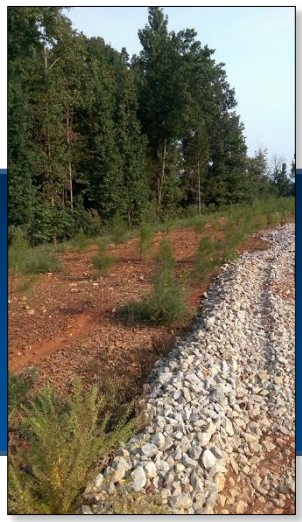
Draft Biological Assessment

C&H Hog Farms
Reference # TA0629

Prepared for:

United States Department of Agriculture
Farm Service Agency and
United States Small Business Administration

October 2015



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ABBREVIATIONS/ACRONYMS

ADEQ	Arizona Department of Environmental Quality
ANHC	Arkansas Natural Heritage Commission
BA	Biological Assessment
BECRET	Big Creek Research and Extension Team
BMP	best management practice
CAFO	Concentrated Animal Feeding Operation
CFR	Code of Federal Regulations
CWA	Clean Water Act
EA	Environmental Assessment
EPA	United States Environmental Protection Agency
ERI	electrical resistivity imaging
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
FSA	Farm Service Agency
GPR	ground penetrating radar
HDPE	high-density polyethylene
HUC	hydrologic unit code
mg	milligrams
mg/L	milligrams per liter
mil	millimeter
N	nitrogen
NEPA	National Environmental Policy Act
NMP	Nutrient Management Plan
NOC	Notice of Coverage
NOI	Notice of Intent
NPDES	National Pollutant Discharge System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
P	phosphorus
P-Index	Arkansas Phosphorus Index
PL	Public Law
SBA	Small Business Administration
sf	square foot
SUP	Special Use Permit
TAN	total ammonia nitrogen
TSP	Technical Service Provider
USC	United State Code
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

1. INTRODUCTION

The purpose of this Biological Assessment (BA) is to address the potential environmental effects that the C&H Hog Farms operation could have on federally listed endangered or threatened species, or their designated critical habitat. Threatened and endangered species are managed under the authority of the Endangered Species Act (ESA) of 1973 (Public Law [PL] 93-205, as amended; 16 United States Code [USC]. 1536 (c)). The ESA requires Federal agencies to ensure that all actions that they authorize, fund, or carry out are not likely to jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of their critical habitat. This biological assessment is prepared in accordance with legal requirements set forth under section 7 of the ESA, and follows the standards established in 7 Code of Federal Regulations (CFR) 1940.312(c).

C&H Hog Farms is a privately owned Concentrated Animal Feeding Operation (CAFO) located approximately 0.7 mile west of Mt. Judea in Newton County, Arkansas. The United States Department of Agriculture (USDA) Farm Service Agency (FSA) and Small Business Administration (SBA) issued guarantees to Farm Credit Services of Western Arkansas for that bank's loans to C&H Hog Farms. Using those loans, the owners of C&H Hog Farms purchased 23.43 acres and constructed new facilities on that site including gestational and farrowing barns and two waste holding ponds. Waste from the farm is applied as fertilizer to nearby land.

CAFOs are regulated by the United States Environmental Protection Agency (EPA) under the Clean Water Act (CWA) (PL 107-303) to control the discharge of pollutants into surface waters through issuance of National Pollutant Discharge Elimination System (NPDES) Permits. In Arkansas, the EPA delegates its authority for NPDES permitting to the Arkansas Department of Environmental Quality (ADEQ).

This BA has been prepared by the FSA and SBA's authorized representative, Ecosphere Environmental Services, Inc. The following species and critical habitat are considered in this BA:

- Rabbitsfoot mussel (*Quadrula cylindrica cylindrica*); Endangered with Critical Habitat
- Snuffbox mussel (*Epioblasma triquetra*); Endangered
- Spectaclecase mussel (*Cumberlandia monodonta*); Endangered
- Ozark cavefish (*Amblyopsis rosae*); Threatened
- Gray bat (*Myotis grisescens*); Endangered
- Indiana bat (*Myotis sodalis*); Endangered
- Northern long-eared bat (*Myotis septentrionalis*); Threatened
- Ozark big-eared bat (*Corynorhinus* [=*Plecotus*] *townsendii ingens*); Endangered

1.1 Background/History

In June of 2012, C&H Hog Farms submitted a Notice of Intent (NOI) to ADEQ for coverage under a NPDES General Permit for its facilities and operations (ADEQ 2012a). The NOI included a major construction

approval application for facilities including waste holding ponds and gestational and farrowing barns that would house up to 6,503 swine. The NOI was published on the ADEQ website and was made available for a 30-day public review and comment period in compliance with Section 5.1 of NPDES General Permit ARG59000. No comments were received (ADEQ 2013a). A Notice of Coverage (NOC) for NPDES General Permit ARG590000 was issued by the ADEQ on August 3, 2012 (ADEQ 2012b).

The FSA and the SBA received applications from Farm Credit Services of Western Arkansas requesting guarantees for loans for C&H Hog Farms. The FSA prepared a Class II Environmental Assessment (EA) pursuant to its regulations related to providing financial assistance to livestock holding facilities exceeding certain threshold capacities as defined by 7 CFR 1940.312(c). Class II EAs are prepared for activities, including Farm Loan Program Activities, that do not qualify for a Categorical Exclusion and exceed thresholds set for preparation of Class I EAs, which are prepared for certain small-scale activities as defined in 7 CFR 1940.311. The Class II EA process is documented in FSA Handbook 1-EQ (Revision 2), Environmental Quality Programs. A notice of the availability of the EA was published on August 6 through 8, 2012 in the Arkansas Democrat-Gazette and the draft EA was made available for review until August 23, 2012. A Finding of No Significant Impact (FONSI) was signed by the FSA on August 25, 2012. A notice of the FONSI's availability was published in the Arkansas Democrat-Gazette from August 25 through 27, 2012. The length of these review periods was in compliance with FSA policies, procedures, and regulations. The notice announced that the FSA would accept comments on the FONSI and EA through September 11, 2012. No comments were received on the draft EA or the FONSI during the public comment periods.

On November 16, 2012, the SBA issued a 75 percent guarantee to Farm Credit Services for that bank's $2,318,200 loan to C&H Hog Farms. On December 17, 2012, the FSA issued a 90 percent guarantee to Farm Credit Services for that bank's $1,302,000 farm loan to C&H Hog Farms.

The loans were used to purchase land and to construct farrowing and gestational barns and waste holding ponds. Construction began in December 2012 and was completed in April 2013. C&H Hog Farms operations began in April 2013.

In August 2013, a complaint was filed against the SBA and the FSA in U.S. District Court of the Eastern District of Arkansas, Western Division (4:13-CV-450 DPM) by environmental groups seeking declaratory and injunctive relief on a number of claims. On December 2, 2014, the Court issued an order holding that the SBA and the FSA had failed to comply with the requirements of the ESA and the National Environmental Policy Act (NEPA), and enjoining the Agencies from making payment on their loan guarantees pending compliance with both acts. The order states that although the C&H facility has been constructed and is operational, "the agencies can still take the hard look at C&H's environmental consequences." All other claims set forth in the complaint were dismissed.

Although the Court enjoined the FSA and the SBA from making any payments on loan guarantees should the operators default, the farm operations continue in accordance with the terms of the facility's NPDES

General Permit. Its owners have submitted required annual reports of activities as required by that permit.

On February 10, 2014, C&H Hog Farms submitted a Major Modification Request by submitting an NOI and revised Nutrient Management Plan (NMP). The revision was requested to allow a Vacuum Tanker to apply waste to Fields 7-9 (ADEQ 2014b). This method was previously approved for Fields 1-4 and 10-14. Section M of the NMP was revised to reflect this change. ADEQ accepted public comments on the revised NMP from February 19 to March 24, 2014 and held one public meeting. ADEQ issued a NOC for the Substantial Change effective June 4, 2014 (ADEQ 2014c).

In April 2014, the EPA Region 6 Compliance Assurance and Enforcement Division made an unannounced inspection. The inspection included review of the physical site conditions, records required by the NPDES General Permit, and soil and water sampling. Waste holding ponds were found to be in good condition, with turf reinforcement mats installed on the inside of the holding ponds to establish vegetative cover and control erosion. Water samples were collected from various streams up- and downgradient of the facility. Soil samples were taken from all currently approved land applications sites. No areas of concern were identified and it was noted that recordkeeping was well managed and available on-site (EPA 2014).

On February 26, 2015, C&H submitted a Major Modification Request by submitting a NOI and a revised NMP (ADEQ 2015a). The revision was requested to allow land application of wastewater via Tank Wagon to be used in Waste Pond 2. This method was previously approved for Waste Pond 1. Section M of the NMP was revised to reflect this change. The ADEQ accepted public comments on the revised NMP from March 18, 2015 through April 20, 2015 and held one public meeting. The ADEQ issued a NOC for the Substantial Change effective May 12, 2015 (ADEQ 2015b).

On May 7, 2015, C&H Hog Farms submitted a Major Modification Request to ADEQ to install 60-mil high-density polyethylene (HDPE) liners over a geotextile base material in both waste ponds and to install an 80-mil HDPE cover and methane flare system on Pond 1 (ADEQ 2015c). These modifications would reduce the potential for seepage of wastes into groundwater, would control odor, and would convert methane into carbon dioxide, a far less potent greenhouse gas. This voluntary measure by the owners is not a change mandated by the ADEQ or any other regulatory agency. As with the farm's previous requests for Major Modifications to the facility's NPDES General Permit, a decision-making process and public comment period will follow the submittal. This process could take up to 180 days to complete. To install the liner, sludge would be removed from the pond using accepted practices and in compliance with the NPDES General Permit. Sludge is periodically removed from the ponds as general maintenance. The ponds would be allowed to dry and then a geotextile composite material would be installed between the HDPE liners and the ponds' existing clay liners. The geotextile is designed to allow gasses to travel between the clay liner and the HDPE liner and escape, preventing the formation of bubbles beneath the ponds.

In July 2014, EC Farm (Permit No. 3540-WR-6) applied for a Major Modification to become a land application site only permit. All land proposed for application has been permitted in the past to receive swine nutrients. A Site Management Plan was developed by a certified planner for the Major Modification request. If approved, the Major Modification would allow for application of swine waste using the P-Index to 596.5 acres, of which 38.7 acres will be removed as the P-Index calculations place these fields in the high or very high range. Those fields will be included in the Site Management Plan and retested for future revisions to the plan. A total of 557.8 acres would be available to apply swine nutrients. The fields are pastureland or hayland and are located in Newton County, Arkansas. The swine fertilizer would be obtained from C&H Hog Farms. This proposal is in the approval process. The ADEQ is the agency responsible for evaluating the permit including its potential effects to threatened and endangered species. Though the proposal is not part of C&H Hog Farms' NPDES permit, it is included in this BA to ensure the potential impacts of C&H Hog Farms' operation on threatened and endangered species are fully evaluated. The addition of these fields for land application of C&H Hog Farms manure would allow for greater flexibility in land application and decreased applications on those fields already approved for application.

1.2 Consultation History

On June 26, 2012, Farm Credit of Western Arkansas contacted the United States Fish and Wildlife Service (USFWS) to initiate consultation over the proposed C&H facility (reference # TA0629). On July 5, 2012, the USFWS advised Farm Credit Services that two federally listed species—the gray bat and the Indiana bat—and one candidate for listing—the rabbitsfoot mussel—were known to occur in the region.

On February 8, 2013, the USFWS responded again to the 2012 request to include the potential for snuffbox mussel to occur in the region and the proposed critical habitat designation for the Buffalo River.

On May 1, 2015, Ecosphere Environmental Services, Inc. contacted the USFWS to discuss the C&H Hog Farms and the preparation of this BA.

On April 17, 2015, FSA sent the USFWS a letter notifying them that Ecosphere Environmental Services, Inc., would be acting as FSA/SBA's authorized representative through the ESA section 7 consultation process for C&H Hog Farms.

2. Description of the Proposed Action and Action Area

2.1 Purpose and Need

The purpose of the proposed action is to reinstate FSA and SBA guarantees for loans made to C&H Hog Farms pursuant to those Agencies' mandates for providing assistance to agriculture producers and/or small businesses. The need for the proposed action is to fulfil FSA's and SBA's responsibilities where appropriate under 7 CFR 761 (Farm Loan Programs; General Program Administration) and 13 CFR 101 (Business Credit and Assistance: General Administration), respectively.

2.2 Proposed Action

2.2.1.1 C&H Hog Farms

The farm site is located on an approximately 23-acre parcel in the southwest ¼ of the northwest ¼ of Section 26, Township 15 North, Range 20 West of Newton County, Arkansas (see Map 1 in Attachment A). Construction of the facilities began in 2012 and was completed in April 2013.

The site where the barns and ponds were constructed is generally flat, with elevations ranging from approximately 900 to 940 feet above mean sea level. Prior to construction, the site was partially wooded. A logging road extended generally south from County Road 6335 through the western third of the site and a number of other smaller roads ran through the tract. Barns and holding ponds were built in a clearing that was enlarged to accommodate the facilities. Approximately 12.5 acres were cleared for facilities construction. Map 2 (Attachment A) shows aerial photographs of the site before and after facilities construction. The facilities are located approximately 355 feet northwest of an unnamed tributary of Big Creek. Big Creek is located approximately 2,150 feet east of the barns and flows into the Buffalo River approximately 6.8 river miles north.

C&H Hog Farms' facilities include an approximately 49,503-square foot (sf) gestation barn and 30,286-sf farrowing barn. The barns can house up to 6,503 swine including 2,503 over 55 pounds (boars, gestating and lactating sows) and 4,000 under 55 pounds (nursery pigs). The barns have slatted floors over 2-foot deep concrete-lined pits. Waste from the barns is washed into the pits under the barns, which empty by pull plugs and gravity drains into Waste Storage Pond 1 through a 15-inch pipe and overflow spillway into Waste Storage Pond 2. Both ponds are earthen and are lined with 18 inches of compacted low permeability soil derived on-site at depths of 7 to 11 feet, which met compaction and permeability requirements. At installation, liners were tested and met with specifications of ASTM D-698, Standard Test Methods for Laboratory Compaction Characteristics of Soil, to ensure that the soil used met engineering specifications for permeability (ADEQ 2015a).

The ADEQ's CAFO NPDES General Permit prohibits, with a narrow exception, all discharge of manure or process wastewater from the production facilities into the waters. Consistent with the EPA's CAFO regulations, the General Permit makes an exception for discharges resulting from an overflow caused by precipitation, so long as the facility has been designed and constructed with the capacity to hold all

effluent generated by the facility as well as the water generated by a once-every 25-year, 24-hour rainfall event.

The required 180-day capacity of storage ponds is 279,436 cubic feet (2,090,326 gallons). This volume is calculated based on the amount of waste produced by the maximum number of animals permitted at the facility, washwater, rainfall from a 24-hour, 25-year event, and 180-day net precipitation. Together, the ponds have a storage capacity of 2,735,922 gallons. This capacity equates to 270 days of storage, exceeding the ADEQ storage requirement of 180 days by 50 percent (ADEQ 2015a).

The ponds are also designed to divert runoff from precipitation events away from the ponds. The shallow concrete pits under the barns provide additional storage capacity. The additional storage capacity from the oversized ponds and the shallow pits minimizes the potential for overflows and allows for operational flexibility in applying wastes at optimum times. Further, the ponds have 1 foot of freeboard above the top of the 25-year, 24-hour capacity level as shown in 4-1. There is a total of 6.5-feet above the Must Pumpdown level.

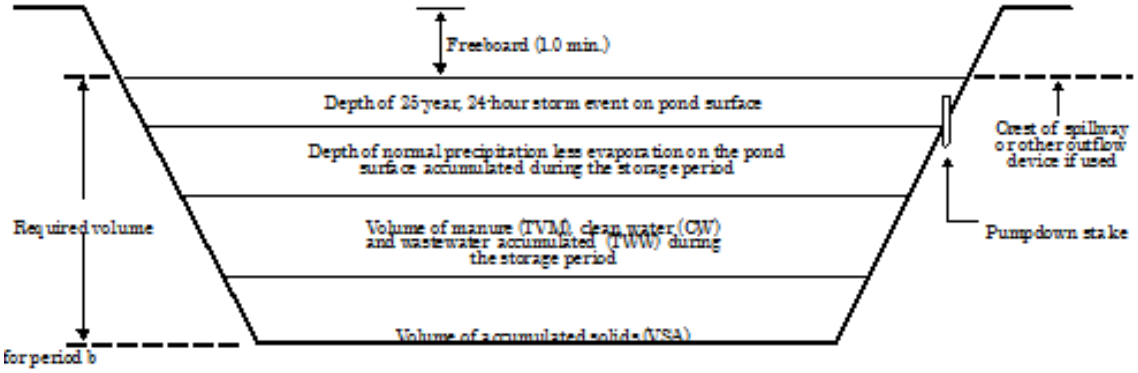


Figure 2-1. Storage pond design (NRCS 2009)

2.2.1.2 Land Application of Wastes

Periodically, waste from the ponds is pumped down and applied onto nearby fields that are used for pasture and hay production, thus consuming the nutrients in a full cycle system. The fields where wastes are applied are either owned or leased by C&H Hog Farms. Owners of these fields enter into land use contracts with C&H Hog Farms. These contracts can include specific guidelines and requirements related to waste application, which can be added by the landowners. None of the landowners specified any such requirement in this instance.

A Natural Resources Conservation Service (NRCS) Certified Nutrient Management Planner and Technical Service Provider (TSP)—DeHaan, Grabs and Associates—prepared the NPDES General Permit application including an NMP. The application was submitted to the ADEQ on June 7, 2012. Infiltration capabilities of soils were assessed for each field by the TSP. The University of Arkansas, Division of Agriculture assessed the baseline soil chemistry. In addition, the NRCS Revised Universal Soil Loss Equation (RUSLE-2) was used to predict erosion. Manure sampling and analysis are conducted prior to each land application by laboratories identified in the NMP. Based on an assessment of soil and manure chemistry,

application rates are calculated prior to each application using the Arkansas Phosphorus Index. Details of soil and manure sampling can be found in the NMP (ADEQ 2015a). Buffer strips are maintained between fields where waste is applied and streams (100 feet), property boundaries (50 feet), and occupied dwellings (500 feet). This and other elements of the design described in Section 2.1.3 are designed to minimize runoff of wastes into surrounding areas.

Table 2-1 describes the location, use, and size of fields identified in the NMP where wastes could be applied (ADEQ 2015a). These are also shown on Map 3 (Attachment A). The acreages given represent the total acreage of each field. Required buffers and setbacks reduce the area where waste can be applied.

The ADEQ Compliance Assistance Inspections have documented issues with three fields. The NMP contains a mapping discrepancy for Field 5 and land use contracts were not available for all of Fields 12 and 16. Until these issues are corrected in the NMP, these fields are not being used for land application of wastes. The ADEQ has stated that removal of application fields to the NPDES General Permit would be considered a non-substantial change and would therefore not require public notice or comment. The addition of land application sites is considered a substantial change to the NMP and would require a public notice and comment period (ADEQ 2014d). However, the fields are included in this analysis to ensure that the full scope of potential impacts related to the operation of the farm are assessed.

Table 2-1. Location and size of fields where wastes from C&H Hog Farms are applied

Field	Use	Legal Location	Area (acres)
1	Rotational Grazing	SW ¼ of Section 25, Township 15N, Range 20W	15.6
2	Rotational Grazing	SW ¼ of Section 25, Township 15N, Range 20W	17.0
3	Hayland	SW ¼ of Section 25, Township 15N, Range 20W	13.6
4	Rotational Grazing	NW ¼ of Section 36, Township 15N, Range 20W	8.8
5[1]	Hayland	NE ¼ of Section 26, Township 15N, Range 20W	23.8
6	Hayland	NE ¼ of Section 26, Township 15N, Range 20W	34.5
7	Hayland	E ½ of Section 26, Township 15N, Range 20W	74.3
8	Hayland	NE ¼ of Section 35, Township 15N, Range 20W	15.5
9	Hayland	NE ¼ of Section 35, Township 15N, Range 20W	41.2
10	Hayland	NE ¼ of Section 35, Township 15N, Range 20W	33.2
11	Hayland	N ½ of Section 35, Township 15N, Range 20W	20.7
12[1]	Hayland	SE ¼ of Section 35, Township 15N, Range 20W	23.7
13	Hayland	S ½ of Section 35, Township 15N, Range 20W N ½ of Section 2, Township 14N, Range 20W	61.6
14	Hayland	SW ¼ of Section 35, Township 15N, Range 20W	18.0

Field	Use	Legal Location	Area (acres)
15	Hayland	NE ¼ of Section 2, Township 14N, Range 20W	61.0
16[1]	Hayland	Section 2 and SE ¼ of Section 3, Township 14N, Range 20W	79.6
17	Hayland	NE ¼ of Section 3 and S 1/2 of Section 34, Township 15N, Range 20W	88.7
		TOTAL	**630.7**

[1] Fields that are entirely or partially unavailable for land application of wastes. See text above.

Note: SW = southwest; N = north; W = west; NE = northeast; E = east; SE = southeast; S = south.

2.2.1.3 Operating Requirements

Operating requirements are elements of an activity designed to reduce or eliminate adverse impacts. These include standard operating procedures, best management practices (BMPs), permitting requirements, and other design specifications. For detailed descriptions of operating requirements, refer to the NMP (ADEQ 2015a) and Attachment G (Operation and Maintenance Guidelines) of the C&H Hog Farms NPDES NOI (ADEQ 2012a). For C&H Hog Farms, standard operating requirements include, but are not limited to, the following.

Inspections, Reporting, and Recordkeeping

- Develop and implement a NMP based on a field-specific assessment. A professional engineer registered in the State of Arkansas and approved by the ADEQ prepared the NMP. For C&H Hog Farms, an NMP was prepared by DeHaan, Grabs & Associates, a Certified Nutrient Management Planner. The NMP was submitted on June 7, 2012 to the ADEQ as part of a comprehensive NPDES General Permit application and was updated in February 2014 and March 2015 to modify equipment used to remove wastes from ponds and apply it to fields.
- The operator annually reviews the facility NMP. An updated waste management plan must be submitted to the ADEQ when significant changes are made or as required by the ADEQ.
- Any accidental discharge from the waste management system or land application sites must be reported no more than 24 hours after discovery to the ADEQ.
- Any accidental discharge must be sampled and analyzed for the parameters listed in the NPDES General Permit.
- All required inspections must be recorded, maintained on-site, and made available to ADEQ upon request including:
  - Daily recording of measureable precipitation.
  - Dates livestock are brought to or removed from the facility.
  - During land application of waste; for each date waste is applied to each field; record temperature, wind speed, and direction; condition of field; type of crop; method of application; waste weight and/or volume; the rate and the acreage over which the waste/wastewater is applied; condition of equipment being used; and condition of pond liner and embankment when wastes are pumped down.

- Weekly inspection of risers and pipes to ensure they are not plugged or damaged.
- Weekly inspection of ponds for signs of leaking or seeping, excessive settling, and vegetation growth or damage.
- Weekly recording of livestock mortalities and carcass disposal pursuant to the Mortality Management Plan.
- Annual soil and waste/wastewater nutrient testing conducted as outlined in the NMP and as required by NPDES General Permit ARG590000.

- Annual reporting to ADEQ must include the following: waste/wastewater analyses conducted; locations, volumes, and application rates for the previous year; methods of application; and types of crops grown on each land application site.
- Maintain a copy of the approved General Water Pollution Control Permit for CAFO Application and the NMP on-site.
- Maintain on-site the previous 5 years of reports of all required inspections, soil and manure nutrient tests, calculations of allowable manure application rates and actual rates applied; documentation of any action taken to correct deficiencies; documentation of any discharge, steps taken to correct.

Facilities Operations and Maintenance

- Vehicular travel is confined to designated areas to prevent erosion and damage to vegetation.
- Growth of trees around holding ponds is prevented. Vegetation growth in the holding ponds below the Must Pumpdown level is controlled to prevent damage to pond liner.
- Components of the waste management system are maintained to ensure all contaminated runoff enters containment ponds.
- The containment ponds are designed, constructed, operated, and maintained to contain all waste/wastewater including the runoff and the direct precipitation from a 25-year, 24-hour rainfall event.
- Pens are maintained to prevent or minimize standing water.
- A pesticide program is undertaken to control insects, if necessary, following EPA standards and consistent with manufacturing labels and guidelines.
- Mortalities are disposed of promptly in accordance with the Mortality Management Plan.
- Land application of waste is planned and carried out to prevent holding pond levels from rising above the Must Pumpdown level.

Land Application of Waste

- Waste/wastewater is not applied to land classified as highly erodible, saturated, or frozen ground, or during rainfall events.
- When possible, land application is downwind from residences and will avoid calm and humid days when conditions restrict the dispersal and dilution of odors.

- Land application avoids, when possible, weekends and holidays when people are more likely to be outdoors.
- Wastes are not applied on snow or frozen ground unless unavoidable. If unavoidable, such application must comply with conditions specified in NPDES General Permit ARG590000.
- Wastes are not applied immediately after rain or within 12 hours of forecasted rain unless it can be immediately incorporated into the soil. A vacuum tanker may be used to knife inject the nutrients for soil incorporation.
- Waste/wastewater is evenly distributed over application sites at the rates specified in the site management plan. Weather conditions and nutrient holding capacity of the soil determine the timing and rate of waste application. All land application areas receive application at rates consistent with infiltration capabilities of the native soil such that there is no runoff to surrounding areas.
- Liquid manure is applied at agronomic rates for Phosphorus (P) application, which follows the Arkansas Nutrient Management Planner phosphorous index risk assessment to ensure there is no risk of surface water pollution.
- Waste/wastewater is not applied within 100 feet to any downgradient surface waters, open tile line intake structures, sinkholes, agricultural wellheads, or other conduits to surface waters.
- Waste application does not occur within 100 feet of any water well.
- Application of waste/wastewater is not made within 50 feet of property lines or 500 feet of neighboring occupied buildings existing as of the date of the permit. The restrictions regarding property lines or neighboring occupied buildings do not apply if the adjoining property is also approved as a land application site under a permit issued by the ADEQ or if the adjoining property owner consents in writing.

Other

Operators notify the appropriate fish and wildlife agency in the event of fish, wildlife, or migratory bird or endangered species kill or die-off on or near a retention pond or in the fields where waste has been applied and which could reasonably have resulted from waste management at the facility.

2.3 Action Area

The action area comprises all areas to be directly or indirectly affected by the proposed project (50 CFR 402.02). Direct effects are caused by the action, and occur at the same time and place as the action. Indirect effects are caused by the action but are later in time and farther removed in distance from the action, but are still reasonably foreseeable (40 CFR 1508.8).

Impacts to listed species from the C&H Hog Farms operations could include the potential for adverse changes to water quality from increased nutrients that could lead to eutrophication of aquatic habitats and eventually reductions in dissolved oxygen concentrations. Several different nitrogenous compounds can be taken up directly by aquatic wildlife from ambient water and at high concentrations can be toxic.

Unionized ammonia (NH_3) is the most toxic, while ammonium (NH_{4+}), nitrate (NO_3^-), and nitrite (NO_2^-) ions are the least toxic (Camargo and Alonso 2006).

Ammonia is naturally occurring and when in water is comprised of two molecules—the ammonium ion and the non-dissociated or unionized ammonia molecule, which is less abundant than ammonium; the ratio of these molecules in water is dependent upon both pH and temperature. Negative physiological effects from ammonia exposure may lead to reductions in feeding, fecundity, and survivorship, resulting in decreased bivalve populations (EPA 2013). Few studies have been conducted to assess nitrate toxicity in aquatic animals (Douda 2010, EPA 2013). The majority of nitrate toxicity studies have focused on the effects of nitrate, especially the effects of wastes associated with fish cultures. More recent studies have documented that amphibians and invertebrates appear to be more sensitive to nitrate than fish (EPA 2013). Several studies have also shown a trend of bivalve mollusks being less sensitive to nitrite than crustaceans or insects (Soucek and Dickinson 2012). Nitrates and nitrites at concentrations below those determined to be toxic may cause reduced movement and reproductive impairment (Douda 2010, Alonso and Camargo 2013).

The fate and transport of nutrients in aquatic systems is dependent upon multiple factors such as the channel substrate, water flow (base or storm flow) and velocity, the size and land use of the watershed exporting nutrients, topography, and soils. The magnitude of impact of any point source depends on the combination of ambient nutrient concentrations in the receiving stream, the nutrient concentration of the effluent, and the magnitude of the point-source discharge relative to stream discharge (Haggard et al. 2005; Hufhines et al. 2011).

Nutrients can be removed from the water column in streams through biotic uptake, movement of water though transient storage zone, denitrification, and abiotic sorption by sediments. To maintain equilibrium in the water column, accumulated phosphorus can be remobilized or recycled acting as a continuing source within waterways. While there are no studies specific to Big Creek, studies have been conducted in the Ozark Plateau in northwest Arkansas. Haggard et al. (2001; 2003; 2005) examined nutrient export and retention in point-source enriched streams from wastewater treatment plants. The studies measured inputs and nutrient retention in Columbia Hollow (3rd order tributary) and in Spavinaw Creek (5th order tributary) above and below its confluence with Columbia Hollow. Net nutrient uptake has also been studied along a 6.1-kilometer reach of the White River in northwest Arkansas (Hufhines et al. 2011). These studies found that nutrients from point-source effluent sources changed water chemistry and were retained for several kilometers (3.1 to 31 kilometers) downstream depending on the nutrient (Haggard et al. 2001; 2005; Hufhines et al. 2011).

Based on this information, the action area for this assessment was delineated as the area encompassing C&H Hog Farms facilities, waste application fields, and Big Creek downstream of the farm and the Buffalo River downstream for a total of 20 river miles (32 kilometers). The action area is shown in Map 4 in Attachment A.

3. ENVIRONMENTAL BASELINE

The environmental baseline includes the past and present effects of all Federal, State, or private actions and other human activities in the action area, the anticipated effects of all proposed Federal projects in the action area that have already undergone formal or early section 7 or section 10 consultation, and the effect of State or private actions, which are contemporaneous with the consultation process (50 CFR 402.02).

3.1 Biological Setting

3.1.1 Geology and Soils

The farm is located in the northeastern part of the Boston Mountains and the southern part of the Springfield Plateau in the Ozark Plateaus. The Ozark Plateaus are an ancient, variably karstified region that has more than 8,000 reported caves and tens of thousands of springs, and a wide and diverse suite of accompanying karst landforms (Imes and Emmet 1994).

Surface geology in the action area ranges from alluvium (clay, silt, sand, and gravel) along streams and rivers to a thick sequence of limestone bedrock. Surficial deposits underlying the farm consist of an approximate 4-foot thick veneer of soil and alluvium (BCRET 2014a). Bedrock underlying the soil and alluvium consists of the 300- to 350-feet thick Mississippian-age Boone Formation and the basal St. Joe Limestone, which ranges in thickness from a featheredge to over 110 feet in thickness (McFarland 1998; Braden and Ausbrooks 2003).

Structurally, bedrock in the farm area is nearly flat lying. Dips are typically less than 3-degrees except for locations where faulting has occurred. Uplift is observed to increase near the Buffalo National River where river bluffs and vertical cave entrances are consistent with uplift from tens to hundreds of meters compared with the same formations in nearby counties (Tennyson et al. 2008).

Soil at the site of C&H Hog Farms is Noark very cherty silt loam, 3 to 8 percent slopes. Table 3-1 contains a summary of soils data from the RUSLE-2 Erosion Calculation Records for the fields where waste from C&H Hog Farms could be land applied. This information is included in Section C of the facility NMP (ADEQ 2015a).

Table 3-1. Soil types, location, and average slope in the project area

Field	Primary Map Unit	Field Average Slope (%)
1	Noark very cherty silt loam, 3-8% slope, Noark very gravelly silt loam	5.5
2	Noark very cherty silt loam, 8-20% slope, Noark very gravelly silt loam	14
3	Razort loam, occasionally flooded/Razort loam	1.5

Field	Primary Map Unit	Field Average Slope (%)
4	Noark very cherty silt loam, 8-20% slope, Noark very gravelly silt loam	14
5	Razort loam, occasionally flooded/Razort loam	0.010
6	Razort loam, occasionally flooded/ Razort loam	0.010
7	Razort loam, occasionally flooded/Razort loam	3
8	Spadra loam, 2-5% slopes/Spadra loam	3.5
9	Spadra loam, occasionally flooded/Spadra loam	1
10	Spadra loam, 2-5% slopes/Spadra loam	3.5
11	Noark very cherty silt loam, 8-20% slope, Noark very gravelly silt loam	14
12	Spadra loam, occasionally flooded/Spadra loam	2
13	Noark very cherty silt loam, 8-20% slope, Noark very gravelly silt loam	14
14	Noark very cherty silt loam, 8-20% slope, Noark very gravelly silt loam	14
15	Noark very cherty silt loam, 8-20% slope, Noark very gravelly silt loam	14
16	Spadra loam, occasionally flooded/Spadra loam	2
17	Arkana very cherty silt loam, 3-8% slope, Arkana very gravelly silt loam	2

Approximately 12.5 acres of the 23-acre tract purchased for construction of the C&H Hog Farms facilities were cleared to accommodate the facilities. Vegetation on the site was primarily a mix of coniferous and deciduous trees common to the area with some open areas including a logging road that ran north to south through the eastern third of the tract. Fields where wastes could be land applied were cleared of native vegetation at some time in the past. Prior to inclusion in the C&H Hog Farms NMP, the hay and pasture were established on these fields, which have been managed for forage production.

It is not known how these fields were managed and maintained prior to their inclusion in C&H Hog Farms NMP. Because they lie outside of the area identified by the Arkansas General Assembly as a Nutrient Surplus Area, development of NMPs is not required (Arkansas Code § 15-20-1104). It is likely that they were periodically seeded, cut, tilled, and fertilized to maximize forage value. Because the fields were not governed by terms of an NMP, soils testing prior to application of fertilizer were not required nor were setbacks, timing restrictions, or any of the operating requirements that C&H Hog Farms must follow. The frequency, application rate, location, timing, and application method of fertilizer not derived from C&H Hog Farms is not known.

3.1.2 Groundwater

C&H Hog Farms is located in the Ozark Plateau aquifer system, which consists of three regional aquifers: from shallowest to deepest, the regional aquifers are the Springfield Plateau, the Ozark, and the St.

Francois aquifers (Imes and Emmett 1994; Adamski et al. 1995; Renken 1998). Specifically, the farm is located on the regional Springfield Plateau aquifer system.

The Springfield Plateau aquifer crops out along the southern and western perimeter of the Springfield Plateau as a narrow belt 5- to 10-miles wide in north-central Arkansas, but it is exposed in a more than 50-mile wide band in northwestern Arkansas (Renken 1998). Springfield Plateau aquifer generally ranges from 200- to 400-feet thick throughout northern Arkansas and is composed entirely of limestones and cherty limestones of the Mississippian-age Boone Formation and its basal member, the St. Joe Limestone (Adamski et al. 1995).

The surface of the unconfined Springfield Plateau aquifer generally reflects overlying topography (Imes and Emmett 1994; Adamski et al. 1995). The unconfined Springfield Plateau aquifer is recharged nearly everywhere by precipitation. Groundwater flows mostly laterally and then discharges into springs and seeps along streams (Adamski et al. 1995).

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 Hog Farms and application fields, 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 and application fields do not exhibit strongly developed karst landforms as demonstrated by a review of the Mt. Judea USGS 7.5 Minute Topographic Quadrangle Map and online aerial photograph information. The topographic and aerial photography review indicated 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. 2001) from deeper groundwater in the Boone Formation may explain development of sinkhole ponds in overburden, due to dewatered secondary porosity in the underlying bedrock. Although a hydraulic connection of surface water and groundwater typifies large-scale features of the Boone Formation (Kresse et al. 2014) in areas of significant karst landform development or at streams that have incised alluvium or overburden, the western floodplain and basal hillslopes above the floodplain in the vicinity of the C&H Hog Farms do not appear to match this characterization.

The primary Springfield Plateau Aquifer of the region, which consists locally of Boone Formation limestone, is characterized by moderate to high secondary porosity. Karst features and springs are more abundant in the nonchert-bearing limestones, such as the St. Joe Limestone of the Boone Formation. The number of sinkholes in the Springfield Plateau generally averages less than 1 per 100 miles^2, except near the city of Springfield, Missouri, where there are more than 10 sinkholes per 100 miles^2 (Adamski et al. 1995).

Groundwater flow rates are difficult to model and quantify in karst systems due to complex dissolution features and preferential flow. As reported by Soto (2014), groundwater dye trace studies have been conducted in eight watershed areas around the area of the Buffalo National River to determine the sources of water that feed the river. Groundwater flow in karst systems can cross the surface watershed

boundaries, and may not correspond with surficial drainage basin divides (Soto 2014). Such conditions have not been demonstrated in the southern part of the Buffalo River watershed.

In 1999, field observations and dye-tracer studies conducted in the Buffalo National River indicated that water discharged from some springs in the Buffalo River watershed originated in the Bull Shoals Lake watershed and traveled at velocities exceeding 640 meters per day (Murray and Hudson 2002). Because much of the Bull Shoals watershed is covered by agricultural land, consisting mostly of livestock operations, it is possible that nutrient contaminants from these agricultural activities reach the Buffalo River by interbasin transfer of groundwater (Murray and Hudson 2002). The Bull Shoals Lake Watershed is located northeast of the C&H Hog Farms.

A groundwater characterization, karst inventory, and a fluorescent dye tracing study are being conducted on Big Creek. However, no data or results are available from these studies (Soto 2014). While a preliminary white paper and PowerPoint presentation are available online for a dye tracer test on big Creek; neither of these materials include the scientific methodology employed, details of the study, or appear to have been peer reviewed.

As part of the C&H Hog Farms NPDES General Permit application, Geotechnical & Testing Services conducted a geologic investigation of the barn and pond locations. The geologic investigation bored test holes to depths ranging from 11 to 18.5 feet. The third boring encountered refusal at 11.5 feet, but characterization of the refusal as bedrock limestone was not provided. (ADEQ 2015a).

In November 2013, a series of ground penetrating radar (GPR) transects were conducted across Fields 5 and 1 to characterize the subsurface conditions that could potentially contribute to preferential flow of groundwater and contaminants in the fields (BCRET 2013). In March 2014, the GPR of Field 12 was completed (BCRET 2014a). The survey indicated changes in subsurface strata, interpretations such as gravel lenses and dissolution cavities. No ground truthing with invasive observation coring has been conducted. The GPR survey did demonstrate that soil properties, such as soil depth to bedrock, were consistent with NRCS soil mapping unit descriptions. The GPR results indicated that at least 49 inches of soil overlies any bedrock. The results of the GPR survey were inconclusive regarding the presence of karst features given the sensitivity of the field equipment and the underlying clay soil (BCRET 2013, 2014a).

An electrical resistivity imaging (ERI) analysis of Fields 5a and 12 was initiated in December 2014 by the School of Geology, Oklahoma State University. The preliminary analysis showed that additional data were needed and a second field effort was conducted in May 2015 (BCRET 2014c, pers. comm. A. N. Sharpley 2015). For the second quarter of 2015, a preliminary report on the December 2014 analysis was completed. The results of the May surveys are not yet available. The 2014 surveys confirmed the soil thickness, presence, extent, and depth of epikarst features and bedrock material. The average epikarst thickness underlying the two fields was found to be highly variable ranging from 6 to 75 feet thick. There appears to be a large doline feature within the weathered bedrock underlying Field 12 Additional analysis could enhance the delineation of possible karst features and further information is

needed to have a more complete view of the field to understand connections between surface and groundwater (Fields and Halihan 2015). These studies need ground truthing to determine the correlation of ERI data to epikarst and alluvium and especially to characterize those units' hydraulic characteristics.

3.1.3 Surface Water

C&H Hog Farms is located in the Buffalo Watershed (8-digit hydrologic unit code [HUC] 11010005) draining approximately 1,340 square miles. The entire farm and the fields where wastes are applied are contained within the Headwaters Big Creek-Buffalo River sub-watershed (12 digit HUC 110100050302), which encompasses approximately 45 square miles. Big Creek drains the Headwaters Big Creek-Buffalo River sub-watershed and is fed by several perennial or intermittent tributaries including Dry, Campbell, Cow, and Tilly creeks. Nutrient management fields 3, 5, 6, 7, 8, 9, 10, and 12 are located adjacent to Big Creek. Fields 1, 2, and 4 are located near two unnamed tributaries of Big Creek. The Waste Ponds 1 and 2 are located approximately 2,200 feet west of Big Creek (Map 2; Attachment A). Big Creek flows into the Buffalo River approximately 6.8 river miles north of the C&H barns and ponds.

In the Buffalo Watershed, surface water quality and streamflow are monitored by the ADEQ, the United States Geological Survey (USGS), and the National Park Service (NPS). There are two USGS gaging stations located within the Headwaters Big Creek-Buffalo River sub-watershed both of which are downstream of the farm. There is one NPS water quality monitoring site (BUFT06) located on Big Creek approximately 6 miles downstream of the farm. These monitoring stations are within the action area. The NPS began monitoring water quality on the Buffalo River and its tributaries within the boundaries of the park in 1985. Between 1985 and 1990, water quality monitoring for metals and nutrients was conducted once each season. Between 1991 and 1995, sites were sampled every other month. Since 1996, most sites have been consistently sampled on a quarterly basis (Mott and Laurans 2004, Usrey 2013).

Buffalo River water quality is generally very good and the Arkansas 303(d) Reports do not identify any impaired stream segments on the Buffalo River in the action area (ADEQ 2008). Mott and Laurans (2004) reported that nitrate concentrations tended to increase near the middle of the river and may be attributed to land use. However, only two monitoring sites near the headwaters of the river had a statistically supported increase in nitrate concentrations over time (between 1985 and 2001). Spring discharge may be contributing to increased nitrate levels at these sites. There is evidence to indicate that nitrate contamination may be coming from sources outside the river’s surface water drainage area. Ammonia and orthophosphate values have been found to be minimal and no significant changes over time were observed for these parameters (Mott and Laurans 2004).

Although the NPS water quality monitoring program may indicate chronic conditions or long-term trends, quarterly sampling for nutrients is insufficient data to capture actual conditions in the dynamic stream system, particularly given the highly variable concentrations of nutrients in relation to stream flow volumes (Usrey 2013). The nearest NPS sampling site (BUFT06) located on Big Creek is approximately 6 river miles downstream of C&H Hog Farms and is located in the Outlet Big Creek-

Buffalo River sub-watershed (HUC 110100050304), which encompasses approximately 40 square miles. Approximately 6 square miles of the Outlet Big Creek-Buffalo river sub-watershed drains directly into Big Creek above the sampling site and the eastern portion of the Piercetown community occurs within that drainage area. Additionally, the entire Left Fork Creek sub-watershed (HUC 110100050301) encompassing approximately 38 square miles, empties into Big Creek above the sampling site. Therefore, land use and development occurring in these sub-watersheds (or portions of) are contributing to the concentrations of nutrients sampled at the BUFT06 monitoring site. Thus, any increase in concentrations—whether statistically significant or not—of nutrients recorded at the BUFFT06 sampling site cannot be directly attributed to the C&H Hog Farms.

To assess the potential point source impacts from C&H Hog Farms on water quality accurately, concentrations of nutrients would need to be monitored at and adjacent to the site and the fields where nutrients are applied. By monitoring immediately upstream and downstream of the farm and at the fields, any measurable increase in concentrations discharging from the operations would be recorded and the contribution from other sources would be eliminated or minimized.

An independent, in-depth, 5-year case study of C&H Hog Farms is currently being conducted by scientists from the University of Arkansas System Division of Agriculture. The Big Creek Research and Extension Team (BCRET) is comprised of faculty and staff from the Division, USGS specialists, Newton County Extension agents, and several technicians. The team includes the region's foremost experts in the fields of agricultural impacts to water quality, livestock nutrient management, soil quality and sustainability, and ecosystems. The team members and their qualifications can be accessed on the BCRET website: http://cars.uark.edu/bcret_home/bios/.

The BCRET report their findings on a quarterly basis to the ADEQ and the Governor's office (BCRET 2013). The quarterly reports can be accessed online at http://www.bigcreekresearch.org/. The study was designed to evaluate the potential impact and sustainable management of the C&H Hog Farms operation. The major study tasks are: to monitor the fate and transport of nitrogen, phosphorus, sediment, and bacteria from land-applied swine effluent to pastures; to assess the potential impact of farming operations on the water quality of Big Creek below the farm; and to determine the effectiveness and sustainability of alternative manure management techniques (BCRET 2014a). The study has been peer-reviewed by a panel of four independent, out-of-state water quality experts (BCRET 2014b).

While the BCRET study does have limited baseline data, it has been ongoing for 21 months, was developed to specifically evaluate C&H Hog Farms potential impacts to water quality, and is considered the best available scientific information.

The BCRET study currently has eight monitoring stations that are sampled on a weekly basis and following storm flow events (Map 5, Attachment A). Ten stations have been established over the course of the study; however, one was abandoned following vandalism and one due to access issues. The two locations upstream and downstream of the farm on Big Creek and the spring located below Field 1 have been sampled since September 2013. Runoff from three of the application fields are also sampled—Field

1 (pasture/slurry applied), Field 12 (hay/slurry applied), and Field 5a (hay/no slurry applied) (BCRET 2014b). Field 5a somewhat serves as a control since no slurry from the farm is applied, but it is likely that the landowner does fertilize the field on a routine basis using chicken litter and/or Triple 19 or another commercial product (pers. comm. Sharpley 2015). Field 5a is not a natural baseline but can be compared to the fields where slurry is applied at a managed rate to evaluate the differences in nutrient or bacteria contributions to surface water. The three fields give a range in landscape position, topography, and soil fertility levels and are considered a representative strata of all the fields where C&H Hog Farms is permitted to apply nutrients (BCRET 2013). An interceptor trench to sample water quality and flow was installed below the manure-holding ponds in the summer of 2014 (BCRET 2014b). A water well adjacent to the barns is also sampled (BCRET 2014c).

In May/June 2015, an additional monitoring station was established in Left Fork as it enters Big Creek and the USGS has installed height gage at that location (USGS 07055792). Nutrient and bacteria concentrations from this location, which drains a watershed similar to Big Creek but does not contain a CAFO operation, can be compared to the concentrations sampled at the site downstream of the farm (BCRET 2015b).

BCRET water quality sampling methodology uses EPA-approved sampling protocols and analyses. Samples are analyzed for dissolved phosphorus, total phosphorus, ammonia, nitrate-N, total nitrogen, total suspended solids, dissolved organic carbon*, E. coli*, and total coliform (bacteria).

As part of the BCRET study, the USGS gaging station on Big Creek (07055790) was instrumented with continuous flow gaging equipment and a nitrate sensor, which provides real-time flow, water temperature, water nitrate, and precipitation data. Stream data recordation began in April 2014 and the additional parameter data recordation began in February 2015 (BCRET 2014b). These data are available online at: http://nwis.waterdata.usgs.gov/nwis/uv?cb_00065=on&cb_00010=on&cb_00631=on&format=gif_mult_parms&site_no=07055790&period=&begin_date=2015-01-01&end_date=2015-06-11. Streamflow, nitrate plus nitrite concentrations, and temperature from the site from January 1 through July 16, 2015 are shown in Figure 3-1 (USGS 2015).

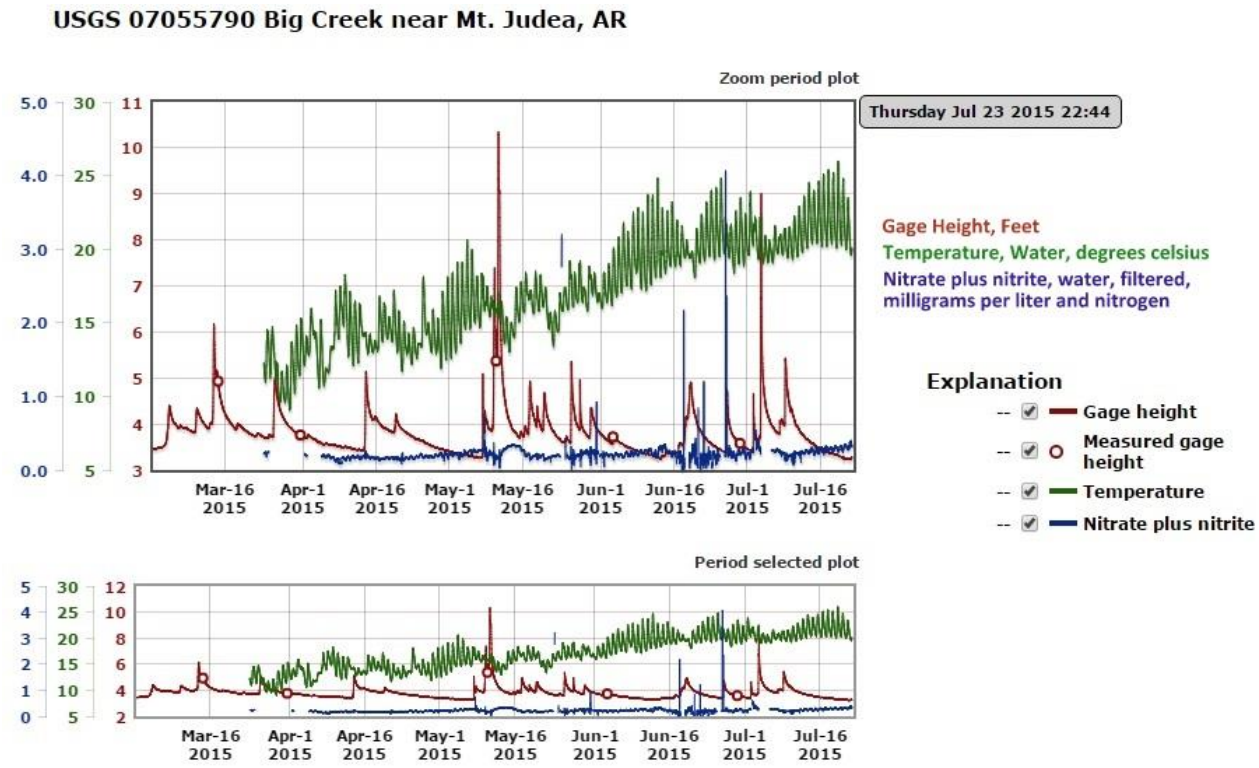


Figure 3-1. USGS 07055790 Big Creek near Mt. Judea, AR station data from January to July 16, 2015

3.2 Other Activities

The action area is located within the Buffalo Watershed. There are a number of activities occurring in the watershed that may be impacting water quality in the action area including agriculture, recreation, development, and industry.

Approximately 39 percent of the land in the Buffalo Watershed is within the boundaries of the Buffalo National River (11 percent), Ozark National Forest (27 percent), or is managed by the Arkansas Game and Fish Commission (1 percent). The remaining 61 percent of the land in the watershed is privately owned. Of this land, approximately 73 percent (686,782 acres) is forest; 25 percent (214,955 acres) is agriculture; 1.5 percent (13,058 acres) is urban, barren, transportation, power or communication infrastructure, and less than 1 percent is water (2,812 acres) (Mott and Laurans 2004).

Other activities in the watershed that affect water quality include:

- Concentrated overgrazing
- Land clearing along riparian zones
- Livestock in the streams
- Consequent bank destabilization and erosion

Recreation impacts include:

- Overcrowding
- Bank and trail erosion from overuse
- Trash
- Stream channel alteration and bank destabilization at major access points to the river in the action area

Additional impacts include:

- Exotic species such as Corbicula, a mussel, have been associated with degrading water quality (Mott and Laurans 2004)
- Prescribed burning and timber harvesting are used to reduce hazardous fuels and maintain ecosystem health and diversity (USDA/FSSR 2005)

The Buffalo National River Water Resources Management Plan (Mott and Laurans 2004) cites conversion of land to pasture in the Buffalo Watershed and increasing poultry production and use of waste as land applied fertilizer as factors affecting water quality in the Buffalo Watershed. The NPS awards Special Use Permits (SUPs) for parcels within portions of the Buffalo National River Park in Newton and Searcy Counties. The SUPs are typically awarded for 5-year terms and are offered for agricultural use (hay cutting). Under the permit conditions, permit holders are responsible for applying the minimum recommended amounts of fertilizer and lime. In 2014, the NPS awarded approximately 1,256 acres within the park as agricultural SUPs. Wildlife Enhancement Plans for selected parcels were developed by the NPS and the Arkansas Game and Fish Commission. Wildlife Habitat Enhancement Plans require various tasks, including bush-hogging, disking, applying lime, fertilizer, and seeds (NPS 2013).

The 2012 Census of Agriculture profile for Newton County documents 648 farms in the county totaling more than 114,000 acres of land in 2012 (USDA 2012a). These numbers represent 2 percent increase in the number of farms and a 1 percent increase in the farmland acreage over 2007 data. By area, 41 percent of farmland is pastureland. The top crop, based on market value, is forage land. The top livestock is turkey, followed by cattle and calves. There are also broiler, layer, and rooster operations in the county, though numbers are withheld in the report to avoid disclosing data on individual operations. According to the ADEQ Water Division Final Permits website (ADEQ 2015d), there are four other swine CAFOs and one dairy in Newton County, all of which are permitted to land apply wastes in accordance with the terms of their permits.

The ADEQ Water Division's 2004 Integrated Water Quality Monitoring and Assessment Report (ADEQ 2004) identifies a number of sources of surface and groundwater contamination including centralized and decentralized municipal water and waste water facilities, septic systems, food processing, industrial facilities, landfills, underground storage tanks, and petroleum development. Such facilities in Newton County that require permits from the ADEQ Water Division include five sawmills and lumberyards, a car wash, municipal water and wastewater treatment plants including the City of Jasper and the Deer, Marble Falls and Nail-Swain Water Associations, a number of road improvement and construction projects, and the septic system for Mt. Judea schools. The municipal water and wastewater treatment

facilities handle waste products in a number of ways including hauling to municipal landfill and land application. Permit information is accessible on the ADEQ Water Division Final Permit website (ADEQ 2015d). The Buffalo National River Water Resources Management Plan (Mott and Laurans 2004) lists septic tanks that are poorly constructed, malfunctioning, or constructed in cherty soils or in karst areas as potential sources of contamination of groundwater. The Arkansas Oil and Gas Commission has records of 20 oil and gas wells, mostly abandoned, in Newton and Searcy Counties, most of which lie in the Buffalo Watershed (AOGC 2015).

3.3 Water Quality Standards or Criteria for Aquatic Wildlife

The EPA recommends a value of 0.01 milligrams per liter (mg/L) total phosphorus for streams and rivers in aggregate ecoregion XI, which includes the Buffalo Watershed (EPA 2000). For aquatic life in freshwater, the EPA recommends an acute criterion magnitude of 17 milligrams (mg) total ammonia nitrogen (TAN)/L and a chronic criterion magnitude of 1.9 mg TAN/L at pH 7 and 20 degrees Centigrade, with the stipulation that the chronic criterion cannot exceed 4.8 mg TAN/L as a 4-day average. All criteria magnitudes are recommended not to be exceeded more than once in 3 years on average (EPA 2013). The EPA recommended standard to protect aquatic life from un-ionized ammonia is 0.02 mg/L; the concentration of which is related to pH and water temperature.

There are no federal water quality criteria for the protection of aquatic life for nitrate or nitrite. Toxicity tests have been conducted on fatmucket clam (*Lampsilis siliquoidea*) and washboard (*Megalonaias nervosa*) and the results suggest that median acute 96-hour lethal concentrations for nitrate were 357 (fatmucket) to 937 mg/L (washboard) and for nitrite 177 mg/L (fatmucket) (Soucek and Dickenson 2012, EPA 2010). Most fresh water streams do not frequently exceed nitrate concentrations of 25 mg/L and a maximum level of 2 mg/L of nitrate has been proposed for the protection of aquatic wildlife (Alonso and Camargo 2006).

3.4 Baseline Water Quality and Monitoring

A comprehensive NMP was prepared and approved by the ADEQ for the operation of C&H Hog Farms. The site-specific plan calculated a nutrient budget for nitrogen and phosphorus that considered all potential sources of nutrients and the estimated crop yield. A field-specific assessment was conducted to designate the form, source, amount, timing, and method of application of manure on each field in order to minimize the potential for any discharge to surface waters. Testing of both soil and manure prior to field application is required, so the application rates can be adjusted to levels of nutrients that can be completely taken up by plants and utilized for growth. The land application rates are based on the Arkansas Phosphorus Index (P-Index), which takes into consideration the concentration of phosphorus in the soil and waste. Soil phosphorus concentration is only one of the factors taken into consideration when evaluating runoff potential. Other factors include soil erosion, soil runoff, flooding, application method and timing, and BMPs are also included in the P-Index calculation for a site. The P-Index, as a risk-based calculator, takes a worst-case scenario approach of assuming that no phosphorus is lost and all is applied. All land application areas receive application at rates consistent with infiltration

capabilities of the native soil such that there is a low risk of runoff to surrounding areas. Buffer strips (100 feet) are maintained between fields where waste is applied and streams to prevent waste runoff into surrounding areas. Wastes/wastewater are not applied to land classified as highly erodible, saturated, or frozen ground, or during rainfall events or when it is likely to rain.

The ADEQ General Permit imposes a rigorous series of recordkeeping and inspection requirements for CAFOs like the C&H Hog Farms operation. C&H Hog Farms is operating in compliance with the ADEQ General Permit. It is possible that over time a phosphorus imbalance in one or more of the fields could occur. A phosphorus imbalance is a condition where soil phosphorus levels are greater than the output in farm production. Since testing of soils and manure is required before each land application of waste from C&H Hog Farms, in the case where soil phosphorus levels are high, the P-index calculation would indicate a moderate or high risk of runoff and fertilizer from C&H could not be applied in that area. Some management options to address a phosphorus imbalance if one does occur could include:

- Feed additives to increase nutrient utilization by animals
- Changes in land application techniques to redistribute phosphorus through the soil
- Manure amendments to reduce phosphorus
- Soil amendments
- Resting fields for greater periods since the farm has 630.7 acres of pasture/cropland permitted to apply wastes and only an estimated 251 acres is needed based on the amount of wastes being produced
- Cover crops/residues
- Off-site transport of wastes

The waste storage ponds are engineered per the USDA-NRCS National Engineering Handbook Part 651 Agricultural Waste Management Field Handbook in accordance with the Arkansas Pollution Control and Ecology Commission Regulation 6.202(B) (ADEQ 2013b). The NPDES General Permit limits potential seepage from the waste holding ponds to 5,000 gallons/acre/day. The soil used for the holding pond liner was the fat clay with sand found on the site at depths of 7 to 11 feet. At pond installation, liners were tested and met with specifications of ASTM D-698, Standard Test Methods for Laboratory Compaction Characteristics of Soil, to ensure that soil used met engineering specifications for impermeability. While the General Permit has a limit for potential seepage, which does not necessarily mean the C&H Hog Farms waste ponds are seeping fluids at that rate or at any rate.

The geotechnical investigation showed no evidence of karst features beneath the C&H Hog Farms facilities, and the abundance of chert indicates a lower propensity for large-scale karst landform development compared to other parts of the Buffalo River watershed (Hudson et al. 2001). Clays with variable and generally low chert or sand content as indicated in the geotechnical report (ADEQ 2012a) would suggest low hydraulic conductivity and low propensity for vadose zone leaching of agricultural contaminants. There is no evident conduit for surface water to reach groundwater in the area of the facilities and ponds.

A manure slurry chemical analysis was conducted in 2013 on the C&H Hog Farms holding ponds and the results for electrical conductivity, total nitrogen, and total phosphorus are listed in Table 3-1 (BCRET 2013). Water quality monitoring has been ongoing in the trench placed below the ponds, which was designed to intercept any subsurface flow of seepage moving along a restricting or less permeable layer. This type of trench collection system has been widely used to monitor shallow subsurface flows in karst systems and in the past to monitor seepage from a swine lagoon (BCRET 2014c). The mean concentrations of total nitrogen and phosphorus, and the electrical conductivity from water sampled from the trench are also shown in Table 3-2 (BCRET 2015b). Any seepage from the ponds would be expected to have similar concentrations of total nitrogen and phosphorus, and electrical conductivity properties. However, the water quality sampled in the trench is significantly different from the slurry composition and does not show any elevated values, indicating that there is no measurable seepage from the pond and no adverse impacts to groundwater quality are occurring.

Table 3-2. Comparison of electrical conductivity, total nitrogen and phosphorus between the manure slurry and water quality monitoring in the collection trench

Location	Electrical Conductivity (µmhos/cm)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
Slurry 0-6 inches	10,020	763.0	134.7
Slurry bottom	9,880	1,565.0	1,139.0
Slurry Profile	10,060	1,514.0	527.5
Trench Site #1	233.3	0.9	0.02
Trench Site #2	182.0	1.5	0.07

Note: µmhos/cm = micromhos per centimeter; mg/L = milligrams per liter

Because the silt loams of the northwest Arkansas region have a higher clay content with depth, phosphorus does not tend to leach since these higher clay sub-soils have increased phosphorus buffering capacity. The mechanism for phosphorus loading into the streams is via surface runoff, which varies in each sub-basin with soil type, slope, vegetation, antecedent moisture, management. Unlike phosphorus, nitrate molecules have low affinity for exchange or covalent bonding in soils and seldom form a precipitant. Whereas phosphorus transport is via overland flow, nitrate movement may be through surface runoff, subsurface flow, and/or groundwater flow. Studies have shown that nitrate in excess of plant requirements may leach through the soil and reach streams via groundwater or inter-flow (Haggard et al. 2003).

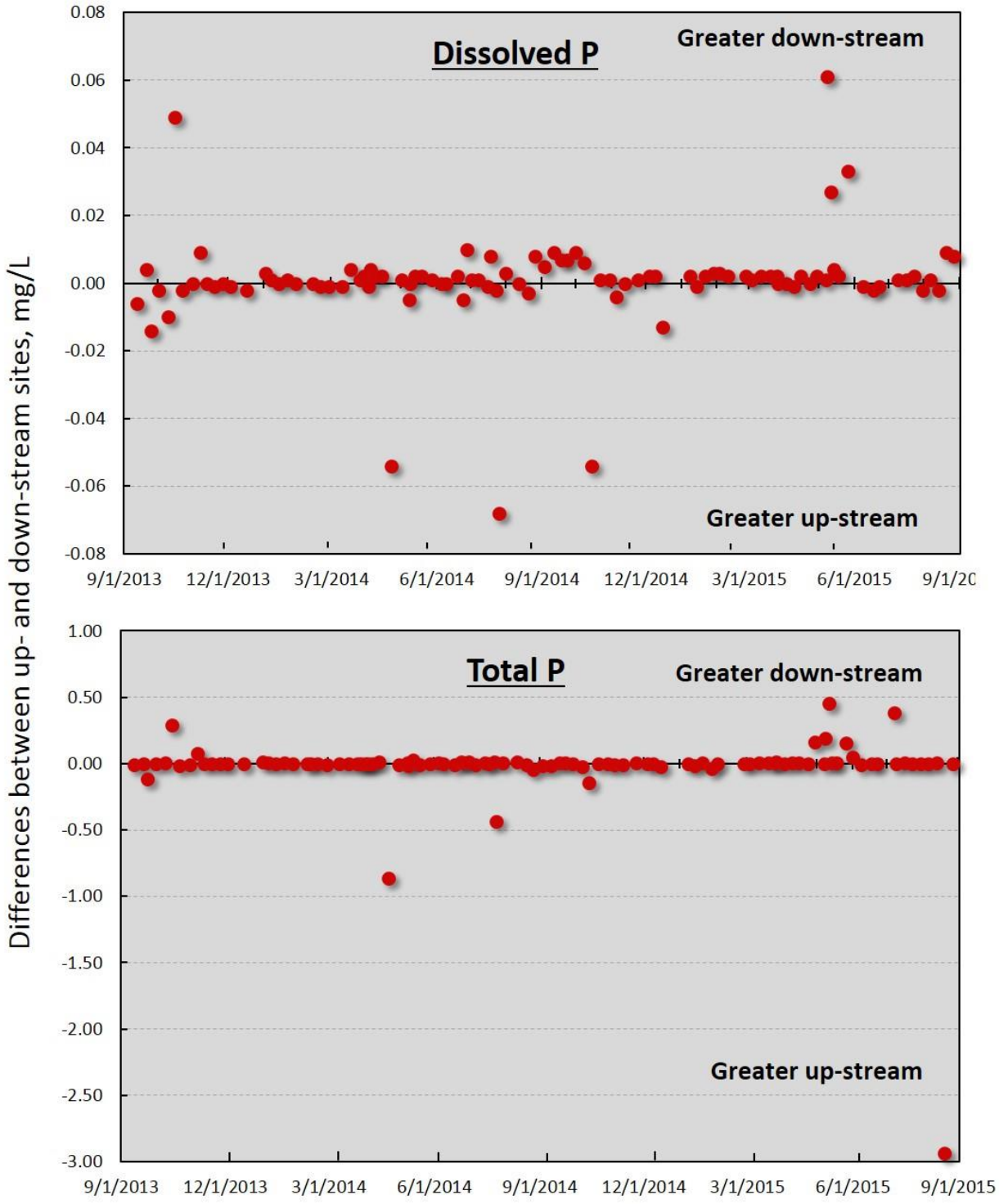
Because C&H Hog Farms and the fields where wastes are applied are located along an intermittent waterway, it is reasonable to assume that there is localized recharge and discharge of surface and groundwater in the area. If the waste ponds were leaking, or nutrients applied to fields were leaching into upper alluvial groundwater, any measurable contribution of those pollutants would be realized at the downstream water quality monitoring station.

There are no observable trends related to the timing of slurry applications and nutrient concentrations recorded during water quality sampling (BCRET 2014c, pers. comm. A. N. Sharpley 2015). During the April 1 to June 30, 2015 (2nd quarter 2015) monitoring period, there were no consistent differences in the trends in concentrations at the downstream site on Big Creek compared with the upstream site (BCRET 2015b).

The concentration of dissolved phosphorus, total phosphorus, nitrate-nitrogen, and total nitrogen measured in Big Creek above (upstream) and below (downstream) C&H Hog Farms from the beginning of the BCRET study (September 12, 2013) through March 31, 2015 are presented graphically in Figures 3-2 through 3-3. The figures show variations in concentration over time and the difference between upstream and downstream concentrations for the same sampling date. These measurements were taken during base flow (normal flow) and storm flow following precipitation events or snowmelt. The measurements have been more routinely taken after installation of samplers at the USGS gaging station was completed in March 2014.

Figures 3-2 shows the difference between the upstream and the downstream concentrations of dissolved phosphorus and total phosphorus, respectively. As in all the Figures, the x-axis is time from the beginning of BRCET water quality sampling (September 2013) to the September 1, 2015. The y-axis is the concentration of the sampled parameter. Each point represents the difference in paired numbers (data set). Two data sets are paired when there is a one-to-one relationship between the values. In this case, the relationship is the concentration of the nutrient or bacteria sampled on the same day at the upstream site and at the downstream site. On the figures, the farther a point is from zero concentration the greater the difference between the two numbers. The smaller the difference the closer the point is to zero. For each paired set of water quality samples, the points above zero are those where the concentration was greater downstream while those below zero are the samples where the concentration was greater upstream.

No significant difference has been found between dissolved or total phosphorus when comparing the upstream and downstream sites (BCRET 2014c, 2015b). Phosphorus concentrations did not change over time upstream or downstream of C&H Hog Farms (BCRET 2014c, 2015a, 2015b). Over the course of the monitoring, with the exception of a few outliers or values related to storm events, the concentrations of dissolved phosphorus have been below 0.02 mg/L. The concentrations of total phosphorus have been consistently below 0.06 mg/L both upstream and downstream of the C&H Hog Farms (BCRET 2015b). Outliers are sample points that are distant from other observations, and can occur by chance in any dataset and are usually due to variability in the measurement or experimental error.



Source: BCRET.

Figure 3-2. Difference in dissolved phosphorus and total phosphorus concentrations in Big Creek downstream and upstream of C&H Hog Farms between September 15, 2013 and September 1, 2015

Table 3-3 compares the dissolved and total phosphorus concentrations measured at the upstream and downstream monitoring sites pre and post C&H Hog Farms operation. The table also includes the standard error of mean, and the standard deviation.

Table 3-3. Comparison of dissolved and total phosphorus concentrations measured at the upstream and downstream sites pre and post C&H Hog Farms operation (9/15/13-6/1/15)

Dissolved Phosphorus (mg/L)			
Timeframe	**Mean**	**Standard Error of Mean**	**Standard Deviation**
Upstream			
Pre 1/1/2014 [a]	0.014	0.002	0.006
Post 1/1/2014 [b]	0.013	0.002	0.019
Downstream			
Pre 1/1/2014 [a]	0.016	0.005	0.017
Post 1/1/2014 [c]	0.015	0.003	0.024
Total Phosphorus (mg/L)			
Timeframe	**Mean**	**Standard Error of Mean**	**Standard Deviation**
Upstream			
Pre 1/1/2014 [a]	0.038	0.009	0.033
Post 1/1/2014 [b]	0.054	0.013	0.115
Downstream			
Pre 1/1/2014 [a]	0.054	0.022	0.083
Post 1/1/2014 [c]	0.051	0.011	0.095

[a] Sample size 14

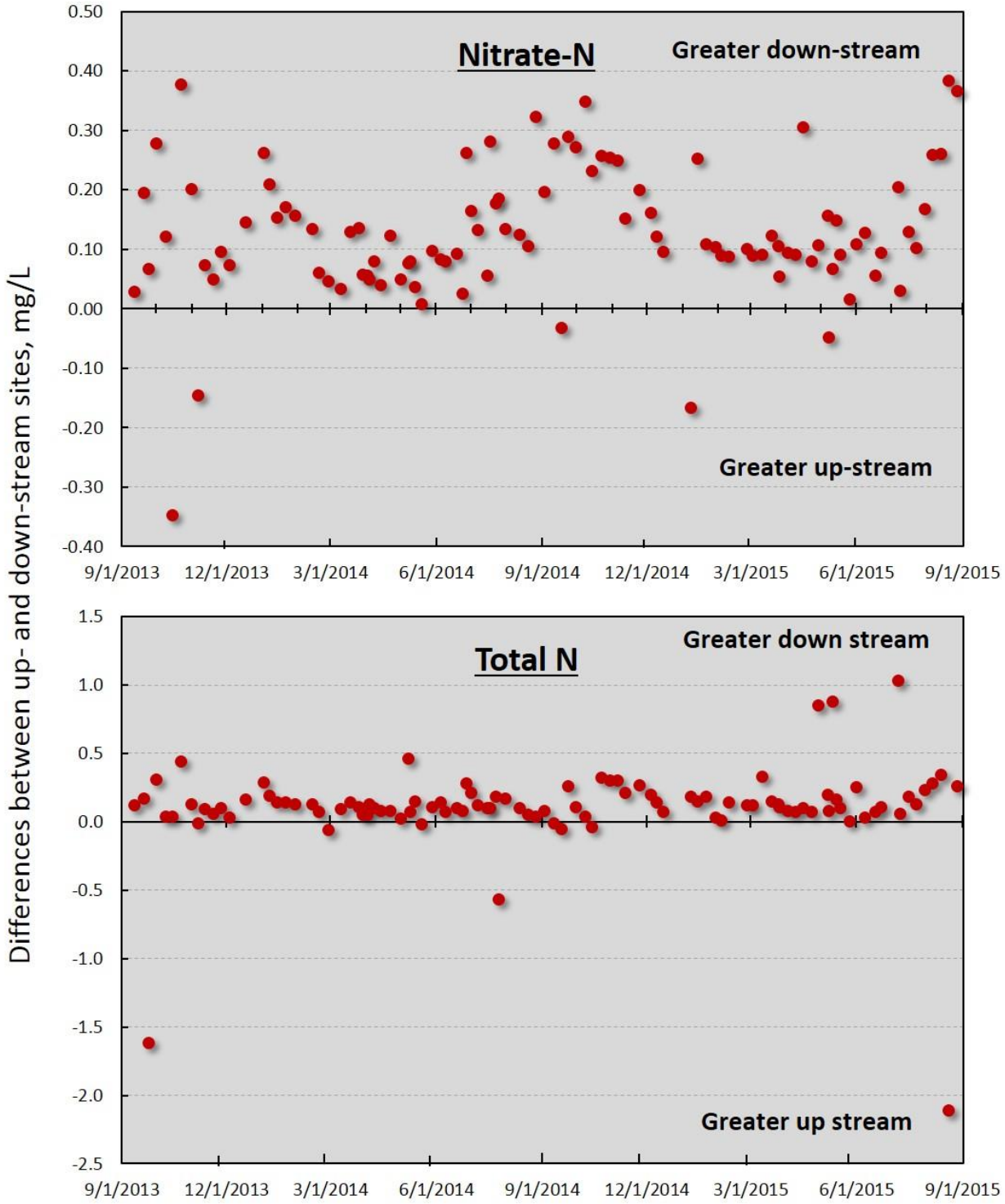
[b] Sample size 81

[c] sample size 78

As shown in Figure 3-3, monitored nitrate concentrations are greater (0.1 mg/L) downstream from the application fields and the higher concentration is probably reflective of the land use continuum and historic management of the greater catchment area that drains into and is monitored at the downstream site. The land use in the monitored watershed encompassing the C&H Hog Farms is 18

percent pasture and 78 percent forest. The downstream monitoring station includes the monitored watershed and the Dry Creek watershed. Upstream of the C&H Hog Farms there is less pasture at 5 percent and more forest (Ozark National Forest) at 92 percent (BCRET 2015b). Numerous studies have documented that agricultural or urban land use relates to decreased water quality. Nutrient concentrations in streams have been observed to increase with proportion of pasture within a drainage area (Haggard et al. 2003, Brion et al. 2011, Huang et al. 2013, Peterson et al. 2014). Total nitrogen and phosphorus export coefficients have been found to increase exponentially with pasture land use (Haggard et al. 2003).

Prior to land application of wastes (September 2013 through December 27, 2013), results from the BCRET water quality sampling calculated the average nitrogen concentrations from all samples at 0.54 mg/L. Based on water chemistry after the application of wastes to fields from January 2014 to December 31, 2014, the study found that nitrogen concentrations decreased upstream and downstream reflecting seasonal variability, which is typical in streams draining the Ozark and Boston Mountains. The difference in total nitrogen concentrations sampled at the upstream and the downstream site are shown in Figure 3-3.



Source: BCRET.

Figure 3-3. Difference in nitrate-N and total nitrogen concentrations in Big Creek downstream and upstream of C&H Hog Farms between September 15, 2013 and September 1, 2015

Table 3-5 compares the nitrate concentrations measured at the upstream and downstream monitoring sites pre and post C&H Hog Farms operation. The table also includes the standard error of mean and the standard deviation. Table 3-4 also illustrates that nitrate concentrations were higher downstream of the farm both before and after the start of C&H Hog Farms operations.

Table 3-4. Comparison of nitrate concentrations measured at the upstream and downstream sites pre and post C&H Hog Farms operation (9/15/13-6/1/15)

Nitrate (mg/L)			
Timeframe	**Mean**	**Standard Error of Mean**	**Standard Deviation**
Upstream			
Pre 1/1/2014 [a]	0.328	0.063	0.235
Post 1/1/2014 [b]	0.121	0.009	0.080
Downstream			
Pre 1/1/2014 [a]	0.415	0.047	0.723
Post 1/1/2014 [c]	0.251	0.013	0.113

[a] Sample size 14

[b] Sample size 81

[c] sample size 78

Table 3-5 compares the total nitrogen concentrations measured at the upstream and downstream monitoring sites pre and post C&H Hog Farms operation. The table also includes the standard error of mean and the standard deviation.

Table 3-5. Comparison of total nitrogen concentrations measured at the upstream and downstream sites pre and post C&H Hog Farms operation (9/15/13-6/1/15)

Total Nitrogen (mg/L)			
Timeframe	**Mean**	**Standard Error of Mean**	**Standard Deviation**
Upstream			
Pre 1/1/2014 [a]	0.536	0.143	0.536
Post 1/1/2014 [b]	0.228	0.019	0.174
Downstream			
Pre 1/1/2014 [a]	0.541	0.062	0.233
Post 1/1/2014 [c]	0.482	0.124	1.096

[a] Sample size 14

[b] Sample size 81

[c] sample size 78

Table 3-6 compares the ammonium-N concentrations measured at the upstream and downstream monitoring sites pre and post C&H Hog Farms operation. The ammonium-N concentrations measured during water quality sampling are the TAN. The table also includes the standard error of mean, the standard deviation, and the percent unionized ammonia based on 26 degrees Celsius and a pH of 7.7, which represent a high water temperature recorded at the gaging station USGS 07055790 Big Creek near Mt. Judea, AR and the average pH from monitored samples on Big Creek at the upstream and downstream monitoring sites.

Table 3-6. Comparison of ammonium-N and percent unionized ammonia concentrations measured at the upstream and downstream sites pre and post C&H Hog Farms operation (9/15/13-6/1/15)

Ammonium-N (mg/L)				
Timeframe	**Mean**	**Percent Unionized Ammonia [d] (mg/L)**	**Standard Error of Mean**	**Standard Deviation**
Upstream				
Pre 1/1/2014 [a]	0.034	0.001	0.003	0.012
Post 1/1/2014 [b]	0.038	0.001	0.003	0.024
Downstream				
Pre 1/1/2014 [a]	0.049	0.001	0.014	0.051
Post 1/1/2014 [c]	0.042	0.001	0.004	0.040

[a] Sample size 14

[b] Sample size 81

[c] sample size 78

[d] calculated at 26 degrees Celsius with a pH of 7.7

As noted in Section 3.1.3, the nearest NPS sampling site (BUFFT06) located on Big Creek is approximately 6 river miles downstream of C&H Hog Farms and is located in the Outlet Big Creek-Buffalo River sub-watershed, which encompasses approximately 40 square miles. Approximately 6 square miles of the Outlet Big Creek-Buffalo river sub-watershed drains directly into Big Creek above the sampling site and the entire Left Fork Creek sub-watershed encompassing approximately 38 square miles, empties into Big Creek above the sampling site. The summary statistics in Table 3-7 are based on water quality data obtained from the EPA STORET database for the NPS monitoring site BUFT06 on Big Creek (EPA 2015). Data were collected quarterly (seasonally) between December 17, 1990 and December 18, 2014. In the summary, table data are presented for nitrate-N (nitrate plus nitrite), orthophosphate (dissolved phosphorus), and ammonia-N. Table 3-7 presents summary statistics pre-and post-operation of the C&H Hog Farms. Operations began in April 2013. As shown in Table 3-7, the post-operations concentrations of monitored nitrate-N, orthophosphate, and ammonia-N are similar, if not lower, to pre-operation concentrations.

Table 3-7. Summary water quality statistics monitored by the National Park Service at the BUFT06 site on Big Creek from 1990 to 2014 (EPA 2015)

Parameter	Statistics	Pre-Operation	Post-Operation
Nitrate-N (Nitrate + Nitrite) (mg/L)	Mean	0.179	0.122
	Standard Deviation	0.174	0.045
	Minimum	Non-detect	0.042
	Maximum	1.420	0.194
Dissolved Phosphorus (orthophosphate) (mg/L) [b]	Mean	0.026	0.027
	Standard Deviation	0.035	0.022
	Minimum	Non-detect	Non-detect
	Maximum	0.207	0.059
Ammonia-N (mg/L)	Mean	0.077	0.057
	Standard Error of the Mean	0.128	0.000
	Standard Deviation	0.131	0.000
	Minimum	Non-detect	Non-detect
	Maximum	0.704	0.057

[a] Lowest value sampled; non-detect also sampled

[b] Method detection level varied between 0.005, 0.01, 0.02 and 0.03 mg/L

There are no data or other evidence to indicate that the operation of C&H Hog Farms is adversely affecting surface water quality in Big Creek. While it is recognized that the available data are somewhat limited, these data are considered sufficient to conclude that if the farm's operation over the last 21 months was contributing measureable concentrations of nutrients or inorganic compounds, then it would be apparent in the water quality monitoring data collected to date, or be observed in emerging trends. There is no indication from the monitored water quality downstream at the NPS BUFT06 station that there are any adverse changes to water quality occurring. Monitored water quality parameters on Big Creek are well below those criteria established to protect aquatic wildlife.

4. SPECIES/CRITICAL HABITAT CONSIDERED

In May 2015, requests for species occurrence records and other data or information were made to the USFWS Arkansas Ecological Services Office and the NPS. An information request was submitted to the Department of Arkansas Natural Heritage Commission (ANHC) to obtain species occurrence data. The ANHC has no records of any federally listed or other special status species of concern occurring on the C&H Hog Farms (ANHC No.: P-CF..- 15-031). The Arkansas Game and Fish Commission was also contacted for information related to federally listed species occurrence records within the area.

Currently, the USFWS Arkansas Ecological Services Office lists eight threatened and endangered species with the potential to occur in Newton County. A current list of species was obtained from the USFWS IPaC-Information, Planning, and Conservation System (USFWS 2015a). Table 4-2 lists these species, their conservation status, habitat associations, and their potential to occur in the project area. No federally listed species have been recorded as occurring within a 2-mile radius of C&H Hog Farms and associated fields.

Of the eight listed species, four are bats, which are terrestrial species. Prior to the construction of the C&H Hog Farms, vegetation on the site was primarily a mix of fragmented coniferous and deciduous trees common to the area with some open areas including a logging road that ran north to south through the eastern third of the tract. This type of vegetation would not have been considered suitable roosting habitat for the four listed bat species based on its fragmented nature, previous disturbance, and tree age, and overall composition. There are no caves within the C&H Hog Farms parcel or within any of the application fields.

All four of the listed bat species have been recorded as roosting or hibernating within approximately 2.75 to 10 miles from the C&H Hog Farms (Table 4-3). Given their home range size, these species would be expected to forage in the action area (NPS 2015a, 2015b; USFWS 2015c). An independent acoustic survey for threatened and endangered bat species was conducted between August 19 and 20, 2015 on Big Creek (Gore 2015a). The survey data were reviewed by the USFWS and Indiana bat, gray bat, and northern long-eared bat presence was confirmed in the study area using acoustic methods for detection. An independent survey was also conducted between September 12 and 13, 2015 on the Left Fork of Big Creek. The three bat species were also recorded during surveys on Left Fork Big Creek (Gore 2015b).

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.

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 document.

The Ozark cavefish *(Amblyopsis rosae)* and the spectaclecase mussel (*Cumberlandia monodonta*) do not occur in the Buffalo Watershed. They are in included in Table 4-3 but are not analyzed further in this document.

Table 4-1. Federally listed species with the potential to occur in Newton County, Arkansas

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
Spectaclecase mussel (*Cumberlandia monodonta*)	Endangered	Generally inhabits large rivers, and is found in microhabitats sheltered from the main force of current. Usually found in firm mud between large rocks in quiet water very near the interface with swift currents (Federal Register 2012b).	Historically, recorded as occurring in the Mulberry River in Franklin County. The Mulberry River is not located within the Buffalo Watershed. This species has not been recorded in the Buffalo River (Federal Register 2012b, USFWS 2015b).	Yes

Species	Status	Habitat Associations	Potential to Occur in the Action Area	Eliminated from Detailed Consideration
Fishes				
Ozark cavefish *(Amblyopsis rosae)*	Threatened	A true troglobitic stygofauna species. Lives in groundwater pools in dark parts of caves or wells. Ozark cavefish are restricted to the Springfield plateau geologic province of the Ozark ecoregion (Federal Register 1984).	There is no suitable habitat within the C&H Hog Farms facilities. The land application of animal waste from swine as managed under the terms and conditions of the NPDES General Permit would not be considered an adverse impact to this species (Federal Register 1984). This species does not occur in the Buffalo Watershed (USFWS 2011).	Yes
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

4.1 Species Descriptions

4.1.1 Rabbitsfoot Mussel

4.1.1.1 Description and Life History

The rabbitsfoot is a medium to large mussel, elongated and rectangular, reaching 6 inches in length. The external shell surface is generally smooth and yellowish, greenish, or olive in color becoming darker and yellowish-brown with age and usually covered with dark green or nearly black chevrons and triangles pointed ventrally. Adults are filter feeders that siphon water into their shells and across four gills that are specialized for respiration and food collection. Food items include algae, bacteria, detritus (disintegrated organic debris), and microscopic animals (Federal Register 2012c).

Sperm is released by the males and are siphoned in by the females during feeding and respiration. Fertilization occurs inside the shell, and success is apparently influenced by mussel density and water flow conditions. The eggs are retained in the gills of the female until they develop into mature larvae called glochidia. The glochidia then have a parasitic stage during which they attach to the gills, fins, or skin of a fish to transform into a juvenile mussel. Blacktail shiner (*Cyprinella venusta*), cardinal shiner (*Luxilus cardinalis*), red shiner (*C. lutrensis*), spotfin shiner (*C. spiloptera*), and bluntface shiner (*C. camura*) have been identified as host fish (Federal Register 2012c).

4.1.1.2 Habitat

The rabbitsfoot mussel is 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. It may also occupy water runs 9 to 12 feet deep. Bottom substrates generally include gravel and sand (Federal Register 2012c). Population density is greatest in areas where velocity and flow is low allowing sediments to remain stable during flooding. Since rabbitsfoot mussels remain in the same general location for their life span, these refuge areas are highly important. The rabbitsfoot typically does not burrow like other freshwater mussels making it more susceptible to displacement into unsuitable habitat during high flows (Federal Register 2012c).

Primary threats to the rabbitsfoot include impoundments, channelization, sedimentation, chemical contaminants, mining, oil and natural gas development, invasive non-indigenous species, temperature, and climate change (Federal Register 2015).

4.1.1.3 Distribution and Status

Rabbitsfoot historically occurred in 140 streams within the lower Great Lakes Subbasin and Mississippi River Basin. The Buffalo River is a western White River tributary. Historically, 13 rivers within the White River system contained rabbitsfoot populations. Since 1985, live or fresh dead individuals have been recorded in 9 of 13 rivers in the White River system. At one time, the main stem of White River and 11 of its tributaries had a large metapopulation of rabbitsfoot. A metapopulation is a group of spatially separated populations of the same species, which interact at some level. The Black, Spring, and Strawberry rivers may still contain a metapopulation. Declining populations are reported from the

Buffalo, Black, Spring, and South Fork Spring tributaries. Many of the tributaries to these streams appear to have declining populations (Federal Register 2012c).

Rabbitsfoot was first documented in the Buffalo River in 1910 with nearly all specimens located in the lower reaches within Searcy County, Arkansas. In comprehensive surveys in 1995 and 2004 to 2005, live rabbitsfoot specimens were found concentrated between Arkansas Highway 7 in Newton County to near the Cedar Creek confluence downstream of Rush, Arkansas. NPS staff collected four live rabbitsfoot in 2008 from a site near the Cedar Creek. In 2011, the same site was surveyed; however, due to changes in channel morphology, few live individuals were recorded. Two live individuals and 23 weathered shells were located at a site downstream. In 2011, two live rabbitsfoot were collected at two sites located between Arkansas Highway 7 and U.S. Highway 65. Populations in the Buffalo River are small and susceptible to extirpation (Federal Register 2012c).

The current population status of rabbitsfoot is declining. It is estimated that the species has been extirpated from approximately 64 percent of its historical range. Of the 51 populations where the species remains, only 11 (8 percent) are viable, 23 populations (45 percent) are at risk of extirpation, and 17 populations (33 percent) show limited recruitment with little evidence of sustainability. The last observation on the Buffalo River was 1995 (Federal Register 2012c).

4.1.1.4 Designated Critical Habitat

Approximately 1,437 river miles of the Arkansas River system has been designated as critical habitat for the rabbitsfoot mussel. Approximately 70.6 river miles of the Buffalo River from Cove Creek confluence southeast of Erbie, Arkansas, downstream to U.S. Highway 65 west of Gilbert, Arkansas and Highway 14 southeast of Mull, Arkansas downstream to Leatherwood Creek confluence in the lower Buffalo Wilderness Area are designated critical habitat (Federal Register 2015). The Buffalo River and critical habitat occurs approximately 6.8 river miles downstream of the C&H Hog Farms as shown on Map 6 (Attachment A).

Primary constituent elements are those specific elements of the physical or biological features that provide for a species' life history processes and are essential to the conservation of these species. For the rabbitsfoot the primary constituent elements are:

1. Geomorphically stable river channels and banks (channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation) with habitats that support a diversity of freshwater mussel and native fish (such as stable riffles, sometimes with runs, and mid-channel island habitats that provide flow refuges consisting of gravel and sand substrates with low to moderate amounts of fine sediment and attached filamentous algae).
2. A hydrologic flow regime (the severity, frequency, duration, and seasonality of discharge over time) necessary to maintain benthic habitats where the species are found and to maintain connectivity of rivers with the floodplain, allowing the exchange of nutrients and sediment for maintenance of the mussels' and fish host's habitat, food availability, spawning habitat for

native fishes, and the ability for newly transformed juveniles to settle and become established in their habitats.

3. Water and sediment quality (including, but not limited to, conductivity, hardness, turbidity, temperature, pH, ammonia, heavy metals, and chemical constituents) necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages.
4. The occurrence of natural fish assemblages, reflected by fish species richness, relative abundance, and community composition, for each inhabited river or creek that will serve as an indication of appropriate presence and abundance of fish hosts necessary for recruitment of the Neosho mucket and rabbitsfoot. Suitable fish host for rabbitsfoot may include, but are not limited to, blacktail shiner from the Black and Little River and cardinal shiner, red shiner, spotfin shiner, bluntface shiner, rainbow darter (*Etheostoma caeruleum*), rosyface shiner (*Notropis rubellus*), striped shiner (*L. chrysocephalus*), and emerald shiner (*N. atherinoides*).
5. Competitive or predaceous invasive (nonnative) species in quantities low enough to have minimal effect on survival of freshwater mussels.

4.1.2 Snuffbox Mussel

4.1.2.1 Description and Life History

The snuffbox is a small- to medium-sized mussel, with males reaching up to 2.8 inches in length. The maximum length of females is about 1.8 inches. The shape of the shell is somewhat triangular (females), oblong, or ovate (males), with the valves solid, thick, and very inflated. The external shell is generally smooth and yellowish or yellowish-green in young individuals, becoming darker with age. Green, squarish, triangular, or chevron-shaped marks cover the umbone (the inflated area of the shell along the dorsal margin), but become poorly delineated stripes with age (Federal Register 2012a).

The snuffbox is a freshwater mussel with a similar life history to the rabbitsfoot mussel. Adults are suspension-feeders spending their entire lives partially or completely buried within the stream bottom. They generally burrow deep into the substrate, except when spawning or attempting to attract a host. They feed on algae, bacteria, detritus, microscopic animals, and dissolved organic material. There is evidence to indicate that they may also deposit-feed on particles in sediment. Juvenile mussels employ foot (pedal) feeding, consuming settled algae and detritus. Little is known about the specific life-history requirements of the snuffbox. In laboratory tests, juvenile snuffboxes have successfully transformed on logperch (*Percina caprodes*), blackside darter (*P. maculata*), rainbow darter, Iowa darter (*E. exile*), blackspotted topminnow (*Fundulus olivaceus*), mottled sculpin (*Cottus bairdii*), banded sculpin (*C. carolinae*), Ozark sculpin (*C. hypselurus*), largemouth bass (*Micropterus salmoides*), and brook stickleback (*Culaea inconstans*) (Federal Register 2012a).

The age of sexual maturity is unknown, but for other freshwater mussels, it can be highly variable ranging from between 0 to 9 years and can be sex dependent. The snuffbox is thought to brood from September to May (Federal Register 2012a).

Primary threats to the snuffbox include impoundments, dredging and channelization, chemical contaminants, mining, oil and natural gas development, siltation, fragmentation and isolation of populations, and exotic species invasion (Federal Register 2012a).

4.1.2.2 Habitat

The snuffbox is found in small- to medium-sized creeks, to larger rivers, and in lakes. It 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). As with other bivalves, refuge areas are highly important. Species-specific ecological requirements have not been determined (e.g., minimum water flow and effects of particular pollutants). The snuffbox reproductive biology, such as age and size at earliest maturity, reproductive longevity, and the level of recruitment needed for species' survival and long-term viability are unknown (Federal Register 2012a).

4.1.2.3 Distribution and Status

Historically, the snuffbox occurred in 210 streams and lakes in 18 states and 1 Canadian province. Remaining populations occur in 79 streams in 14 states and 1 Canadian province. In Arkansas, the species is found in the Buffalo, Spring, and Strawberry rivers. The species status has declined significantly range-wide at an estimated 62 percent. Populations are highly fragmented and restricted to short reaches. Approximately 32 percent of streams where populations remain are represented by only one or two recent live or fresh dead individuals (Federal Register 2012a).

The remaining populations have been categorized into three groups. Stronghold populations are defined as having sizeable populations generally distributed over a significant and more or less contiguous length of stream (30 river miles or greater), with ample evidence of recent recruitment, and currently considered viable. Significant populations are defined as small generally restricted populations with limited recent recruitment and viability. Marginal populations are defined as those that are very small and highly restricted, with no evidence of recent recruitment, of questionable viability, and that may be on the verge of extirpation in the immediate future. Based on these criteria, there are 7 stronghold populations, 24 significant populations, and 48 marginal populations of snuffbox (Federal Register 2012a).

The species status in the Buffalo River is marginal. Snuffbox was last observed in 2006 in the Buffalo in a small population. The population trend and viability in the Buffalo River is unknown (Federal Register 2012a).

4.2 Effects to Listed Species and Designated Critical Habitat

4.2.1 Rabbitsfoot Mussel

From the confluence with Big Creek, the nearest rabbitsfoot mussel recorded occurrence is approximately 26.6 river miles downstream, on the Buffalo River outside the action area. The rabbitsfoot has not been recorded as occurring within Big Creek and it is not considered suitable habitat since it is dry for periods of time during the warmer months and exhibits generally cobbled, rocky

substrate for much of its reach. Rabbitsfoot mussel may be present in the action area in the Buffalo River but in low numbers.

There is no designated critical habitat within or adjacent to C&H Hog Farms or the application fields. Critical habitat for rabbitsfoot mussel has been designated and occurs in the action area on the Buffalo River approximately 6.8 river miles downstream of the C&H Hog Farms.

Direct effects are those that are caused by the proposed action and occur at the same time and place. There would be no direct effects to rabbitsfoot mussel or designated critical habitat.

Indirect effects are those that are caused by, or result from, the proposed action and are later in time, but reasonably certain to occur. In contrast to direct effects, indirect effects are more subtle, and may affect individuals and populations and habitat quality over an extended period of time, long after construction activities have been completed.

A NMP was prepared by C&H Hog Farms and approved by ADEQ for the operation of the C&H Hog Farms, and is being implemented. The NMP uses sophisticated software and multiple site-specific inputs to develop a waste application plan that minimizes potential impacts from fertilizing fields. The farm's General Permit contains numerous provisions that are designed to protect surface and groundwater. The application of wastes to fields adjacent to Big Creek is closely managed under the terms and conditions of the NPDES General Permit.

No measurable increases in concentrations of nitrogen, nitrates, ammonia, or phosphorus in Big Creek have been identified during the course of water quality monitoring at C&H Hog Farms over the last 21 months. There is no indication of negative impacts to water quality downstream on Big Creek based on NPS water quality monitoring data. Indirect adverse effects to rabbitsfoot mussel and designated critical habitat would be avoided by the continual ADEQ oversight, inspections, and reporting requirements of the C&H Hog Farms operations and ongoing adaptive management and planning.

The trench system below the ponds serves as a leak detection system. There is no indication that the waste holding ponds are seeping at a measurable rate or adversely affecting surface or groundwater quality. Should the major modification to line the ponds with 60-mil HDPE liners over a geotextile base material be approved, any potential indirect impacts to rabbitsfoot mussel and designated critical habitat would be minimized even further.

Land application is planned and carried out to prevent the holding pond levels from rising above the Must Pumpdown level (Figure 4-1). The entire waste management system is inspected weekly, and following rainfall events, to record the depth of water in the evaporative ponds, inspect risers and pipes, check the waste ponds for signs of leaking or seepage, excessive settling, damage from vehicles or other equipment, rodents, or erosion. Should a significant rainfall event occur and the pond level rise above the Must Pumpdown level, Field 7 (74.3 acres available) has been identified for land application.

Unlike liquid and slurry manure storage ponds constructed 20 or more years ago, the C&H Hog Farms pond design has been engineered to NRCS standards in accordance with ADEQ regulations to avoid a breach even at maximum capacity. There is no potential risk from Big Creek flooding the ponds because of the distance to the creek and since the ponds are elevated well above the creek.

Because the ponds are designed to divert stormwater from entering the ponds, during a rainfall event the amount of water entering the ponds would be limited to what is falling directly over the ponds. This further minimizes the potential for the ponds to overflow. The ponds have much greater capacity than a 25-year, 24 hour flood event (6.96 inches). The amount of rainfall in a 100-year, 24-hour storm event would be approximately 8.48 inches (NOAA 2015). The 1 foot of freeboard above the 25-year, 24-hour storage level has a volume of greater than 425,000 gallons. Based on the total square footage at the top of the ponds, 1 inch of rainfall would equate to approximately 35,000 gallons. Therefore, including the freeboard, the ponds have sufficient storage to hold the volume generated by a 100-year, 24-hour storm event.

Although highly unlikely, an overflow during a significant rainfall event could have short-term impacts to surface water quality since nutrients concentrations and sediment would dilute or be available for biological uptake during downstream transport through the system. Stream volumes and velocities would be greater during a severe weather event and nutrients and sediment would dilute and disperse at rates much greater than base flow and would move rapidly through the system. If the ponds were to overtop, the fluid would mix with stormwater and travel approximately 2,200 feet overland to Big Creek and then 6.8 miles to the Buffalo River. Any discharge during a rainfall event would be restricted to an overflow; the entire contents of the ponds would not be discharged. The amount of overflow would be directly related to the amount of rainfall (1 inch equates to approximately 35,000 gallons) and that overflow would be dilute from its normal concentration.

It is also possible there could be an accidental discharge of waste, which could reach surface waters. However, all land application equipment is regularly inspected for leaks and monitoring is conducted for land application procedures. Waste management operational requirements, facility design, and BMPs are in place to avoid accidental discharges of waste. The honey tankers used to transport the fertilizer from the ponds to the application fields carry up to 3,000 gallons. During its operation, C&H Hog Farms has not had an accidental discharge.

Given the implementation of BMPs and the engineered design and over-capacity of the holding ponds, it is highly unlikely that an overflow from the ponds would occur even in a severe flood event or a series of heavy rainfall events. Should an accidental discharge occur, no adverse effects to rabbitsfoot mussel and designated critical habitat are expected since the volume of discharge would be limited to the amount in a honey tanker and because of the distance to suitable habitat. Depending on the location and amount, an accidental discharge, if one were to occur, may not reach surface waters. Surface water quality could be impacted on a short-term basis, depending on the amount and location of an accidental discharge, but based on the potential discharge volume any changes to nutrient concentrations or sediment would be expected to dilute or be biologically taken up with increasing distance downstream of the source.

Therefore, an accidental discharge is not expected to result in long-term (chronic) impacts to surface water quality or to adversely modify potential or designated critical habitat.

Based on the implementation of the NMP and adaptive management options, operational requirements and BMPs, the proposed action may affect, is not likely to adversely affect rabbitsfoot mussel.

The proposed action would not affect the geomorphology, hydrologic flow regime, or change the native fish assemblages or populations of nonnative invasive species. The proposed action may affect, is not likely to adversely modify rabbitsfoot mussel designated critical habitat.

4.2.2 Snuffbox Mussel

Snuffbox mussel has not been recorded as occurring in Big Creek and it is not considered suitable habitat since it is dry for periods of time during the warmer months and exhibits generally cobbled, rocky substrate for much of its reach. Although not historically recorded in the action area, the portion of the Buffalo River in the action area is considered suitable habitat. Snuffbox mussel may possibly be present in the Buffalo River in the action area in low numbers.

There would be no direct effects to snuffbox mussel or potential habitat.

A NMP was prepared by C&H Hog Farms and approved by the ADEQ for the operation of the C&H Hog Farms, and is being implemented. The NMP uses sophisticated software and multiple site-specific inputs to develop a waste application plan that minimizes potential impacts from fertilizing fields. Nutrient Management Plans are required in Nutrient Surplus Areas in Arkansas to reduce exports of nutrients and improve water quality. The farm is not located in a Nutrient Surplus Area. The farm's General Permit contains numerous provisions that are designed to protect surface and groundwater. The application of wastes to fields adjacent to Big Creek is closely managed under the terms and conditions of the NPDES General Permit.

No measurable increases in concentrations of nitrogen, nitrates, ammonia, or phosphorus in Big Creek have been identified during the course of water quality monitoring at C&H Hog Farms and the application fields over the last 21 months. NPS data collected at Big Creek (BUFT06) do not show any emerging trends in nutrient related parameters or any measurable increases. Indirect adverse effects to snuffbox mussel and potential habitat in the action area would be avoided by the continual monitoring of the C&H Hog Farms operations and ongoing adaptive management and planning.

The trench system below the ponds serves as a leak detection system. There is no indication that the waste holding ponds are seeping at a measurable rate or adversely affecting water quality. Should the major modification to line the ponds with 60-mil HDPE liners over a geotextile base material be approved, any potential indirect impacts to snuffbox mussel or potential habitat would be minimized even further.

Land application is planned and carried out to prevent the holding pond levels from rising above the Must Pumpdown level. The entire waste management system is inspected weekly, and following rainfall

events, to record the depth of water in the evaporative ponds, inspect risers and pipes, check the ponds for signs of leaking or seepage, excessive settling, damage from vehicles or other equipment, rodents, or erosion. Should a significant rainfall event occur and the pond level rise above the Must Pumpdown level, Field 7 (74.3 acres available) has been identified for land application.

Unlike liquid and slurry manure storage ponds constructed 20 or more years ago, the C&H Hog Farms pond design has been engineered to avoid a breach even at maximum capacity. There is no potential risk from Big Creek flooding the ponds because of the distance to the creek and since the ponds are elevated well above the creek.

Because the ponds are designed to divert stormwater from entering the ponds, during a rainfall event the amount of water entering the ponds would be limited to what is falling directly over the ponds. This further minimizes the potential for the ponds to overflow. The ponds have much greater capacity than a 25-year, 24 hour flood event (6.96 inches). The amount of rainfall in a 100-year, 24-hour storm event would be approximately 8.48 inches (NOAA 2015). The 1 foot of freeboard above the 25-year, 24-hour storage level has a volume of greater than 425,000 gallons. Based on the total square footage at the top of the ponds, 1 inch of rainfall would equate to approximately 35,000 gallons. Therefore, including the freeboard, the ponds have sufficient storage to hold the volume generated by a 100-year, 24-hour storm event.

Although highly unlikely, an overflow during a significant rainfall event could have short-term impacts to surface water quality since nutrient concentrations and sediment would dilute or be available for biological uptake during downstream transport through the system. Stream volumes and velocities would be greater during a severe weather event and nutrients and sediment would dilute and disperse at rates much greater than base flow and would move rapidly through the system. If the ponds were to overtop, the fluid would mix with stormwater and travel approximately 2,200 feet overland to Big Creek and then 6.8 miles to the Buffalo River. Any discharge during a rainfall event would be restricted to an overflow; the entire contents of the ponds would not be discharged. The amount of overflow would be directly related to the amount of rainfall (1 inch equates to approximately 35,000 gallons) and that overflow would be dilute from its normal concentration.

It is also possible there could be an accidental discharge of waste, which could reach surface waters. However, all land application equipment is regularly inspected for leaks and monitoring is conducted for land application procedures. Waste management operational requirements, facility design, and BMPs are in place to avoid accidental discharges of waste. Honey tankers used to land apply manure carry 3,000 gallons. During its operation, C&H Hog Farms has not had an accidental discharge.

Given the implementation of BMPs and the engineered design and over-capacity of the holding ponds, it is highly unlikely that an overflow from the ponds would occur even in a severe flood event or a series of heavy rainfall events. Should an accidental discharge occur, no adverse effects to snuffbox mussel and suitable habitat are expected since the volume of discharge would be limited to the amount carried in a honey tanker, and because of the distance to suitable habitat. Depending on the location and amount,

an accidental discharge, if one were to occur, may not reach surface waters. Surface water quality could be impacted on a short-term basis, depending on the amount and location of an accidental discharge, but based on the potential volume of discharge any changes to nutrient concentrations or sediment would be expected to dilute or be biologically taken up with increasing distance downstream of the source. Therefore, an accidental discharge is not expected to result in long-term (chronic) impacts to surface water quality or to adversely modify potential or designated critical habitat.

Based on the implementation of the NMP and adaptive management options, operational requirements and BMPs, the proposed action may affect, is not likely to adversely affect snuffbox mussel.

5. DETERMINATION OF EFFECT

Table 6-1 provides a summary of the preliminary determination of effect for the species considered in this BA

Table 5-1. Species address in this assessment and determination of effect

Species	Determination of Effect
Rabbitsfoot mussel	May affect, not likely to adversely affect
Rabbitsfoot mussel Designated Critical Habitat	May affect, not likely to adversely affect
Snuffbox mussel	May affect, not likely to adversely affect
Spectaclecase mussel	No effect
Ozark cavefish	No effect
Gray bat	No effect
Indiana bat	No effect
Northern long-eared bat	No effect

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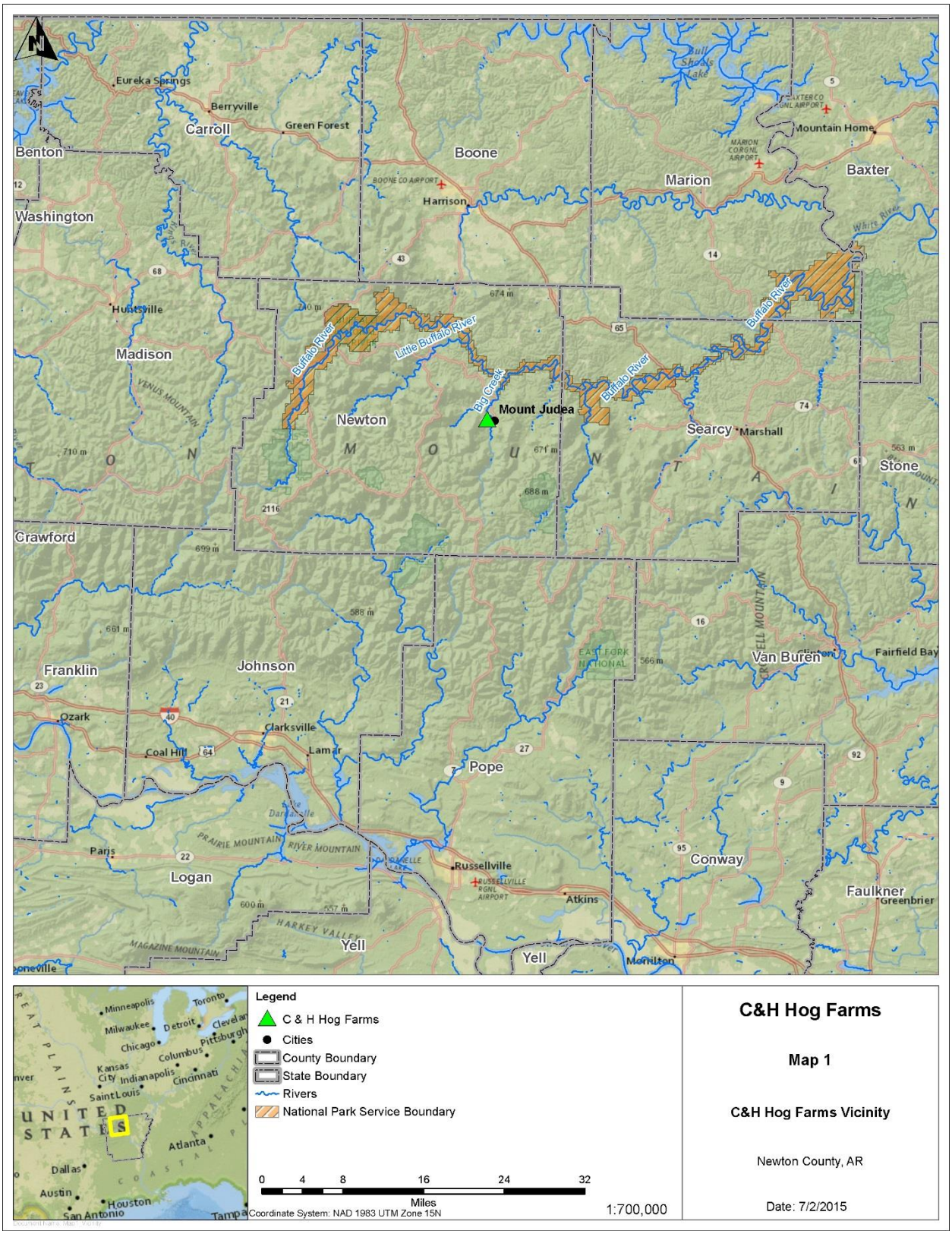
Attachment A – Maps


Eureka Springs
Berryville
Carroll
Green Forest
Benton
Boone
Harrison
Marion
Mountain Home
Baxter
Washington
Huntsville
Madison
Newton
Mount Judea
Searcy
Marshall
Stone
Crawford
Franklin
Johnson
Van Buren
Fairfield Bay
Ozark
Clarksville
Coal Hill
Lamar
Pope
Paris
Logan
Russellville
Conway
Atkins
Faulkner
Greenbrier
Yell
Buffalo River
Little Buffalo River
Big Creek
Bull Shoals Lake
White River
Venus Mountain
Prairie Mountain
River Mountain
Magazine Mountain
Harkey Valley
Petit Jean Mountain
Lake Dardanelle
Minneapolis
Toronto
Milwaukee
Detroit
Chicago
Pittsburgh
Columbus
Kansas City
Indianapolis
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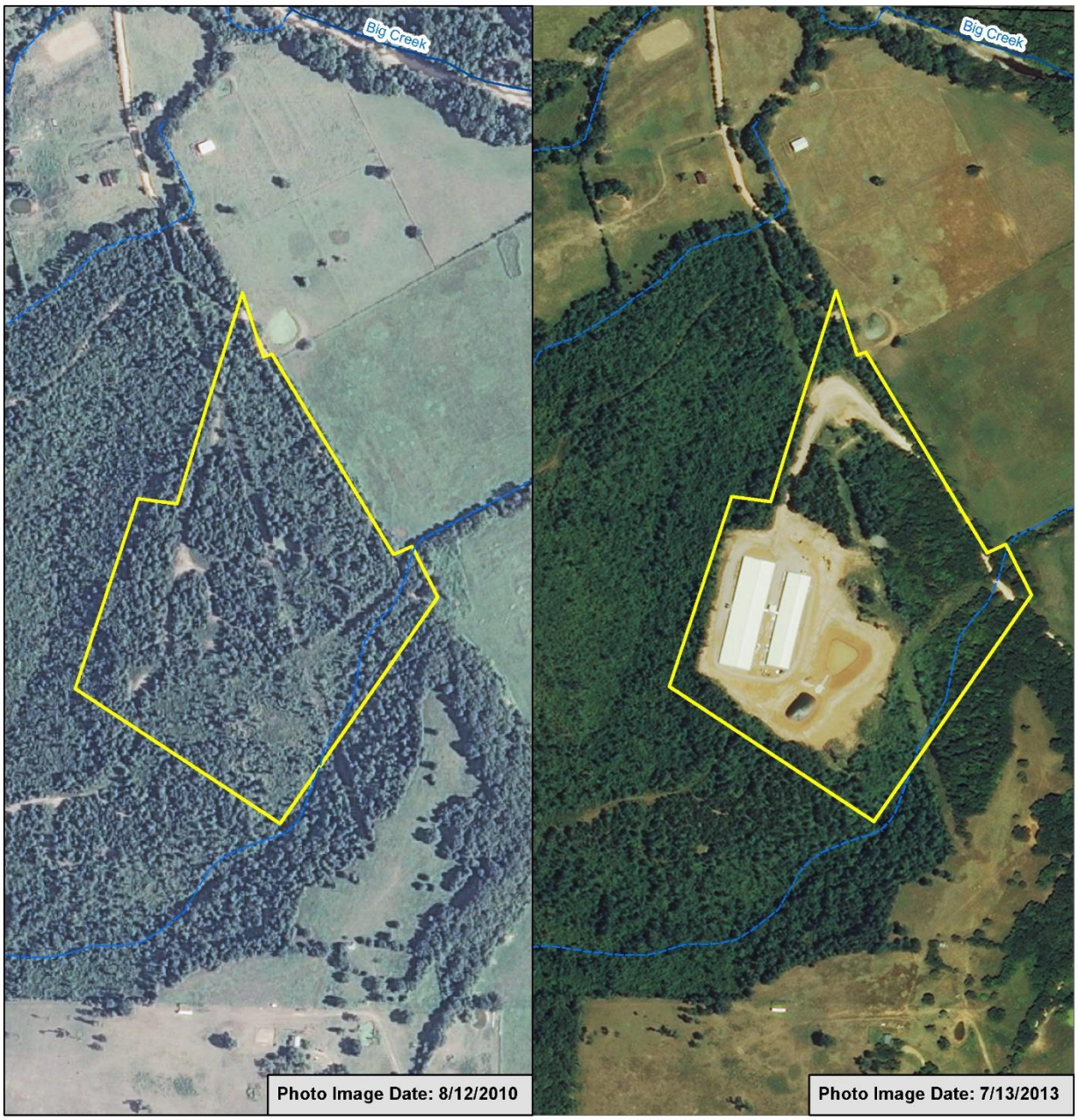
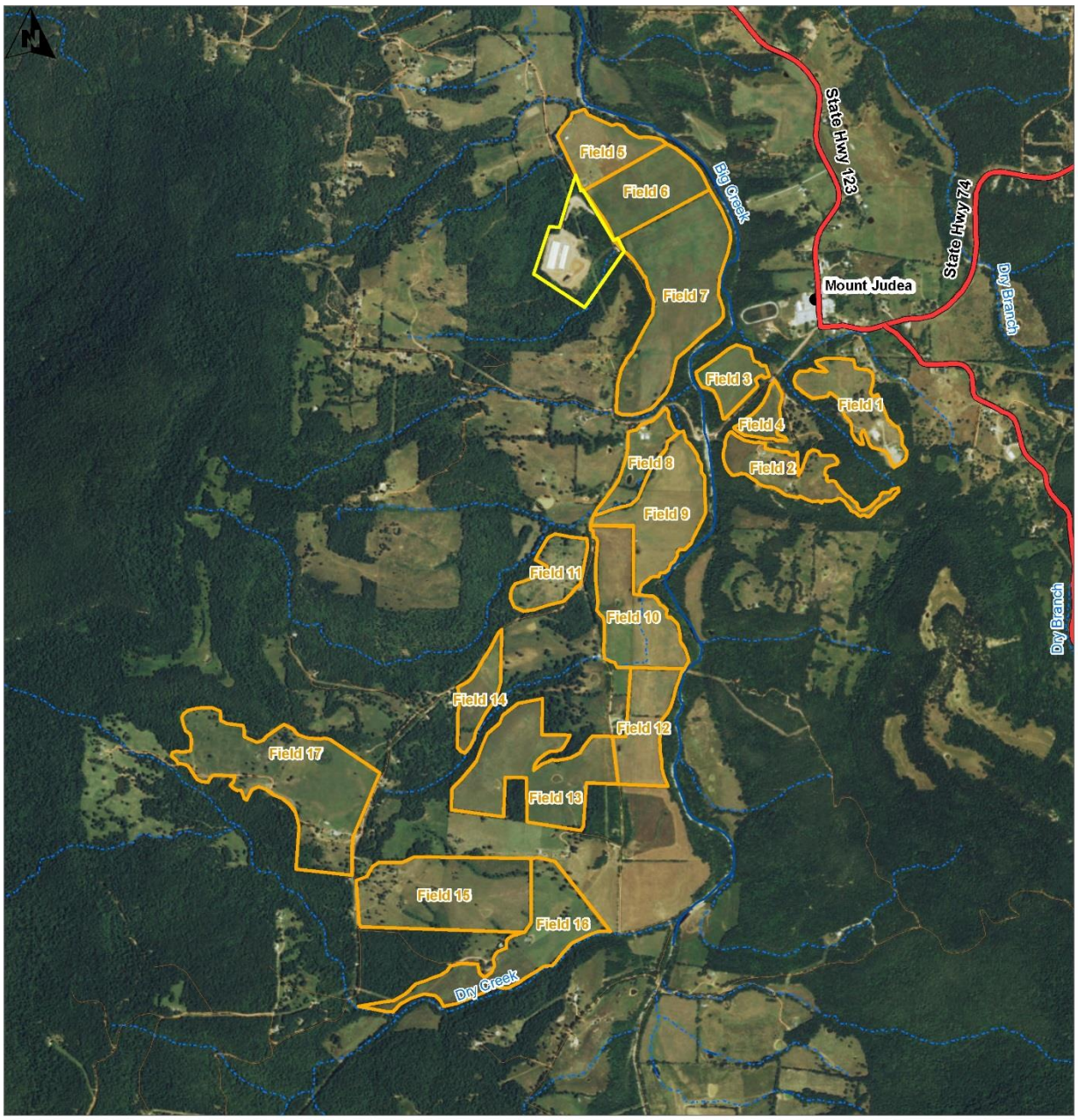
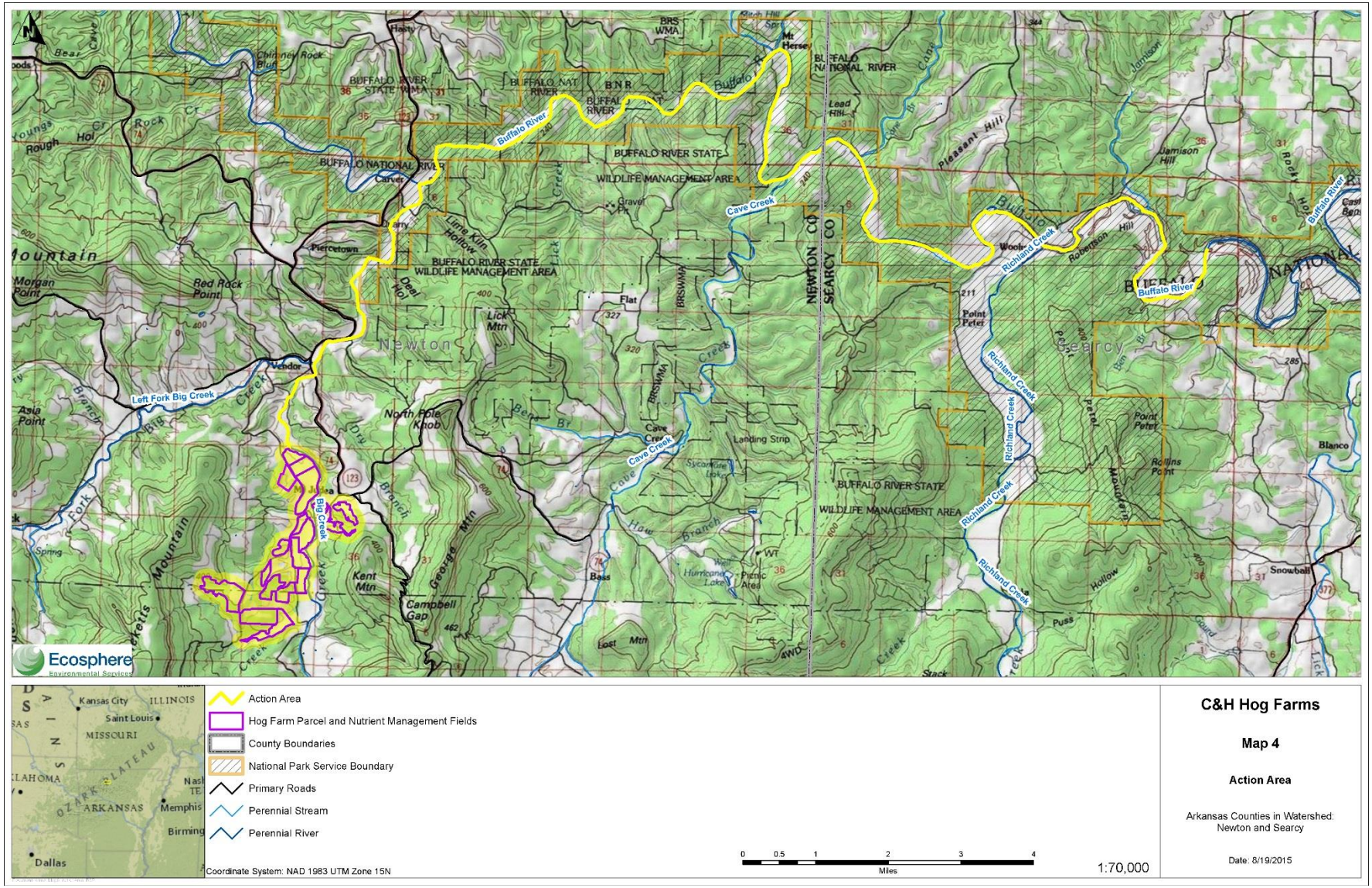
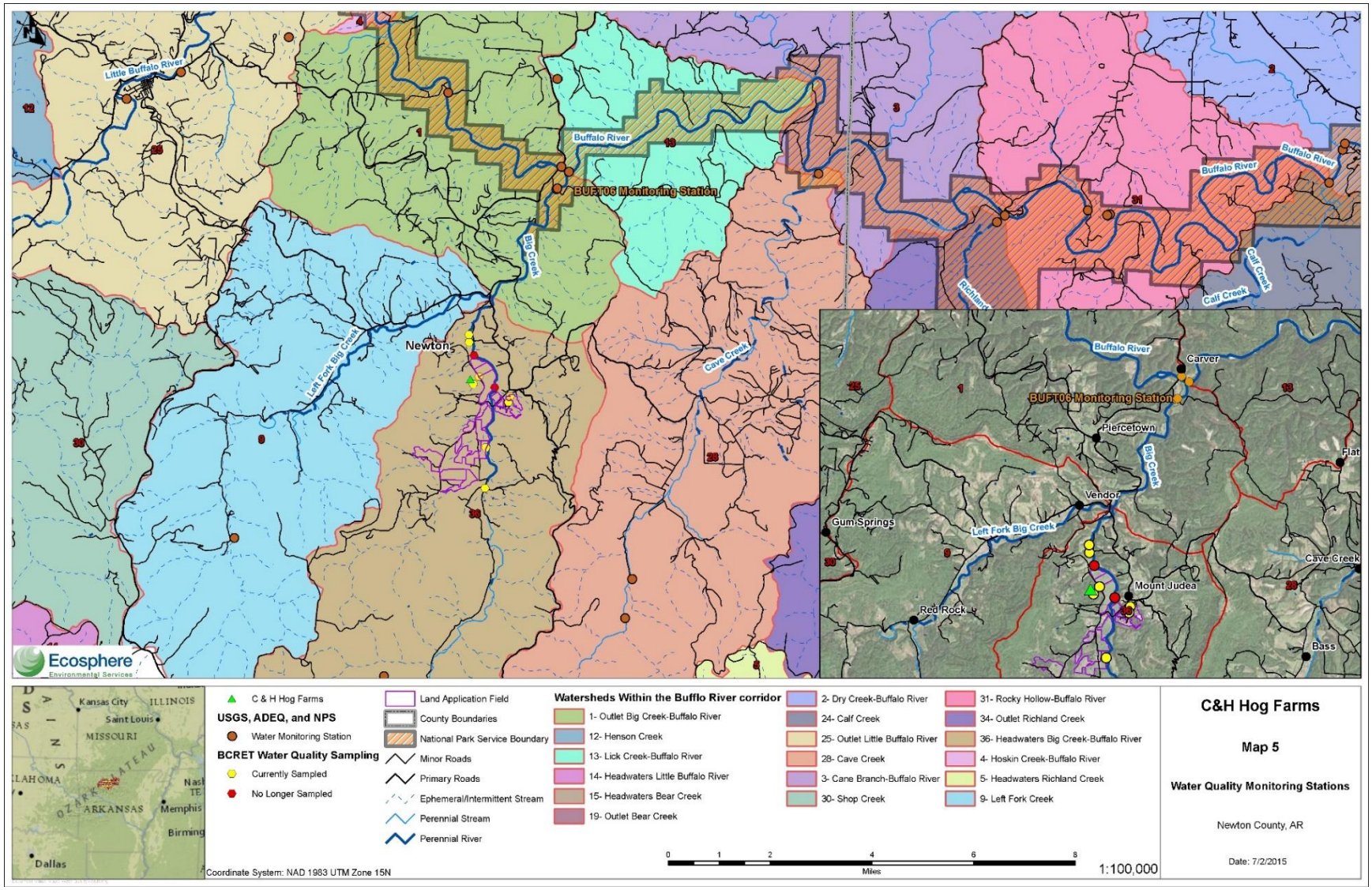
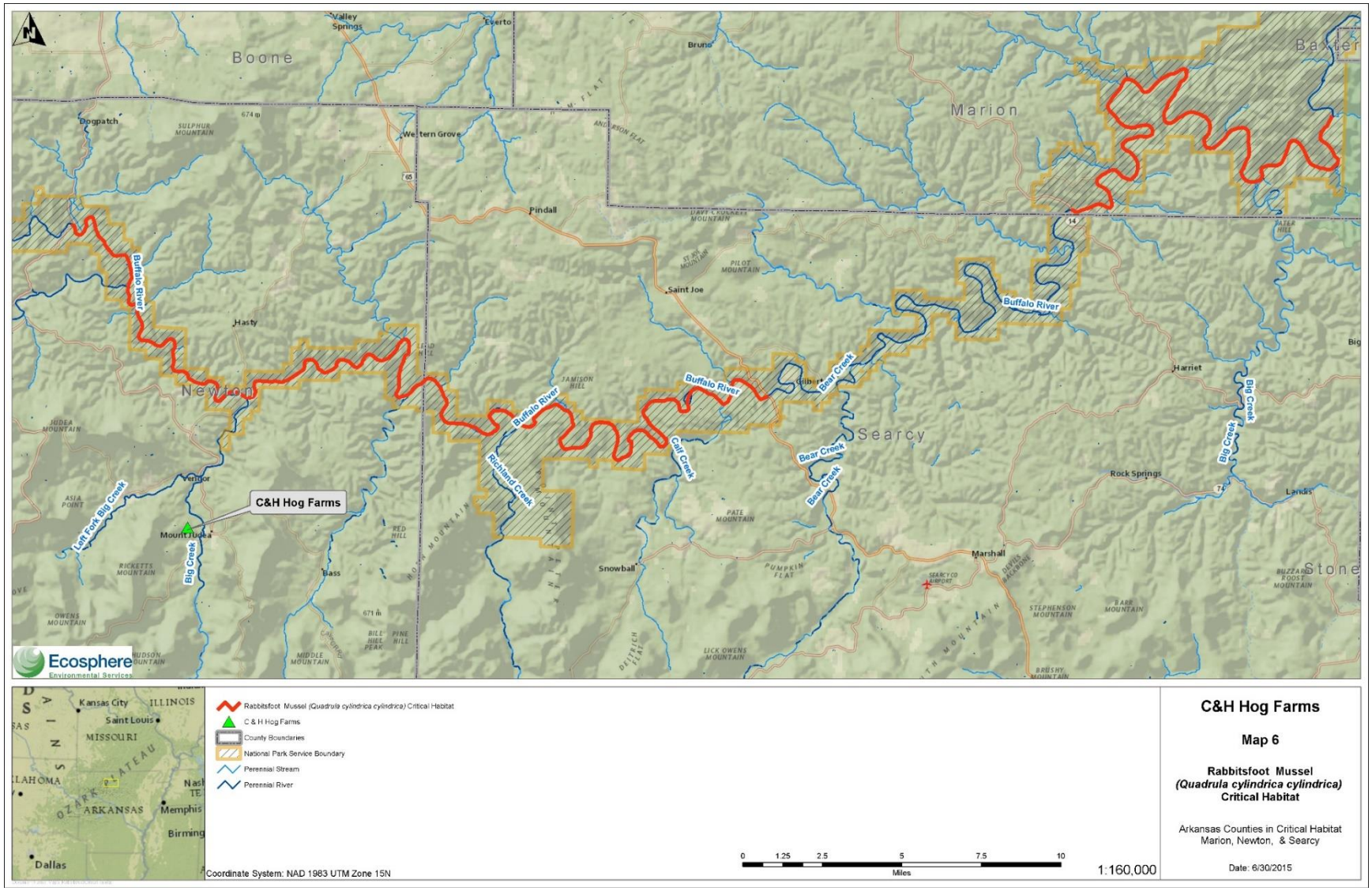
Miles
Coordinate System: NAD 1983 UTM Zone 15N
1:700,000
C&H Hog Farms
Map 1
C&H Hog Farms Vicinity
Newton County, AR
Date: 7/2/2015


Big Creek
Photo Image Date: 8/12/2010
Big Creek
Photo Image Date: 7/13/2013
Legend
C&H Hog Farms Parcel
Intermittent Stream
Perennial Stream
0 125 250 500 750 1,000
Feet
Coordinate System: NAD 1983 UTM Zone 15N
1:6,000
C&H Hog Farms
Map 2
C&H Hog Farms Before and After
Newton County, AR
Section 26, Township 15N, Range 20W
Date: 6/30/2015


Field 5
Field 6
Field 7
Field 3
Field 1
Field 4
Field 2
Field 8
Field 9
Field 11
Field 10
Field 14
Field 12
Field 17
Field 13
Field 15
Field 16
Big Creek
State Hwy 123
State Hwy 74
Mount Judea
Dry Branch
Dry Branch
Dry Creek
Little Rock
ARKANSAS
Legend
C & H Hog Farms Parcel
Land Application Field
Highways
Minor Roads
Intermittent Stream
Perennial Stream
0 0.125 0.25 0.5 0.75 1
Miles
Coordinate System: NAD 1983 UTM Zone 15N
1:24,000
C&H Hog Farms
Map 3
C&H Hog Farms and Land
Newton County, AR
Sections 26, 28, 34, 36, 38,
Township 15N, Range 20W
Sections 2 & 3, Township 14N, Range 20W
Date: 7/2/2015


Ecosphere
Environmental Services
Action Area
Hog Farm Parcel and Nutrient Management Fields
County Boundaries
National Park Service Boundary
Primary Roads
Perennial Stream
Perennial River
Coordinate System: NAD 1983 UTM Zone 15N
0 0.5 1 2 3 4
Miles
1:70,000
C&H Hog Farms
Map 4
Action Area
Arkansas Counties in Watershed:
Newton and Searcy
Date: 8/19/2015
Kansas City
ILLINOIS
Saint Louis
MISSOURI
ARKANSAS
Memphis
Dallas
Buffalo River
Cave Creek
Richland Creek
Left Fork Big Creek
Big Creek
BUFFALO RIVER STATE WILDLIFE MANAGEMENT AREA
BUFFALO NATIONAL RIVER
NEWTON CO
SEARCY CO
Newton
Searcy
Pleasant Hill
Point Peter
Blanco
Snowball
Campbell Gap
Kent Mtn
Lick Mtn
North Pole Knob
Red Rock Point
Asia Point
Morgan Point
Jamison Hill
Robertson Hill
Rollins Point
Landing Strip
Hurricane Lake
Lost Mtn
Piercetown
Carver
Vendor
Gravel Pit
Bass
Flat
Lead Hill
Mt Hersey


Little Buffalo River
Buffalo River
BUFT06 Monitoring Station
Big Creek
Left Fork Big Creek
Newton
Cave Creek
Richland
Calf Creek
Carver
Piercetown
Vendor
Gum Springs
Mount Judea
Red Rock
Bass
Ecosphere
Environmental Services
C & H Hog Farms
USGS, ADEQ, and NPS
Water Monitoring Station
BCRET Water Quality Sampling
Currently Sampled
No Longer Sampled
Land Application Field
County Boundaries
National Park Service Boundary
Minor Roads
Primary Roads
Ephemeral/Intermittent Stream
Perennial Stream
Perennial River
Watersheds Within the Bufflo River corridor
1- Outlet Big Creek-Buffalo River
12- Henson Creek
13- Lick Creek-Buffalo River
14- Headwaters Little Buffalo River
15- Headwaters Bear Creek
19- Outlet Bear Creek
2- Dry Creek-Buffalo River
24- Calf Creek
25- Outlet Little Buffalo River
28- Cave Creek
3- Cane Branch-Buffalo River
30- Shop Creek
31- Rocky Hollow-Buffalo River
34- Outlet Richland Creek
36- Headwaters Big Creek-Buffalo River
4- Hoskin Creek-Buffalo River
5- Headwaters Richland Creek
9- Left Fork Creek
Coordinate System: NAD 1983 UTM Zone 15N
Miles
1:100,000
C&H Hog Farms
Map 5
Water Quality Monitoring Stations
Newton County, AR
Date: 7/2/2015


Boone
Marion
Newton
Searcy
Valley Springs
Everton
Bruno
Dogpatch
Western Grove
Pindall
Saint Joe
Hasty
Harriet
Rock Springs
Landis
Marshall
Snowball
Bass
Mount Judea
Big Creek
Left Fork Big Creek
Buffalo River
Richland Creek
Cave Creek
Bear Creek
C&H Hog Farms
Ecosphere
Environmental Services
Rabbitsfoot Mussel (Quadrula cylindrica cylindrica) Critical Habitat
C & H Hog Farms
County Boundaries
National Park Service Boundary
Perennial Stream
Perennial River
Coordinate System: NAD 1983 UTM Zone 15N
0 1.25 2.5 5 7.5 10
Miles
1:160,000
C&H Hog Farms
Map 6
Rabbitsfoot Mussel
(Quadrula cylindrica cylindrica)
Critical Habitat
Arkansas Counties in Critical Habitat
Marion, Newton, & Searcy
Date: 6/30/2015