatic insects, etc.) communities of Big Creek and the Buffalo River. The proximity to the Buffalo River and anti-degradation policy concerns are another immediate concern.

The U.S. Geological Survey operated a streamgage equipped with a multi-parameter (pH, water temperature, specific conductance, and dissolved oxygen) probe on Big Creek at Carver from June 2014 through May 2017. Dissolved oxygen concentrations frequently did not meet the dissolved oxygen water-quality standard (6 mg/L) in each year and the lower part of Big Creek has been placed on the 2018 draft list of impaired Arkansas waters because of the low dissolved oxygen concentrations (https://www.adeq.state.ar.us/water/planning/integrated/303d/list.aspx). The standard was not met on 60 days in 2014, 61 days in 2015, and 52 days in 2016. The minimum concentrations were 4.0, 4.4, and 4.2 mg/L in 2014, 2015, and 2016, respectively. In 2014 and 2015 the concentrations less than 6 mg/L first occurred in early to late August and persisted into mid-September. In 2016 concentrations less than 6 mg/L first occurred in late June and persisted into early August and then recurred from early September until mid-September. These low dissolved oxygen concentrations seemed to occur when water temperatures warmed to approximately 26° - 29° Celsius (79° to 84° Fahrenheit) and streamflow decreased to 4 to 10 ft^3/sec. (see figs. 16-17). These periods were usually preceded by increases in specific conductance to about 240 to 250 microsiemens per centimeter. Increases of dissolved oxygen concentrations during and after the periods of low concentration were typified by increases in streamflow and/or decreases in water temperature.

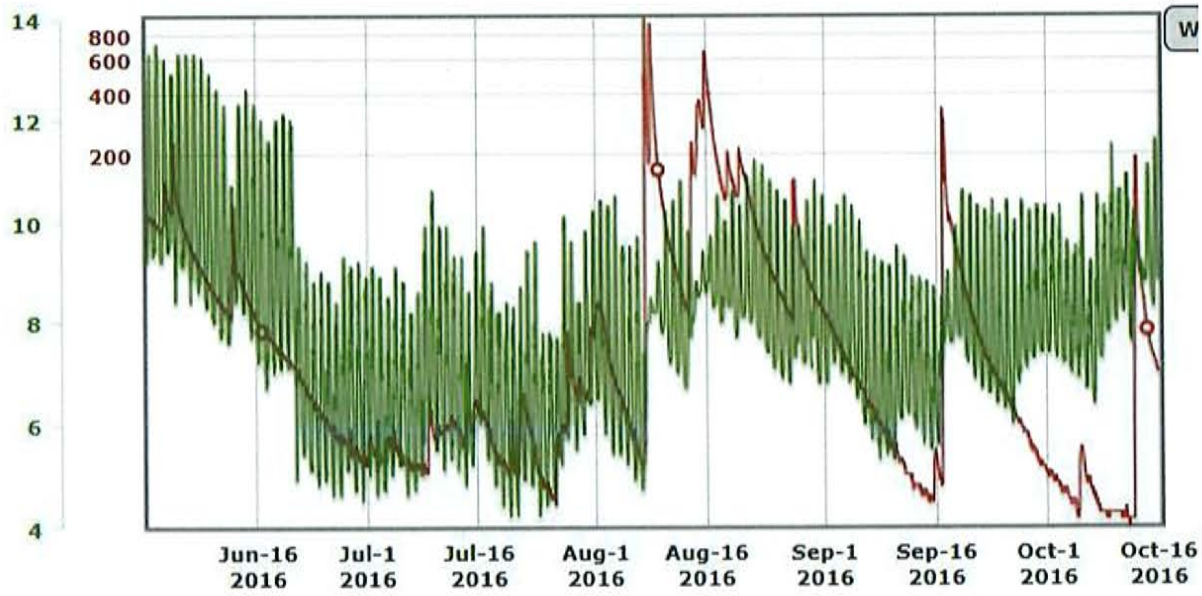
The combination of low streamflow and high specific conductance suggests that dominance of groundwater in the streamflow followed by summer warming is a factor in the low dissolved oxygen concentrations. I am not aware of data for dissolved oxygen concentrations in karst groundwater reaching streams as diffuse flow but the concentrations could be susceptible to presence of contaminants (organic carbon or organic nitrogen) that would require oxygen during bacterial decomposition and respiration. Reareation rates in groundwater could be lower than in streams and there is no photosynthesis in groundwater to add oxygen to the water. Dissolved oxygen concentrations for three springs in the Buffalo National River water-quality database average 9.2 mg/L, so dissolved oxygen concentrations certainly can be protective of aquatic life.

This is another example of how important good quality groundwater is to Ozark ecosystems. When groundwater (which in degraded conditions, or where rearation rates are low, could be low in dissolved oxygen) is contaminated by nutrients that can stimulate algal growth and respiration and by contamination by organic carbon and organic nitrogen that can stimulate bacterial decomposition is discharged to surface water, the result can be depressed dissolved oxygen concentrations. Algal respiration and bacterial decomposition both decrease dissolved oxygen concentrations.



Green is dissolved oxygen, red is water temperature

Figure 16. Dissolved oxygen concentrations and water temperature June through October 2016 at Big Creek near Carver



Green is dissolved oxygen, red is streamflow

Figure 17. Dissolved oxygen concentrations and streamflow June through October 2016 at Big Creek near Carver

The magnitude of the departure, in concentration and persistence, of the dissolved oxygen concentrations from the state water-quality standard should be of consideration under the Regulation 2

anti-degradation policy as it pertains to the Buffalo River because it is an Extraordinary Resource Water and Natural and Scenic Waterway. The Buffalo River is about 0.5 river mile downstream from the Big Creek near Carver and potentially closer than that for a groundwater connection. During periods of low flow, which is when dissolved oxygen concentrations at Carver are lowest, as much as one-third of flow in the Buffalo River is contributed by Big Creek and groundwater flowing into the Buffalo River (Moix and Galloway, 2005). Both of these sources could be affected by the low dissolved oxygen concentrations at Carver. The anti-degradation policy states that "those uses and water quality for which the outstanding waterbody was designated shall be protected by (1) water quality controls, (2) maintenance of natural flow regime, (3) protection of instream habitat, and (4) encouragement of land management practices protective of the watershed."

8.0 Water Quality of Ephemeral Stream (BC4)-A Tributary of Big Creek

In my opinion, increasing trends in some nutrients, dissolved organic carbon, and E. coli in samples from site BC4 (Ephemeral Stream) indicate that inputs of these constituents to Big Creek are increasing and potentially affecting water quality of Big Creek near the hog farms and downstream from the confluence of this stream and Big Creek. If concentrations are increasing in base flow samples it is likely that concentrations in storm water also are increasing—and concentrations are almost certainly higher in the storm water than in base flow. Temporal trends in BCRET-designated base flow water-quality data from March 2014 through March 2017 were assessed. Statistical analysis was performed on all samples that were identified as "base,grab" samples by BCRET. To further clarify, an ephemeral stream flows only in direct response to precipitation yet there were 48 "base" samples in addition to those designated as storm samples. The existence of the base samples indicates that the stream is not an ephemeral stream, but rather an intermittent stream with a groundwater flow component. These 48 "base,grab" samples were analyzed for BC4 (variously referred to by BCRET as Culvert or Ephemeral Stream). Statistically significant increasing trends in nitrate, total nitrogen, dissolved phosphorus, dissolved organic carbon, and *E. coli* bacteria were detected (table 6 and figs. 18-21). These results suggest that groundwater and runoff from the watershed area (which includes the hog barns and waste ponds) are being affected by C&H Hog Farms operations. The watershed area of BC4 is approximately 0.17 square mile and is approximately 64 percent forest (delineated using the U.S. Geological Survey StreamStats application; https://streamstats.usgs.gov/ss/).

Table 6. Temporal trends in selected constituents from site BC4

Temporal trends from March 26, 2014 through March 16, 2017

	BC4 concentration trends	
	Direction	p value
NH3	Not significant	
NO3	Increasing	0.002
TN	Increasing	<0.001
OP	Increasing	0.011
TP	Not significant	
Chloride	Insufficient data	
DOC	Increasing	0.01
TSS	Not significant	
E. coli	Increasing	0.08

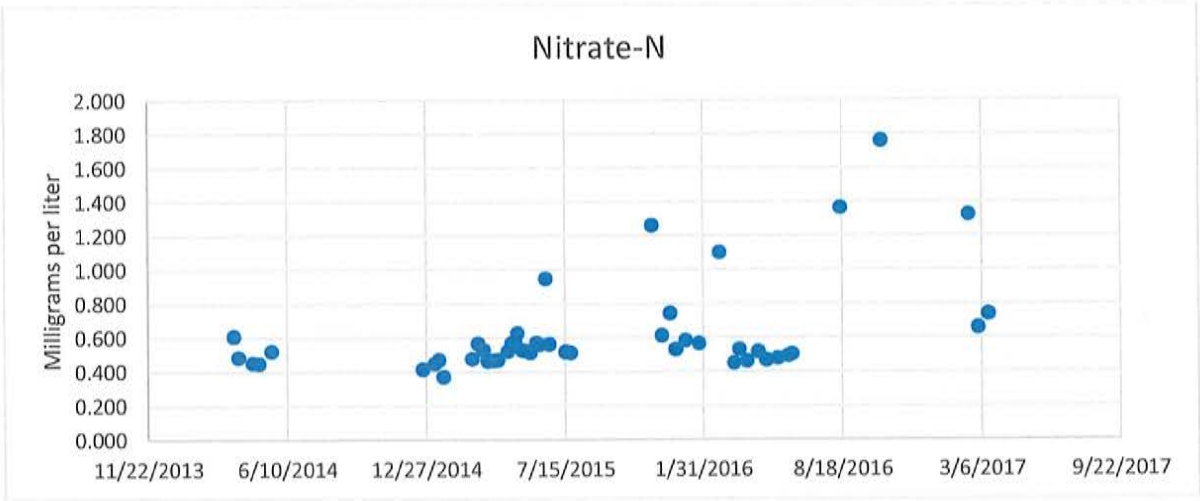


Figure 18. Nitrate concentrations at BC4 (Ephemeral Stream) from January 2014 through March 2017

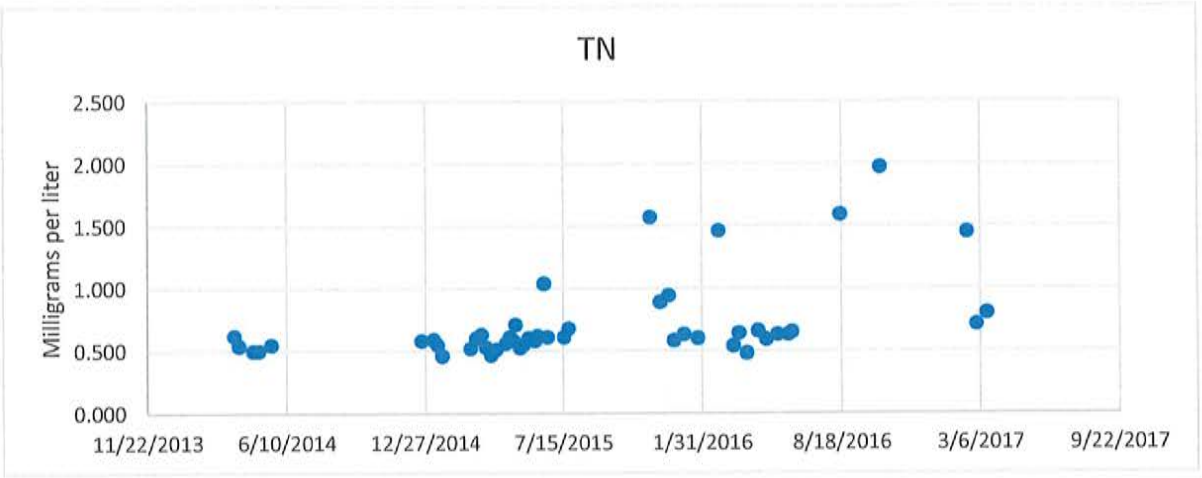


Figure 19. Total nitrogen concentrations at BC4 (Ephemeral Stream) from January 2014 through March 2017

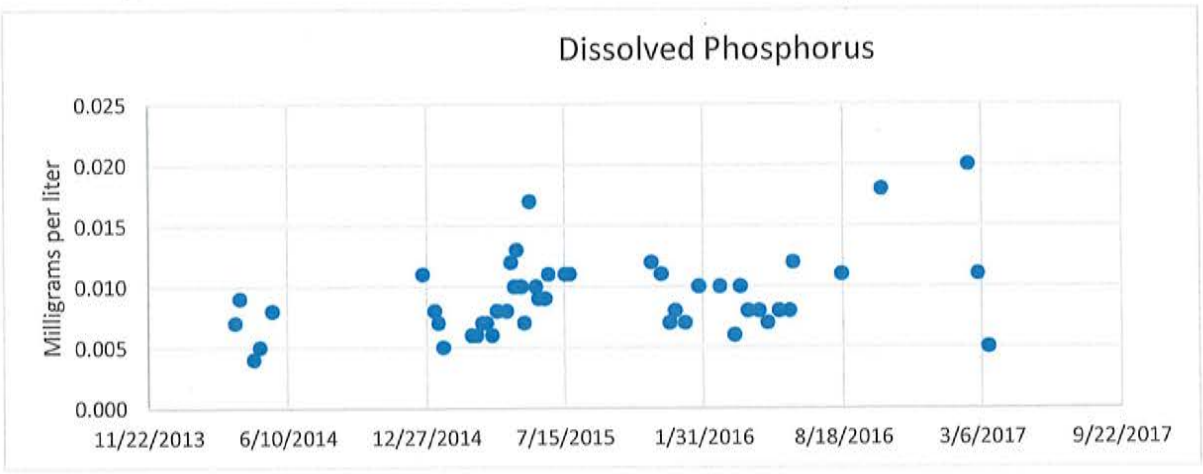


Figure 20. Dissolved phosphorus concentrations at BC4 (Ephemeral Stream) from January 2014 through March 2017

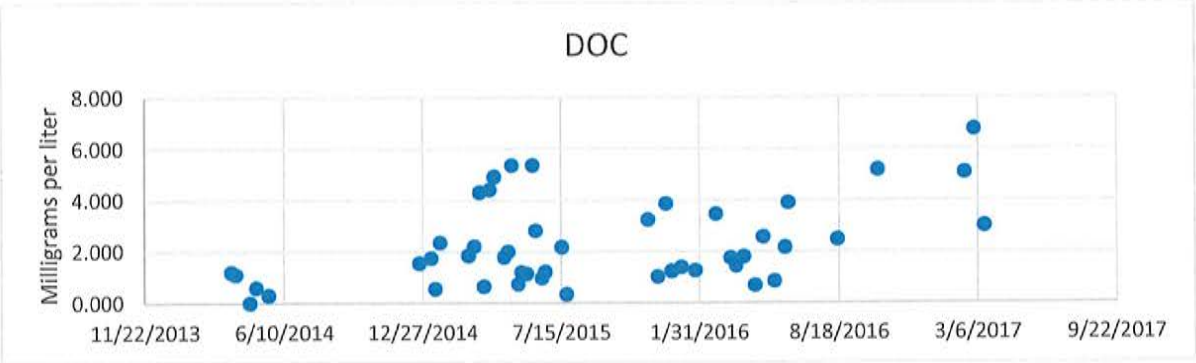


Figure 21. Dissolved organic carbon concentrations at BC4 (Ephemeral Stream) from January 2014 through March 2017

9.0 Aquatic Biology

In my opinion, comparison of concentrations of total nitrogen and total phosphorus at BC7 to biological thresholds for nutrients in wadeable Ozark streams indicates that existing concentrations are approaching (total nitrogen) or have exceeded (total phosphorus) concentrations affecting periphyton (attached algae), macroinvertebrate (aquatic insects, etc.), and fish communities.

Justus and others (2009) conducted a study of the relation of summer (July through August) base flow nutrient concentrations and periphyton, macroinvertebrate, and fish communities of 30 wadeable Ozark streams spanning a range of nutrient concentrations. This study's seasonal time period, water quality sampling methods, geographic location, and stream size are all very comparable to information collected at Big Creek (Justus and others, 2009). The streams also were similar in size to Big Creek, were in watersheds without substantial urban influence, and were sampled consistently within a multi-week period.

Biological indexes responsive to nutrient concentrations were developed for each of the three communities. Higher index values are indicative of biological communities that are more likely to be representative of least-disturbed sites with lower nutrient concentrations. Justus and others (2009) presented relations between the indices and concentrations of total nitrogen and total phosphorus (fig. 22); I have modified the figure by adding blue lines that approximate interpreted thresholds (my interpretation), a green line that shows the piecewise regression breakpoint (threshold) for total nitrogen (only), and orange lines that indicate the June 15 through August 31 means of total nitrogen and total phosphorus at BC7. The piecewise regression, which looks for a breakpoint between two linear parts of a relation, was performed using software available at https://www.waterlog.info/segreg.htm. The mean BC7 total nitrogen concentration is approximately one-third to one-half of the nitrogen thresholds, indicating that Big Creek biological communities are not being adversely affected by the existing total nitrogen concentrations. The mean BC7 total phosphorus concentration is nearly double the interpreted phosphorus threshold, indicating that the biological communities are being adversely affected by the existing phosphorus concentrations.

Dissolved phosphorus concentrations were increasing at Ephemeral Stream and at BC7 (relative to BC6, i.e. BC7 minus BC6 concentrations). Trend analyses indicate increasing concentrations of ammonia, nitrate, and total nitrogen at one or more of several sampling sites (BC7, Ephemeral Stream, and House Well). Widespread increases in these nutrients indicate that any impact on aquatic communities will continue to worsen.

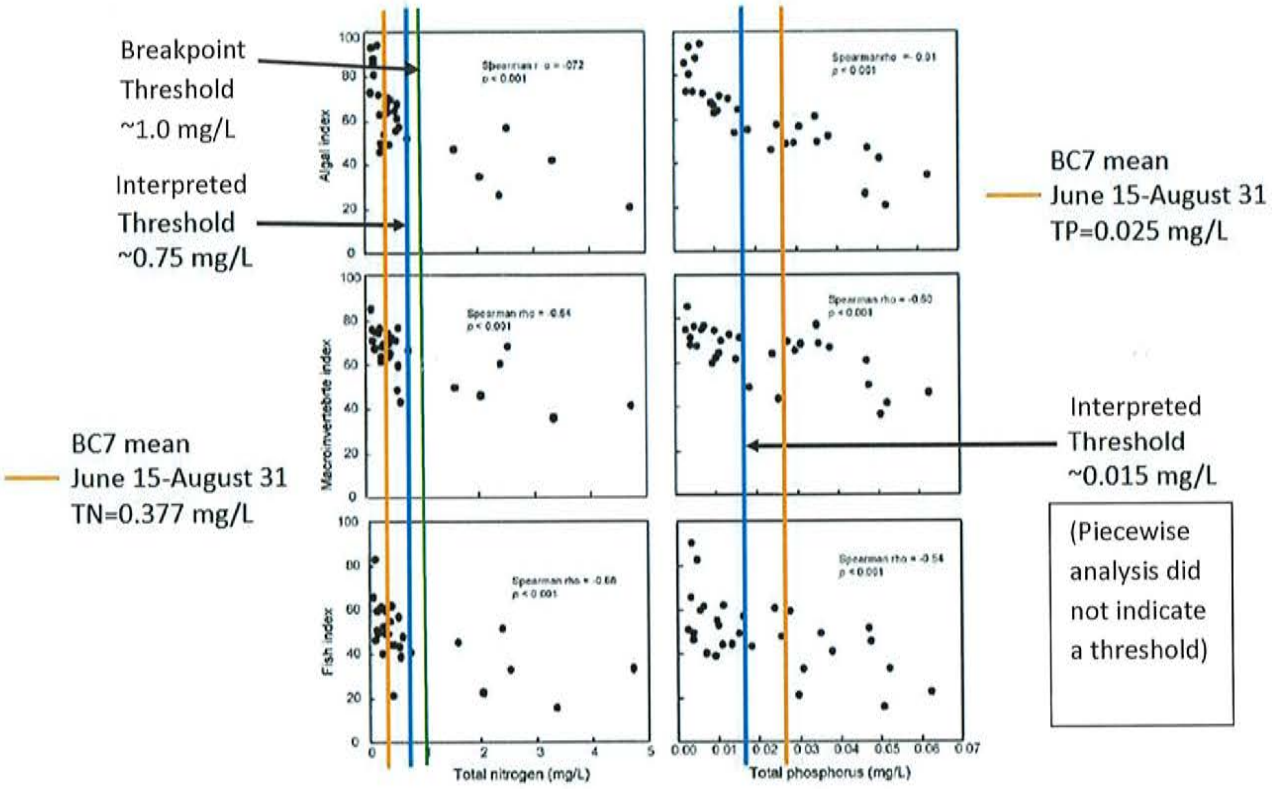


Figure 22. Relations of Ozark periphyton, macroinvertebrate, and fish index values with associated concentrations of total nitrogen and total phosphorus and comparison to BC7 mean total nitrogen and total phosphorus concentrations (modified from Justus and others, 2009)

10.0 Water Quality of Groundwater

Base samples from BC6, BC7, and Ephemeral Stream are composed largely of groundwater effluent, and so my previously described analyses of the data from these sites indirectly addresses groundwater quality. BCRET has directly sampled groundwater at two locations—the House Well located about 330 feet north of the waste ponds and a spring located about 0.8 mile southeast of the waste ponds on the opposite side (east side) of Big Creek. The well is drilled 325 feet through the Boone Formation (cherty limestone), Fernvale/Plattin Limestones, and into the Everton Formation (limestone). During the drilling of the well, water-bearing intervals were encountered at depths of 145 feet in the Boone Formation and 265 feet and 285 feet in the Everton Formation (based on driller's log by Arnold Well Drilling and Pump Service and information in Braden and Ausbrooks, 2003).

Because of a change in the sample collection point and a modification of the sampling protocol (see BCRET October-December 2015 Quarterly Report for details), samples collected from the House Well prior to September 30, 2015 were not included in my analyses. This is unfortunate because this resulted in 29 months of data (at most, less for some constituents) at the House Well. Plots of constituent concentrations against time did not indicate consistent seasonal patterns so the entire period after September 29, 2015 was analyzed for temporal trends.

In my opinion the increasing trends in concentrations of three nitrogen constituents in samples from the BCRET House Well site indicate contamination of the shallow groundwater aquifer. The steadily increasing pattern observed for several parameters indicates a constant input to the local aquifer feeding the well. Results at BC7 also indicate a strong correlation between increasing nitrate concentrations during low flow periods characterized by increased groundwater discharge.

Ammonia, nitrate, and total nitrogen concentrations all increased significantly (table 7 and figs. 23-25) in samples from the House Well. *E. coli* concentrations (table 7 and fig. 25) and specific conductance values decreases significantly. Most *E. coli* concentrations were less than 2 colonies per 100 milliliters—usually reported as 1 or <1, so the actual change in concentration was very small. The decrease in specific conductance values may, at least in part, be due to changes around the well caused by pulverized limestone produced during the drilling of the House Well. The increasing trends in concentrations of three forms of nitrogen dominated by dissolved phases suggest that dissolved material may be leaching into the groundwater while suspended material is not reaching the groundwater.

Table 7. Temporal trends in selected constituents from the House Well

Temporal trends from September 2015 through February 2018

	House Well concentration trends	
	Direction	p value
NH3	Increasing	<0.001
NO3	Increasing	<0.001
TN	Increasing	<0.001
OP	Not significant	
TP	Not significant	
Chloride	Not significant	
DOC	Not significant	
TSS	Not significant	
E. coli	Decreasing	<0.001
Specific conductance	Decreasing	<0.001

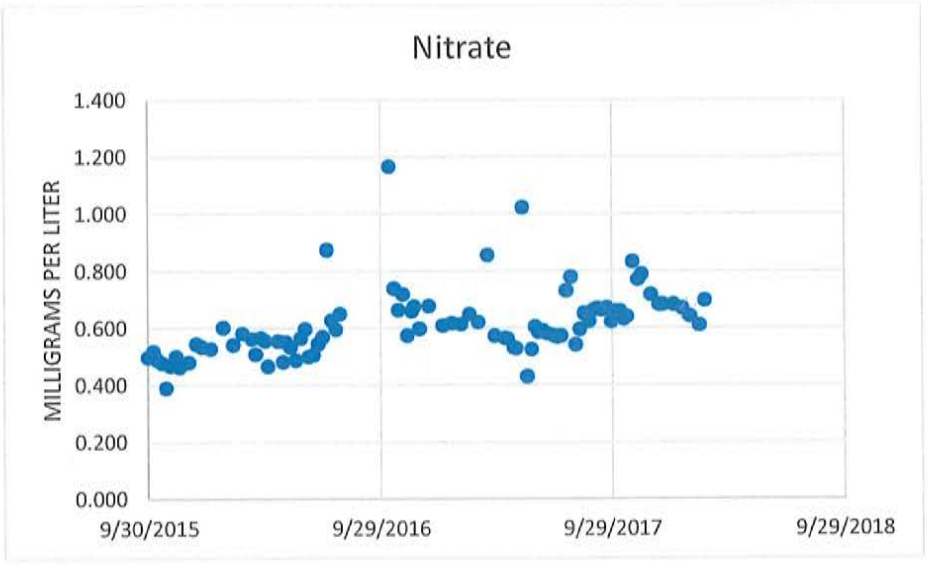


Figure 23. Nitrate concentrations at House Well from September 2015 through February 2018

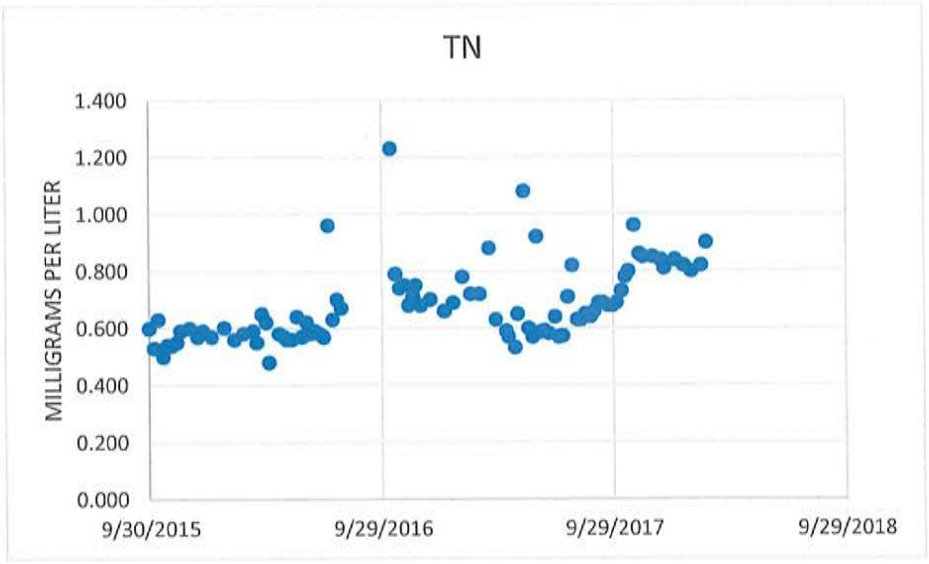


Figure 24. Total nitrogen concentrations at House Well from September 2015 through February 2018

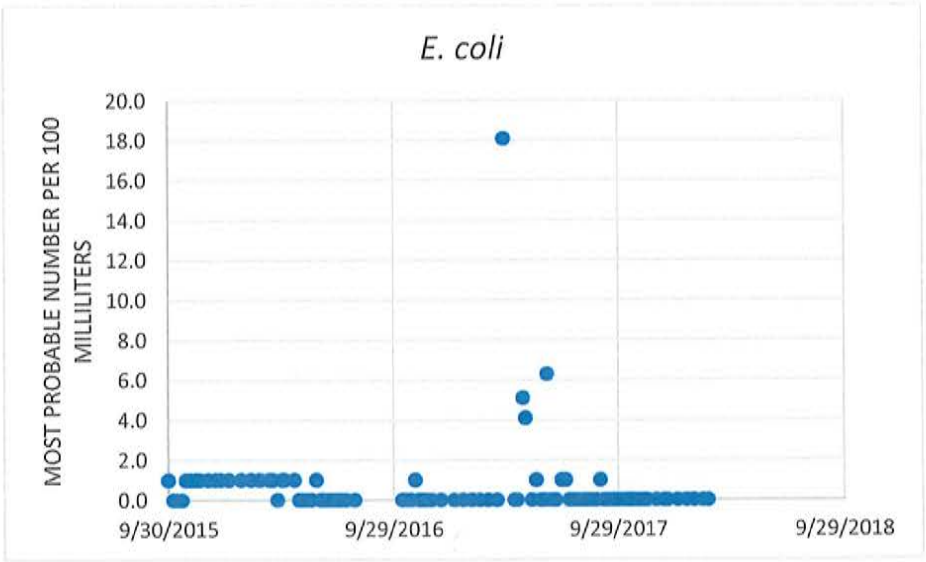


Figure 25. *E. coli* concentrations at House Well from September 2015 through February 2018

The spring (site BC5) outlet also is in the Boone Formation, however, without a dye tracing study, the area that contributes to the spring cannot be determined. Nevertheless, there are some substantial differences between the water quality of the well and the spring—or at least between the water-quality data values, because I could not determine which, if any, samples from the spring were associated with storm flow and so should not be included in the analysis. Total phosphorus, dissolved organic carbon, and total suspended solids concentrations are higher for the spring (means of 0.07, 5.2, and 33 mg/L, respectively) than for the House Well (means of 0.02 and 2.1, and 0.4 mg/L, respectively). *E. coli* concentrations also are higher for the spring (mean of 563 most probable number of colonies per 100 milliliters) than for the House Well (mean of 0.6 colonies). Total nitrogen means for the House Well (0.68 mg/L) and the spring (0.65 mg/L) are very similar, but nitrate means are higher for the House Well (0.61 mg/l versus 0.43 mg/L). Flow volumes associated with samples from the spring are not reported in the BCRET database, but it is likely that the highest of the total phosphorus, dissolved organic carbon, total suspended solids, and *E. coli* values are associated with high flows (and are probably storm-related) from the spring. Data about the flow volumes from the spring, the lag time between local precipitation and flow volumes, and dye tracing would provide insight into recharge area for this spring.

Lack of information about flow volumes makes it difficult to interpret the concentration data from the spring—or to interpret how the spring data relate and compare to the well data. I have included all data in my trend analyses and do not know how much, if any, the results are influenced by high flows. Except for total phosphorus, all nutrient concentrations decreased significantly (table 8 and fig. 26). Chloride, dissolved organic carbon, and total suspended solids increased significantly (table 8 and figs. 27 and 28).

Table 8. Temporal trends in selected constituents from the spring

Temporal trends from September 2014 through September 2017

	Spring concentration trends	
	Direction	p value
NH3	Decreasing	0.096
NO3	Decreasing	0.003
TN	Decreasing	0.007
OP	Decreasing	0.07
TP	Not significant	
Chloride	Increasing	0.03
DOC	Increasing	0.003
TSS	Increasing	0.001
E. coli	Not significant	

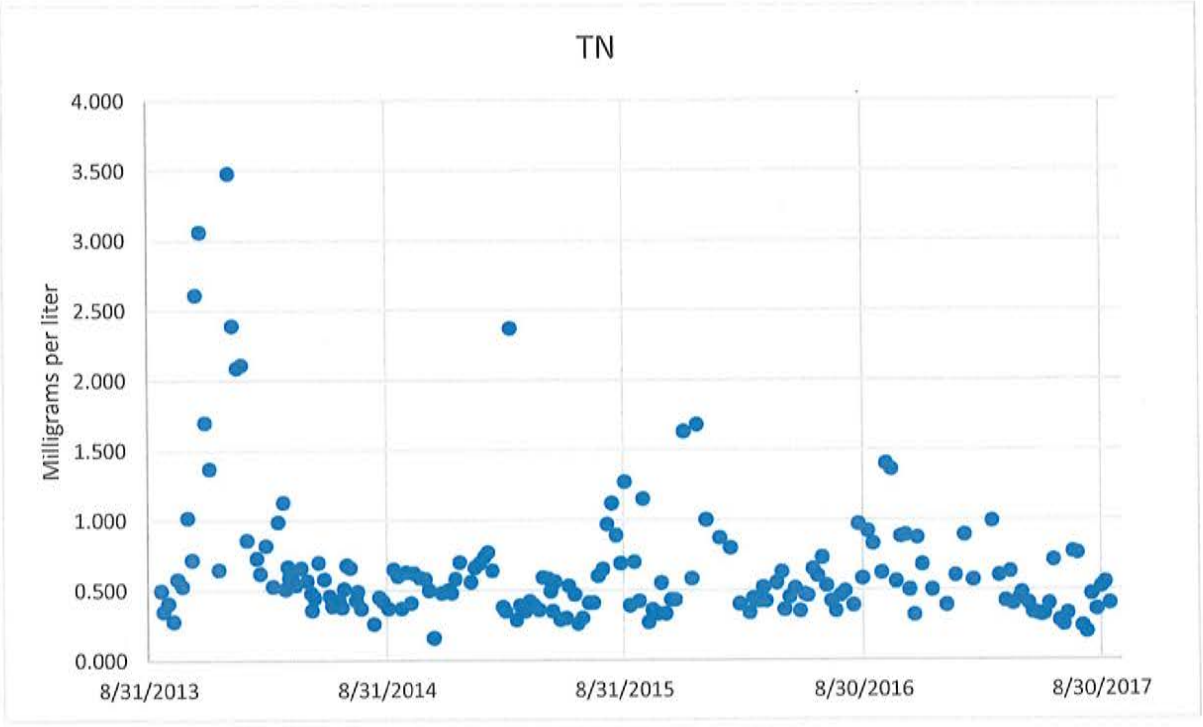


Figure 26. Nitrate concentrations at spring from September 2013 through August 2017

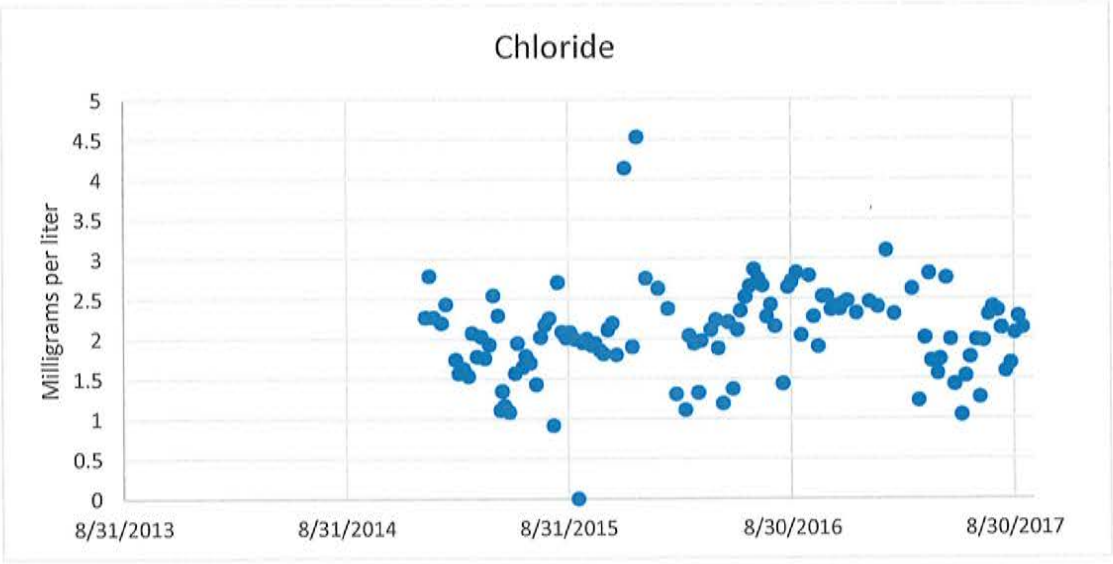


Figure 27. Chloride concentrations at spring from September 2013 through August 2017

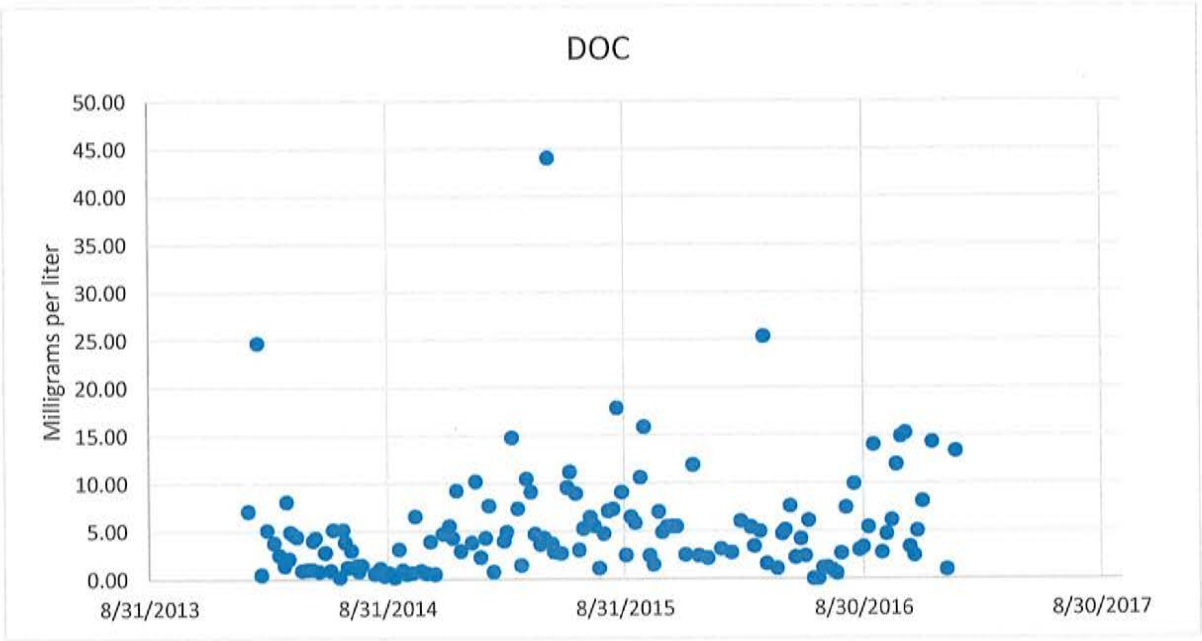


Figure 28. Dissolved organic carbon concentrations at spring from September 2013 through August 2017

11.0 Water Quality of Trench

In my opinion, water-quality from a trench downslope from the two waste holding ponds indicates that the contents from both ponds are seeping into the downslope trench.

The trench (fig. 29; description and figure from BCRET Quarterly Report, July-September 2014) is approximately 200 feet long and located approximately 150 feet downslope from the ponds and 10 feet below the base of the ponds. The trench drains to both ends with a high point in the middle. A more detailed description of the trench is given in the BCRET Quarterly Report for July-September 2014.

Parts of the following analysis of the trench data, including the approaches described below, are based on an unpublished report by hydrologist David N. Mott dated May 15, 2018 (Mott, 2018). However, to the extent that I have used his results and interpretations I concur with those results and interpretations. Table 9 is modified slightly (formatting only) from Mott's report and I independently verified the values shown. This unpublished report is included in the expert report of Thomas Aley dated May 24,2018.

Because of a lack of data previous to construction of the ponds or from a background site in similar geology three approaches and associated hypotheses were used to evaluate the data and determine if waste is leaking from one or both of the ponds into the trench.

The first approach was to compare concentrations and other values between the two ends of the trench. The hypothesis was that concentrations at the two ends should be the same—indicating that neither trench site was receiving pond waste seepage or that both were receiving the same waste.



Trench 1 and Pond 1 are to the southwest. Trench 2 and Pond 2 are to the northeast.

Figure 29. Location of waste ponds and trench collection points (from BCRET)

The water quality of the two trench sites is substantially different (table 9). This difference indicates that one or both trench sites is receiving an input other than from the background seepage from the overlying soil or regolith.

Table 9. Mean concentrations and results of two-tailed t-test comparing Trench 1 and Trench 2

[This table has been reformatted from a table in an unpublished report by Mott (2018). The highlighted mean is significantly higher than the other mean. * denotes that one value was 21.95 milligrams per liter. Mg/L is milligrams per liter, MPN is most probable number, cm is centimeter]

	Mean		Two-tailed t-test
	Trench 1	Trench 2	p-value
Dissolved phosphorus (mg/L)	0.005	0.005	Not significant
Total phosphorus (mg/L)	0.022	0.067	<0.001
Ammonia (mg/L)	0.48*	0.06	Not significant
Nitrate (mg/L)	0.542	1.585	<0.001
Total nitrogen (mg/L)	1.44	2.17	Not significant
Chloride (mg/L)	1.62	0.808	<0.001
Total suspended solids (mg/L)	8.8	13.7	Not significant
Dissolved organic carbon (mg/L)	2.03	4.87	<0.001
Total coliforms (MPN per 100 mL)	14,969	38,549	0.08
E. coli (MPN per 100 mL)	475	881	Not significant
Conductance (microsiemens per cm)	226	164	<0.001
Total dissolved solids (mg/L)	127	115	Not significant

The second approach was to assume that the trench with the highest values of waste-associated constituents must be receiving waste. Therefore, it appears that Trench 2 is receiving a source of waste that is consistently elevating the concentration of total phosphorus, nitrate, dissolved organic carbon, and total coliform above the values in Trench 1 (table 9). Although not statistically significant, Trench 2 concentrations of total nitrogen, total suspended solids, and *E. coli* are substantially higher than in Trench 1.

The third approach was to assume that if only one of the trenches is receiving pond seepage, then mean and maximum values in the other trench should always be lower than in the trench receiving a waste pond leakage input. However, Trench 1 mean values for ammonia (although not statistically significant), chloride, and conductance (also not statistically significant) are substantially higher than mean values for Trench 1. These higher means (particularly ammonia) suggest that Trench 1 also is receiving some seepage (perhaps intermittently) from the ponds.

The high mean for ammonia in Trench 1 primarily is the result of a single concentration (fig. 30). The laboratory value reported for Trench 1 on 4/24/17 was 21.95 mg/L. Leidy and Morris (1990) reported typical values for ammonia from the Boone Formation in northwestern Boone County, Arkansas during the "wet season". These values were a mean of 0.04, a minimum of 0.01, and a maximum of 0.20 mg/L. The ammonia concentration from Trench 1 was two to three orders of magnitude greater than the mean. Later samples from 4/27/17 and 5/1/17 returned ammonia concentrations of 1.04 and 0.61

mg/L, respectively, and were also substantially greater than the values from Boone County. This suggests that Trench 1 also has received waste leakage, probably from Pond 1 given the ammonia result, and high ammonia concentration (1,350 milligrams per liter) in a sample from Pond 1 collected and analyzed by the Arkansas Department of Environmental Quality (Harbor Environmental and Safety, 2016). Median ammonia concentrations from Pond 1 range (depending on sampling depth in the pond) from 1,150 to 1,437 milligrams per liter (BCRET October-December 2016 Quarterly Report).

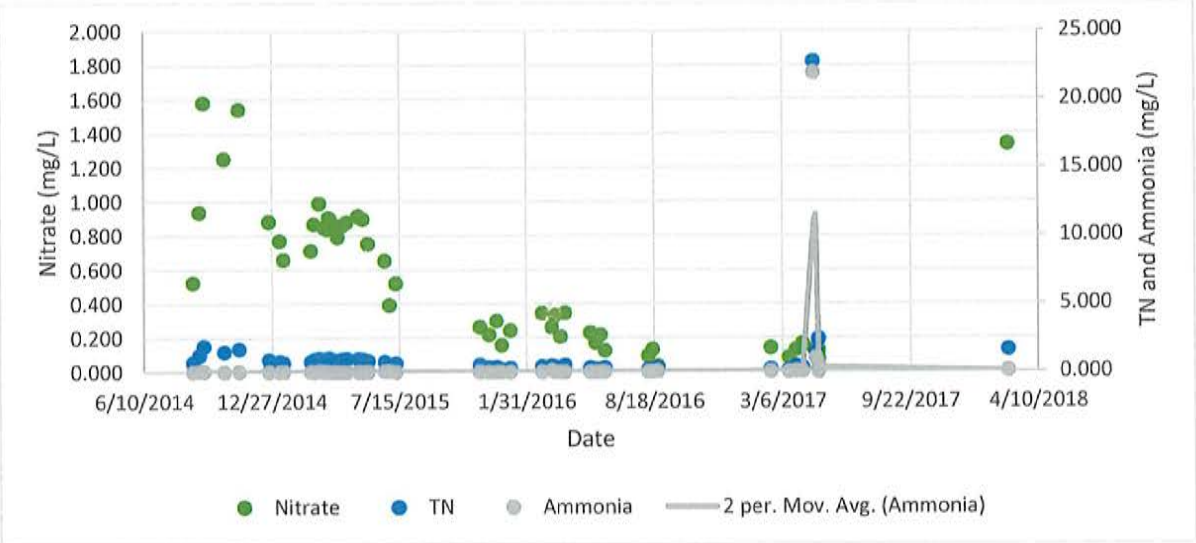


Figure 30. Nitrate, total nitrogen, and ammonia concentrations from Trench 1—including an unusually high ammonia concentration (from Mott, 2018 unpublished report)

Chloride is commonly used as a tracer to evaluate leakage from landfills, holding ponds, and contaminated areas. In the BCRET April-June 2016 Quarterly Report the use of chloride to monitor for leakage from Pond 1 and Pond 2 is suggested. I concur that this is a good approach. However, the following suggests that this might not always be a good approach: While the ammonia concentration was spiking in Trench 1, chloride concentrations declined from about 2.0 -2.5 milligrams per liter to a minimum of 0.557 milligrams per liter (fig. 31). This is unexpected given that concentrations in the ponds exceed 500 milligrams per liter (Harbor Environmental and Safety, 2016) with median concentrations ranging (depending on sampling depth in the pond) from 360 - 468 milligrams per liter (BCRET October-December 2016 Quarterly Report) and concentrations in groundwater in the Boone Formation usually exceed 1 milligram per liter (Leidy and Morris, 1990 and BCRET data). A possible geochemical explanation for the low chloride concentrations is attachment of chloride ions to clay and limestone present between the point of leakage and the point of sampling. For example, the soil testing conducted during the Harbor Drilling study showed a high correlation between clay content of the soils and chloride concentrations, indicating that these soils actively sorb chloride ions. The Harbor drilling study also detected chloride values in soils that exceeded typical values reported by Leidy and Morris (1990) in Boone County. The fluctuation of chloride values and the negative response to ammonia

indicates there may be more complicated chemical interactions taking place and makes using chloride as a tracer an uncertain option until these interactions can be ruled out or understood.



Figure 31. Concurrent increase in ammonia concentration and decrease in chloride concentration in samples from Trench 1 (from Mott, 2018 unpublished report)

An additional line of evidence that the holding ponds are discharging and measurably impacting groundwater is contained within the Harbor drilling report (Harbor Environmental and Safety, 2016). The borehole drilled by Harbor had a total depth of 120.5 feet below ground surface. This depth is similar to the 138 feet noted for the static water level on the Arnold well drilling log for the house well. Because of yield issues with the borehole the Harbor authors state that the 5th and final sample "B-1GW-5 is likely mostly groundwater; as the field parameters stabilized and the borehole continued to make water." It is likely the Harbor borehole final depth had encountered the water table when sample B-1GW-5 was collected. A flaw in the assessment employed by Harbor was to compare the water sample from the borehole only to average values from wells in Boone County, Arkansas. The results should also have been compared to the nearby House Well.

The mean concentration for total phosphorus from the House Well is 0.02 mg/L and the maximum observed post BCRET retrofit and adoption of USGS standards was 0.042 mg/L. The Harbor borehole sample returned a total phosphorus concentration of 0.313 mg/L, or 14 times greater than the maximum total phosphorus concentration from the House Well, and 16 times greater than the mean. Chloride concentrations were also elevated in the Harbor borehole sample relative to the House Well. The mean chloride concentration for the spring sampled by BCRET was also substantially lower than the borehole results at 0.07 mg/L. Detection limits used by the Harbor lab for other parameters such as ammonia and total nitrogen were too high to be used in this comparison. The results indicate the location of the aquifer sampled by the Harbor borehole is receiving a source of phosphorus.

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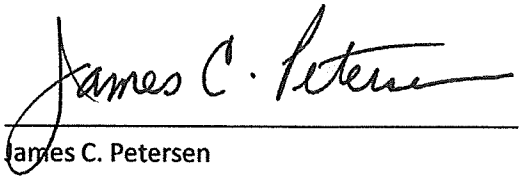
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13.0 Amendments

This report reflects information and opinions as of the date of this report. This report may be amended when additional data or information becomes available.

Signature:



James C. Petersen

October 16, 2018

14.0 Appendix A--Curriculum Vitae

I am an aquatic biologist and a water-quality hydrologist. I was a hydrologist with the U.S. Geological Survey Arkansas Water Science Center (and then the Lower Mississippi-Gulf Water Science Center) from 1979 through January 2016. During much of that time I was responsible, either individually or as part of a study team, for conducting several studies of surface-water and ground-water quality and aquatic biology in Arkansas, Missouri, and Oklahoma. Since 1992 most of these studies have been conducted in Ozark streams when I was study unit biologist and then study unit chief of the Ozark Plateaus study unit of the National Water Quality Assessment program. I have authored or co-authored more than 35 journal articles and U.S. Geological Survey reports. The topics of many of these manuscripts were water-

quality statistics of Arkansas streams and the water quality and biology of surface water and groundwater of the Ozark Plateaus and Boston Mountains of Arkansas, Missouri, and Oklahoma.

I retired from the U.S. Geological Survey in January 2016 and since that time have been a freelance scientific writer/editor.

I received a Bachelor of Science degree in biology in 1975 with an emphasis in fisheries biology from the University of South Dakota. I received a Master of Science degree from Oklahoma State University in zoology in 1979 with an emphasis in water-pollution biology. During my time with the U.S. Geological Survey (USGS) I took training courses in hydrologic statistics, water-pollution biology, organic chemistry, project planning and report writing at the USGS National Training Center.

Prior Testimony: I have not previously provided deposition or trial testimony.

Publications

The following are two sets of scientific publications that I have authored/co-authored (those most pertinent to evaluation of Big Creek hydrology; other publications):

Publications most pertinent to evaluation of Big Creek hydrology:

U.S. GEOLOGICAL SURVEY SIR 2014-5009
Effects of Land Use, Stream Habitat, and Water Quality on Biological Communities of Wadeable Streams in the Illinois River Basin of Arkansas, 2011 and 2012
James C. Petersen, B.G. Justus, and Bradley J. Meredith

U.S. GEOLOGICAL SURVEY SIR 2012-5086
Seasonal Patterns in Nutrients, Carbon, and Algal Responses in Wadeable Streams within Three Geographically Distinct Areas of the United States, 2007-08
Kathy E. Lee, David L. Lorenz, James C. Petersen, and John B. Greene

A Comparison of Algal, Macroinvertebrate, and Fish Assemblage Indices for Assessing Low-Level Nutrient Enrichment in Wadeable Ozark Streams. Ecological Indicators (2010)
B.G. Justus, James C. Petersen, Suzanne R. Femmer, Jerri V.Davis, and J.E. Wallace

U.S. GEOLOGICAL SURVEY OFR 2007-1302
Methods for Monitoring Fish Communities of Buffalo National River and Ozark National Scenic Riverways in the Ozark Plateaus of Arkansas and Missouri: Version 1.0
James C. Petersen, B.G. Justus, H.R. Dodd, D.E. Bowles, L.W. Morrison, M.H. Williams, and G.A. Rowell

U.S. GEOLOGICAL SURVEY SIM 2005-2908
Fishes of Buffalo National River
James C. Petersen

U.S. GEOLOGICAL SURVEY SIR 2005-5130
The Fishes of Buffalo National River, Arkansas, 2001-2003
James C. Petersen and B.G. Justus

U.S. GEOLOGICAL SURVEY OFR 2004-1277
Stream Habitat and Water-Quality Information for Sites in the Buffalo River Basin and Nearby Basins of Arkansas, 2001-2002
James C. Petersen

U.S. GEOLOGICAL SURVEY SIR 2004-5119
Fish Communities of the Buffalo River Basin and Nearby Basins of Arkansas and their Relation to Selected Environmental Factors, 2001-2002
James C. Petersen

U.S. GEOLOGICAL SURVEY CIRCULAR 1158
Water Quality in the Ozark Plateaus, 1992-1995.
James C. Petersen, James C. Adamski, Richard W. Bell, Jerri V. Davis, Suzanne R. Femmer, David A. Freiwald and Robert L. Joseph

U.S. GEOLOGICAL SURVEY WRI 2002-4024
Hydrologic characteristics of Bear Creek near Silver Hill and Buffalo River Near St. Joe, Arkansas, 1999-2000
James C. Petersen, Brian E. Haggard and W. Reed Green

U.S. GEOLOGICAL SURVEY WRI 2002-4210
Periphyton Communities in Streams of the Ozark Plateaus and Their Relations to Selected Environmental Factors
James C. Petersen, and Suzanne R. Femmer

U.S. GEOLOGICAL SURVEY FS 092-99
Quality of Ozark Streams and Ground Water, 1992-1995.
James C. Petersen, James C. Adamski, Richard W. Bell, Jerri V. Davis, Suzanne R. Femmer, David A. Freiwald and Robert L. Joseph

U.S. GEOLOGICAL SURVEY WRI 98-4155
Water-Quality Assessment of the Ozark Plateaus Study Unit, Arkansas, Kansas, Missouri, and Oklahoma-Fish Communities in Streams and Their Relations to Selected Environmental Factors
James C. Petersen

U.S. GEOLOGICAL SURVEY WRI 95-4042
Water-Quality Assessment of the Ozark Plateaus Study Unit, Arkansas, Kansas, Missouri, and Oklahoma-Analysis of Information on Nutrients, Suspended Sediment, and Suspended Solids, 1970-92
Jerri V. Davis, James C. Petersen, James C. Adamski, and David A. Freiwald

U.S. GEOLOGICAL SURVEY WRI 94-4022
Environmental and Hydrologic Setting of the Ozark Plateaus Study Unit, Arkansas, Kansas, Missouri, and Oklahoma
James C. Adamski, James C. Petersen, David A. Freiwald, and Jerri V. Davis

U.S. GEOLOGICAL SURVEY WRI 92-4044
Trends in stream water-quality data in Arkansas during several time periods between 1975-1989
Petersen, J. C.

U.S. GEOLOGICAL SURVEY WRI 90-4017
Trends and comparison of water quality and bottom material of northeastern Arkansas streams, 1974-85, and effects of planned diversions
Petersen, J. C.

U.S. GEOLOGICAL SURVEY WRI 88-4112
Statistical summary of selected water-quality data (water years 1975 through 1985) for Arkansas rivers and streams
Petersen, J. C.

U.S. GEOLOGICAL SURVEY OFR 84-727
Compilation of data collected and derived for water years 1980 and 1981 for the purpose of water-quality modeling of the lower Ouachita River and selected tributaries, south-central Arkansas
Petersen, J. C.; Morris, E. E.

U.S. GEOLOGICAL SURVEY WRI 83-4092
Water-quality assessment of the Illinois River basin, Arkansas
Terry, J. E.; Morris, E. E.; Petersen, James C.; Darling, M. E.

Other publications:

U.S. GEOLOGICAL SURVEY SIR 2012-5246
Simulated Effects of Hydrologic, Water Quality, and Land-Use Changes of the Lake Maumelle Watershed, Arkansas, 2004-10
Rheannon M. Hart, W. Reed Green, Drew A. Westerman, James C. Petersen, and Jeanne L. De Lanois

U.S. GEOLOGICAL SURVEY SIR 2012-5086
Seasonal Patterns in Nutrients, Carbon, and Algal Responses in Wadeable Streams within Three Geographically Distinct Areas of the United States, 2007-08
Kathy E. Lee, David L. Lorenz, James C. Petersen, and John B. Greene

U.S. GEOLOGICAL SURVEY SIR 2008-5018
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Joel M. Galloway, James C. Petersen, Erica L. Shelby, and Jim A. Wise

New distributional records of lampreys from Arkansas. 2006. *Henry W. Robison, C. Renn Tumlinson, James C. Petersen. Journal of the Arkansas Academy of Science vol. 60, article 35.*

U.S. GEOLOGICAL SURVEY SIR 2005-5129
The Fishes of Pea Ridge National Military Park, Arkansas, 2003
B.G. Justus and James C. Petersen

U.S. GEOLOGICAL SURVEY SIR 2005-5128
The Fishes of George Washington Carver National Monument, Missouri, 2003
James C. Petersen and B.G. Justus

U.S. GEOLOGICAL SURVEY SIR 2005-5127
The Fishes of Wilson's Creek National Battlefield, Missouri, 2003
James C. Petersen and B.G. Justus

U.S. GEOLOGICAL SURVEY SIR 2005-5126
The Fishes of Hot Springs National Park, Arkansas, 2003
James C. Petersen and B.G. Justus

U.S. GEOLOGICAL SURVEY WRI 2002-4187
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A Recent Record of the White Sucker, Catostomus commersoni, in the White River System, Arkansas. 1996. James C. Petersen, Faron D. Usrey, W.E. Keith, and James A. Wise, *Journal of the Arkansas Academy of Science vol. 50*

Sublethal effects of biologically treated petroleum refinery wastewaters on agonistic behavior of male orangespotted sunfish, *Lepomis humilis* (Girard). James C. Petersen, Sterling L. Burks, and Rudolph J. Miller. Environmental Toxicology and Chemistry (1986), vol. 5, issue 5, pp. 463-471.

U.S. GEOLOGICAL SURVEY WRI 85-4116
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Petersen, J. C.; Broom, M. E.; Bush, W. V..

U.S. GEOLOGICAL SURVEY OFR 82-761
Reconnaissance of stormwater-runoff water quality of the Big Piney Creek segment of the Cedar-Piney Creeks watershed, Yell County, Arkansas
Petersen, James C.

U.S. GEOLOGICAL SURVEY OFR 81-819
Water-quality reconnaissance of the Larkin Creek watershed, Lee and St. Francis counties, Arkansas
Petersen, James C.

U.S. GEOLOGICAL SURVEY OFR 81-806
Water-quality reconnaissance of Patton Lake, Jefferson County, Arkansas
Petersen, James C.

15.0 Appendix B--Methods Used for Analysis of Nutrient Management Watershed Concentrations and Yields

To estimate the flux (an instantaneous load, calculated as the product of the concentration of an individual sample and the 15-minute streamflow), yield (calculated as the flux divided by the drainage area), and concentrations for waters flowing from the pasture areas of the BC6 watershed and the Nutrient Management Watershed, a several step process was used to examine nitrate and dissolved phosphorus data. The process included estimation of streamflow at BC6, estimation of concentrations of nitrate and total phosphorus in water from hypothetical watersheds with 100 percent forest land use, and use of two component mixing models. The ultimate goal of this process was to estimate the yield (mass per second per square mile) and concentration of nitrate and total phosphorus from areas of pasture land use in the Nutrient Management Watershed and the BC6 watershed. The individual pasture yields from the BC6 and Nutrient Management Watershed watersheds were compared using the Wilcoxon Signed Rank Test and trends were analyzed using Spearman's rank correlation. For trend analysis the data were restricted to October 1, 2014 to September 30, 2017 to avoid seasonal bias. The trend analysis was performed on the difference (△ yield, Nutrient Management Watershed yield minus BC6 watershed yield) between the two watersheds. Steps in the process are listed below.

1. Streamflow for BC6 was estimated using the following equation:
   Flow at BC6= (Flow at BC7 -2.4 ft^3/sec) x 0.67

   where 2.4 ft^3/sec is the approximate flow at BC7 when BC6 stops flowing
   where 0.67 is the watershed ratio for the drainage areas of BC6 and BC7

2. Two-component mixing models (Mott and Steele, 1991) were used to calculate concentrations from forest and pasture lands from the BC6 and NMW watersheds for each of the sample collections. The models were of the form:
   $Q_{DS} X C_{DS} = (Q_f x C_f) + (Q_p x C_p)$, where Q is streamflow, C is concentration, DS is the BCRET site at the downstream end of the watersheds (BC6 for the BC6 watershed, BC7 for the NMW watershed), f is forest, and p is pasture.

   The equations were rewritten to solve for the unknown, C_p. C_f was estimated from a regression fit of mean concentration with percent pasture in the watershed for Buffalo National River sites on Richland Creek, Beech Creek, and the Buffalo River (near Boxley) and site BC6. For a few constituents C_f estimated using best professional judgment. The resulting regression equations were solved for a watershed with 0 percent pasture. Q_f and Q_p were calculated by multiplying the Q for BC6 or BC7 times the proportion of forest or pasture in BC6 or NMW watersheds. The rewritten equations were of the form:

$$C_{p,\,BC6} = ((C_{BC6} * Q_{BC6}) - (C_{f,\,BC6} * Q_{f,\,BC6}))/Q_{P,BC6}$$

3. Pasture concentrations (C_p) from individual samples were multiplied by the streamflow (Q_p) associated with the time and location (BC6 or BC7) of the sample and a conversion factor (28.316) resulting in an instantaneous flux (mg/sec) for each sample. Yields (mg/sec/mi^2) were calculated by dividing fluxes by the square miles associated with the area of pasture in the watershed.

Arkansas Department of Environmental Quality
ATTN: C&H Draft Denial
5301 Northshore Drive
North Little Rock, Arkansas 72118-5317
Water-draft-permit-comment@adeq.state.ar.us

I noticed that your website does not reflect the Interim Order and Stay issued by the Circuit Court on October 17, 2018. A copy of that Interim Order and Stay is attached hereto. Instead of advising the public of this Interim Order and Stay, it appears that the website was updated to state that the comment period for the draft decision to deny Regulation No. 5 Permit No. 5264-W has been extended to October 24, 2018. We believe that the public notice and comment period have been stayed, and that any action by ADEQ on our application for Regulation No. 5 Permit No. 5264-W, including terminating receipt of comments on or after October 24, 2018 at 4:30 pm, would be in violation of the Circuit Court's exclusive jurisdiction over C&H's application for Regulation No. 5 Permit No. 5264-W, and in violation of the Interim Order and Stay, and therefore null and void. We will bring any such matter to the attention of the Circuit Court as appropriate.

In the meantime, C&H is submitting, under protest, the attached Hydrogeologic and Supplemental Workplan as additional information for consideration in support of its application for Regulation No. 5 Permit No. 5264-W.

C&H Hog Farms, Inc.

Jason Henson 10/23/18
Jason Henson, President

HYDROGEOLOGIC AND SUPPLEMENTAL WORKPLAN

C&H Hog Farms, Inc.
Vendor, Arkansas
AFIN: 51-00164
Permit 5264-W

October 16, 2018

Terracon Project No. 35187309



Prepared For:
C&H Hog Farms
Vendor, AR

Prepared by:
Terracon Consultants, Inc.
Bryant, Arkansas

terracon.com

Terracon

Environmental ■ Facilities ■ Geotechnical ■ Materials

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1.0 INTRODUCTION

C&H Hog Farms, Inc. is submitting this Hydrogeologic and Supplemental Workplan (Workplan) in response the Arkansas Department of Environmental Quality (ADEQ) Statement of Basis draft denial of ADEQ Regulation No. 5 Permit 5264-W for the applicant below:

C&H Hog Farms, Inc.
HC 72 Box 2
Vendor, AR 72683
AFIN: 51-00164 Permit 5264-W

1.1 FACILITY LOCATION

The facility is located as follows: HC 72 Box 2 near the community of Mount Judea in Newton County, Arkansas. The facility is located at the following coordinates:

Latitude 35 55 30.47 N Longitude 93 4 18.42 W

The location of the site is depicted on Figure 1, which was reproduced from a portion of the USGS 7.5-minute series topographic map. The operating facility site is depicted on the site diagram, which is included as Figure 2.

1.2 PERMIT HISTORY AND BACKGROUND

The facility was previously permitted under APC&EC Regulation 6. The applicant submitted a permit application to administratively change from a Regulation 6 permit to a permit under APC&EC Regulation 5, which was received on April 7, 2016, with additional information received on June 29, 2016, December 6, 2017, December 26, 2017, and December 29, 2017. On January 10, 2018, the Department issued a decision to deny this permit application.

The applicant appealed this decision to the Commission, Docket No. 18-001-P. On August 24, 2018, the Commission approved Minute Order 18-20, adopting the Administrative Law Judge's (ALJ) recommended decision as set out in Order No. 14 in Docket No. 18-001-P, and that decision has been appealed to the Circuit Court in Newton County.

The facility operates as a sow-farrowing facility. The permit application proposed the following numbers of swine: 6 boars, 2,252 gestating sows, 420 lactating sows, and 750 nursery pigs.

1.3 PURPOSE, SCOPE, AND APPLICABILITY

ADEQ has denied issuance of the Regulation 5 permit after determining that certain engineering and geological studies are lacking, and more information is needed to support granting of the permit. In particular, ADEQ has requested that the following items be addressed:

- Groundwater Assessment;
- Geologic Assessments;
- Berm Integrity Assessment;
- Pond Construction Quality Assurance;
- Assessment of High Risk Areas of Land Application Sites;
- Pond Levee Integrity and Assessment Requirements; and,
- Emergency Response Preparedness

The purpose of this document is to provide additional documentation on the above referenced items, and to provide guidance on the additional investigative site studies. This will be conducted as a condition of permit approval

1.4 HYDROGEOLOGIC SETTING

The uppermost geologic formation below the site is the Mississippian-age Boone Formation (Haley, et al., 1993). The Boone formation consists of gray, fine- to coarse-grained fossiliferous limestone interbedded with chert. Some sections may be predominantly limestone or chert. The cherts are dark in color in the lower part of the sequence and light in the upper part. The quantity of chert varies considerably both vertically and horizontally. The sequence includes an oolite (Short Creek) member near the top of the Boone Formation in western exposures and the generally chert-free St. Joe Member at its base. Thickness of the Boone Formation ranges from approximately 300 to 350 feet in most of northern Arkansas (McFarland, 2004).

Groundwater below the site is contained within the Ozark Plateaus aquifer system, which consists of three distinct water bearing zones separated by two distinct confining units. The uppermost aquifer is the Springfield Plateau aquifer, which is contained in the Boone Formation and the St. Joe Member of the Boone Formation (Renken, 1998). Additional information concerning site specific geology is discussed below.

1.4.1 Site Hydrogeologic Setting

Four soil borings have previously been advanced at the site and the lithology and groundwater conditions are discussed below.

GTS, Inc. advanced three shallow geotechnical borings, prior to development of site operations, in May 2012. The three soil borings were identified as BH-1, BH-2, and BH-3. The soil borings

were advanced to depths ranging from approximately 11.5 to 18.5 feet below ground surface (bgs). Groundwater was not encountered in the GTS, Inc. soil borings.

Harbor Environmental and Safety (Harbor) advanced one soil boring at the site in September 2016. The soil boring was identified as B-1 and was advanced to a depth of approximately 120.5 feet bgs. According to the Harbor boring log, groundwater was reported to be present during drilling at approximately 59 feet bgs. However, groundwater samples were collected at various depths throughout the boring.

It should be noted that the sonic drilling method used during the Harbor boring "utilized a fairly substantial volume of potable water" once bedrock was encountered to advance the borehole. Therefore, making a definitive interpretation of the depth to first encountered groundwater more difficult.

Soil lithology encountered during the soil borings was generally as follows:

- 0 to 8 feet – lean clay and silty clay
- 8 feet to 13 feet – clay with gravel and chert fragments
- 13 feet to 28 feet – weathered limestone with some clay beds
- 28 feet to 120.5 – competent limestone with some fractures and bedding planes

The soil boring logs are presented in Appendix A. A map illustration of the location of the soil borings is presented in **FIGURE 2**.

2.0 SITE CHARACTERIZATION TASKS

2.1 GROUNDWATER ASSESSMENT

The previous Harbor soil boring drilled at the site indicates that groundwater was encountered around 59 feet bgs, while a second porous zone was encountered around 99 feet bgs. This showed that the groundwater separation requirement was met. In order to further define subsurface conditions and evaluate groundwater flow direction from the waste storage ponds, three (3) groundwater monitoring wells (B-2/MW-2, B-3/MW-3 and B-4/MW-4) will be installed downgradient of the ponds as a condition of permit approval. Once installed, the wells may also be used to monitor groundwater quality at this area.

Soil Borings

The previous Harbor soil boring drilled at the site indicates that approximately 13 feet of unconsolidated regolith (clay, chert and limestone fragments) is present overlying limestone bedrock, and groundwater was encountered around 59 feet bgs, while a second porous zone was encountered around 99 feet bgs. Therefore, it is estimated that the proposed new wells will be drilled to a depth of between 60 to 100 feet bgs (final depths will be determined based on-site geology and depth to groundwater encountered during drilling).

It is anticipated that the borings will be drilled utilizing both hollow stem auger and air hammer drilling techniques. The upper unconsolidated soils will be drilled and sampled using hollow stem augers. Upon encountering bedrock, the borings will be drilled using air hammer methods. Upon reaching a depth of approximately 50 feet bgs, drilling activities will be temporarily suspended every ten feet and the borings left open to observe the potential presence of groundwater and stabilized groundwater conditions. These subcontract drilling services will be conducted by a State of Arkansas licensed driller.

Figure 2 presents the location of previous site exploration borings and location of the three proposed new monitoring wells.

Well Construction

Each of the new monitoring wells will be constructed in accordance with *ASTM D5092 Standard Practice for Design and Installation of Groundwater Monitoring Well in Aquifers*. The borings will be converted into permanent groundwater monitoring wells, which can be incorporated into an on-site groundwater monitoring system. Monitoring wells will be constructed as follows:

- Installation of 10 feet of 2-inch diameter, 0.010-inch machine slotted PVC well screen with a threaded bottom cap;
- Installation of 2-inch diameter, threaded, flush-joint PVC riser pipe to above ground surface;

- Addition of pre-sieved 12/20 grade silica sand for annular sand pack around the well screen from the bottom of the boring to approximately 2 feet above the top of the well screen;
- Placement of 2 feet of coated bentonite pellets above the sand pack;
- Addition of Portland cement/bentonite slurry to near ground surface; and,
- A stick-up monument type steel protective cover and a concrete pad at ground surface.

A licensed Arkansas professional geologist will oversee and document the installation of the groundwater monitoring wells.

Survey

Upon completion of the installation of the new groundwater monitoring wells, the latitude, longitude and top of casing elevations will be surveyed by an Arkansas licensed surveyor. A mark will be placed on the north side of the top of casing on each monitoring well to indicate the survey point. The top of casing elevation will be measured to the nearest 0.01 foot to the North American Vertical Datum (NAVD).

2.2 GEOLOGIC ASSESSMENT

These are “not” in-situ ponds. The excavation area was below the constructed ponds and was approximately three acres in size that reached from elevation ~912.0 to elevation ~885.0. The bottom of pond #2 (top of the clay liner) is 894.3. This exceeds the 5-foot separation requirement from groundwater. The soil berms were initially constructed and then an 18” clay liner was constructed within the soil berm area.

The three groundwater monitoring wells will be used to further define the subsurface geological characteristics of the site as a condition of permit approval. During drilling activities, a log of the drilling conditions and lithology encountered will be recorded by a Terracon geologist. The borings will be logged in the field following descriptions provided in the Unified Soil Classification System (USCS).

The information will be recorded on a boring log, which will become part of the project file. Information recorded may include:

- Boring or well identification;
- Location of the boring and drilling method;
- Names of drilling contractor and logger;
- Start and finish dates;
- Depth at which saturated conditions were first encountered;
- Well construction details and screened interval;
- Water level measurements;
- Lithologic descriptions;
- Color;

- Depths of lithologic boundaries; and,
- General rock drilling hardness, zones of drill bit drop, and drill rig reactions.

Once the wells are installed, downhole geophysical logging of the three borings will be conducted using natural gamma and resistivity logging to define contact depth and thickness of clay and/or bedrock stratagraphic characteristics.

2.3 INVESTIGATIVE REPORT

Upon completion of the field work as stated herein, a Hydrogeologic and Supplemental Investigation Report will be prepared, and results summarized in a written report. The report will be prepared under the supervision of and certified by an Arkansas Registered Geologist. The report will contain a detailed description of field activities and methodology. The report will contain all pertinent maps, figures and geologic cross-sections. The maps and cross sections included in the written report will have a uniform scale and the report will include the following:

- Location of existing wells;
- Boring logs and geophysical testing results;
- Water table and potentiometric flow map;
- Geologic cross sections illustrating:
    - Ø Stratigraphy
    - Ø Water table and/or potentiometric surface
    - Ø Lithologic logs of exploration borings
    - Ø Screened intervals in piezometers
    - Ø Geophysical logs of exploration borings
    - Ø Piezometer installation including screened interval

2.4 BERM INTEGRITY ASSESSMENT

We believe that the ponds were constructed according to the regulations. As previously mentioned, three borings logs were submitted by C&H Hog Farms. These berms and ponds were engineer designed and constructed with an additional 18-inch of constructed and tested clay liner inside the pond areas. These are “not” in-situ ponds that would require additional borings to verify the in-situ materials. The excavation area was approximately three acres that reached from elevation ~912.0 to elevation ~885.0. The bottom of pond #2 (top of the clay liner) is 894.3. This exceeds the 5-foot separation requirement from groundwater. The soil berms were initially constructed and then an 18” clay liner was constructed within the soil berms. The remolded perm test was 5 x 10^{-7} cm/sec which is 2 times better than the 1 x 10^{-6} cm/sec required by Table 10-4 in the AWMFH Handbook.

As the ADEQ previously stated, Karst terrain is characterized by springs, caves, and sinkholes. In addition as previously stated by the ADEQ, “AWMFH, 65l.0702(c) states**: Sinkholes or caves** in karst topography or underground mines may disqualify a site for a waste storage pond or

treatment lagoon. As per the ADEQ Memo by Caleb Osborne (Associate Director) to Becky Keogh (Director) dated January 18, 2017 "**There was no evidence of a release from the storage ponds**". Also, in this same memo "Mr. Hubbard and Mr. Huetter describe fracturing in the limestone and agree that no voids were encountered during the boring. Mr. Hubbard further elaborates that there were no significant karst-related voids identified in the core recovery or by driller observation. There were also twelve (12) reasons given in the "Final Environmental Assessment, C&H Hog Farms, Newton County, Arkansas", Prepared by the USDA dated December 15, 2015 why there were no significant impacts at this facility.

C & H Hog Farms will perform additional safeguards to their facility as a condition of permit approval. The facility will install a geosynthetic liner above the previously installed 18-inch clay liner. The site personnel will also perform weekly inspections of the berms and have a third-party engineer inspect the berms annually. Although the installation of the geosynthetics and berm inspections should reduce the chance of a slope failure, the facility has prepared an enhanced emergency response plan (**APPENDIX D**). These additional safe guards will be discussed later in this report.

2.5 POND CONSTRUCTION QUALITY ASSURANCE

C&H Hog Farms will install an additional synthetic liner system above the previously installed 18-inch clay liner as a condition of permit approval even though we believe that the C&H geology report dated May 18, 2012, The Pond Construction QA/QC Soil Testing report dated April 12, 2013, the USDA Final Environmental Assessment Report dated December 2015, the Harbor Drilling report, and the toe drains installed at the toe of the slope show that the current system is functioning properly. The addition of a 40-mil LLDPE geomembrane will add additional safe-guards to the current system. An additional layer of geomembrane will be installed on the entire crest as a rub sheet to protect the 40-mil LLDPE geomembrane liner. A gas vent will be placed in each pond to reduce the geomembrane from floating. The drawing with the 40-mil LLDPE details and specifications can be found in **APPENDIX B.**

2.6 ASSESSMENT OF HIGH RISK AREAS OF LAND APPLICATION SITES

AWMFH 651.0504 (a)-(n) and Table 5-3 are based on recommendations, not requirements for land application of agricultural waste (nutrients). The facility proposes using 40 fields for land application. The proposed 40 fields consist of 831.7 acres. 611.8 acres of the 831.7 acres are utilized for land application (See **APPENDIX E**). Each delineated field from the Regulation 5 Nutrient Management Plan has been listed with the predominate soil type and the associated soil characteristics from Table 5-3 (See **APPENDIX F**). Most application fields are in the Slight category for the different soil characteristics, with no limitations of land application. A few fields are in the Moderate category with recommendations of reduced or split applications, which are accomplished by using the ARNMP Phosphorous Index planning tool. In some cases, the AWMFH 5-32 Table recommends the incorporation of liquid waste (nutrients) as quickly as possible. Although this practice would be acceptable in a row crop situation, these fields are in

permanent pasture and hay, for which incorporation of liquid nutrients could cause significant and severe erosion, which will lead to greater environmental concerns down the road.

2.7 POND LEVEE INTEGRITY AND ASSESSMENT REQUIREMENTS

The facility will have personnel, at intervals not exceeding seven days, inspect for any appearances of actual or potential structural weakness and other conditions which are disrupting or have the potential to disrupt the operation or safety of the facility. The results of the inspection by a qualified person will be recorded in the facility's operating record (See **APPENDIX C**). The facility will be inspected on a periodic basis (annually) by a qualified professional engineer to ensure that the design, construction, operation, and maintenance of the Hog Farm is consistent with recognized and generally accepted good engineering standards.

2.8 EMERGENCY RESPONSE PREPAREDNESS

As previously discussed, the installation of the additional geosynthetics and the berm inspections should reduce the possibility of a slope failure. The facility has compiled an emergency response plan. The C & H Emergency Response Plan is in **APPENDIX D.**

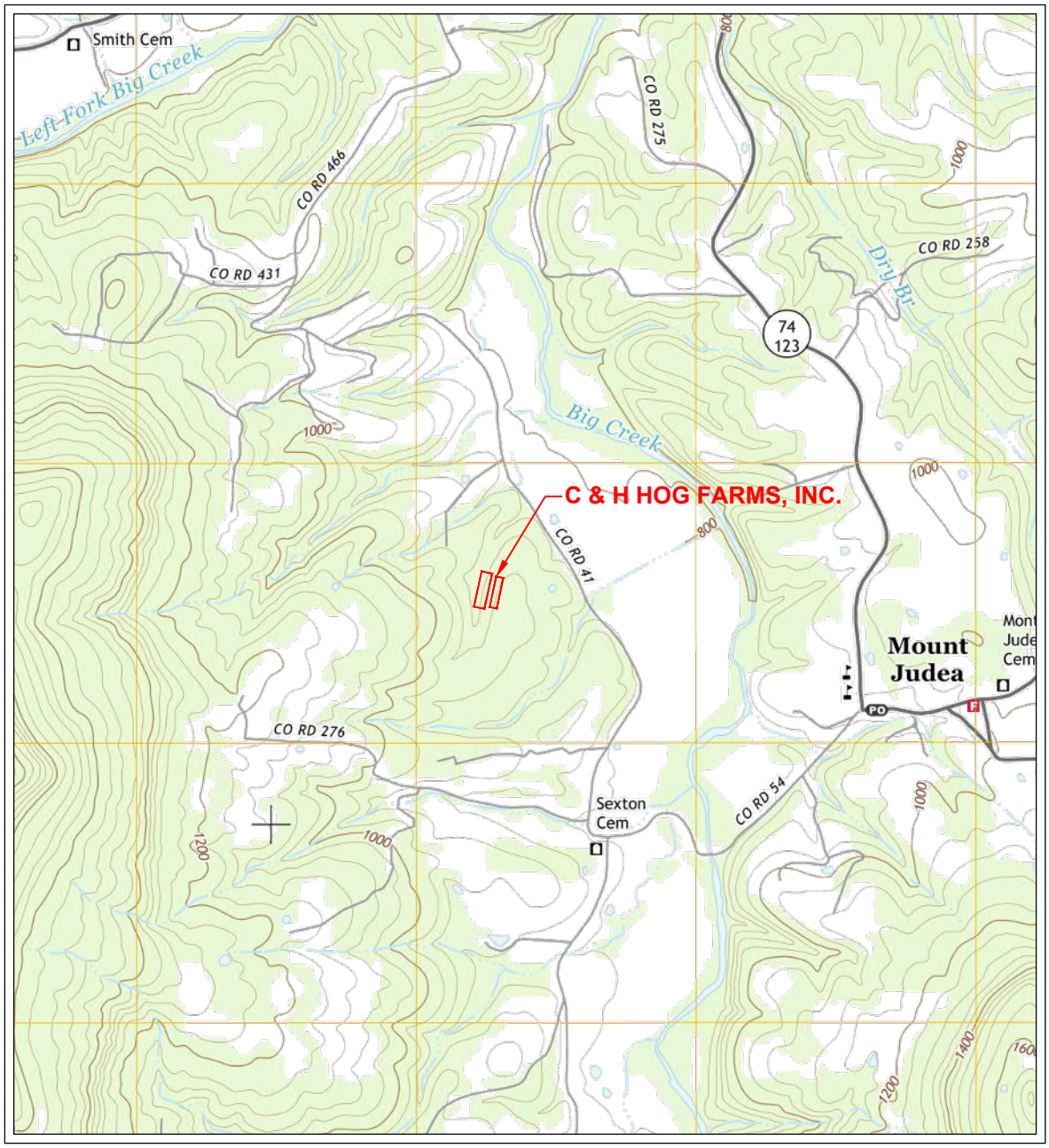
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Haley, B. R., 1993, Geologic Map of Arkansas, Arkansas Geological Commission, Little Rock, Arkansas.

McFarland, J.D., 2004, Stratigraphic Summary of Arkansas (Information Circular 36). Arkansas Geological Commission. Little Rock, Arkansas.

Renken, R.A., 1998, Ground Water Atlas of the United States, Segment 5, Arkansas, Louisiana, Mississippi. Hydrologic Investigations Atlas 730-F, United States Geological Survey, Reston, Virginia.

UNITED STATES – DEPARTMENT OF THE INTERIOR – GEOLOGICAL SURVEY



SCALE 1:24 000

1 .5 0 KILOMETERS 1 2

1000 0 METERS 1000 2000

1 .5 0 1

MILES

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 10 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

N

MOUNT JUDEA QUADRANGLE 1975 - Revised 1980 7.5 MINUTE SERIES (TOPOGRAPHIC)

Project Mngr: DCM	Project No. 584-001-35187129	Terracon Consulting Engineers and Scientists	SITE LOCATION MAP	FIG. No.
Drawn By: TLB	Scale: AS SHOWN	25809 I-30 SOUTH BRYANT, AR 72022	HYDROGEOLOGIC AND SUPPLEMENTAL WORKPLAN	1
Checked By: DCM	File No. 005	PH. (501) 847-9292 FAX. (501) 847-9210	C&H HOG FARMS INC.	
Approved By: DCM	Date: 10/12/2018		VENDOR ARKANSAS	



LEGEND:

- BH-1 GTS SOIL BORING MAY 2012
- B-1 HARBOR SPRINGS (SEPTEMBER 2016)
- B-2 TERRACON PROPOSED BORING

N

0 50 100 200

SCALE IN FEET

Project Mngr:	DCM
Drawn By:	TLB
Checked By:	TLB
Approved By:	DCM

Project No.	584-001-35187129
Scale:	AS SHOWN
File No.	006
Date:	10/12/2018

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

EXISTING AND PROPOSED BORING LOCATIONS

HYDROGEOLOGIC AND SUPPLEMENTAL WORKPLAN

C&H HOG FARMS INC.

VENDOR ARKANSAS

FIG. No. 2

Previous Boring Logs
APPENDIX A

LOG OF BORING NO.B-1

Proposed Pond and Building Pads
Mt. Judea, Arkansas

GTS, Inc.
Geotechnical & Testing Services
Fayetteville, AR

Project No.: 12-15049 Location: Shown on Boring Location Diagram

DEPTH, FT	SYMBOL	SAMPLES	SAMPLE No.	RECOVERY (in.)	DESCRIPTION OF MATERIAL	USCS	%<#200	HAND PENETROMETER, TSF ■ / LAB. COHESION, TSF ▲ (0.4, 0.8, 1.2, 1.6) / WATER CONTENT, % ● (PL — LL; 20, 40, 60, 80)	BLOWS PER FT
0					Surface Description=Grass Cover Rootmat = 4"				
			1	12	SILTY SAND medium dense, brown with organics	SM			17
					SILTY CLAY very stiff, tan and orange with organics	CL-ML			
2.5			2	16	LEAN CLAY, with sand very stiff, gray, red and tan	CL			18
			3	18	SANDY LEAN CLAY, with gravel very stiff, orangish brown and red with sandstone fragments	CL			21
5			4	16	SANDY LEAN CLAY, with trace gravel very stiff, brown, tan and red with rootlets and sandstone fragments	CL			30
7.5			5	18	SANDY LEAN CLAY, with gravel very stiff, orange, brown and light gray with chert and sandstone fragments	CL			48
10			6	18					47
12.5			7	18					50
15					BOTTOM OF BORING AT 13½ FEET				
17.5									

COMPLETION DEPTH: 13.5 ft.
DATE: 5/14/2012
RIG: Diedrich D-50

DEPTH TO WATER: DURING DRILLING: DRY
AT COMPLETION: DRY
AT 24 HOURS: N/A

LOG OF BORING NO.B-2

Proposed Pond and Building Pads
Mt. Judea, Arkansas

GTS, Inc.
Geotechnical & Testing Services
Fayetteville, AR

Project No.: 12-15049 Location: Shown on Boring Location Diagram

DEPTH, FT	SYMBOL	SAMPLES	SAMPLE No.	RECOVERY (in.)	DESCRIPTION OF MATERIAL	USCS	%<#200	HAND PENETROMETER, TSF ■ / LAB. COHESION, TSF ▲ (0.4 0.8 1.2 1.6) / WATER CONTENT, % ● (PL — LL, 20 40 60 80)	BLOWS PER FT
0					Surface Description=Grass Cover Rootmat = 2"				
			1	13	SILT, with sand medium dense, brown with organics	SM			25
2.5			2	15	CLAYEY GRAVEL, with sand dense, red and tan with chert fragments	GC			30
			3	18	CLAYEY SAND / SANDY LEAN CLAY dense, very stiff, red and tan with extremely weathered sandstone fragments and chert fragments	CL			30
5			4	18		SC			26
7.5			5	18	FAT CLAY, with sand very stiff, light gray, red and orangish tan	CH			22
10			6	17	SANDY FAT CLAY very stiff, light gray, red and orangish tan	CH			25
12.5			7	15	GRAVELLY FAT CLAY very stiff, light gray, red and orangish tan with chert fragments	CH			65
15			8	18	FAT CLAY, with gravel very stiff, light gray and tan with chert fragments	CH			34
17.5					FAT CLAY very stiff, tan with ferrous nodules	CH			

COMPLETION DEPTH: 18.5 ft.
DATE: 5/15/2012
RIG: Diedrich D-50

DEPTH TO WATER: DURING DRILLING: DRY
AT COMPLETION: DRY
AT 24 HOURS: N/A

LOG OF BORING NO.B-2

Proposed Pond and Building Pads
Mt. Judea, Arkansas

GTS, Inc.
Geotechnical & Testing Services
Fayetteville, AR

Project No.: 12-15049 Location: Shown on Boring Location Diagram

DEPTH, FT	SYMBOL	SAMPLES	SAMPLE No.	RECOVERY (in.)	DESCRIPTION OF MATERIAL	USCS	%<#200	HAND PENETROMETER, TSF ■ / LAB. COHESION, TSF ▲ (0.4 0.8 1.2 1.6) / WATER CONTENT, % ● (PL — LL; 20 40 60 80)	BLOWS PER FT
			9	18					20
					BOTTOM OF BORING AT 18½ FEET				
20									
22.5									
25									
27.5									
30									
32.5									
35									

LOG OF BORING NO.B-3

Proposed Pond and Building Pads
Mt. Judea, Arkansas

GTS, Inc.
Geotechnical & Testing Services
Fayetteville, AR

Project No.: 12-15049 Location: Shown on Boring Location Diagram

DEPTH, FT	SYMBOL	SAMPLES	SAMPLE No.	RECOVERY (in.)	DESCRIPTION OF MATERIAL	USCS	%<#200	HAND PENETROMETER, TSF ■ / LAB. COHESION, TSF ▲ (0.4 0.8 1.2 1.6) / WATER CONTENT, % ● (PL — LL; 20 40 60 80)	BLOWS PER FT
0			1	10	SILT, with sand and trace gravel medium dense, orangish brown with organics and chert fragments	ML			13
2.5			2	18	CLAYEY SAND, with gravel medium dense, orangish tan and brown with chert fragments	SC			29
			3	16	CLAYEY GRAVEL, with sand dense, red and brown with sandstone and chert fragments	GC			38
5			4	16					72
					CHERT SEAM = 6"				
7.5			5	18	FAT CLAY, with sand very stiff, light gray, brown and orangish tan, blocky	CH			24
10			6	11	CLAYEY GRAVEL, with sand very dense, brown and tan with chert fragments	GC			50/5"
12.5					AUGER REFUSAL AT 11½ FEET				
15									
17.5									

COMPLETION DEPTH: 11.5 ft.
DATE: 5/14/2012
RIG: Diedrich D-50

DEPTH TO WATER: DURING DRILLING: DRY
AT COMPLETION: DRY
AT 24 HOURS: N/A

BORING LOG
B-1

C&H Hog Farms Facility
Mt. Judea, Arkansas

Prepared for:
Arkansas Department of Environmental Quality

Date Completed:	9/23/16	Latitude:	35.92279
Hole Diameter:	6.0 in.	Longitude:	-93.073269
Drilling Method:	Rotosonic	Driller:	Cascade Drilling
Sampling Method:	10-Ft. Core Barrel/Sleeve	Logged By:	T. Huetter, P.G.
Total Boring Depth:	120.5 ft.	Company:	Harbor Environmental

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Soil Sample (ft.)	REMARKS
			Assume elevation 915 msl		
0	CL		SILTY CLAY w/ some chert and limestone fragments, yellowish red (5YR 4/6), fill.	B-1S-1 (0-0.5 ft.)	Hand auger to 2.3 ft. (refusal) then commenced sonic drilling.
				B-1S-2 (5.0 ft.)	
10	CH		FAT CLAY, very few chert and limestone fragments, same color as above.	B-1S-3 (10.0 ft.)	
	LS		LIMESTONE, fine-grained, gray (5Y 5/1), fossiliferous.	B-1S-4 (13.5 ft.)	
	CH		Same FAT CLAY as above.	B-1S-5 (18.5 ft.)	Duplicate soil sample collected (BD-1).
20			LIMESTONE, fine-grained, weathered and fractured, gray (5Y 5/1) to buff, fossiliferous.		
			CLAY interval as above.	B-1S-6 (25.0 ft.)	Driller reported water loss at approx. 25 ft.
					890 msl
30			LIMESTONE, competent w/ some fracturing and bedding planes, gray (5Y 5/1), fossiliferous.		
40	LS		Competent, no indication of bedding planes or natural fractures.		5.1' recovery from 28.5 to 38.5 ft. Total approx. 750 gallons potable water added.
50			Some oxidation in natural fractures.		7.8' recovery from 38.5 to 48.5 ft.
60					~9' recovery from 48.5 to 58.5 ft.

BORING LOG
B-1

C&H Hog Farms Facility
Mt. Judea, Arkansas

Prepared for:
Arkansas Department of Environmental Quality

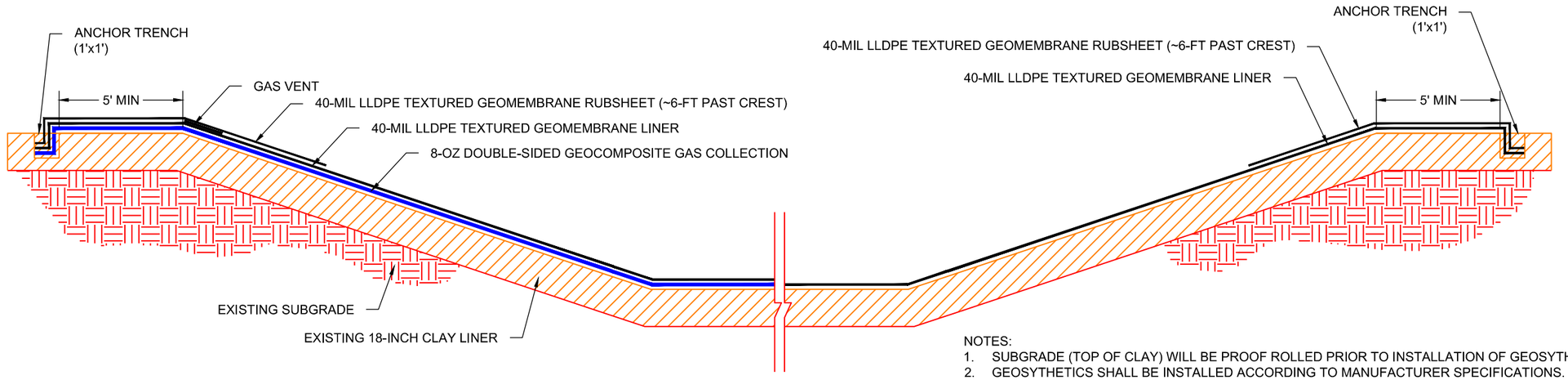
Date Completed:	9/23/16	Latitude:	35.92279
Hole Diameter:	6.0 in.	Longitude:	-93.073269
Drilling Method:	Rotosonic	Driller:	Cascade Drilling
Sampling Method:	10-Ft. Core Barrel/Sleeve	Logged By:	T. Huetter, P.G.
Total Boring Depth:	120.5 ft.	Company:	Harbor Environmental

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Soil Sample (ft.)	REMARKS
60			LIMESTONE, competent w/ some fracturing and bedding planes, gray (5Y 5/1), fossiliferous.		856 msl groundwater
			Fractured		Collect B-1GW-1, BD-2 (duplicate), and B-1GW-2 groundwater samples, Depth: 68.5 ft.
70					7.5' recovery from 58.5 to 68.5 ft.
80					8.5' recovery from 68.5 to 78.5 ft.
			Increased fractures.		
	LS				~9' recovery from 78.5 to 88.5 ft.
90					
					10' recovery from 88.5 to 987.5 ft. Collect B-1GW-3 groundwater sample Depth: 98.5 ft.
100			LIMESTONE, competent, interbedded with thin to medium beds of shaley limestone, gray (5Y 5/1), fossiliferous.		816 msl High porosity zone
110					Driller switched to longer core barrel. 11' recovery from 98.5 to 109 ft.
					11' recovery from 109 to 120.5 ft. Collect B-1GW-4 and B-1GW-5 groundwater samples, TD = 120.5 ft.
120					

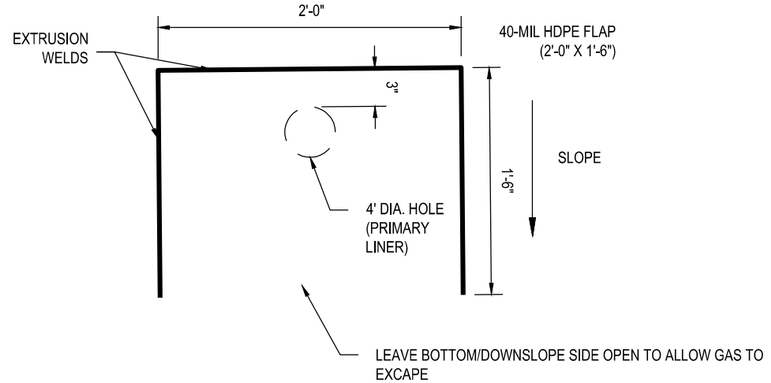
Geophysical logging conducted on borehole (9/23/16) then boring grouted to land surface with Portland cement via tremmie method. Grout topped off on 9/26/16. Full thickness of limestone bedrock cores maintained in core boxes.

11-01-2016 C:\Projects\C&H Hog Farm\B-1 Boring Log.bor

Pond Detail with Geosynthetics
APPENDIX B



NOTES:
1. SUBGRADE (TOP OF CLAY) WILL BE PROOF ROLLED PRIOR TO INSTALLATION OF GEOSYTHETICS.
2. GEOSYTHETICS SHALL BE INSTALLED ACCORDING TO MANUFACTURER SPECIFICATIONS.
3. DOUBLE-SIDED GEOCOMPOSITE GAS COLLECTION LINE SHALL BE ONE ROLL WIDTH WIDE RUNNING FROM THE CREST TO THE CENTER EACH POND. THERE WILL BE ONE GAS COLLECTION LINE PER POND DUE TO SMALL SIZE.
4. DOUBLE-SIDED GEOCOMPOSITE MATERIAL SHALL BE SKAPS TN-220-2-8 OR EQUIVALENT. THE MATERIAL WILL BE APPROVED BASED ON MANUFACTURER'S CERTIFICATES.
5. 40-MIL LLDPE TEXTURED GEOMEMBRANE SHALL BE INSTALLED ACROSS EACH POND
   - 5.1. MATERIAL SHALL CONFORM TO SPECIFICATIONS IN TABLES 1A AND 1 B.
   - 5.2. TRIAL SEAMS SHALL BE PERFORMED PRIOR TO WELDING.
   - 5.3. TRIAL SEAMS, NON-DESTRUCTIVE TESTING, AND DESTRUCTIVE TESTING SHALL MEET SPECIFICATIONS IN TABLE 1B.
6. 40-MIL LLDPE TEXTURED GEOMEMBRANE RUBSHEET SHALL BE INSTALLED ALONG THE CREST OF EACH POND.
   - 6.1. TRIAL SEAMS SHALL BE PERFORMED PRIOR TO WELDING
   - 6.2. TRIALS SEAMS AND NON DESTRUCTIVE TESTING SHALL MEET SPECIFICATIONS IN TABLE 1B.
   - 6.3. DESTRUCTIVE TESTING IS NOT REQUIRED ON THE RUBSHEET.
7. RUBSHEET SEAMS SHALL BE FUSION WELDED.
8. ANCHOR TRENCH SHALL BE BACKFILLED WITH CLAY RICH MATERIAL.



GAS VENT

DETAIL 1

SCALE: N.T.S.

TABLE 1A
40 mil LLDPE Textured MQC Specifications

Resin Manufacturer (1)			
Test	**Method(2)**	**Testing Frequency**	**Min. Requirements (5)**
Density	ASTM D 1505 ASTM 792, Meth B	200,000 lb and per batch	> 0.915 g/cm3
Melt Flow Index	ASTM D 1238 (190°C/2.16 kg)	200,000 lb and per batch	≤ 1.0 g / 10 min.
Manufacturer's Quality Control			
Thickness, nominal	ASTM D 5994	Each Roll	40 mil
Thickness, Min. ave	ASTM D 5994	Each Roll	38 mil
Thickness, lowest indiv. For 8 of 10 spec.	ASTM D 5994	Each Roll	36 mil
Thickness, lowest indiv. For 1 of 10 spec.	ASTM D 5994	Each Roll	34 mil
Asperity Height (Min. ave.) 3	GRI GM13 ASTM D 7466	Each Roll	16 mil
Density	ASTM D 1505	Per 200,000 lb.	0.939 g/cm3
Carbon Black Dispersion 4	ASTM D 5596	Per 45,000 lb	Category 1 or 2
Carbon Black Content 6	ASTM D 1603 ASTM D 4218	Per 20,000 lb	2 to 3 %
Tensile Properties:			
Break	ASTM D 6693 Type IV	Per 20,000 lb	
Strength	Dumbbell, 2 ipm		60 lb/in
Elongation	G.L. = 2.0 inches		250%
Tear Resistance	ASTM D 1004	Per 45,000 lb	22 lb
Puncture Resistance	ASTM D 4833	Per 45,000 lb	44 lb
Conformance Testing by CQA Engineer			
Thickness, nominal	ASTM D 5994	1 per 100,000 sf	60 mil
Thickness, Min. ave	ASTM D 5994		57 mil
Thickness, lowest indiv. For 8 of 10 spec.	ASTM D 5994		54 mil
Thickness, lowest indiv. For 1 of 10 spec.	ASTM D 5994		51 mil
Asperity Height (Min. ave.)	GRI GM12	1 per 100,000 sf	16 mil
Density	ASTM D 1505	1 per 100,000 sf	0.94 g/cm3
Carbon Black Dispersion 2	ASTM D 5596	1 per 100,000 sf	Category 1 or 2
Carbon Black Content	ASTM D 1603 ASTM D 4218	1 per 100,000 sf	2 to 3 %
Tensile Properties:			
Break	ASTM D 6693 Type IV	1 per 100,000 sf	
Strength	Dumbbell, 2 ipm		115 lb/in
Elongation	G.L. = 2.0 inches		100%
Yield			
Strength			132 lb/in
Elongation			12%
Tear Resistance	ASTM D 1004	1 per 100,000 sf	45 lb
Trial Seams			
Shear	ASTM D 6392	Every 5 (five) hours of	Shear 121 ppi
Peel Fusion3		seaming.	Peel 98 ppi
Peel Extrusion3			Peel 78 ppi
Destructive Seam Testing			
Shear	ASTM D 6392	1 per 500 linear feet (LF) of seam	Shear 121 ppi
Peel Fusion3			Peel 98 ppi
Peel Extrusion3			Peel 78 ppi
Non-destructive Seam Field Testing			
Air Pressure	GRI GM6	Dual track fusion weld seams	Min 27 psi, held for 5 minutes; losing ≤ 3 psi; puncture opposite end after test to check for continuity
Vacuum	ASTM D 4437	Extrusion Seams	3 to 5 in Hg held for ≥ 15 sec.
Oxidation Induction Time (OIT)			
Standard OIT	ASTM D 3895	200,000 lb and per batch	100 min
High Pressure OIT	ASTM D 5885		400 min
Oven Aging @ 850C			
Standard OIT	ASTM D 3895	Per each formulation	35%
High Pressure OIT	ASTM D 5885		60%
UV Resistance			
High Pressure OIT	ASTM D 5885	Per each formulation	35%

1. The polyethylene resin from which the geomembrane is made will generally be in the density range of 0.926 g/ml or lower, and have a melt index value per ASTM D1238 of less than 1.0 g/10 min. This refers to the natural, i.e., nonformulated, resin. The resin shall be virgin material with no more than 10% rework. If rework is used, it must be a similar HDPE as the parent material. No post consumer resin (PCR) of any type shall be added to the formulation.
2. Test to be performed according to the latest test method as approved by the certifying engineer.
3. Textured geomembrane shall generally have uniform texturing appearance. It shall be free from agglomerated texturing material and such defects that would affect the specified properties of the geomembrane.
4. Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
5. If 40-mil LLDPE smooth is used, it must meet GRI-GM13 standards. Use of smooth geomembrane instead of textured geomembrane must be approved by the certifying engineer.
6. Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

TABLE 1B
40 mil LLDPE Textured Conformance and Field Testing Specifications

Resin Manufacturer			
Test	**Method(1)**	**Testing Frequency**	**Min. Requirements**
Density	ASTM D 1505 ASTM 792, Meth B	200,000 lb and per batch	> 0.932 g/cm3
Melt Flow Index	ASTM D 1238 (190°C/2.16 kg)	200,000 lb and per batch	≤ 1.0 g / 10 min.
Manufacturer's Quality Control			
Thickness, nominal	ASTM D 5994	Each Roll	60 mil
Thickness, Min. ave	ASTM D 5994	Each Roll	57 mil
Thickness, lowest indiv. For 8 of 10 spec.	ASTM D 5994	Each Roll	54 mil
Thickness, lowest indiv. For 1 of 10 spec.	ASTM D 5994	Each Roll	51 mil
Asperity Height (Min. ave.)	GRI GM12	Each Roll	16 mil
Density	ASTM D 1505	Per 200,000 lb.	0.94 g/cm3
Carbon Black Dispersion 2	ASTM D 5596	Per 45,000 lb	Category 1 or 2
Carbon Black Content	ASTM D 1603 ASTM D 4218	Per 20,000 lb	2 to 3 %
Tensile Properties:			
Break	ASTM D 6693 Type IV	Per 20,000 lb	
Strength	Dumbbell, 2 ipm		115 lb/in
Elongation	G.L. = 2.0 inches		100%
Yield			
Strength			132 lb/in
Elongation			12%
Tear Resistance	ASTM D 1004	Per 45,000 lb	45 lb
Puncture Resistance	ASTM D 6392	Per 45,000 lb	120 lb
Conformance Testing by CQA Engineer			
Thickness, nominal	ASTM D 5994	1 per 100,000 sf	40 mil
Thickness, Min. ave	ASTM D 5994		38 mil
Thickness, lowest indiv. For 8 of 10 spec.	ASTM D 5994		36 mil
Thickness, lowest indiv. For 1 of 10 spec.	ASTM D 5994		34 mil
Asperity Height (Min. ave.)	GRI GM13 ASTM D 7466	1 per 100,000 sf	16 mil
Density	ASTM D 1505	1 per 100,000 sf	0.939 g/cm3
Carbon Black Dispersion 2	ASTM D 5596	1 per 100,000 sf	Category 1 or 2
Carbon Black Content 3	ASTM D 1603 ASTM D 4218	1 per 100,000 sf	2 to 3 %
Tensile Properties:			
Break	ASTM D 6693 Type IV	1 per 100,000 sf	
Strength	Dumbbell, 2 ipm		60 lb/in
Elongation	G.L. = 2.0 inches		250%
Tear Resistance	ASTM D 1004	1 per 100,000 sf	22 lb
Trial Seams			
Shear	ASTM D 6392 GRI GM 19	Every 5 (five) hours of	Shear 60 ppi
Peel Fusion4		seaming.	Peel 50 ppi
Peel Extrusion4			Peel 44 ppi
Destructive Seam Testing			
Shear	ASTM D 6392 GRI GM 19	1 per 500 linear feet (LF) of seam	Shear 60 ppi
Peel Fusion4			Peel 50 ppi
Peel Extrusion4			Peel 44 ppi
Shear Elongation at break	GRI GM19	1 per 500 linear feet (LF) of seam	
Fusion 4			50%
Extrusion 4			50%
Peel Separation	GRI GM19	1 per 500 linear feet (LF) of seam	
Fusion			25%
Extrusion			25%
Non-destructive Seam Field Testing			
Air Pressure	GRI GM6	Dual track fusion weld seams	Min 30 psi, held for 5 minutes; losing < 4 psi; puncture opposite end after test to check for continuity
Vacuum	ASTM D 4437	Extrusion Seams	4 to 8 psi held for ≥ 10 sec.

1. Test to be performed according to the latest test method as approved by the certifying engineer.
2. Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
3. Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.
4. Four (4) out of five (5) specimens must meet the requirements. The 5th specimen can be as low as 80% of the listed values. For peel adhesion, seam separation shall not extend more than 25 percent in the same interface. Testing shall be discontinued when the sample has visually yielded a sample. Elongation measurements should be omitted for field testing.

FIGURE 1

DESIGNED BY:	DCM
DRAWN BY:	TLB
APPVD. BY:	DCM
SCALE:	N.T.S
DATE:	9/24/2018
JOB NO.	584-001-35187129
ACAD NO.	004
SHEET NO.:	16 OF 16

POND DETAILS

GESTATION-FARROWING FARM
C & G HOG FARMS
NEWTON COUNTY ARKANSAS

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

REV.	DATE	BY	DESCRIPTION

Berm Integrity Inspections
APPENDIX C

Pond Levee Integrity and Assessment Requirements
C & H Farms

The C & H Hog Farms (Facility) will choose a site employee(s) to be the qualified person to perform the inspection on the facility.

- The facility will examined by a qualified person as follows:
    - At intervals not exceeding seven days, inspect for any appearances of actual or potential structural weakness and other conditions which are disrupting or have the potential to disrupt the operation or safety of the facility
    - The results of the inspection by a qualified person will be recorded in the facility's operating record.
- *Annual inspections by a qualified professional engineer.*
    - The facility will be inspected on a periodic basis by a qualified professional engineer to ensure that the design, construction, operation, and maintenance of the Hog Farm is consistent with recognized and generally accepted good engineering standards. The inspection must, at a minimum, include:
        - A review of available information regarding the status and condition of the facility, including, but not limited to, files available in the operating record (e.g., the results of inspections by a qualified person, and results of previous annual inspections); and
        - A visual inspection of the CCR unit to identify signs of distress or malfunction of the Facility.
- *Inspection report.* The qualified professional engineer must prepare a report following each inspection that addresses the following:
    - Any changes in geometry of the structure since the previous annual inspection;
    - Any appearances of an actual or potential structural weakness of the Facility, in addition to any existing conditions that are disrupting or have the potential to disrupt the operation and safety of the Facility; and
    - Any other change(s) which may have affected the stability or operation of the Facility since the previous annual inspection.

If a deficiency or release is identified during an inspection, the owner or operator must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

Pond Levee Integrity and Assessment
C & H Farms

Weekly Pond Levee Inspection

Inspected by: _____

Inspection Date: _____

Storage Levels: Pond #1 _____
Pond #2 _____

Any appearance of an actual or potential structural weakness of the pond
a. Any signs of sliding or sloughing of the soil layer that might indicate a slope failure.
_____ No
_____ Yes

If yes, recommended corrective action/responsible party
_____
_____
_____

Corrective Action Completed _____
(Sign and Date)

Any appearance of erosion from storm water.
a. Any signs of erosion to berms or letdowns?
_____ No
_____ Yes

If yes, recommended corrective action/responsible party
_____
_____
_____

Corrective Action Completed _____
(Sign and Date)

Any Observations:
_____
_____
_____
_____
_____
_____

Emergency Action Plan
APPENDIX D

Emergency Action Plan

C&H Hog Farms, Inc.
Vendor, Arkansas
Permit No. 5264-W
AFIN: 51-00164

October 2018
Project No. 35187129



Prepared for:
C&H Hog Farms, Inc
HC 72 Box 2
Vendor, AR 72683
(870) 434-5004

Prepared by:
Terracon Consultants, Inc.
25809 Interstate 30 South
Bryant, Arkansas 72022

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Appendix B SPILL FORM

1.0 FARM EMERGENCY CONTACT INFORMATION

1.1 Owner Emergency Contacts

Primary Contact: Jason Henson
Phone: 870-434-5004
Cell: 870-688-1318
Address: HC 72 Box 2
Vendor, AR

Alternate Contact: Richard Campbell
Phone: 870-434-5004
Cell: 870-715-0753
Address: HC 72 Box 2
Vendor, AR 72683

Alternate Contact: Philip Campbell
Phone: 870-434-5004
Cell: 870-715-0754
Address: HC 72 Box 2
Vendor, AR 72683

1.2 Farm Information

Name of Farm: C & H Hog Farms, Inc.
Address of Farm: HC 72 Box 2, Vendor AR 72683
Directions to Farm: approx. 1.6 mi west of Mt. Judea, AR on County Road 41
Storage Site(s) address/location (if different)

1.3 Neighbors Contacts

Name: Shawn Ricketts
Phone: 870-434-5927
Cell:
Address: HC 72 Box 3
Vendor, AR 72683

Name: Donna Freeman
Phone: 870-434-5023
Cell:
Address: HC 72
Mount Judea, AR 72655

Name: Charles Campbell
Phone: 870-434-5330
Cell:
Address: HC 72 Box 15
Mount Judea, AR 72655

Name: Abandoned
Phone:
Cell: unassigned
Address:

Name: Chuck Pridmore
Phone:
Cell:
Address: HC 72
Mount Judea, AR 72655

2.0 AGENCY EMERGENCY TELEPHONE NUMBERS

Fire/Police/Medical Central Dispatch	
Emergency phone	911
Hospital	
North Arkansas Regional Medical Center	870-414-4000
Veterinarian	
Dr. Kayla Blake	251-586-1920
Fire Department	
Mt. Judea VFD	911
National Emergency Response	
National Response Center (NRC)	800-424-8802
United States EPA, Region 6 24-Hour Spill Reporting	866-372-7445
State Emergency Response	
Arkansas Department of Emergency Management (ADEM) Spill Response (24 / 7)	800-322-4012
ADEQ Main Office	501-682-0744
Response/Cleanup Contractors	
TAS Environmental Services, L.P. (Cleanup Contractor)	888-654-0111
Waste Services, Inc. (Cleanup Contractor)	501-888-4323
Environmental Consultants	
Terracon	501-249-4334

3.0 CHEMICAL INFORMATION

Number	Product Name	Max. Lbs./Gals on site	Active Ingredient (AI)	SDS	Seasons on Hands SP=Spring S=Summer F=Fall W=Winter YR=Year-Round	Building or Area Stored
1	Allflex Tag Pen	20 ct	Liquefied Petroleum Gas, Ethanol	See Appendix A	YR	Farrowing Barn Storage Room
2	Chlorhexidine Solution 2%	8 gal	Chlorhexidine Gluconate	See Appendix A	YR	Farrowing Barn Storage Room
3	Clorox Disinfecting Wipes – Citrus Blend	15 lbs	Ethylene glycol monohexyl ether	See Appendix A	YR	Farrowing Barn Office
4	Clorox Toilet Bowl Cleaner w/ Bleach	2 gal	Sodium hypochlorite	See Appendix A	YR	Farrowing Barn Office
5	Dial for Men Hydrofresh	4 gal	Alcohols, C10-16, ethoxylated, sulfates, sodium salts, 2EO	See Appendix A	YR	Farrowing Barn Office
6	Gain Laundry Detergent	80 lb	Tetramethyl Acetyloctahydronaphthalenes	See Appendix A	YR	Farrowing Barn Office
7	Germicidal Ultra Bleach	120 gal	Sodium hypochlorite	See Appendix A	YR	Farrowing Barn Storage Room & Office
8	Great Value Glass Cleaner	3 gal	Ethylene glycol, monobutyl ether acetate	See Appendix A	YR	Farrowing Barn Office
9	Permectrin II	10 gal	Permethrin	See Appendix A	YR	Farrowing Barn Storage Room
10	Prima Spray-On II Blue Livestock Marking Dye	16 gal	Ethanol, Liquefied Petroleum Gas	See Appendix A	YR	Farrowing Barn Storage Room
11	Prima Glo Fluorescent Livestock Marking Paint – Green	16 gal	Liquefied Petroleum Gas, Ethanol	See Appendix A	YR	Farrowing Barn Storage Room
12	Prima Glo Fluorescent Livestock Marking Paint – Orange	16 gal	Liquefied Petroleum Gas, Ethanol	See Appendix A	YR	Farrowing Barn Storage Room
13	Prima Glo & Prima Spray On & Prima Marc	16 gal	Acetone, Heptane, Isobutane/Propellant Blend	See Appendix A	YR	Farrowing Barn Storage Room
14	Scrubbing Bubbles Foaming Bleach Bathroom Cleaner	2 gal	Sodium carbonate, Sodium hypochlorite, Sodium chloride	See Appendix A	YR	Farrowing Barn Office
15	Starbar QuikStrike Fly Bait	120 lb	Dinotefuran	See Appendix A	YR	Farrowing Barn Office
16	Swine-O-Dyne	5 gal	Phosphoric acid (Orthophosphoric acid)	See Appendix A	YR	Farrowing Barn Storage Room
17	Synergize	20 gal	Quaternary ammonium compounds	See Appendix A	YR	Farrowing Barn Storage Room

4.0 FARM FLAMMABLES AND REFRIGERANTS

Fuel Type	Total Capacity and Container Type	Max. Lbs./Gals on site	Seasons on Hands SP=Spring, S=Summer, F=Fall, W=Winter YR=Year-Round	Building or Area Stored (Location Description)
Diesel Fuel Gasoline	500 gal steel tanks	1,000 gal	YR	North and South ends of buildings
Fuel Oil	n/a	n/a	n/a	n/a
New Oil (Motor and Hydraulic)	5 gal plastic containers	15 gal	YR	Storage container, south end of buildings
Used Oil (oil burner storage)	n/a	n/a	n/a	n/a
Propane (pressure washers, heat, water heater)	1,000 gal steel tanks	5,000 gal	YR	Two (2) located on North end of buildings, Three (3) located on South end of buildings
Oxygen/Acetylene (cart tanks vs handheld tanks)	n/a	n/a	n/a	n/a
Kerosene	n/a	n/a	n/a	n/a
Anhydrous Ammonia for Refrigeration	n/a	n/a	n/a	n/a
Carbon Dioxide (used for piglet euthanizing)	7 lb steel cylinders	14 lbs	YR	Generator Room

5.0 FARM RESPONSE RESOURCES

Resource	Farm Location
Water Sources (Blow-off valve, which can be used as fire hydrant and Frost-Free water hydrant)	North end of Farrowing Barn
Shovels	Farrowing Barn Storage Room, EcoDrum shed
Fire Extinguishers (Employees trained in use)	Farrowing Barn Office & Storage Room, Gestation Barn Entry
Excavation Equipment	Contact Carl Royce 870-688-8991
Medical Kits	Farrowing Barn Office
Flashlights/Generator	Generator Room
Absorbent Materials	Farrowing Barn Office & Storage Rom
Personal Protective Equipment: (chemical-resistant) suits, gloves, boots	Farrowing Barn Office & Storage Room
Manure Pumping Equipment/Contractor Empty Tanks or Containers (to hold manure, liquids, absorbent material or contaminated material/soil)	North end of Farrowing Barn
Safety Data Sheets (SDSs): All employers are required to have a Safety Data Sheet (SDS) for each hazardous chemical stored or used in the workplace and to make SDSs available to employees.	Farrowing Barn Office & accessible via internet
Needle Disposal Containers	Farrowing Barn Storage Room
Showering Area (Biosecurity measure for protection against transmission of disease to swine population & first aid measure for employees)	Farrowing Barn Office

6.0 EMERGENCY ACTION PLANS FOR MANURE

6.1 Breach of Manure or Commercial Fertilizer Storage

Stop any flow into storage area, build containment dams, add soil to berms and apply manure/fertilizer from discharge to fields at rates described in Nutrient Management Plan. Prepare a Spill or Release Report (See Appendix B).

6.2 Manure Spill in the Field

Stop applications, build containment dams and collect material. Apply collected material at rates described in Nutrient Management Plan. Prepare a Spill or Release Report (See Appendix B).

6.3 Manure Storage Volume Enters the Freeboard Area

Land apply manure at rates described in Nutrient Management Plan to fields that are least likely to pose a discharge risk. Pump manure to an isolated area of a field with poor drainage to avoid berm overtopping and structure failure. Prepare a Spill or Release Report (See Appendix B).

6.4 Spill on Roadway

Human injuries, if present, take precedence. Stop any additional spills, build containment dams, remove material and land apply at rates described in Nutrient Management Plan. Contact the road commission and drain commission. Do not wash material into roadside ditches or surface water. Prepare a Spill or Release Report (See Appendix B) .

6.5 Runoff of Manure from the Field

Stop applications, plow a diversion trench and remove manure/fertilizer, if necessary. Prepare a Spill or Release Report (See Appendix B).



N

0 100 200 400

SCALE IN FEET

Project Mngr:	DCM
Drawn By:	TLB
Checked By:	TLB
Approved By:	DCM

Project No.	584-001-35187129
Scale:	AS SHOWN
File No.	001
Date:	9/24/2018

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Consulting Engineers and Scientists
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PH. (501) 847-9292 FAX. (501) 847-9210

FACILITY LOCATION MAP

EMERGENCY ACTION PLAN

C&H HOG FARMS INC.

VENDOR ARKANSAS

FIG. No. 1



N

0 50 100 200

SCALE IN FEET

Project Mngr:	DCM
Drawn By:	TLB
Checked By:	TLB
Approved By:	DCM

Project No.	584-001-35187129
Scale:	AS SHOWN
File No.	002
Date:	9/24/2018

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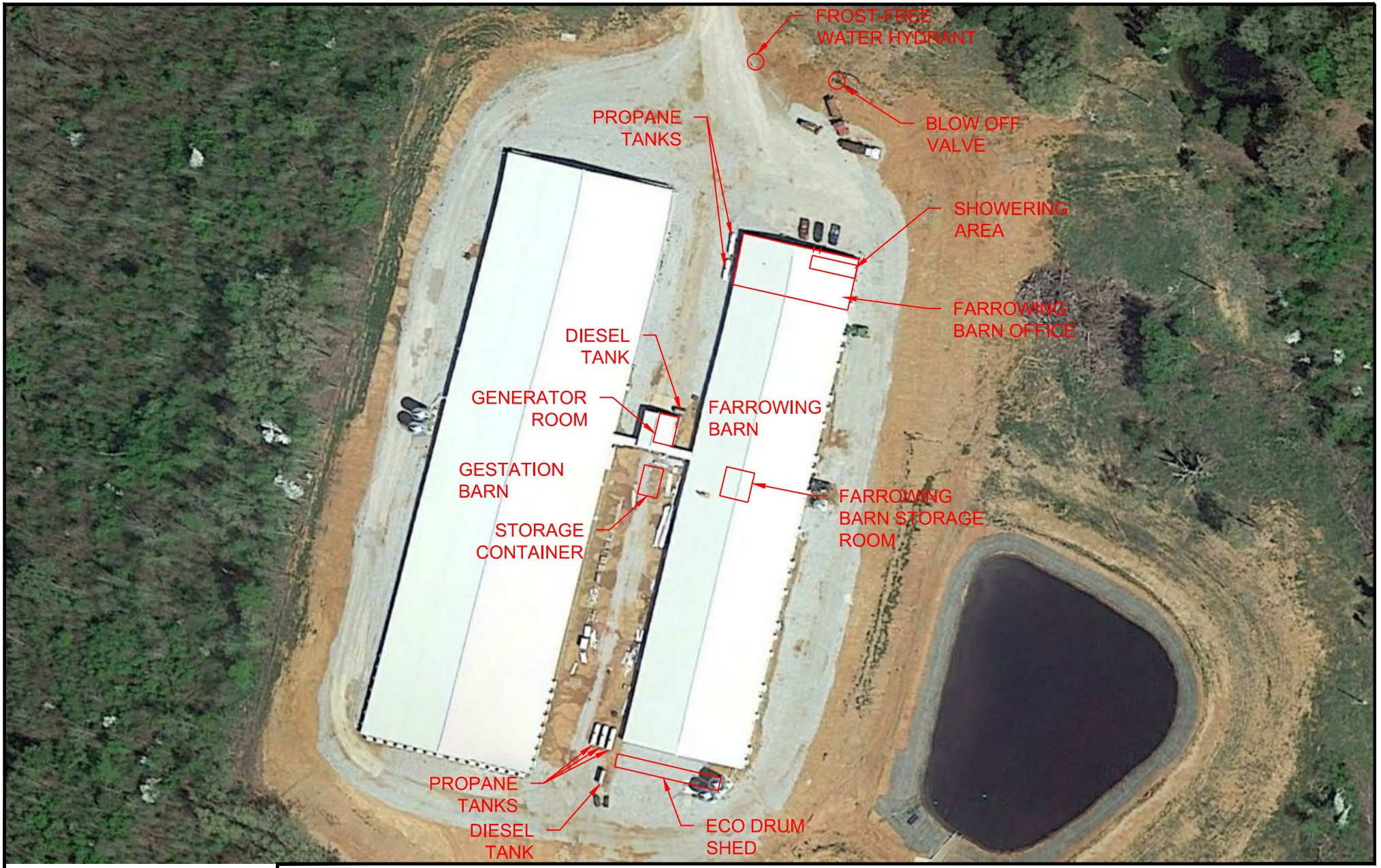
FACILITY LAYOUT MAP

EMERGENCY ACTION PLAN

C&H HOG FARMS INC.

VENDOR ARKANSAS

FIG. No. 2



N

0 25 50 100

SCALE IN FEET

Project Mngr:	DCM
Drawn By:	TLB
Checked By:	TLB
Approved By:	DCM

Project No.	584-001-35187129
Scale:	AS SHOWN
File No.	003
Date:	9/24/2018

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BARN LAYOUT

EMERGENCY ACTION PLAN

C&H HOG FARMS INC.

VENDOR ARKANSAS

FIG. No.

3

APPENDIX A
SDS

6537. C13420

Material Safety Data Sheet

Section 1 Product and Company Identification

Product Name: **ALLFLEX TAG PEN**
MSDS #: S104 **Date Prepared:** 01/11/95
Revision #: 1.2 **Date Revised:** 08/11/10

Manufacturer:
ALLFLEX USA, INC.
2805 East 14th St.
Dallas/Ft. Worth Airport, TX
75261-2266
Information Telephone: 214-456-3686
Emergency Telephone: 847-956-7600
Chemical Formula: Mixture

Supplier:
EEC use):

CAS No.: Not applicable.. **Synonyms:** Not applicable.. **Derivation:** Not applicable..
General Use: Marking pen for plastic ear tags.

Section 2 Composition/Information on Ingredients

Ingredient	CAS No.	%
Xylene [1,4,5]	1330-20-7	26-36
ACGIH: (TLV-TWA) 100ppm, (TLV-STEL) 150ppm OSHA: TWA=100ppm EPA: RCRA designation is U239, CERCLA RQ is 1000 lbs., EPCRA sec. 313 de minimus concentration = 1.0% SARA: Health Assessment Rank = 72 SDWA: MCL = 10 mg/l, MCLG = 10 mg/l		
Methyl Isobutylketone	108-01-1	10-25
ACGIH: (TLV-TWA) 50 ppm, (TLV-STEL) 75 ppm		
n-Butanol [1,3,4,5,6]	71-36-3	10-20
ACGIH: TWA (ceiling) = 50 ppm OSHA: TWA = 100 ppm EPA: CERCLA RQ = 5000 lbs.; RCRA U031		
Ethylene Glycol Phenol Ether	122-36-3	10-20
2-Amino-2-methyl-1-propanol [3,5]	124-68-5	1-2

(For Section 2 footnotes: See Section 15)

Section 3 Hazards Identification

EMERGENCY OVERVIEW: DANGER: Contains xylene and MIBK. Harmful or fatal if swallowed. If swallowed, do not induce vomiting. Call a physician immediately. Flammable. Keep away from heat or flame. Vapor harmful. Avoid contact with eyes or prolonged contact with skin, Use only in well ventilated area. KEEP OUT OF REACH OF CHILDREN.

POTENTIAL HEALTH EFFECTS:
Primary Entry Routes: Eyes, Skin, Ingestion, Inhalation

Acute Effects

Eyes: Can cause severe irritation, redness, tearing, blurred vision.

Skin: Prolonged or repeated contact can cause moderate irritation, defatting, dermatitis.

Ingestion: Can cause gastrointestinal irritation, nausea, vomiting, and diarrhea; aspiration into lungs can cause chemical pneumonitis which can be fatal.

Inhalation: Excessive inhalation of vapors can cause nasal and respiratory irritation, dizziness, weakness, fatigue, nausea, headache, possible unconsciousness, and even asphyxiation.

Chronic Effects

Eyes: Not determined.

Skin: Not determined.

Ingestion: Not determined.

Inhalation: Not determined.

Carcinogenicity: Not applicable.

Target Organ Effects: Not determined.

Medical Conditions Aggravated by Long-Term Exposure: Not determined.

Other Information: Not applicable.

HMIS Rating: Health 2, Flammability 3, Reactivity 0

Section 4 First Aid

Eye Contact: Flush with large amounts of water and get medical attention.

Skin Contact: Wash with soap and water; remove contaminated clothing and launder before reuse.

Ingestion: Do not induce vomiting, keep person warm, quiet, and get medical attention.

Inhalation: Remove affected person to fresh air, administer oxygen if breathing is difficult, apply artificial respiration and get medical attention if breathing has stopped.

Other Information: Not applicable.

Section 5 Fire Fighting Measures

Flash Point (method): Xylene: 81°F/27°C (toc)

Autoignition Temperature: Not determined.

LEL: 1.0% **UEL:** 7.0 for xylene.

Flammability Classification: Flammable liquid.

Extinguishing Media: Regular foam, carbon dioxide, dry chemical.

Hazardous Combustion Products: Carbon dioxide, carbon monoxide.

Unusual Fire or Explosion Hazards: Vapors are heavier than air and may travel along the ground and be ignited by remote ignition sources.

Fire-Fighting Instructions/Equipment: Keep personnel removed and upwind of any fire. Wear full fire-fighting turn-out gear (full Bunker gear), and respiratory protection (SCBA).

NFPA Rating: Health 2, Flammability 3, Reactivity 0

Section 6 Accidental Release Measures

Use recommended personal protective equipment (see Section 8).

Small Spill: Remove sources of ignition and provide ventilation. Small quantities may be picked up with absorbent material.

Large Spill: Remove sources of ignition and provide ventilation. Large spills may be absorbed with sawdust or other suitable absorbent.

Section 7 Handling and Storage

Handling Precautions: Use recommended personal protective equipment (see Section 8). Wash thoroughly after handling.

Storage Requirements: Store in a cool, dry area; away from excessive heat or sources of ignition.

Section 8 Exposure Controls/Personal Protection

Eye/Face Protection: Safety glasses or goggles.
Skin Protection: Rubber gloves.
Respiratory Protection: For organic solvent vapors.
Other Personal Protective Equipment: Eye wash and safety shower.
Engineering Controls: Normal room ventilation. Local exhaust in confined areas.
Administrative Controls: Users of this product must be properly trained and qualified in its use.
Other Information: Not applicable.

Section 9 Physical and Chemical Properties

Appearance/Physical State: Marking pen containing black liquid ink.
Odor: Organic solvent.
Odor Threshold (ppm): Not determined.
Specific Gravity (H_2O = 1): 0.91 - 0.93
Solubility in Water: Insoluble.
Coefficient of Water/Oil Solubility: <1
pH: Not applicable.
Melting Point: Not applicable.
Boiling Point: 232°F/111°C for xylene.
Vapor Pressure (mm Hg at 20°C): 9.5 for xylene.
Vapor Density (Air = 1): 3.6 for xylene.
Evaporation Rate (n-BuAc=1): 0.75 for xylene
V.O.C.: 83 - 91%(w/w), Not determined(v/v), 6.4 - 7.0 lbs./gal.

Section 10 Stability and Reactivity

Chemical Stability: Stable
Hazardous Polymerization: Will not occur.
Conditions to Avoid: Not applicable.
Chemicals to Avoid: Strong oxidizing agents.
Hazardous Decomposition Products: Not determined.

Section 11 Toxicological Information

Sensitization to Product: Not applicable.
Irritancy of Product: Skin, eyes, lungs, gastrointestinal tract.
Reproductive Toxicity: Not applicable.
Teratogenicity: Not applicable.
Mutagenicity: Not applicable.

Toxicological information regarding individual ingredients, if applicable, may be found in Section 2.

Section 12 Ecological Information

Not determined.

Section 13 Disposal Considerations

Dispose of in accordance with applicable federal, state, and local regulations.

Section 14 Transport Information

U.S. D.O.T.: Consumer commodity ORM-D.

Section 15 Regulatory Information

Footnotes for Section 2:

1 Subject to the reporting requirements of SARA Title III, Section 313.
2 Appears on the California Safe Drinking Water and Toxic Enforcement Act Substances List.
3 Appears on the Massachusetts Substances List.
4 Appears on the New Jersey Right-To-Know Hazardous Substances List.
5 Appears on the Pennsylvania Hazardous Substances List.
6 Appears on the Canadian WHMIS Ingredient Disclosure List.

U.S. Federal Hazardous Substances Labeling Act: FINE LINE MARKER ONLY: This product meets the requirements of the U.S. Federal Hazardous Substances Labeling Act exemption for pens and markers because it is a porous-tip ink-marking device constructed so that a) the ink is held within an absorbent material so that no free liquid is within the device, b) under reasonably foreseeable conditions of manipulation and use the ink will emerge only through the porous writing nib, and c) the device has a capacity of not more than 10 grams of ink which has a single oral LD50 of more than 2.5 g/kg of body weight of the test animal.

OSHA Hazard Status: This product is considered to be hazardous as defined by the U.S. OSHA HCS (29 CFR 1910.1200).

Toxic Substances Control Act (TSCA): All ingredients contained in this product are listed on the U.S. EPA TSCA Chemical Substance Inventory.

Canadian Domestic Substances List (DSL): All ingredients contained in this

product are listed on the Canadian EPA (CEPA) Domestic Substances List (DSL).

European Inventory of Existing Chemical Substances (EINECS): All ingredients contained in this product are listed on the European Inventory of Existing Chemical Substances (EINECS).

WHMIS Rating (Canada): D-2B, B-3

Risk Phrases (Canada): DANGER: Contains xylene and MIBK. Harmful or fatal if swallowed. Flammable. Vapor harmful. KEEP OUT OF REACH OF CHILDREN.

Precautionary Statements (Canada): If swallowed, do not induce vomiting. Call a physician immediately. Keep away from heat or flame. Avoid contact with eyes or prolonged contact with skin, Use only in well ventilated area.

Further regulatory information regarding individual ingredients, if applicable, may be found in Section 2.

This product has been classified in accordance with the hazard criteria of the U.S. OSHA Hazard Communication Standard and the Canadian WHMIS Controlled Products Regulations. This MSDS contains all the information required by the above regulations and conforms to ANSI Z400.1-1993.

Section 16 Other Information

THE INFORMATION ON THIS MSDS REFERS TO THE INKS USED IN THIS PRODUCT AND IT APPLIES TO HANDLING THESE INKS IN BULK.

MSDS Prepared By: Director of Chemical Safety

The information contained herein is based on data available to us and is accurate and reliable to the best of our knowledge and belief. However, Allflex USA, Inc. makes no representations as to its completeness or accuracy. Information is supplied on condition that persons receiving such information will make their own determination as to its suitability for their purposes prior to use. In no event will Allflex USA, Inc. be responsible for damages of any nature whatsoever resulting from the use of or reliance upon the information contained herein.

SAFETY DATA SHEET

Chlorhexidine 2% Solution

1. SUBSTANCE IDENTITY/COMPANY CONTACT INFORMATION

PRODUCT NAME: Chlorhexidine Solution
MOLECULAR FORMULA: Mixture
CHEMICAL FAMILY: Antiseptic, Antimicrobial
USE: Antimicrobial skin cleanser
SUPPLIER:
Aspen Veterinary Resources
TELEPHONE NUMBERS:
Emergency (Chemtrec 24 hours): (800) 424-9300
Information**:** (888) 215-1256

2. HAZARDS IDENTIFICATION

Signal word: WARNING

Pictograms



HAZARD STATEMENTS
H318 – Causes serious eye damage
H335 – May cause respiratory irritation

Precautionary statements

P305, P351, P338 – If in eyes; rinse with water for at least 15 minutes. Remove contact lenses. Seek medical attention

OTHER HAZARDS

CARCINOGENIC STATUS: Ingredients are not considered carcinogenic by NTP, IARC, or OSHA.
EFFECTS OF EXPOSURE: May cause skin, eye, and mucous membrane irritation and burns (symptoms such as discomfort, redness, tearing, sneezing, and runny nose). May cause allergic skin reactions. Exposure may cause nausea, vomiting, diarrhea, cramps, and colitis.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: None known

3. COMPOSITION/INFORMATION OF INGREDIENTS

Mixture of the substances listed in this section.

INGREDIENT 1
COMMON NAME: Water
CAS: 7732-18-5
% BY WEIGHT: >80%
EXPOSURE LIMIT(S):

INGREDIENT 2
COMMON NAME: Chlorhexidine Gluconate
CAS: 18472-51-10
% BY WEIGHT: 2%
EXPOSURE LIMIT(S): Not established.

INGREDIENT 3
COMMON NAME: Lauramine Oxide
CAS: 1643-20-5
% BY WEIGHT: Trade secret
EXPOSURE LIMIT(S): Not established.

Additional ingredients are present in < 1% of the formulation and are not considered carcinogens.

EXPOSURE LIMIT(S) FOR THE MATERIAL: Not established.

4. FIRST AID MEASURES

EYES: Remove contact lenses, if present. Rinse immediately with plenty of water, including under the eyelids, for at least 15 minutes. If irritation persists, obtain medical attention.
SKIN: Wash off with soap and water. If reaction occurs, seek medical attention.
INHALATION: Move to fresh air.
INGESTION: Contact a physician or poison control center.

5. FIRE FIGHTING MEASURES

FLASH POINT: Not applicable (predominantly water).
LOWER EXPLOSION LIMIT (LEL): Not applicable.
UPPER EXPLOSION LIMIT (UEL): Not applicable.
EXTINGUISHING MEDIA: Water, carbon dioxide, or dry chemical.
FIRE FIGHTING PROCEDURES: Wear self-contained breathing apparatus and full-body protective equipment.
UNUSUAL FIRE OR EXPLOSION HAZARDS: None known.
HAZARDOUS COMBUSTION PRODUCTS: Carbon monoxide, carbon dioxide

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS: Ensure adequate ventilation. Avoid contact with skin, eyes and clothing.

ENVIRONMENTAL PRECAUTIONS: Do not let product enter drains. Do not flush into surface water. Do not flush to groundwater and soil.

METHODS FOR CLEANING UP: Absorb the liquid with suitable material, then transfer into a suitable container for disposal.

7. HANDLING AND STORAGE

HANDLING: Use with adequate ventilation. Avoid contact with skin, eyes, and clothing. Wash thoroughly after handling. Launder contaminated clothing before reuse.

STORAGE: Store at room temperature. Store in a dry area away from direct sunlight, heat, and incompatible materials. Protect from freezing and physical damage. Reseal containers immediately after use. Store away from food and beverages. Keep out of reach of children.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

RESIPRATORY PROTECTION: Not required under normal conditions of use.
VENTILATION: Good general ventilation should suffice.
HAND PROTECTION: Not normally required.
EYE PROTECTION: Safety glasses. Care should be taken to avoid accidental exposure.
OTHER PROTECTIVE EQUIPMENT: Not required.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Blue liquid
Odor: Not available.
pH: 5.0-7.0
Flash Point: NA
Auto ignition Temperature: NA
Boiling Point/Range: NA
Melting Point/Range: NA
Flammability (solid, gas): NA
Upper/Lower Flammability: NA
Vapor Pressure: NA
Vapor Density: NA
Specific Gravity: 1.00-1.01
Water Solubility: Soluble
Reactivity in Water: NA
Decomposition Temperature: NA

10. STABILITY AND REACTIVITY

STABILITY: Stable under normal conditions.
PHYSICAL CONDITIONS TO AVOID: Heat - high temperature.
INCOMPATIBILITY WITH OTHER MATERIALS: Do not clean with anionic detergents that will precipitate the chlorhexidine into a water insoluble residue.
HAZARDOUS DECOMPOSITION PRODUCTS: No data.
HAZARDOUS POLYMERIZATION: Will not occur.

11. TOXICOLOGICAL INFORMATION

ACUTE TOXICITY:
No data is available for the 2% product. The following is for Chlorhexidine Gluconate:
LD_{50} Oral rat 2000mg/kg
LD_{50} Oral mouse: 1260mg/kg
CHRONIC TOXICITY:
No known chronic effects.
REPRODUCTIVE/DEVELOPMENTAL TOXICITY:
Non-teratogenic.

12. ECOLOGICAL INFORMATION

No relevant studies identified.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Dispose of by incineration in accordance with applicable local and national regulations.

14. TRANSPORT REGULATIONS

Not regulated by the United States Department of Transportation (DOT), International Maritime Organization (IMO), or International Air Transport Association (IATA).

15. REGULATORY INFORMATION

Federal
TSCA: All of the components are listed in the United States TSCA (Toxic Substances Control Act) inventory.

SARA: No component is listed

State
California Prop 65: No components listed under Prop 65

16. OTHER INFORMATION

Revision Date: 07/21/15

The information and recommendations presented in this SDS are based on sources believed to be accurate. The supplier assumes no liability for the accuracy or completeness of this information. It is the user's responsibility to determine the suitability of the information for their particular purposes.

SAFETY DATA SHEET

Issuing Date January 5, 2015 **Revision Date** New **Revision Number** 0

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product identifier

Product Name **Clorox® Disinfecting Wipes$_1$ - Citrus Blend**

Other means of identification

EPA Registration Number 5813-79

Recommended use of the chemical and restrictions on use

Recommended use Moistened disinfecting wipes

Uses advised against No information available

Details of the supplier of the safety data sheet

Supplier Address
The Clorox Company
1221 Broadway
Oakland, CA 94612

Phone: 1-510-271-7000

Emergency telephone number

Emergency Phone Numbers For Medical Emergencies call: 1-800-446-1014
For Transportation Emergencies, call Chemtrec: 1-800-424-9300

2. HAZARDS IDENTIFICATION

Classification

This product is not considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

GHS Label elements, including precautionary statements

Emergency Overview

This product is not considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

Appearance Clear, colorless liquid absorbed into white, non-woven wipes **Physical State** Thin liquid absorbed into non-woven wipes **Odor** Citrus, lemon, lime

Precautionary Statements - Prevention
None

Precautionary Statements - Response
None

Precautionary Statements - Storage
None

Precautionary Statements - Disposal
None

Hazards not otherwise classified (HNOC)
Not applicable

Unknown Toxicity
21.5% of the mixture consists of ingredient(s) of unknown toxicity

Other information
No information available

Interactions with Other Chemicals
No information available.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No.	Weight %	Trade Secret
Ethylene glycol monohexyl ether	112-25-4	1 - 5	*
n-Alkyl (68% C12, 32% C14) dimethyl ethylbenzyl ammonium chloride	85409-23-0	0.1 - 0.2	*
n-Alkyl (5% C12, 60% C14, 30% C16, 5% C18) dimethyl benzyl ammonium chloride	53516-76-0	0.1 - 0.2	*

* The exact percentage (concentration) of composition has been withheld as a trade secret.

4. FIRST AID MEASURES

First aid measures

General Advice Show this safety data sheet to the doctor in attendance.

Eye Contact Hold eye open and rinse slowly and gently with water for 15 - 20 minutes. If present, remove contact lenses after the first 5 minutes of rinsing, then continue rinsing eye. Call a poison control center or doctor for further treatment advice.

Skin Contact Rinse skin with plenty of water. If irritation persists, call a doctor.

Inhalation Move to fresh air. If breathing problems develop, call a doctor.

Ingestion Drink a glassful of water. Call a doctor or poison control center.

Most important symptoms and effects, both acute and delayed

Most Important Symptoms and Effects Liquid may cause eye irritation.

Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable Extinguishing Media
CAUTION: Use of water spray when fighting fire may be inefficient.

Specific Hazards Arising from the Chemical

Hazardous Combustion Products
Oxides of carbon.

Explosion Data

Sensitivity to Mechanical Impact No.

Sensitivity to Static Discharge No.

Protective equipment and precautions for firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal Precautions Avoid contact with eyes.

Other Information Refer to protective measures listed in Sections 7 and 8.

Environmental precautions

Environmental Precautions See Section 12 for additional ecological information.

Methods and material for containment and cleaning up

Methods for Containment Prevent further leakage or spillage if safe to do so.

Methods for Cleaning Up Containerize. Wash residual down to sanitary sewer. Contact the sanitary treatment facility in advance to assure ability to process washed-down material.

7. HANDLING AND STORAGE

Precautions for safe handling

Handling Handle in accordance with good industrial hygiene and safety practice. Avoid contact with eyes, skin, and clothing. Do not eat, drink, or smoke when using this product.

Conditions for safe storage, including any incompatibilities

Storage Keep containers tightly closed in a dry, cool, and well-ventilated place.

Incompatible Products None known.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Ethylene glycol monohexyl ether 112-25-4	None	None	None
n-Alkyl (68% C12, 32% C14) dimethyl ethylbenzyl ammonium chloride 85409-23-0	None	None	None
n-Alkyl (5% C12, 60% C14, 30% C16, 5% C18) dimethyl benzyl ammonium chloride 53516-76-0	None	None	None

ACGIH TLV: American Conference of Governmental Industrial Hygienists - Threshold Limit Value. OSHA PEL: Occupational Safety and Health Administration - Permissible Exposure Limits. NIOSH IDLH: Immediately Dangerous to Life or Health.

Appropriate engineering controls

Engineering Measures Showers
Eyewash stations
Ventilation systems

Individual protection measures, such as personal protective equipment

Eye/Face Protection No special protective equipment required.

Skin and Body Protection No special protective equipment required.

Respiratory Protection No protective equipment is needed under normal use conditions. If irritation is experienced, ventilation and evacuation may be required.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical and Chemical Properties

Physical State	Thin liquid absorbed into non-woven wipes		
Appearance	Clear liquid absorbed into non-woven wipes	**Odor**	Citrus, lemon, lime
Color	Colorless liquid - white non-woven wipes	**Odor Threshold**	No information available

Property	**Values**	**Remarks/ Method**
pH	6 - 9 (liquid)	None known
Melting/freezing point	No data available	None known
Boiling point / boiling range	No data available	None known
Flash Point	No data available	None known
Evaporation rate	No data available	None known
Flammability (solid, gas)	No data available	None known
Flammability Limits in Air		
Upper flammability limit	No data available	None known
Lower flammability limit	No data available	None known
Vapor pressure	No data available	None known
Vapor density	No data available	None known
Specific Gravity	~1.0 (liquid)	None known
Water Solubility	Complete (liquid)	None known
Solubility in other solvents	No data available	None known
Partition coefficient: n-octanol/water	No data available	None known
Autoignition temperature	No data available	None known
Decomposition temperature	No data available	None known
Kinematic viscosity	No data available	None known
Dynamic viscosity	No data available	None known
Explosive Properties	Not explosive	
Oxidizing Properties	No data available	

Other Information

Softening Point	No data available
VOC Content (%)	No data available
Particle Size	No data available
Particle Size Distribution	No data available

10. STABILITY AND REACTIVITY

Reactivity

No data available.

Chemical stability
Stable under recommended storage conditions.

Possibility of Hazardous Reactions
None under normal processing.

Conditions to avoid
None known based on information supplied.

Incompatible materials
None known.

Hazardous Decomposition Products
None known.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Product Information .

Inhalation Exposure to vapor or mist may irritate respiratory tract.

Eye Contact Liquid may cause irritation.

Skin Contact Liquid may cause slight irritation.

Ingestion Ingestion of liquid may cause slight irritation to mucous membranes and gastrointestinal tract.

Component Information

Chemical Name	LD50 Oral	LD50 Dermal	LC50 Inhalation
Ethylene glycol monohexyl ether 112-25-4	739 mg/kg (Rat)	721 mg/kg (Rabbit)	>0.5 mg/L (Rat, 4 h)

Information on toxicological effects

Symptoms Liquid may cause redness and tearing of eyes.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Sensitization No information available.

Mutagenic Effects No information available.

Carcinogenicity None of the ingredients in this product are on the IARC, OSHA, or NTP carcinogen lists.

Reproductive Toxicity No information available.

STOT - single exposure No information available.

STOT - repeated exposure No information available.
Chronic Toxicity No known effect based on information supplied.
Target Organ Effects Respiratory system, eyes, skin, gastrointestinal tract (GI).

Aspiration Hazard No information available.

Numerical measures of toxicity - Product Information

ATEmix (oral)
40.1 g/kg

ATEmix (dermal)
59.8 g/kg

12. ECOLOGICAL INFORMATION

Ecotoxicity
No information available.

Persistence and Degradability
No information available.

Bioaccumulation
No information available.

Other adverse effects
No information available.

13. DISPOSAL CONSIDERATIONS

Disposal methods
Dispose of in accordance with all applicable federal, state, and local regulations.

Contaminated Packaging
Do not reuse empty containers. Dispose of in accordance with all applicable federal, state, and local regulations.

14. TRANSPORT INFORMATION

DOT Not regulated.

TDG Not regulated.

ICAO Not regulated.

IATA Not regulated

IMDG/IMO Not regulated

15. REGULATORY INFORMATION

Chemical Inventories

TSCA All components of this product are either on the TSCA 8(b) Inventory or otherwise exempt from listing.

DSL/NDSL All components are on the DSL or NDSL.

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

U.S. Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product contains a chemical which is subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

Chemical Name	CAS No.	Weight %	Threshold Value (%)
Ethylene glycol monohexyl ether	112-25-4	1 - 5	1.0

SARA 311/312 Hazard Categories

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

CWA (Clean Water Act)
This product does not contain any substances that are regulated pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

CERCLA
This product does not contain any substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material.

EPA Statement
This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets and for workplace labels of non-pesticide chemicals. Following is the hazard information as required on the pesticide label:

> **CAUTION:** Causes moderate eye irritation. Avoid contact with eyes or clothing. Wash thoroughly with soap and water after handling.

US State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania	Rhode Island	Illinois
Ethylene glycol monohexyl ether 112-25-4			X	X	X
Isopropyl alcohol 67-63-0	X	X	X	X	

International Regulations

Canada
WHMIS Hazard Class
D2B Toxic materials



16. OTHER INFORMATION

NFPA	**Health Hazard**	1	**Flammability**	0	**Instability**	0	**Physical and Chemical Hazards** -
HMIS	**Health Hazard**	1	**Flammability**	0	**Physical Hazard**	0	**Personal Protection** A

Prepared By
Product Stewardship
23 British American Blvd.
Latham, NY 12110
1-800-572-6501

Preparation/Revision Date January 5, 2015

Revision Note New

Reference 1073956/174191.002

General Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information, and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal, and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

SAFETY DATA SHEET

Issuing Date January 5, 2015 **Revision Date** March 12, 2016 **Revision Number** 3

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product identifier

Product Name **Clorox® Toilet Bowl Cleaner - with Bleach - Rain Clean® Scent**

Other means of identification

EPA Registration Number 5813-89

Recommended use of the chemical and restrictions on use

Recommended use Disinfecting toilet bowl cleaner with bleach

Uses advised against No information available

Details of the supplier of the safety data sheet

Supplier Address
The Clorox Company
1221 Broadway
Oakland, CA 94612

Phone: 1-510-271-7000

Emergency telephone number

Emergency Phone Numbers For Medical Emergencies, call: 1-800-446-1014
For Transportation Emergencies, call Chemtrec: 1-800-424-9300

2. HAZARDS IDENTIFICATION

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

Skin corrosion/irritation	Category 1
Serious eye damage/eye irritation	Category 1

GHS Label elements, including precautionary statements

Emergency Overview

Signal word **Danger**

Hazard Statements
Causes severe skin burns and eye damage
Causes serious eye damage



Appearance Clear, green **Physical State** Viscous liquid **Odor** Apple, fruity, floral, bleach

Precautionary Statements - Prevention
Wash face, hands and any exposed skin thoroughly after handling.
Wear protective gloves, protective clothing, face protection, and eye protection such as safety glasses.

Precautionary Statements - Response
Immediately call a poison center or doctor.
If swallowed: Rinse mouth. Do NOT induce vomiting.
If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water.
Wash contaminated clothing before reuse.
If inhaled: Remove person to fresh air and keep comfortable for breathing.
Specific treatment (see supplemental first aid instructions on this label).
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Precautionary Statements - Storage
Store locked up.

Precautionary Statements - Disposal
Dispose of contents in accordance with all applicable federal, state, and local regulations.

Hazards not otherwise classified (HNOC)
Although not expected, heart conditions or chronic respiratory problems such as asthma, chronic bronchitis, or obstructive lung disease may be aggravated by exposure to high concentrations of vapor or mist.

Unknown Toxicity
0.11% of the mixture consists of ingredient(s) of unknown toxicity.

Other information
Very toxic to aquatic life.
Toxic to aquatic life with long lasting effects.

Interactions with Other Chemicals
Reacts with other household chemicals such as other toilet bowl cleaners, rust removers, acids, or products containing ammonia to produce hazardous irritating gases, such as chlorine and other chlorinated compounds.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS-No	Weight %	Trade Secret
Sodium hypochlorite	7681-52-9	1 - 5	*
Sodium cocoate	67701-10-4	0.5 - 1.5	*
Sodium hydroxide	1310-73-2	0.1 - 1	*
Myristamine oxide	3332-27-2	0.1 - 1	*
Lauramine oxide	1643-20-5	0.1 - 1	*

* The exact percentage (concentration) of composition has been withheld as a trade secret.

4. FIRST AID MEASURES

First aid measures

General Advice Call a poison control center or doctor immediately for treatment advice. Show this safety data sheet to the doctor in attendance.

Eye Contact Hold eye open and rinse slowly and gently with water for 15 - 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

Skin Contact Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

Inhalation Move to fresh air. If breathing is affected, call a doctor.

Ingestion Call a poison control center or doctor immediately for treatment advice. Have person sip a glassful of water if able to swallow. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give anything by mouth to an unconscious person.

Protection of First-aiders Avoid contact with skin, eyes, and clothing. Use personal protective equipment as required. Wear personal protective clothing (see section 8).

Most important symptoms and effects, both acute and delayed

Most Important Symptoms and Effects Burning of eyes and skin.

Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically. Use of gastric lavage or emesis is contraindicated.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable Extinguishing Media
CAUTION: Use of water spray when fighting fire may be inefficient.

Specific Hazards Arising from the Chemical
This product causes burns to eyes, skin, and mucous membranes. Thermal decomposition can release sodium chlorate and irritating gases and vapors.

Explosion Data

Sensitivity to Mechanical Impact None.

Sensitivity to Static Discharge None.

Protective equipment and precautions for firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal Precautions Avoid contact with eyes, skin, and clothing. Ensure adequate ventilation. Use personal protective equipment as required. For spills of multiple products, responders should evaluate the MSDSs of the products for incompatibility with sodium hypochlorite. Breathing protection should be worn in enclosed and/or poorly-ventilated areas until hazard assessment is complete.

Other Information Refer to protective measures listed in Sections 7 and 8.

Environmental precautions

Environmental Precautions See Section 12 for ecological Information.

Methods and material for containment and cleaning up

Methods for Containment Prevent further leakage or spillage if safe to do so.

Methods for Cleaning Up Absorb and containerize. Wash residual down to sanitary sewer. Contact the sanitary treatment facility in advance to assure ability to process washed-down material.

7. HANDLING AND STORAGE

Precautions for safe handling

Handling Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes, and clothing. Do not eat, drink, or smoke when using this product.

Conditions for safe storage, including any incompatibilities

Storage Store in a location inaccessible to children. Tightly close cap between uses.

Incompatible Products Other toilet bowl cleaners, rust removers, acids, or products containing ammonia.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Sodium hydroxide 1310-73-2	Ceiling: 2 mg/m^3	TWA: 2 mg/m^3	IDLH: 10 mg/m^3 Ceiling: 2 mg/m^3
Sodium hypochlorite 7681-52-9	None	None	None
Sodium cocoate 67701-10-4	None	None	None
Myristamine oxide 3332-27-2	None	None	None
Lauramine oxide 1643-20-5	None	None	None

ACGIH TLV: American Conference of Governmental Industrial Hygienists - Threshold Limit Value. OSHA PEL: Occupational Safety and Health Administration - Permissible Exposure Limits. NIOSH IDLH: Immediately Dangerous to Life or Health.

Appropriate engineering controls

Engineering Measures Showers
Eyewash stations
Ventilation systems

Individual protection measures, such as personal protective equipment

Eye/Face Protection If splashes are likely to occur: Wear safety glasses with side shields (or goggles) or face shield.

Skin and Body Protection Wear rubber or neoprene gloves and protective clothing such as long-sleeved shirt.

Respiratory Protection If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.

Hygiene Measures Wash hands after direct contact. Do not wear product-contaminated clothing for prolonged periods. Remove and wash contaminated clothing before re-use. Do not eat, drink, or smoke when using this product.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical and Chemical Properties

Physical State	Viscous liquid		
Appearance	Clear	**Odor**	Apple, fruity, floral, bleach
Color	Green	**Odor Threshold**	No information available

Property	**Values**	**Remarks/ Method**
pH	12.5 - 13.5	None known
Melting/freezing point	No data available	None known
Boiling point / boiling range	No data available	None known
Flash Point	Not flammable	None known
Evaporation rate	No data available	None known
Flammability (solid, gas)	No data available	None known
Flammability Limits in Air		
Upper flammability limit	No data available	None known
Lower flammability limit	No data available	None known
Vapor pressure	No data available	None known
Vapor density	No data available	None known
Specific Gravity	~1.05	None known
Water Solubility	Soluble in water	None known
Solubility in other solvents	No data available	None known
Partition coefficient: n-octanol/water	No data available	None known
Autoignition temperature	No data available	None known
Decomposition temperature	No data available	None known
Kinematic viscosity	No data available	None known
Dynamic viscosity	~1000 cP	None known
Explosive Properties	Not explosive	
Oxidizing Properties	No data available	

Other Information

Softening Point	No data available
VOC Content (%)	No data available
Particle Size	No data available
Particle Size Distribution	No data available

10. STABILITY AND REACTIVITY

Reactivity
Reacts with other household chemicals such as other toilet bowl cleaners, rust removers, acids, or products containing ammonia to produce hazardous irritating gases, such as chlorine and other chlorinated compounds.

Chemical stability
Stable under recommended storage conditions.

Possibility of Hazardous Reactions
None under normal processing.

Conditions to avoid
None known based on information supplied.

Incompatible materials
Other toilet bowl cleaners, rust removers, acids, or products containing ammonia.

Hazardous Decomposition Products
None known based on information supplied.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Product Information .

Inhalation Exposure to vapor or mist may irritate respiratory tract and cause coughing. Inhalation of high concentrations may cause pulmonary edema.

Eye Contact Corrosive. May cause severe damage to eyes.

Skin Contact May cause severe irritation to skin. Prolonged contact may cause burns to skin.

Ingestion Ingestion may cause burns to gastrointestinal tract and respiratory tract, nausea, vomiting, and diarrhea.

Component Information

Chemical Name	LD50 Oral	LD50 Dermal	LC50 Inhalation
Sodium hypochlorite 7681-52-9	8200 mg/kg (Rat)	>10000 mg/kg (Rabbit)	-
Sodium hydroxide 1310-73-2	-	1350 mg/kg (Rabbit)	-

Information on toxicological effects

Symptoms May cause redness and tearing of the eyes. May cause burns to eyes. May cause redness or burns to skin. Inhalation may cause coughing.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Sensitization No information available.

Mutagenic Effects No information available.

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Chemical Name	ACGIH	IARC	NTP	OSHA
Sodium hypochlorite 7681-52-9	-	Group 3	-	-

IARC (International Agency for Research on Cancer)
Group 3 - Not Classifiable as to Carcinogenicity in Humans

Reproductive Toxicity No information available.

STOT - single exposure No information available.

STOT - repeated exposure No information available.
Chronic Toxicity Carcinogenic potential is unknown.
Target Organ Effects Respiratory system, eyes, skin, gastrointestinal tract (GI).

Aspiration Hazard No information available.

Numerical measures of toxicity - Product Information

The following values are calculated based on chapter 3.1 of the GHS document
No information available.

12. ECOLOGICAL INFORMATION

Ecotoxicity
Very toxic to aquatic life. Toxic to aquatic life with long lasting effects.

Persistence and Degradability
No information available.

Bioaccumulation
No information available.

Other adverse effects
No information available.

13. DISPOSAL CONSIDERATIONS

Disposal methods
Dispose of in accordance with all applicable federal, state, and local regulations.

Contaminated Packaging
Do not reuse empty containers. Dispose of in accordance with all applicable federal, state, and local regulations.

14. TRANSPORT INFORMATION

DOT LIMITED QUANTITY.

TDG

UN-No	UN1760
Proper Shipping Name	CORROSIVE LIQUID, N.O.S.
Hazard Class	8
Packing Group	II
Description	UN1760, CORROSIVE LIQUID, N.O.S. (SODIUM HYPOCHLORITE, SODIUM HYDROXIDE), 8, II.

ICAO

UN-No	UN1760
Proper Shipping Name	CORROSIVE LIQUID, N.O.S.
Hazard Class	8
Packing Group	II
Description	UN1760, CORROSIVE LIQUID, N.O.S. (SODIUM HYPOCHLORITE, SODIUM HYDROXIDE), 8, II.

IATA

UN-No	UN1760
Proper Shipping Name	CORROSIVE LIQUID, N.O.S.
Hazard Class	8
Packing Group	II
Description	UN1760, CORROSIVE LIQUID, N.O.S. (SODIUM HYPOCHLORITE, SODIUM HYDROXIDE), 8, II.

IMDG/IMO

UN-No	UN1760
Proper Shipping Name	CORROSIVE LIQUID, N.O.S.
Hazard Class	UN1760
Packing Group	CORROSIVE LIQUID, N.O.S.
EmS No.	F-A, S-B
Marine Pollutant	Marine Pollutant exception per IMDG Code 2.10.2.7.
Description	UN1760, CORROSIVE LIQUID, N.O.S. (SODIUM HYPOCHLORITE, SODIUM HYDROXIDE), 8, II.

15. REGULATORY INFORMATION

Chemical Inventories

TSCA	All components of this product are either on the TSCA 8(b) Inventory or otherwise exempt from listing.
DSL/NDSL	All components are on the DSL or NDSL.

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

U.S. Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act
This product contains the following substances which are regulated pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

Chemical Name	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants	CWA - Hazardous Substances
Sodium hypochlorite 7681-52-9	100 lb			X
Sodium hydroxide 1310-73-2	1000 lb			X

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Chemical Name	Hazardous Substances RQs	Extremely Hazardous Substances RQs	RQ
Sodium hypochlorite 7681-52-9	100 lb	-	RQ 100 lb final RQ RQ 45.4 kg final RQ
Sodium hydroxide 1310-73-2	1000 lb	-	RQ 1000 lb final RQ RQ 454 kg final RQ

EPA Statement
This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets and for workplace labels of non-pesticide chemicals. Following is the hazard information as required on the pesticide label:

> **DANGER: CORROSIVE.** Causes irreversible eye damage. Causes skin irritation. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals. Do not get in eyes, on skin, or on clothing. For prolonged use, wear gloves. Wash thoroughly with soap and water after handling. Remove and wash contaminated clothing before reuse. Use only in well-ventilated areas.

US State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania	Rhode Island	Illinois
Sodium hypochlorite 7681-52-9	X	X	X	X	
Sodium hydroxide 1310-73-2	X	X	X	X	

International Regulations

Canada
WHMIS Hazard Class
E - Corrosive material



16. OTHER INFORMATION

NFPA	**Health Hazard** 3	**Flammability** 0	**Instability** 0	**Physical and Chemical Hazards** -
HMIS	**Health Hazard** 3	**Flammability** 0	**Physical Hazard** 0	**Personal Protection** B

Prepared By
Product Stewardship
23 British American Blvd.
Latham, NY 12110
1-800-572-6501

Revision Date March 12, 2016

Revision Note Revision Sections 3 and 8.

Reference 1101253/139644.002

General Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal, and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

Revision Number: 006.0 **Issue Date:** 11/11/2015

1. IDENTIFICATION OF THE SUBSTANCE OR MIXTURE AND OF THE SUPPLIER

Product identifier used on the label:

Dial ® For Men Hair and Body Wash — Ultimate Clean, HydroFresh
Dial ® For Men Body Wash – Full Force, Odor Armor
Dial ® For Men Magnetic Body Wash — Clean Rinsing
Dial ® For Men Fresh Reaction Body Wash – Alpine, Sub Zero
RightGuard ® Body Wash—Cooling/Chill, Hydrating, Refreshing, Energizing, Odor Combat

Other means of identification:

1815329 (DFM H&BW Ultimate Clean); 1815340 (DFM H&BW HydroFresh); 1815253 (DFM BW Full Force); 1925365 (Odor Armor); 1815548 (DFM Magnetic Clean Rinsing BW); 1937928 (DFM Fresh Reaction Alpine); 1937924 (DFM Fresh Reaction Sub Zero); 1901564 (RG BW Cooling/Chill); 1901562 (RG BW Hydrating); 1901567(RG BW Refreshing); 1901565 (RG BW Energizing, Xtreme Fresh Energizing); 2030593 (Odor Combat)

Recommended use of the chemical and restrictions on use: Shower Gel/Body wash, No restrictions on use.

Name, address and telephone number of the chemical manufacturer:

The Dial Corporation, a Henkel Company
7201 E. Henkel Way
Scottsdale, AZ 85255-9672 USA

CHEMTREC: 1-800-424-9300 (24 hours daily)
Internet: www.henkelna.com

Emergency telephone number: Medical Emergencies: 1-888-689-9082

2. HAZARD IDENTIFICATION

The hazards described in this OSHA Globally Harmonized System Safety Data Sheet (SDS) are not intended for consumers, and does not address consumer use of the product. For information regarding consumer applications of this product, refer to the product label.

Classification of the substance or mixture in accordance with paragraph (d) of §1910.1200

HAZARD CLASS	HAZARD CATEGORY
EYE IRRITATION	2B

Signal word, hazard statement(s), symbol(s) and precautionary statement(s) in accordance with paragraph (f) of §1910.1200

Signal word: WARNING
Hazard Statement(s): Causes eye irritation.
Symbol(s): None

Precautionary Statements:
Prevention: Wash thoroughly after handling.
Response: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
If eye irritation persists: Get medical attention.
Storage: Not prescribed
Disposal: Not prescribed

Hazards not otherwise classified: Not available.

Classification complies with OSHA Hazard Communication Standard (29 CFR 1910.1200) and is consistent with the provisions of the United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

See Section 11 for additional toxicological information.

3. COMPOSITION / INFORMATION ON INGREDIENTS

The following chemicals are classified as health hazards in accordance with paragraph (d) of § 1910.1200.

Chemical Name*	CAS Number (Unique Identifier)	Concentration
Alcohols, C10-16, ethoxylated, sulfates, sodium salts, 2EO	68585-34-2	5 – 10 %
1-Propanaminium, 3-amino-N-(carboxymethyl)-N,N-dimethyl-, N-coco acyl derivs., hydroxides, inner salts	61789-40-0	1 - 5%
Glycerol	56-81-5	1 - 5%
Sodium chloride	7647-14-5	1 - 5%

*The specific chemical identity and/or exact percentage (concentration) of composition has been withheld because a trade secret is claimed in accordance with paragraph (i) of §1910.1200.

4. FIRST AID MEASURES

Description of necessary measures

Inhalation: First aid measures not required.
Skin contact: First aid measures not required. Cosmetic product and therefore not necessary.
Eye contact: Rinse eyes immediately with plenty of water, occasionally lifting upper and lower lids, until no evidence of product remains. Get medical attention if pain or irritation develops.
Ingestion: Dilution by rinsing the mouth and giving water or milk to drink is generally recommended. Contact physician or local poison control center.

Most important symptoms and effects, both acute and delayed

After eye contact: Causes mild to moderate irritation. After skin contact: Repeated or prolonged excessive exposure may cause irritation or dermatitis. After ingestion: Nausea and possible vomiting may occur. After inhalation: Unlikely to occur due to the physical properties of the product. At elevated temperatures, vapors or mists may cause irritation.

Indication of any immediate medical attention and special treatment needed

After eye contact: Rinse eyes with plenty of water until no evidence of product remains. After skin contact: Rinse affected area with large amounts of water until no evidence of product remains. After ingestion: Dilution by rinsing the mouth and giving a glass of water to drink is generally recommended. After inhalation: Remove from exposure area to fresh air.

5. FIRE FIGHTING MEASURES

Suitable (and unsuitable) extinguishing media

Suitable extinguishing media: Dry chemical, carbon dioxide, water spray or regular foam.
Unsuitable extinguishing media: None known

Specific hazards arising from the chemical

Oxides of carbon and oxides of nitrogen.

Special protective equipment and precautions for fire-fighters

In case of fire, wear a full-face positive-pressure self-contained breathing apparatus and protective suit. Avoid breathing vapors, keep upwind. Isolate area. Keep unnecessary personnel away.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Wear skin, eye and respiratory protection as recommended in Section 8. Stop leak if you can do it without risk. Spills present a slipping hazard. Keep unnecessary personnel away. Ventilate spill area if possible. Make sure area is slip-free before re-opening to traffic.

Environmental Precautions

Small or household quantities may be disposed in sewer or other liquid waste system. For larger quantities check with your local water treatment plant.

Methods and materials for containment and cleaning up

SMALL SPILLS: Contain and absorb with sand or other absorbent material and place into clean, dry containers for later disposal. Wash site of spillage thoroughly with water. LARGE SPILLS: Dike far ahead of spill to prevent further movement. Recover by pumping or by using a suitable absorbent material and place into containers for later disposal. Dispose in suitable waste container.

7. HANDLING AND STORAGE

Precautions for safe handling

Do not get in eyes. Do not take internally. Use with adequate ventilation. Avoid generating aerosols and mists.

Conditions for safe storage, including any incompatibilities

Store in original containers in a cool dry area. Storage areas for large quantities (warehouse) should be well ventilated. Keep the containers tightly closed when not in use.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

OSHA permissible exposure limit (PEL), American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV), and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the safety data sheet, where available.

Hazardous Component(s)	ACGIH	OSHA PEL	AIHA WEEL	OTHER
Alcohols, C10-16, ethoxylated, sulfates, sodium salts, 2EO	None	None	None	None
Glycerol	None	5 mg/m3 PEL Respirable fraction. 15 mg/m3 PEL Total dust.	None	None
Sodium chloride	None	None	None	None

Appropriate engineering controls
Provide local exhaust or general dilution ventilation to keep exposure to airborne contaminants below the permissible exposure limits where mists or vapors may be generated.

Individual protection measures

Respiratory: Air contamination monitoring should be carried out where mists or vapors are likely to be generated, to assure that the employees are not exposed to airborne contaminants above the permissible exposure limits.

Eye: Splash-proof safety glasses are required to prevent eye contact where splashing of product may occur.

Hand/Body: Protective gloves are required where repeated or prolonged skin contact may occur.
Protective clothing is required where repeated or prolonged skin contact may occur.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: liquid, colored
Odor: characteristic
Odor threshold: Not available
pH: 4.50 – 5.00 (25 °C)
Melting point/ range: Not available.
Boiling point/range: Not available.
Flash point: > 93.3 °C (> 199.94 °F)
Evaporation rate: Not available.
Flammable/Explosive limits - lower: Not available.
Flammable/Explosive limits - upper: Not available.
Vapor pressure: Not available.
Vapor density: Not available.
Solubility in water: Soluble
Partition coefficient (n-octanol/water): Not available.
Autoignition temperature: Not available.
Decomposition temperature: Not available.
Viscosity: 8,000-24,000 mPa.s
VOC content: Not available.
Specific gravity: 1.03 – 1.05 g/ml

10. STABILITY AND REACTIVITY

Reactivity: This product may react with strong alkalies.

Chemical stability: Stable under normal ambient temperature (70°F, 21°C) and pressure (1 atm).

Possibility of hazardous reactions: Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

Conditions to avoid: Avoid storing in direct sunlight and avoid extremes of temperature.

Incompatible materials: Strong oxidizers and alkalis.

Hazardous decomposition products: Thermal decomposition may release toxic and/or hazardous gases, including ammonia.

11. TOXICOLOGICAL INFORMATION

Likely routes of exposure including symptoms related to characteristics

Inhalation: Unlikely to occur due to the physical properties of the product. At elevated temperatures, vapors or mists may cause irritation.
Skin contact: Repeated or prolonged excessive exposure may cause irritation or dermatitis.
Eye contact: Causes mild to moderate irritation.
Ingestion: May cause mild gastrointestinal irritation with nausea, vomiting, diarrhea and abdominal pain.
Physical/Chemical: No physical/chemical hazards are anticipated for this product.

Other relevant toxicity information:
This product is a personal care or cosmetic product. Direct contact with eyes causes irritation. No adverse effects are anticipated to skin from normal use.

Numerical measures of toxicity, including delayed and immediate effect

Hazardous Component(s)	LD50s and LC50s	Immediate and Delayed Health Effects
Alcohols, C10-16, ethoxylated, sulfates, sodium salts, 2EO	None	Irritant
1-Propanaminium, 3-amino-N-(carboxymethyl)-N,N-dimethyl-, N-coco acyl derivs. hydroxides, inner salts	None	Irritant, Allergen
Glycerol	None	Blood, Irritant, Kidney, Nuisance dust
Sodium chloride	Oral LD50 (RAT) = 3,000 mg/kg	Irritant

Carcinogenicity information

Hazardous Component(s)	NTP Carcinogen	IARC Carcinogen	OSHA Carcinogen
Alcohols, C10-16, ethoxylated, sulfates, sodium salts, 2EO	No	No	No
1-Propanaminium, 3-amino-N-(carboxymethyl)-N,N-dimethyl-, N-coco acyl derivs. hydroxides, inner salts	No	No	No
Glycerol	No	No	No
Sodium chloride	No	No	No

Carcinogenicity None of the ingredients in this product are listed as carcinogens by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP) or the Occupational Safety and Health Administration (OSHA).
Mutagenicity None of the ingredients in this product are known to cause mutagenicity.
Toxicity to reproduction None of the ingredients in this product are known to have reproductive, fetal, or developmental hazards.

12. ECOLOGICAL INFORMATION

Aquatic Toxicity:
This product is anticipated to be safe for the environment at concentrations predicted in household settings under normal use conditions.

Toxicity to fish:
The aquatic toxicity profile of this product has not been determined.

Toxicity to aquatic invertebrates:
The aquatic toxicity profile of this product has not been determined.

Toxicity to algae:
The aquatic toxicity profile of this product has not been determined.

Persistence and Degradability: The persistence and degradability of this product has not been determined. The hazardous ingredients are readily biodegradable.

Hazardous substances	Result value	Route of application	Species	Method
Alcohols, C10-16, ethoxylated, sulfates, sodium salts, 2EO	Readily biodegradable	aerobic	80 – 83 %	OECD 301 B (CO_2 evolution)
1-Propanaminium, 3-amino-N-(carboxymethyl)-N,N-dimethyl-, N-coco acyl derivs. hydroxides, inner salts	Readily biodegradable	aerobic	86 %	OECD 301 D (closed bottle)
Glycerol	Readily biodegradable	aerobic	90 – 94 %	EU Method C.4-E

Bioaccumulation Potential: The bioaccumulation potential of this product has not been determined.

Mobility: The mobility of this product (in soil and water) has not been determined.

13. DISPOSAL CONSIDERATIONS

Waste Number and Description: Not applicable, not regulated.

Disposal Considerations:
Disposal of products: This product is not a RCRA hazardous waste and can be disposed of in accordance with federal, state and local regulations.
Disposal of packages: Place in trash.

Additional information: Observe all federal, state and local regulations when storing or disposing of this substance

14. TRANSPORT INFORMATION

The transport information provided in this section only applies to the material/formulation itself, and is not specific to any package/configuration.

U.S. Department of Transportation Ground (49 CFR)

Proper shipping name: Not regulated
Hazard class or division: None
Identification number: None
Packing group: None

International Air Transportation (ICAO/IATA)

Proper shipping name: Not regulated
Hazard class or division: None
Identification number: None
Packing group: None

Water Transportation (IMO/IMDG)

Proper shipping name: Not regulated
Hazard class or division: None
Identification number: None
Packing group: None

15. REGULATORY INFORMATION

Occupational Safety and Health Act: Hazard Communication Standard, 29 CFR 1910.1200(g) Appendix D: The Occupational Safety and Health Administration (OSHA) require that the Safety Data Sheets (SDSs) are readily accessible to employees for all hazardous chemicals in the workplace. Since the use pattern and exposure in the workplace are generally not consistent with those experienced by consumers, this SDS may contain health hazard information not relevant to consumer use.

United States Regulatory Information:

TSCA 8 (b) Inventory Status: All components are listed or are exempt from listing on the Toxic Substances Control Act Inventory.
TSCA 12 (b) Export Notification: None above reporting de minimis
CERCLA/SARA Section 302: None above reporting de minimis
CERCLA/SARA Section 311/312: Not available.
CERCLA/SARA Section 313: None above reporting de minimis
California Proposition 65: No California Proposition 65 listed chemicals are known to be present.

Canada Regulatory Information:

CEPA DSL/NDSL Status: One or more components are not listed on, and are not exempt from listing on either the Domestic Substances List or the Non-Domestic Substances List.

16. OTHER INFORMATION

DISCLAIMER: The data contained herein are furnished for information only and are believed to be reliable. However, Henkel Corporation and its affiliates ("Henkel") does not assume responsibility for any results obtained by persons over whose methods Henkel has no control. It is the user's responsibility to determine the suitability of Henkel's products or any production methods mentioned herein for a particular purpose, and to adopt such precautions as may be advisable for the protection of property and persons against any hazards that may be involved in the handling and use of any Henkel's products. In light of the foregoing, Henkel specifically disclaims all warranties, express or implied, including warranties of merchantability and fitness for a particular purpose, arising from sale or use of Henkel's products. Henkel further disclaims any liability for consequential or incidental damages of any kind, including lost profits.

This safety data sheet contains changes from the previous version in sections: 1

Prepared by: R&D Support Services

Issue date: 11/11/2015 **Supercedes:** Rev. 5, 06/25/2015

SAFETY DATA SHEET

Issuing Date: 19-Jan-2017 **Revision Date:** 19-Jan-2017 **Version** 1

This Safety Data Sheet (SDS) is not required under local legislation, implementing the UN Globally Harmonized System (GHS). This SDS is being provided as a courtesy to help assist in the safe handling and proper use of the product

1. IDENTIFICATION

Product Name	Gain Original Fresh
Product Identifier	91033402_RET_NG
Product Type:	Finished Product - Consumer (Retail) Use Only
Recommended Use	Laundry Care.
Details of the supplier of the safety data sheet	PROCTER & GAMBLE - Fabric and Home Care Division Ivorydale Technical Centre 5289 Spring Grove Avenue Cincinnati, Ohio 45217-1087 USA Procter & Gamble Inc. P.O. Box 355, Station A Toronto, ON M5W 1C5 1-800-331-3774
E-mail Address	pgsds.im@pg.com
Emergency Telephone	Transportation (24 HR) CHEMTREC - 1-800-424-9300 (U.S./ Canada) or 1-703-527-3887 Mexico toll free in country: 800-681-9531

2. HAZARD IDENTIFICATION

"Consumer Products", as defined by the US Consumer Product Safety Act and which are used as intended (typical consumer duration and frequency), are exempt from the OSHA Hazard Communication Standard (29 CFR 1910.1200). This SDS is being provided as a courtesy to help assist in the safe handling and proper use of the product.

This product is classifed under 29CFR 1910.1200(d) and the Canadian Hazardous Products Regulation as follows:.

Not Classified.

Hazard Statements	None
Hazard pictograms	None
Precautionary Statements	None
Precautionary Statements - Response	None

Precautionary Statements - Storage None

Precautionary Statements - Disposal None

Hazards not otherwise classified (HNOC) None

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients are listed according to 29CFR 1910.1200 Appendix D and the Canadian Hazardous Products Regulation

Chemical Name	Synonyms	Trade Secret	CAS-No	Weight %
Tetramethyl Acetyloctahydronaphthalenes	Tetramethyl Acetyloctahydronaphthalenes	No	54464-57-2	0.1 - 1.0

4. FIRST AID MEASURES

First aid measures for different exposure routes

Eye contact Rinse with plenty of water. Get medical attention immediately if irritation persists.

Skin contact Rinse with plenty of water. Get medical attention if irritation develops and persists.

Ingestion Drink 1 or 2 glasses of water. Do NOT induce vomiting. Get medical attention immediately if symptoms occur.

Inhalation Move to fresh air. If symptoms persist, call a physician.

Most important symptoms/effects, acute and delayed None under normal use conditions.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media Dry chemical, CO_2, alcohol-resistant foam or water spray. Dry chemical. Alcohol-resistant foam.

Unsuitable Extinguishing Media None.

Special hazard None known.

Special protective equipment for fire-fighters As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

Specific hazards arising from the chemical None.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Use personal protective equipment. Do not get in eyes, on skin, or on clothing.

Advice for emergency responders Use personal protective equipment as required.

Environmental precautions Keep out of waterways
Do not discharge product into natural waters without pre-treatment or adequate dilution

Methods and materials for containment and cleaning up

Methods for containment Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Prevent product from entering drains. Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13).

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling Use personal protective equipment as required. Keep container closed when not in use. Never return spills in original containers for re-use. Keep out of the reach of children.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place.

Incompatible products None known.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines No exposure limits noted for ingredient(s).

Exposure controls

Engineering Measures **Distribution, Workplace and Household Settings:**
Ensure adequate ventilation

Product Manufacturing Plant (needed at Product-Producing Plant ONLY):
Where reasonably practicable this should be achieved by the use of local exhaust ventilation and good general extraction

Personal Protective Equipment

Eye Protection **Distribution, Workplace and Household Settings:**
No special protective equipment required

Product Manufacturing Plant (needed at Product-Producing Plant ONLY):
Use appropriate eye protection

Hand Protection **Distribution, Workplace and Household Settings:**
No special protective equipment required

Product Manufacturing Plant (needed at Product-Producing Plant ONLY):
Protective gloves

Skin and Body Protection

Distribution, Workplace and Household Settings:
No special protective equipment required

Product Manufacturing Plant (needed at Product-Producing Plant ONLY):
Wear suitable protective clothing

Respiratory Protection

Distribution, Workplace and Household Settings:
No special protective equipment required

Product Manufacturing Plant (needed at Product-Producing Plant ONLY):
In case of inadequate ventilation wear respiratory protection

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State @20°C	Liquid
Appearance	opaque green
Odor	characteristic, Perfume
Odor threshold	No information available

Property	Values	Note
pH value	2.7 - 3.8	
Melting/freezing point	No information available	
Boiling point/boiling range	No information available	
Flash point	No information available	.
Evaporation rate	No information available	
Flammability (solid, gas)	No information available	
Flammability Limits in Air		
Upper flammability limit	No information available	
Lower Flammability Limit	No information available	
Vapor pressure	No information available	
Vapor density	No information available	
Relative density	No information available	
Water solubility	No information available	
Partition coefficient: n-octanol/water	No information available	
Autoignition temperature	No information available	.
Decomposition temperature	No information available	.
Viscosity of Product	No information available	
VOC Content (%)	Products comply with US state and federal regulations for VOC content in consumer products.	

10. STABILITY AND REACTIVITY

Reactivity None under normal use conditions.

Stability Stable under normal conditions.

Hazardous polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

Conditions to Avoid None under normal processing.

Materials to avoid None in particular.

Hazardous Decomposition Products None under normal use conditions.

11. TOXICOLOGICAL INFORMATION

Product Information

Information on likely routes of exposure

Inhalation	No known effect.
Skin contact	No known effect.
Ingestion	No known effect.
Eye contact	No known effect.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Acute toxicity	No known effect.
Skin corrosion/irritation	No known effect.
Serious eye damage/eye irritation	No known effect.
Skin sensitization	No known effect.
Respiratory sensitization	No known effect.
Germ cell mutagenicity	No known effect.
Neurological Effects	No known effect.
Reproductive toxicity	No known effect.
Developmental toxicity	No known effect.
Teratogenicity	No known effect.
STOT - single exposure	No known effect.
STOT - repeated exposure	No known effect.
Target Organ Effects	No known effect.
Aspiration hazard	No known effect.
Carcinogenicity	No known effect.

12. ECOLOGICAL INFORMATION

Ecotoxicity

The product is not expected to be hazardous to the environment.

Persistence and degradability	No information available.
Bioaccumulative potential	No information available.
Mobility	No information available.
Other adverse effects	No information available.

13. DISPOSAL CONSIDERATIONS

Waste treatment

Waste from Residues / Unused Products	Disposal should be in accordance with applicable regional, national and local laws and regulations.
Contaminated packaging	Disposal should be in accordance with applicable regional, national and local laws and regulations.
California Hazardous Waste Codes (non-household setting)	331

14. TRANSPORT INFORMATION

DOT	Not regulated
IMDG	Not regulated
IATA	Not regulated

15. REGULATORY INFORMATION

U.S. Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302):.

Chemical Name	CAS-No	Hazardous Substances RQs	Extremely Hazardous Substances RQs	CERCLA/SARA 302 TPQ
Formic acid	64-18-6	5000 lb	-	
Sodium hydroxide	1310-73-2	1000 lb	-	
Hydrogen chloride	7647-01-0	5000 lb	5000 lb	500 lb

Clean Air Act, Section 112 Hazardous Air Pollutants (HAPs) (see 40 CFR 61)
This product contains the following substance(s) which are either listed as hazardous air pollutants (HAPS) or VOC's per the Clean Air Act:

Chemical Name	CAS-No	CAA (Clean Air Act) - 1990 Hazardous Air Pollutants
Hydrogen chloride	7647-01-0	X

Clean Water Act
This product contains the following substances which are regulated pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42):.

Chemical Name	CAS-No	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants	CWA - Hazardous Substances
Formic acid	64-18-6	5000 lb	-	-	X
Sodium hydroxide	1310-73-2	1000 lb	-	-	X
Hydrogen chloride	7647-01-0	5000 lb	-	-	X

California Proposition 65
This product is not subject to warning labeling under California Proposition 65.

U.S. State Regulations (RTK)
.

Chemical Name	CAS-No	Pennsylvania
Ethanol	64-17-5	X
Formic acid	64-18-6	X

International Inventories

United States
All intentionally-added components of this product(s) are listed on the US TSCA Inventory.

Canada
This product is in compliance with CEPA for import by P&G.

Legend
United States Toxic Substances Control Act Section 8(b) Inventory (TSCA)
CEPA - Canadian Environmental Protection Act

16. OTHER INFORMATION

Issuing Date: 19-Jan-2017
Revision Date: 19-Jan-2017
Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

KIK CUSTOM PRODUCTS

SAFETY DATA SHEET

Revision Date 19-Apr-2015 **Version** 1

1. IDENTIFICATION

Product identifier

Product Name Frosty Acres Restaurant Pride Advantage Germicidal Ultra Bleach

Other means of identification

Product UPC 48200-26675
Product Code 11005915041

Recommended use of the chemical and restrictions on use

Recommended Use Disinfectant. Cleaning agent. Chlorine-based bleaching agents.
Uses advised against Do not mix with other chemicals

Details of the supplier of the safety data sheet

Manufacturer Address
KIK International LLC
33 Macintosh Blvd.
Concord, Ontario
Canada L4K 4L5
1-800-479-6603

Emergency telephone number

Emergency Telephone Poison Control Center (Medical) : (866) 366-5048
Chemtel (Transportation) 1-888-255-3924

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin corrosion/irritation	Category 2
Serious eye damage/eye irritation	Category 1

Label elements

Emergency Overview

Danger

Hazard statements
Causes skin irritation
Causes serious eye damage



Color light yellow **Physical state** liquid **Odor** Chlorine

Precautionary Statements - Prevention
Wash face, hands and any exposed skin thoroughly after handling

Wear protective gloves/protective clothing/eye protection/face protection

Precautionary Statements - Response
Immediately call a POISON CENTER or doctor/physician
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Immediately call a POISON CENTER or doctor/physician
IF ON SKIN: Wash with plenty of soap and water
If skin irritation occurs: Get medical advice/attention
Take off contaminated clothing and wash before reuse

Precautionary Statements - Storage
Keep out of reach of children. Store in a well-ventilated place. Store in a closed container. Protect from sunlight.

Hazards not otherwise classified (HNOC)
Not applicable

Other Information
0% of the mixture consists of ingredient(s) of unknown toxicity

3. COMPOSITION/INFORMATION ON INGREDIENTS

Mixture

Chemical Name	CAS No.	Weight-%
Sodium hypochlorite	7681-52-9	5-7*

*The exact percentage (concentration) of composition has been withheld as a trade secret.

4. FIRST AID MEASURES

Description of first aid measures

Eye contact Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes.

Skin contact Wash skin with soap and water. If symptoms persist, call a physician.

Inhalation Remove to fresh air.

Ingestion Do NOT induce vomiting. Clean mouth with water and drink afterwards plenty of water. If symptoms persist, call a physician.

Most important symptoms and effects, both acute and delayed

Symptoms No information available.

Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically. Probable mucosal damage may contraindicate the use of gastric lavage.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media No information available.

Specific hazards arising from the chemical
No information available.

Explosion data
Sensitivity to Mechanical Impact None.
Sensitivity to Static Discharge None.

Protective equipment and precautions for firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Avoid contact with skin, eyes or clothing. Use personal protective equipment as required. Ensure adequate ventilation, especially in confined areas.

Environmental precautions

Environmental precautions See Section 12 for additional ecological information.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Pick up and transfer to properly labeled containers.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling Avoid contact with skin, eyes or clothing. Do not eat, drink or smoke when using this product. Use personal protective equipment as required. Handle in accordance with good industrial hygiene and safety practice.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place.

Incompatible materials Acids, Ammonia.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies. .

Appropriate engineering controls

Engineering Controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles).

Skin and body protection Wear protective gloves and protective clothing.

Respiratory protection If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved

respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.

General Hygiene Considerations Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	liquid		
Appearance	clear, light yellow	**Odor**	Chlorine
Color	light yellow	**Odor threshold**	No information available

Property	**Values**	**Remarks • Method**
pH	12.0 - 12.5	
Melting point/freezing point	No information available	
Boiling point / boiling range	No information available	
Flash point	No information available	
Evaporation rate	No information available	
Flammability (solid, gas)	No information available	
Flammability Limit in Air		
Upper flammability limit:	No information available	
Lower flammability limit:	No information available	
Vapor pressure	No information available	
Vapor density	No information available	
Specific Gravity	~1.08	
Water solubility	Soluble in water	
Solubility in other solvents	No information available	
Partition coefficient	No information available	
Autoignition temperature	No information available	
Decomposition temperature	No information available	
Kinematic viscosity	No information available	
Dynamic viscosity	No information available	
Density	No information available	
Bulk density	No information available	
Explosive properties	No information available	
Oxidizing properties	No information available	

Other Information

Softening point	No information available
Molecular weight	No information available
VOC Content (%)	No information available

10. STABILITY AND REACTIVITY

Reactivity
No data available
Chemical stability
Stable under recommended storage conditions.
Possibility of Hazardous Reactions
None under normal processing.
Conditions to avoid
Do not mix with other chemicals. Extremes of temperature and direct sunlight.
Incompatible materials
Acids, Ammonia.
Hazardous Decomposition Products
None known based on information supplied.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Inhalation Inhalation of vapors in high concentration may cause irritation of respiratory system.

Eye contact Avoid contact with eyes. May cause burns.

Skin contact Avoid contact with skin. May cause irritation.

Ingestion May be harmful if swallowed.

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Sodium hypochlorite 7681-52-9	= 8200 mg/kg (Rat)	> 10000 mg/kg (Rabbit)	-

Information on toxicological effects

Symptoms No information available.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Sensitization No information available.
Germ cell mutagenicity No information available.
Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Chemical Name	ACGIH	IARC	NTP	OSHA
Sodium hypochlorite 7681-52-9	-	Group 3	-	-

IARC (International Agency for Research on Cancer)
Not classifiable as a human carcinogen

Reproductive toxicity No information available.
STOT - single exposure No information available.
STOT - repeated exposure No information available.
Aspiration hazard No information available.

Numerical measures of toxicity - Product Information

12. ECOLOGICAL INFORMATION

Ecotoxicity

Very toxic to aquatic life with long lasting effects

0% of the mixture consists of components(s) of unknown hazards to the aquatic environment

Chemical Name	Algae/aquatic plants	Fish	Crustacea
Sodium hypochlorite 7681-52-9	0.095: 24 h Skeletonema costatum mg/L EC50	0.06 - 0.11: 96 h Pimephales promelas mg/L LC50 flow-through 4.5 - 7.6: 96 h Pimephales promelas mg/L LC50 static 0.4 - 0.8: 96 h Lepomis macrochirus mg/L LC50 static 0.28 - 1: 96 h Lepomis macrochirus mg/L LC50 flow-through 0.05 - 0.771: 96 h Oncorhynchus mykiss mg/L LC50 flow-through 0.03 - 0.19: 96 h Oncorhynchus mykiss mg/L LC50 semi-static 0.18 - 0.22: 96 h Oncorhynchus mykiss mg/L LC50 static	0.033 - 0.044: 48 h Daphnia magna mg/L EC50 Static 2.1: 96 h Daphnia magna mg/L EC50

Persistence and degradability
No information available.

Bioaccumulation

No information available.

Mobility
No information available.

Other adverse effects No information available

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal of wastes Disposal should be in accordance with applicable regional, national and local laws and regulations.

Contaminated packaging Do not reuse container. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT Not regulated

IATA

UN/ID no.	3082
Proper shipping name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (SODIUM HYPOCHLORITE)
Hazard Class	9
Packing Group	III
Description	UN3082, ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (SODIUM HYPOCHLORITE), 9, III

IMDG

UN/ID no.	3082
Proper shipping name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (SODIUM HYPOCHLORITE)
Hazard Class	9
Packing Group	III
Description	UN3082, ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (SODIUM HYPOCHLORITE), 9, III
Marine pollutant	This material meets the definition of a marine pollutant

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL/NDSL	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

US Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

SARA 311/312 Hazard Categories

Acute health hazard	Yes
Chronic Health Hazard	No
Fire hazard	No
Sudden release of pressure hazard	No
Reactive Hazard	No

CWA (Clean Water Act)

This product contains the following substances which are regulated pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

Chemical Name	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants	CWA - Hazardous Substances
Sodium hypochlorite 7681-52-9	100 lb	-	-	X

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Chemical Name	Hazardous Substances RQs	CERCLA/SARA RQ	Reportable Quantity (RQ)
Sodium hypochlorite 7681-52-9	100 lb	-	RQ 100 lb final RQ RQ 45.4 kg final RQ

US State Regulations

California Proposition 65

This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania
Sodium hypochlorite 7681-52-9	X	X	X

U.S. EPA Label Information

EPA Pesticide Registration Number 70271-13-55020

EPA Statement

This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets, and for workplace labels of non-pesticide chemicals. Following is the hazard information as required on the pesticide label:

Difference between SDS and EPA Pesticide label

DANGER: Corrosive. May cause severe skin and eye irritation or chemical burns to broken skin. Causes eye damage. Wear safety glasses and rubber gloves when handling this product. Wash after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Avoid breathing vapors. Vacate poorly ventilated areas as soon as possible. Do not return until strong odors have dissipated.

16. OTHER INFORMATION, INCLUDING DATE OF PREPARATION OF THE LAST REVISION

NFPA	**Health hazards** 2	**Flammability** 0	**Instability** 1	**Physical and Chemical Properties** -
HMIS	**Health hazards** 2	**Flammability** 0	**Physical hazards** 1	**Personal protection** B

Prepared By Regulatory Affairs
Revision Date 19-Apr-2015
Revision Note No information available

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with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

SAFETY DATA SHEET

Revision Date 06-May-2015 **Version** 1

1. IDENTIFICATION

Product identifier
Product Name Great Value Glass Cleaner

Other means of identification
Product UPC 78742-04960
Product Code 15403065644

Recommended use of the chemical and restrictions on use
Recommended Use Consumer use. Cleaning agent.
Uses advised against Do not mix with other chemicals

Details of the supplier of the safety data sheet

Manufacturer Address
KIK International LLC
33 Macintosh Blvd.
Concord, Ontario
Canada L4K 4L5
1-800-479-6603

Distributor
Wal-Mart Stores, Inc.
702 SW 8th ST.
Bentonville, AR 72712
1-877-505-2267

Emergency telephone number
Emergency Telephone Poison Control Center (Medical) : (866) 366-5048
Chemtel (Transportation) 1-888-255-3924

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is not considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Label elements

Emergency Overview

The product contains no substances which at their given concentration, are considered to be hazardous to health

Color blue **Physical state** liquid **Odor** Slight Ammonia

Hazards not otherwise classified (HNOC)
Not applicable

Other Information

3. COMPOSITION/INFORMATION ON INGREDIENTS

Mixture

Chemical Name	CAS No.	Weight-%
Ethylene glycol, monobutyl ether acetate	112-07-2	0.5 - 1.5*
Ammonia	7664-41-7	0.1 - 0.5*

*The exact percentage (concentration) of composition has been withheld as a trade secret.

4. FIRST AID MEASURES

Description of first aid measures

Eye contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin contact Wash skin with soap and water. If symptoms persist, call a physician.

Inhalation Remove to fresh air.

Ingestion Do NOT induce vomiting. Clean mouth with water and drink afterwards plenty of water. If symptoms persist, call a physician.

Most important symptoms and effects, both acute and delayed

Symptoms No information available.

Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media No information available.

Specific hazards arising from the chemical
No information available.

Explosion data
Sensitivity to Mechanical Impact None.
Sensitivity to Static Discharge None.

Protective equipment and precautions for firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Avoid contact with skin, eyes or clothing. Use personal protective equipment as required. Ensure adequate ventilation, especially in confined areas.

Environmental precautions

Environmental precautions See Section 12 for additional ecological information.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Pick up and transfer to properly labeled containers.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice. Do not mix with other chemicals.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place.

Incompatible materials None known based on information supplied.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines .

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Ethylene glycol, monobutyl ether acetate 112-07-2	TWA: 20 ppm	-	TWA: 5 ppm TWA: 33 mg/m^3
Ammonia 7664-41-7	STEL: 35 ppm TWA: 25 ppm	TWA: 50 ppm TWA: 35 mg/m^3 (vacated) STEL: 35 ppm (vacated) STEL: 27 mg/m^3	IDLH: 300 ppm TWA: 25 ppm TWA: 18 mg/m^3 STEL: 35 ppm STEL: 27 mg/m^3

NIOSH IDLH Immediately Dangerous to Life or Health

Other Information Vacated limits revoked by the Court of Appeals decision in AFL-CIO v. OSHA, 965 F.2d 962 (11th Cir., 1992).

Appropriate engineering controls

Engineering Controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles).

Skin and body protection Wear protective gloves and protective clothing.

Respiratory protection If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.

General Hygiene Considerations Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	liquid		
Appearance	aqueous solution	**Odor**	Slight Ammonia
Color	blue	**Odor threshold**	No information available

Property	**Values**	**Remarks • Method**
pH	11	
Melting point/freezing point	No information available	
Boiling point / boiling range	No information available	
Flash point	No information available	
Evaporation rate	No information available	
Flammability (solid, gas)	No information available	
Flammability Limit in Air		
Upper flammability limit:	No information available	
Lower flammability limit:	No information available	
Vapor pressure	No information available	
Vapor density	No information available	
Specific Gravity	No information available	
Water solubility	Soluble in water	
Solubility in other solvents	No information available	
Partition coefficient	No information available	
Autoignition temperature	No information available	
Decomposition temperature	No information available	
Kinematic viscosity	No information available	
Dynamic viscosity	No information available	
Density	No information available	
Bulk density	No information available	
Explosive properties	No information available	
Oxidizing properties	No information available	

Other Information

Softening point	No information available
Molecular weight	No information available
VOC Content (%)	No information available

10. STABILITY AND REACTIVITY

Reactivity
No data available
Chemical stability
Stable under recommended storage conditions.
Possibility of Hazardous Reactions
None under normal processing.
Conditions to avoid
Do not mix with other chemicals. Extremes of temperature and direct sunlight.
Incompatible materials
None known based on information supplied.
Hazardous Decomposition Products
None known based on information supplied.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Inhalation	Inhalation of vapors in high concentration may cause irritation of respiratory system.
Eye contact	Avoid contact with eyes. May cause slight irritation.
Skin contact	Avoid contact with skin. Substance may cause slight skin irritation.

Ingestion Ingestion may cause irritation to mucous membranes.

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Ethylene glycol, monobutyl ether acetate 112-07-2	= 1600 mg/kg (Rat)	= 1480 mg/kg (Rabbit)	-
Ammonia 7664-41-7	= 350 mg/kg (Rat)	-	= 2000 ppm (Rat) 4 h

Information on toxicological effects

Symptoms No information available.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Sensitization No information available.
Germ cell mutagenicity No information available.
Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Chemical Name	ACGIH	IARC	NTP	OSHA
Ethylene glycol, monobutyl ether acetate 112-07-2	A3	-	-	-

ACGIH (American Conference of Governmental Industrial Hygienists)
A3 - Animal Carcinogen

Reproductive toxicity No information available.
STOT - single exposure No information available.
STOT - repeated exposure No information available.
Chronic toxicity No information available.
Aspiration hazard No information available.

Numerical measures of toxicity - Product Information

The following values are calculated based on chapter 3.1 of the GHS document .
ATEmix (inhalation-dust/mist) 112.8 mg/l

12. ECOLOGICAL INFORMATION

Ecotoxicity

Toxic to aquatic life with long lasting effects

98.57845% of the mixture consists of components(s) of unknown hazards to the aquatic environment

Chemical Name	Algae/aquatic plants	Fish	Crustacea
Ethylene glycol, monobutyl ether acetate 112-07-2	500: 72 h Desmodesmus subspicatus mg/L EC50	-	37: 48 h Daphnia magna mg/L EC50
Ammonia 7664-41-7	-	0.44: 96 h Cyprinus carpio mg/L LC50 0.26 - 4.6: 96 h Lepomis macrochirus mg/L LC50 1.17: 96 h Lepomis macrochirus mg/L LC50 flow-through 0.73 - 2.35: 96 h Pimephales promelas mg/L LC50 5.9: 96 h Pimephales promelas mg/L LC50 static 1.5: 96 h Poecilia reticulata mg/L LC50 1.19: 96 h Poecilia reticulata mg/L LC50 static	25.4: 48 h Daphnia magna mg/L LC50

Persistence and degradability
No information available.

Bioaccumulation
No information available.

Mobility
No information available.

Chemical Name	Partition coefficient
Ethylene glycol, monobutyl ether acetate 112-07-2	1.51
Ammonia 7664-41-7	-1.14

Other adverse effects No information available

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal of wastes Disposal should be in accordance with applicable regional, national and local laws and regulations.

Contaminated packaging Do not reuse container. Refer to all federal, state and local regulations prior to disposal of container and unused contents by reuse, recycle or disposal.

14. TRANSPORT INFORMATION

DOT Not regulated

IATA Not regulated

IMDG Not regulated

15. REGULATORY INFORMATION

International Inventories
TSCA Complies
DSL/NDSL Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

US Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product contains a chemical or chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

Chemical Name	SARA 313 - Threshold Values %
Ethylene glycol, monobutyl ether acetate - 112-07-2	1.0

SARA 311/312 Hazard Categories

Acute health hazard	No
Chronic Health Hazard	No
Fire hazard	No
Sudden release of pressure hazard	No
Reactive Hazard	No

CWA (Clean Water Act)
This product contains the following substances which are regulated pollutants pursuant to the Clean Water Act (40 CFR 122.21

and 40 CFR 122.42)

Chemical Name	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants	CWA - Hazardous Substances
Ammonia 7664-41-7	100 lb	-	-	X

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Chemical Name	Hazardous Substances RQs	CERCLA/SARA RQ	Reportable Quantity (RQ)
Ammonia 7664-41-7	100 lb	100 lb	RQ 100 lb final RQ RQ 45.4 kg final RQ

US State Regulations

California Proposition 65

This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania
Ethylene glycol, monobutyl ether acetate 112-07-2	X	-	X
Ammonia 7664-41-7	X	X	X

U.S. EPA Label Information

EPA Pesticide Registration Number This product does not contain any substances regulated as pesticides

Difference between SDS and CPSC label

This product is regulated under Consumer Product Safety Commission and is subject to certain labeling requirements under the Federal Hazardous Substances Act (16 CFR Part 1500) . These requirements differ from the classification criteria and hazard information required for safety data sheets and for workplace product labels.

16. OTHER INFORMATION, INCLUDING DATE OF PREPARATION OF THE LAST REVISION

NFPA	**Health hazards** 0	**Flammability** 0	**Instability** 0	**Physical and Chemical Properties** -
HMIS	**Health hazards** 0	**Flammability** 0	**Physical hazards** 0	**Personal protection** X

Prepared By Regulatory Affairs
Revision Date 06-May-2015
Revision Note No information available

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End of Safety Data Sheet

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product information

Product Name: PERMECTRIN™ II
SDS Number: 122000008520

Use : Pesticide

Company
BAYER HEALTHCARE LLC
Animal Health Division
12707 Shawnee Mission Parkway
(West 63rd)
Shawnee, KS 66216-1846
USA
(800) 633-3796

In case of emergency: (800) 422-9874
Chemtrec: (800) 424-9300
BAYER INFORMATION PHONE:(800) 633-3796
INTERNATIONAL:(703) 527-3887

2. HAZARDS IDENTIFICATION

Emergency Overview

Colour: Light yellow to yellow **Form:** liquid **Odour:** oily.

GHS Classification:

Acute toxicity (Oral)	:	Category 4
Acute toxicity (Inhalation)	:	Category 4
Eye irritation	:	Category 2
Skin sensitization	:	Category 1
Germ cell mutagenicity	:	Category 1B
Carcinogenicity	:	Category 1B

GHS Label element:

Hazard pictograms :



Signal word : Danger

Hazard statements : H302 Harmful if swallowed.
H317 May cause an allergic skin reaction.
H319 Causes serious eye irritation.
H332 Harmful if inhaled.
H340 May cause genetic defects.
H350 May cause cancer.

Precautionary statements : **Prevention:**
P201 Obtain special instructions before use.
P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P273 Avoid release to the environment.
P281 Use personal protective equipment as required.
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.
Response:
P308 + P313 IF exposed or concerned: Get medical advice/ attention.

Other hazards which do not result in classification:

None known.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Weight percent	Components	CAS-No.
10%	Permethrin	52645-53-1
1 - 5%	n-butanol	71-36-3

4. FIRST AID MEASURES

General advice: Take off all contaminated clothing immediately.

If inhaled: Remove to fresh air. Call a physician immediately.

In case of skin contact: After contact with skin, wash immediately with plenty of soap and water. If skin reactions occur, contact a physician.

In case of eye contact: In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

If swallowed: If swallowed, seek medical advice immediately and show this container or label.

Note to Physician: Do not induce vomiting: contains petroleum distillates and/or aromatic solvents.

Contact Number: Use the Bayer Emergency Number in Section 1

5. FIREFIGHTING MEASURES

Suitable extinguishing media: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Unsuitable extinguishing media: High volume water jet

Specific hazards during firefighting: Fire may cause evolution of: Carbon monoxide (CO) Carbon dioxide (CO2)

Special protective equipment for firefighters: In the event of fire, wear self-contained breathing apparatus. Use personal protective equipment.

Further information: Prevent fire extinguishing water from contaminating surface water or the ground water system.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Use personal protective equipment.

Methods for cleaning up: Cover spilled product with liquid-binding material (sand, silica gel, acid binder, universal binder, hybilat). Take up mechanically and fill into labeled, closable containers.

Additional advice: No special precautions required.

Further Accidental Release Notes No special precautions required.

7. HANDLING AND STORAGE

Handling:
Avoid formation of aerosol. Only handle product with local exhaust ventilation. Avoid contact with skin, eyes and clothing.

No special protective measures against fire required.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Respiratory protection:
Recommended Filter type: Organic vapor with prefilter

None required for consumer use of this product.

Hand protection:
Chemically resistant gloves.
None required for consumer use of this product.

Eye protection:
Safety glasses

None required for consumer use of this product.

Other protective measures:
Wear suitable protective equipment.

Please consult label for end-user requirements.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form:	liquid
Colour:	Light yellow to yellow
Odour:	oily
Odour Threshold:	No applicable information is available
Melting point:	No applicable information is available
Boiling point/boiling range:	No applicable information is available
Density:	0.859 g/cm³
Bulk density:	No applicable information is available
Vapour pressure:	No applicable information is available
Viscosity, dynamic:	No applicable information is available
Viscosity, kinematic:	No applicable information is available
Flow time:	No applicable information is available
Surface tension:	No applicable information is available
Miscibility with water:	No applicable information is available
Water solubility:	No applicable information is available
pH:	4.86 at 10 g/l
Relative density:	No applicable information is available
Partition coefficient:	No applicable information is available
Solubility(ies):	No applicable information is available
Flash point:	151 °F (66.11 °C)
Flammability (solid, gas):	No applicable information is available
Ignition temperature:	No applicable information is available
Explosion limits:	No applicable information is available

10. STABILITY AND REACTIVITY

Conditions to avoid: No data available

Materials to avoid: Oxidizing agents

Hazardous reactions: No data available

Thermal decomposition:

No data available

Hazardous decomposition products:
Carbon monoxide (CO), Carbon dioxide (CO2)

Oxidizing properties:

No statements available.

Impact sensitivity:
No data available

11. TOXICOLOGICAL INFORMATION

Other information on toxicity:
Permethrin
Cutaneous sensations may occur, such as burning or stinging on the face and mucosae. However, these sensations cause no lesions and are of a transitory nature (max. 24 hours).

Other information on toxicity:
n-butanol
Liver and kidney injuries may occur.

After absorption of large quantities Dizziness, Liver disorders, drowsiness, headaches, Weakness

Acute oral toxicity:
Permethrin
LD50 Rat: 430 mg/kg

n-butanol
LD50 Rat: 790 mg/kg

Acute inhalation toxicity:
Permethrin
LC50 Rat: 2.3 mg/l, 4 h

n-butanol
LC50 Rat: 8000 ppm, 4 h

Acute dermal toxicity:
Permethrin
LD50 Rabbit: > 2,000 mg/kg

LD50 Rat: > 2,500 mg/kg

n-butanol
LD50 Rabbit: 3,400 mg/kg

Skin irritation:
Permethrin
Rabbit
Result: No skin irritation

n-butanol
Rabbit
Result: Mild skin irritation
Method: OECD 404

Eye irritation:
Permethrin
Rabbit
Result: Mild eye irritation

n-butanol
Rabbit
Result: Causes serious eye damage.
Method: OECD 405

Sensitisation:
Permethrin
Result: May cause sensitisation by skin contact.

n-butanol
Skin sensitization guinea pig
Result: Did not cause sensitisation on laboratory animals.
Method: OECD 406

Genotoxicity in vitro:
n-butanol
Ames test
Result: negative

Micronucleus test
Result: negative

In vitro gene mutation study in mammalian cells (Hamster V79-cells)
Result: No evidence of a genotoxic effect.
Method: OECD 476

Genotoxicity in vivo:
n-butanol
Micronucleus test, Mouse
Result: No evidence of a genotoxic effect.
Method: OECD 474

Reproductive toxicity:
n-butanol
NOAEL: 2000 ppm
Result: Animal testing did not show any effects on fertility.
Method: OECD Test Guideline 416

Pharmaceutic effects:
Permethrin
Insecticide

Carcinogenicity:
No Carcinogenic substances as defined by IARC, NTP and/or OSHA

Experience with human exposure:
Components:
71-36-3 :
May cause skin irritation and/or dermatitis.

STOT - single exposure:
Components:

71-36-3 :
Assessment: May cause drowsiness or dizziness.

STOT - repeated exposure:
No data available

12. ECOLOGICAL INFORMATION

General advice:
Do not allow to enter surface waters or groundwater.

Toxicity to fish:
Permethrin
LC50 0.0076 mg/l
Test species: Poecilia reticulata Duration of test: 48 h

n-butanol
Acute Fish toxicity: LC50 1,730 mg/l
Test species: Pimephales promelas (fathead minnow) Duration of test: 96 h

Toxicity to daphnia and other aquatic invertebrates:
Permethrin
EC50 37 µg/l
Test species: Daphnia magna (Water flea) Duration of test: 48 h
Method: OECD 202

EC50 0.00017 mg/l
Test species: Daphnia magna (Water flea) Duration of test: 48 h

n-butanol
EC50 1,983 mg/l
Test species: Daphnia magna (Water flea) Duration of test: 48 h

Toxicity to algae:
Permethrin
EC50 0.5 mg/l
Duration of test: 72 h

Biodegradability:
Permethrin
0 %, 28 d Not rapidly biodegradable

n-butanol
98 %, 28 d rapidly biodegradable
Method: OECD 301 E

13. DISPOSAL CONSIDERATIONS

If discarded in its purchased form, this product would not be a hazardous waste either by listing or by characteristic. However, under RCRA, it is the responsibility of the product user to determine at the time of disposal, whether a material containing the product or derived from the product should be classified as a hazardous waste. (40 CFR 261.20-24)

Waste disposal should be in accordance with existing federal, state and local environmental control laws.

14. TRANSPORT INFORMATION

Land transport (CFR)
non-regulated

US Sea transport (IMDG)
non-regulated

US Air transport (ICAO / IATA cargo aircraft only)
non-regulated

US Air transport (ICAO / IATA passenger and cargo aircraft)
non-regulated

International IATA

UN Number	3082
Description of the goods	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (PERMETHRIN)
Class	9
Packaging group	III
Dangerous goods labels	9
Environmentally hazardous	yes

International IMDG

UN Number	3082
Description of the goods	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (PERMETHRIN)
Class	9
Packaging group	III
IMDG-Labels	9
EmS Number	F-A
Marine pollutant	yes

15. REGULATORY INFORMATION

Other regulations: No statements available.

US. EPA Emergency Planning and Community Right-To-Know Act (EPCRA) SARA Title III Section 302 Extremely Hazardous Substance (40 CFR 355, Appendix A)
Components
None

US. EPA Emergency Planning and Community Right-To-Know Act (EPCRA) SARA Title III Section 313 Toxic Chemicals (40 CFR 372.65) - Supplier Notification Required
Components
Permethrin

US. EPA CERCLA Hazardous Substances (40 CFR 302) Components

n-butanol	Reportable quantity: 5000 lbs

Massachusetts, New Jersey or Pennsylvania Right to Know Substance Lists

Weight percent	Components	CAS-No.
7 - 13%	Permethrin	52645-53-1

New Jersey Environmental Hazardous Substances List and/or New Jersey RTK Special Hazardous Substances Lists

Weight percent	Components	CAS-No.
7 - 13%	Permethrin	52645-53-1

California Prop. 65

To the best of our knowledge, this product does not contain any of the listed chemicals, which the state of California has found to cause cancer, birth defects or other reproductive harm.

OSHA Hazcom Standard Rating Hazardous

16. OTHER INFORMATION

Changes since the last version are highlighted in the margin. This version replaces all previous versions.

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

SAFETY DATA SHEET (SDS)

Compliant with OSHA Hazard Communication Standard as defined in 29 CFR 1910.1200.
Prepared to UN-GHS Revision 3.

Revised on 22 October 2013

1) PRODUCT AND COMPANY INFORMATION

Product identifier:

Trade name: Prima Glo & Prima Spray On & Prima Marc (paint)

Product Description: Livestock marking paint

Emergency telephone number:

Please call Chemtrec at 1-800-424-9300

Manufacturer/Supplier:
Prima Tech USA
P.O. Box 336, Kenansville, NC 28349
Phone: 1-910-296-6116
Fax: 1-910-296-0306
Toll-free: 1-888-833-7099
www.primatechusa.com
info@PrimaTechUSA.com

2) HAZARD IDENTIFICATION

- **Hazard classifications of the chemical**

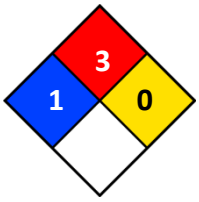
 **WARNING** Skin irritation, category 2 Causes skin irritation Wear protective gloves. IF ON SKIN: Wash with plenty of water. Seek medical advice if irritation persists. Take off contaminated clothing and wash before reuse.	 **WARNING** Eye irritation, category 2A Causes serious eye irritation IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing. Seek medical advice if irritation persists.	 **WARNING** Specific target organ toxicity (single exposure), category 3 May cause drowsiness or dizziness IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a doctor if you feel unwell.
 **DANGER** Aspiration hazard, category 1 May be fatal if swallowed and enters airways IF SWALLOWED: Immediately call a POISON CONTROL CENTER. Do **NOT** induce vomiting.	 **DANGER** Flammable aerosol, category 1 Extremely flammable aerosol Keep away from heat, sparks, open flames, and hot surfaces—No smoking. Do not spray on an open flame or other ignition source. Pressurized container: Do not pierce or burn, even after use. Protect from sunlight. Do not expose to temperatures exceeding 50°C/122°F	 **WARNING** Dissolved gas Contains gas under pressure; may explode if heated Protect from sunlight. Store in a well-ventilated place.

(continued on page 2)

(continued from page 1)

NFPA/HMIS Definitions:
0-Least, 1-Slight, 2-Moderate,
3-High, 4-Extreme (Scale 0-4)

NFPA:



HEALTH: 1

FLAMMABILITY: 3

REACTIVITY: 0

HMIS:

HEALTH	**1**
FIRE	**3**
REACTIVITY	**0**

KEEP OUT OF REACH OF CHILDREN

3) Composition/Information on Ingredients

- **Dangerous components of the mixture***

Chemical name:	**Identifier:**	**Concentration:**
Acetone	CAS: 67-64-1	15-40%
Heptane	CAS: 142-82-5	10-30%
Isobutane/Propellant blend	CAS: 68476-86-8	15-40%

*Mixture contains additional chemicals that are not considered hazardous and are not included on SDS

4) FIRST-AID MEASURES

- **GENERAL ADVICE:** Have SDS or product label if medical advice is needed. Seek a medical professional or doctor if you feel unwell or if irritation(s) persist.
- **IF SWALLOWED:** Do **NOT** induce vomiting. Call a POISON CONTROL CENTER or doctor immediately. Never give anything by mouth to an unconscious person. May be fatal if swallowed and enters airways.
- **IF INHALED:** Remove person to fresh air and keep at rest in a position comfortable for breathing. Victim may experience dizziness or drowsiness—do not operate machinery or drive if inhaled and dizziness persists. If not breathing or breathing is difficult, administer artificial respiration and/or oxygen as needed--seek medical aid if person can not breathe or has difficulty breathing.
- **IF IN EYES:** Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do—continue rinsing. Victim may experience serious eye irritation. Consult a doctor if irritation persists.
- **IF ON SKIN:** Wash with plenty of water. Take off contaminated clothing and wash before reuse. Victim may experience skin irritation. Consult a doctor if irritation persists.

5) FIRE-FIGHTING MEASURES

- **EXTINGUISHING METHODS:** Dry chemical, sand, or carbon dioxide after spray has stopped.
- **IF EXTINGUISHING METHODS ARE UNAVAILABLE:** Cool container with water if exposed to heat or flame, move container away from fire area if this can be done without further risk.
- **FIRE HAZARDS:** Contains gas under pressure, pressurized container: May explode if ignited or exposed to heat.
- **SUGGESTED EQUIPMENT AND PRECAUTIONS FOR FIREFIGHTERS:** No special measures are required.

6) ACCIDENTAL RELEASE MEASURES

- **IF ACCIDENTALLY RELEASED OR SPILLED:** Remove or eliminate all sources of ignition. Establish ventilation to keep atmospheric concentrations below limits. Avoid breathing vapors. Wear protective equipment. Keep unprotected persons away.
- **NEUTRALIZING CHEMICAL:** Absorb into clay-like absorbent material.
- **WASTE DISPOSAL METHOD:** Dispose of in accordance with state, local, and federal regulations. Prevent material from entering waterways or sewage. Container may be recycled if completely emptied.

7) HANDLING AND STORAGE

- **CONDITIONS FOR SAFE HANDLING:** Wear protective equipment. Follow instructions found on label.
- **CONDITIONS FOR SAFE STORAGE:** Do not expose to temperatures above 50°C/122°F. Store in a well-ventilated place. Protect from sunlight. Keep away from heat and other sources of ignition. Keep away from oxidizing agents.

8) EXPOSURE CONTROLS/PERSONAL PROTECTION

- **EXPOSURE LIMITS**

Chemical name:	Identifier:	PEL:	ACGIH:	NIOSH:
Acetone	CAS: 67-64-1	1000 ppm	750 ppm	250 ppm
Heptane	CAS: 142-82-5	500 ppm	500 ppm	440 ppm
Isobutane/Propellant Blend	CAS: 68476-86-8	5000 ppm	5000 ppm	5000 ppm

- **VENTILIATION REQUIREMENTS:** Good mechanical ventilation may be adequate for maintaining airborne concentrations below established exposure limits for large uncontrolled releases.
- **IF EXPOSURE LIMITS ARE EXCEDED AND INHALED:** Use a NOISH approved respirator.



Handle material with gloves and protective clothing. Inspect gloves prior to use. Use proper glove removal techniques so that no skin comes into contact with the outside of the glove. Gloves must be chemically resistant (such as rubber).



Use NIOSH/OSHA or EN 166 approved eye protection

(continued on page 4)

(continued from page 3)



Practice good industrial hygiene. Wash hands before breaks and at the end of the workday. Keep material away from foodstuffs, beverages, and feed. Wash and launder all contaminated clothing.

9) PHYSICAL AND CHEMICAL PROPERTIES

- **APPEARANCE:** Varies based on specific color/dye used in formulation
- **ODOR:** Solvent-like odor
- **ODOR THRESHOLD:** Not determined or not applicable
- **pH:** Not determined or not applicable
- **VAPOR PRESSURE:** Approximately 70psi at 70°F/21°C
- **DENSITY:** .88 g/cm³
- **SOLUBILITY:** 0%
- **MELTING/FREEZING POINT:** Not determined or not applicable
- **BOILING POINT:** 104°F/40°C
- **FLAMMABLE EXPLOSIVE LIMITS (% volume in air):** 1.2%-9.5%
- **FLASH POINT (TCC closed cup):** <20°F/-6.67°C
- **FLAME EXTENSION :** Does extend flame
- **FLAMMABILITY:** Contains flammable chemicals
- **AUTO-IGNITION TEMPERATURE:** Does not auto-ignite
- **DECOMPOSITION TEMPERATURE:** Not determined or not applicable
- **EVAPORATION RATE:** Not determined or not applicable
- **VISCOSITY:** Not determined or not applicable
- **VOLATILES BY VOLUME:** <85%

10) STABILITY AND REACTIVITY

- **CHEMICAL STABILITY:** Stable under normal conditions
- **HAZARDOUS POLYMERIZATION:** Can not occur
- **INCOMPATIBLE MATERIALS:** Strong oxidizing agents
- **HAZARDOUS DECOMPOSITION PRODUCTS:** Carbon dioxide and carbon monoxide and other combustion products are possible
- **CONDITIONS TO AVOID:** Heat, sparks, open flames, ignition sources, and sunlight.

11) TOXICOLOGICAL INFORMATION

- **Most likely routes of exposure:** inhalation, ingestion, skin and eye contact
- **Symptoms are more likely to increase the longer the exposure to the chemical**
- **Symptoms may include (but are not limited to):**
  Headache, dizziness, vertigo, incoordination, hilarity
  Persistent gasoline taste in mouth
  Eye, nose, and respiratory irritation

(continued on page 5)

(continued from page 5)

- **The following mixture components are found on the National Toxicology Program Report:** No components listed on National Toxicology Program Report
- **The following mixture components are found on the International Agency for Research on Cancer Monograph list:** No components listed on International Agency for Research on Cancer Monograph list

12) ECOLOGICAL INFORMATION

- **TOXICITY TO AQUATIC LIFE:** Very toxic to aquatic life with long lasting effects
  Do not expose to open waterways or dispose of product through drains or sewage
- **MOBILITY IN SOIL:** not determined or not applicable
- **PERSISTENCE AND DEGRADABILITY:** not determined or not applicable
- **BIOACCUMULATIVE POTENTIAL:** not determined or not applicable
- **PBT and vPvB ASSESSMENT:** not determined or not applicable

13) DISPOSAL CONSIDERATIONS

- Please refer to section 8 for proper personal equipment for use when disposing of container
- Please refer to local, state, and national regulations for proper disposal methods
- Offer surplus and non-recyclables to a licensed disposal company.
- Product, when completely emptied, may be recycled if allowed by local ordinances
- Empty product completely before placed in trash or introduced to a landfill as the product may still burst if heated or damaged

14) TRANSPORT INFORMATION

- **UN IDENTIFICATION NUMBER:** 1950
- **UN SHIPPING NAME:** Flammable Gas Aerosol
- **TRANSPORT HAZARD CLASS:** 2.1
- **DEPARTMENT OF TRANSPORTATION SHIPPING NAME:** Consumer Commodity
- **DEPARTMENT OF TRANSPORTATION HAZARD CLASS:** ORM-D Level 3 Aerosol
- **SHIPPING LABEL:** Flammable gas, Marine pollutant



- **ENVIRONMENTAL HAZARDS:** Marine pollutant. Very toxic to aquatic life with long lasting effects
- **INTERNATIONAL BULK CHEMICAL CODE:** Not determined or not applicable
- **SPECIAL SHIPPING PRECAUTIONS:** Ship container up-right without excessive load on top

15) REGULATORY INFORMATION

- This product is for industrial/institutional use only and is not to be used by general consumers
- The product is regulated by the OSH Act which is found in 29 CFR 1910.1200 of the United States code
- **SARA 302 COMPONENTS:** No components of mixture are subject to reporting
- **SARA 313 COMPONENTS:** This product may contain trace-levels of Formaldehyde (CAS: 50-00-0)
- **MASSACHUSETTS RIGHT TO KNOW COMPONENTS:** This product may contain trace-levels of Formaldehyde (CAS: 50-00-0)
- **PENNSYLVANIA RIGHT TO KNOW COMPONENTS:** This product may contain trace-levels of Formaldehyde (CAS: 50-00-0)
- **NEW JERSEY RIGHT TO KNOW COMPONENTS:** This product may contain trace-levels of Formaldehyde (CAS: 50-00-0)
- **CALIFORNIA PROP 65 COMPONENTS:** This product does not contain any chemicals known to the State of California to cause cancer, birth defects, or any other reproductive harm

16) OTHER INFORMATION

- This SDS was completed using the most up to date information available at the time of its completion; however, no representation, warranty, or guarantee is made as to its accuracy, reliability, or completeness. It is the user's responsibility to satisfy himself/herself as to the suitability and completeness of such information for his or her particular use. We do not accept any liability for any loss or damage that may occur from the use of this information nor do we offer warranty against patent infringement. The SDS does not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.
- Abbreviations and acronyms used: ACGIH: American Conference of Governmental Industrial Hygienists. CAS: Chemical Abstracts Service. CFR: Code of Federal Regulations. GHS: Globally Harmonized System. HMIS: Hazardous Materials Identification System. NFPA: National Fire Protection Association. NOISH: National Institute for Occupational Safety and Health. OSHA: Occupational Safety and Health Administration. PEL: Permissible Exposure Limit. SARA: Superfund Amendments and Reauthorization Act (regulation by the EPA). UN: United Nations.

SAFETY DATA SHEET

Prima Glo Fluorescent Green

SECTION 1 - IDENTIFICATION

Product Identifier

Product Number(s) *N7518CT*

Product Name *Prima Glo Fluorescent Livestock Marking Paint - Green - Inverted Tip*

Other Means of Identification *None*

Recommended Use and Restrictions on Use

Recommended Use *Livestock marking dye.*

Restrictions on Use *None Identified*

24 hr Emergency Phone Number

800-255-3924

(Chem-Tel)

MANUFACTURER DETAILS		SUPPLIER DETAILS	
Name	*Chem-Pak, Inc.*	**Name**	*Neogen Corporation*
Address	*242 Corning Way Martinsburg WV 25405*	**Address**	*279 Faison W. McGowan Road Kenansville NC 28349*
Phone Number	*800-336-9828*	**Phone Number**	*910-296-6020*
Fax Number	*304-262-9643*	**Fax Number**	

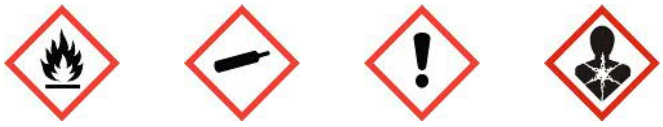
SECTION 2 - IDENTIFICATION

Hazard Classification

HEALTH HAZARDS				PHYSICAL HAZARDS					
Acute Tox. Oral	4	Mutagenicity		Unstable Explosive		Refrigerated Liq. Gas		Pyrophoric Solid	
Acute Tox. Skin		Carcinogenicity		Explosive		Flammable Liquid		Emits Flammable Gas	
Acute Tox. Inhalation		Tox. to Reproduction		Flammable Gas		Flammable Solid		Oxidizing Liquid	
Skin Irritation		STOT SE	1	Aerosol	1	Self-Reactive Sub.		Oxidizing Solid	
Eye Irritation		STOT RE		Oxidizing Gas		Pyrophoric Liquid		Organic Peroxide	
Resp. Sensitization		Aspiration Hazard		Gas Under Pressure	X	Self-Heating Substance		Corrosive to Metal	
Skin Sensitization				**ENVIRONMENTAL HAZARDS** *(GHS Rev 3 Only)*					
				Aquatic Acute		Aquatic Chronic		Ozone Depleting	

Signal Word *Danger*

Hazard Pictograms



Hazard Statements *Extremely flammable aerosol. Contains gas under pressure; may explode if heated. Harmful if swallowed. Causes damage to organs.*

Precautionary Statements

General *Keep out of reach of children.*

Prevention *Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Do not spray on an open flame or other ignition source. Do not pierce or burn, even after use. Do not breathe spray. Wash hands thoroughly after handling. Do not eat, drink , or smoke when using this product.*

Response *IF exposed: Call a doctor. IF SWALLOWED: Immediately call a POISON CENTER or doctor if you feel unwell. Rinse mouth.*

Storage *Store in a well-ventilated place. Store locked up. Protect from sunlight. Do not expose to temperatures exceeding 50 °C/122°F.*

Disposal *Dispose of contents/container in accordance with local regulations.*

Hazards Not Otherwise Classified *None identified.*

Unknown Acute Toxicity *5 % by wt*

SECTION 3 - COMPOSITION / INFORMATION ON INGREDIENTS

ID	INGREDIENT	CAS NUMBER	% WT RANGE*
1	*Liquefied Petroleum Gas*	*0068476-86-8*	*30 - 60*
2	*Ethanol*	*0000064-17-5*	*30 - 60*
3	*Methanol*	*0000067-56-1*	*7 - 13*
4	*Acetone*	*0000067-64-1*	*3 - 7*
5	*Ethyl Acetate*	*0000141-78-6*	*1 - 5*

** Exact percentages of composition withheld as trade secret*

SECTION 4 - FIRST AID MEASURES

Description of First-Aid Measures

General *If exposed or concerned seek medical advice/attention.*

Eye Contact *Immediately flush with clear water for at least 15 minutes, including under the eyelids. Consult a doctor.*

Skin Contact *Remove with soap and water, rinsing and repeating for 15 minutes. Use skin cream to counter any resulting dryness. Consult a physician if irritation continues. If large skin area is affected, remove contaminated clothing.*

Ingestion *Do not induce vomiting! Immediately have the victim drink plenty of water. Do not give milk or digestible oils. Keep airways free. Contact a physician. Never give anything by mouth if victim is rapidly losing consciousness, unconscious, or convulsing.*

Inhalation *Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Seek medical attention if symptoms persist or if unconscious.*

First-Aid Responder Protection *Wear adequate personal protective equipment based on the nature and severity of the emergency.*

Most Important Symptoms and Effects, Both Acute and Delayed

Eye Contact *Liquid contact may cause pain along with moderate eye irritation.*

Skin Contact *Prolonged or repeated exposure may cause skin irritation. Repeated contact may cause drying or flaking of skin. May cause more severe response if confined to skin.*

Ingestion *Due to being an aerosol, the product does not lend itself to ingestion. Should ingestion occur, it may cause irritation to membranes of the mouth, throat, and gastrointestinal tract resulting in vomiting and/or cramps. Aspiration of vomit into the lungs may cause inflammation, and possible chemical pneumonitis, bronchopneumonia, or pulmonary edema.*

Inhalation *Prolonged or repeated overexposure is anesthetic. May cause irritation of the respiratory tract, or acute nervous system depression characterized by headache, dizziness, staggering gait, confusion or death. Irritation of the mucous membranes, coughing, and dyspnea are also possible.*

Indication of Immediate Medical Attention and Special Treatment

Notes to Physician *Treat symptomatically.*

Specific Treatments/Antidotes *No information available.*

Immediate Medical Attention *No information available.*

SECTION 5 - FIRE-FIGHTING MEASURES

Extinguishing Media

Suitable Extinguishing Media *Water, CO2, dry chemical, or universal aqueous film forming foam*

Unsuitable Extinguishing Media *Water jet*

Specific Hazards Arising from the Chemical or Mixture

Decomposition Products *Oxides of carbon (CO, CO2), smoke, and/or vapors*

Hazards from the Product *CONTENTS EXTREMELY FLAMMABLE AND UNDER PRESSURE. In a fire or if heated, a pressure increase will occur which may result in the container bursting. Vapours heavier than air may spread along the ground and travel to an ignition source.*

Advice for Firefighters

Protective Actions *Use water spray to cool fire exposed containers as contents may rupture violently from heat developed pressure.*

Protective Equipment *As with any fire wear SCBA pressure-demand, MSHA/NIOSH approved, and full protective gear.*

SECTION 6 - ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures

For Non-Emergency Personnel *No action should be taken by non-emergency personnel without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spill. Remove ignition sources and provide adequate ventilation only if it is safe to do so.*

For Emergency Responders *Use personal protection as recommended in Section 8. Observe precautions provided for non-emergency personnel.*

Environmental Precautions

Precautions *Keep out of drains, sewers, ditches, and waterways. Minimize use of water to prevent environmental contamination.*

Methods and Materials for Containment and Cleaning Up

Containment Procedures *Product is an aerosol, therefore spills and leaks are unlikely. In case of rupture, released content may be contained with oil/solvent absorbent pads, socks, and/or absorbents. DO NOT use combustible material such as sawdust.*

Cleanup Procedures *Spills from aerosol cans are unlikely and are generally of small volume. Large spills are therefore not normally considered a problem. In case of actual rupture, avoid breathing vapors and ventilate area well. Remove sources of ignition and use non-sparking equipment. Soak up material with inert absorbent and place in safety containers for proper disposal.*

Other Information *Aerosol products represent a limited hazard and will not spill or leak unless ruptured. In case of rupture contents are generally evacuated from the can rapidly. Area should be ventilated immediately and continuous ventilation provided until all fumes and vapors have been removed. Aerosol cans should never be incinerated or burned. See Section 13 for disposal.*

Prohibited Materials *Combustible absorbent material such as sawdust, use of equipment that may cause sparking.*

SECTION 7 - HANDLING AND STORAGE

Precautions for Safe Handling

General Handling Precautions *KEEP OUT OF THE REACH OF CHILDREN. Avoid prolonged or repeated skin contact. Avoid breathing of vapors. Do not incinerate (burn) containers. Always replace overcap when not in use. Avoid use around open flames or other sources of ignition. Exposure to heat or prolonged exposure to sun may cause can to burst. Use only with adequate ventilation, opening doors or windows to achieve cross-ventilation. Wash hands after use.*

Hygiene Recommendations *Do not eat, drink or smoke when using this product. Wash hands thoroughly after use. Remove contaminated clothing and protective equipment before entering eating or smoking areas.*

Conditions for Safe Storage Including Any Incompatibilities

Storage Requirements *Storage of individual cans should be done in an area below 50 °C (122 °F), and away from heat sources. Ensure can is in a secure place to prevent knocking over and accidental rupture. For storage of pallet quantities, compliance with NFPA 30B (Manufacture and Storage of Aerosol Products) is recommended. This product is classified as a Level 3 Aerosol.*

Incompatibilities *Segregate storage away from materials indicated in Section 10*

SECTION 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

Control Parameters

Occupational Exposure Limits

ID	OSHA			NIOSH				ACGIH			AIHA
	PEL	STEL	CEILING	IDLH	REL	STEL	CEILING	TLV	STEL	CEILING	WEEL
1	1000 ppm	–	–	2000 ppm	1000 ppm	–	–	1000 ppm	–	–	–
2	–	–	–	3300 ppm	1000 ppm	–	–	1000 ppm	–	–	–
3	200 ppm	–	–	6000 ppm	200 ppm	250 ppm	–	200 ppm	250 ppm	–	–
4	1000 ppm	–	–	2500 ppm	250 ppm	–	–	500 ppm	250 ppm	–	–
5	400 ppm	–	–	2000 ppm	400 ppm	–	–	400 ppm	–	–	–

Biological Exposure Indices

ID	DETERMINANT	SAMPLING TIME	BEI	NOTATION
3	*Methanol in urine*	*End of shift*	*15 mg/L*	*B, Ns*
4	*Acetone in urine*	*End of shift*	*50 mg/L*	*Ns*

Other Control Parameters *Not Available*

Appropriate Engineering Control

Engineering Measures *Use only with adequate ventilation. General ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. Local exhaust ventilation or an enclosed handling system may be necessary to control air contamination below that of the lowest OEL from the table above.*

Individual Protection Measures

Hygiene Considerations *Avoid breathing vapors and contact with the skin and eyes. Always replace overcap when not in use. Keep out the reach of children. Wash hands after use.*

Thermal Protection *This product does not present a thermal hazard.*

Respiratory Protection *An approved respirator with organic vapor cartridge may be permissible under certain circumstances where airborne concentrations are expected to exceed occupational exposure limits. If respirators are needed, compliance with OSHA standard 29 CFR 1910.134 is necessary.*

Skin Protection *For brief contact, no precautions other than clean body-covering clothing should be needed. When prolonged or repeated contact could occur, use protective clothing impervious to the ingredients listed in Section 2.*

Eye/Face Protection *Safety glasses with side shields are recommended as a minimum for any type of industrial chemical handling. Where eye contact with this material could occur, chemical splash proof goggles are recommended.*

Other Protective Equipment *Safety showers and eye-wash stations should be available in the workplace near where the material will be used.*

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Physical Properties

Boiling Point	*> 56.1 °C (133.0 °F)*	***Melting / Freezing Point***	*>-97.7 °C (-143.0 °F)*
Flash Point, Liquid	*> -17.0 °C (1.4 °F)*	***Flash Point, Propellant***	*-104.4 °C (-156.0 °F)*
Explosive Limits	*2.50% - 36.00%*	***Autoignition Temperature, Liquid***	*385.0 °C (725.0 °F)*
Flammability	*Extremely Flammable Aerosol*	***Relative Density (H2O = 1)***	*0.674 g/cc*
Molecular Weight	*Not Available*	***Weight***	*5.624 lbs/gal*
Vapor Pressure	*70.00 psig*	***pH***	*Not Available*
Vapor Density	*2.000 g/cc Maximum*	***Evaporation Rate***	*Not Available*
Form	*Pressurized Product*	***Partition Coefficient***	*Not Available*
Viscosity	*Not Available*	***Refractive Index***	*Not Available*
Odor Threshold	*Not Available*	***Heat of Combustion (△Hc)***	*Not Available*
Odor	*Paint Like*	***Water Solubility***	*Not Available*
Appearance / Color	*Green Liquid*	***Decomposition Temperature***	*Not Available*

Air Quality Properties

Percent Volatile	*95% Wt (95% Vol) Max*	***VOC Regulatory***	*5.264 lbs/gal (630.723 g/L)*
Percent VOC	*90% Wt (91% Vol) Max*	***VOC Actual***	*5.04 lbs/gal (603.854 g/L)*
Percent HAP	*12% Wt (10% Vol) Max*	***HAP Content***	*0.65 lbs/gal (77.803 g/L)*
Solids/Non Volatile Content	*6% Wt (6% Vol) Max*	***Maximum Incremental Reactivity***	*1.14 g O3/g*
Global Warming Potential	*3.548*		

SECTION 10 - STABILITY AND REACTIVITY

Reactivity *No specific test data related to reactivity is available for this product or its ingredients.*

Chemical Stability *This product is stable.*

Hazardous Reactions *Under normal conditions of storage and use, hazardous reactions are not expected to occur.*

Conditions to Avoid *Keep away from heat, sparks, flame, and red hot metal.*

Material Incompatibility *Acids, Activated Carbon, Alkali Metals, Alkalis, Ammonia, Carbon Tetrachloride, Chlorine Dioxide, Diethyl Zinc, Hexachloromelamine, Hydrogen Peroxide, Isocyanates, Isoprene, Lithium Aluminum Hydride, Mineral Acids, Nitrates, Potassium Tert-Butoxide, Strong Oxidizing Agents, Strong Reducing Agents, Sulfur Dichloride,Trichloromelamine*

Decomposition Productions *Oxides of Carbon, Acetic Acid, Formaldehyde, Hydrogen Peroxide, Isoproanol, Methanol may be formed depending on fire conditions.*

SECTION 11 - TOXICOLOGICAL INFORMATION

Acute Toxicity Estimates *(mixture)*

Oral LD_{50} *627 mg/kg*

Dermal LD_{50} *16441 mg/kg*

Inhalation LC_{50} *657 mg/L 4-hour*

Acute Toxicity on Ingredients

ID	ORAL LD50		DERMAL LD50		INHALATION LC50		
	VALUE	SPECIES	VALUE	SPECIES	VALUE	TIME	SPECIES
1	–	–	–	–	658 mg/L	4h	rat
2	7060 mg/kg	rat	>15800 mg/kg	rabbit	>32380 ppm	4h	rat
3	143 mg/kg	human	17100 mg/kg	rabbit	128.2 mg/L	4h	rat
4	5800 mg/kg	rat	20000 mg/kg	rabbit	50100 mg/m3	8h	rat
5	5620 mg/kg	rat	>18000 mg/kg	rabbit	10600 ppm	4h	rat

Health Hazard Classification

Skin Corrosion / Irritation *Classification criteria not met*

Eye Damage / Irritation *Classification criteria not met*

Respiratory Irritation *Classification criteria not met*

Respiratory / Skin Sensitization *Classification criteria not met*

Germ Cell Mutagenicity *Classification criteria not met*

Reproductive Toxicity *Classification criteria not met*

STOT - Single Exposure *Cateogry 1*

STOT - Repeated Exposure *Classification criteria not met*

Aspiration Hazard *Classification criteria not met*

Carcinogen Data

ID	Calif Prop-65	OSHA	NIOSH	ACGIH	NTP	IARC
–	No	No	No	No	No	No

Information on the Likely Routes of Exposure

Routes of Exposure *Skin contact, skin absorption, eye contact, inhalation, ingestion*

Information on Physical, Chemical and Toxicological Effects

Symptoms of Exposure *Asphyxia, Blindness, Central Nervous System Depression, Cough, Dermatitis, Dizziness, Drowsiness, Skin Irritation, Throat Irritation, Upper Respiratory System Irritation, Visual Disturbance, Vomiting*

Delayed and Immediate Effects and also Chronic Effects from Short and Long-Term Exposure

Delayed Effects *No known delayed effects.*

Immediate Effects *No known immediate effects.*

Chronic Effects *Reports have associated repeated and prolonged occupational overexposure to solvents with irreversible brain and nervous system damage (sometimes referred to as "Solvent or Painter's Syndrome"). Intentional misuse by concentrating and inhaling this product may be harmful or fatal.*

Medical Conditions Aggravated *May aggravate personnel with pre-existing disorders associated with any of the Target Organs.*

Target Organs *Cardiovascular System, Central Nervous System, Eyes, Liver, Lumphoid System, Respiratory System, Skin*

SECTION 12 - ECOLOGICAL INFORMATION

Acute Aquatic Toxicity

ID	FISH			INVERTEBRATES			AQUATIC PLANTS			MICROORGANISMS		
	TYPE	VALUE	PERIOD	TYPE	VALUE	PERIOD	TYPE	VALUE	PERIOD	TYPE	VALUE	PERIOD
2	LC50	11000 mg/L	96h	EC50	10800 mg/L	24h	LOEC	1450 mg/L	8d	LOEC	6500 mg/L	16h
3	LC50	15400 mg/L	96h	EC50	>10000 mg/L	48h	EC50	22000 mg/L	96h	EC5	6600 mg/L	16h
4	LC50	5540 mg/L	96h	LC50	8800 mg/L	48h	NOEC	530 mg/L	8d	EC5	1700 mg/L	16h
5	LC50	230 mg/L	96h	EC50	717 mg/L	48h	IC50	3300 mg/L	48h	EC10	2900 mg/L	16h

Ecological Data

ID	PERSISTENCE AND DEGRADABILITY				BIOACCUMULATIVE POTENTIAL		MOBILITY
	PERSISTENCE	BOD	COD	ThOD	Pow / Kow	BCF	Koc
2	–	930 mg/g / 5d	1700 mg/g	2.1 mg/g	-0.31 log Pow	–	–
3	72% / 5 days	850 mg/g	1420 mg/g	1500 mg/g	-77 log Pow	0.48 log BCF	0.44 log Koc
4	90.9% / 28 days	1.85 mg/g / 5 d	2.07 mg/g	2.21 g/g	-0.24 log Pow	0.69 BCF	1.26 log Koc
5	100% / 28 days	1 g/g	1.69 g/g	1.82 g/g	0.73 log Pow	1.48 log BCF	0.788 log Koc

Other Adverse Effects *No additional information available.*

SECTION 13 - DISPOSAL CONSIDERATIONS

Waste Disposal *Characteristics and waste stream classification can change with product use and location. It is the responsibility of the user to determine the proper storage, transportation, treatment, and/or disposal methodologies for spent materials and residues at the time of disposition. All waste must be disposed of in compliance with the respective national, federal, state, and/or local regulations.*

Waste Disposal of Packaging *An aerosol container that does not contain a significant amount of liquid would meet the definition of scrap metal (40 CFR 261.1(c)(6)), and would be exempt from RCRA regulation under 40 CFR 261.6(a)(3)(iv) if it is to be recycled. If containers are to be disposed of (not recycled) it must be managed under all applicable RCRA and state regulations.*

Landfill Precautions *Not available*

Incineration Precautions *** DO NOT INCINERATE ** CONTENTS UNDER PRESSURE ****

SECTION 14 - TRANSPORTATION INFORMATION

Transportation Information	***Ground Transportation*** *(DOT)*	***Air Transportation*** *(IATA)*	***Ocean Transportation*** *(IMDG)*
UN Number	*UN1950*	*UN1950*	*UN1950*
Proper Shipping Name	*Aerosols, Limited Quantity*	*Aerosols, Flammable, Limited Quantity*	*Aerosols, Limited Quantity*
Hazard Class(es)	*2.1*	*2.1*	*2.1*
Packaging Group	—	—	—
Marine Pollutant	*No*	*No*	*No*
Hazard Label(s)			

SECTION 15 - REGULATORY INFORMATION

Federal Regulations

ID	TSCA	SARA 302					SARA 311/312				CLEAN AIR ACT		CLEAN
	LISTED	EHS TPQ	RCRA	CERCLA	SARA 313	FIRE	REACTIVITY	ACUTE	CHRONIC	PRESSURE	HAP	SOCMI	WATER ACT
1	Yes	–	–	–	–	Yes	–	–	–	–	–	–	–
2	Yes	–	–	–	–	Yes	–	–	–	--	–	–	–
3	Yes	–	U154	5000	12%	Yes	–	Yes	–	–	Yes	Yes	–

ID	TSCA LISTED	SARA 302 EHS TPQ	RCRA	CERCLA	SARA 313	FIRE	SARA 311/312 REACTIVITY	SARA 311/312 ACUTE	SARA 311/312 CHRONIC	SARA 311/312 PRESSURE	CLEAN AIR ACT HAP	CLEAN AIR ACT SOCMI	CLEAN WATER ACT
4	Yes	–	U112	5000	–	Yes	–	Yes	–	–	–	–	–
5	Yes	–	U112	5000-	–	Yes	–	Yes	–	–	–	–	–

State Regulations

ID	CA P-65	DE RQ	MA RTK CODES	ME TYPE	ME RQ	MN RTK	MN AIR	MN WATER	NJ RTK	NY AIR	NY LAND	NY ACUTE	PA LISTED	WA PEL TWA	WI TABLE	WV TAP
2	–	–	2,4,5,6 * T1*	–	–	AO	–	–	–	–	–	–	Yes	1000 ppm	–	–
3	D	5000	2,4,5,6 F8 F9	–	2000	ANO	1	–	–	5000	1	–	Yes-E	200 ppm	–	–
4	–	5000	2,4,5,6 F8 F9	–	20000	AON	–	–	--	5000	1	–	Yes-E	750 ppm	–	–
5	–	5000	2,4,5,6 F8	–	20000	AO	–	–	–	5000	1	–	Yes-E	400 ppm	–	–

SECTION 16 - OTHER INFORMATION

SDS Revision History

Revision 1, 11/03/2015, Original in GHS Version 3 Format.

SDS Compliance

This SDS complies with the below listed regulations only. For SDS that comply with other countries, please contact our Regulatory Department at msds@chem-pak.com

OSHA Hazard Communication Standard (HCS 2012) 29 CFR 1910.1200
Globally Harmonized System of Classification and Labeling of Chemicals (GHS) Revision 3

Disclaimer of Liability

The information contained herein is based upon data provided to us by our suppliers, and reflects our best judgement. However, no warranty of merchantability, fitness for any use, or any other warranty or guarantee is expressed or implied regarding the accuracy of such data, or the results to be obtained from use thereof. Since the information contained herein may be applied under conditions beyond our control and with which we may be unfamiliar, we do not assume any responsibility for the results of such application. This information is furnished upon the condition that the persons receiving it shall make their own determinations of the suitability of the material for any particular use. Although certain hazards are described herein, we cannot guarantee these are the only hazards that exist.

SAFETY DATA SHEET

Prima Glo Fluorescent Orange

SECTION 1 - IDENTIFICATION

Product Identifier

Product Number(s) *N7519CT*

Product Name *Prima Glo Fluorescent Livestock Marking Paint - Orange - Inverted Tip*

Other Means of Identification *None*

Recommended Use and Restrictions on Use

Recommended Use *Livestock marking dye.*

Restrictions on Use *None Identified*

24 hr Emergency Phone Number

800-255-3924

(Chem-Tel)

MANUFACTURER DETAILS		SUPPLIER DETAILS	
Name	*Chem-Pak, Inc.*	**Name**	*Neogen Corporation*
Address	*242 Corning Way Martinsburg WV 25405*	**Address**	*279 Faison W. McGowan Road Kenansville NC 28349*
Phone Number	*800-336-9828*	**Phone Number**	*910-296-6020*
Fax Number	*304-262-9643*	**Fax Number**	

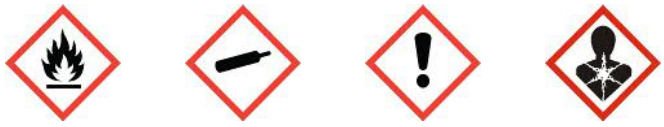
SECTION 2 - IDENTIFICATION

Hazard Classification

HEALTH HAZARDS				PHYSICAL HAZARDS					
Acute Tox. Oral	4	Mutagenicity		Unstable Explosive		Refrigerated Liq. Gas		Pyrophoric Solid	
Acute Tox. Skin		Carcinogenicity		Explosive		Flammable Liquid		Emits Flammable Gas	
Acute Tox. Inhalation		Tox. to Reproduction		Flammable Gas		Flammable Solid		Oxidizing Liquid	
Skin Irritation		STOT SE	1	Aerosol	1	Self-Reactive Sub.		Oxidizing Solid	
Eye Irritation		STOT RE		Oxidizing Gas		Pyrophoric Liquid		Organic Peroxide	
Resp. Sensitization		Aspiration Hazard		Gas Under Pressure	X	Self-Heating Substance		Corrosive to Metal	
Skin Sensitization				**ENVIRONMENTAL HAZARDS** *(GHS Rev 3 Only)*					
				Aquatic Acute		Aquatic Chronic		Ozone Depleting	

Signal Word *Danger*

Hazard Pictograms



Hazard Statements *Extremely flammable aerosol. Contains gas under pressure; may explode if heated. Harmful if swallowed. Causes damage to organs.*

Precautionary Statements

General *Keep out of reach of children.*

Prevention *Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Do not spray on an open flame or other ignition source. Do not pierce or burn, even after use. Do not breathe spray. Wash hands thoroughly after handling. Do not eat, drink , or smoke when using this product.*

Response *IF exposed: Call a doctor. IF SWALLOWED: Immediately call a POISON CENTER or doctor if you feel unwell. Rinse mouth.*

Storage *Store in a well-ventilated place. Store locked up. Protect from sunlight. Do not expose to temperatures exceeding 50 °C/122°F.*

Disposal *Dispose of contents/container in accordance with local regulations.*

Hazards Not Otherwise Classified *None identified.*

Unknown Acute Toxicity *5 % by wt*

SECTION 3 - COMPOSITION / INFORMATION ON INGREDIENTS

ID	INGREDIENT	CAS NUMBER	% WT RANGE*
1	*Liquefied Petroleum Gas*	*0068476-86-8*	*30 - 60*
2	*Ethanol*	*0000064-17-5*	*30 - 60*
3	*Methanol*	*0000067-56-1*	*7 - 13*
4	*Acetone*	*0000067-64-1*	*3 - 7*
5	*Ethyl Acetate*	*0000141-78-6*	*1 - 5*

** Exact percentages of composition withheld as trade secret*

SECTION 4 - FIRST AID MEASURES

Description of First-Aid Measures

General *If exposed or concerned seek medical advice/attention.*

Eye Contact *Immediately flush with clear water for at least 15 minutes, including under the eyelids. Consult a doctor.*

Skin Contact *Remove with soap and water, rinsing and repeating for 15 minutes. Use skin cream to counter any resulting dryness. Consult a physician if irritation continues. If large skin area is affected, remove contaminated clothing.*

Ingestion *Do not induce vomiting! Immediately have the victim drink plenty of water. Do not give milk or digestible oils. Keep airways free. Contact a physician. Never give anything by mouth if victim is rapidly losing consciousness, unconscious, or convulsing.*

Inhalation *Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Seek medical attention if symptoms persist or if unconscious.*

First-Aid Responder Protection *Wear adequate personal protective equipment based on the nature and severity of the emergency.*

Most Important Symptoms and Effects, Both Acute and Delayed

Eye Contact *Liquid contact may cause pain along with moderate eye irritation.*

Skin Contact *Prolonged or repeated exposure may cause skin irritation. Repeated contact may cause drying or flaking of skin. May cause more severe response if confined to skin.*

Ingestion *Due to being an aerosol, the product does not lend itself to ingestion. Should ingestion occur, it may cause irritation to membranes of the mouth, throat, and gastrointestinal tract resulting in vomiting and/or cramps. Aspiration of vomit into the lungs may cause inflammation, and possible chemical pneumonitis, bronchopneumonia, or pulmonary edema.*

Inhalation *Prolonged or repeated overexposure is anesthetic. May cause irritation of the respiratory tract, or acute nervous system depression characterized by headache, dizziness, staggering gait, confusion or death. Irritation of the mucous membranes, coughing, and dyspnea are also possible.*

Indication of Immediate Medical Attention and Special Treatment

Notes to Physician *Treat symptomatically.*

Specific Treatments/Antidotes *No information available.*

Immediate Medical Attention *No information available.*

SECTION 5 - FIRE-FIGHTING MEASURES

Extinguishing Media

Suitable Extinguishing Media *Water, CO2, dry chemical, or universal aqueous film forming foam*

Unsuitable Extinguishing Media *Water jet*

Specific Hazards Arising from the Chemical or Mixture

Decomposition Products *Oxides of carbon (CO, CO2), smoke, and/or vapors*

Hazards from the Product *CONTENTS EXTREMELY FLAMMABLE AND UNDER PRESSURE. In a fire or if heated, a pressure increase will occur which may result in the container bursting. Vapours heavier than air may spread along the ground and travel to an ignition source.*

Advice for Firefighters

Protective Actions *Use water spray to cool fire exposed containers as contents may rupture violently from heat developed pressure.*

Protective Equipment *As with any fire wear SCBA pressure-demand, MSHA/NIOSH approved, and full protective gear.*

SECTION 6 - ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures

For Non-Emergency Personnel *No action should be taken by non-emergency personnel without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spill. Remove ignition sources and provide adequate ventilation only if it is safe to do so.*

For Emergency Responders *Use personal protection as recommended in Section 8. Observe precautions provided for non-emergency personnel.*

Environmental Precautions

Precautions *Keep out of drains, sewers, ditches, and waterways. Minimize use of water to prevent environmental contamination.*

Methods and Materials for Containment and Cleaning Up

Containment Procedures *Product is an aerosol, therefore spills and leaks are unlikely. In case of rupture, released content may be contained with oil/solvent absorbent pads, socks, and/or absorbents. DO NOT use combustible material such as sawdust.*

Cleanup Procedures *Spills from aerosol cans are unlikely and are generally of small volume. Large spills are therefore not normally considered a problem. In case of actual rupture, avoid breathing vapors and ventilate area well. Remove sources of ignition and use non-sparking equipment. Soak up material with inert absorbent and place in safety containers for proper disposal.*

Other Information *Aerosol products represent a limited hazard and will not spill or leak unless ruptured. In case of rupture contents are generally evacuated from the can rapidly. Area should be ventilated immediately and continuous ventilation provided until all fumes and vapors have been removed. Aerosol cans should never be incinerated or burned. See Section 13 for disposal.*

Prohibited Materials *Combustible absorbent material such as sawdust, use of equipment that may cause sparking.*

SECTION 7 - HANDLING AND STORAGE

Precautions for Safe Handling

General Handling Precautions *KEEP OUT OF THE REACH OF CHILDREN. Avoid prolonged or repeated skin contact. Avoid breathing of vapors. Do not incinerate (burn) containers. Always replace overcap when not in use. Avoid use around open flames or other sources of ignition. Exposure to heat or prolonged exposure to sun may cause can to burst. Use only with adequate ventilation, opening doors or windows to achieve cross-ventilation. Wash hands after use.*

Hygiene Recommendations *Do not eat, drink or smoke when using this product. Wash hands thoroughly after use. Remove contaminated clothing and protective equipment before entering eating or smoking areas.*

Conditions for Safe Storage Including Any Incompatibilities

Storage Requirements *Storage of individual cans should be done in an area below 50 °C (122 °F), and away from heat sources. Ensure can is in a secure place to prevent knocking over and accidental rupture. For storage of pallet quantities, compliance with NFPA 30B (Manufacture and Storage of Aerosol Products) is recommended. This product is classified as a Level 3 Aerosol.*

Incompatibilities *Segregate storage away from materials indicated in Section 10*

SECTION 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

Control Parameters

Occupational Exposure Limits

ID	OSHA			NIOSH				ACGIH			AIHA
	PEL	STEL	CEILING	IDLH	REL	STEL	CEILING	TLV	STEL	CEILING	WEEL
1	1000 ppm	–	–	2000 ppm	1000 ppm	–	–	1000 ppm	–	–	–
2	–	–	–	3300 ppm	1000 ppm	–	–	1000 ppm	–	–	–
3	200 ppm	–	–	6000 ppm	200 ppm	250 ppm	–	200 ppm	250 ppm	–	–
4	1000 ppm	–	–	2500 ppm	250 ppm	–	–	500 ppm	250 ppm	–	–
5	400 ppm	–	–	2000 ppm	400 ppm	–	–	400 ppm	–	–	–

Biological Exposure Indices

ID	DETERMINANT	SAMPLING TIME	BEI	NOTATION
3	*Methanol in urine*	*End of shift*	*15 mg/L*	*B, Ns*
4	*Acetone in urine*	*End of shift*	*50 mg/L*	*Ns*

Other Control Parameters *Not Available*

Appropriate Engineering Control

Engineering Measures *Use only with adequate ventilation. General ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. Local exhaust ventilation or an enclosed handling system may be necessary to control air contamination below that of the lowest OEL from the table above.*

Individual Protection Measures

Hygiene Considerations *Avoid breathing vapors and contact with the skin and eyes. Always replace overcap when not in use. Keep out the reach of children. Wash hands after use.*

Thermal Protection *This product does not present a thermal hazard.*

Respiratory Protection *An approved respirator with organic vapor cartridge may be permissible under certain circumstances where airborne concentrations are expected to exceed occupational exposure limits. If respirators are needed, compliance with OSHA standard 29 CFR 1910.134 is necessary.*

Skin Protection *For brief contact, no precautions other than clean body-covering clothing should be needed. When prolonged or repeated contact could occur, use protective clothing impervious to the ingredients listed in Section 2.*

Eye/Face Protection *Safety glasses with side shields are recommended as a minimum for any type of industrial chemical handling. Where eye contact with this material could occur, chemical splash proof goggles are recommended.*

Other Protective Equipment *Safety showers and eye-wash stations should be available in the workplace near where the material will be used.*

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Physical Properties

Boiling Point	*> 56.1 °C (133.0 °F)*	***Melting / Freezing Point***	*>-97.7 °C (-143.0 °F)*
Flash Point, Liquid	*> -17.0 °C (1.4 °F)*	***Flash Point, Propellant***	*-104.4 °C (-156.0 °F)*
Explosive Limits	*2.50% - 36.00%*	***Autoignition Temperature, Liquid***	*385.0 °C (725.0 °F)*
Flammability	*Extremely Flammable Aerosol*	***Relative Density (H2O = 1)***	*0.674 g/cc*
Molecular Weight	*Not Available*	***Weight***	*5.624 lbs/gal*
Vapor Pressure	*70.00 psig*	***pH***	*Not Available*
Vapor Density	*2.000 g/cc Maximum*	***Evaporation Rate***	*Not Available*
Form	*Pressurized Product*	***Partition Coefficient***	*Not Available*
Viscosity	*Not Available*	***Refractive Index***	*Not Available*
Odor Threshold	*Not Available*	***Heat of Combustion (△Hc)***	*Not Available*
Odor	*Paint Like*	***Water Solubility***	*Not Available*
Appearance / Color	*Orange Liquid*	***Decomposition Temperature***	*Not Available*

Air Quality Properties

Percent Volatile	*95% Wt (95% Vol) Max*	***VOC Regulatory***	*5.264 lbs/gal (630.723 g/L)*
Percent VOC	*90% Wt (91% Vol) Max*	***VOC Actual***	*5.04 lbs/gal (603.854 g/L)*
Percent HAP	*12% Wt (10% Vol) Max*	***HAP Content***	*0.65 lbs/gal (77.803 g/L)*
Solids/Non Volatile Content	*6% Wt (6% Vol) Max*	***Maximum Incremental Reactivity***	*1.14 g O3/g*
Global Warming Potential	*3.548*		

SECTION 10 - STABILITY AND REACTIVITY

Reactivity *No specific test data related to reactivity is available for this product or its ingredients.*

Chemical Stability *This product is stable.*

Hazardous Reactions *Under normal conditions of storage and use, hazardous reactions are not expected to occur.*

Conditions to Avoid *Keep away from heat, sparks, flame, and red hot metal.*

Material Incompatibility *Acids, Activated Carbon, Alkali Metals, Alkalis, Ammonia, Carbon Tetrachloride, Chlorine Dioxide, Diethyl Zinc, Hexachloromelamine, Hydrogen Peroxide, Isocyanates, Isoprene, Lithium Aluminum Hydride, Mineral Acids, Nitrates, Potassium Tert-Butoxide, Strong Oxidizing Agents, Strong Reducing Agents, Sulfur Dichloride,Trichloromelamine*

Decomposition Productions *Oxides of Carbon, Acetic Acid, Formaldehyde, Hydrogen Peroxide, Isoproanol, Methanol may be formed depending on fire conditions.*

SECTION 11 - TOXICOLOGICAL INFORMATION

Acute Toxicity Estimates *(mixture)*

Oral LD_{50} *627 mg/kg*

Dermal LD_{50} *16441 mg/kg*

Inhalation LC_{50} *657 mg/L 4-hour*

Acute Toxicity on Ingredients

ID	ORAL LD50		DERMAL LD50		INHALATION LC50		
	VALUE	SPECIES	VALUE	SPECIES	VALUE	TIME	SPECIES
1	–	–	–	–	658 mg/L	4h	rat
2	7060 mg/kg	rat	>15800 mg/kg	rabbit	>32380 ppm	4h	rat
3	143 mg/kg	human	17100 mg/kg	rabbit	128.2 mg/L	4h	rat
4	5800 mg/kg	rat	20000 mg/kg	rabbit	50100 mg/m3	8h	rat
5	5620 mg/kg	rat	>18000 mg/kg	rabbit	10600 ppm	4h	rat

Health Hazard Classification

Skin Corrosion / Irritation *Classification criteria not met*

Eye Damage / Irritation *Classification criteria not met*

Respiratory Irritation *Classification criteria not met*

Respiratory / Skin Sensitization *Classification criteria not met*

Germ Cell Mutagenicity *Classification criteria not met*

Reproductive Toxicity *Classification criteria not met*

STOT - Single Exposure *Cateogry 1*

STOT - Repeated Exposure *Classification criteria not met*

Aspiration Hazard *Classification criteria not met*

Carcinogen Data

ID	Calif Prop-65	OSHA	NIOSH	ACGIH	NTP	IARC
–	No	No	No	No	No	No

Information on the Likely Routes of Exposure

Routes of Exposure *Skin contact, skin absorption, eye contact, inhalation, ingestion*

Information on Physical, Chemical and Toxicological Effects

Symptoms of Exposure *Asphyxia, Blindness, Central Nervous System Depression, Cough, Dermatitis, Dizziness, Drowsiness, Skin Irritation, Throat Irritation, Upper Respiratory System Irritation, Visual Disturbance, Vomiting*

Delayed and Immediate Effects and also Chronic Effects from Short and Long-Term Exposure

Delayed Effects *No known delayed effects.*

Immediate Effects *No known immediate effects.*

Chronic Effects *Reports have associated repeated and prolonged occupational overexposure to solvents with irreversible brain and nervous system damage (sometimes referred to as "Solvent or Painter's Syndrome"). Intentional misuse by concentrating and inhaling this product may be harmful or fatal.*

Medical Conditions Aggravated *May aggravate personnel with pre-existing disorders associated with any of the Target Organs.*

Target Organs *Cardiovascular System, Central Nervous System, Eyes, Liver, Lumphoid System, Respiratory System, Skin*

SECTION 12 - ECOLOGICAL INFORMATION

Acute Aquatic Toxicity

ID	FISH			INVERTEBRATES			AQUATIC PLANTS			MICROORGANISMS		
	TYPE	VALUE	PERIOD	TYPE	VALUE	PERIOD	TYPE	VALUE	PERIOD	TYPE	VALUE	PERIOD
2	LC50	11000 mg/L	96h	EC50	10800 mg/L	24h	LOEC	1450 mg/L	8d	LOEC	6500 mg/L	16h
3	LC50	15400 mg/L	96h	EC50	>10000 mg/L	48h	EC50	22000 mg/L	96h	EC5	6600 mg/L	16h
4	LC50	5540 mg/L	96h	LC50	8800 mg/L	48h	NOEC	530 mg/L	8d	EC5	1700 mg/L	16h
5	LC50	230 mg/L	96h	EC50	717 mg/L	48h	IC50	3300 mg/L	48h	EC10	2900 mg/L	16h

Ecological Data

ID	PERSISTENCE AND DEGRADABILITY				BIOACCUMULATIVE POTENTIAL		MOBILITY
	PERSISTENCE	BOD	COD	ThOD	Pow / Kow	BCF	Koc
2	–	930 mg/g / 5d	1700 mg/g	2.1 mg/g	-0.31 log Pow	–	–
3	72% / 5 days	850 mg/g	1420 mg/g	1500 mg/g	-77 log Pow	0.48 log BCF	0.44 log Koc
4	90.9% / 28 days	1.85 mg/g / 5 d	2.07 mg/g	2.21 g/g	-0.24 log Pow	0.69 BCF	1.26 log Koc
5	100% / 28 days	1 g/g	1.69 g/g	1.82 g/g	0.73 log Pow	1.48 log BCF	0.788 log Koc

Other Adverse Effects — *No additional information available.*

SECTION 13 - DISPOSAL CONSIDERATIONS

Waste Disposal — *Characteristics and waste stream classification can change with product use and location. It is the responsibility of the user to determine the proper storage, transportation, treatment, and/or disposal methodologies for spent materials and residues at the time of disposition. All waste must be disposed of in compliance with the respective national, federal, state, and/or local regulations.*

Waste Disposal of Packaging — *An aerosol container that does not contain a significant amount of liquid would meet the definition of scrap metal (40 CFR 261.1(c)(6)), and would be exempt from RCRA regulation under 40 CFR 261.6(a)(3)(iv) if it is to be recycled. If containers are to be disposed of (not recycled) it must be managed under all applicable RCRA and state regulations.*

Landfill Precautions — *Not available*

Incineration Precautions — *** DO NOT INCINERATE ** CONTENTS UNDER PRESSURE ****

SECTION 14 - TRANSPORTATION INFORMATION

Transportation Information	***Ground Transportation*** *(DOT)*	***Air Transportation*** *(IATA)*	***Ocean Transportation*** *(IMDG)*
UN Number	*UN1950*	*UN1950*	*UN1950*
Proper Shipping Name	*Aerosols, Limited Quantity*	*Aerosols, Flammable, Limited Quantity*	*Aerosols, Limited Quantity*
Hazard Class(es)	*2.1*	*2.1*	*2.1*
Packaging Group	—	—	—
Marine Pollutant	*No*	*No*	*No*
Hazard Label(s)			

SECTION 15 - REGULATORY INFORMATION

Federal Regulations

ID	TSCA	SARA 302				SARA 311/312					CLEAN AIR ACT		CLEAN
	LISTED	EHS TPQ	RCRA	CERCLA	SARA 313	FIRE	REACTIVITY	ACUTE	CHRONIC	PRESSURE	HAP	SOCMI	WATER ACT
1	Yes	–	–	–	–	Yes	–	–	–	–	–	–	–
2	Yes	–	–	–	–	Yes	–	–	–	--	–	–	–
3	Yes	–	U154	5000	12%	Yes	–	Yes	–	–	Yes	Yes	–

ID	TSCA LISTED	SARA 302 EHS TPQ	RCRA	CERCLA	SARA 313	FIRE	REACTIVITY	SARA 311/312 ACUTE	SARA 311/312 CHRONIC	SARA 311/312 PRESSURE	CLEAN AIR ACT HAP	CLEAN AIR ACT SOCMI	CLEAN WATER ACT
4	Yes	–	U112	5000	–	Yes	–	Yes	–	–	–	–	–
5	Yes	–	U112	5000-	–	Yes	–	Yes	–	–	–	–	–

State Regulations

ID	CA P-65	DE RQ	MA RTK CODES	ME TYPE	ME RQ	MN RTK	MN AIR	MN WATER	NJ RTK	NY AIR	NY LAND	NY ACUTE	PA LISTED	WA PEL TWA	WI TABLE	WV TAP
2	–	–	2,4,5,6 * T1*	–	–	AO	–	–	–	–	–	–	Yes	1000 ppm	–	–
3	D	5000	2,4,5,6 F8 F9	–	2000	ANO	1	–	–	5000	1	–	Yes-E	200 ppm	–	–
4	–	5000	2,4,5,6 F8 F9	–	20000	AON	–	–	--	5000	1	–	Yes-E	750 ppm	–	–
5	–	5000	2,4,5,6 F8	–	20000	AO	–	–	–	5000	1	–	Yes-E	400 ppm	–	–

SECTION 16 - OTHER INFORMATION

SDS Revision History

Revision 1, 11/03/2015, Original in GHS Version 3 Format.

SDS Compliance

This SDS complies with the below listed regulations only. For SDS that comply with other countries, please contact our Regulatory Department at msds@chem-pak.com

OSHA Hazard Communication Standard (HCS 2012) 29 CFR 1910.1200
Globally Harmonized System of Classification and Labeling of Chemicals (GHS) Revision 3

Disclaimer of Liability

The information contained herein is based upon data provided to us by our suppliers, and reflects our best judgement. However, no warranty of merchantability, fitness for any use, or any other warranty or guarantee is expressed or implied regarding the accuracy of such data, or the results to be obtained from use thereof. Since the information contained herein may be applied under conditions beyond our control and with which we may be unfamiliar, we do not assume any responsibility for the results of such application. This information is furnished upon the condition that the persons receiving it shall make their own determinations of the suitability of the material for any particular use. Although certain hazards are described herein, we cannot guarantee these are the only hazards that exist.

SAFETY DATA SHEET

Prima Spray-On II Blue

SECTION 1 - IDENTIFICATION

Product Identifier

Product Number(s) *N7468CT*

Product Name *Prima Spray-On II Blue Livestock Marking Dye - Inverted Tip*

Other Means of Identification *None*

Recommended Use and Restrictions on Use

Recommended Use *Livestock marking dye.*

Restrictions on Use *None Identified*

24 hr Emergency Phone Number

800-255-3924

(Chem-Tel)

MANUFACTURER DETAILS		SUPPLIER DETAILS	
Name	*Chem-Pak, Inc.*	**Name**	*Neogen Corporation*
Address	*242 Corning Way* *Martinsburg WV 25405*	**Address**	*279 Faison W. McGowan Road* *Kenansville NC 28349*
Phone Number	*800-336-9828*	**Phone Number**	*910-296-6020*
Fax Number	*304-262-9643*	**Fax Number**	

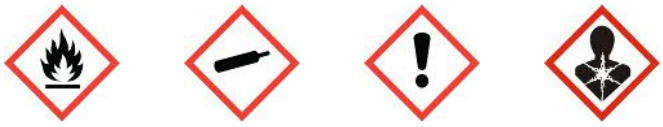
SECTION 2 - IDENTIFICATION

Hazard Classification

HEALTH HAZARDS				PHYSICAL HAZARDS					
Acute Tox. Oral	4	Mutagenicity		Unstable Explosive		Refrigerated Liq. Gas		Pyrophoric Solid	
Acute Tox. Skin		Carcinogenicity		Explosive		Flammable Liquid		Emits Flammable Gas	
Acute Tox. Inhalation		Tox. to Reproduction		Flammable Gas		Flammable Solid		Oxidizing Liquid	
Skin Irritation		STOT SE	1	Aerosol	1	Self-Reactive Sub.		Oxidizing Solid	
Eye Irritation		STOT RE		Oxidizing Gas		Pyrophoric Liquid		Organic Peroxide	
Resp. Sensitization		Aspiration Hazard		Gas Under Pressure	X	Self-Heating Substance		Corrosive to Metal	
Skin Sensitization				**ENVIRONMENTAL HAZARDS** *(GHS Rev 3 Only)*					
				Aquatic Acute		Aquatic Chronic		Ozone Depleting	

Signal Word *Danger*

Hazard Pictograms



Hazard Statements *Extremely flammable aerosol. Contains gas under pressure; may explode if heated. Harmful if swallowed. Causes damage to organs.*

Precautionary Statements

General *Keep out of reach of children.*

Prevention *Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Do not spray on an open flame or other ignition source. Do not pierce or burn, even after use. Do not breathe spray. Wash hands thoroughly after handling. Do not eat, drink , or smoke when using this product.*

Response *If exposed: Call a doctor. IF SWALLOWED: Immediately call a POISON CENTER or doctor if you feel unwell. Rinse mouth.*

Storage *Store in a well-ventilated place. Protect from sunlight. Do not expose to temperatures exceeding 50 °C/122°F.*

Disposal *Dispose of contents/container in accordance with local regulations.*

Hazards Not Otherwise Classified *None identified.*

Unknown Acute Toxicity *3 % by wt*

SECTION 3 - COMPOSITION / INFORMATION ON INGREDIENTS

ID	INGREDIENT	CAS NUMBER	% WT RANGE*
1	*Ethanol*	*0000064-17-5*	*40 - 70*
2	*Liquefied Petroleum Gas*	*0068476-86-8*	*15 - 40*
3	*Methanol*	*0000067-56-1*	*5 - 10*
4	*Ethyl Acetate*	*0000141-78-6*	*1 - 5*
5	*Butyl Cellosolve*	*0000111-76-2*	*1 - 5*

** Exact percentages of composition withheld as trade secret*

SECTION 4 - FIRST AID MEASURES

Description of First-Aid Measures

General *If exposed or concerned seek medical advice/attention.*

Eye Contact *Immediately flush with clear water for at least 15 minutes, including under the eyelids. Consult a doctor.*

Skin Contact *Remove with soap and water, rinsing and repeating for 15 minutes. Use skin cream to counter any resulting dryness. Consult a physician if irritation continues. If large skin area is affected, remove contaminated clothing.*

Ingestion *Do not induce vomiting! Immediately have the victim drink plenty of water. Do not give milk or digestible oils. Keep airways free. Contact a physician. Never give anything by mouth if victim is rapidly losing consciousness, unconscious, or convulsing.*

Inhalation *Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Seek medical attention if symptoms persist or if unconscious.*

First-Aid Responder Protection *Wear adequate personal protective equipment based on the nature and severity of the emergency.*

Most Important Symptoms and Effects, Both Acute and Delayed

Eye Contact *Liquid contact may cause pain along with moderate eye irritation.*

Skin Contact *Prolonged or repeated exposure may cause skin irritation. Repeated contact may cause drying or flaking of skin. May cause more severe response if confined to skin.*

Ingestion *Due to being an aerosol, the product does not lend itself to ingestion. Should ingestion occur, it may cause irritation to membranes of the mouth, throat, and gastrointestinal tract resulting in vomiting and/or cramps. Aspiration of vomit into the lungs may cause inflammation, and possible chemical pneumonitis, bronchopneumonia, or pulmonary edema.*

Inhalation *Prolonged or repeated overexposure is anesthetic. May cause irritation of the respiratory tract, or acute nervous system depression characterized by headache, dizziness, staggering gait, confusion or death. Irritation of the mucous membranes, coughing, and dyspnea are also possible.*

Indication of Immediate Medical Attention and Special Treatment

Notes to Physician *Treat symptomatically.*

Specific Treatments/Antidotes *No information available.*

Immediate Medical Attention *No information available.*

SECTION 5 - FIRE-FIGHTING MEASURES

Extinguishing Media

Suitable Extinguishing Media *Water, CO2, dry chemical, or universal aqueous film forming foam*

Unsuitable Extinguishing Media *Water jet*

Specific Hazards Arising from the Chemical or Mixture

Decomposition Products *Oxides of carbon (CO, CO2), smoke, and/or vapors*

Hazards from the Product *CONTENTS EXTREMELY FLAMMABLE AND UNDER PRESSURE. In a fire or if heated, a pressure increase will occur which may result in the container bursting. Vapours heavier than air may spread along the ground and travel to an ignition source.*

Advice for Firefighters

Protective Actions *Use water spray to cool fire exposed containers as contents may rupture violently from heat developed pressure.*

Protective Equipment *As with any fire wear SCBA pressure-demand, MSHA/NIOSH approved, and full protective gear.*

SECTION 6 - ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures

For Non-Emergency Personnel *No action should be taken by non-emergency personnel without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spill. Remove ignition sources and provide adequate ventilation only if it is safe to do so.*

For Emergency Responders *Use personal protection as recommended in Section 8. Observe precautions provided for non-emergency personnel.*

Environmental Precautions

Precautions *Keep out of drains, sewers, ditches, and waterways. Minimize use of water to prevent environmental contamination.*

Methods and Materials for Containment and Cleaning Up

Containment Procedures *Product is an aerosol, therefore spills and leaks are unlikely. In case of rupture, released content may be contained with oil/solvent absorbent pads, socks, and/or absorbents. DO NOT use combustible material such as sawdust.*

Cleanup Procedures *Spills from aerosol cans are unlikely and are generally of small volume. Large spills are therefore not normally considered a problem. In case of actual rupture, avoid breathing vapors and ventilate area well. Remove sources of ignition and use non-sparking equipment. Soak up material with inert absorbent and place in safety containers for proper disposal.*

Other Information *Aerosol products represent a limited hazard and will not spill or leak unless ruptured. In case of rupture contents are generally evacuated from the can rapidly. Area should be ventilated immediately and continuous ventilation provided until all fumes and vapors have been removed. Aerosol cans should never be incinerated or burned. See Section 13 for disposal.*

Prohibited Materials *Combustible absorbent material such as sawdust, use of equipment that may cause sparking.*

SECTION 7 - HANDLING AND STORAGE

Precautions for Safe Handling

General Handling Precautions *KEEP OUT OF THE REACH OF CHILDREN. Avoid prolonged or repeated skin contact. Avoid breathing of vapors. Do not incinerate (burn) containers. Always replace overcap when not in use. Avoid use around open flames or other sources of ignition. Exposure to heat or prolonged exposure to sun may cause can to burst. Use only with adequate ventilation, opening doors or windows to achieve cross-ventilation. Wash hands after use.*

Hygiene Recommendations *Do not eat, drink or smoke when using this product. Wash hands thoroughly after use. Remove contaminated clothing and protective equipment before entering eating or smoking areas.*

Conditions for Safe Storage Including Any Incompatibilities

Storage Requirements *Storage of individual cans should be done in an area below 50 °C (122 °F), and away from heat sources. Ensure can is in a secure place to prevent knocking over and accidental rupture. For storage of pallet quantities, compliance with NFPA 30B (Manufacture and Storage of Aerosol Products) is recommended. This product is classified as a Level 3 Aerosol.*

Incompatibilities *Segregate storage away from materials indicated in Section 10*

SECTION 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

Control Parameters

Occupational Exposure Limits

ID	OSHA			NIOSH				ACGIH			AIHA
	PEL	STEL	CEILING	IDLH	REL	STEL	CEILING	TLV	STEL	CEILING	WEEL
1	–	–	–	3300 ppm	1000 ppm	–	–	1000 ppm	–	–	–
2	1000 ppm	–	–	2000 ppm	1000 ppm	–	–	1000 ppm	–	–	–
3	200 ppm	–	–	6000 ppm	200 ppm	250 ppm	–	200 ppm	250 ppm	–	–
4	400 ppm	–	–	2000 ppm	400 ppm	–	–	400 ppm	–	–	–
5	50 ppm	–	–	700 ppm	5 ppm	–	–	20 ppm	–	–	–

Biological Exposure Indices

ID	DETERMINANT	SAMPLING TIME	BEI	NOTATION
3	*Methanol in urine*	*End of shift*	*15 mg/L*	*B, Ns*
5	*Butoxyacetic acid (BAA) in urine*	*End of shift*	*200 mg/g creatinine*	*–*

Other Control Parameters *Not Available*

Appropriate Engineering Control

Engineering Measures *Use only with adequate ventilation. General ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. Local exhaust ventilation or an enclosed handling system may be necessary to control air contamination below that of the lowest OEL from the table above.*

Individual Protection Measures

Hygiene Considerations *Avoid breathing vapors and contact with the skin and eyes. Always replace overcap when not in use. Keep out the reach of children. Wash hands after use.*

Thermal Protection *This product does not present a thermal hazard.*

Respiratory Protection *An approved respirator with organic vapor cartridge may be permissible under certain circumstances where airborne concentrations are expected to exceed occupational exposure limits. If respirators are needed, compliance with OSHA standard 29 CFR 1910.134 is necessary.*

Skin Protection *For brief contact, no precautions other than clean body-covering clothing should be needed. When prolonged or repeated contact could occur, use protective clothing impervious to the ingredients listed in Section 2.*

Eye/Face Protection *Safety glasses with side shields are recommended as a minimum for any type of industrial chemical handling. Where eye contact with this material could occur, chemical splash proof goggles are recommended.*

Other Protective Equipment *Safety showers and eye-wash stations should be available in the workplace near where the material will be used.*

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Physical Properties

Boiling Point	*> 64.6 °C (148.2 °F)*	***Melting / Freezing Point***	*>-97.7 °C (-143.0 °F)*
Flash Point, Liquid	*> 11.0 °C (51.8 °F)*	***Flash Point, Propellant***	*-104.4 °C (-156.0 °F)*
Explosive Limits	*6.00% - 36.00%*	***Autoignition Temperature, Liquid***	*385.0 °C (725.0 °F)*
Flammability	*Extremely Flammable Aerosol*	***Relative Density (H2O = 1)***	*0.716 g/cc*
Molecular Weight	*Not Available*	***Weight***	*5.978 lbs/gal*
Vapor Pressure	*70.00 psig*	***pH***	*Not Available*
Vapor Density	*1.110 g/cc Maximum*	***Evaporation Rate***	*Not Available*
Form	*Pressurized Product*	***Partition Coefficient***	*Not Available*
Viscosity	*Not Available*	***Refractive Index***	*Not Available*
Odor Threshold	*Not Available*	***Heat of Combustion (△Hc)***	*Not Available*
Odor	*Paint Like*	***Water Solubility***	*Not Available*
Appearance / Color	*Blue Liquid*	***Decomposition Temperature***	*Not Available*

Air Quality Properties

Percent Volatile	*97% Wt (97% Vol) Max*	***VOC Regulatory***	*5.788 lbs/gal (693.453 g/L)*
Percent VOC	*97% Wt (97% Vol) Max*	***VOC Actual***	*5.788 lbs/gal (693.453 g/L)*
Percent HAP	*7% Wt (6% Vol) Max*	***HAP Content***	*0.388 lbs/gal (46.377 g/L)*
Solids/Non Volatile Content	*4% Wt (4% Vol) Max*	***Maximum Incremental Reactivity***	*1.339 g O3/g*
Global Warming Potential	*2.181*		

SECTION 10 - STABILITY AND REACTIVITY

Reactivity *No specific test data related to reactivity is available for this product or its ingredients.*

Chemical Stability *This product is stable.*

Hazardous Reactions *Under normal conditions of storage and use, hazardous reactions are not expected to occur.*

Conditions to Avoid *Keep away from heat, sparks, flame, and red hot metal.*

Material Incompatibility *Acids, Alkali Metals, Alkalis, Ammonia, Bases, Carbon Tetrachloride, Chlorine Dioxide, Diethyl Zinc, Hydrogen Peroxide, Isocyanates, Lithium Aluminum Hydride, Mineral Acids, Nitrates, Potassium Tert-Butoxide, Strong Oxidizing Agents*

Decomposition Productions *Oxides of Carbon, Acetic Acid, Isoproanol, Peroxides may be formed depending on fire conditions.*

SECTION 11 - TOXICOLOGICAL INFORMATION

Acute Toxicity Estimates *(mixture)*

Oral LD_{50} *1117 mg/kg*

Dermal LD_{50} *11086 mg/kg*

Inhalation LC_{50} *1055 mg/L 4-hour*

Acute Toxicity on Ingredients

ID	ORAL LD50		DERMAL LD50		INHALATION LC50		
	VALUE	SPECIES	VALUE	SPECIES	VALUE	TIME	SPECIES
1	7060 mg/kg	rat	>15800 mg/kg	rabbit	>32380 ppm	4h	rat
2	–	–	–	–	658 mg/L	4h	rat
3	143 mg/kg	human	17100 mg/kg	rabbit	128.2 mg/L	4h	rat
4	5620 mg/kg	rat	>18000 mg/kg	rabbit	10600 ppm	4h	rat
5	880 mg/kg	rat	1060 mg/kg	rabbit	2211 mg/m3	4h	rat

Health Hazard Classification

Skin Corrosion / Irritation *Classification criteria not met*

Eye Damage / Irritation *Classification criteria not met*

Respiratory Irritation *Classification criteria not met*

Respiratory / Skin Sensitization *Classification criteria not met*

Germ Cell Mutagenicity *Classification criteria not met*

Reproductive Toxicity *Classification criteria not met*

STOT - Single Exposure *Cateogry 1*

STOT - Repeated Exposure *Classification criteria not met*

Aspiration Hazard *Classification criteria not met*

Carcinogen Data

ID	Calif Prop-65	OSHA	NIOSH	ACGIH	NTP	IARC
5	No	–	–	A3	–	3

Information on the Likely Routes of Exposure

Routes of Exposure *Skin contact, skin absorption, eye contact, inhalation*

Information on Physical, Chemical and Toxicological Effects

Symptoms of Exposure *Asphyxia, Blindness, Cough, Dermatitis, Dizziness, Drowsiness, Skin Irritation, Throat Irritation, Upper Respiratory System Irritation, Visual Disturbance, Vomiting*

Delayed and Immediate Effects and also Chronic Effects from Short and Long-Term Exposure

Delayed Effects *No known delayed effects.*

Immediate Effects *No known immediate effects.*

Chronic Effects *Reports have associated repeated and prolonged occupational overexposure to solvents with irreversible brain and nervous system damage (sometimes referred to as "Solvent or Painter's Syndrome"). Intentional misuse by concentrating and inhaling this product may be harmful or fatal.*

Medical Conditions Aggravated *May aggravate personnel with pre-existing disorders associated with any of the Target Organs.*

Target Organs *Bladder, Blood, Cardiovascular System, Central Nervous System, Eyes, Liver, Lumphoid System, Respiratory System, Skin*

SECTION 12 - ECOLOGICAL INFORMATION

Acute Aquatic Toxicity

ID	FISH			INVERTEBRATES			AQUATIC PLANTS			MICROORGANISMS		
	TYPE	VALUE	PERIOD	TYPE	VALUE	PERIOD	TYPE	VALUE	PERIOD	TYPE	VALUE	PERIOD
1	LC50	11000 mg/L	96h	EC50	10800 mg/L	24h	LOEC	1450 mg/L	8d	LOEC	6500 mg/L	16h
3	LC50	15400 mg/L	96h	EC50	>10000 mg/L	48h	EC50	22000 mg/L	96h	EC5	6600 mg/L	16h
4	LC50	230 mg/L	96h	EC50	717 mg/L	48h	IC50	3300 mg/L	48h	EC10	2900 mg/L	16h
5	LC50	1474 mg/L	96h	EC50	1550 mg/L	48h	LOEC	900 mg/L	7d	EC5	911 mg/L	48h

Ecological Data

ID	PERSISTENCE AND DEGRADABILITY				BIOACCUMULATIVE POTENTIAL		MOBILITY
	PERSISTENCE	BOD	COD	ThOD	Pow / Kow	BCF	Koc
1	–	930 mg/g / 5d	1700 mg/g	2.1 mg/g	-0.31 log Pow	–	–
3	72% / 5 days	850 mg/g	1420 mg/g	1500 mg/g	-77 log Pow	0.48 log BCF	0.44 log Koc
4	100% / 28 days	1 g/g	1.69 g/g	1.82 g/g	0.73 log Pow	1.48 log BCF	0.788 log Koc
5	90.4% / 28 days	–	–	–	0.81 log Pow	0.5 log BCF	–

Other Adverse Effects *No additional information available.*

SECTION 13 - DISPOSAL CONSIDERATIONS

Waste Disposal *Characteristics and waste stream classification can change with product use and location. It is the responsibility of the user to determine the proper storage, transportation, treatment, and/or disposal methodologies for spent materials and residues at the time of disposition. All waste must be disposed of in compliance with the respective national, federal, state, and/or local regulations.*

Waste Disposal of Packaging *An aerosol container that does not contain a significant amount of liquid would meet the definition of scrap metal (40 CFR 261.1(c)(6)), and would be exempt from RCRA regulation under 40 CFR 261.6(a)(3)(iv) if it is to be recycled. If containers are to be disposed of (not recycled) it must be managed under all applicable RCRA and state regulations.*

Landfill Precautions *Not available*

Incineration Precautions *** DO NOT INCINERATE ** CONTENTS UNDER PRESSURE ****

SECTION 14 - TRANSPORTATION INFORMATION

Transportation Information	***Ground Transportation*** *(DOT)*	***Air Transportation*** *(IATA)*	***Ocean Transportation*** *(IMDG)*
UN Number	*UN1950*	*UN1950*	*UN1950*
Proper Shipping Name	*Aerosols, Limited Quantity*	*Aerosols, Flammable, Limited Quantity*	*Aerosols, Limited Quantity*
Hazard Class(es)	*2.1*	*2.1*	*2.1*
Packaging Group	—	—	—
Marine Pollutant	*No*	*No*	*No*
Hazard Label(s)			

SECTION 15 - REGULATORY INFORMATION

Federal Regulations

ID	TSCA	SARA 302						SARA 311/312			CLEAN AIR ACT		CLEAN
	LISTED	EHS TPQ	RCRA	CERCLA	SARA 313	FIRE	REACTIVITY	ACUTE	CHRONIC	PRESSURE	HAP	SOCMI	WATER ACT
1	Yes	–	–	–	–	Yes	–	–	–	–	–	–	–
2	Yes	–	–	–	–	Yes	–	–	–	--	–	–	–
3	Yes	–	U154	5000	6%	Yes	–	Yes	–	–	Yes	Yes	–
4	Yes	–	U112	5000	–	Yes	–	Yes	–	–	–	–	–
5	Yes	–	–	--	–	–	–	Yes	–	–	–	–	–

State Regulations

ID	CA P-65	DE RQ	MA RTK CODES	ME TYPE	ME RQ	MN RTK	MN AIR	MN WATER	NJ RTK	NY AIR	NY LAND	NY ACUTE	PA LISTED	WA PEL TWA	WI TABLE	WV TAP
1	–	–	2,4,5,6 * T1*	–	–	AO	–	–	–	–	–	–	Yes	1000 ppm	–	–
3	D	5000	2,4,5,6 F8 F9	–	2000	ANO	1	–	–	5000	1	–	Yes-E	200 ppm	–	–
4	–	5000	2,4,5,6 F8	–	20000	AO	–	–	--	5000	1	–	Yes-E	400 ppm	–	–
5	–	–	2,4,6 F8	–	–	AO	–	–	–	–	–	–	Yes	25 ppm	A	–

SECTION 16 - OTHER INFORMATION

SDS Revision History

Revision 1, 11/03/2015, Original in GHS Version 3 Format.

SDS Compliance

This SDS complies with the below listed regulations only. For SDS that comply with other countries, please contact our Regulatory Department at msds@chem-pak.com

OSHA Hazard Communication Standard (HCS 2012) 29 CFR 1910.1200
Globally Harmonized System of Classification and Labeling of Chemicals (GHS) Revision 3

Disclaimer of Liability

The information contained herein is based upon data provided to us by our suppliers, and reflects our best judgement. However, no warranty of merchantability, fitness for any use, or any other warranty or guarantee is expressed or implied regarding the accuracy of such data, or the results to be obtained from use thereof. Since the information contained herein may be applied under conditions beyond our control and with which we may be unfamiliar, we do not assume any responsibility for the results of such application. This information is furnished upon the condition that the persons receiving it shall make their own determinations of the suitability of the material for any particular use. Although certain hazards are described herein, we cannot guarantee these are the only hazards that exist.

Safety Data Sheet

Section 1: Identification

Product identifier

Product Name • **Starbar QuikStrike Fly Bait**

Synonyms • 100508297; 100508298; 100508299; EPA Reg. No.: 2724-812

Product Description • Blue granular solid.

Relevant identified uses of the substance or mixture and uses advised against

Recommended use • For control of house flies in industrial, commercial and agricultural settings.

Restrictions on use •

KEEP OUT OF THE REACH OF CHILDREN. Avoid contact with skin, eyes, or clothing. Keep away from heat, sparks and flames.

Details of the supplier of the safety data sheet

Manufacturer • Wellmark International

1501 E. Woodfield Road, Suite 200 West
Schaumburg, IL 60173
United States

Emergency telephone number

Manufacturer • 1-800-424-9300 - CHEMTREC

Manufacturer • 1-703-527-3887 - CHEMTREC - Outside North America - Collect Calls Accepted

Manufacturer • 1-800-347-8272

Section 2: Hazard Identification

United States (US)

According to: OSHA 29 CFR 1910.1200 HCS

Classification of the substance or mixture

OSHA HCS 2012 • Combustible Dust

Label elements

OSHA HCS 2012

WARNING

Hazard statements • May form combustible dust concentrations in air.

Other hazards

OSHA HCS 2012 •

This pesticide is highly toxic to bees. This pesticide is toxic to shrimp. Under United States Regulations (29 CFR 1910.1200 - Hazard Communication Standard), this

product is considered hazardous.

Section 3 - Composition/Information on Ingredients

Substances

- Material does not meet the criteria of a substance.

Mixtures

Composition		
Chemical Name	**Identifiers**	**%**
Dinotefuran	**CAS:**165252-70-0	0.5%
9-Tricosene, (Z)	**CAS:**27519-02-4	0.04%
Sucrose	**CAS:**57-50-1	> 99%
Other ingredients	NDA	< 1%

Section 4: First-Aid Measures

Description of first aid measures

Inhalation

- IF INHALED: If breathing is difficult, remove person to fresh air and keep at rest in a position comfortable for breathing. Get medical attention if symptoms occur.

Skin

- IF ON SKIN: Wash skin with soap and water.

Eye

- IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention if symptoms occur.

Ingestion

- IF SWALLOWED: Call a POISON CONTROL center or doctor if you feel unwell. Rinse mouth. Do NOT induce vomiting.

Most important symptoms and effects, both acute and delayed

- Refer to Section 11 - Toxicological Information.

Indication of any immediate medical attention and special treatment needed

Notes to Physician

- Treat symptomatically and supportively.

Other information

- None specified.

Section 5: Fire-Fighting Measures

Extinguishing media

Suitable Extinguishing Media

- Use water spray or water fog.

Unsuitable Extinguishing Media

- Avoid use of pressurized dry-chemical extinguishers on powdered materials to prevent

dust suspensions and dust explosion hazards. Hose streams should be used with great care to avoid creating dust clouds. Fog nozzles should be used.

Firefighting Procedures

- Combustible dust - use low-pressure medium fog streams to avoid dust clouds.
Ventilate closed spaces before entering.
Eliminate ignition sources.
Non-sparking tools such as scoop shovels or natural-bristle brooms may be appropriate.

Special hazards arising from the substance or mixture

Unusual Fire and Explosion Hazards

- Avoid generating dust; fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.

Hazardous Combustion Products

- Decomposes upon heating and may produce toxic vapors/gases.

Advice for firefighters

- Wear positive pressure self-contained breathing apparatus (SCBA).

Section 6 - Accidental Release Measures

Personal precautions, protective equipment and emergency procedures

Personal Precautions

- Keep all sources of ignition away and avoid creating dusty conditions. Use appropriate Personal Protective Equipment (PPE).

Emergency Procedures

- Contain spill and monitor for excessive dust accumulation. Use normal clean up procedures. ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Ventilate closed spaces before entering. Turn off electric power to area. Evacuate area.

Environmental precautions

- Avoid generating dust. Do NOT wash away into sewer.

Methods and material for containment and cleaning up

Containment/Clean-up Measures

- Dust Deposits should not be allowed to accumulate on surfaces, as these may form an explosive mixture if they are released into the atmosphere in sufficient concentration.
Sweep or scoop up spills, dispose of any unusable material in approved landfill. Non-sparking tools should be used.

Section 7 - Handling and Storage

Precautions for safe handling

Handling

- Avoid contact with skin, eyes, and clothing. Remove clothing immediately if product gets inside. Wash thoroughly and put on clean clothing. No open flames, no sparks and no smoking. Avoid breathing dust. To minimize dust generation and accumulation, spills should be cleaned up, and, dust accumulations should be removed promptly.

Conditions for safe storage, including any incompatibilities

Storage

- Do not contaminate water, food, or feed by storage or disposal. Keep container/package tightly closed in a cool, well-ventilated place. Keep only in the

original container. Keep out of reach of children. Store away from heat or open flame.

Incompatible Materials or Ignition Sources
- Oxidizing agents. Strong acids. Heat, sparks, open flame.

Section 8 - Exposure Controls/Personal Protection

Control parameters

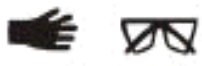
Exposure Limits/Guidelines
- No data available.

Exposure Limits/Guidelines				
	Result	ACGIH	NIOSH	OSHA
Sucrose (57-50-1)	TWAs	10 mg/m3 TWA	10 mg/m3 TWA (total dust); 5 mg/m3 TWA (respirable dust)	15 mg/m3 TWA (total dust); 5 mg/m3 TWA (respirable fraction)

Exposure controls

Engineering Measures/Controls
- Local exhaust ventilation.

Personal Protective Equipment

Pictograms
- 

Respiratory
- If airborne dust is present or in case of inadequate ventilation, use appropriate respiratory protection.

Eye/Face
- Wear safety glasses.

Hands
- Wear appropriate gloves.

Skin/Body
- If prolonged exposure is anticipated, it is recommended for handlers to wear appropriate clothing to prevent skin contact.

General Industrial Hygiene Considerations
- Handle in accordance with good industrial hygiene and safety practice.

Environmental Exposure Controls
- Dust deposits should not be allowed to accumulate on surfaces, as these may form an explosive mixture if they are released into the atmosphere in sufficient concentration. Avoid dispersal of dust in the air (i.e., clearing dust surfaces with compressed air).

Section 9 - Physical and Chemical Properties

Information on Physical and Chemical Properties

Material Description			
Physical Form	Solid	Appearance/Description	Blue granules.
Color	Blue	Odor	Fish-like
Odor Threshold	No data available		
General Properties			
Boiling Point	No data available	Melting Point/Freezing Point	No data available
Decomposition Temperature	No data available	pH	6.15 in 1% aq. solution
Specific Gravity/Relative Density	= 0.93 Water=1	Bulk Density	50 lb(s)/ft³

Water Solubility	Soluble	Viscosity	Not relevant
Volatility			
Vapor Pressure	No data available	Vapor Density	No data available
Evaporation Rate	No data available		
Flammability			
Flash Point	Not relevant	UEL	No data available
LEL	No data available	Autoignition	No data available
Flammability (solid, gas)	No data available		
Environmental			
Octanol/Water Partition coefficient	No data available		

Section 10: Stability and Reactivity

Reactivity

- This material is friable and can create small dust particles during any handling, processing, and transfer operations. This material can form explosive dust/air suspensions that are ignitable under some conditions.

Chemical stability

- Stable under normal temperatures and pressures.

Possibility of hazardous reactions

- Hazardous polymerization will not occur.

Conditions to avoid

- Heat, sparks, open flame. Excessive heat.

Incompatible materials

- Strong oxidizers. Strong acids.

Hazardous decomposition products

- Decomposes on heating above 401°F (205°C) and may produce toxic fumes/gases.

Section 11 - Toxicological Information

Information on toxicological effects

Components		
Dinotefuran (0.5%)	165252-70-0	**Acute Toxicity:** Ingestion/Oral-Rat LD50 • 2000-2804 mg/kg; Inhalation-Rat LC50 • >4.09 mg/L 4 Hour (s); Skin-Rabbit LD50 • >2000 mg/kg; **Irritation:** Eye-Rabbit • Essentially non-irritating; Skin-Rabbit • Essentially non-irritating
9-Tricosene, (Z) (0.04%)	27519-02-4	**Acute Toxicity:** Ingestion/Oral-Rat LD50 • >5000 mg/kg; Inhalation-Rat LC50 • >5 g/m³; Skin-Rabbit LD50 • >2000 mg/kg

GHS Properties	Classification
Acute toxicity	**OSHA HCS 2012** • Acute Toxicity - Dermal - Classification criteria not met; Acute Toxicity - Inhalation - Classification criteria not met; Acute Toxicity - Oral - Classification criteria not met
Skin corrosion/Irritation	**OSHA HCS 2012** • Classification criteria not met
Serious eye damage/Irritation	**OSHA HCS 2012** • Classification criteria not met

Skin sensitization	**OSHA HCS 2012** • Classification criteria not met
Respiratory sensitization	**OSHA HCS 2012** • Classification criteria not met
Aspiration Hazard	**OSHA HCS 2012** • Classification criteria not met
Carcinogenicity	**OSHA HCS 2012** • Classification criteria not met
Germ Cell Mutagenicity	**OSHA HCS 2012** • Classification criteria not met
Toxicity for Reproduction	**OSHA HCS 2012** • Classification criteria not met
STOT-SE	**OSHA HCS 2012** • Classification criteria not met
STOT-RE	**OSHA HCS 2012** • Classification criteria not met

Potential Health Effects

Inhalation

Acute (Immediate)
- Exposure to dust may cause respiratory irritation.

Chronic (Delayed)
- No data available

Skin

Acute (Immediate)
- Exposure to dust may cause irritation.

Chronic (Delayed)
- No data available

Eye

Acute (Immediate)
- Exposure to dust may cause irritation.

Chronic (Delayed)
- No data available

Ingestion

Acute (Immediate)
- Under normal conditions of use, no health effects are expected.

Chronic (Delayed)
- No data available

Mutagenic Effects
- Dinotefuran technical was negative in the following in vitro assays: Ames Assay, mouse lymphoma (L5178Y), mammalian cytogenetics (CHL/IU) or DNA Repair.

Carcinogenic Effects
- No component of this product present at 0.1% or greater is listed by IARC, OSHA or NTP.

Reproductive Effects
- Dinotefuran technical did not produce developmental effects in rats at doses up to 1000 mg/kg/day (the highest does tested). 9-Tricosene, (Z) did not produce developmental effects in rats.

Section 12 - Ecological Information

Toxicity

Components		
Dinotefuran (0.5%)	165252-70-0	**Aquatic Toxicity-Fish:** 96 Hour(s) LC50 *Rainbow Trout* >100 mg/L [Acute] **Aquatic Toxicity-Crustacea:** 48 Hour(s) LC50 *Daphnia magna* >1000 mg/L [Acute]
9-Tricosene, (Z) (0.04%)	27519-02-4	**Aquatic Toxicity-Fish:** 96 Hour(s) LC50 *Rainbow Trout* >1000 mg/L [Acute] 96 Hour(s) LC50 *Blue Gill* >1000 mg/L [Acute] **Aquatic Toxicity-Crustacea:** 48 Hour(s) LC50 *Daphnia magna* 1.08 mg/L [Acute]

Persistence and degradability

- No data available.

Bioaccumulative potential

- No data available

Mobility in Soil

- No data available

Other adverse effects

Potential Environmental Effects

- This pesticide is toxic to shrimp and highly toxic to bees.

Section 13 - Disposal Considerations

Waste treatment methods

Product waste

- Dispose of content and/or container in accordance with local, regional, national, and/or international regulations. Do not contaminate water, food, or feed by storage disposal. Do not allow into any sewer on the ground, or into any body of water.

Packaging waste

- Do not reuse or refill this container. Dispose of content and/or container in accordance with local, regional, national, and/or international regulations.

Section 14 - Transport Information

	UN number	UN proper shipping name	Transport hazard class (es)	Packing group	Environmental hazards
DOT	Not Applicable	Not Regulated	Not Applicable	Not Applicable	Not Applicable
IMO/IMDG	Not Applicable	Not Regulated	Not Applicable	Not Applicable	Not Applicable
IATA/ICAO	Not Applicable	Not Regulated	Not Applicable	Not Applicable	Not Applicable

Special precautions for user

- None specified.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

- No data available

Other information

IMO/IMDG

- No data available

IATA/ICAO

- No data available

Section 15 - Regulatory Information

Safety, health and environmental regulations/legislation specific for the substance or mixture

SARA Hazard Classifications

- Not classified

FIFRA – Pesticide Labeling

This material is a pesticide product registered by the United States Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets (SDS), and for workplace labels of non-pesticide chemicals. The hazard information required on the pesticide label is reproduced below. The pesticide label also includes other important information, including directions for use.

CAUTION

Precautionary Statements •

Users should remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.
Users should wash hands with plenty of soap and water before eating, drinking, chewing gum, using tobacco, or using the toilet. Users should remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
Keep away from fire, sparks and heated surface.
KEEP OUT OF THE REACH OF CHILDREN.

Hazards to Humans and Domestic Animals •

HAZARDS TO HUMANS AND DOMESTIC ANIMALS - CAUTION- Harmful if swallowed. Harmful if absorbed through skin. Harmful if inhaled. Avoid contact with skin, eyes or clothing. Avoid breathing spray mist. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals. Wear long-sleeved shirt and long pants, socks, shoes and gloves. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Remove and wash contaminated clothing before reuse.

First Aid •

IF INHALED: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth to mouth if possible. Call poison control center or doctor for treatment advice.
IF ON SKIN: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.
IF SWALLOWED: Call a poison control center or doctor for treatment advice. Have a person sip a glass of water, if able to swallow. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give anything by mouth to an unconscious person.
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-347-8272 for emergency medical treatment information.

Environmental Hazards •

This product is toxic to shrimp. Do not apply directly to water, areas where surface water is present, or to intertidal areas below the mean high water mark. Drift or runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment washwaters. This product is highly toxic to bees exposed to direct treatment. Do not apply this product if bees are foraging in the treatment areas.

Inventory		
Component	**CAS**	**TSCA**
9-Tricosene, (Z)	27519-02-4	Yes
Dinotefuran	165252-70-0	No
Sucrose	57-50-1	Yes

Section 16 - Other Information

Revision Date • 04/January/2016

Last Revision Date • 04/January/2016

Preparation Date • 04/January/2016

Disclaimer/Statement of • The information and statements herein are believed to be reliable but are not to be

Liability

construed as a warranty or representation for which we assume legal responsibility. Users should undertake sufficient verification and testing to determine the suitability for their own particular purpose of any information or products referred to herein. NO WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE IF MADE.

SCRUBBING BUBBLES® FOAMING BLEACH BATHROOM CLEANER

Version *1*.2 Print Date 07/02/2015

Revision Date 02/24/2015 SDS Number 350000004370

1. PRODUCT AND COMPANY IDENTIFICATION

Product information

Product name : **SCRUBBING BUBBLES® FOAMING BLEACH BATHROOM CLEANER**

Recommended use : Hard Surface Cleaner

Manufacturer, importer, supplier : S.C. Johnson & Son, Inc.
1525 Howe Street
Racine WI 53403-2236

Telephone : +18005585252

Emergency telephone number : 24 Hour Medical Emergency Phone: (866)231-5406
24 Hour International Emergency Phone: (703)527-3887
24 Hour Transport Emergency Phone: (800)424-9300

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

Globally Harmonized System (GHS) Classification

Hazard classification	Hazard category	Hazards identification
Skin irritation	Category 2	Causes skin irritation.
Eye irritation	Category 2A	Causes serious eye irritation.

Labelling
Hazard symbols
Exclamation mark

Signal word
Warning

Hazard statements
Causes skin irritation.
Causes serious eye irritation.

Precautionary statements
If medical advice is needed, have product container or label at hand.
Keep out of reach of children.
Read label before use.
Specific treatment (see supplemental first aid instructions on this label).
IF ON SKIN: Wash with plenty of soap and water.
If skin irritation occurs: Get medical advice/ attention.

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
If eye irritation persists: Get medical advice/ attention.
Take off contaminated clothing and wash before reuse.
Wear protective gloves/ eye protection/ face protection.
Wash hands thoroughly after handling.

Other hazards : None identified

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS-No.	Weight percent
Sodium carbonate	497-19-8	1.00 - 5.00
Sodium hypochlorite	7681-52-9	1.00 - 5.00
Sodium chloride	7647-14-5	1.00 - 5.00

The specific chemical identity and/or exact percentage (concentration) of this composition has been withheld as a trade secret.

For additional information on product ingredients, see www.whatsinsidescjohnson.com.

4. FIRST AID MEASURES

Eye contact : IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/ attention.

Skin contact : Wash off with plenty of water. Take off contaminated clothing and wash before reuse.

Inhalation : No special requirements.

Ingestion : No special requirements

5. FIREFIGHTING MEASURES

Suitable extinguishing media : Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Specific hazards during : Container may melt and leak in heat of fire.

firefighting

Further information	:	Fight fire with normal precautions from a reasonable distance. Standard procedure for chemical fires. Wear full protective clothing and positive pressure self-contained breathing apparatus.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions	:	Use personal protective equipment.
Personal precautions	:	Wear personal protective equipment. Wash thoroughly after handling.
Environmental precautions	:	Outside of normal use, avoid release to the environment.
Methods and materials for containment and cleaning up	:	Dike large spills. Clean residue from spill site.

7. HANDLING AND STORAGE

Handling

Precautions for safe handling	:	Avoid contact with skin, eyes and clothing. For personal protection see section 8. Use only as directed. KEEP OUT OF REACH OF CHILDREN AND PETS. Wash thoroughly after handling.
Advice on protection against fire and explosion	:	Normal measures for preventive fire protection.

Storage

Requirements for storage areas and containers	:	Keep container closed when not in use.

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8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Limits

Components	CAS-No.	mg/m3	ppm	Non-standard units	Basis
Sodium carbonate	497-19-8	10 mg/m3	-	-	SUPPLIER

Personal protective equipment

Respiratory protection : Substantial amounts of mist/vapors can be controlled with local exhaust ventilation or respiratory protection.

Hand protection : Wear suitable gloves.

Eye protection : Safety glasses with side-shields

Skin and body protection : No special requirements.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. Wash thoroughly after handling.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form : liquid

Color : light yellow

Odor : Bleach

Odour Threshold : No data available

pH : 12.5 - 13.5

Melting point/freezing point : 0 C

Initial boiling point and boiling range : 100 °C

SCRUBBING BUBBLES® FOAMING BLEACH BATHROOM CLEANER

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Flash point	:	does not flash
Evaporation rate	:	No data available
Flammability (solid, gas)	:	No data available
Upper/lower flammability or explosive limits	:	No data available
Vapour pressure	:	No data available
Vapour density	:	No data available
Relative density	:	1.09 g/cm3
Solubility(ies)	:	completely soluble
Partition coefficient: n-octanol/water	:	No data available
Auto-ignition temperature	:	No data available
Decomposition temperature	:	No data available
Viscosity, dynamic	:	similar to water
Viscosity, kinematic	:	similar to water
Oxidizing properties	:	No data available
Volatile Organic	:	0 % - additional exemptions may apply

Compounds **Total VOC (wt. %)***		*as defined by US Federal and State Consumer Product Regulations
Other information	:	None identified

10. STABILITY AND REACTIVITY

Possibility of hazardous reactions	:	If accidental mixing occurs and toxic gas is formed, exit area immediately. Do not return until well ventilated.
Conditions to avoid	:	Direct sources of heat.
Incompatible materials	:	Do not mix with bleach or any other household cleaners. Strong bases
Hazardous decomposition products	:	Thermal decomposition can lead to release of irritating gases and vapours.

11. TOXICOLOGICAL INFORMATION

Emergency Overview	:	Warning
Acute oral toxicity	:	LD50 Measured > 5,000 mg/kg
Acute inhalation toxicity	:	No data available
Acute dermal toxicity	:	LD50 Measured > 2,000 mg/kg

GHS Properties	Classification	Routes of entry
Acute toxicity	No classification proposed	-
Skin irritation	Category 2	-

Eye irritation	Category 2A	-
Skin sensitisation	No classification proposed	-
Respiratory sensitisation	No classification proposed	-
Germ cell mutagenicity	No classification proposed	-
Carcinogenicity	No classification proposed	-
Reproductive toxicity	No classification proposed	-
Specific target organ toxicity - single exposure	No classification proposed	-
Specific target organ toxicity - repeated exposure	No classification proposed	-
Aspiration hazard	No classification proposed	-

Aggravated Medical Condition : None known.

12. ECOLOGICAL INFORMATION

Product : The product itself has not been tested.

Toxicity
The ingredients in this formula have been reviewed and no adverse impact to the environment is expected when used according to label directions.

Toxicity to fish

Components	End point	Species	Value	Exposure time
Sodium carbonate	static test LC50	Lepomis macrochirus	300 mg/l	96 h
Sodium hypochlorite	semi-static test LC50	Oncorhynchus mykiss (rainbow trout)	0.03 - < 0.19 mg/l	96 h

	NOEC		0.01 - < 0.1 mg/l	28 d
Sodium chloride	flow-through test LC50	Lepomis macrochirus	5,840 mg/l	96 h
	NOEC	Pimephales promelas (fathead minnow)	252 mg/l	33 d

Toxicity to aquatic invertebrates

Components	End point	Species	Value	Exposure time
Sodium carbonate	semi-static test EC50	Ceriodaphnia sp.	200 - 227 mg/l	248 h
Sodium hypochlorite	static test EC50	Daphnia magna (Water flea)	0.033 - 0.044 mg/l	48 h
Sodium chloride	static test EC50	Daphnia magna (Water flea)	340.7 - 469.2 mg/l	48 h
	NOEC	Daphnia pulex	314 mg/l	21 d

Toxicity to aquatic plants

Components	End point	Species	Value	Exposure time
Sodium carbonate	No data available			
Sodium hypochlorite	EC50	Skeletonema costatum	0.095 mg/l	72 h

Sodium chloride	IC50	Algae	3,014 mg/l	72 h

Persistence and degradability

Component	Biodegradation	Exposure time	Summary
Sodium carbonate	No data available		
Sodium hypochlorite	No data available		
Sodium chloride	No data available		

Bioaccumulative potential

Component	Bioconcentration factor (BCF)	Partition Coefficient n-Octanol/water (log)
Sodium carbonate	No data available	No data available
Sodium hypochlorite	No data available	-3.42
Sodium chloride	1.09 QSAR	0.54

Mobility

Component	End point	Value
Sodium carbonate	No data available	
Sodium hypochlorite	No data available	
Sodium chloride	No data available	

PBT and vPvB assessment

Component	Results
Sodium carbonate	Not fulfilling PBT and vPvB criteria
Sodium hypochlorite	Not fulfilling PBT and vPvB criteria
Sodium chloride	Not fulfilling PBT and vPvB criteria

Other adverse effects : None known.

13. DISPOSAL CONSIDERATIONS

Consumer may discard empty container in trash, or recycle where facilities exist.

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14. TRANSPORT INFORMATION

Please refer to the Bill of Lading/receiving documents for up-to-date shipping information.

Land transport
Not classified as dangerous in the meaning of transport regulations.

Sea transport
Not classified as dangerous in the meaning of transport regulations.

Air transport
Not classified as dangerous in the meaning of transport regulations.

15. REGULATORY INFORMATION

Notification status	:	All ingredients of this product are listed or are excluded from listing on the U.S. Toxic Substances Control Act (TSCA) Chemical Substance Inventory.
Notification status	:	All ingredients of this product comply with the New Substances Notification requirements under the Canadian Environmental Protection Act (CEPA).
California Prop. 65	:	This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

HMIS Ratings

Health	3
Flammability	0
Reactivity	0

SCRUBBING BUBBLES® FOAMING BLEACH BATHROOM CLEANER

Version *1*.2 Print Date 07/02/2015

Revision Date 02/24/2015 SDS Number 350000004370

NFPA Ratings

Health	3
Fire	0
Reactivity	0
Special	-

This information is being provided in accordance with the Occupational Safety and Health Administration (OSHA) regulation (29 CFR 1910.1200). The information supplied is designed for workplaces where product use and frequency of exposure exceeds that established for the labeled consumer use.

Further information

This document has been prepared using data from sources considered to be technically reliable. It does not constitute a warranty, expressed or implied, as to the accuracy of the information contained herein. Actual conditions of use are beyond the seller's control. User is responsible to evaluate all available information when using product for any particular use and to comply with all Federal, State, Provincial and Local laws and regulations.

Prepared by	SC Johnson Global Safety Assessment & Regulatory Affairs (GSARA)

SECTION 1: Identification of the substance/mixture and of the company

1.1 Product identifier

- Product Name: **Synergize™**
- Product Part Number(s): **403381, 409038, 433600, 433602, 433605, 434700**
- Brand(s): Preserve International
- ABN(s): Synergize Cool™, Synergize NF™, Synergize NP™, Synergize NP-NF™

1.2 Relevant identified uses of the substance or mixture and uses advised against

- Use of the substance/preparation: Disinfectant
- Uses advised against: It is a violation of Federal law to use this product in a manner inconsistent with its label. Read the entire label before use and follow all Directions for Use, Use Restrictions, and Precautions.

1.3 Details of the supplier of the safety data sheet

- Manufactured By: Preserve International
- Address: 944 Nandino Blvd.
  Lexington, Kentucky 40511
  USA

Preserve International is a wholly-owned subsidiary of Neogen Corporation.

- Telephone: 859/254-1221 • 800/627-8829
- Email: Inform@neogen.com

1.4 Emergency telephone numbers

- Medical: 1-800-498-5743 (United States and Canada)
- Spill: 1-800-424-9300 (United States and Canada)

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (29 CFR 1910.1200)

- Acute toxicity, oral, Cat. 4, H302, Skin corrosion, Cat. 1B, H314, Serious eye damage, Cat. 1, H318, Sensitization, skin, Cat. 1, H317, Sensitization, respiratory, Cat. 1, H334; Aspiration hazard, Cat. 2, H305, Hazardous to the aquatic environment, acute hazard, Cat. 1, H400

Classification (WHMIS 2015 HPR)

- Acute toxicity, oral, Cat. 4, H302, Skin corrosion, Cat. 1B, H314, Serious eye damage, Cat. 1, H318, Sensitization, skin, Cat. 1, H317, Sensitization, respiratory, Cat. 1, H334; Aspiration hazard, Cat. 2, H305, Hazardous to the aquatic environment, acute hazard, Cat. 1, H400

2.2 Label elements



GHS05 GHS07 GHS08 GHS09

- Signal Word (OSHA/HPR): **DANGER**
- Signal Word (EPA-FIFRA): **DANGER**
- Symbols: GHS05, GHS07, GHS08, GHS09
- Hazard phrases
  Harmful if swallowed.
  Causes severe skin burns and eye damage.
  May cause an allergic skin reaction.
  May cause allergy or asthma symptoms or breathing difficulties if inhaled.
  May be fatal if swallowed and enters airways.
  Very toxic to aquatic life.
- Precautionary phrases
  Do not breathe mist/fumes/vapors/spray.
  Wash hands thoroughly after handling.
  Do not eat, drink or smoke when using this product.
  Use only outdoors or in a well-ventilated area.
  Contaminated work clothing should not be allowed out of the workplace.
  Avoid release to the environment.

SECTION 2: Hazards identification (continued)

Wear protective gloves/protective clothing/eye protection/face protection.
In case of inadequate ventilation wear respiratory protection.
If swallowed: Immediately call a poison center or doctor/physician.
Rinse mouth. Do NOT induce vomiting.
If on skin (or hair): Immediately remove all contaminated clothing. Rinse skin with water/shower.
If skin irritation or rash occurs: Get medical advice/attention.
Wash contaminated clothing before reuse.
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
If inhaled: Remove person to fresh air and keep comfortable for breathing.
Immediately call a poison center or doctor/physician.
Collect spillage. Hazardous to the aquatic environment.
Store locked up.
Dispose of contents/container in accordance with local, regional, national, and/or international regulations.

2.3 Other hazards

- Keep out of reach of children and animals.

SECTION 3: Composition/information on ingredients

3.1 Mixtures

This product is a mixture of the substances listed below with the addition of non-hazardous materials

Chemical	Concentration*	CAS No.	H-Statements	Symbols
Quaternary ammonium compounds	20.0-30.0%	68391-01-5	H302, H314, H400	GHS05, GHS07, GHS09
Glutaraldehyde	5.0-10.0%	111-30-8	H301, H314, H317, H331, H334, H400	GHS05, GHS06, GHS08, GHS09
Phosphoric acid	1.0-5.0%	7664-38-2	H314, H318	GHS05
Pine oil	1.0-2.0%	8002-09-3	H226, H305, H315, H317, H411	GHS02, GHS07, GHS08

*The exact percentage (concentration) of composition has been withheld as a trade secret.
Ingredients not precisely identified are proprietary or non-hazardous. Values are not product specifications.
For full text of H-Statements, see Section 16.

SECTION 4 First aid measures

4.1 Description of first aid measures

- General
  Have safety data sheet, product container, or label with you when calling 1-800-498-5743, a poison control center, or doctor.
  In case of doubt, or when symptoms persist, seek medical attention.
  When used as directed, the hazards associated with this product can be minimized, but like any other chemical, it should be treated with care, respect, and common sense.
- Contact with skin
  Causes severe skin burns. May cause an allergic skin reaction.
  Immediately remove contaminated clothing.
  Wash affected area with plenty of soap and water/shower.
  If skin irritation or rash occurs: Call 1-800-498-5743, a poison control center, or doctor for medical advice/attention.
  Contaminated clothing should be laundered before reuse.
- Contact with eyes
  Causes serious eye damage.
  If substance has gotten into eyes, rinse with plenty of water for at least 15 minutes.
  Irrigate eyes thoroughly while lifting eyelids.
  Remove contact lenses, if present and easy to do. Continue rinsing.
  If eye irritation persists: Call 1-800-498-5743, a poison control center, or doctor for medical advice/attention.

SECTION 4 First aid measures (continued)

- Ingestion
  Harmful if swallowed.
  May be fatal if swallowed and enters airways.
  If swallowed, rinse mouth with water.
  Do NOT induce vomiting.
  Immediately call 1-800-498-5743, a poison control center, or doctor for medical advice/ attention.
- Inhalation
  May cause allergy or asthma symptoms or breathing difficulties if inhaled.
  If breathing is difficult, remove person to fresh air and keep comfortable for breathing.
  If experiencing respiratory symptoms: Call 1-800-498-5743, a poison control center, or doctor for medical advice/attention.

4.2 Most important symptoms and effects, both acute and delayed

- The most important known symptoms are described in the labeling (see Section 2.2) and/or in Section 11.

4.3 Indication of any immediate medical attention and special treatment needed

- Treat symptomatically.
- Further information is available from the ProPharma Emergency Number (1-800-498-5743) provided in this document.

SECTION 5: Fire-fighting measures

5.1 Suitable (and unsuitable) extinguishing media

- In case of fire: use water spray, foam, carbon dioxide or dry agent for extinction.
- If water is to be used to fight fire, dike and collect runoff.

5.2 Special hazards arising from the substance or mixture

- Smoke from fires is toxic. Take precautions to protect personnel from exposure.
- Material is lighter than water and a fire may be spread by the use of water.
- Containers may explode in the heat of a fire.
- Vapors may be heavier than air.
- Avoid excess runoff from fire-fighting from entering lakes, streams, ponds, or other open waters.
- See Section 10 for additional Stability and Reactivity information.

5.3 Advice for firefighters

- Flammable liquid and vapor.
- Keep container(s) exposed to fire cool by spraying with water.
- Wear chemical protection suit and positive-pressure breathing apparatus.
- Wear protective clothing as per Section 8.

5.4 Hazardous Combustion Products

- Hazardous combustion products include carbon monoxide, phosphine, oxides of phosphorus, and hydrogen gas.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

- Spills should be cleaned up immediately to avoid slip and fall accidents and injuries.
- Wear personal protective clothing, and observe precautions outlined Section 8.
- Evacuate personnel not directly involved in spill clean-up.
- Shut off source of leak/release, if safe to do so.
- Shut down and/or remove equipment in spill area, if safe to do so.
- Avoid breathing vapors.
- Wash thoroughly after dealing with spillage.

6.2 Environmental Precautions

- Do not allow to enter public sewers and watercourses.
- Avoid releasing to the environment.

6.3 Methods and material for containment and cleaning up

- Material is lighter than water and may be spread by the use of water.
- Absorb spillage in inert material and shovel up.
- Dike large spills as necessary.

SECTION 6: Accidental release measures (continued)

- Place in sealable containers and label them.
- Ventilate the area and wash spill site after material pick-up is complete.
- Dispose of contaminated materials and wastes in accordance with local/national/international regulations.

6.4 Reference to other sections

- See Section 7 for storage. For disposal, see Section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

- Do not breathe vapor/mist/spray/fumes.
- Avoid contact with skin, eyes, and clothing.
- Do not eat, drink, smoke, or apply cosmetics when using this product.
- Ensure adequate ventilation.
- Eyewash bottles should be available.
- Use personal protective equipment, as required by label instructions and/or workplace procedures.
- Wash hands thoroughly after using this product.
- Do not reuse or refill product container. See label or Section 13 for disposal instructions.

7.2 Conditions for safe storage, including any incompatibilities

- Store locked up.
- Do not contaminate water, food, or feed by storage or disposal.
- Keep container tightly closed in a cool, dry, well-ventilated place.
- Carefully reseal opened containers and store upright to prevent leakage.
- Store away from metals, strong oxidizing agents, excessive heat, and ignition sources.
- Incompatible with strong oxidizing agents. Reacts with most common metals to produce hydrogen gas. Corrosive to many materials including leather, rubber, and many organics.

7.3 Specific end use(s)

- Disinfectant

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

THE FOLLOWING RECOMMENDATIONS FOR EXPOSURE CONTROLS/PERSONAL PROTECTION ARE INTENDED FOR THE MANUFACTURE, FORMULATION, PACKAGING, AND USE OF THIS PRODUCT.

FOR COMMERCIAL APPLICATIONS AND/OR ON-FARM APPLICATIONS CONSULT THE PRODUCT LABEL.

Components with workplace control parameters

Component	CAS No.	Value	Control Parameters	Basis
Glutaraldehyde	111-30-8	Ceiling	0.2 ppm, 0.8 mg/m^3	USA-NIOSH Recommended Exposure Limits
Phosphoric acid	7664-38-2	TWA	1 mg/m^3	USA-OSHA Table Z-1 Limits for Air Contaminants - 1910.1000
		TWA	1 mg/m^3	USA-NIOSH Recommended Exposure Limits
		STEL	3 mg/m^3	USA-NIOSH Recommended Exposure Limits
		TWA	1 mg/m^3	USA-ACGIH Threshold Limit Values (TLV)
		STEL	3 mg/m^3	USA-ACGIH Threshold Limit Values (TLV)

8.2 Exposure controls

- Eyewash bottles should be available.
- Wear air-purifying full-face respirators with organic vapor cartridges tested and approved under MSHA/NIOSH standards for chemicals.
- Handle with gloves. Wash the outside of gloves before removing. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good industrial hygiene. Wash and dry hands.
- Wear safety glasses and face shield (8-inch minimum) or chemical safety goggles approved under appropriate government standards such as ANSI or MSHA/NIOSH.

SECTION 8: Exposure controls/personal protection (continued)

- Handlers must wear a long-sleeved shirt, long pants, and shoes plus socks.
- Wear a chemical-resistant apron when cleaning equipment, mixing, or loading.
- Personal Protective Equipment (PPE) must be inspected before use. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables use detergent and hot water. Keep and wash PPE separately from other laundry.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance:	Clear liquid
Odor:	Mild pine odor
pH:	4.5 – 5.25
Melting Point/Range:	No data available
Boiling Point/Range:	No data available
Flash Point (Test Method):	No data available
Evaporation Rate:	No data available
Flammable Limits (% in air):	No data available
Flammability:	Extremely flammable aerosol
Vapor Pressure:	No data available
Vapor Density:	No data available
Specific Gravity:	1.02 – 1.05
Relative Density:	8.5 – 8.75 lbs/gallon
Solubility in water:	Completely soluble
Partition Coefficient (n-Octanol/Water):	No data available
Autoignition Temperature:	Product is not self-igniting
Viscosity:	No data available
Explosive Properties:	No data available
Oxidizing Properties:	Product is not classified as an oxidizer

9.2 Other information

- No additional data available

SECTION 10: Stability and reactivity

10.1 Reactivity

- No information available

10.2 Chemical stability

- Considered stable under recommended storage and handling conditions

10.3 Possibility of hazardous reactions

- No hazardous reactions known if used for its intended purpose.
- Reacts with most common metals to produce hydrogen gas.

10.4 Conditions to avoid

- Ignition sources, excessive heat

10.5 Incompatible materials

- Strong oxidizing agents, metals

10.6 Hazardous decomposition products

- Carbon monoxide, phosphine, oxides of phosphorus, and hydrogen gas

SECTION 11: Toxicological information

11.1 Information on toxicological effects

- Causes burns by all exposure routes. May cause central nervous system depression.
- Contact with skin
  Causes severe skin burns. May cause an allergic skin reaction.
  ATEmix=31,250 mg/kg (dermal)
  Based on available data, the acute toxicity classification criteria are not met.
- Contact with eyes
  Causes serious eye damage/irritation.

SECTION 11: Toxicological information (continued)

- Ingestion
  Harmful if swallowed. May be fatal if swallowed and enters airways.
  ATEmix=1,515 mg/kg (oral)
- Inhalation
  May cause allergy or asthma symptoms or breathing difficulties if inhaled.
  Inhalation of high concentrations may cause coughing and shortness of breath. May cause chemical burns to the respiratory tract.
  ATEmix=9.8 mg/L (inhalation – vapors)
  Based on available data, the acute toxicity classification criteria are not met.
- Carcinogenicity
  Not listed in the National Toxicology Program (NTP) 13th Report on Carcinogens.
  Not listed in the International Agency for Research on Cancer (IARC) Monographs, Volumes 1-112.
  Not listed in OSHA standard 1910.1003 Carcinogens.
- Mutagenicity
  No information available
- Teratogenicity
  No information available

SECTION 12: Ecological information

12.1 Toxicity
- This product is classified as hazardous to the environment under U.S. regulations, with acute and chronic effects.
- No data available.

12.2 Persistence and degradability
- No data available

12.3 Bioaccumulation potential
- No data available

12.4 Mobility in soil
- No data available

12.5 Other adverse effects
- To the best of our knowledge, the properties of this product have not been fully evaluated.
- An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

12.6 Ecological information, as required on the FIFRA label
- Do not discharge effluent containing this product directly to water. Do not contaminate water when disposing of equipment wash water or rinsate.

SECTION 13: Disposal considerations

13.1 Waste treatment methods
- Do not contaminate water, food, or feed by storage or disposal.
- Improper disposal of excess pesticide spray mixture or rinsate is a violation of Federal law.
- If wastes cannot be disposed of according to label instructions, contact your State Pesticide or Environmental Control Agency, or Hazard Waste representative at nearest EPA Regional Office for guidance.
- Do not discharge into drains or the environment, dispose to an authorized hazardous waste collection point.
- Do not reuse or refill empty containers.

SECTION 14: Transport information

14.1 Domestic surface transport (US DOT)
- Proper Shipping Name: Disinfectant, liquid, corrosive, n.o.s. (Phosphoric acid mixture)
- DOT UN No.: UN1903
- DOT Hazard Class: 8
- DOT Packing Group: III
- DOT Label(s): Corrosive
- Special Provisions: Not applicable

SECTION 14: Transport information (continued)

14.2 Ocean/Sea (IMO/IMDG)

- Proper Shipping Name: DISINFECTANT, LIQUID, CORROSIVE, N.O.S. (PHOSPHORIC ACID MIXTURE)
- IMDG UN No.: UN1903
- IMDG Hazard Class: 8
- IMDG Packing Group: III
- IMDG Label(s): Corrosive
- Special Provisions: UN Specification packagings must meet packing group II performance standards.

14.3 Air (ICAO/IATA)

- Proper Shipping Name: Disinfectant, liquid, corrosive, n.o.s. (Phosphoric acid mixture)
- ICAO UN No.: UN1903
- ICAO Hazard Class: 8
- ICAO Packing Group: III
- ICAO Label(s): Corrosive

Special Provisions: UN Specification packagings must meet packing group II performance standards.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under Federal pesticide law (FIFRA). These requirements differ from the classification criteria and hazard information required for safety data sheets and for workplace labels of non-pesticide chemicals. Following is the hazard information as required on the pesticide label:

KEEP OUT OF REACH OF CHILDREN
DANGER
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

Corrosive. Causes irreversible eye damage and skin burns. May be fatal if inhaled. Harmful if swallowed or absorbed through skin. Do not get in eyes, on skin or on clothing. Do not breathe spray mist. Wear goggles or face shield and. Wear a dust/mist/filtering respirator (MSHA/NIOSH approval number TC-21C) or a NIOSH-approved respirator with any N, P, R, or HE prefilter. Wear protective clothing and rubber gloves. Prolonged or frequent repeated skin contact may cause allergic reaction in some individuals. Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet. Remove and wash contaminated clothing before reuse.

EPA Registration Number: 66171-7

15.2 United States Regulatory Information

EPA SARA Title III Classifications

SARA 302 (EHS) Reportable Quantity (RQ):

No components listed

Section 311/312 Hazard Classes:

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	Yes
Sudden Release of Pressure Hazard	Yes
Reactive Hazard	No

Section 313 Toxic Chemicals:

Phosphoric acid, CAS No. 7664-38-2

CERLCA Reportable Quantity (RQ):

Phosphoric acid, CAS No. 7664-38-2 = 5,000 lbs.

RCRA Hazardous Waste Classification (40 CFR 261):

No components subject to reporting requirements

Clean Air Act (CAA) 112(r) Threshold Quantity (TQ):

No components subject to reporting requirements

Toxic Substance Control Act (TSCA):

This product is exempt from TSCA, subject to FIFRA

SECTION 15: Regulatory information (continued)

State Right-to-Know

Massachusetts

Phosphoric acid, CAS No. 7664-38-2
Glutaraldehyde, CAS No. 111-30-8
Pine oil, CAS No. 8002-09-3

New Jersey

Phosphoric acid, CAS No. 7664-38-2
Glutaraldehyde, CAS No. 111-30-8

Pennsylvania

Phosphoric acid, CAS No. 7664-38-2
Glutaraldehyde, CAS No. 111-30-8

California Prop 65

This product does not contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

15.3 Canadian Regulatory Information

This product has been classified in accordance with the hazard criteria of the Hazardous Products Regulations (HPR). The labelling may differ subject to the requirements of the Food and Drugs Act (FDA).

WHMIS Classification: Exempt

DIN: 02260336

Inventory Status

Domestic Substances List (DSL)	Listed
Non-Domestic Substances List (NDSL)	Not listed

SECTION 16: Other information

Document Number: SDS-1100.00, Synergize
Date of Preparation: February 8, 2017
Revision: Rev. 00
Replaces: New issue

Text not given with phrase codes where they are used elsewhere in this safety data sheet: H226: Flammable liquid and vapor. H301: Toxic if swallowed. H302: Harmful if swallowed. H305: May be fatal if swallowed and enters airways. H314: Causes severe skin burns and eye damage. H315: Causes skin irritation. H317: May cause an allergic skin reaction. H318: Causes serious eye damage. H319: Causes serious eye irritation. H331: Toxic if inhaled. H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled. H335: May cause respiratory irritation. H372: Causes damage to organs with prolonged or repeated exposure. H400: Very toxic to aquatic life. H411: Toxic to aquatic life with long-lasting effects.

For non-emergency (e.g. current product information)
Call: **1-800-621-8829**

Synergize™ is a Trademark of Preserve International and Neogen Corporation.

This document is believed to be correct, but does not purport to be all inclusive and shall be used only as a guide. Preserve International and Neogen Corporation shall not be held liable for any damage resulting from handling or from contact with the above product. These suggestions should not be confused with state, municipal or insurance requirements, and constitute NO WARRANTY.

APPENDIX B
SPILL FORM

SPILL DESCRIPTION FORM

(Information to be provided when reporting spill)

Reporter/Caller Information

Full Name _____ Position/Title _____

Normal Phone Number _____ Emergency Phone Number _____

Company Information

Name _____ Organization Type _____

Street Address _____

City _____ State _____ Zip _____

Facility Oil Storage Capacity _____ Units _____

Facility Latitude _____ Facility Longitude _____

Required Reporting Information

Were Materials Discharged? _____ Confidential Materials? _____

Meeting Federal Obligations to Report? _____ Date Called _____

Calling for Responsible Party? _____ Time Called _____

Spill or Release Information

Spill or Release Description _____

Date of Incident _____ Time _____ AM or PM

Incident Address or Location _____

State _____ Zip _____ County _____

Nearest City _____ Direction from City _____

Distance from City _____ Units _____

Section _____ Township _____ Range _____

Spilled or Released Material Information

Material Name _____ CHRIS Code _____

Quantity Released _____ Units _____

Source of Release _____

Container Type _____ Capacity _____ Units _____

Contaminated Media (Soil or Water) _____

Quantity on/in Water _____ Units _____ Quantity on/in Soil _____ Units _____

Actions Taken to Stop Spill or Release _____

Number of Injuries _____ Number of Deaths _____

Evacuations Performed _____ Number Evacuated _____

Damages _____ Estimated Cost of Damages _____

Notifications Made

NRC: ☐ U.S. EPA: ☐ State: ☐

Fire: ☐ Police: ☐ Other: _____

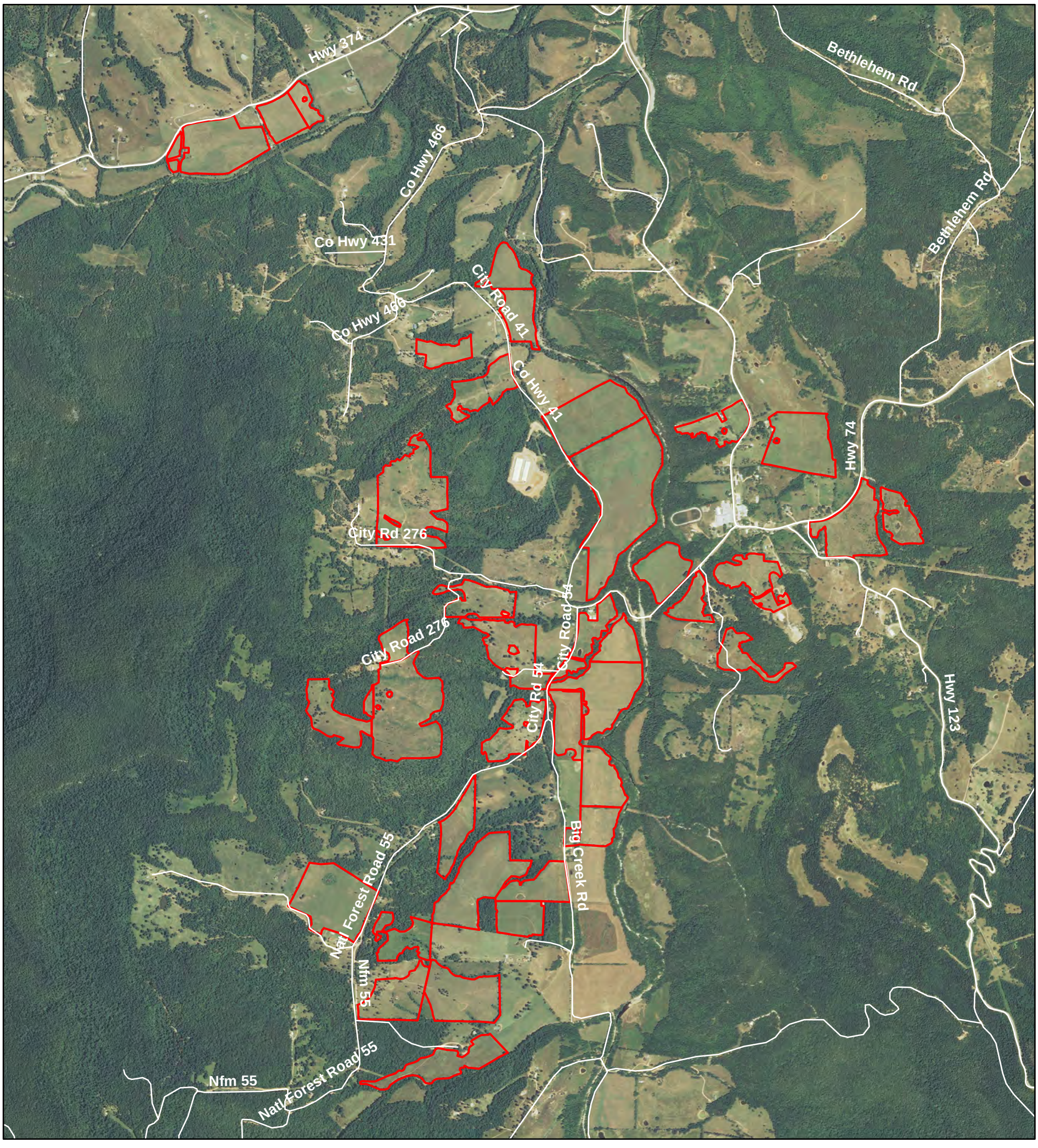
Land Application Fields
Appendix E

TABLE 1

Summary of Land Application Fields

Field Number	Open Acres	Spreadable Acres	Percent Usable
1	17.7	8.2	46%
2	8.8	6.0	68%
3	16.7	13.2	79%
4	10.9	7.2	66%
5	13.3	9.7	73%
6	9.1	5.6	62%
6A	17.5	7.3	42%
7	72.9	62.5	86%
7A	35.1	28.3	81%
8	10.7	7.2	67%
8A	2.9	1.4	48%
9	29.6	24.6	83%
9A	11.6	10.3	89%
10	14.7	13.6	93%
10A	17.7	16.4	93%
11	19.2	13.3	69%
12	13.1	11.2	85%
13	13.0	11.6	89%
13A	36.9	29.8	81%
13B	15.5	8.1	52%
14	15.1	7.6	50%
15	28.2	21.5	76%
15A	14.2	10.4	73%
15B	21.0	13.7	65%
16	21.3	15.2	71%
17	36.1	30.9	86%
18	29.6	21.7	73%
19	13.3	10.1	76%
20	24.8	20.7	83%
21	49.8	18.6	37%
21A	19.8	15.6	79%
21B	7.1	6.0	85%
22	46.4	35.2	76%
23	33.8	28.1	83%
24	11.6	8.0	69%
32	11.9	10.0	84%
33	5.9	3.4	58%
34	16.5	12.8	78%
35	26.3	18.4	70%
36	12.1	8.4	69%
Total			
40	831.7	611.8	74%

County Road Map Overview



Legend

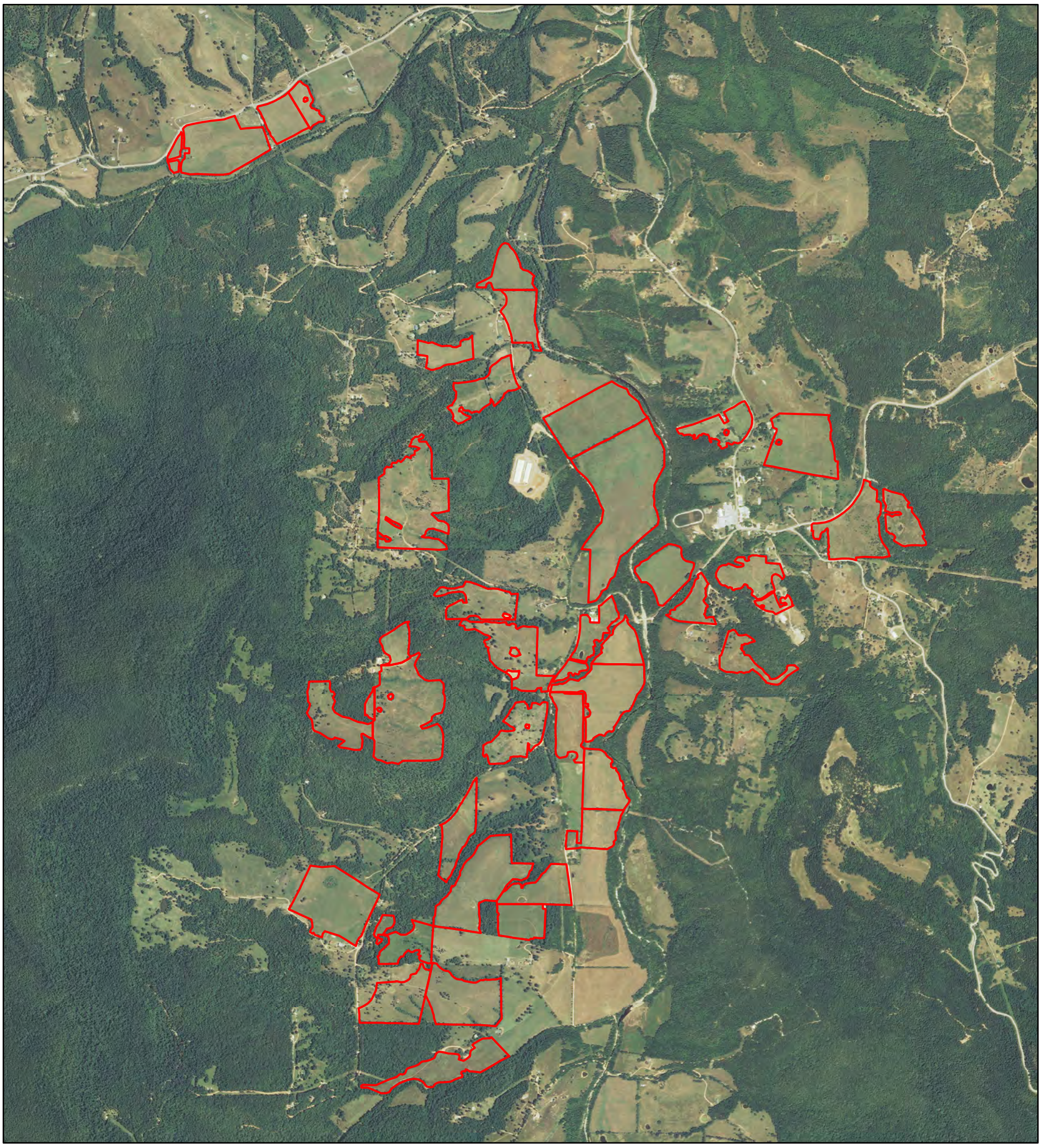
road_tanw_l_ar101

Correct Field Boundaries

1,800 0 1,800 3,600 5,400 7,200 Feet

N

Correct Field Boundaries



Legend

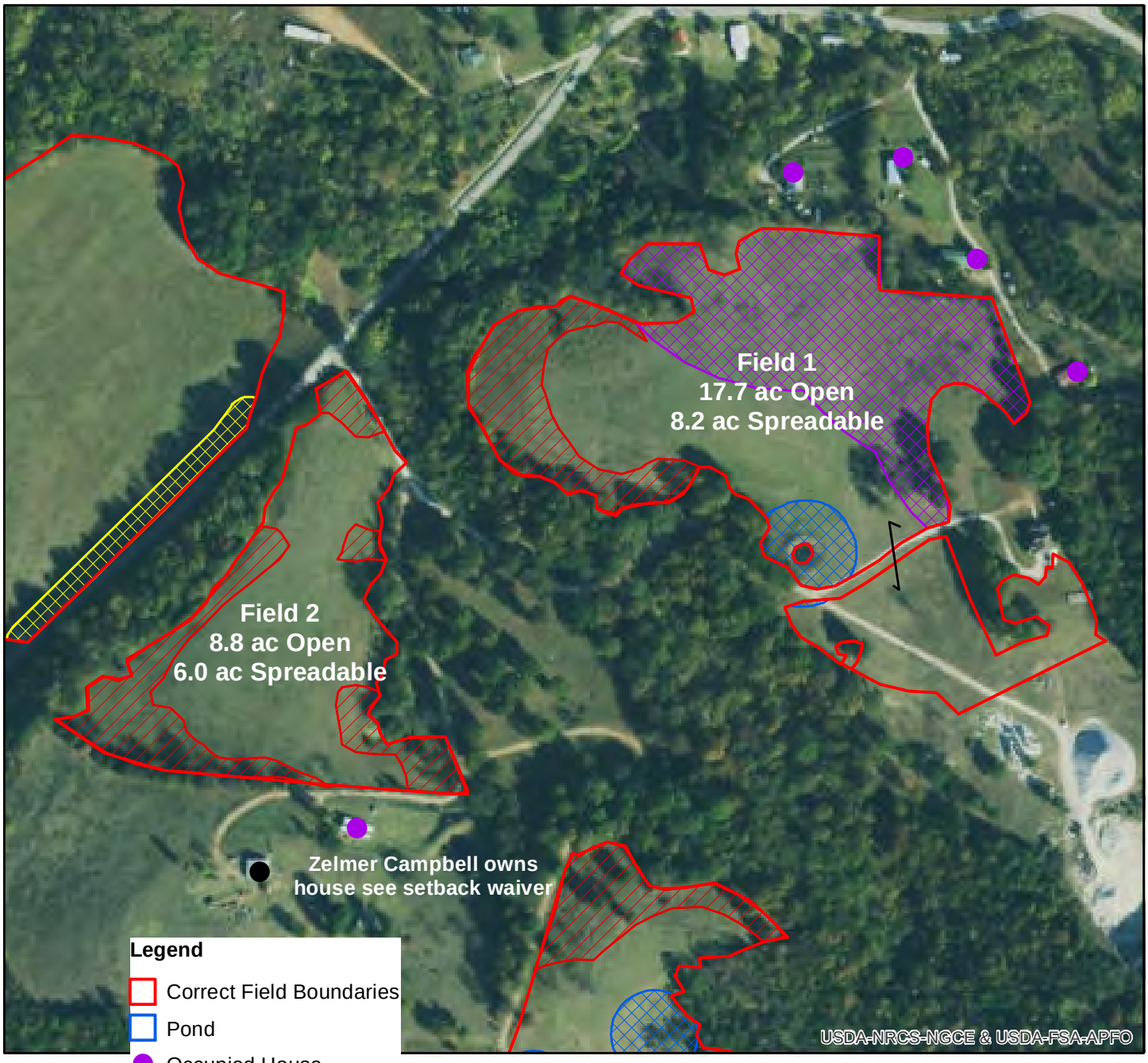
Correct Field Boundaries

1,800 0 1,800 3,600 5,400 7,200

Feet

N

Buffered Field Map
Field 1 and 2
Jason Henson
T15N, R20W, S25
Mt. Judea Quad



Legend

- Correct Field Boundaries
- Pond
- Occupied House
- Unoccupied House
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- Steep Slope Buffer
- NAIP

200 0 200 400 600 800 Feet

N

Buffered Field Map
Field 4
Jason Henson
T15N, R20W, S36
Mt. Judea Quad



Legend

- Correct Field Boundaries
- Pond
- Occupied House
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- Steep Slope Buffer

140 0 140 280 420 560 Feet

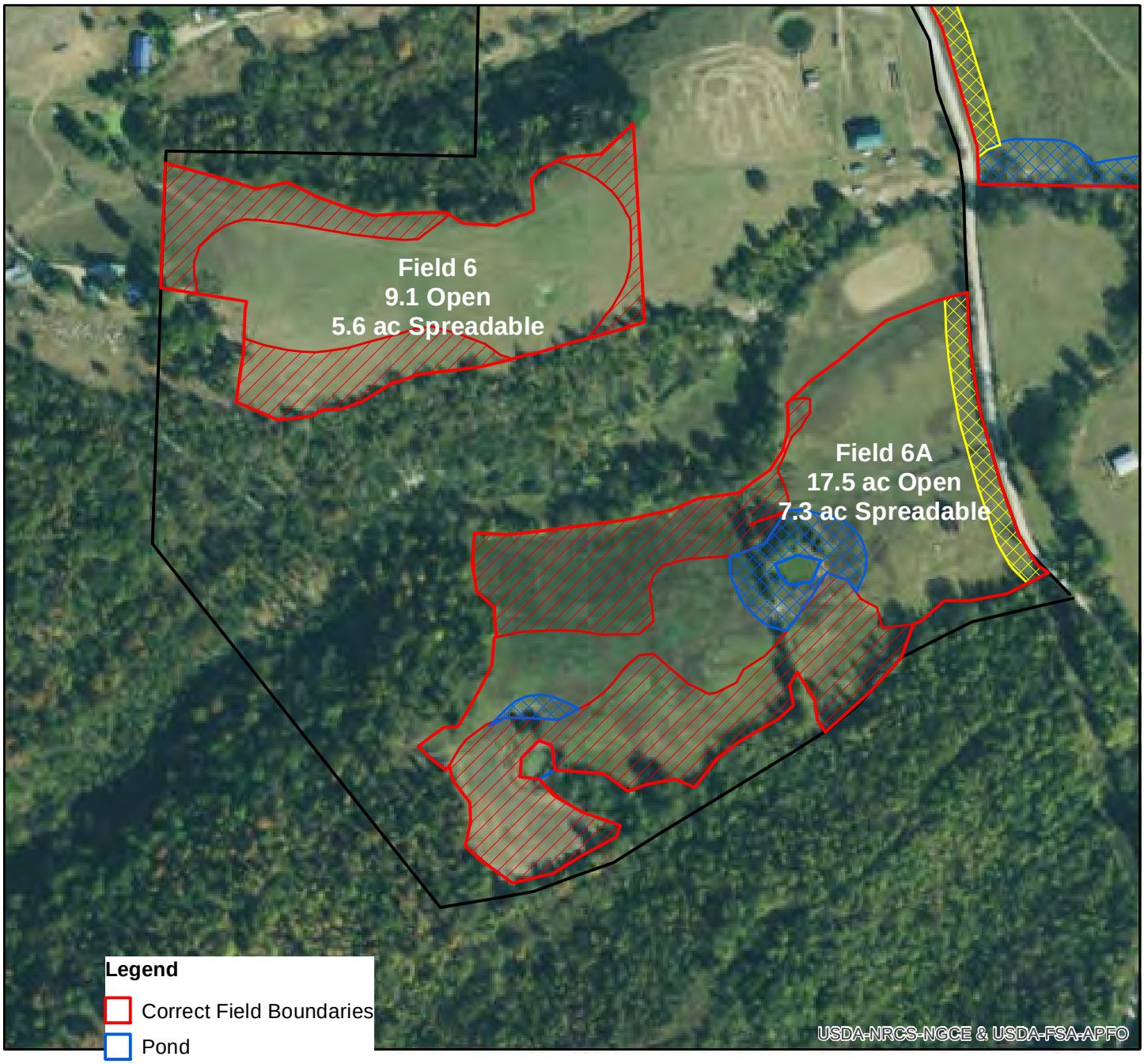
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N

Buffered Field Map
Field 5
Louetta/Glen Ricketts
T15N, R20W, S23
Mt. Judea Quad



Buffered Field Map
Field 6 Louetta/Glen Ricketts
Field 6A Shawn Ricketts
T15N, R20W, S26
Mt. Judea Quad



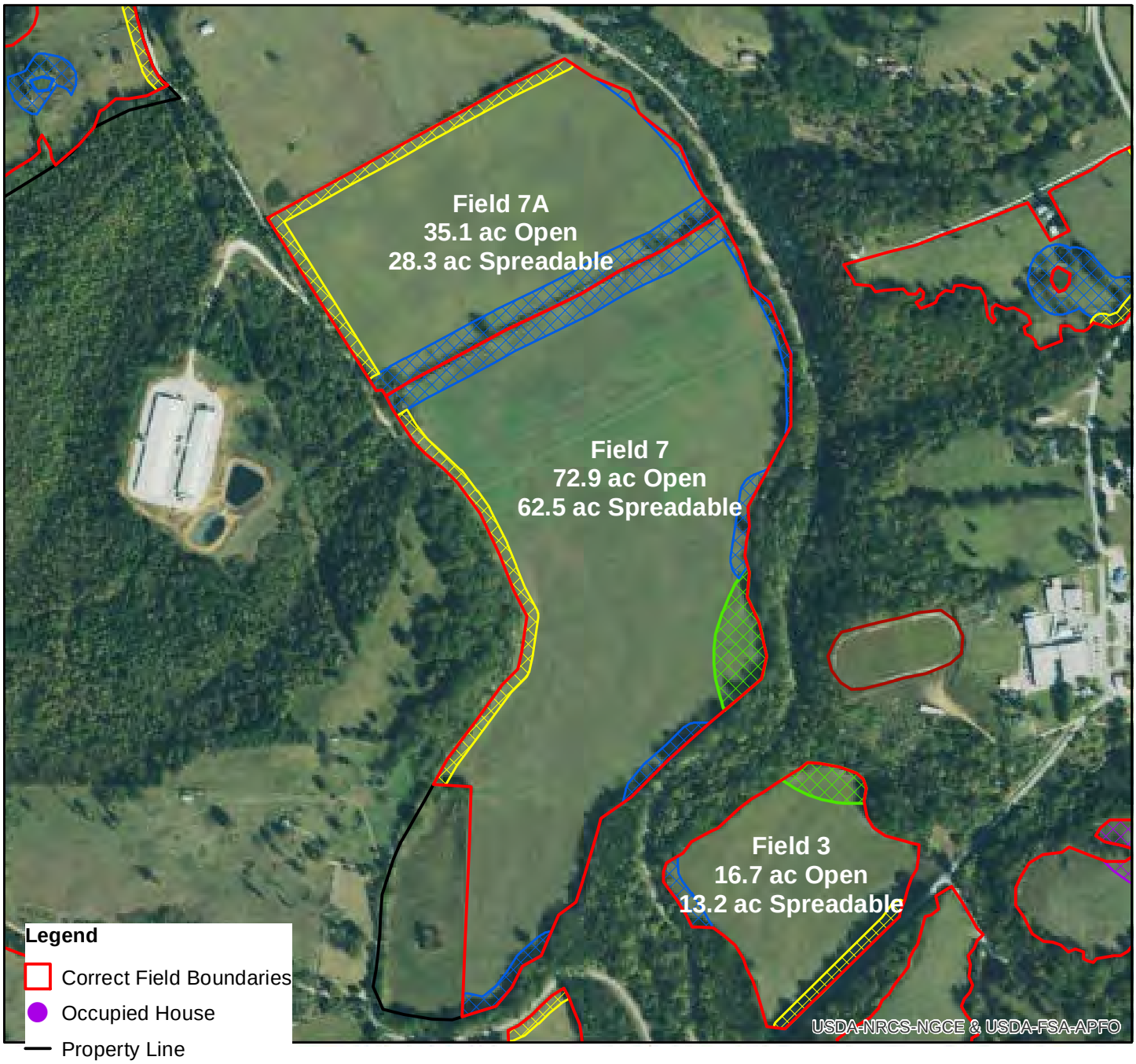
Legend

- Correct Field Boundaries
- Pond
- Unoccupied House
- Property Line
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- Steep Slope Buffer
- NAIP

190 0 190 380 570 760 Feet

N

Buffered Field Map
Field 7 and 7A
E.G. Campbell
Field 3 Charles Campbell
T15N, R20W, S25 and S26
Mt. Judea Quad



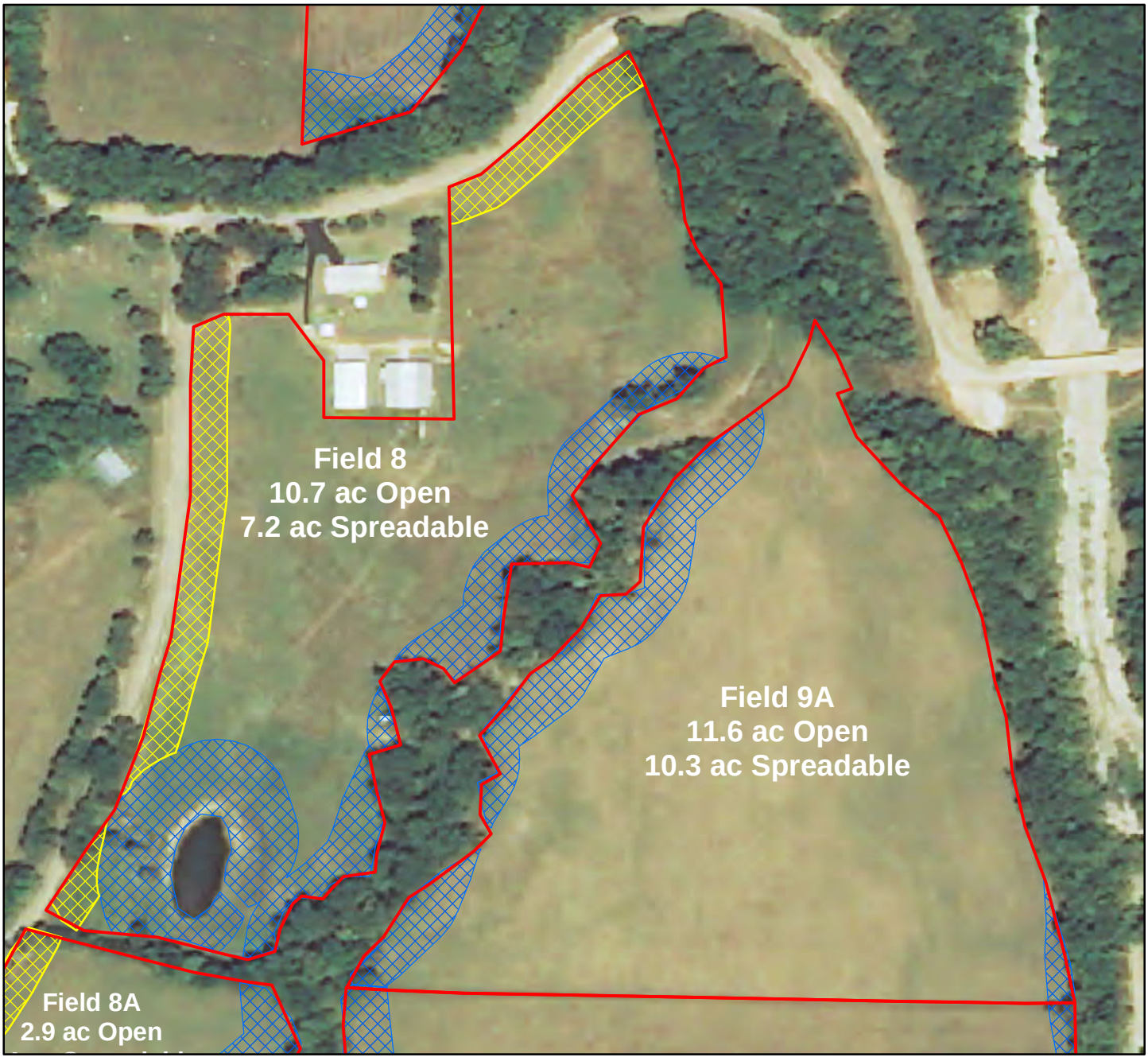
Legend

- Correct Field Boundaries
- Occupied House
- Property Line
- Pond
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- Track Line
- Track Line 500 Ft Buffer
- NAIP

380 0 380 760 1,140 1,520
Feet

N

Buffered Field Map
Charles Campbell
Fields 8 and 9A
T15N, R20W, S26 & S35
Mt. Judea Quad



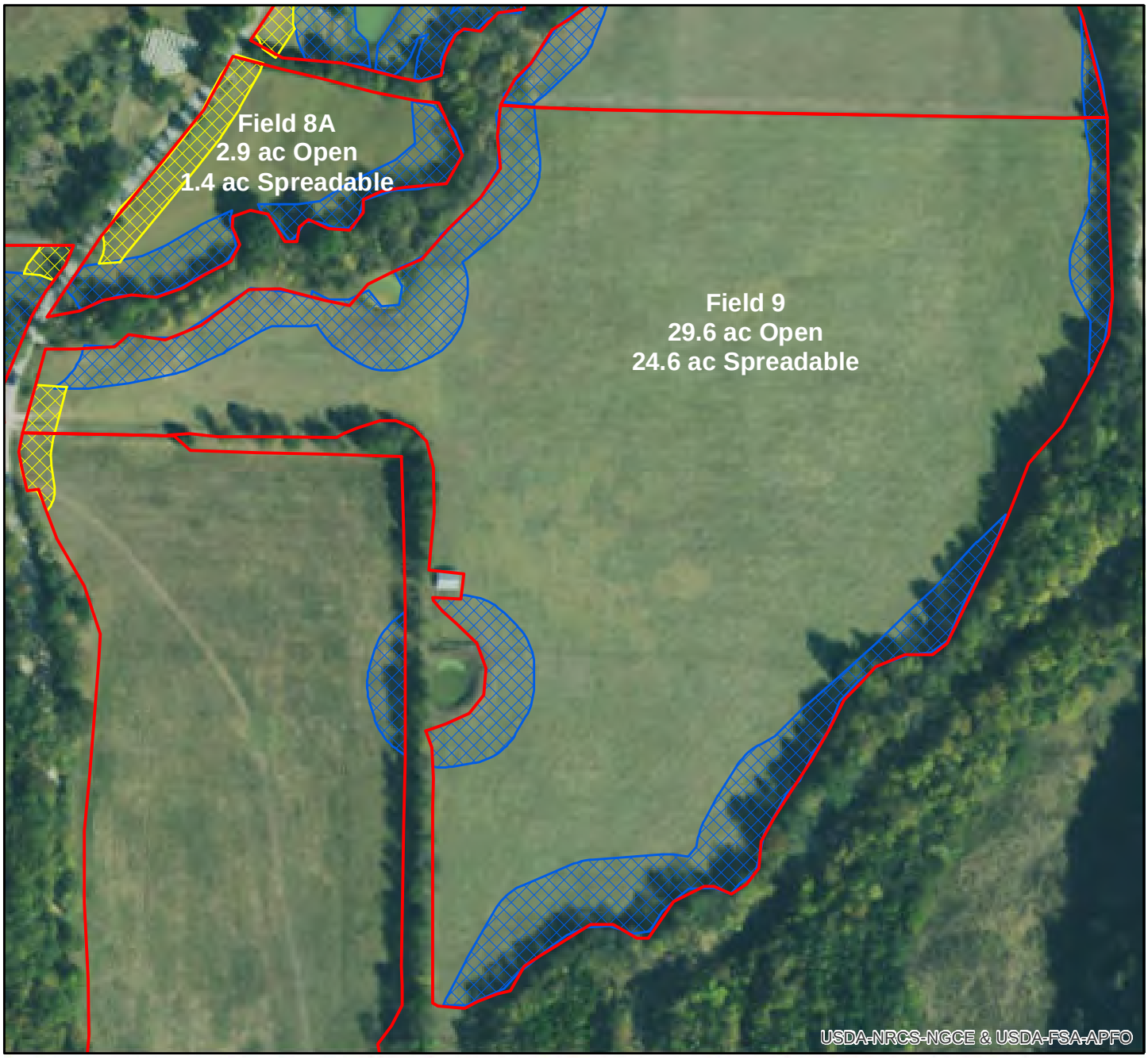
Legend

- Correct Field Boundaries
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- Steep Slope buffer

120 0 120 240 360 480 Feet

N

Buffered Field Map
Charles Campbell
Fields 8A and 9
T15N, R20W, S35
Mt. Judea Quad



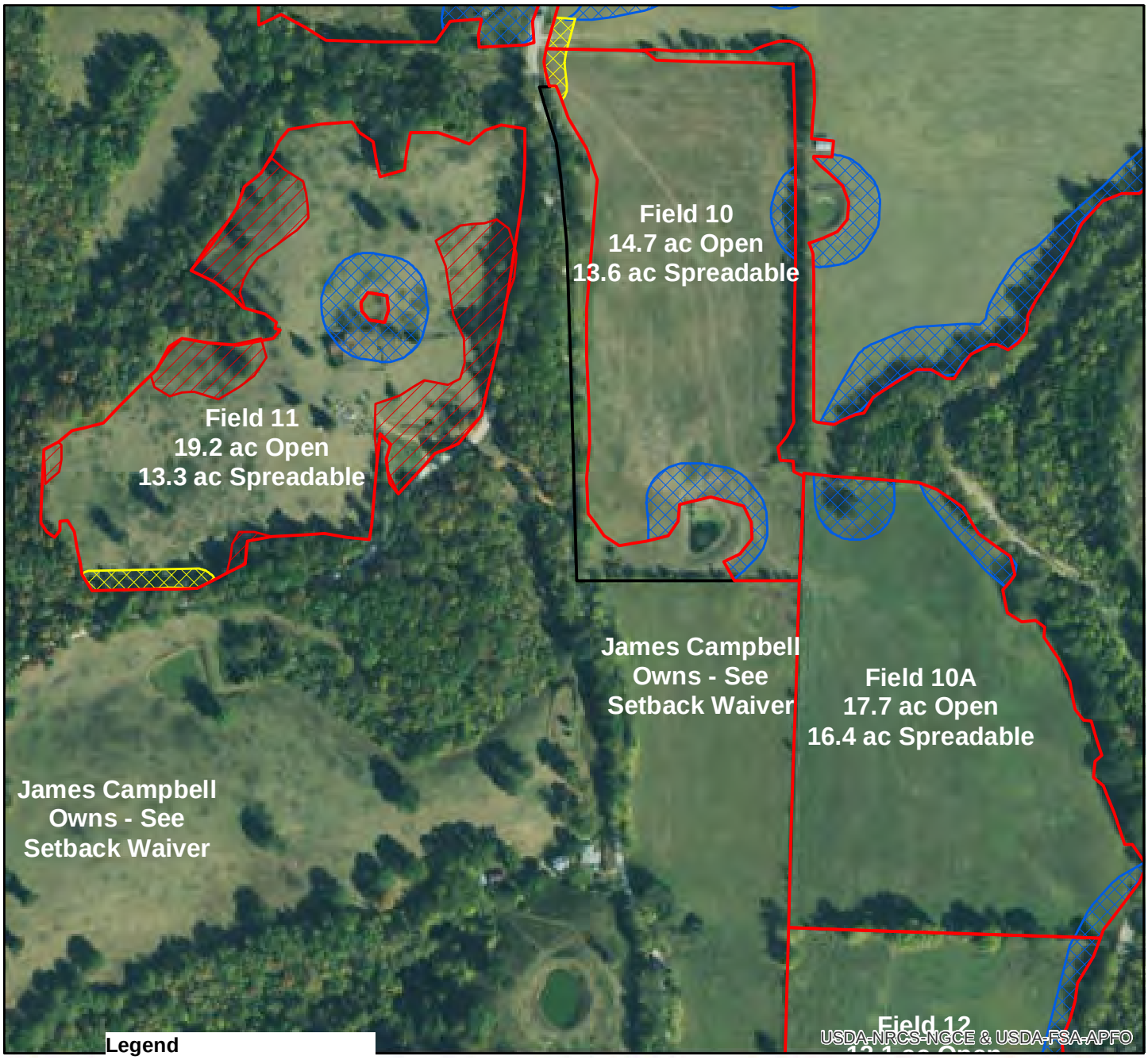
Legend

- Correct Field Boundaries
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- Steep Slope Buffer
- NAIP

140 0 140 280 420 560 Feet
10

N

Buffered Field Map
Fields 10 and 11 Fayma Dickey
Field 10A Billy F. Cheatham
T15N, R20W, S35
Mt. Judea Quad



Legend

- Correct Field Boundaries
- Property Line
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- Steep Slope Buffer
- NAIP

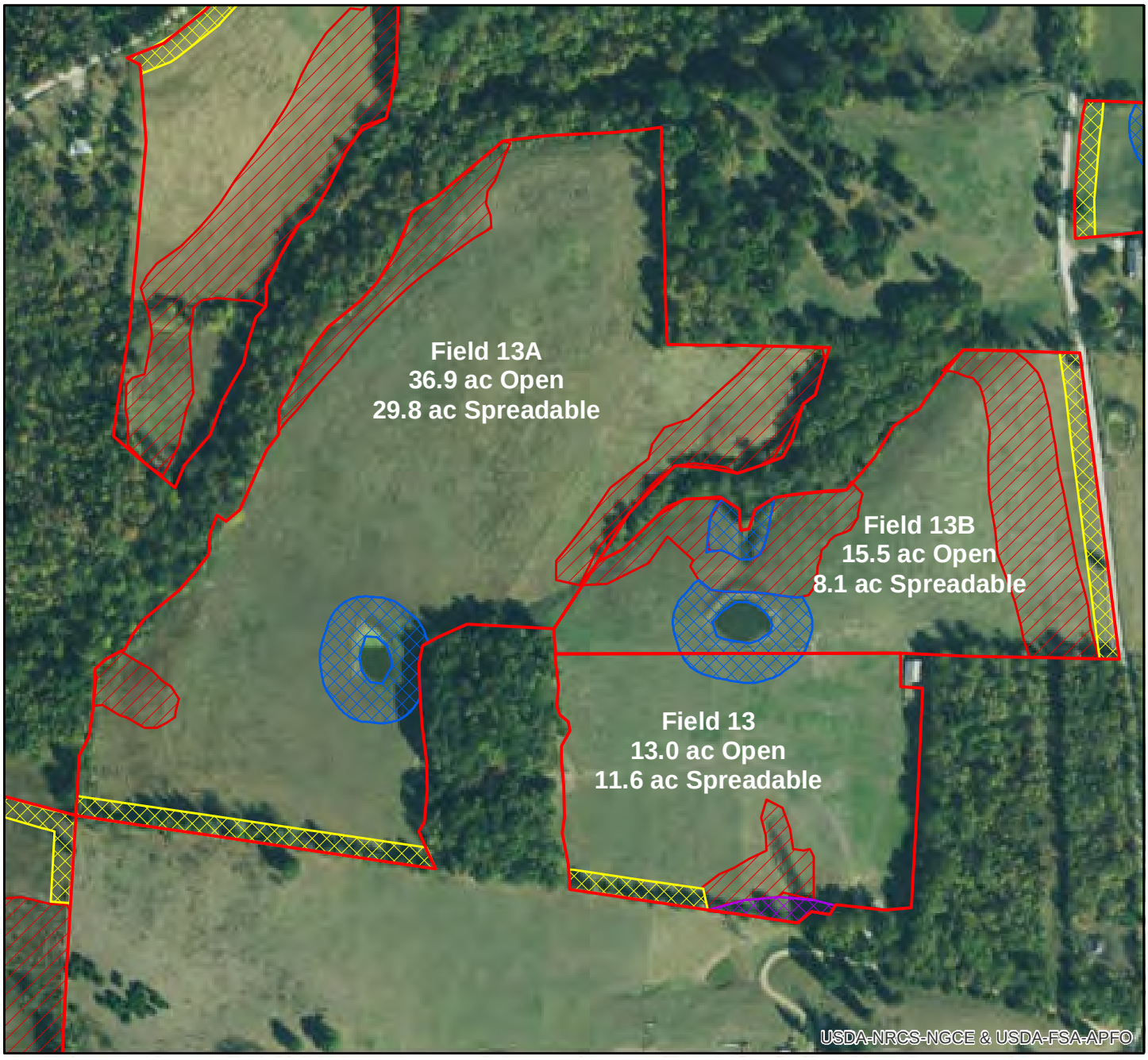
220 0 220 440 660 880 Feet

N

Buffered Field Map
Robert Flud
Field 12
T15N, R20W, S35
Mt. Judea Quad



Buffered Field Map
Fields 13, 13A, 13B
Charles Campbell
T15N, R20W, S35
T14N, R20W, S2
Mt. Judea Quad



Legend

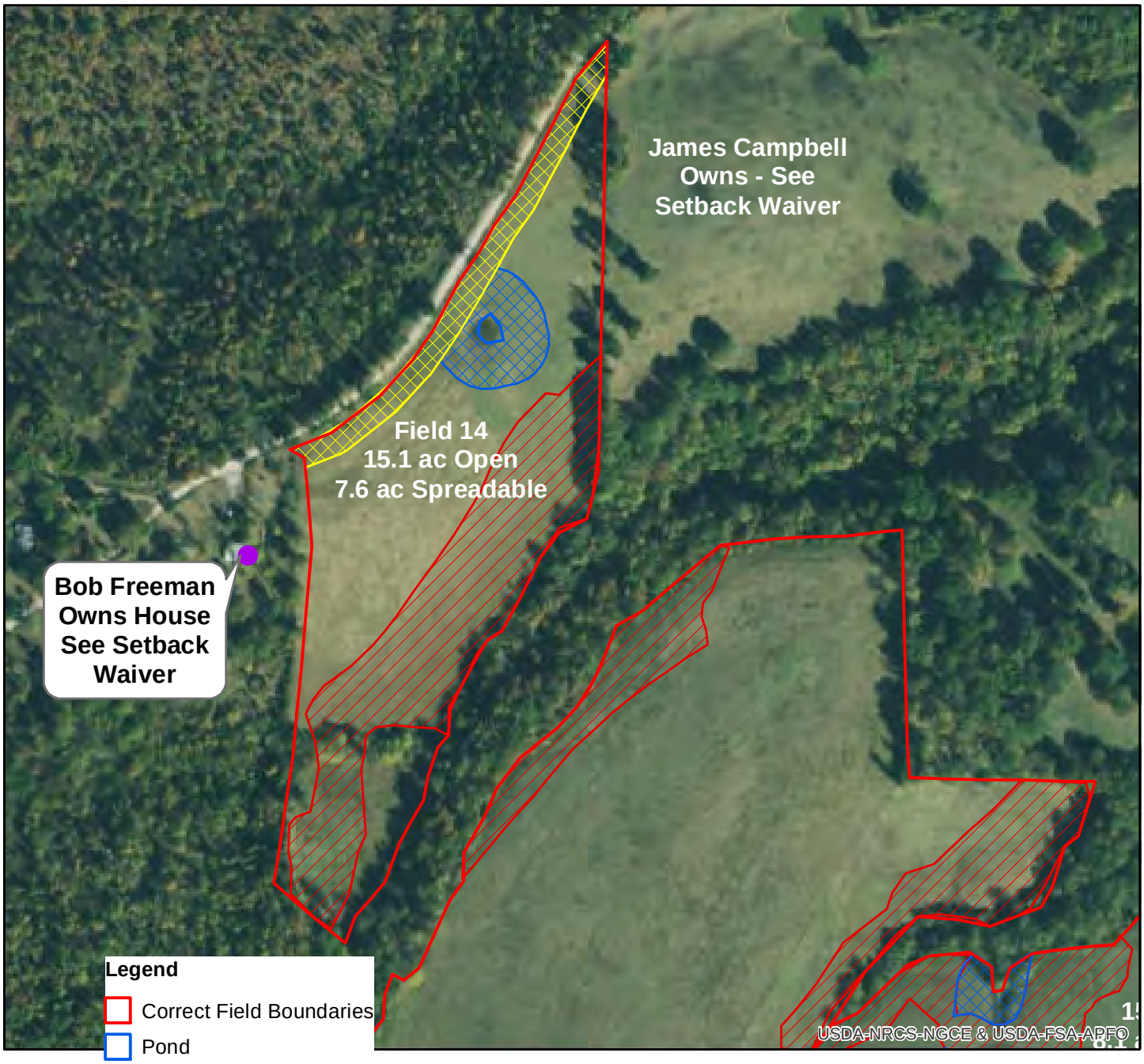
- Correct Field Boundaries
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- Steep Slope Buffer
- NAIP

220 0 220 440 660 880 Feet

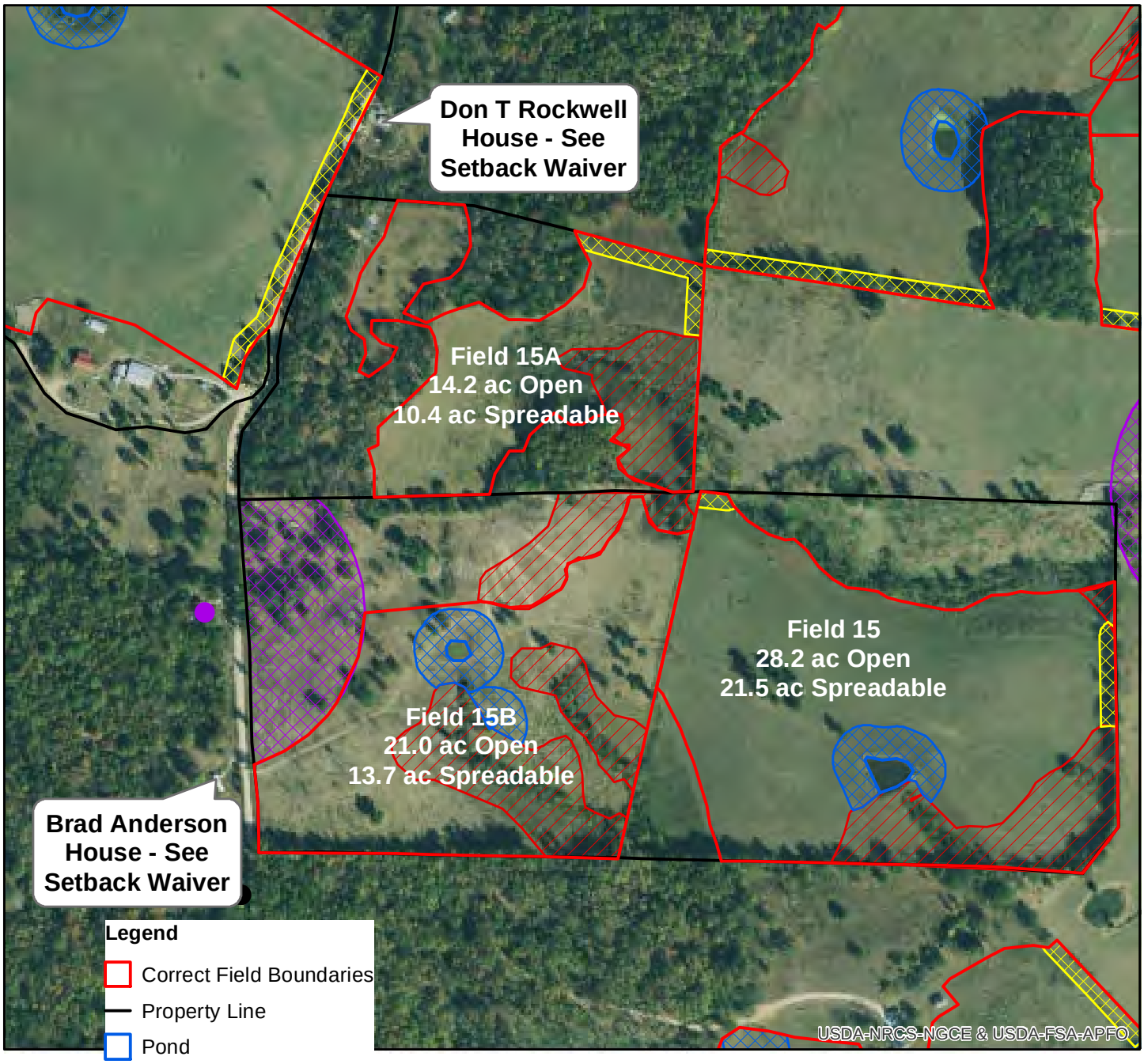
13

N

Buffered Field Map
Field 14
Charles Campbell
T15N, R20W, S35
Mt. Judea Quad



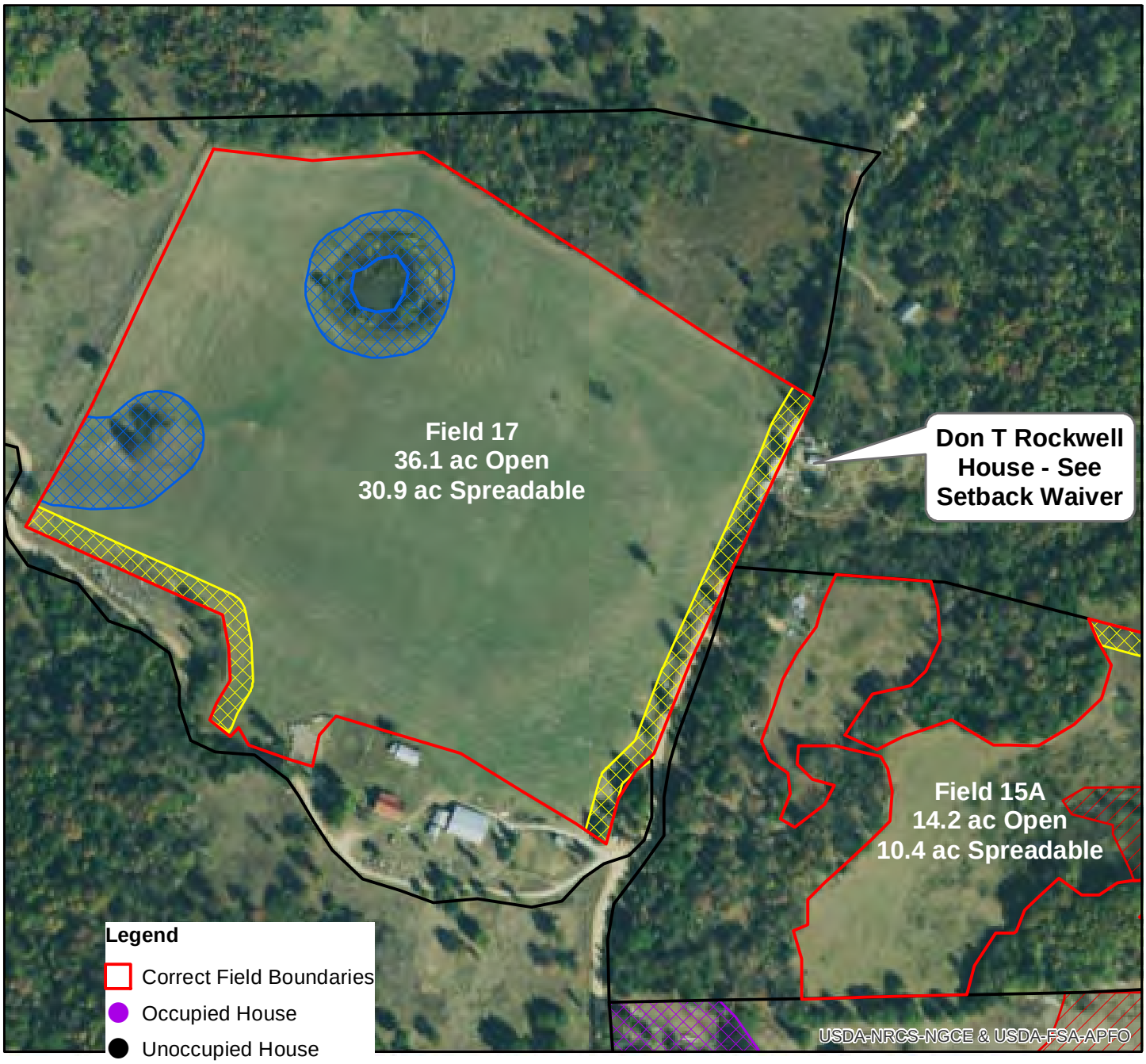
Buffered Field Map
Fields 15, 15A, 15B
Clayel Criner
T14N, R20W, S2
Mt. Judea Quad



Buffered Field Map
Field 16
Barbara Hefley
T14N, R20W, S2
Mt. Judea Quad



Buffered Field Map
Field 17
Jason Criner
T15N, R20W, S34 & 35
T14N, R20W, S2 & 3
Mt. Judea Quad



Legend

- Correct Field Boundaries
- Occupied House
- Unoccupied House
- Pond
- Property Line
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- Steep Slope Buffer
- NAIP

190 0 190 380 570 760 Feet

17

N

Buffered Field Map
Field 18
Murl Bryant
T15N, R20W, S25
Mt. Judea Quad



Legend

- Pond
- Correct Field Boundaries
- Occupied House
- Unoccupied House
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- Steep Slope Buffer
- NAIP

140 0 140 280 420 560 Feet

18

N

Buffered Field Map
Field 19
Murl Bryant
T15N, R20W, S25
Mt. Judea Quad



Legend

- Pond
- Correct Field Boundaries
- Occupied House
- Unoccupied House
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- Steep Slope Buffer
- NAIP

140 0 140 280 420 560 Feet

19

N

Buffered Field Map
Field 20
Rondal Campbell
T15N, R20W, S35
Mt. Judea Quad



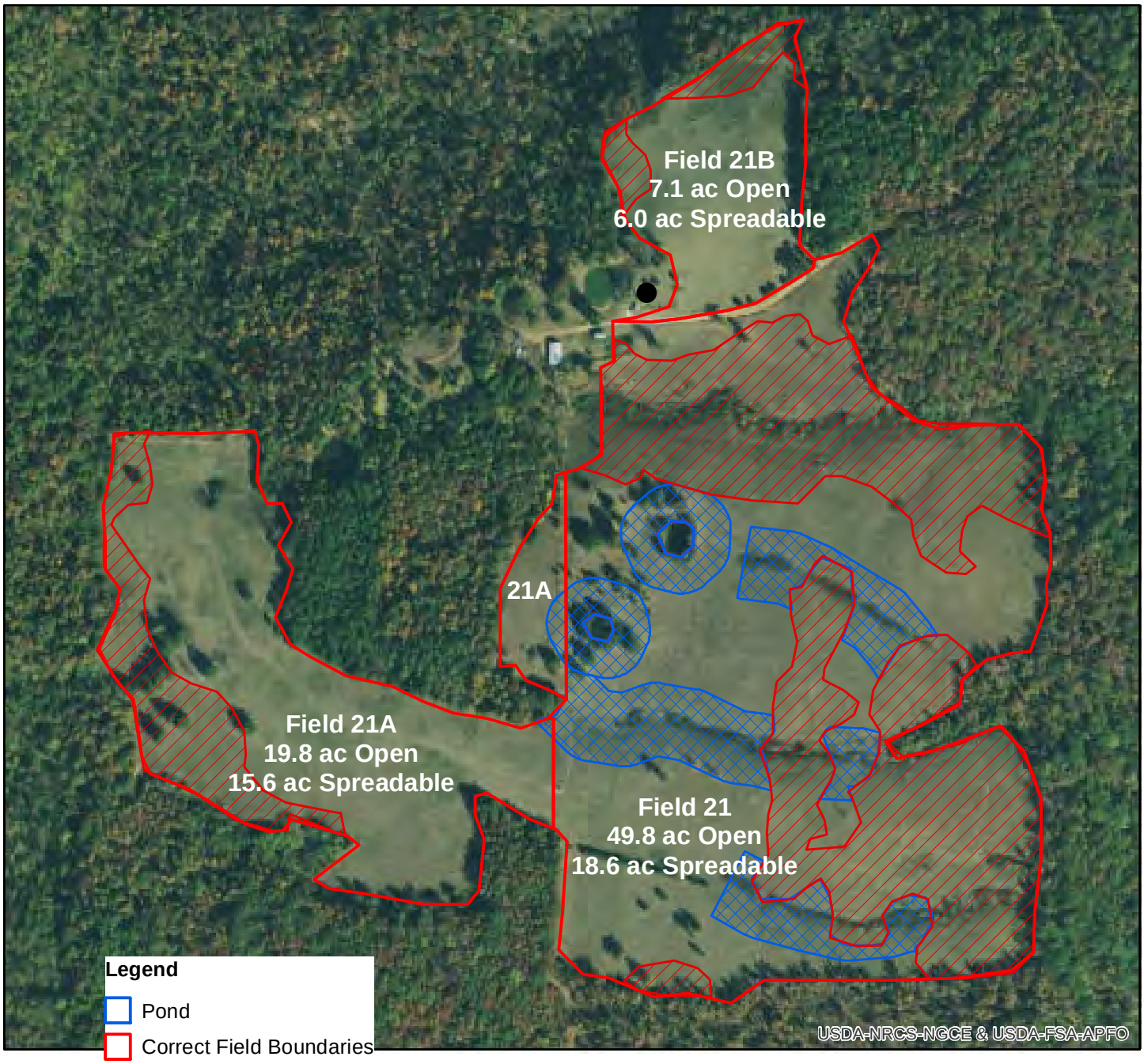
Legend

- Pond
- Correct Field Boundaries
- Occupied House
- Unoccupied House
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- Steep Slope Buffer
- NAIP

140 0 140 280 420 560 Feet
20

N

Buffered Field Map
Fields 21, 21A, 21B
Rondal Campbell
T15N, R20W, S34 and S35
Mt. Judea Quad



Legend

- Pond
- Correct Field Boundaries
- Occupied House
- Unoccupied House
- Steep Slope Buffer
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- NAIP

240 0 240 480 720 960 Feet

21

N

Buffered Field Map
Field 22
Kelis Campbell
T15N, R20W, S26
Mt. Judea Quad



Legend

- Pond
- Correct Field Boundaries
- Occupied House
- Unoccupied House
- Steep Slope Buffer
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- NAIP

200 0 200 400 600 800 Feet

N

Buffered Field Map
Greg Grice
Field 23
T15N, R20W, S22
Mt. Judea Quad



Buffered Field Map
Field 24
Donald Haddock
T15N, R20W, S23
Mt. Judea Quad



Legend

- Correct Field Boundaries
- Unoccupied House
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- Steep Slope Buffer

90 0 90 180 270 360
Feet

24

N

Buffered Field Map
Field 32 & 33
Howard Criner
T15N, R20W, S22
Mt. Judea Quad



Legend

- Pond
- Correct Field Boundaries
- Occupied House
- Unoccupied House
- Steep Slope Buffer
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- NAIP

120 0 120 240 360 480 Feet
25

N

Buffered Field Map
Rondal Campbell
Field 34
T15N, R20W, S26
Mt. Judea Quad



Legend

- Pond
- Correct Field Boundaries
- Occupied House
- Unoccupied House
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- Steep Slope Buffer
- NAIP

140 0 140 280 420 560 Feet

N

Buffered Field Map
Fields 35 and 36
C & H Hog Farms, Inc.
T15N, R20W, S25
Mt. Judea Quad



Legend

- Correct Field Boundaries
- Pond
- Occupied House
- Unoccupied House
- 50 Ft Buffer
- 100 Ft Buffer
- 500 Ft Buffer
- Steep Slope Buffer
- NAIP

190 0 190 380 570 760 Feet

N

Assessment of Land Application Sites
Appendix F

ASSESSMENT OF LAND APPLICATION SITES
REFERENCE AWMFH 651.0504 (a)-(n) TABLE 5-3

Field Number	Taken from Regulation 5 NMP
Map unit symbol	Soil survey data/ map unit data
Predominant soil	Soil survey data/ map unit data taken from field delineations (Regulation 5 NMP)
Available Water Supply (inches)	Convert cm to inches. Cm/2.54 = inches. Soil survey data from map unit components used. The agricultural waste management handbook requests AWS data, despite the fact that Available water capacity is listed (incorrectly). For the available water supply, when a weighted average of all component values is computed, percent composition is the weighting factor
Bulk Density (g/cc)	Weighted average from upper 6 inches of soil map unit components
CEC (meq/100g)	Direct surface measurement by field from U of A Extension Service soil test results, Regulation 5 NMP. (CEC) are milliequivalents per 100 g (meq/100 g) or centimoles per kg (cmolc/kg)
Depth Bedrock (in) (Depth to Any Restrictive Layer)	Convert Cm to inches. Cm/2.54 = inches. Weighted average of soil survey component depth to bed rock
Water Table Depth (in) (Depth to Water Table)	Soil survey data using minimum/max value for all components in a soil map unit
Flooding (Flooding Frequency Class)	From soil survey map units
Stoniness (% by volume) % Course fragments 3-10 inches by volume	Weighted average of horizons and components from soil survey data
Stoniness (% by volume) % Coarse fragments> 10" by volume	Weighted average of horizons and components from soil survey data
Hydrologic soil group (intake)	Soil survey data from dominant condition
Permeability (inches/hour) (ksat)	The most limiting average value from the component or components was used from soil survey data

pH	Direct surface measurement by field from U of A Extension Service soil test results, Regulation 5 NMP.
Ponding (Ponding Frequency Class)	From soil survey component/map unit data
Salinity(mmhos/cm)(EC) (Electrical Conductivity)	EC/Salinity (mmhos/cm)= (decisiemens/m); From soil survey data
Slope %	From soil survey component/map unit data
SAR (Sodium Adsorption Ratio)	Soil survey data from dominant condition

Field Number	Map Unit Symbol	Predominant Soil	Available Water Supply (inches)	Limitation	Bulk Density (g/cc)	Limitation
1	42	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
2	43	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
3	48	Razort	25.60 cm/10.07 in	Slight	1.48	Slight
4	43	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
5	48	Razort	25.60 cm/10.07 in	Slight	1.48	Slight
6	42	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
6A	42	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
7	48	Razort	25.60 cm/10.07 in	Slight	1.48	Slight
7A	48	Razort	25.60 cm/10.07 in	Slight	1.48	Slight
8	51	Spadra	22.56 cm/8.88 in	Slight	1.45	Slight
8A	50	Spadra	22.56 cm/8.88 in	Slight	1.45	Slight
9	50	Spadra	22.56 cm/8.88 in	Slight	1.45	Slight
9A	50	Spadra	22.56 cm/8.88 in	Slight	1.45	Slight
10	51	Spadra	22.56 cm/8.88 in	Slight	1.45	Slight
10A	50	Spadra	22.56 cm/8.88 in	Slight	1.45	Slight
11	43	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
12	50	Spadra	22.56 cm/8.88 in	Slight	1.45	Slight
13	43	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
13A	43	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
13B	43	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
14	43	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
15	43	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
15A	2	Arkana-Moko	6.53 cm/2.57 in	Severe	1.40	Slight
15B	43	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
16	50	Spadra	22.56 cm/8.88 in	Slight	1.45	Slight
17	1	Arkana	8.40 cm/ 3.30 in	Moderate	1.38	Slight
18	42	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
19	42	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
20	43	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
21	13	Enders	18.65 cm/7.34 in	Slight	1.38	Slight
21A	13	Enders	18.65 cm/7.34 in	Slight	1.38	Slight
21B	11	Enders	18.65 cm/7.34 in	Slight	1.38	Slight
22	13	Enders	18.65 cm/7.34 in	Slight	1.38	Slight
23	48	Razort	25.60 cm/10.07 in	Slight	1.48	Slight
24	48	Razort	25.60 cm/10.07 in	Slight	1.48	Slight
32	48	Razort	25.60 cm/10.07 in	Slight	1.48	Slight
33	48	Razort	25.60 cm/10.07 in	Slight	1.48	Slight
34	43	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
35	42	Noark	15.47 cm/6.09 in	Slight	1.45	Slight
36	15	Enders-Leesburg	19.68 cm/7.74 in	Slight	1.39	Slight

Field Number	Map Unit Symbol	CEC (meq/100g)	Limitation	Depth Bedrock (in)	Limitation
1	42	28.25	Slight	>200 cm/>78 in	Slight
2	43	13.42	Moderate	>200 cm/>78 in	Slight
3	48	13.86	Moderate	>200 cm/>78 in	Slight
4	43	15.64	Slight	>200 cm/>78 in	Slight
5	48	16	Slight	>200 cm/>78 in	Slight
6	42	8	Moderate	>200 cm/>78 in	Slight
6A	42	12	Moderate	>200 cm/>78 in	Slight
7	48	10.24	Moderate	>200 cm/>78 in	Slight
7A	48	9	Moderate	>200 cm/>78 in	Slight
8	51	14.57	Moderate	>200 cm/>78 in	Slight
8A	50	12.45	Moderate	>200 cm/>78 in	Slight
9	50	18.75	Slight	>200 cm/>78 in	Slight
9A	50	16.13	Slight	>200 cm/>78 in	Slight
10	51	14.45	Moderate	>200 cm/>78 in	Slight
10A	50	12.91	Moderate	>200 cm/>78 in	Slight
11	43	10.64	Moderate	>200 cm/>78 in	Slight
12	50	12	Moderate	>200 cm/>78 in	Slight
13	43	13.49	Moderate	>200 cm/>78 in	Slight
13A	43	14.41	Moderate	>200 cm/>78 in	Slight
13B	43	13.31	Moderate	>200 cm/>78 in	Slight
14	43	10.14	Moderate	>200 cm/>78 in	Slight
15	43	10.28	Moderate	>200 cm/>78 in	Slight
15A	2	11	Moderate	59 cm/ 23 in	Moderate
15B	43	13.86	Moderate	>200 cm/>78 in	slight
16	50	12.91	Moderate	>200 cm/>78 in	Slight
17	1	17	Slight	77 cm/ 30 in	Moderate
18	42	12	Moderate	>200 cm/>78 in	Slight
19	42	14	Moderate	>200 cm/>78 in	Slight
20	43	12	Moderate	>200 cm/>78 in	Slight
21	13	7	Moderate	137 cm/ 53 in	Slight
21A	13	8	Moderate	137 cm/ 53 in	Slight
21B	11	8	Moderate	137 cm/ 53 in	Slight
22	13	7	Moderate	137 cm/ 53 in	Slight
23	48	8	Moderate	>200 cm/>78 in	Slight
24	48	10	Moderate	>200 cm/>78 in	Slight
32	48	7	Moderate	>200 cm/>78 in	Slight
33	48	14	Moderate	>200 cm/>78 in	Slight
34	43	7	Moderate	>200 cm/>78 in	Slight
35	42	8.43	Moderate	>200 cm/>78 in	Slight
36	15	7.78	Moderate	137 cm/ 53 in	Slight

Field Number	Map Unit Symbol	Water Table Depth (ft)	Limitation	Flooding	Limitation
1	42	>200 cm/78 in/6.5 ft	Slight	None	Slight
2	43	>200 cm/78 in/6.5 ft	Slight	None	Slight
3	48	>200 cm/78 in/6.5 ft	Slight	Occasional	Moderate
4	43	>200 cm/78 in/6.5 ft	Slight	None	Slight
5	48	>200 cm/78 in/6.5 ft	Slight	Occasional	Moderate
6	42	>200 cm/78 in/6.5 ft	Slight	None	Slight
6A	42	>200 cm/78 in/6.5 ft	Slight	None	Slight
7	48	>200 cm/78 in/6.5 ft	Slight	Occasional	Moderate
7A	48	>200 cm/78 in/6.5 ft	Slight	Occasional	Moderate
8	51	>200 cm/78 in/6.5 ft	Slight	None	Slight
8A	50	>200 cm/78 in/6.5 ft	Slight	Occasional	Moderate
9	50	>200 cm/78 in/6.5 ft	Slight	Occasional	Moderate
9A	50	>200 cm/78 in/6.5 ft	Slight	Occasional	Moderate
10	51	>200 cm/78 in/6.5 ft	Slight	None	Slight
10A	50	>200 cm/78 in/6.5 ft	Slight	Occasional	Moderate
11	43	>200 cm/78 in/6.5 ft	Slight	None	Slight
12	50	>200 cm/78 in/6.5 ft	Slight	Occasional	Moderate
13	43	>200 cm/78 in/6.5 ft	Slight	None	Slight
13A	43	>200 cm/78 in/6.5 ft	Slight	None	Slight
13B	43	>200 cm/78 in/6.5 ft	Slight	None	Slight
14	43	>200 cm/78 in/6.5 ft	Slight	None	Slight
15	43	>200 cm/78 in/6.5 ft	Slight	None	Slight
15A	2	>200 cm/78 in/6.5 ft	Slight	None	Slight
15B	43	>200 cm/78 in/6.5 ft	Slight	None	Slight
16	50	>200 cm/78 in/6.5 ft	Slight	Occasional	Moderate
17	1	>200 cm/78 in/6.5 ft	Slight	None	Slight
18	42	>200 cm/78 in/6.5 ft	Slight	None	Slight
19	42	>200 cm/78 in/6.5 ft	Slight	None	Slight
20	43	>200 cm/78 in/6.5 ft	Slight	None	Slight
21	13	>200 cm/78 in/6.5 ft	Slight	None	Slight
21A	13	>200 cm/78 in/6.5 ft	Slight	None	Slight
21B	11	>200 cm/78 in/6.5 ft	Slight	None	Slight
22	13	>200 cm/78 in/6.5 ft	Slight	None	Slight
23	48	>200 cm/78 in/6.5 ft	Slight	Occasional	Moderate
24	48	>200 cm/78 in/6.5 ft	Slight	Occasional	Moderate
32	48	>200 cm/78 in/6.5 ft	Slight	Occasional	Moderate
33	48	>200 cm/78 in/6.5 ft	Slight	Occasional	Moderate
34	43	>200 cm/78 in/6.5 ft	Slight	None	Slight
35	42	>200 cm/78 in/6.5 ft	Slight	None	Slight
36	15	>200 cm/78 in/6.5 ft	Slight	None	Slight

Field Number	Map Unit Symbol	Stoniness (% by volume) % Coarse fragments 3-10" by volume	Limitation	Stoniness (% by volume) % Coarse fragments >10"	Limitation
1	42	4%	Slight	2%	Slight
2	43	4%	Slight	2%	Slight
3	48	0	Slight	0	Slight
4	43	4%	Slight	2%	Slight
5	48	0	Slight	0	Slight
6	42	4%	Slight	2%	Slight
6A	42	4%	Slight	2%	Slight
7	48	0	Slight	0	Slight
7A	48	0	Slight	0	Slight
8	51	0	Slight	0	Slight
8A	50	0	Slight	0	Slight
9	50	0	Slight	0	Slight
9A	50	0	Slight	0	Slight
10	51	0	Slight	0	Slight
10A	50	0	Slight	0	Slight
11	43	4%	Slight	2%	Slight
12	50	0	Slight	0	Slight
13	43	4%	Slight	2%	Slight
13A	43	4%	Slight	2%	Slight
13B	43	4%	Slight	2%	Slight
14	43	4%	Slight	2%	Slight
15	43	4%	Slight	2%	Slight
15A	2	9%	Slight	12%	Severe
15B	43	4%	Slight	2%	Slight
16	50	0	Slight	0	Slight
17	1	7%	Slight	1%	Slight
18	42	4%	Slight	2%	Slight
19	42	4%	Slight	2%	Slight
20	43	4%	Slight	2%	Slight
21	13	2%	Slight	1%	Slight
21A	13	2%	Slight	1%	Slight
21B	11	1%	Slight	1%	Slight
22	13	2%	Slight	1%	Slight
23	48	0	Slight	0	Slight
24	48	0	Slight	0	Slight
32	48	0	Slight	0	Slight
33	48	0	Slight	0	Slight
34	43	4%	Slight	2%	Slight
35	42	4%	Slight	2%	Slight
36	15	3%	Slight	1%	Slight

Field Number	Map Unit Symbol	Hydrologic Soil Group (Intake)	Limitation	Permeability (inches/hour)	Limitation
1	42	B	Slight	1.3	Slight
2	43	B	Slight	1.3	Slight
3	48	B	Slight	1.3	Slight
4	43	B	Slight	1.3	Slight
5	48	B	Slight	1.3	Slight
6	42	B	Slight	1.3	Slight
6A	42	B	Slight	1.3	Slight
7	48	B	Slight	1.3	Slight
7A	48	B	Slight	1.3	Slight
8	51	B	Slight	1.3	Slight
8A	50	B	Slight	1.3	Slight
9	50	B	Slight	1.3	Slight
9A	50	B	Slight	1.3	Slight
10	51	B	Slight	1.3	Slight
10A	50	B	Slight	1.3	Slight
11	43	B	Slight	1.3	Slight
12	50	B	Slight	1.3	Slight
13	43	B	Slight	1.3	Slight
13A	43	B	Slight	1.3	Slight
13B	43	B	Slight	1.3	Slight
14	43	B	Slight	1.3	Slight
15	43	B	Slight	1.3	Slight
15A	2	D	Moderate	0.03	Severe
15B	43	B	Slight	1.3	Slight
16	50	B	Slight	1.3	Slight
17	1	D	Moderate	0.03	Severe
18	42	B	Slight	1.3	Slight
19	42	B	Slight	1.3	Slight
20	43	B	Slight	1.3	Slight
21	13	D	Moderate	0.03	Severe
21A	13	D	Moderate	0.03	Severe
21B	11	D	Moderate	0.03	Severe
22	13	D	Moderate	0.03	Severe
23	48	B	Slight	1.3	Slight
24	48	B	Slight	1.3	Slight
32	48	B	Slight	1.3	Slight
33	48	B	Slight	1.3	Slight
34	43	B	Slight	1.3	Slight
35	42	B	Slight	1.3	Slight
36	15	D	Moderate	0.03	Severe

Field Number	Map Unit Symbol	pH	Limitation	Ponding	Limitation
1	42	7.1	Slight	None	None
2	43	6.2	Slight	None	None
3	48	6.7	Slight	None	None
4	43	5.6	Moderate	None	None
5	48	6.5	Slight	None	None
6	42	5.9	Moderate	None	None
6A	42	5.8	Moderate	None	None
7	48	5.4	Moderate	None	None
7A	48	5.5	Moderate	None	None
8	51	6.5	Slight	None	None
8A	50	6.2	Slight	None	None
9	50	6.9	Slight	None	None
9A	50	6.6	Slight	None	None
10	51	5.3	Moderate	None	None
10A	50	5.7	Moderate	None	None
11	43	5.4	Moderate	None	None
12	50	5.8	Moderate	None	None
13	43	6.4	Slight	None	None
13A	43	6.3	Slight	None	None
13B	43	6.6	Slight	None	None
14	43	5.8	Moderate	None	None
15	43	5.7	Moderate	None	None
15A	2	5.6	Moderate	None	None
15B	43	5.9	Moderate	None	None
16	50	5.5	Moderate	None	None
17	1	6.5	Slight	None	None
18	42	6.5	Slight	None	None
19	42	6.8	Slight	None	None
20	43	6.5	Slight	None	None
21	13	6.2	Slight	None	None
21A	13	6.3	Slight	None	None
21B	11	6.3	Slight	None	None
22	13	5.6	Moderate	None	None
23	48	5.8	Moderate	None	None
24	48	5.4	Moderate	None	None
32	48	5.9	Moderate	None	None
33	48	6.0	Slight	None	None
34	43	5.9	Moderate	None	None
35	42	5.6	Moderate	None	None
36	15	5.4	Moderate	None	None

Field Number	Map Unit Symbol	EC/Salinity (mmhos/cm)= (decisiemens/m)	Limitation	Slope % (Avg)	Limitation
1	42	0.0	Slight	3-8% (5%)	Slight
2	43	0.0	Slight	8-20% (14%)	Moderate
3	48	0.0	Slight	0-3% (2%)	Slight
4	43	0.0	Slight	8-20% (14%)	Moderate
5	48	0.0	Slight	0-3% (2%)	Slight
6	42	0.0	Slight	3-8% (5%)	Slight
6A	42	0.0	Slight	3-8% (5%)	Slight
7	48	0.0	Slight	0-3% (2%)	Slight
7A	48	0.0	Slight	0-3% (2%)	Slight
8	51	0.0	Slight	2-5% (2.5%)	Slight
8A	50	0.0	Slight	0-3% (2%)	Slight
9	50	0.0	Slight	0-3% (2%)	Slight
9A	50	0.0	Slight	0-3% (2%)	Slight
10	51	0.0	Slight	2-5% (2.5%)	Slight
10A	50	0.0	Slight	0-3% (2%)	Slight
11	43	0.0	Slight	8-20% (14%)	Moderate
12	50	0.0	Slight	0-3% (2%)	Slight
13	43	0.0	Slight	8-20% (14%)	Moderate
13A	43	0.0	Slight	8-20% (14%)	Moderate
13B	43	0.0	Slight	8-20% (14%)	Moderate
14	43	0.0	Slight	8-20% (14%)	Moderate
15	43	0.0	Slight	8-20% (14%)	Moderate
15A	2	0.0	Slight	8-20% (14%)	Moderate
15B	43	0.0	Slight	8-20% (14%)	Moderate
16	50	0.0	Slight	0-3% (2%)	Slight
17	1	0.0	Slight	3-8% (5%)	Slight
18	42	0.0	Slight	3-8% (5%)	Slight
19	42	0.0	Slight	3-8% (5%)	Slight
20	43	0.0	Slight	8-20% (14%)	Moderate
21	13	0.0	Slight	3-20% (12%)	Moderate
21A	13	0.0	Slight	3-20% (12%)	Moderate
21B	11	0.0	Slight	3-8% (5%)	Slight
22	13	0.0	Slight	3-20% (12%)	Moderate
23	48	0.0	Slight	0-3% (2%)	Slight
24	48	0.0	Slight	0-3% (2%)	Slight
32	48	0.0	Slight	0-3% (2%)	Slight
33	48	0.0	Slight	0-3% (2%)	Slight
34	43	0.0	Slight	8-20% (14%)	Moderate
35	42	0.0	Slight	3-8% (5%)	Slight
36	15	0.0	Slight	8-20% (14%)	Moderate

Field Number	Map Unit Symbol	SAR	Limitation
1	42	0.0	Slight
2	43	0.0	Slight
3	48	0.0	Slight
4	43	0.0	Slight
5	48	0.0	Slight
6	42	0.0	Slight
6A	42	0.0	Slight
7	48	0.0	Slight
7A	48	0.0	Slight
8	51	0.0	Slight
8A	50	0.0	Slight
9	50	0.0	Slight
9A	50	0.0	Slight
10	51	0.0	Slight
10A	50	0.0	Slight
11	43	0.0	Slight
12	50	0.0	Slight
13	43	0.0	Slight
13A	43	0.0	Slight
13B	43	0.0	Slight
14	43	0.0	Slight
15	43	0.0	Slight
15A	2	0.0	Slight
15B	43	0.0	Slight
16	50	0.0	Slight
17	1	0.0	Slight
18	42	0.0	Slight
19	42	0.0	Slight
20	43	0.0	Slight
21	13	0.0	Slight
21A	13	0.0	Slight
21B	11	0.0	Slight
22	13	0.0	Slight
23	48	0.0	Slight
24	48	0.0	Slight
32	48	0.0	Slight
33	48	0.0	Slight
34	43	0.0	Slight
35	42	0.0	Slight
36	15	0.0	Slight

Available Water Supply, 0 to 150 cm

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
1	Arkana very cherty silt loam, 3 to 8 percent slopes	8.40	—	—
2	Arkana-Moko complex, 8 to 20 percent slopes	6.53	—	—
11	Enders gravelly loam, 3 to 8 percent slopes	18.65	—	—
13	Enders stony loam, 3 to 15 percent slopes	18.65	—	—
15	Enders-Leesburg complex, 8 to 20 percent slopes	19.68	—	—
42	Noark very cherty silt loam, 3 to 8 percent slopes	15.47	—	—
43	Noark very cherty silt loam, 8 to 20 percent slopes	15.47	—	—
48	Razort loam, occasionally flooded	25.60	—	—
50	Spadra loam, occasionally flooded	22.56	—	—
51	Spadra loam, 2 to 5 percent slopes	22.56	—	—
Totals for Area of Interest			**526,959.1**	**100.0%**

Description

Available water supply (AWS) is the total volume of water (in centimeters) that should be available to plants when the soil, inclusive of rock fragments, is at field capacity. It is commonly estimated as the amount of water held between field capacity and the wilting point, with corrections for salinity, rock fragments, and rooting depth. AWS is reported as a single value (in centimeters) of water for the specified depth of the soil. AWS is calculated as the available water capacity times the thickness of each soil horizon to a specified depth.

For each soil layer, available water capacity, used in the computation of AWS, is recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For the derivation of AWS, only the representative value for available water capacity is used.

The available water supply for each map unit component is computed as described above and then aggregated to a single value for the map unit by the process described below.

A map unit typically consists of one or more "components." A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated (e.g., available water supply), the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the process is to derive a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for the map units can be generated. Aggregation is needed because map units rather than components are delineated on the soil maps.

The composition of each component in a map unit is recorded as a percentage. A composition of 60 indicates that the component typically makes up approximately 60 percent of the map unit.

For the available water supply, when a weighted average of all component values is computed, percent composition is the weighting factor.

Rating Options

Units of Measure: centimeters

Aggregation Method: No Aggregation Necessary

Tie-break Rule: Higher

Bulk Density, One-Third Bar

Map unit symbol	Map unit name	Rating (grams per cubic centimeter)	Acres in AOI	Percent of AOI
1	Arkana very cherty silt loam, 3 to 8 percent slopes	1.38	—	—
2	Arkana-Moko complex, 8 to 20 percent slopes	1.40	—	—
11	Enders gravelly loam, 3 to 8 percent slopes	1.38	—	—
13	Enders stony loam, 3 to 15 percent slopes	1.38	—	—
15	Enders-Leesburg complex, 8 to 20 percent slopes	1.39	—	—
42	Noark very cherty silt loam, 3 to 8 percent slopes	1.45	—	—
43	Noark very cherty silt loam, 8 to 20 percent slopes	1.45	—	—
48	Razort loam, occasionally flooded	1.48	—	—
50	Spadra loam, occasionally flooded	1.45	—	—
51	Spadra loam, 2 to 5 percent slopes	1.45	—	—
Totals for Area of Interest			**526,959.1**	**100.0%**

Description

Bulk density, one-third bar, is the ovendry weight of the soil material less than 2 millimeters in size per unit volume of soil at water tension of 1/3 bar, expressed in grams per cubic centimeter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: grams per cubic centimeter

Aggregation Method: Weighted Average

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): Depth Range (Weighted Average)

Top Depth: 0

Bottom Depth: 6

Units of Measure: Inches

Depth to Any Soil Restrictive Layer

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
1	Arkana very cherty silt loam, 3 to 8 percent slopes	77	—	—
2	Arkana-Moko complex, 8 to 20 percent slopes	59	—	—
11	Enders gravelly loam, 3 to 8 percent slopes	137	—	—
13	Enders stony loam, 3 to 15 percent slopes	137	—	—
15	Enders-Leesburg complex, 8 to 20 percent slopes	137	—	—
42	Noark very cherty silt loam, 3 to 8 percent slopes	>200	—	—
43	Noark very cherty silt loam, 8 to 20 percent slopes	>200	—	—
48	Razort loam, occasionally flooded	>200	—	—
50	Spadra loam, occasionally flooded	>200	—	—
51	Spadra loam, 2 to 5 percent slopes	>200	—	—
Totals for Area of Interest			**526,959.1**	**100.0%**

Description

A "restrictive layer" is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers.

This theme presents the depth to any type of restrictive layer that is described for each map unit. If more than one type of restrictive layer is described for an individual soil type, the depth to the shallowest one is presented. If no restrictive layer is described in a map unit, it is represented by the "> 200" depth class.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: centimeters

Aggregation Method: Weighted Average

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Interpret Nulls as Zero: No

Depth to Water Table

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
1	Arkana very cherty silt loam, 3 to 8 percent slopes	>200	—	—
2	Arkana-Moko complex, 8 to 20 percent slopes	>200	—	—
11	Enders gravelly loam, 3 to 8 percent slopes	>200	—	—
13	Enders stony loam, 3 to 15 percent slopes	>200	—	—
15	Enders-Leesburg complex, 8 to 20 percent slopes	>200	—	—
42	Noark very cherty silt loam, 3 to 8 percent slopes	>200	—	—
43	Noark very cherty silt loam, 8 to 20 percent slopes	>200	—	—
48	Razort loam, occasionally flooded	>200	—	—
50	Spadra loam, occasionally flooded	>200	—	—
51	Spadra loam, 2 to 5 percent slopes	>200	—	—
Totals for Area of Interest			**526,959.1**	**100.0%**

Description

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: centimeters

Aggregation Method: Minimum or Maximum

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Interpret Nulls as Zero: No

Beginning Month: January

Ending Month: December

Flooding Frequency Class

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Arkana very cherty silt loam, 3 to 8 percent slopes	None	—	—
2	Arkana-Moko complex, 8 to 20 percent slopes	None	—	—
11	Enders gravelly loam, 3 to 8 percent slopes	None	—	—
13	Enders stony loam, 3 to 15 percent slopes	None	—	—
15	Enders-Leesburg complex, 8 to 20 percent slopes	None	—	—
42	Noark very cherty silt loam, 3 to 8 percent slopes	None	—	—
43	Noark very cherty silt loam, 8 to 20 percent slopes	None	—	—
48	Razort loam, occasionally flooded	Occasional	—	—
50	Spadra loam, occasionally flooded	Occasional	—	—
51	Spadra loam, 2 to 5 percent slopes	None	—	—
Totals for Area of Interest			**526,959.1**	**100.0%**

Description

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent.

"None" means that flooding is not probable. The chance of flooding is nearly 0 percent in any year. Flooding occurs less than once in 500 years.

"Very rare" means that flooding is very unlikely but possible under extremely unusual weather conditions. The chance of flooding is less than 1 percent in any year.

"Rare" means that flooding is unlikely but possible under unusual weather conditions. The chance of flooding is 1 to 5 percent in any year.

"Occasional" means that flooding occurs infrequently under normal weather conditions. The chance of flooding is 5 to 50 percent in any year.

"Frequent" means that flooding is likely to occur often under normal weather conditions. The chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year.

"Very frequent" means that flooding is likely to occur very often under normal weather conditions. The chance of flooding is more than 50 percent in all months of any year.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: More Frequent

Beginning Month: January

Ending Month: December

TEXTURE MODIFIER AND HORIZON FRAGMENTS COMPARED TO PASSING SIEVE AND FRACTIONS >3 INCH.

[Volumes for lo-rv-hi that are calculated from seive data may not appear in the correct sequence. This is due to varying amounts of the >3 inch fraction. Seive data is expressed on the basis of the amount <3 inch, while the >3 inch is the whole soil basis.]

DMU DESCRIPTION	COMPNAME	Horizon Name	Depth (cm)	Modifer(s) * is RV	Horizon Fragments Size (mm) lo- rv- hi	Horizon Fragments Volume lo- rv- hi	Calc from sieve; volume and size lo-rv-hi	size	% Passing Sieve and % >3 inches lo-rv-hi	size
101001------	Arkana----------	A	0-18	Very gravelly*	2 4 5	5 7 14	0- 0- 0	2-5	25-38-50	#10
					5 40 75	20 29 43	35-41-42	5-75	25-38-50	#4
					75 162 250	10 12 23	0-12-27	75-250	0-20-40	3-10in
					250 625 1000	0 3 6	0- 3- 6	250-1000	0- 5-10	>10in
----------	----------	Bt	18-84	None*, Gravelly	2 4 5	0 7 28	0- 7- 7	2-5	50-77-100	#10
					5 40 75	0 6 23	0- 7-27	5-75	60-89-100	#4
					75 162 250	0 1 6	0- 1- 6	75-250	0- 1-10	3-10in
							0- 0- 0	250-1000	0- 0- 0	>10in
----------	----------	R	84-89	None*			0- 0- 0	2-5		
							0- 0- 0	5-75		
							0- 0- 0	75-250		
							0- 1- 0	250-1000		
101042------	Noark----------	A	0-10	Very gravelly*	2 4 5	0 7 14	0- 2- 4	2-5	25-38-50	#10
					5 40 75	0 32 40	35-44-53	5-75	30-40-50	#4
					75 162 250	0 3 6	0- 3- 6	75-250	0- 5-10	3-10in
					250 625 1000	0 2 3	0- 2- 3	250-1000	0- 3- 5	>10in
----------	----------	E	10-36	Very gravelly*, Gravelly	2 4 5	0 14 28	0- 2- 4	2-5	25-50-75	#10
					5 40 75	0 26 40	15-32-53	5-75	30-53-75	#4
					75 162 250	0 3 6	0- 3- 6	75-250	0- 5-10	3-10in
					250 625 1000	0 2 3	0- 2- 3	250-1000	0- 3- 5	>10in
----------	----------	Bt1	36-109	Very gravelly*, Very gravelly	2 4 5	0 7 14	0- 2- 4	2-5	25-38-50	#10
					5 40 75	0 32 40	35-44-53	5-75	30-40-50	#4
					75 162 250	0 3 6	0- 3- 6	75-250	0- 5-10	3-10in
					250 625 1000	0 2 3	0- 2- 3	250-1000	0- 3- 5	>10in
----------	----------	Bt2	109-183	Very gravelly*, Extremely gravelly	2 4 5	0 12 23	0- 0- 0	2-5	10-30-50	#10
					5 40 75	0 37 51	35-53-73	5-75	10-30-50	#4
					75 162 250	0 5 9	0- 5- 9	75-250	0- 8-15	3-10in

					250 625 1000	0 2 3	0- 2- 3 250-1000	0- 3- 5	>10in
101043------	----------	A	0-10	Very gravelly*	2 4 5 5 40 75 75 162 250 250 625 1000	0 7 14 0 32 40 0 3 6 0 2 3	0- 2- 4 2-5 35-44-53 5-75 0- 3- 6 75-250 0- 2- 3 250-1000	25-38-50 #10 30-40-50 #4 0- 5-10 3-10in 0- 3- 5 >10in	

DMU DESCRIPTION	COMPNAME	Horizon Name	Depth (cm)	Modifer(s) * is RV	Horizon Fragments Size (mm) lo- rv- hi	Horizon Fragments Volume lo- rv- hi	Calc from sieve; volume and size lo-rv-hi size	% Passing Sieve and % >3 inches lo-rv-hi size
----------	----------	E	10-36	Very gravelly*, Gravelly	2 4 5 5 40 75 75 162 250 250 625 1000	0 14 28 0 26 40 0 3 6 0 2 3	0- 2- 4 2-5 15-32-53 5-75 0- 3- 6 75-250 0- 2- 3 250-1000	25-50-75 #10 30-53-75 #4 0- 5-10 3-10in 0- 3- 5 >10in
----------	----------	Bt1	36-109	Very gravelly*, Very gravelly	2 4 5 5 40 75 75 162 250 250 625 1000	0 7 14 0 32 40 0 3 6 0 2 3	0- 2- 4 2-5 35-44-53 5-75 0- 3- 6 75-250 0- 2- 3 250-1000	25-38-50 #10 30-40-50 #4 0- 5-10 3-10in 0- 3- 5 >10in
----------	----------	Bt2	109-183	Very gravelly*, Extremely gravelly	2 4 5 5 40 75 75 162 250 250 625 1000	0 12 23 0 37 51 0 5 9 0 2 3	0- 0- 0 2-5 35-53-73 5-75 0- 5- 9 75-250 0- 2- 3 250-1000	10-30-50 #10 10-30-50 #4 0- 8-15 3-10in 0- 3- 5 >10in
101048------	Razort----------	A	0-30	None*	2 4 5 5 40 75	0 7 14 0 6 11	0- 1- 3 2-5 0- 6-12 5-75 0- 0- 0 75-250 0- 0- 0 250-1000	75-88-100 #10 80-90-100 #4 0- 0- 0 3-10in 0- 0- 0 >10in
----------	----------	Bt	30-140	None*, Gravelly	2 4 5 5 40 75	0 6 23	0- 0- 0 2-5 0-12-27 5-75 0- 0- 0 75-250 0- 0- 0 250-1000	60-80-100 #10 60-80-100 #4 0- 0- 0 3-10in 0- 0- 0 >10in
----------	----------	2C	140-165	Gravelly*, None	2 4 5 5 40 75	0 18 43 0 16 40	0- 2- 4 2-5 0-23-58 5-75 0- 0- 0 75-250 0- 0- 0 250-1000	25-63-100 #10 30-65-100 #4 0- 0- 0 3-10in 0- 0- 0 >10in

101050------	Spadra----------	Ap	0-18	None*	2 4 5 5 40 75	0 7 14 0 5 9	0- 3- 6 2-5 0- 4- 9 5-75 0- 0- 0 75-250 0- 0- 0 250-1000	75-88-100 #10 85-93-100 #4 0- 0- 0 3-10in 0- 0- 0 >10in
----------	----------	Bt	18-102	None*, None	2 4 5 5 40 75	0 9 17 0 3 6	0- 6-13 2-5 0- 3- 6 5-75 0- 0- 0 75-250 0- 0- 0 250-1000	70-85-100 #10 90-95-100 #4 0- 0- 0 3-10in 0- 0- 0 >10in

DMU DESCRIPTION	COMPNAME	Horizon Name	Depth (cm)	Modifer(s) * is RV	Horizon Fragments Size (mm) lo- rv- hi	Volume lo- rv- hi	Calc from sieve; volume and size lo-rv-hi size	% Passing Sieve and % >3 inches lo-rv-hi size
----------	----------	C	102-183	None*, Gravelly	2 4 5 5 40 75	0 8 28 0 6 23	0- 8- 7 2-5 0- 6-28 5-75 0- 0- 0 75-250 0- 0- 0 250-1000	50-77-100 #10 60-90-100 #4 0- 0- 0 3-10in 0- 0- 0 >10in
101051------	----------	Ap	0-18	None*	2 4 5 5 40 75	0 7 14 0 5 9	0- 3-•6 2-5 0- 4- 9 5-75 0- 0- 0 75-250 0- 0- 0 250-1000	75-88-100 #10 85-93-100 #4 0- 0- 0 3-10in 0- 0- 0 >10in
----------	----------	Bt	18-102	None*, None	2 4 5 5 40 75	0 9 17 0 3 6	0- 6-13 2-5 0- 3- 6 5-75 0- 0- 0 75-250 0- 0- 0 250-1000	70-85-100 #10 90-95-100 #4 0- 0- 0 3-10in 0- 0- 0 >10in
----------	----------	C	102-183	None*, Gravelly	2 4 5 5 40 75	0 8 28 0 6 23	0- 8- 7 2-5 0- 6-28 5-75 0- 0- 0 75-250 0- 0- 0 250-1000	50-77-100 #10 60-90-100 #4 0- 0- 0 3-10in 0- 0- 0 >10in
MLRA 117 - Enders stony loam, 3 to 15 percent	Enders----------	A	0-8	Stony*	2 4 5 5 40 75 75 162 250 250 625 1000	0 5 9 1 4 9 3 12 9 9 13 9	0- 6-10 2-5 1- 4-11 5-75 3-10-15 75-250 9-11-13 250-1000	57-79-98 #10 78-91-98 #4 5-17-25 3-10in 15-19-21 >10in

slopes-----								
----------	----------	E	8-20	Gravelly*, Stony	2 4 5 5 40 75 75 162 250 250 625 1000	0 5 9 1 5 9 3 5 9 9 5 9	0- 1- 2 2-5 2- 6- 8 5-75 3- 6- 9 75-250 9-15-23 250-1000	75-85-95 #10 80-88-95 #4 5-10-15 3-10in 15-25-35 >10in
----------	----------	Bt1	20-102	None*, Gravelly	2 4 5 5 40 75 75 162 250 250 625 1000	0 7 28 0 2 3	0- 8-30 2-5 0- 1- 3 5-75 0- 2- 3 75-250 0- 2- 3 250-1000	50-83-100 #10 95-98-100 #4 0- 3- 5 3-10in 0- 3- 5 >10in
----------	----------	Bt2	102-137	None*, Channery	2 4 5 5 40 75 75 162 250	0 7 43 0 4 26 0 3 6	6- 8-23 2-5 0- 4-35 5-75 0- 3- 6 75-250 0- 0- 0 250-1000	25-80-90 #10 55-93-100 #4 0- 5-10 3-10in 0- 0- 0 >10in

DMU DESCRIPTION	COMPNAME	Horizon Name	Depth (cm)	Modifer(s) * is RV	Horizon Fragments Size (mm) lo- rv- hi	Horizon Fragments Volume lo- rv- hi	Calc from sieve; volume and size lo-rv-hi size	% Passing Sieve and % >3 inches lo-rv-hi size
----------	----------	Cr	137-147	None*			0- 0- 0 2-5 0- 0- 0 5-75 0- 0- 0 75-250 0- 0- 0 250-1000	
MLRA 117 - Enders gravelly loam, 3 to 8 percent slopes-----	----------	A	0-8	Gravelly*	2 4 5 5 40 75 75 162 250 250 625 1000	0 7 14 0 20 28 0 3 6 0 2 3	0- 7-14 2-5 11-19-27 5-75 0- 2- 4 75-250 0- 1- 2 250-1000	41-60-82 #10 61-71-82 #4 0- 4- 7 3-10in 0- 2- 3 >10in
----------	----------	E	8-20	Gravelly*, Stony	2 4 5 5 40 75 75 162 250 250 625 1000	0 5 9 1 5 9 3 5 9 9 5 9	1- 5- 9 2-5 2- 5- 9 5-75 0- 0- 0 75-250 8-13-17 250-1000	67-81-95 #10 84-91-97 #4 0- 0- 0 3-10in 14-21-27 >10in
----------	----------	Bt1	20-102	None*, Gravelly	2 4 5 5 40 75 75 162 250 250 625 1000	0 6 6 0 2 3	0- 0- 0 2-5 0- 0- 0 5-75 0- 2- 3 75-250 0- 2- 3 250-1000	100-100-100 #10 100-100-100 #4 0- 3- 5 3-10in 0- 3- 5 >10in

----------	----------	Bt2	102-137	None*, Channery	2 4 5 5 40 75 75 162 250	0 7 43 0 4 26 0 3 6	0- 0- 0 2-5 0- 0- 0 5-75 0- 3- 5 75-250 0- 0- 0 250-1000	100-100-100 #10 100-100-100 #4 0- 5- 9 3-10in 0- 0- 0 >10in
----------	----------	Cr	137-147	None*			0- 0- 0 2-5 0- 0- 0 5-75 0- 0- 0 75-250 0- 0- 0 250-1000	
MLRA 117 - Enders-Leesburg complex, 8 to 20 percent slopes-----	----------	A	0-8	Stony*	2 4 5 5 40 75 75 162 250 250 625 1000	0 5 9 1 4 9 3 12 9 9 13 9	0- 6-10 2-5 1- 4-11 5-75 3-10-15 75-250 9-11-13 250-1000	57-79-98 #10 78-91-98 #4 5-17-25 3-10in 15-19-21 >10in
----------	----------	E	8-20	Gravelly*, Stony	2 4 5 5 40 75 75 162 250 250 625 1000	0 5 9 1 5 9 3 5 9 9 5 9	0- 1- 2 2-5 2- 6- 8 5-75 3- 6- 9 75-250 9-15-23 250-1000	75-85-95 #10 80-88-95 #4 5-10-15 3-10in 15-25-35 >10in

DMU DESCRIPTION	COMPNAME	Horizon Name	Depth (cm)	Modifer(s) * is RV	Horizon Fragments Size (mm) lo- rv- hi	Horizon Fragments Volume lo- rv- hi	Calc from sieve; volume and size lo-rv-hi size	% Passing Sieve and % >3 inches lo-rv-hi size
----------	----------	Bt1	20-102	None*, Gravelly	2 4 5 5 40 75 75 162 250 250 625 1000	0 7 28 0 2 3	0- 8-30 2-5 0- 1- 3 5-75 0- 2- 3 75-250 0- 2- 3 250-1000	50-83-100 #10 95-98-100 #4 0- 3- 5 3-10in 0- 3- 5 >10in
----------	----------	Bt2	102-137	None*, Channery	2 4 5 5 40 75 75 162 250	0 7 43 0 4 26 0 3 6	6- 8-23 2-5 0- 4-35 5-75 0- 3- 6 75-250 0- 0- 0 250-1000	25-80-90 #10 55-93-100 #4 0- 5-10 3-10in 0- 0- 0 >10in
----------	----------	Cr	137-147	None*			0- 0- 0 2-5 0- 0- 0 5-75 0- 0- 0 75-250	

| | | |

to 20 percent slopes-----								
----------	----------	Bt1	25-84	Gravelly*, Gravelly	2 4 5 5 40 75 75 162 250	0 6 11 5 10 14	3- 3- 3 2-5 6-10-14 5-75 0- 6-12 75-250 0- 0- 0 250-1000	70-78-85 #10 75-83-90 #4 0-10-20 3-10in 0- 0- 0 >10in
----------	----------	Bt2	84-183	Cobbly*, Gravelly	2 4 5 5 40 75 75 162 250	0 6 11 0 10 14 0 5 9	3- 3- 3 2-5 6-10-14 5-75 0- 5- 9 75-250 0- 0- 0 250-1000	70-78-85 #10 75-83-90 #4 0- 8-15 3-10in 0- 0- 0 >10in

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Arkana very cherty silt loam, 3 to 8 percent slopes	D	—	—
2	Arkana-Moko complex, 8 to 20 percent slopes	D	—	—
11	Enders gravelly loam, 3 to 8 percent slopes	D	—	—
13	Enders stony loam, 3 to 15 percent slopes	D	—	—
15	Enders-Leesburg complex, 8 to 20 percent slopes	D	—	—
42	Noark very cherty silt loam, 3 to 8 percent slopes	B	—	—
43	Noark very cherty silt loam, 8 to 20 percent slopes	B	—	—
48	Razort loam, occasionally flooded	B	—	—
50	Spadra loam, occasionally flooded	B	—	—
51	Spadra loam, 2 to 5 percent slopes	B	—	—
Totals for Area of Interest			**526,959.1**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

SEVEN BASIC PHYSICAL PROPERTIES OF SOILS

This report is sorted by map unit name. The * preceeding a texture designates the 'RV' texture. A # designates a stratified layer.

Compname	Depth	Texture	Sand	Silt	Clay	Ksat	Bulk density	OM	Frags
	cm		Pct	Pct	Pct	um/s	one third bar	Pct	Pct
100 Arkana------	0-18	*GRV-SIL	15- 26- 30	39- 53- 66	15- 21- 27	4.00-9.00 -14.00	1.25-1.38-1.50	2.0-3.0-4.0	51
----------	18-84	*C GR-C	1- 8- 10	2- 19- 37	60- 73- 85	0.01-0.21 -0.42	1.20-1.33-1.45	0.5-0.8-1.0	14
----------	84-89	*UWB	?-?-?	?-?-?	--	0.42-1.00 -1.40	?-?-?	---	0
50 Arkana-------	0-18	*GRV-SIL	15- 26- 30	39- 53- 66	15- 21- 27	4.00-9.00 -14.00	1.25-1.38-1.50	2.0-3.0-4.0	51
----------	18-84	*C GR-C	1- 8- 10	2- 19- 37	60- 73- 85	0.01-0.21 -0.42	1.20-1.33-1.45	0.5-0.8-1.0	14
----------	84-89	*UWB	?-?-?	?-?-?	--	0.42-1.00 -1.40	?-?-?	---	0
35 Moko---------	0-10	*STV-SIL	?- 25-?	?- 53-?	18- 23- 27	4.00-9.00 -14.00	1.25-1.43-1.60	2.0-3.0-4.0	52
----------	10-33	*STV-SIC L STX-SIL, STV-L, STV-SIL	?- 18-?	?- 54-?	18- 28- 35	4.00-9.00 -14.00	1.25-1.43-1.60	0.5-0.8-1.0	57
----------	33-38	*UWB	?-?-?	?-?-?	--	0.42-1.00 -1.40	?-?-?	---	0
100 Noark-------	0-10	*GRV-SIL	?- 29-?	?- 53-?	10- 18- 25	4.00-9.00 -14.00	1.35-1.45-1.55	1.0-2.0-3.0	44
----------	10-36	*GRV-SIL GR-SIL	?- 29-?	?- 53-?	10- 18- 25	4.00-9.00 -14.00	1.35-1.45-1.55	0.1-0.6-1.0	45
----------	36-109	*GRV-SIC GRV-C	?- 3-?	?- 42-?	40- 55- 70	4.00-9.00 -14.00	1.25-1.33-1.40	0.1-0.6-1.0	44
----------	109-183	*GRV-C GRX-C, GRV-SIC	?- 12-?	?- 28-?	45- 60- 75	4.00-9.00 -14.00	1.25-1.33-1.40	0.0-0.3-0.5	56
----------	0-10	*GRV-SIL	?- 29-?	?- 53-?	10- 18- 25	4.00-9.00 -14.00	1.35-1.45-1.55	1.0-2.0-3.0	44
----------	10-36	*GRV-SIL GR-SIL	?- 29-?	?- 53-?	10- 18- 25	4.00-9.00 -14.00	1.35-1.45-1.55	0.1-0.6-1.0	45
----------	36-109	*GRV-SIC GRV-C	?- 3-?	?- 42-?	40- 55- 70	4.00-9.00 -14.00	1.25-1.33-1.40	0.1-0.6-1.0	44
----------	109-183	*GRV-C GRX-C, GRV-SIC	?- 12-?	?- 28-?	45- 60- 75	4.00-9.00 -14.00	1.25-1.33-1.40	0.0-0.3-0.5	56
95 Razort-------	0-30	*L	?- 43-?	?- 40-?	10- 18- 25	4.00-9.00 -14.00	1.35-1.48-1.60	1.0-2.0-3.0	13
----------	30-140	*L SIL, CL, GR-L	?- 38-?	?- 36-?	18- 27- 35	4.00-9.00 -14.00	1.35-1.48-1.60	0.5-1.3-2.0	12
----------	140-165	*GR-SL GR-SIL, GRV-SIL,	?- 67-?	?- 15-?	10- 18- 25	14.00-28.00-42.00	1.35-1.43-1.50	0.5-0.8-1.0	34

		L							
95 Spadra-------	0-18	*L	?- 43-?	?- 40-?	10- 18- 25	4.00-9.00 -14.00	1.30-1.45-1.60	1.0-2.0-3.0	12
----------	18-102	*SCL L, CL	?- 60-?	?- 18-?	10- 23- 35	4.00-9.00 -14.00	1.30-1.45-1.60	0.5-0.8-1.0	12
----------	102-183	*FSL SL, GR-FSL	?- 69-?	?- 16-?	5- 15- 25	4.00-9.00 -14.00	1.30-1.45-1.60	0.1-0.6-1.0	14
----------	0-18	*L	?- 43-?	?- 40-?	10- 18- 25	4.00-9.00 -14.00	1.30-1.45-1.60	1.0-2.0-3.0	12
----------	18-102	*SCL L, CL	?- 60-?	?- 18-?	10- 23- 35	4.00-9.00 -14.00	1.30-1.45-1.60	0.5-0.8-1.0	12
----------	102-183	*FSL SL, GR-FSL	?- 69-?	?- 16-?	5- 15- 25	4.00-9.00 -14.00	1.30-1.45-1.60	0.1-0.6-1.0	14
80 Enders-------	0-8	*GR-L	26- 43- 52	28- 40- 45	10- 18- 20	4.00-9.00 -14.00	1.25-1.38-1.50	2.0-3.0-4.0	32
----------	8-20	*GR-SIL STV-L, ST-SL, ST-SIL	20- 29- 40	36- 53- 70	10- 18- 25	4.00-9.00 -14.00	1.25-1.38-1.50	0.5-0.8-1.7	31
----------	20-102	*C SIC, GR-SICL	5- 23- 30	10- 29- 54	35- 48- 60	0.01-0.21 -0.42	1.15-1.30-1.45	0.1-0.6-0.8	12
----------	102-137	*C SIC, CN-SIC, CNV-C	5- 22- 30	10- 28- 50	40- 50- 60	0.01-0.21 -0.42	1.20-1.33-1.45	0.0-0.3-0.6	14
----------	137-147	*BR	?-?-?	?-?-?	--	0.42-1.00 -1.40	?-?-?	---	0
85 Enders-------	0-8	*ST-L	26- 45- 52	28- 40- 45	10- 15- 20	4.00-9.00 -14.00	1.25-1.38-1.50	2.0-3.0-4.0	34
----------	8-20	*GR-SIL STV-L, ST-SL, ST-SIL	20- 29- 40	36- 53- 70	10- 18- 25	4.00-9.00 -14.00	1.25-1.38-1.50	0.5-0.8-1.7	31
----------	20-102	*C SIC, GR-SICL	5- 23- 30	10- 29- 54	35- 48- 60	0.01-0.21 -0.42	1.15-1.30-1.45	0.1-0.6-0.8	13
----------	102-137	*C SIC, CN-SIC, CNV-C	5- 22- 30	10- 28- 50	40- 50- 60	0.01-0.21 -0.42	1.20-1.33-1.45	0.0-0.3-0.6	14
----------	137-147	*BR	?-?-?	?-?-?	--	0.42-1.00 -1.40	?-?-?	---	0
60 Enders-------	0-8	*ST-L	26- 45- 52	28- 40- 45	10- 15- 20	4.00-9.00 -14.00	1.25-1.38-1.50	2.0-3.0-4.0	34
----------	8-20	*GR-SIL STV-L, ST-SL, ST-SIL	20- 29- 40	36- 53- 70	10- 18- 25	4.00-9.00 -14.00	1.25-1.38-1.50	0.5-0.8-1.7	31
----------	20-102	*C SIC, GR-SICL	5- 23- 30	10- 29- 54	35- 48- 60	0.01-0.21 -0.42	1.15-1.30-1.45	0.1-0.6-0.8	13

SEVEN BASIC PHYSICAL PROPERTIES OF SOILS--Continued

This report is sorted by map unit name. The * preceeding a texture designates the 'RV' texture. A # designates

Physical soil properties_final - Copy
a stratified layer.

Compname	Depth	Texture	Sand	Silt	Clay	Ksat	Bulk density	OM	Frags
	cm		Pct	Pct	Pct	um/s	one third bar	Pct	Pct
----------	102-137	*C SIC, CN-SIC, CNV-C	5- 22- 30	10- 28- 50	40- 50- 60	0.01-0.21 -0.42	1.20-1.33-1.45	0.0-0.3-0.6	14
----------	137-147	*BR	?-?-?	?-?-?	--	0.42-1.00 -1.40	?-?-?	---	0
30 Leesburg-----	0-25	*ST-L	?- 46-?	?- 42-?	7- 13- 18	14.00-28.00-42.00	1.30-1.40-1.50	1.0-2.0-3.0	30
----------	25-84	*GR-CL GR-SICL, GR-SCL	?- 34-?	?- 37-?	20- 30- 40	4.00-9.00 -14.00	1.35-1.48-1.60	0.1-0.6-1.0	22
----------	84-183	*CB-CL GR-CL, GR-SICL, GR-C	?- 31-?	?- 31-?	27- 39- 50	4.00-9.00 -14.00	1.25-1.43-1.60	0.0-0.3-0.5	21

Ponding Frequency Class

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Arkana very cherty silt loam, 3 to 8 percent slopes	None	—	—
2	Arkana-Moko complex, 8 to 20 percent slopes	None	—	—
11	Enders gravelly loam, 3 to 8 percent slopes	None	—	—
13	Enders stony loam, 3 to 15 percent slopes	None	—	—
15	Enders-Leesburg complex, 8 to 20 percent slopes	None	—	—
42	Noark very cherty silt loam, 3 to 8 percent slopes	None	—	—
43	Noark very cherty silt loam, 8 to 20 percent slopes	None	—	—
48	Razort loam, occasionally flooded	None	—	—
50	Spadra loam, occasionally flooded	None	—	—
51	Spadra loam, 2 to 5 percent slopes	None	—	—
Totals for Area of Interest			**526,959.1**	**100.0%**

Description

Ponding is standing water in a closed depression. The water is removed only by deep percolation, transpiration, or evaporation or by a combination of these processes. Ponding frequency classes are based on the number of times that ponding occurs over a given period. Frequency is expressed as none, rare, occasional, and frequent.

"None" means that ponding is not probable. The chance of ponding is nearly 0 percent in any year.

"Rare" means that ponding is unlikely but possible under unusual weather conditions. The chance of ponding is nearly 0 percent to 5 percent in any year.

"Occasional" means that ponding occurs, on the average, once or less in 2 years. The chance of ponding is 5 to 50 percent in any year.

"Frequent" means that ponding occurs, on the average, more than once in 2 years. The chance of ponding is more than 50 percent in any year.

Rating Options

Aggregation Method: Minimum or Maximum

Component Percent Cutoff: None Specified

Tie-break Rule: More Frequent

Beginning Month: January

Ending Month: December

Electrical Conductivity (EC)

Map unit symbol	Map unit name	Rating (decisiemens per meter)	Acres in AOI	Percent of AOI
1	Arkana very cherty silt loam, 3 to 8 percent slopes	0.0	—	—
2	Arkana-Moko complex, 8 to 20 percent slopes	0.0	—	—
11	Enders gravelly loam, 3 to 8 percent slopes	0.0	—	—
13	Enders stony loam, 3 to 15 percent slopes	0.0	—	—
15	Enders-Leesburg complex, 8 to 20 percent slopes	0.0	—	—
42	Noark very cherty silt loam, 3 to 8 percent slopes	0.0	—	—
43	Noark very cherty silt loam, 8 to 20 percent slopes	0.0	—	—
48	Razort loam, occasionally flooded	0.0	—	—
50	Spadra loam, occasionally flooded	0.0	—	—
51	Spadra loam, 2 to 5 percent slopes	0.0	—	—
Totals for Area of Interest			**526,959.1**	**100.0%**

Description

Electrical conductivity (EC) is the electrolytic conductivity of an extract from saturated soil paste, expressed as decisiemens per meter at 25 degrees C. Electrical conductivity is a measure of the concentration of water-soluble salts in soils. It is used to indicate saline soils. High concentrations of neutral salts, such as sodium chloride and sodium sulfate, may interfere with the absorption of water by plants because the osmotic pressure in the soil solution is nearly as high as or higher than that in the plant cells.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: decisiemens per meter

Aggregation Method: Weighted Average

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): Depth Range (Weighted Average)

Top Depth: 0

Bottom Depth: 6

Units of Measure: Inches

Sodium Adsorption Ratio (SAR)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Arkana very cherty silt loam, 3 to 8 percent slopes	0.0	—	—
2	Arkana-Moko complex, 8 to 20 percent slopes	0.0	—	—
11	Enders gravelly loam, 3 to 8 percent slopes	0.0	—	—
13	Enders stony loam, 3 to 15 percent slopes	0.0	—	—
15	Enders-Leesburg complex, 8 to 20 percent slopes	0.0	—	—
42	Noark very cherty silt loam, 3 to 8 percent slopes	0.0	—	—
43	Noark very cherty silt loam, 8 to 20 percent slopes	0.0	—	—
48	Razort loam, occasionally flooded	0.0	—	—
50	Spadra loam, occasionally flooded	0.0	—	—
51	Spadra loam, 2 to 5 percent slopes	0.0	—	—
Totals for Area of Interest			**526,959.1**	**100.0%**

Description

Sodium adsorption ratio is a measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. Soils that have SAR values of 13 or more may be characterized by an increased dispersion of organic matter and clay particles, reduced saturated hydraulic conductivity (Ksat) and aeration, and a general degradation of soil structure.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Aggregation Method: Weighted Average

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: Yes

Layer Options (Horizon Aggregation Method): Depth Range (Weighted Average)

Top Depth: 0

Bottom Depth: 6

Units of Measure: Centimeters

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IN THE CIRCUIT COURT OF NEWTON COUNTY, ARKANSAS
CIVIL DIVISION

C & H HOG FARMS, INC. APPELLANT

VS. CASE NO. 51CV-18-58

ARKANSAS POLLUTION CONTROL
& ECOLOGY COMMISSION APPELLEE

BUFFALO RIVER WATERSHED ALLIANCE, INC.,
ARKANSAS CANOE CLUB, GORDON WATKINS AND
MARTI OLESEN INTERVENORS

INTERIM ORDER AND STAY PENDING APPEAL

This case came on for hearing on October 17, 2018. After reading the pleadings in the case, hearing the arguments of counsel, and considering the testimony presented the court finds and holds:

The Intervenors should be, and hereby are, allowed to intervene in this lawsuit as permissive intervenors.

On January 10, 2018 the Arkansas Department of Environmental Quality (ADEQ) issued its decision denying the application of C&H Hog Farms, Inc. (C&H) pursuant to Regulation No. 5 for a liquid animal waste management system permit concentrated animal feeding operation in Mt. Judea, Arkansas ("Permitting Decision"). On January 11, 2018 C&H filed a Motion for Stay of Permitting Decision with the Arkansas Pollution Control and Ecology Commission ("Commission"), which was granted on January 17, 2018. On January 18, 2018 C&H appealed the Permitting Decision to the Commission. On August 24, 2018 the Commission remanded the Permitting Decision to ADEQ and closed the docket of the appeal. On September 6, 2018 C&H filed a Notice of Appeal of the Commission's decision, which included a request to further stay the Director's Permitting Decision and to stay the Commission's decision.

The court finds that pursuant to Ark. Code Ann. § 8-4-223, this court obtained jurisdiction over C&H's application for a Regulation No. 5 permit for a liquid animal waste management system permit in Mt. Judea, Arkansas, the subject matter of this appeal, on September 6, 2018, when C&H filed its notice of appeal (the "Permit Matter"). Minute Order No. 18-20 issued by the Commission, including the remand and instructions stated therein, should be, and hereby is, stayed. To avoid substantial prejudice, the stay allowing C&H to continue to operate its facility is continued until further order of this court.

IT IS SO ORDERED.

John Putman

Circuit Judge

Date: October 17, 2018



What's New at ADEQ?

ADEQ is now accepting applications for the 2019 Environmental Awards

ADEQ's annual environmental awards recognize businesses and organizations in Arkansas for their efforts to protect and enhance the state's environment through three prestigious awards: the Arkansas Environmental Stewardship (ENVY) Award, the Arkansas Environmental Technology (TECHe) Award, and the E^2 Energy Award. Businesses, nonprofits, and government entities are encouraged to apply. Application forms and more information about the awards are available at **https://www.adeq.state.ar.us/poa/enterprise-services/awards/**.

Comment Period Extended to October 24

The comment period for ADEQ's draft decision to deny a Regulation 5 permit for C&H Hog Farm in Newton County is currently open and has been extended to receive comments through 4:30 p.m. on Wednesday, October 24. To submit a public comment on the **C&H Hog Farm permit draft decision**, go to **http://water.adeq.commentinput.com/?id=m45xxd**.

October 24, 2018

TO: Arkansas Department of Environmental Quality
ATTN: C&H Draft Denial
5301 Northshore Drive
North Little Rock, AR 72118-5317

FROM: Arkansas Farm Bureau Federation
John Bailey, P.E.
Director, Environmental & Regulatory Affairs
P.O. Box 31
Little Rock, AR 72203

RE: Comments on permit 5264-W

To whom it may concern:

The Arkansas Farm Bureau Federation would like to offer the following comments opposing the denial of C&H Hog Farms's Regulation 5 permit. Our organization is a non-profit agriculture advocacy association with more than 190,000 members of whom 50,000 are directly engaged in agriculture production. Despite the fact there is no scientific evidence showing that C&H Hog Farms is causing an environmental impact, the Arkansas Department of Environmental Quality (ADEQ) has denied the owners of the farm a permit.

C&H Hog Farms is the most heavily scrutinized and monitored farm in the state. The Big Creek Research and Extension Team was originally created by then Governor Mike Beebe to evaluate the potential impact and sustainable management of the C&H Farms operation on the water quality of Big Creek. Several years later, the State of Arkansas funded a drilling study to evaluate the lithology/geology below the waste storage ponds at C&H Hog Farms and to assess potential subsurface impact from the waste storage ponds. Most recently, current Governor Asa Hutchinson created the Beautiful Buffalo River Action Committee and authorized the development of a Watershed Management Plan for the Buffalo River Watershed that would evaluate the tributaries to determine which would need the most attention. Despite conclusions of these state-funded independent third-party analyses showing C&H Hog Farms is having no impact, ADEQ ignored the science and denied the issuance of a Regulation 5 permit to C&H Hog Farms.

In addition to ignoring the science, the ADEQ chose the most intentionally difficult path for C&H Hog Farms to obtain permit coverage. The ADEQ has the authority to either require a work plan which would provide additional testing or sampling prior to issuance of the permit or include a schedule of compliance in the permit outlining what actions are necessary to maintain coverage. In either case, a timeline is set to allow the applicant a reasonable timeframe to provide any missing information before compliance actions

are taken. Because C&H Hog Farms has already been constructed and has operated for over five years without a single violation, a work plan or schedule of compliance would have been the reasonable approach. However, rather than using one of these approaches, the Department instead chose to immediately deny the permit and put the owners' livelihood in jeopardy.

The owners of C&H attempted to comply with ADEQ's request for additional information as is documented by emails between ADEQ and C&H, the conclusion of which ADEQ stated to C&H that the necessary information had been submitted only to deny C&H's permit for "technical deficiencies." These deficiencies were not identified in any detail until 10 days after in the "Blanz memo". In an attempt to comply or resolve the confusion regarding what, specifically, was deficient, the owners met with ADEQ at their offices a few days after being denied a permit. The Department, referring to a 422-page document, told C&H that when they read this then they would talk to them. Even then the list was not detailed or complete as evidenced by the addition of two new "deficiencies", one of which is unaddressable. It is noteworthy that according to ADEQ's website out of 2,422 agricultural permit applications submitted, including dozens of farms in the Buffalo River watershed, only one permit application has ever been denied.

Farm Bureau's focus is to ensure that sound science drives the production practices of our farmers and ranchers and to ensure that regulatory controls being applied to farmers and ranchers employ the same science. The justifications outlined in the Statement of Basis denying C&H Hog Farms a permit to operate, at a minimum, should result in additional permit conditions (i.e. installing synthetic liners), not denial of the permit. The Arkansas Farm Bureau would like to offer the following comments and ask that the ADEQ issue the February 15, 2017 draft Regulation 5 permit.

Animal Waste Management Field Hand Handbook

The ADEQ cites "requirements" of the Animal Waste Management Field Handbook (AWMFH) as justification for denial of the permit. However, the AWMFH does not provide requirements but instead planning considerations. These considerations are to be used by farmers and professional engineers to minimize costs while protecting water quality. In no case does the AWMFH ever recommend that a farm not be built, but instead recommends appropriate construction considerations as you will see below. C&H's engineer has stated that he reviewed these considerations and he is comfortable with his design as a professional.

The ADEQ goes on to say "[t]he list below is not intended to reflect all requirements of the AWMFH and it is not intended to reflect all factors that may have been considered by ADEQ during the review of the application." This sentence should be revised by removing the word 'not' to provide clarity. Farm Bureau believes that ADEQ as a state agency should be obligated to provide the applicant all reasons for denial. Doing so prevents the ADEQ from continuing to move the goal posts and bankrupting C&H Hog Farms through never-ending engineering and attorney fees.

The following reasons were provided as rational for denial of the permit:

- *Groundwater Assessment: A groundwater flow direction study to determine the directional flow(s) from any waste storage ponds (Citation APC&EC Regulation 5.402, AWMFH 651.0703(b)).*

The AWMFH 651.0703(b) states "A desirable site for a waste storage pond or treatment lagoon is in an area where groundwater is not flowing away from the site toward a well, spring, or important underground water supply." A site investigation provided by C&H Hog Farms to ADEQ on December 6, 2017 states that all wells located near the lagoons have either been properly closed or are a significant distance away. The results from this site investigation are considered protective in accordance with table 10-4 of the AWMFH. Currently the BCRET is sampling all known streams and springs (including interceptor trenches) near and around the lagoons and has found no impacts. The February 15, 2017, draft permit proposed continued monitoring which included an evaluation of any statistically significant increases within the measured points. Lastly, there is no underground water supply in the area. Therefore, if all of the reasons for needing directional groundwater flow have already been addressed, then the 'requirement' is unnecessary and should be removed.

- *Geologic Assessments: A complete geologic investigation, including but not limited to:*
    - *Borings within the pool areas to ascertain the groundwater elevation is not within 5 feet of invert of the ponds (Citation: APC&EC Regulation 5.402, AWMFH 651, Table 10-4);*
    - *Borings within the pool areas to ascertain the foundation of earth-filled structures ("For structures with a pool area, use at least five test holes or pits or one per 10,000 square feet of pool area, whichever is greater." (Citation APC&EC Regulation 5.402, AWMFH 651.0703(b)(4)); and*
    - *Borings within the pool areas to rule out the presence of large voids in karst (Citation: APC&EC Regulation 5.402, AWMFH 651, Table 10-4).*
- *Berm Integrity Assessment: Borings are required in the embankment centerline of the berms as part of the detailed geologic investigation. (Citation APC&EC Regulation 5.402, AWMFH 651.0704(b)(4)).*

As stated in the AWMFH 651.704(b), "The purpose of a detailed geologic investigation is to determine geologic conditions at a site that will affect or be affected by design, construction, and operation of an animal waste management system component.", meaning all of the assessments listed above would only result in considering the need to revise construction requirements, <u>not preclude them from building an animal waste storage system</u>. In this case, C&H Hog Farms has already been constructed and has been in operation for 5 years with no violations or impacts to water quality. Table 10-4 in the AWMFH evaluates the risk vs. vulnerability of the site to determine the appropriate pond construction recommendations. The farm already meets the recommendations in place by the AWMFH. C&H Hog Farms has submitted documentation demonstrating they are not in a 'very high' risk area, and information contained in the drill study as well as the drilling reports from the two onsite drinking water wells do not indicate they are located in a 'very high' vulnerability area. Also, it should be noted that even if C&H Hog Farms were found to be in a 'very high' risk or vulnerability area, the recommendation in Table 10-4 in the AWMFH recommends other storage alternatives or to properly seal wells and reevaluate vulnerability. It does not

preclude C&H Hog Farms from operating. It should be noted that C&H in fact paid to have an abandoned house well (cistern) properly closed when identified by ADEQ during the "response to comments" before ADEQ denied the permit. C&H Hog Farms has also proposed and received approval to install a synthetic liner in both lagoons. In instances where Table 10-4 indicates a synthetic liner is required, the table also says "*(or properly seal well and reevaluate vulnerability) No additional site characterization required." Although these investigations may not have been performed with the original application, additional investigation by BCRET, ADEQ, Harbor Environmental and Safety, and FTN & Associates should be sufficient to show the intent of the recommendations has been met and there is not a justifiable reason for denial on this basis. Therefore, we recommend any requirement for geologic assessment and berm integrity be removed from the statement of basis and reason for denial.

- *Pond Construction Quality Assurance: The record included one recompacted permeability test. That single test is insufficient to determine liner integrity. The necessary soil investigations including, but not limited to, percentage of fines and soil permeability evaluations, have not been performed at this facility in accordance with AWMFH 651 Table 10-4 and Appendix 10D. (Citation: APC&EC Regulation 5.402, AWMFH 651, Table 10-4 and Appendix 10D and 10E).*

The requirement for additional recompacted permeability tests in not dependent on a site investigation. A review of previously approved applications has shown in the past that one test has been acceptable; therefore, listing additional permeability tests as reason for denial is arbitrary and capricious. As previously stated, C&H Hog Farms has proposed and received approval to install a synthetic liner in both lagoons. No additional compaction test is necessary when installing synthetic liners. In addition, the ADEQ references Appendix 10E as a citation. Appendix 10E only discusses proper installation of synthetic liners but provides no reason why it is included. For the reasons stated above, the requirement for additional recompacted permeability tests is not a reason for denial. The ADEQ should at the most require either additional testing or installation of the synthetic liner, not denial of the permit.

- *Assessment of High-Risk Areas of Land Application Sites: A field assessment for all land application sites including all of the characteristics listed in AWMFH 651.0504 (a)-(n), and the resulting field management plans (Citation: APC&EC Regulation 5.402, AWMFH 651.0504(a)-(n) and Table 5-3).*

Typical assessment of the land application sites for permitting purposes is done through the use of NRCS's Web Soil Survey. Based upon this assessment tool, and AWMFH recommendations, most land applications sites (fields) are acceptable without restriction and the remaining land application sites are acceptable with restrictions. At no time is a recommendation of no land application assigned to any field. Even so, C&H's NMP writer(s) walked every field in an effort to ground truth the web soil survey information. As a result, setbacks and buffers were increased resulting in a reduction of allowable land application acres from the original permit submission.

- *Pond Levee Integrity and Assessment Requirements: An adequate Operations and Maintenance Plan for the pond levee, including an inspection schedule and plan document, was not included in the record. An adequate plan should at a minimum include:*

- *Whether the inspections are internal or independently performed by a third party;*
- *The specific checklist of items for the inspection to cover;*
- *Recordkeeping requirements;*
- *Frequency of inspections; and*
- *How the inspection results will be reviewed and/or audited.*

(Citation: AWMFH 651.1302(d); Natural Resources Conservation Service Operation and Maintenance, Waste Storage Facility, Code 313).

- *Emergency Response Preparedness: An emergency action plan regarding potential consequences of failure of the waste impoundment embankments or accidental release (Citation: APC&EC Regulation 5.402, AWMFH 651.0204(a)-(b)).*

The final items are simply paperwork requirements and had the ADEQ simply requested the information instead of denying the permit, C&H Hog Farms would have happily provided the information when requested.

Deficiencies in the Geological Investigation

The purpose of the Geological Investigation was to evaluate a specific location based on claims by environmental groups, who opposed C&H Hog Farms. The environmental groups claimed that Electrical Resistivity Imaging showed that C&H Hog Farms's holding ponds were leaking. Despite the fact the Big Creek Research and Extension Team presented scientific evidence at an APC&EC meeting stating the contrary, the ADEQ mandated that the owners of C&H Hog Farms allow the drilling to take place or be forced to shut down. The drilling study was completed and a final report was prepared by Harbor Environmental and Safety which concluded there was no evidence of the ponds leaking, reaching the same conclusion that was presented to the ADEQ originally by the BCRET. The Department should have used the final drill report to demonstrate compliance with the AWMFH requirements that are stated as the reasons for denial.

Karst

Although ADEQ spends a significant amount of time in the statement of basis discussing karst, Arkansas Farm Bureau has never argued that karst was not present. However, Regulation 5 does not preclude C&H Hog Farms from obtaining an operating permit. Even Regulation 22 for Solid Waste Management does not preclude the issuance of a landfill permit coverage in karst terrain. The ADEQ should not be allowed to retroactively review a permit that has been previously approved for construction and operation with no gap in coverage without proper cause. If through monitoring it is determined that additional requirements are necessary, the Department may include additional requirements in an effort to protect water quality.

In addition, a study was conducted by the U.S. Geological Survey in cooperation with the Natural Resources Conservation Service, the University of Arkansas, and the Arkansas Department of Environmental Quality to examine swine waste storage lagoons in a mantled karst terrane (Appendix A). The Study evaluated potential leakage from existing holding ponds and a settling basin as well as a newly

constructed Anaerobic lagoon at the University of Arkansas' Savoy Experimental Watershed. The Savoy Swine Facility is a demonstration farm that provides a long term model for environmental management. The study points out that the "Savoy Swine Facility is located within the Springfield Plateau, which is underline by nearly flat lying Mississippian-age cherty limestones and limestones" and has "[k]arst features such as springs, sinkholes, losing streams, caves, and conduits…in the study area."

Water quality samples were collected from several sampling locations which included wells, springs, seeps, and an interceptor trench. The study concluded that "very little leakage from the waste holding ponds and settling basin occurs" and goes on to say the reason for minimal leakage is due to the high solids content in the animal waste which provided a seal significantly reducing seepage. The study concludes with "[b]ased on these results, the swine waste lagoon…is minimally affecting the ground-water quality of the area."

303(d) List

The data used for the assessment of Big Creek was obtained from eight (8) different monitoring locations over a 5-mile stretch. Typically, when assessing streams, the Department has only had one set of data available to it from a single monitoring station to review. This results in all data being used for assessment purposes. In the case of Big Creek, the Department reviewed data from multiple monitoring locations up and down Big Creek. However, the Department's current assessment methodology practice is to use the highest value of a data set and throw out all other data. This practice does not provide an accurate representation of what is actually occurring in the stream and represents only the worst case scenario. For example, in 2016 the Department identified eight single instances where the E-coli criteria were exceeded during the primary contact season. Although additional data was provided with all eight of the afore mentioned exceedances, only the highest test result was used. However, the accompanying data for five of the exceedances shows a significant decrease over the values used for assessment purposes, with the remaining three reporting similar numbers. Farm Bureau recommends that an appropriate average, such as the commonly recognized standard methodology of geometric mean, be used for assessing E-coli on a segment.

This practice is especially concerning when considering the fact that, half of the data collected in 2016 resulting in Big Creek exceeding the assessment standard was collected by a group that has publically stated their goal is to shut down C&H Hog Farms. These groups know how many samples need to be submitted to cause a stream to be listed and can systematically collect numerous samples at a specific time and location only to submit the highest values knowing that the Department will use those and discard the remaining values. This is intentionally subverting scientific process and protocols.

In addition to utilizing all data submitted for assessment purposes, Farm Bureau recommends the Department reconsider its evaluation of Big Creek as single segment. Upon closer review, the data shows that most of the exceedances of the E-coli criteria occurred upstream of the confluence of Dry Creek. Again, using the 2016 data, six of the eight exceedances of the E-coli criteria occurred upstream of the confluence with Dry Creek. Of the two remaining exceedances, a review of the data shows that on one

date the upstream value exceeded the criteria, but the higher downstream value was utilized instead. The second date curiously did not have an upstream value submitted. Based on a more thorough evaluation of the data and the numerous monitoring locations, Big Creek should be divided into reaches or segments delineated by the confluence with major tributaries, as is common practice when assessing other waterbodies, rather than treating Big Creek as a single unit. Farm Bureau believes the most practical way is for the Department to assess Big Creek by upper, middle, and lower segments. The head waters of Big Creek to the confluence of Dry Creek as the upper segment, Dry Creek to Left Fork Big Creek as the middle segment and, Left Fork Big Creek to the Buffalo River is the lower segment.

A review of the continuous Dissolved Oxygen (DO) provided by the Department showed all data and exceedance of the criteria were from 2013. This is **prior to C&H Hog Farms applying a single drop of waste**. What was not clear is if the Department continues to measure DO on Big Creek. If the 303(d) list is finalized with Big Creek being impaired for DO, Farm Bureau requests the Department continue monitoring if there is any chance of Big Creek being delisted.

Based on the comments above and a review of the data, it is clear that C&H Hog Farms is not contributing to the impairment of Big Creek. It should also be noted that according to the ADEQ website there are 119 TMDL's issued for the state of Arkansas with hundreds of facilities operating under discharge and non-discharge permits that contribute or are the cause for impairment. **None of those TMDL's require that a facility's permit be denied or terminated**. In addition to the TMDL's there are even more streams listed as impaired. Once again, the ADEQ is not proposing to deny of those permits. Even if C&H was contributing to the impairment, it is not reason to deny the permit.

Nitrates

In the statement of basis, the ADEQ discusses nitrate-N by saying "In addition to this proposed listing of Big Creek and the Buffalo River as impaired waterbodies, the Big Creek Research Extension Team (BCRET) has documented an increase in nitrate-N near the facility. In the April 1 to June 30, 2018 Quarterly Report, BCRET presented data that documents a statistically significant increase of nitrate-N in the ephemeral stream (BC4) and the house well (W1) since 2014. (BCRET April-June 2018, Figure 24). Increased nitrate-N in both the ephemeral stream and the house well suggest that these systems may be hydrologically connected to areas where farm activities take place." However, ADEQ fails to provide all of the information stated in the BCRET April 1 to June 30, 2018 report.

The report states "This analysis indicates a statistically significant increase in Nitrate-N concentrations in ephemeral stream and well samples over the monitoring period (Figure 19). Additionally, there has been a gradual increase in geomean nitrate concentrations of well samples each water year of site monitoring (i.e., April 1 to March 31; Figure 24). In contrast, concentrations of chloride, a conservative element that can move freely through the soil without chemical, physical, or biological modification, did not exhibit any statistically significant change over the monitoring period in ephemeral stream and well samples (i.e., April 2015 to April 2018; Figure 22)."

The report goes on to say, "The chloride concentration and electrical conductivity of slurry in holding ponds 1 and 2 is appreciably greater than that measured upstream of the C&H Farm in Big Creek (i.e., BC6), which represents background concentrations not impacted by farm operations (see Table 9). Given chloride and electrical conductivity can be considered as conservative tracers of water flow, the lack of any increasing trend in these analyses for well (W1), trench (T1 and T2), or ephemeral stream (BC4) samples, suggests that elevated nitrate-N concentrations in well and ephemeral stream samples may be influenced ***by sources other than the holding ponds*** [emphasis added] (i.e., sources that have low chloride and electrical conductivity values)."

First, the word statistically significant increase doesn't mean that nitrates are significantly increasing at some order of magnitude, it means that nitrates are increasing but it is not due to sampling error even if the increase is less than the sampling error of the test. For example, you can have a statistically significant increase from 0.01 mg/L to 0.011 mg/L even with a sampling error of +/- 0.005 mg/L and not be due to rounding either. The definition of the statement does not represent magnitude of increase, all that can be said with any certainty is that Nitrates are increasing over the sampling period. These concentrations are extremely low from the outset. Some have described Big Creek's water quality as "excellent, very high, and even pristine." While there may be an increase, 10% of a very small number is still a very small number. Two things that are certain concerning the nitrates issue; 1) the nitrates are increasing very slowly; and 2) it cannot be said that nitrates only started increasing when the farm was built. Because the nitrates are increasing at such a slow rate it is conceivable that nitrates have been increasing in the groundwater long before C&H was built.

The second part to BCRET's statement is the key "concentrations of chloride, a conservative element that can move freely through the soil without chemical, physical, or biological modification, did not exhibit any statistically significant change over the monitoring period". Meaning the argument that the increase in nitrates is a result of the C&H Hog Farms operation is weak, if not all together false. Nitrates cannot be considered in a vacuum. They must be evaluated in context with all other data, i.e. chlorides.

Taking the nitrate conversation a little further, the BCRET also looked into the impacts of nutrient concentrations on Big Creek as well (Appendix B). The report concluded that, "[t]he evaluation of flow-adjusted concentrations over time showed that nutrients in Big Creek were not increasing over the short duration of monitoring for which concentration and discharge data were available (May 2014 through April 201). At this point in time, it is evident that nutrient concentrations in Big Creek have not increased at the monitored site."

What is clear is that ADEQ's statement that monitoring data from C&H Hog Farms collected by BCRET "suggest that these systems may be hydrologically connected" is without merit.

Soil Test Phosphorus

Although the Arkansas 303(d) list does not list Big Creek or the Buffalo River as impaired, the ADEQ stated a reason for denial is "Arkansas scientists agree that there is no agronomic reason or need for [Soils Test Phosphorus] to be greater than about 50 ppm (Mehlich-3 extraction). As of the C&H Hog Farms,

Inc. 2017 Annual Report, soil test phosphorus for all fields receiving waste were greater than 50 ppm." The ADEQ does not regulate or permit based on agronomic uptake but instead uses the P-index to assess phosphorus runoff risk. Is the Department arguing to limit all STP for poultry, dairy, and swine to 50 ppm, and devastate agriculture in Arkansas, or is it ADEQ's plan to be arbitrary and capricious by applying this requirement only to C&H Hog Farms? Is the Department also prepared to limit land applications of waste water treatment plant biosolids and sludges to 50 ppm STP?

Conclusion

As stated in the opening remarks, the ADEQ continues to ignore independent third-party scientific groups that were created and paid for using taxpayer money to evaluate the impacts of the hog farm on Big Creek, that have repeatedly stated C&H Hog Farms is not impacting Big Creek. The direct measurements of Big Creek, surrounding ditches, springs, the house well, and interceptor trenches shows that C&H Hog Farms is not having an impact on water quality. There is no evidence the previously approved construction plans are inadequate and require additional testing and review. Therefore, it is recommended the ADEQ issue the original draft Regulation 5 permit to C&H Hog Farms, without changes.

Attachment:

Appendix A
Appendix B

Appendix A

Ground-Water Quality Near a Swine Waste Lagoon in a Mantled Karst Terrane in Northwestern Arkansas

Christopher M. Hobza[1], David C. Moffit[2], Danny P. Goodwin[3], Timothy Kresse[4], John Fazio[4], John V. Brahana[5], and Phillip D. Hays[1]
[1]U.S. Geological Survey Arkansas Water Science Center, Fayetteville, AR
[2]Natural Resources Conservation Service National Water Management Center, Ft. Worth, TX
[3]Natural Resources Conservation Service National Water Management Center, Little Rock, AR
[4]Arkansas Department of Environmental Quality, Little Rock, AR
[5]University of Arkansas Department of Geosciences, Fayetteville, AR

ABSTRACT

Livestock production is generally the predominant agricultural practice in mantled karst terranes because the thin, rocky soils associated with carbonate bedrock are not conducive to crop production. Unfortunately, livestock production in karst areas can create environmental problems because of rapid, focused flow through soil and regolith. A study was conducted by the U.S. Geological Survey in cooperation with the Natural Resources Conservation Service National Water Management Center, the University of Arkansas, and the Arkansas Department of Environmental Quality to examine a swine waste storage lagoon in a mantled karst terrane at the University of Arkansas' Savoy Experimental Watershed to evaluate the effects of a swine waste lagoon on ground-water quality. The Savoy Experimental Watershed is a long-term, multidisciplinary research site, which is approximately 1,250 hectares and encompasses parts of six drainage basins. An anaerobic swine waste lagoon was constructed at the Savoy Swine Facility in compliance with U.S. Department of Agriculture Natural Resources Conservation Service Conservation Waste Storage Practice Standard no. 313 in one of the drainage basins. An inventory of springs, seeps, sinkholes, and losing streams was conducted in the basin where the waste lagoon was constructed. Based on the inventory, nine shallow monitoring wells were augered to refusal in the regolith. Shallow ground-water from wells, springs, and an interceptor trench was sampled and analyzed for nutrients, major cations, and major anions during high-flow and low-flow conditions. Results from ground-water sampling indicate concentrations of chloride and nitrate were higher than concentrations from non-agricultural land-use areas in the Ozarks, but were comparable to concentrations near the site prior to the construction of the swine facility. A sample collected from an interceptor trench indicated that nutrients are able to pass through the clay liner. The results of an electromagnetic geophysical survey indicated that there were no preferred flow paths from the swine waste storage lagoon. Based on these results, it appears that the swine waste lagoon built using the Natural Resources Conservation Service Conservation Practice no. 313 is minimally affecting the ground-water quality of the area.

INTRODUCTION

Animal production in northwestern Arkansas is the predominant agricultural practice because the thin, rocky soils are unsuitable for sustainable crop production. Nationally, Arkansas ranks 2nd in broiler production, 16th in cattle, and 17th in swine production (U.S. Department of Agriculture, 2003). Animal waste generated from these agricultural operations typically is applied to local pastures, often in excess of nutrient requirements. These excess nutrients have little opportunity for natural attenuation in a mantled karst setting because of thin soils and underlying karst geology that allow rapid, focused flow resulting in contaminated ground and surface waters. Adamski (1987) compared nutrient concentrations in springs in an intensely farmed area with a minimally affected forested area and reported that the areas of intense livestock production had elevated concentrations of nitrate and chloride.

One potential source of ground-water contamination is from animal waste stored in anaerobic lagoons generated from confined animal feeding operations. These lagoon structures are designed to store animal waste for a specified time period until the waste is ready to be applied as liquid fertilizer to adjacent pastures or cropland. If not properly located, designed, constructed, and maintained, animal waste lagoons can adversely affect water quality through the introduction of excess nutrients and bacteria (Ham and DeSutter, 2000).

The Natural Resources Conservation Service (NRCS) has developed several Best Management Practices (BMPs) to reduce this risk of ground-water contamination. Waste Storage Practice no. 313 was created to allow producers to safely and effectively store animal waste while protecting ground-water resources in environmentally sensitive areas across a variety of hydrogeological environments (Natural Resources Conservation Service, 2003). Ideally, these structures are located in areas with thick soils, over deep or confined aquifers, and away from domestic water supplies. When this is not possible, the NRCS provides options that allow an additional measure of safety such as an impermeable geosynthetic membrane liner or a compacted liner constructed from native soil with a specific permeability.

This BMP has been successful in protecting ground-water resources in other hydrogeologic settings, (David Moffit, Natural Resources Conservation Service, oral commun., 2004) but its effectiveness has not been evaluated in areas with thin soils such as a mantled karst setting. To address this need, the U.S. Geological Survey in cooperation with the Natural Resources Conservation Service National Water Management Center, the University of Arkansas, and the Arkansas Department of Environmental Quality designed a study to determine the effectiveness of Waste Storage Practice no. 313 for storing swine waste in a mantled karst setting. The purpose of this report is to describe ground-water quality near the swine waste lagoon.

STUDY AREA

The Savoy Swine Facility is located within the Savoy Experimental Watershed (SEW) in northern Washington County in northwestern Arkansas (fig. 1). The SEW serves as a long-term, multi-disciplinary research site to examine water-quality problems associated with livestock production in a mantled karst setting. The SEW offers a unique opportunity to test and evaluate the environmental effects of different animal agricultural practices. In 2002 the University of Arkansas constructed the Savoy Swine Facility to improve planned large-scale swine production. The Savoy Swine Facility is managed as a demonstration farm to provide a long-term model for environmentally friendly management of animal nutrition, animal waste and odors (Maxwell and others, 2003).

The Savoy Swine Facility is located within the Springfield Plateau (Fenneman, 1938), which is underlain by nearly flat lying Mississippian-age cherty limestones and limestones. These sedimentary sequences have been incised by streams to form dendritic drainages and rolling hills. Karst features such as springs, sinkholes, losing streams, caves, and conduits are present in the study area (Little, 1999).

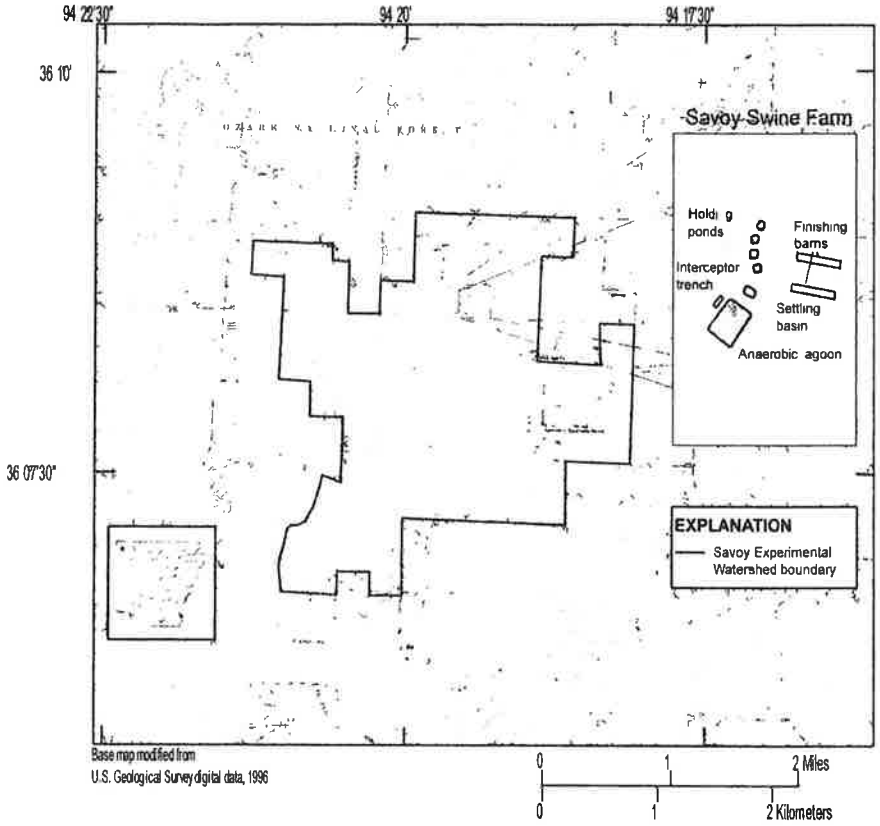


Figure 1. Location of the Savoy Swine Farm and diagram of waste storage infrastructure within the Savoy Experimental Watershed.

The major geologic units present in the study area are the Chattanooga Shale, the St. Joe Limestone Member of the Boone Formation, and the Boone Formation. The Chattanooga Shale is a black, Devonian-age shale that is approximately 45 feet thick within the SEW (Little, 1999) that unconformably underlies the St. Joe Limestone Member. The Chattanooga Shale acts as a regional confining unit where it is present in the Ozarks separating groundwater flow between the Mississippian-age limestones which compose the Springfield Plateau aquifer and the underlying Ordovician-age dolomites and sandstones which compose the Ozark aquifer (Imes and Emmett, 1994). The St. Joe Limestone Member, which is part of the Boone Formation is a relatively pure limestone, is conformably overlain by cherty limestone. The Boone Formation consists of Mississippian-age cherty limestones and is thickest beneath the uplands throughout the study area. The bedrock in the study area is overlain by regolith that is the weathering product of the cherty limestone of the Boone Formation that creates the mantled karst topography. The soils formed from the regolith are composed of silt loams and the associated subsoils are silty clay loam or cherty silt loam (Harper and others, 1969).

The waste storage infrastructure at the Savoy Swine Facility was constructed in compliance with Waste Storage Practice no. 313 (Natural Resources Conservation Service, 2003). Because the swine facility was constructed over an unconfined limestone aquifer, more stringent design options were considered for the waste lagoon. The most economical solution was to construct a compacted clay liner from sieved native soil with a target coefficient of permeability of 1.0×10^{-7} centimeters per second (Stan Rose, Natural Resources Conservation Service, oral commun., 2004). Because of budget constraints during the construction, the Savoy Swine Facility is only able to house half the animals it was initially designed for. As a result the waste storage

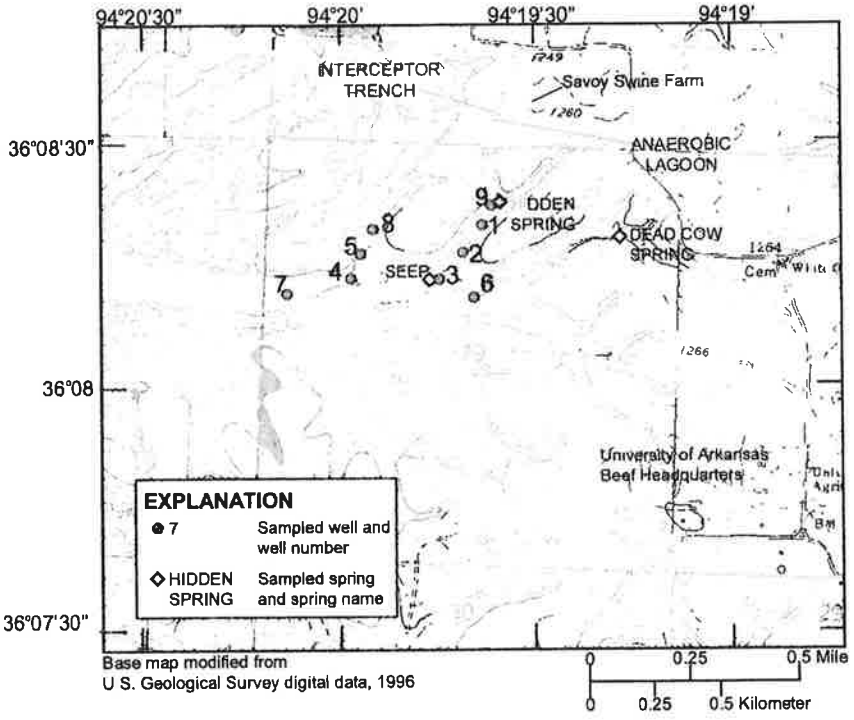


Figure 2. Location of water-quality sampling points within study area.

infrastructure is substantially oversized with respect to the number of animals served (Karl VanDevender, University of Arkansas, oral commun., 2004). The Savoy Swine Farm has a unique project-specific design constructed with four holding ponds each designed to store animal waste for a set of animals with a specific diet (fig. 1).

METHODS

A karst inventory was conducted in the area of the swine farm to gain a better understanding of the ground-water system prior to sampling point selection and well drilling. An inventory of springs, seeps, sinkholes, and losing and gaining reaches of streams was compiled. Nine shallow monitoring wells were augered to the depth of drilling refusal in the regolith. All wells were constructed with 2-inch polyvinyl chloride (PVC) casing and slotted PVC screen sections. A sand filter pack was installed surrounding the screened section with 2 feet of bentonite overlying the filter pack to prevent surface contamination. An interceptor trench was installed west of the anaerobic lagoon on the swine farm and was excavated with a backhoe to the bedrock surface to allow collection of lagoon leachate moving downgradient from the anaerobic lagoon after a storm event (fig. 1).

Sampling points consisted of monitoring wells, springs, seeps, and the interceptor trench. Water-quality samples were collected (fig. 2) during high-flow conditions in April 2004 and low-flow conditions in October 2004. The interceptor trench was sampled after one storm event on July 27, 2004. All samples were analyzed for nutrients including nitrate plus nitrite, ammonium, total Kjeldahl nitrogen, total phosphorus, and orthophosphate, major cations and major anions by the Arkansas Department of Environmental Quality (ADEQ) Water Quality Laboratory in Little Rock, Arkansas. Nitrate plus nitrite concentrations are reported as nitrate for this report because nitrate is the dominant form of nitrogen for this analyte. Fewer monitoring wells

were sampled during low-flow conditions because some of the wells were dry or did not yield water for sampling.

An electromagnetic geophysical survey was conducted near the waste storage infrastructure to determine any areas of preferential seepage from the lagoon and to assess the selection and placement of the sampling points. An EM-31 is a frequency domain electromagnetic instrument that is capable of determining subsurface conductivity (Geonics, 1984). Electromagnetic surveys have been successful in the past locating areas of preferred seepage from animal waste lagoons. Areas of lagoon seepage result in anomalously high subsurface conductivities compared to unaffected areas (Brune and Doolittle, 1990). Conductivity data were collected with a horizontal dipole instrument orientation providing an average depth of investigation of 6 meters. Global Positioning System (GPS) data and subsurface conductivity data were collected simultaneously. These data were plotted and contoured using the computer program Surfer (2002) for visual interpretation of results.

GROUND-WATER QUALITY

Concentrations of nitrate and chloride for both high-flow and low-flow sampling events were above background concentrations, but were low compared to other areas in the Ozarks affected by livestock production (table 1). Background concentrations for nitrate plus nitrite in forested, relatively pristine areas of the Ozarks are typically less than 0.5 milligrams per liter (mg/L) as nitrogen (N) and 5.0 mg/L for chloride (Steele, 1983). Data collected in this study indicate that local livestock production probably is affecting the ground-water quality of the area. Concentrations of nitrate ranged from 0.27 to 2.39 mg/L as N during high-flow conditions and 0.84 to 3.41 mg/L as N during low-flow conditions. Chloride concentrations ranged from 3.95 to 14.8 mg/L during high-flow conditions and 14.1 to 30.2 mg/L during low-flow conditions. Concentrations of both nitrate and chloride were higher during the low-flow sampling event probably because of mixing and dilution that occurs during high-flow conditions.

Table 1. Concentrations of nitrate and chloride for low-flow and high-flow sampling events

[Background concentrations of nitrate and chloride are from relatively pristine, forested areas of the Ozarks. Source sample collected from anaerobic lagoon]

Sampling point	High-flow sampling (concentrations in mg/L)			Low-flow sampling (concentrations in mg/L)			
	Date	Nitrate as N	Chloride	Date	Nitrate as N	Chloride	Ammonium as N
Well 1	4-12-04	1.08	14.8	-	-	-	-
Well 2	4-12-04	2.10	6.96	10-5-04	1.37	18.4	-
Well 3	4-12-04	1.23	9.97	10-5-04	1.07	18.9	-
Well 4	4-12-04	0.32	5.87	10-5-04	0.98	14.4	-
Well 5	4-12-04	0.46	3.95	-	-	-	-
Well 6	4-12-04	0.75	5.87	10-6-04	0.84	15.2	-
Well 7	4-12-04	0.27	3.95	10-6-04	0.99	14.1	-
Well 8	4-12-04	0.62	14.3	10-5-04	2.22	29.1	-
Well 9	4-12-04	1.99	12.9	-	-	-	-
Hidden Spring	4-12-04	2.39	11.5	10-5-04	3.41	30.2	-
Dead Cow Spring	-	-	-	10-5-04	2.59	19.8	-
Seep	4-12-04	1.32	8.90	10-5-04	1.15	16.0	-
Interceptor Trench	7-27-04	23.5	10.5	-	-	-	1.19
Anaerobic lagoon	6-13-05	-	-	6-13-05	0.44	462	40.0
Background [1]	-	0.5	5.0	-	-	-	-

[1] From Steele (1983)

These results were comparable to a previous study conducted prior to the construction of the Savoy Swine Facility. Little (1999) collected water-quality samples from springs, seeps, and wells proximal to the study area under high-flow and low-flow sampling conditions. Nitrate concentrations ranged from 0.06 to 4.64 mg/L as N and chloride concentrations ranged from 2.89 to 27.0 mg/L as N. The elevated concentrations suggest that the basin probably was affected by local livestock production prior to the construction of the Savoy Swine Facility. The highest concentrations of nitrate and chloride were detected near the University of Arkansas Beef Headquarters towards the eastern portion of the study area (fig. 2).

The results from the interceptor trench sample indicate that nitrogen is seeping through the anaerobic lagoon liner as ammonium with nitrification converting the ammonium into nitrate. The interceptor trench sample had concentrations of nitrate at 23.5 mg/L as N and ammonium concentrations at 1.19 mg/L as N. A water-quality sample was collected from the anaerobic lagoon on June 13, 2005. The form of nitrogen within the anaerobic lagoon is predominantly ammonium, with concentrations at 40.0 mg/L as N. Nitrate concentrations were 0.44 mg/L as N and chloride concentrations were 462 mg/L in the lagoon sample (table 1). The lagoon leachate is probably mixing with other waters resulting in lower concentrations of nitrate and chloride in downgradient sampled wells and springs. Based on these ground-water quality data, the swine waste lagoon built using the Natural Resources Conservation Practice no. 313 is minimally affecting the ground-water quality of the area.

ELECTROMAGNETIC GEOPHYSICAL SURVEY

The results of the EM-31 survey did not identify any areas of preferential seepage from the holding ponds, settling basin, or anaerobic lagoon. Subsurface conductivities ranged from 0.6 to 21.0 millimhos per meter. It appears that most of the leakage is from the anaerobic lagoon and the leachate is migrating from the source in a fairly uniform pattern (fig. 3). There is very little leakage from the waste holding ponds and settling basin. This is probably because the animal waste stored in both the holding ponds and settling basin contains a much higher proportion of solid animal waste compared to the anaerobic lagoon. The solid waste is able to create a seal that decreases liner permeability (Natural Resources Conservation Service, 2003). Based on the results of the EM-31 survey it appears that the oversizing of the waste storage infrastructure is having a negative impact on the effectiveness of the anaerobic lagoon.

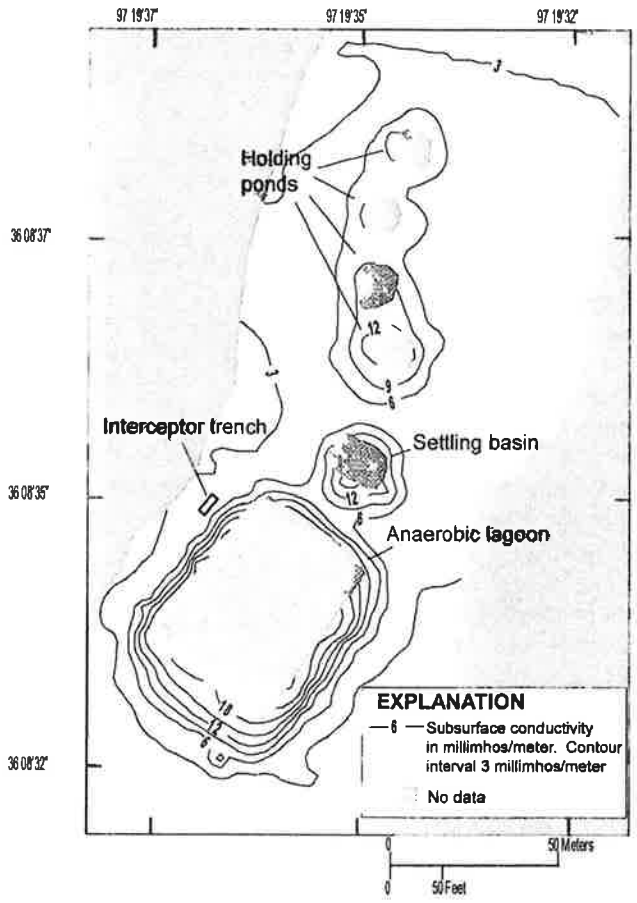


Figure 3. Results of EM-31 electromagnetic survey.

SUMMARY

A study was conducted to evaluate the effects of a swine waste lagoon on ground-water quality in a mantled karst terrane at the University of Arkansas' Savoy Experimental Watershed. An anaerobic swine waste lagoon was constructed at the Savoy Swine Facility in compliance with U.S. Department of Agriculture NRCS Conservation Waste Storage Practice Standard no. 313. An inventory of springs, seeps, and losing streams was conducted in the basin where the waste lagoon was constructed. Based on the inventory, sampling sites were selected and nine shallow monitoring wells were augered to the depth of drilling refusal in the regolith. Shallow ground-water from wells, springs and an interceptor trench was sampled for nutrients, major cations, and major anions during high-flow and low-flow conditions.

Data collected in this study indicate that the ground-water quality of the area is probably being affected by local livestock production. The concentrations of nitrate and chloride for both high-flow and low-flow sampling events were above background concentrations, but were low compared to other agriculturally affected areas in the Ozarks. Concentrations of nitrate plus nitrite ranged from 0.27 to 2.39 mg/L as N during high-flow conditions and 0.84 to 3.41 mg/L as N during low-flow conditions. Chloride concentrations ranged from 3.95 to 14.8 mg/L during high-flow conditions and 14.1 to 30.2 mg/L during low-flow conditions. Concentrations of both nitrate and chloride were higher during the low-flow sampling event probably because of mixing and dilution that occurs during high-flow conditions.

These results were comparable to a previous study conducted prior to the construction of the Savoy Swine Facility. Water-quality samples were collected from springs, seeps, and wells within near the study area under high-flow and low-flow sampling conditions. Nitrate concentrations ranged from 0.06 to 4.64 mg/L as N and chloride concentrations ranged from 2.89 to 27.0 mg/L. The elevated concentrations suggest that ground water in the basin has been affected by local livestock production prior to the construction of the Savoy Swine Facility.

A water-quality sample collected from an interceptor trench after a storm event on July 27, 2004 had concentrations of nitrate at 23.5 mg/L as N and dissolved ammonium concentrations at 1.19 mg/L as N. The results from the interceptor trench sample indicate that nitrogen is seeping through the anaerobic lagoon liner as ammonium with nitrification converting the ammonium into nitrate. The lagoon leachate probably is mixing with other waters resulting in lower concentrations of nitrate and chloride in downgradient sampled wells and springs.

The results of an electromagnetic geophysical survey identified no areas of preferred seepage from the holding ponds, settling basin, and anaerobic lagoon. Most of the leakage appears to be from the anaerobic lagoon and the leachate is migrating from the source in a fairly uniform pattern. Very little leakage from the waste holding ponds and settling basin occurs. This is probably because the animal waste stored in both the holding ponds and settling basin contains a much higher proportion of solid animal waste compared to the anaerobic lagoon. Based on these results, the swine waste lagoon built using the Natural Resources Conservation Service Conservation Practice no. 313 is minimally affecting the ground-water quality of the area.

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Appendix B

DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

Agriculture and Natural Resources

FSA9537

Nutrient Concentrations in Big Creek Correlate to Regional Watershed Land Use

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In the Ozark Mountain karst region, nutrient concentrations in streams of the Buffalo, Upper Illinois and Upper White River watersheds increase as the percent of land in pasture and urban use increases. Averaged over the last three years, nutrient concentrations in Big Creek above and below the C&H Farm are similar to concentrations found in other watersheds where there is a similar amount of pasture and urban land use.

Background

Land use within watersheds influences the quantity and quality of water draining from a watershed. As land disturbance increases and use intensifies, there is a general increase in stormwater runoff and nutrient inputs that leads to a greater potential for nutrient discharge to receiving waters. For instance, with urban growth, more impervious surfaces increase the flashiness of runoff, stream flows and wastewater treatment discharge. Also, as areas of agricultural production grow, more fertilizer is applied to achieve optimum production. Thus, as the percent of a watershed drainage area in pasture, row crop or urban use increases, there is a general increase in nutrient concentrations in storm and base flows.

In this fact sheet, we show the effect of land use on nitrogen (N) and phosphorus (P) concentrations in streams of the Ozark Highlands and Boston Mountains, northwest Arkansas, by combining previously published data for the Upper Illinois River Watershed (Haggard et al., 2010), Upper White River Watershed (Giovannetti et al., 2013) and ongoing monitoring in the Buffalo River Watershed. The location of these watersheds is shown in Figure 1. The relationships between stream nutrient concentrations and land use for the region are used to determine if a permitted concentrated animal feeding operation (CAFO) in Big Creek Watershed, a sub-watershed of the Buffalo River Watershed, has affected stream water quality. Land use in these watersheds is given in Table 1.

Nitrate-N, total N, dissolved P and total P concentrations have been measured over varying periods during base flow at the outlet of sub-watersheds in the Big Creek (two sites, 2014 to 2017), Buffalo (20 sites, 1985 to 2017), Upper Illinois (29 sites, 2009) and Upper White River Watersheds (20 sites, 2005 to 2006) (Figure 1).

Data from Big Creek were paired with discharge available from a gaging station just downstream from the swine CAFO, where the USGS developed the rating curve; discharge information was only available from May 2014 through December 2017. The data were then used to look at changes in flow-adjusted nutrient concentrations[A] in Big Creek (White et al., 2004).

[A]Concentration is defined as the mass of a substance (M), such as a nutrient, over the volume of water (V) in which it is contained, or C = M/V. "**Flow-adjusted nutrient concentrations**" – when looking at how concentrations change over time in streams, we have to consider how concentrations might also change with stream flow (volume of water) and not just change in mass; nutrient concentrations often have some type of relation to flow, maybe increasing or even decreasing as stream flow increases. We have to flow-adjust concentrations so we can remove the variability in concentrations that flow might cause to see how things are changing over time.

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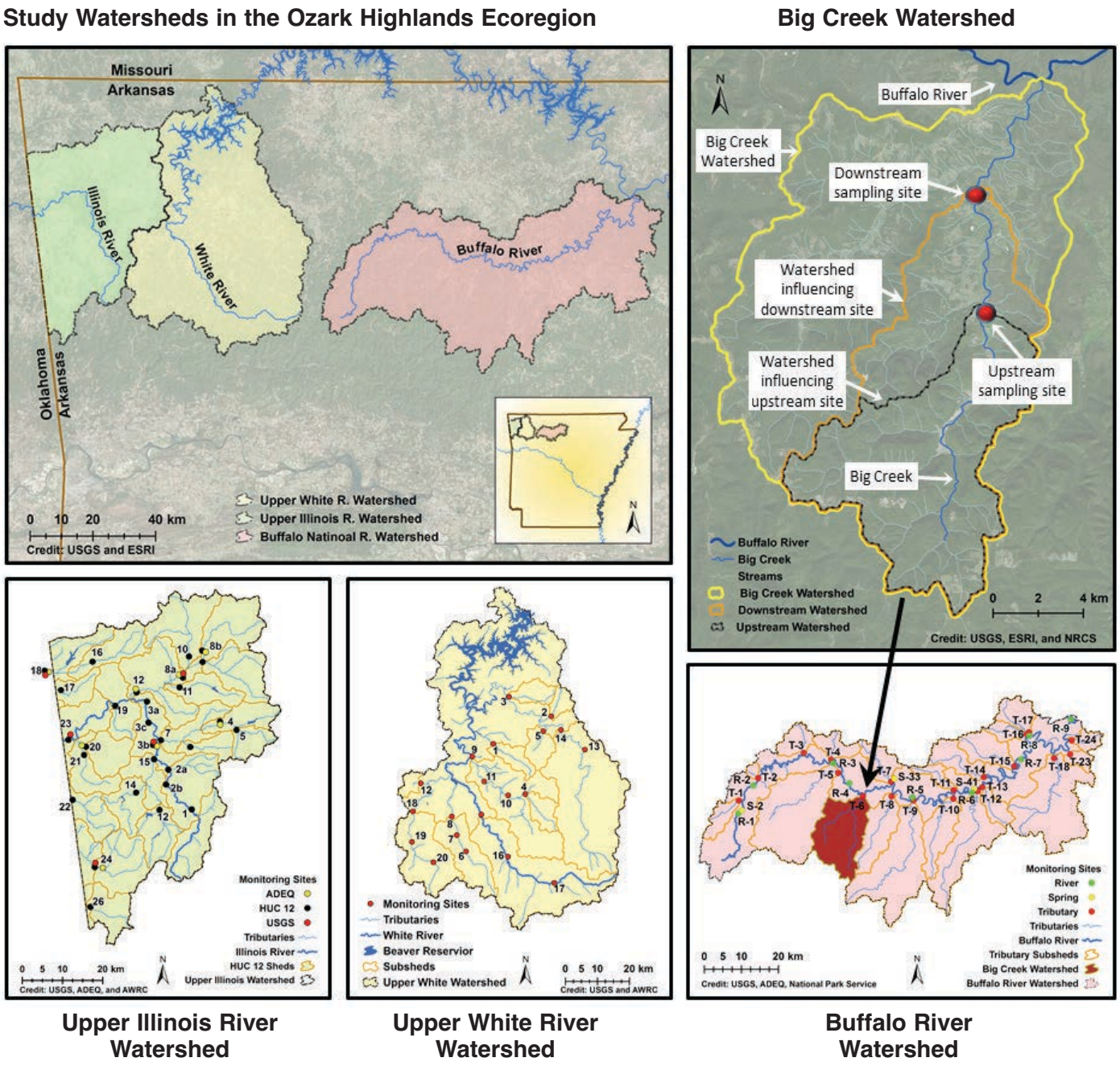


Figure 1. Location of the Big Creek, Buffalo River, Upper Illinois River and Upper White River watersheds in the Boston Mountains and Ozark Highlands ecoregion. *Information from U.S. Geological Survey (USGS), Environmental Systems Research Institute (ESRI) and National Aeronautics and Space Administration (NASA).*

Table 1. Percent of forest, pasture and urban land use in the Big Creek, Buffalo River, Upper Illinois and Upper White River watersheds.

Watershed	Forest	Pasture	Urban
	- % -		
Big Creek*			
Upstream	89.5	8.0	2.6
Downstream	79.5	17.0	3.5
Buffalo River	52 - 99	0 - 25	0 - 1
Upper White River	34 - 90	7 - 55	0 - 44
Upper Illinois River	2 - 70	27 - 69	3 - 61

*Up and downstream of CAFO operation and fields permitted to receive manure.

Putting Stream Nutrient Concentrations Into Context at Big Creek

Geometric mean concentrations[B] of stream P and N are related to the percent of watershed drainage area in pasture and urban land use for the Buffalo, Upper Illinois and Upper White River watersheds (R^2 of 0.56 to 0.81 where the number of observations is 71; Figure 2)[C]. The dashed lines on Figure 2 represent the upper and lower thresholds concentrations, where there is a 95 percent confidence that a stream draining a watershed with a specific percent pasture and urban land use will have a P and N concentration within those thresholds.

The relationship between land use and stream nutrient concentrations is not a model that can be used to predict concentration. Given the large variability observed in these relationships, they simply show trends between two variables, land use and stream nutrient concentrations. Continued monitoring of stream concentrations in Big Creek will continue to more reliably define trends.

As the percent pasture and urban land (i.e., land use intensity) increases, so does stream P and N concentrations (see Figure 2). The general increase in nutrient concentrations is consistent with the fact that fertilizer (as mineral and manure sources) is routinely applied to pastures to maintain forage production, as well as deposition of nutrients by grazing cattle.

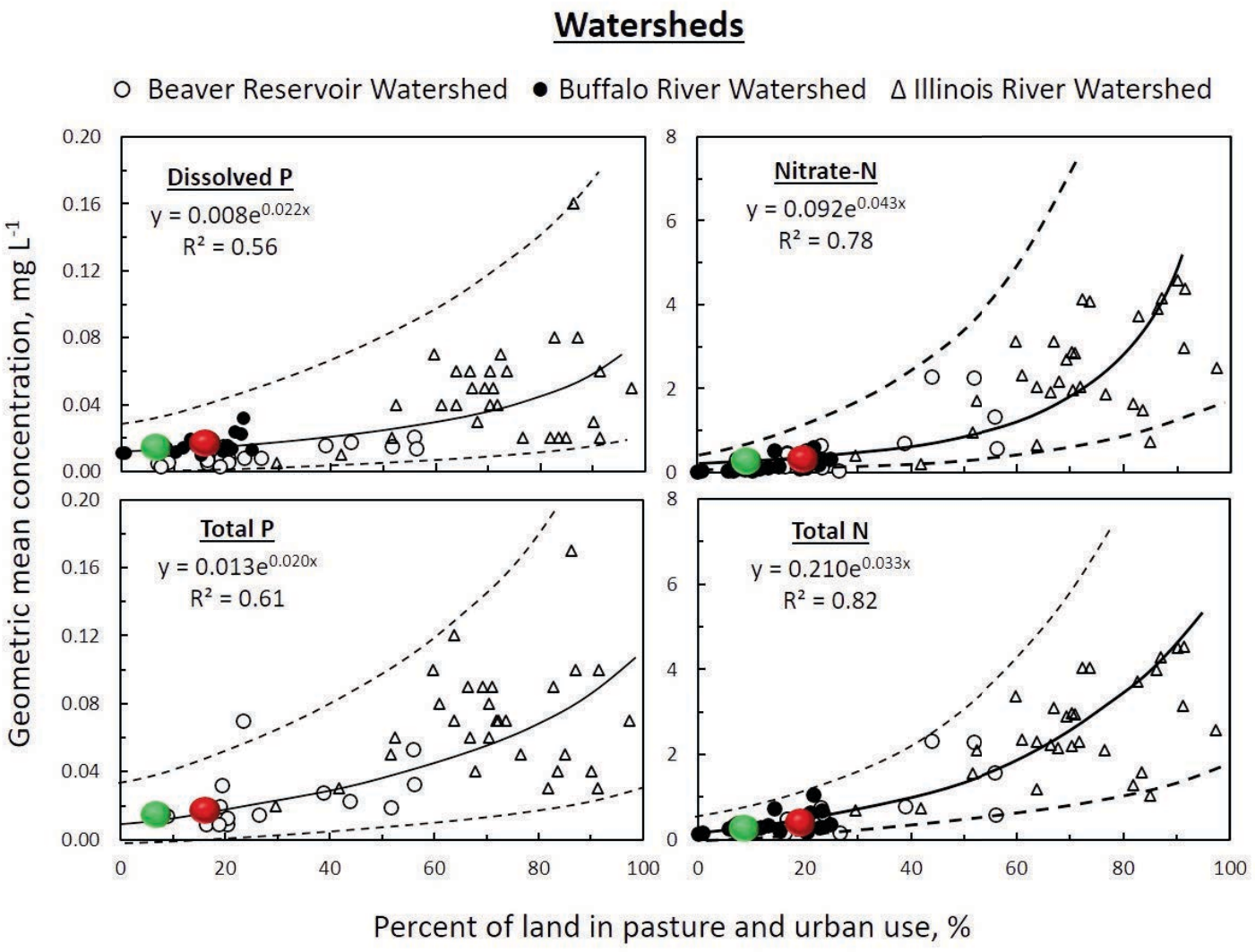


Figure 2. Relationship between land use and the geometric mean N and P concentrations (mg L^{-1}) in the Buffalo, Upper Illinois and Upper White River watersheds. Dashed lines represent the 95 percent confidence intervals for the estimated mean (solid line). Green points are geometric mean concentrations measured upstream of the CAFO on Big Creek and red points are geometric mean concentrations measured downstream of the CAFO on Big Creek.

[B]"**Geometric means**" – There are many ways to calculate the central or typical value of a data set, like the average or median. With water quality data, the geometric mean is often used because it minimizes the influence of really low or high values on the average.

[C]"**R^2**" is the **coefficient of determination** – the proportion of variance in the dependent variable (i.e., vertical axis) that is predictable from the independent variable (i.e., horizontal axis). The closer to 1 the value is, means less variability and the better the relationship between the two variables is.

In the Big Creek watershed, the percent of land influenced by human activities (i.e., pasture plus urban) doubles from ~10 percent to ~20 percent in the drainage area upstream and downstream of the CAFO. In Big Creek itself, upstream of the swine production CAFO, the geometric mean concentrations of dissolved P, total P, nitrate-N and total N during base flow were 0.009, 0.030, 0.10 and 0.20 mg L^{-1}, respectively, between September 2013 and December 2017. Directly downstream of the CAFO, the geometric mean concentrations in Big Creek during base flow over the same period were 0.011, 0.030, 0.25 and 0.37 mg L^{-1}, respectively.

Geometric mean nutrient concentrations in Big Creek above and below the swine production CAFO and its current potential sphere of influence from slurry applications are similar to or lower than concentrations measured in rivers draining other subwatersheds in the Upper Illinois and Upper White River watersheds with similar proportions of agricultural land use. (See Figure 2.)

Have Nutrient Concentrations Changed in the Short Term at Big Creek?

Long-term (e.g., decadal scale) water quality data are needed to reliably assess how stream nutrient concentrations have changed in response to watershed management and climate variations (Hirsch et al., 2015). The literature shows that stream nutrient concentrations can change relatively quickly in response to effluent management (e.g., Haggard, 2010; Scott et al., 2011), but seeing a response (i.e., decrease or increase in concentrations) from landscape management can take decades or more (Green et al., 2015; Sharpley et al., 2013). A myriad of factors may influence observed nutrient concentrations in streams, including discharge, biological processes and climactic conditions (i.e., drought and floods), and dominant transport pathways. Thus, we need to use caution when interpreting trends in water quality over databases that only cover a limited timeframe. Flow-adjusted concentrations showed no

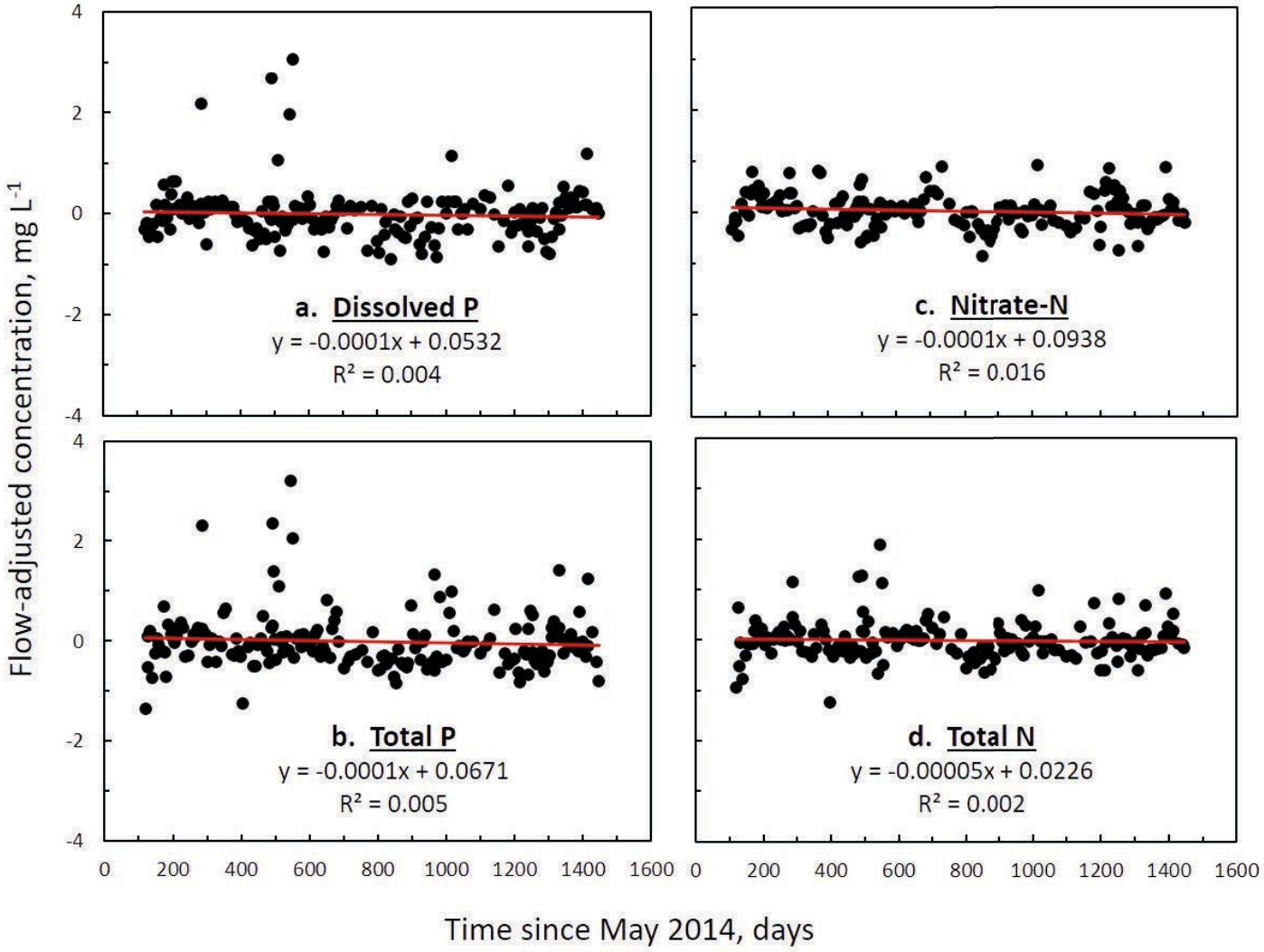


Figure 3. Change in flow-adjusted concentration of (a) dissolved P, (b) total P, (c) nitrate-N and (d) total N over time since May 2014, when monitoring in Big Creek started.

statistically significant increasing or decreasing trends in dissolved P, total P, nitrate-N and total N (R2 <0.016); where number of observations is 182) over the current monitoring period (Figure 3).

Summary

Nutrient concentrations at Big Creek upstream and downstream of the swine CAFO, and indeed most tributaries of the Buffalo River, are low relative to other watersheds in this ecoregion (Figure 2). This provides a starting point to build a framework to evaluate changes in nutrient concentrations of streams as a function of land use and management.

The evaluation of flow-adjusted concentrations over time showed that nutrients in Big Creek were not increasing over the short duration of monitoring for which concentration and discharge data were available (May 2014 through April 2017). At this point in time, it is evident that nutrient concentrations in Big Creek have not increased at the monitored site. However, flow and nutrient concentration data over a longer period are needed to reliably quantify water quality trends and characterize sources, and monitoring needs to continue for at least a decade to evaluate how discharge, season and time influence nutrient fluxes.

Stream nutrient concentration-land use relationships are not a predictive tool. However, use of these relationships provides a method to determine if nutrient concentrations in a given watershed are similar to observed nutrient concentration-land use gradients in other watersheds of the Ozark Highlands and Boston Mountains. Over time, tracking these relationships provides a mechanism to note and evaluate changes in nutrient concentrations.

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Printed by University of Arkansas Cooperative Extension Service Printing Services.

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FSA9537-PD-3-2018N

Marti Olesen Comments on Regulation 5 Draft Denial of Permit

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VIA U.S. MAIL AND EMAIL

Director Keogh, Caleb Osborne,

I agree with and support the ADEQ's STATEMENT OF BASIS and its decision to deny the C&H swine CAFO Permit No. 5264-W AFIN 51-00164:
"This Statement of Basis is for information and justification of the draft permitting decision only. The Arkansas Department of Environmental Quality (ADEQ) hereby issues a draft denial of the application for Arkansas Pollution Control and Ecology Commission (APC&EC or "Commission") Regulation 5 Permit 5264-W, AFIN 51-00164."

I begin my comments by including the passionate words of Dr. Kenneth Smith, author of the book, *Buffalo River Country*, a timeless narrative of the Buffalo National River and its hinterlands, reflecting on its scenery, geology, flora, fauna, history, and archaeology. He served for many years as the park's master trail planner and trail builder with a long term vision for the Buffalo National River. Listen to his speech at the Arkansas State Tourism convention where he was honored and inducted into the Tourism Hall of Fame in 2017. https://vimeo.com/208539794

I include by reference the comments of the Buffalo River Watershed Alliance and the ADEQ draft denial of the permit. Since the Buffalo National River is designated as an Outstanding National Resource Water and Extraordinary Resource Water, it is subject to more stringent water quality standards than many other streams. Because most essential bases have been evaluated extensively by both ADEQ and BRWA, I will focus here on the frequently neglected aspect of the least considered, the threatened, endangered, and rare species that are essential to the integrity and future of the Buffalo National River and the sustainable fabric of its watershed. Having been labeled an "extreme elitist economic environmentalist" by some, I can only say in defense that the river cannot speak for itself, its lifeforms and the creatures that depend upon it can't speak for themselves, and so I volunteer to speak for them. Although given a nod in the Environmental Assessments (EA) that have been submitted for loan guarantees for the C&H operation, they have not been examined thoroughly as to the parts they play in maintaining the quality of the water or the watershed.
A federal court district judge ordered a "harder look" than was taken in the cursory "checklist" EA submitted for C&H's CAFO loan. (https://buffaloriveralliance.org/Resources/Documents/C _ H Hog Farms Inc EA _ FONSI 26 Sept 2012.pdf) The second EA contracted by the Farm Services Agency (FSA) and the Small Business Administration (SBA) with an Australian firm, Cardno-GS and Ecosphere Environmental Services, a New Mexico firm specializing in the western United States to draft a new EA, also turned out to be flawed for many reasons. The "deeper look" Cardno took was incomplete and shallow as we now know. Subsequent information has come to light that negates its determinations about C&H's location in karst terrain and its role in affecting the watershed's critical habitat for these rare and important species.
(Cardno EA, 3-30-3-32: https://buffaloriveralliance.org/Resources/Documents/Aug 2015 Draft EA on remand.pdf)

Exhaustive studies show that the wilderness habitat that these species depend upon for their lives is dwindling and being segmented, divided into pieces due to disruptive factors we all recognize, agriculture, logging, construction of homes and cabins, etc. However, the added impairments attributable to runoff from a single liquid waste swine CAFO from the excessive manure applied to fields and from leakage through underground karst channels as recharge into the Buffalo National River (BNR) and Big Creek may well be the critical factors in these species' continued existence in this watershed. The degradation of the waters affected by the waste, the extensive algal cover, increased pathogens, heavy metals, and low dissolved oxygen content may be the environmental "straw that breaks the camel's back", so to speak. People often negate the importance of the loss of some little-known fish, or bat, or mussel. They see plenty of wildlife but don't recognize that entire chains of predator/prey relationships rely upon a balance that has emerged in the present design we see in a particular forest or waterway. We need reminders that we have been charged as stewards to care for living creatures. When the least of these has its very existence threatened, our nation has established laws and practices that help us to protect and sustain them again.

Here in the BNR watershed, because of its many caves, clear streams and hardwood forests, several threatened and endangered species of bats find refuge. At night they forage up to 10 miles over the creeks and in the woods to feed on insects. White Nose Syndrome (WNS), a fungus that has decimated bats across America, found its way in 2014 to the BNR watershed as a new threat. The combination of the spread of WNS, along with reductions of their highly sensitive macroinvertebrate insect prey, may wipe out these beneficial mammals. The Gray, Long Nose, and Indiana bats feed primarily on Mayflies and other key macroinvertebrate insect species that thrive only in pristine watersheds along streams such as Big Creek and the Buffalo River. There are at least thirteen known caves and innumerable pockets and crevices in the Boone formation along the Big Creek and its Left Fork that serve as ideal roosts and hibernarium for these bats. In the Buffalo River watershed more than 440 caves and over 500 springs draw them here. (See Caves map NPS below.) The smaller colonies, because of their relative isolation away from the bigger caves where WNS infects large populations and has been so deadly, may be the rare survivors. The threat of added endangerment from microcystins contained in abundant algal growth in the Buffalo National River is another factor of concern for bat survival. The bats dine on the arthropods that are affected and declining because of this exponential increase in algal cover. In studies of bats in algae infested waters, as bats dip down to drink the water and forage for insects above a waterway, researchers have found them coated with green algal slime which appears to have suffocated them. If that was not the cause of death, then the accumulation of mycrocystin toxins from the insects they ate poisoned them from within. (See "Mortality of Little Brown Bats (Myotis lucifugus carissima) Naturally Exposed to Microcystin-LR" Journal of Wildlife Diseases, 55(1), 2019, pp. 000–000 Ó Wildlife Disease Association 2019.) (See also, "Survey of Threatened and Endangered Bat Species on Big Creek" by James W. Gore" Link: https://buffaloriveralliance.org/Resources/Documents/Ex 3 - Gore FINAL - truncated version, reduced size.pdf"Survey of Threatened and Endangered Bat Species on Left Fork of Big Creek by James W. Gore" Link: https://buffaloriveralliance.org/Resources/Documents/Bat Survey Left Fork Final-2.pdf (Comments F3 and F4 pp. 98-104, BRWA comments.)

The following excerpts and tables from the FSA/SBA Cardno Environmental Assessment (https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/Environ-Cultural/fonsi_hog_farms_final_assesment.pdf) show the dismissive and inaccurate evaluations made about Ozark endangered and threatened species, especially as relates to the complicated BNR karst terrain and its unique fit to enable the survival of these species. (pp. 32-47). In addition, the analyses in this EA document must now be reappraised since subsequent findings and information brought forth during the past few years have proved its conclusions and predictions false. Please take the time to review the assessments in that report. It is time to reconsider the effects impaired water quality has on these endangered species.

From the Cardno EA: “The presence of foraging bats on the C&H Hog Farms or the application fields does not mean that they would be adversely impacted by the farm operation. The C&H Hog Farms operation is not expected to inhibit or modify the movement of foraging bat species that may forage in the area.” After several years of scientific water quality monitoring since then, we now know that when fields are smothered in excessive waste applications of phosphorus and nitrates, pathogens and nutrient runoff negatively affect the water quality of tributary Big and Left Fork creeks as well as the Buffalo.

“Significant changes in water quality could adversely affect macroinvertebrate populations occurring in Big Creek, which indirectly could affect bat species through a reduction in prey base. However, no measureable adverse impacts to surface water quality in Big Creek have been identified based on the BCRET and NPS water quality monitoring data. Therefore, no effects to Indian bat, gray bat, or northern long-eared bat are expected to result from the proposed action. The four bat species are included in Table 3-3, but are not analyzed further” in this Cardno document.

In addition, consider the blanket statement in the report, *“There are no caves within the C&H Hog Farms facilities including the application fields* in the table below.” We know that no adequate geotechnical investigations have been made to determine that conclusion. We do know that there is a doline feature beneath at least one of the fields from ERI test results and that the Harbor borehole drilling has revealed the convoluted nature of underground geology beneath the waste ponds and spreading fields, showing voids and epikarst channels. Note that Cardno states in the table below that the Gray, Indiana, Ozark big-eared, and Northern long-eared bats bat were recorded in the Big Creek and Left Fork areas. These bats forage for miles in the woods and they winter in local caves, John Eddings Cave being one example. (See attachment #1 for extent of caves in the BNR watershed.)

Mammals				
Gray bat *(Myotis grisescens)*	Endangered	Inhabits caves year-round. Occupies cold hibernating caves or mines in winter and warmer caves during summer (USFWS 2009).	There are no caves within the C&H Hog Farms facilities including the application fields. The nearest recorded location used for summer roosting by transient gray bats is approximately 2.75 miles from the farm (NPS 2015a, 2015b; USFWS 2015c). This species was recorded in summer 2015 as occurring in the action area on Big Creek and the Left Fork of Big Creek (Gore 2015a, 2015b).	Yes
Indiana bat (*Myotis sodalis*)	Endangered	Hibernate during winter in caves or, occasionally, in abandoned mines. During summer roosts under the peeling bark of dead and dying trees (Federal Register 2007).	There are no caves or contiguous old-growth forests within the within the C&H Hog Farms facilities including the application fields. This species was recorded in summer 2015 as occurring in the action area on Big Creek and the Left Fork of Big Creek (Gore 2015a, 2015b).	Yes

Species	Status	Habitat Associations	Potential to Occur in the Action Area	Eliminated from Detailed Consideration
Northern long-eared bat (*Myotis septentrionalis*)	Threatened	Summer roost habitat is generally correlated with old growth forests composed of trees 100 years old or older with low edge-to-interior rations. Hibernates in caves or inactive mines (Federal Register 2011).	There is no suitable roosting or hibernacula habitat within the C&H Hog Farms facilities. The nearest hibernaculum location used is approximately 4 miles from the farm (NPS 2015a; 2015b, USFWS 2015c). This species was recorded in summer 2015 as occurring in the action area on Big Creek and the Left Fork of Big Creek (Gore 2015a, 2015b).	Yes
Ozark big-eared bat *(Corynorhinus [=Plecotus] townsendii ingens)*	Endangered	Associated with caves, cliffs, and rock ledges in well-drained, oak-hickory Ozark forests (USFWS 1995).	There is no suitable roosting or hibernacula habitat within C&H Hog Farms facilities. This species recorded approximately 3.8 miles from the farm in December 2014 (NPS 2015a; 2015b, USFWS 2015c).	Yes

Besides the demise of bats serving as the "straw that broke the camel's back" in this ecosystem, we have the lowly mussels as a precarious "canary in the coal mine" for the integrity of the Buffalo National River which has been designated "critical habitat" by the Department of Interior for the Rabbitsfoot mussel Theliderma cylindrical and the Snufflebox mussel. (Federal Register/Vol. 80, No. 83/Thursday, April 30, 2015/Rules and Regulations.) These mussels are threatened throughout their rapidly shrinking range in the Buffalo National River. With the exponential growth of algal blooms stretching for 70 miles along the river sections, including those where they live, these vulnerable species are at severe risk. The continued presence and vitality of filter feeding mollusks plays its role in the sustainability and health of this prime outstanding resource water habitat. See the table below from the Cardno FSA/SBA EA.

Species	Status	Habitat Associations	Potential to Occur in the Action Area	Eliminated from Detailed Consideration
Clams				
Rabbitsfoot mussel *(Quadrula cylindrica cylindrica)*	Threatened with Designated Critical Habitat	Found in small- to medium-sized streams and some larger rivers. It usually occurs in shallow water areas along the bank and adjacent runs and shoals with reduced water velocity. May occupy deep water runs, 9 to 12 feet of water. Bottom substrates generally include gravel and sand (Federal Register 2012c).	From the confluence with Big Creek, the nearest rabbitsfoot mussel recorded occurrence is approximately 26.6 river miles downstream on the Buffalo River (USFWS 2015b).	No
Snuffbox mussel *(Epioblasma triquetra)*	Endangered	Found in small- to medium-sized creeks to larger rivers, and in lakes. Occurs in swift currents of riffles and shoals and wave-washed shores of lakes over gravel and sand with occasional cobble and boulders (Federal Register 2012a).	From the confluence with Big Creek, the nearest snuffbox mussel recorded occurrence is approximately 81 river miles downstream on the Buffalo River (USFWS 2015b).	No

One species that draws visitors and serious fishermen to the river is the Smallmouth Bass. This sport fish requires the clean, high quality waters that the mussels serve to filter. Although Smallmouth Bass transition their diets toward eating more fish as they grow, all rely almost exclusively on insects for their diet as juveniles. See table 5 and descriptors pp. 29-32 of the Assessment Methodology. Sensitive arthropods are accounted for in the Hilsenhoff Biotic Index and Mayflies make up the E in EPT (Ephemeroptera, Plecoptera, Trichoptera; aka mayflies, stoneflies, caddisflies) metrics. They rank in the highest, least tolerant species category on the Aquatic Life Designation, and are very important for many species of fish, including the coveted Smallmouth Bass. In this article from the UK, Mayflies are a tipping point for pollution. Arkansas' assessment tool measures them, and bats depend on these highly sensitive macroinvertebrates for their survival. The ripple effects of deleting entire species from the BNR food chain affects other species dependent on the makeup of this long established pristine habitat. It is reasonable to predict that they will also suffer detrimental consequences from the same distressed water quality that threatens the continued survival of these target species. "At levels very close to existing guideline limits - 25mg per litre of fine sediment and 0.07 mg/l of phosphate - the researchers found 80% of the (Mayfly) eggs died."
https://www.theguardian.com/environment/2018/jan/11/insect-declines-new-alarm-over-mayfly-is-tip-of-iceberg-warn-experts

This serves to remind us that the Buffalo River must be protected from excess nitrogen and phosphorous running off from agricultural over application, and recharge into the Buffalo mainstream through subsurface karst channels and springs. The resultant algal growth changes the make-up of the water and its oxygen supply, clouding the light with its mats and covering the bottoms with residual degradation and excretions. Sewage algae and long strands of bright green algal slime stretch unrelenting through the once sweet water. Low dissolved oxygen interferes with breathing for blue ribbon Smallmouth Bass and other key species that live in the streams. "Dissolved oxygen deficiency is the most common and overarching measure of water quality because dissolved oxygen is critical for many forms of aquatic life that use oxygen in respiration, including fish, invertebrates, bacteria and plants." (Read more at: https://phys.org/news/2018-10-watershed-groups-positive-impact-local.html#jCp).

When considering impairment of the river:
"Under Reg. 2.509 Nutrients
(A) Materials stimulating algal growth shall not be present in concentrations sufficient to cause objectionable algal densities or other nuisance aquatic vegetation or otherwise impair any designated use of the waterbody. Impairment of a waterbody from excess nutrients is dependent on the natural waterbody characteristics such as stream flow, residence time, stream slope, substrate type, canopy, riparian vegetation, primary use of waterbody, season of the year and ecoregion water chemistry."

During the past three years, the Buffalo National River has experienced significant algal blooms primarily downstream of the confluence of the Big Creek at Carver on the Buffalo. A University of Arkansas extension publication on soil phosphorus, (with authors including Dr. Andrew Sharpley leader of the BCRET water monitoring team) describe the problem of continued applications of waste as fertilizer on increased algal growth:

The repeated application of manure at rates meeting plant N needs will increase soil test P levels.

A large amount of research between 1985 and 2000, showed that as STP increased, especially in the top 2 to 4 inches of soil, so did the concentration of soluble P in runoff (Figure 1). While conservation programs and improved pasture management and productivity were decreasing total P losses, research found that more of the P that was moving was in a soluble form, which was immediately available for algal uptake. This exacerbated the frequency and occurrence of nuisance algae blooms in freshwater lakes and reservoirs. In most cases, biological productivity (or eutrophication) is accelerated by P inputs because N and carbon can freely exchange between air and water and some blue-green algae can fix atmospheric N.

Research shows as soil test P increases, so does the concentration of P in runoff.

Soil Phosphorus: Management
Sharpley, Daniels, Vandevender, Slaton
U of A Extension Service UAEX Publication #9528. #1029
FSA1029-PD-9-10RV

"The repeated application of manure at rates meeting plant N needs will increase soil test P levels.
A large amount of research between 1985 and 2000, showed that as STP increased, especially in the top 2 to 4 inches of soil, so did the concentration of soluble P in runoff (Figure 1). While conservation programs and improved pasture management and productivity were decreasing total P losses, research found that more of the P that was moving was in a soluble form, which was immediately available for algal uptake. This exacerbated the frequency and occurrence of nuisance algae blooms in freshwater lakes and reservoirs. In most cases, biological productivity (or eutrophication) is accelerated by P inputs because N and carbon can freely exchange between air and water and some blue-green algae can fix atmospheric N."

"Growers with confined livestock and poultry operations import feed onto the farm. This feed contains P at nationally recommended dietary levels for healthy animals to maintain bone structure

strength, reproduction, etc. However, as only about 30 percent of that P is absorbed by the animal, most of the dietary P passes through the animal and is excreted in manure."

Dr. Sharpley also discusses phosphorus in this video. The Role of Phosphorus Management - January 30, 2015 Youtube presentation from Maryland Phosphorus Symposium. Quote from approximately 32;00: "**We can't expect cheap food and clean water at the same time.**" He points out that phosphorus causes acceleration of algal growth and the eutrophication of water zones.
https://www.youtube.com/watch?v=0lvkRwXpZYY&feature=youtu.be

Everyone has heard of the butterfly effect. In the river the choice of a single threatened "butterfly" species is impossible to make. It is now apparent that the lack of dissolved oxygen, the surplus of nutrients (nitrates and phosphorus), the resultant slimy strings and mats of algae, and excess pathogens, change the life stream of each of its most sensitive inhabitants. The river's designation as an Outstanding Natural Resource water, and "primary contact" EPA category should provide protections for the health and lives of all creatures great and small that need, enjoy and rely on its clean water, from Mayfly to human child.

The human end of this habitat chain feels the effects when small towns and businesses lose their appeal for customers and residents. When no one visits the watershed, where will the residents find work? Not everyone wants to work in a confined animal feeding operation. Restaurants, cabins, and gift shops can't provide jobs if no one comes to view or play or fish on the River. Too many other communities have already experienced this downward spiral. When the waters cloud and stink, people turn to other venues for their work and recreation. Children move away to the cities and communities begin to die.

Although Farm Bureau, Pork Producers, JBS and C&H itself posit its operation as a state of the art poster child family farm, C&H has not submitted adequate information to the ADEQ or the people of Arkansas that demonstrate that it is not impairing the Buffalo National River. Information in the form of a groundwater flow direction dye tracing studies is missing. (See photograph below from the Harbor Drilling Report showing calcite crystals formed in an underground void discovered between 18.5-28 feet below ground surface from a single borehole.) There simply are not sufficient geotechnical investigation results that portray the inherent karst geology as an acceptable operation location. Storm water monitoring data is needed of run-off from the site and the waste application fields currently in use, including EC Farms liquid waste application fields (which are also in the BNR watershed and along its key tributaries). Since most runoff occurs during flash flooding and storm events this kind of monitoring is essential to accurately assess accurate nutrient management plan application practices. If there is insufficient information submitted by the C&H operation showing that its facility, storage ponds and application fields will function as projected in its application, then this new Reg 5 permit must be denied, the site closed, and removed from the BNR watershed's karst hydrogeology.

Besides the references I include below, I would like to comment on the argument that C&H makes that no other facilities have received the scrutiny it has received, that it is being singled out for unfair and unprecedented treatment, and held to higher standards than any other swine CAFO in the state. The Arkansas regulations are written and publicly available for anyone to read. C&H is applying for a new permit under this regulation, and it must be treated as a new permit. It is clear that the permit application does not meet its criteria. It is irrelevant whether they ask to be compared to other permits that exist under Reg 5. This is an individual, site specific, no discharge permit. With this crucial permitting decision, ADEQ is using the state's regulations to protect the waters and health of the people of Arkansas at this specific site. That C&H sits in a karst hydrogeologic setting and that its proximity and operations affect the Buffalo National River require it to be examined thoroughly. C&H may not have realized that this location is unique and extremely valuable to the integrity of the designation of the outstanding resource water quality of the Buffalo National River, but the reality remains that it is. It isn't comparable to the other locations of swine CAFOs in the state. The combination of problems that its location creates is unprecedented for Arkansas. It's application for a permit is for a site that ADEQ has

indicated the agency cannot defend because of the huge quantities of unknown factors it involves. The watershed of the Buffalo serves as a top tier assessment category against which water quality degradation for the rest of state is compared. The lives of its inhabitants, even the lowliest and least tolerant of insects, truly contribute to its stability and sustainability. C&H is certainly not the only factor in the increased problems affecting the river, but it is the single largest factor contributing to the degradation, and it has been documented during the river's rapid decline over the past five years. Much needs to be addressed and remedied to improve the water quality of the Buffalo National River. However, this is a single application for an individual permit must be held to the requirements of the regulation and denied.

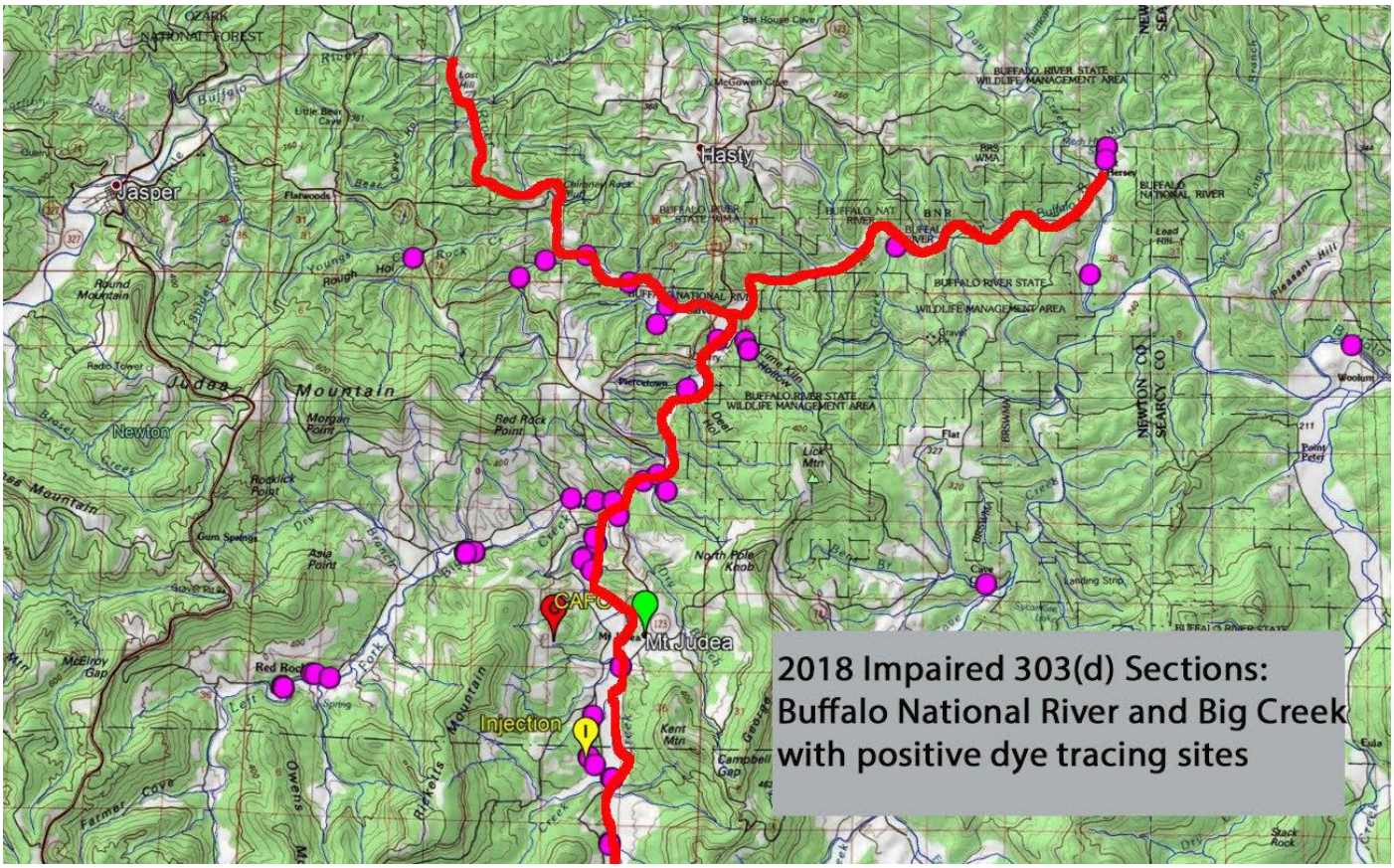
So, the lowly mussel, the intolerant Mayfly, and the quirky bats have a tale to tell us about what happens when we live as if we were wearing blinders, seeing only the scenes we prefer. We must pay attention to the least of these creatures, and examine how they relate to our own state's future, and that of its natural resources. If we keep our eye on the sparrow, (or in this case the bat, the mussel and the Mayfly), if Arkansas focuses on the narrow turquoise sliver in the middle of its portion of America, then our most unique and vulnerable ecosystem will prosper. It is a last refuge for its most susceptible inhabitants. If we are good stewards, we will have fresh water in our wells, fresh air to breathe, abundant wildlife, and the indescribable beauty that draws almost a million people to visit every year, where they, too, can take in that rarer and rarer vision of a watershed intact, creation preserved and flourishing. By no stretch of the imagination or objective scientific review can swine Confined Animal Feeding Operations be a fit for the spectacular and singular karst environment of the Buffalo National River.

Sincerely,

Marti Olesen
P.O. 104
Ponca, AR 72670

I include the following references to support my comments:

- Overlay of two maps showing the 303d impaired waters (red) in the watershed and the dye trace results (pink) of Dr.Van Brahana's investigation of dye receptor sites from a well close to the C&H operation. One site was 12 miles from the injection and others showed a lateral movement under a mountain to the Left Fork of Big Creek. This is included to show the utter unpredictability of karst hydrogeological connections in the C&H vicinity.



Harbor Drilling Report, subsurface investigations show calcite crystals formed inside a void formation demonstrating inadequacy of thorough geotechnical investigations into the hydrogeology of the operation's karst terrain: photos #11 and 12:

Photo #:	12	Date:	9/21/16	Time:	1415	Photographer:	C. Yeatman
Description:	Core recovery from 18.5 to 28.5'						



Photo #:	11	Date:	9/21/16	Time:	1415	Photographer:	C. Yeatman
Description:	Core recovery from 18.5 to 28.5'						



- **Dr. Bert Fisher Expert report** concludes: “C&H Hog Farms’ failure to conduct an appropriate field assessment of all land application sites contemplated in C&H Hog Farms Regulation 5 permit application, including, but not limited to, soil thickness and water capacity alone would have been sufficient grounds to deny issuance of a Regulation 5 permit to C&H Hog Farms. As a consequence of C&H Hog Farms’ failure to conduct appropriate and required geological investigations the record developed by C&H Farms in support of their Regulation 5 permit application lacked necessary and critical information to support granting C& H Farms a Regulation 5 permit. The requirements to obtain a permit under Regulation 5 are minimum 105 of 132 standards. The permit application submitted by C&H Hog Farms did not meet the minimum standards required by Regulation 5. ADEQ properly denied issuance of a Regulation 5 permit to C&H Hog Farms.”

- **National Park Service, USGS analysis:**

  Tourism to Buffalo National River Creates $71.1 Million in Economic Benefits Harrison, Arkansas – A new National Park Service (NPS) report shows that 1.5 million visitors to Buffalo National River in 2017 spent $62.6 million in communities near the park. That spending supported 911 jobs in the local area and had a cumulative benefit to the local economy of $71.1 million. "Buffalo National River is pleased to welcome a diverse group of visitors from across the state and around the country," said Acting Superintendent Laura Miller. "In addition to the recreational opportunities available at Buffalo National River we are happy to share the park's natural and cultural resources with our visitors. It is our hope that local communities continue to benefit economically from the tourism that is generated by the park." (The peer-reviewed visitor spending analysis was conducted by economists Catherine Cullinane Thomas of the U.S. Geological Survey and Lynne Koontz of the National Park Service.)

- **Buffalo River Watershed Alliance Comments:**

- pp.40-41, BRWA comments: Regulation 5.404 Subsurface Investigation Requirements states:

“The subsurface investigation for earthen holding ponds and treatment lagoons suitability and liner requirements may consist of auger holes, dozer pits, or backhoe pits that should extend to at least two (2) feet below the planned bottom of the excavation.”

The AWMFH 651.0704(4) Guide to detailed geologic investigation page 7-21 goes further suggesting the following for sampling the subsurface where ponds are planned. This is noted as to be particularly applicable for complex and inconsistent environments such as karst.

“For structures with a pool area, use at least five test holes or pits or one per 10,000 square feet of pool area, whichever is greater. These holes or pits should be as evenly distributed as possible across the pool area. Use additional borings or pits, if needed, for complex sites where correlation is uncertain. The borings or pits should be dug no less than 2 feet below proposed grade in the pool area or to refusal (limiting layer).”

The original NPDES Reg 6 NOI specifies pond area in section C2 “design calculations” as follows:

• Top of Waste Storage Pond 1 20,857 Square feet
• Top of Waste Storage Pond 2 35,262 Square feet

It should be noted that the Reg 5 permit application specifies different square footage areas for the two ponds than the original NOI. Likewise the application also specifies square footage for a total drainage area. None of these figures agree, but for the purposes of this comment they do not vary enough to make a

difference.
The original NPDES Reg 6 NOI shows records for three borings in the Geologic Investigation document. These are numbered B-1, B-2, B-3. Only B-2 and B-3 were in the area of the ponds (see Comment C3). Using the guide from AWMFH page 7-21(4), there should have been at least 6 distributed borings if "pool area" is interpreted as encompassing both pools. More borings if "pool area" is interpreted as per pool. It is unclear how much latitude Chapter 7 provides the engineer regarding the detailed investigation. Certainly the risk factors were present to justify the AWMFH recommendations. The fact that the engineer recognized that drilling two holes was important but chose not to follow AWMFH guidance for the recommended number in the pond area suggests that the geologic investigation in this permit application is not proportional to the risk factors as discussed in Part A. The sensitivity of the watershed calls for the detailed geologic investigation to be revisited.

- pp. 50-52, BRWA comments:

The indication of epikarst at 13.8 to 28 ft below ground level confirms porous weathered rock at a depth that is above the floor of the ponds with the pond #2 invert at 20 ft below the surface of where the bore hole was drilled (See Appendix C12 for elevations). The AWMFH table 10-D in Appendix 10D (Appendix C-10 of this document) notes the following regarding karst in the Vulnerability to Risk matrix when siting a facility: "large voids e.g. karst, lava tubes, mine shafts) as a very high vulnerability suggesting that the engineer "Evaluate other storage alternatives". No such alternatives were considered. As a result, this permit does not comply with AWMFH guidance.

What we know for certain is that there is at the very least 23.6 cubic ft area of subsurface open space at a depth of 20 to 28.5 ft where drilling water was lost and where the grout would not rise. The elevation of where the bore hole was drilled was about 914.3 ft (see Appendix C12 page 2) which means the subterranean opening occurred at an elevation between 894.3 and 885.8 ft (where water was lost) or 889.3 (where grout would not rise). The elevation of the floor of Pond #2 is 894.3 ft which places a clearly identified opening of some sort roughly even with the floor of pond 2 or a few feet below.
AWMFH table 10-4 (Appendix C10) that identifies vulnerability to risk, lists "Large voids (e.g, karst, lava tubes, mine shafts) OR highest anticipated ground water elevation within 5 ft of invert" as a "Very high" vulnerability and suggests Evaluate other storage alternatives.
In AWMFH Appendix 10-D under When a liner should be considered the following is stated:
"Some bedrock may contain large openings caused by solutioning and dissolving of the bedrock by ground water. Common types of solutionized bedrock are limestone and gypsum. When sinks or openings are known or identified during the site investigation, these areas should be avoided and the proposed facility located elsewhere."

- p. 54 BRWA comments:

AWMFH 651.0701 Overview of geologic material and groundwater under Aquifers page 7-7 says this about perched aquifers:
"A perched aquifer (fig. 7–8) is a local zone of unconfined groundwater occurring at some level above the regional water table, with unsaturated conditions existing above and below it. They form where downward-percolating groundwater is

blocked by a zone of lesser permeability and accumulates above it. This lower confining unit is called a perching bed, and they commonly occur where clay lenses are present, particularly in glacial outwash and till. These perched aquifers are generally of limited lateral extent and may not provide a long-lasting source of water. Perched aquifers can also cause problems in construction dewatering and need to be identified during the site investigation."

- p. 70 BRWA Comments:

The approved pond liner retrofit is of notable concern as it is possible that ADEQ will view this as a solution to the comments in Part C regarding geological issues, and also Part D regarding degradation. Unfortunately, not only does a synthetic liner at this stage present unique risks, it would not satisfy the very serious vulnerabilities identified by comments: C10, C11, C12, and C13. It has been subsequent to the pond liner modification approval that indications of subsurface karst, epikarst, voids, fractures, and perched groundwater have been revealed by Dr. Halihan's ERI transects and validated by the Harbor Environmental drilling exercise. These risks were unknown at the time ADEQ approved the synthetic liner permit modification in June of 2014. When the circumstances of each of these four comments (C10 thru 13) are applied to the AWMFH Appendix 10D vulnerability to risk matrix (Appendix C10 of this document) the vulnerability is identified as "very high" and the recommendation is: -"Evaluate other storage alternatives". The 10D vulnerability to risk matrix is not suggesting mitigation of the impoundment, but that it never should have been constructed at that location based on the risk factors present.

The take-away is that ADEQ's approved synthetic liner modification is now outdated because of what has come to light in recent studies. The approval of the pond liner modification should be rescinded.

- The AWMFH devotes the entirety of Chapter 7 to guidance around "Geologic and Groundwater Considerations". AWMFH 651.0702 Engineering Geology Considerations in Planning states the following under Part (I) Topography:

"Karst topography is formed on limestone, gypsum, or similar rocks by dissolution and is characterized by sinkholes, caves, and underground drainage. Common problems associated with karst terrain include highly permeable foundations and the associated potential for groundwater contamination, and sinkholes can open up with collapsing ground. As such, its recognition is important in determining potential siting problems."

- Regulation 5.404 Subsurface Investigation Requirements reads as follows:

"The subsurface investigation for earthen holding ponds and treatment lagoons suitability and liner requirements may consist of auger holes, dozer pits, or backhoe pits that should extend to at least (2) feet below the planned bottom of the excavation."

- p. 97 BRWA comments

ADEQ describes the proposed impairment of Big Creek and the Buffalo in the following response to comments on the Regulation 5 permit from January:

"ADEQ considers all readily available data to determine the status of water quality in Arkansas and to identify waterbodies that fail to meet standards defined in APC&EC Regulation 2. ADEQ recently completed water quality assessments for the development of

a proposed 2018 303(d) List and 305(b) Integrated Report as required by the Clean Water Act. In the Buffalo River Watershed, four Assessment Units (two sections of Big Creek and two sections of the Buffalo National River) have been identified as impaired: three for bacteria, and one for dissolved oxygen. Based on data for submitted by USGS for the 2018 303(d) list, ADEQ proposes listing Big Creek (AR_11010005_022) as impaired for dissolved oxygen."

- pp.108-109, BRWA comments

BRWA concurs with Professional Geologist Tom Aley's analyses, and especially that: "Given the abundance of karst features beneath the land application fields, it is my opinion that, if waters of the state are to be protected from manure contamination, then the fields associated with the C&H Hog Farms are not suited to land application of liquid hog manure"....
We concur with Professional Geologist Tom Aley that the AWMFH (p. 2-8) requires that investigations into groundwater must be made to map and determine direction of flow and receiving stream locations, as well as hydraulic gradient. (Appendix 7A)

- **Tom Aley Expert report**:

- pp. 41-42 BRWA agrees with Professional Geologist Tom Aley's assessment that discrepancies in the depth to bedrock borings reported by the DeHaan engineer and the boring log recorder show that such a hasty and unchecked process does not meet the AWMFH requirements for a site investigation beneath the waste storage ponds. Aley suggests that instead of a site investigation into the karst suitability for siting a facility, this was merely a probe to find suitable clay soils to be used in constructing the liners. He also states that the borings did nothing to confirm they had delved 10 feet into bedrock, that instead of ascertaining bedrock, the auger could very well have encountered a large rock or pinnacle, as is common in epikarst.

- pp. 45-48 BRWA comments

We agree with Professional Geologist Tom Aley's response to the DeHaan analysis of the clay liner composition. Instead of the fatty clay the firm describes, the results from the boreholes used to determine the suitability of the clay for liner material reports clayey gravel with sand and chert fragments. There were no sieve size measurements so the chert and gravel amounts are unknown in the clays used from this source.

- p.115 BRWA comments:

-The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. Additionally, ground penetrating radar studies demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3. Geotechnical investigations are necessary to demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed investigations.

- **ADEQ's assessment, pp.111-116**

p. 111 ADEQ's assessment:
A facility located in a sensitive geologic area must have an Emergency Response Plan to address any failure of the waste containment system. Section 651.0204(a) of the AWMFH requires facilities with waste impoundments with embankments to consider the risk to life, property, and the environment should the embankment fail. Pursuant to Section 651.0204(b) of the AWMFH, a thorough geologic investigation is essential as a prerequisite to planning seepage control for a waste impoundment. The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH.

p.112
The necessary geotechnical investigations have not been performed at this facility in accordance with the AWMFH Section 651.0704(b)(4), Section 651 Table 10-4, and Appendix 10D. Additionally, ground penetrating radar studies demonstrate the necessity of full geotechnical investigations at all land application sites in accordance with AWMFH 651.0504 (a)–(n) and Table 5-3. Geotechnical investigations are necessary to demonstrate that this facility is not contributing to water quality impairments of Big Creek and the Buffalo National River. The proposed listing of Big Creek and the Buffalo National River as impaired further illustrates the need for these detailed investigations.

-A groundwater flow study has not been submitted to the Department for review. The Department has no knowledge of any groundwater studies that may have informed the placement of the interceptor trenches. The information on the interceptor trenches provided in the BCRET Quarterly Report for July 1 to September 30, 2014 is not sufficient to determine the appropriateness of the placement of the interceptor trenches for the purpose of monitoring leakage from the waste storage ponds. At this time, the Department does not have sufficient information to comment on the appropriateness of placement of the trenches or on the sufficiency of those trenches as a monitoring system for the waste storage ponds.

- **Director Keogh's deposition**:

p 117 When asked about consideration of alternatives to a denial of the C&H Reg 5 permit application, Director Keogh recalls team discussion about the possibility of using a conditional permit with a "Schedule of Compliance" that listed detailed information that could be submitted by the applicant. ADEQ made the decision not to utilize this alternative because the record of information was too incomplete to demonstrate compliance with Reg 5. (pp. 21-24)
In a meeting with Governor Hutchinson about the C&H Reg 5 denial decision prior to issuing it, Director Keogh relates that her administrative superior, the Governor, was aware and supported the decision to deny the permit. (pp. 27-28)
BRWA supports the ADEQ decision to deny this permit that was reviewed by the Governor before it was issued, including the explanation of the reasons the permit application record was incomplete. (p. 32)
Director Keogh was questioned about when the so called "Blanz memo" was made available to C&H. BRWA agrees with the ADEQ that the decision to deny the permit was based on the terms of Regulation 5 and that applicants have the responsibility to adhere to the regulation and the AWFH and the Technical Guide that Reg 5 includes, and to submit the information required for the ADEQ to consider when evaluating an application. (pp. 58-59)

- **Katherine McWilliams deposition**

pp.117-118 BRWA points out that many concerned individuals took the time and effort to read the entire Regulation 5, and the AWMFH and technical guide it relies upon in order to see if the C&H permit application satisfied the Reg 5 liquid swine waste conditions. The C&H owners and/or the engineers and experts they relied upon for making sure their permit would be incompliance with the regulation could certainly have done the same. As Katherine McWilliams confirmed in her deposition, the AWMFH and technical guide are comprehensive.

- p. 15: BRWA agrees with McWilliams statement that the Reg 5 permit is an individual permit in the state of Arkansas and that Reg 5 permits rely upon the site specific conditions in the AWMFH and the technical guide. When asked about Dr. Blanz's added conditions, she responded: "So it's an individual permit (Reg 5) there were some individual conditions, specific conditions added... for the facility."

pp. 41-43: McWilliams confirms that based on comments ADEQ received, they (questions about the technical completeness of the permit) could not be adequately answered without additional information, which had not been provided by C&H. She explains that additional information would have been from the geologic investigation from the handbook.

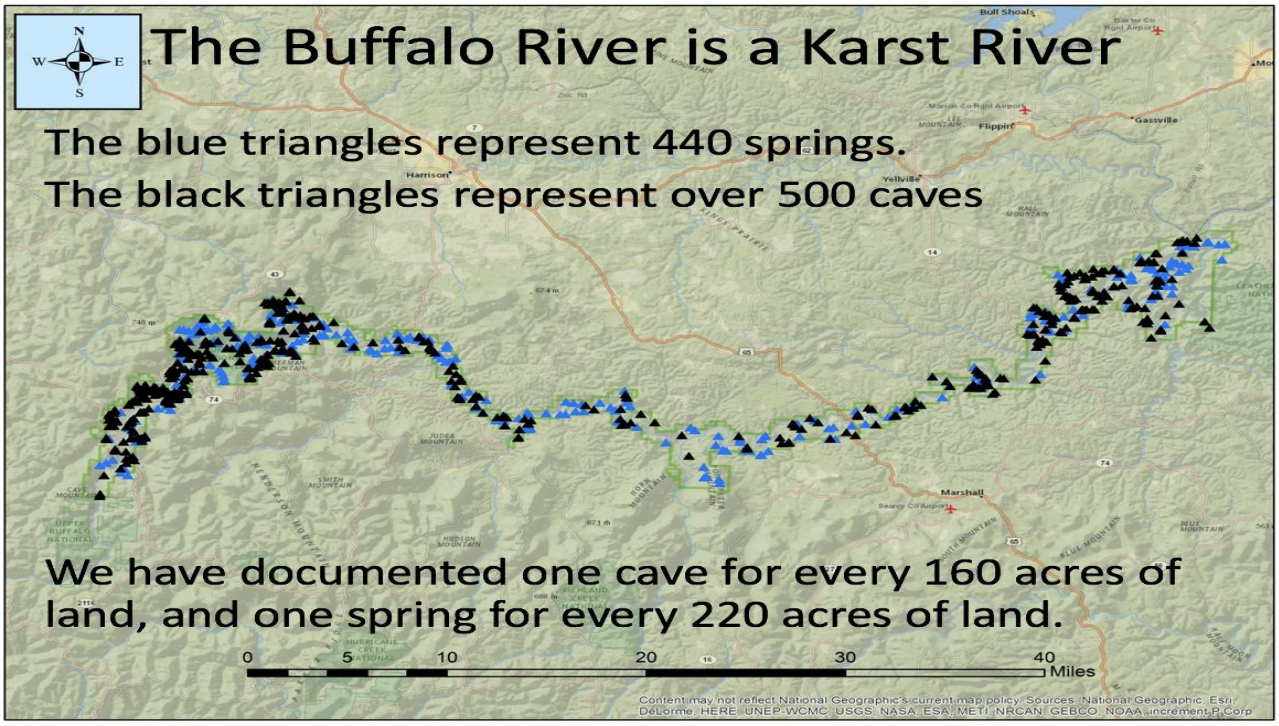
pp. 46-48: When asked about a groundwater flow direction study and waste storage pond, McWilliams says it referred to the AWFMH, Chapter 7, and would have been included as part of the geologic investigation information for the site which was requested by ADEQ.

pp. 53-54: When asked about the compaction test and permeability analysis of the pond liner, McWilliams says it was part of the "as built" supplemental information requested by ADEQ.

- p.126 Dr.Blanz deposition

The seepage calculations are in the C&H application and the manual calls for seepage.
Dr. Blanz:
"**The seepage, of course, is the same as a leak**, but a leak could be also from when the pond is pumped down periodically to remove the waste and get the solids. There was not enough information provided in the application to know if the ponds were built properly". (p. 165)

- **Caves map, National Park Service**:



- **Buffalo National Park 40 point letter, 2013, to the Farm Services Agency written in response to FSA/SBA Environmental Assessment.**

  This includes information about the threatened and Endangered Species that must be protected and their threatened habitat, as well as many other warnings of environmental impairment that have since occurred after the erroneous original permitting of this CAFO in 2012. NPS Letter, See pp. 10-11