Jason Henson
C & H Hog Farms, Inc.
HC 72 Box 10
Mount Judea, AR 72655

February 26, 2015

Re: Major Modification Request – Utilization of Waste Storage Pond 2
AFIN: 51-00164, Permit No.: ARG590001

Mr. John Bailey
Permit Branch Manager
Water Division
Arkansas Department of Environmental Quality
5301 Northshore Drive
North Little Rock, AR 72118-5317

Dear Mr. Bailey:

C & H Hog Farms, Inc. is in receipt of the Department's response to our revision request.

Enclosed are the revised Notice of Intent (NOI) and a full copy of the revised NMP. The revision is found in Section M under the subheading "Method Selected for Land Application of Wastewater". Previously, the Tank Wagon method was identified for Waste Storage Pond 1. The revision now identifies the Tank Wagon method for Waste Storage Ponds 1 and 2. This is the only revision we are seeking at this time.

C & H Hog Farms, Inc. believes this to be a nonsubstantial change; however, in the interest of time, we request that the Department deem this revision a major modification. C & H Hog Farms, Inc. respectfully requests a public hearing be scheduled for the earliest possible date.

Please do not hesitate to contact me if you have any questions or concerns regarding this request.

Respectfully,

Jason Henson

Jason Henson
C & H Hog Farms, Inc.

Enclosures

NPDES Notice of Intent (NOI)
Concentrated Animal Feeding Operations(CAFO)
ARG590000

I. GENERAL INFORMATION

A. TYPE OF BUSINESS	B. CONTACT INFORMATION	C. FACILITY OPERATION STATUS
Concentrated Animal Feeding Operation	Owner/or Operator Name Jason Henson Address (No-POBOX) HC 72 Box 10 Telephone: 870-688-1318 Email: jasonh_1995@yahoo.com City Mount Judea State: AR Zip Code 72655	☒ 1. Existing Facility ☐ 2. Proposed Facility

D. FACILITY INFORMATION

Name: C & H Hog Farms Telephone: 870-688-1318

Address: HC 72 Box 10

City: Mount Judea State: AR Zip Code: 72655

County: Newton Latitude: 35, 55' 13.6" Longitude: 93, 4' 51.0"

If contract operation: Name of Integrator: _____

Address of Integrator: _____

II CONCENTRATED ANIMAL FEEDING OPERATION CHARACTERISTICS

A. TYPE AND NUMBER OF ANIMALS

1. TYPE	2. ANIMALS	
	NO. IN OPEN CONFINEMENT	NO. HOUSED UNDER ROOF
☐ Mature Dairy Cows		
☐ Dairy Heifers		
☐ Veal Calves		
☐ Cattle (not dairy or veal calves)		
☒ Swine (55 lbs. or over)		2,503
☒ Swine (under 55 lbs.)		4,000
☐ Horses		

B. Manure, Litter, and/or Wastewater Production and Use

1. How much manure, litter, and wastewater is generated annually by the facility? .....tons 2,090,081 gallons
2. If land applied how many acres of land under the control of the applicant are available for applying the CAFOs manure/litter/wastewater? 630.7 acres
3. How many tons of manure or litter, or gallons of waste-water produced by the CAFO will be transferred annually to other persons? 0 tons/gallons (*circle one)*

☐ Sheep or Lambs			
☐ Turkeys			
☐ Chickens (Broilers)			
☐ Chickens (Layers)			
☐ Ducks			
☐ Other Specify			
3. TOTAL ANIMALS		6,503	

C. ☐ TOPOGRAPHIC MAP

D. TYPE OF CONTAINMENT, STORAGE AND CAPACITY

1. Type of Containment	Total Capacity (in gallons)	
☐ Lagoon		
☒ Holding Pond	2,735,922	
☐ Evaporation Pond		
☒ Other: Specify Shallow Pits	759,542	

2. Report the total number of acres contributing drainage: 0 acres

3. Type of Storage	Total Number of Days	Total Capacity (gallons/tons)	
☐ Anaerobic Lagoon			
☐ Storage Lagoon			
☐ Evaporation Pond			
☐ Aboveground Storage Tanks			
☐ Belowground Storage Tanks			
☐ Roofed Storage Shed			
☐ Concrete Pad			
☐ Impervious Soil Pad			
☐ Other: Specify _____			

E. NUTRIENT MANAGEMENT PLAN

Note: A permit application is not complete until a nutrient management plan (NMP) is submitted with NOI.

1. Please indicate whether a nutrient management plan has been included with this permit application. ☒Yes No (STOP)

2. Is a nutrient management plan being implemented for the facility? ☒ Yes No

3.The date of the last review or revision of the nutrient management plan. Date: January 24, 2015

4. If not land applying, describe alternative use(s) of manure, litter, and or wastewater:

F. LAND APPLICATION BEST MANAGEMENT PRACTICES

Please check any of the following best management practices that are being implemented at the facility to control runoff and protect water quality:

☐ Buffers ☒Setbacks ☐ Conservation tillage ☐ Constructed wetlands ☐ Infiltration field ☒Grass filter ☐ Terrace

III. CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A. Name and Official Title (*print or type*) Jason Henson, President	B. Phone No. (870) 688-1318
C. Signature Jason Henson	D. Date Signed 2/26/15

DeHaan, Grabs & Associates, LLC
Consulting Engineers
www.dgaengineering.com

Nutrient Management Plan For

C&H Hog Farms

Newton County, AR

Prepared by DeHaan, Grabs & Associates, LLC,

May 2012

North Dakota Office
P.O. Box 522
Mandan, ND 58554-0522
(701) 663-1116
Fax (701) 667-1356

Nutrient Management Plan
Table of Contents

Section A: Introduction

NARRATIVE FOR C&H HOG FARMS
NUTRIENT MANAGEMENT PLAN

This Nutrient Management Plan was developed for C&H Hog Farms. The farm located approximately 1.6 miles to the west of Mt. Judea AR. Driving directions from Mt. Judea is approximate 0.8 miles southwest on County Rd 54 and right on County rd 41 approximately 0.75 miles. The site is located on the left hand side of the road on a logging trail. The legal location is Section 26, Township 15 North, Range 20 West, Newton County, Arkansas. This Nutrient Management Plan was developed as a joint effort between C&H Hog Farms, the Natural Resources Conservation, and DeHaan, Grabs & Associates, LLC.

The total available for crop uptake of N (18,497 lbs) and available P_2O_5 (14,213 lbs) produced annually by the livestock was determined by DeHaan, Grabs & Associates, LLC using Arkansas Nutrient Management Planner with 2009 PI. The Waste Storage Ponds have capacity of 3,495,464 gallons (this includes the shallow pits). The Waste Storage Ponds have capacity at the Must Pumpdown Elevation of 2,469,903 gallons. The volume between the Freeboard and the Must Pumpdown Elevation is 35,564 gallons. Effluent from Waste Storage Pond 1 will be applied through a Vac Tanker, whereas the effluent from Waste Storage Pond 2 will applied through a traveling gun and a permanent pipeline. The rate will be calculated in accordance to the crop needs using the Nutrient Management Planner with 2009 PI. The NMP includes 670.4 acres of agricultural land, most of which is available for manure application. After excluded acres the land available is approximately 630.7 acres. The typical crops grown are native grass (Bermudagrass and Fescue) either taken off as rotated pasture or hay. When calculating projected land base requirements and RUSLE 2 calculations, predicted crop yield goals was used. When calculating annual nutrient application needs, actual yields on a per field basis will be used.

The record keeping section is important for the proper application of nutrients from the facility. Records of commercial fertilizer will also be maintained. The facility will maintain the following documentation from each application of manure or wastewater: current soil sample analysis, current manure or wastewater analysis, records showing equipment calibration, a Water Quality Risk Assessment (WQRA) map showing actual area application, and a completed Arkansas Nutrient Management Planner summary showing calculated application rate.

Nutrient Management Plan

The Nutrient Management Plan (NMP) is an important part of the conservation management system (CMS) for your Animal Feeding Operation (AFO). This NMP documents the planning decisions and operation and maintenance for the animal feeding operation. It includes background information and provides guidance, reference information and Web-based sites where up-to-date information can be obtained. Refer to the Producer Activity document for information about day-to-day management activities and recordkeeping. Both this document and the Producer Activity document shall remain in the possession of the producer/landowner.

Farm contact information: C&H Hog Farms, (Jason Henson) 870-688-1318
HC 72 PO Box 10
Mount Judea, AR 72655

Latitude/Longitude: 35, 55', 13.60" & -93, 4' 51.0"
Plan Period: 2012-2017
Animal Type: Swine
Animal Units: 999

Owner/Operator

As the owner/operator of this NMP, I, as the decision maker, have been involved in the planning process and agree that the items/practices listed in each element of the NMP are needed. I understand that I am responsible for keeping all the necessary records associated with the implementation of this NMP. It is my intention to implement/accomplish this NMP in a timely manner as described in the plan.

Signature: _____ Date:
Name: Jason Henson

Conservation Planner

As a Conservation Planner, I certify that I have reviewed both the Nutrient Management Plan and Producer Nutrient Management Activities documents for technical adequacy and that the elements of the documents are technically compatible, reasonable and can be implemented.

Signature: Nathan A. Pesta Date: June 1, 2012
Name: Nathan A. Pesta, P.E.
Title: Senior Project Engineer

Manure and Wastewater Handling and Storage

Signature: _____ Date:
Name: Geoffrey H. Bates, P.E.
Title: President

Nutrient Management

The Nutrient Management component of this plan meets the AR Nutrient Management 590 Practice Standard.

Signature: _____ Date:
Name: Geoffrey H. Bates P.E.
Title: President

NUTRIENT MANANGEMENT PLAN CONTACT INFORMATION

1. **Facility:**

NAME:	C&H Hog Farms
ADDRESS:	HC 72 PO Box 10
	Mount Judea, AR 72655
PHONE NUMBER:	(870) 688-1318
EMAIL:	jasonh@rittermail.com
MANAGER:	Jason Henson

2. **Owners:**

NAME:	Jason Henson
ADDRESS:	HC 72 PO Box 10
	Mount Judea, AR 72655
PHONE NUMBER:	(870) 715-9468

3. **NMP Developed by:** DeHaan, Grabs & Associates, LLC

NAME:	Nathan A. Pesta
ADDRESS:	P.O. Box 522
	Mandan, ND 58554
PHONE NUMBER:	(701) 663-1116
CELL NUMBER:	(701) 400-3950

4. **Legal Location of Facility**
Middle, Section 26, T-15-N, R-20-E, Newton County, AR

NUTRIENT MANAGEMENT PLAN INFORMATION

Type of Livestock:..... Swine
Number of head: 6503
Average Weight:.....153.6 lbs

Total Number of
Acres Included in NMP after excluded acres:.....630.7 acres

References

The nutrient management plan was developed based on compliance criteria described in the following documents:

☒ **Arkansas Pollution Control and Ecology Commission Regulation 5 dated** ***March 28, 2008***

☒ **USDA, Natural Resources Conservation Service (NRCS) conservation practice standard** ***Nutrient Management ("590")*** **dated** ***December 2004***

☐ _____ **County zoning ordinance for animal feeding operations dated/amended**

Land Base

The nutrient management plan has sufficient land base to meet land application on a Nitrogen (N)-based for fields 5-9. Fields 1-4 and 10-17 are in addition and will be applied on a Phosphorus (P)-based manure application rate. P-based levels for spreading manure generally requires a significantly greater land base the N-based. When necessary, fields targeted for phosphorus-based manure application are identified in the **Manure Application Planning** section of this plan.

Local Zoning Ordinances

Operator Name: C&H Hog Farms County: Newton

The livestock operator is responsible for complying with all local ordinances. The operator shall address all of the following items and ensure any local requirements are met and/or included in this plan.

1. Does the county have any ordinances that require special permitting or approvals for siting animal feeding operations or land application of manure? ____ Yes _X_ No

   If yes, has the county permitted or approved this site? ____ Yes ____ No

   If no, do you intend to get approval or obtain local permits prior to land application of manure? ____ Yes ____ No

   Application of manure cannot occur until the operator obtains all local approvals.

2. Is the land application area, or any portion, located within the jurisdictional area of a city or town? ____ Yes _X_ No

   If yes, does the city or town have any special permitting for siting animal feeding operations or application of manure within their jurisdictional area? ____ Yes _X_ No

   If yes, has the city or town permitted or approved this site? ____ Yes ____ No

   If no, do you intend to get approval or obtain local permits prior to land application of manure? ____ Yes ____ No

   Application of manure cannot occur until the operator obtains local approval.

3. Are there specific setback distances that the county or city requires for application of manure? (For example, some local governments require specific setbacks from residences and public right-of-ways.) ____ Yes _X_ No

   If yes, show the applicable setbacks on the required field maps and exclude these areas from the total number of acres.

4. Is the land application site located in a wellhead protection area? ____ Yes _X_ No

   If yes, the producer needs to contact the local county, city or public water supply official to discuss specific requirements.

(Operator Signature) (Date)

Section B: Nutrient Utilization Plan

B. NUTRIENT UTILIZATION PLAN

The Following is in this section:

1. Location
2. Record Keeping
3. Soil Sampling
4. Manure Sampling
5. Nutrient Budget for Land Application
6. Timing, Rate, and Frequency of Liquid and Solid Manure Applications
7. Land Application of Liquid Manure
8. Amounts of Nitrogen Applied
9. Solid Accumulation in the Retention Storage Pond
10. Check Valves/Safety Switches
11. Effluent/Solids Easement Agreement
12. Prevention of Destruction of Endangered or Threatened Species
13. Setback Requirements
14. Typical Crops Grown and Crop Yields for the Land Application Areas
15. Nutrient Utilization Plan Amendments

B. NUTRIENT UTILIZATION PLAN

1. **Location**
This plan is for C& H Hog Farms which is located in Newton County, Arkansas with a legal description of Section 26, Township 15 North, Range 20 West.

2. **Record Keeping.**
   a. A liquid manure pumping data sheet will be completed at the end of all pumping events by the person(s) responsible for monitoring the application event.

      The pumping data sheet will include calculations for rate, gallons applied, hours of application time, type of crop applied to, method of application and total acres to be applied.

   b. A solids manure application data sheet will be completed at the end of all land application events by the person(s) responsible for monitoring the application event.

      The application data sheet will include calculations for rate, cubic feet or tons applied, type of crop applied to, method of application and total acres to be applied.

   c. During Periods of Land Application, daily inspections shall be conducted and record the following
      1) Record the days each field is applied to, as well as weather conditions including; temperature, wind speed and wind direction.
      2) Inspect and record the condition of the land application fields being used.
      3) Inspect and record the condition of all land application equipment being used.
      4) Inspect and record the condition of the waste storage pond liner and embankment near the pump intake if pumping is taking place

   d. Inspections after Rainfall events shall be conducted and record the following:
      1) Record the depth of the water in all retention ponds.
      2) Inspect risers and pipe to ensure they are not plugged or damaged. Clean any significant sediment build up as soon as possible.
      3) Inspect storage ponds for signs of leaking or seepage, excessive settling, excessive vegetation growth or damage due to vehicles or equipment, rodents or erosion. Report any leakage as detailed above and make plans to rectify any problems.

4) Inspect fences and safety signs around the facility, if applicable, to ensure they are present and in good condition. If necessary repair immediately.
5) Record any livestock mortalities and how the carcasses were properly disposed of. (i.e. rendering service receipts, location of burial, etc.)

f. Annual inspections shall be conducted and record the following.

1) Conduct soil and manure testing as required by this plan.
2) Prepare an annual Nutrient Management Plan based on current data.
3) Annual reporting should be completed as referenced in http://www.adeq.state.ar.us/water/forms_inst.htm

3. **Soil Sampling.**

a. Composite base-line soil test samples for a new facility or a new land application area and land receiving liquid manure will be taken at least annually.

b. Soil samples will be taken before the land application of liquid and solids manure to determine the manure application rate appropriate to the land application area.

c. Samples will be taken as follows:

1) At least 20 cores taken to a depth of 24 inches shall be collected for each field.

a) One composite sample shall consist of the top six inches of no fewer than 20 combined. The other sample shall be the remaining six to 24 inches of at least 6-8 combined.

b) Phosphorus, copper and zinc shall be tested from the combined top six inches of the cores from a field.

c) Nitrate-N and chloride shall be tested from the combined six to 24 inches of the cores from a field.

d) The core composite portions of any sample, when mixed together, shall represent the field at the depths from the cores.
e) The soil samples shall be taken at least every 40 acres.

2) The samples will then be mixed in a plastic bucket (not metal) to form a representative composite sample for the field.

3) A subsample will be taken from the mixed composite and placed in the cloth bag provided by the analytical laboratory.

4) Soil samples for Nitrate-N and Phosphorus shall be taken no less than annually. The soil samples shall be certified by the person taking the samples as being a representative sample of the soil and of the nutrient values of the field being tested.

5) A copy of the certification of each composite soil sample and the laboratory results for each sample shall be maintained in the office of the facility and made available to the Department of Health or designee upon inspection. The certification will show the date the sample was taken, the approximate locations in the field from which the cores were taken, the depth or depths of the cores that constitutes the sample, the name of the person who took the sample and the date the sample delivered to a laboratory.

4. **Manure Sampling.**

a. Manure samples in conjunction with soil samples, will be taken prior to land application to determine land application rate.

b. Liquid and solid manure samples will be analyzed by a certified laboratory for pH, total dissolved salts, potassium, total nitrogen, ammonium-nitrogen and phosphorus.

5. **Nutrient Budget for Land Application.**

a. Nutrient loss due to volitization, evaporation, and crop uptake will be accounted for each time liquid manure is applied to the land application area.

b. In addition, communications with the farmer(s) will ensure proper planning of commercial fertilizer applications with liquid manure applications so that excess nutrients will not be applied to the land.

6. **Timing, Rate, and Frequency of Liquid and Solid Manure Applications.**

a. Liquid and solid manure will be applied at agronomic rates.

Weather conditions and nutrient holding capacity of the soil will determine the timing and rate of application.

b. Liquid and solid manure will not be applied to land classified as highly erodible according to the conservation compliance provisions of the Federal Food Security Act of 1985, saturated or frozen ground, or during a rainfall event.

Most land applications will be conducted in the spring, summer and fall.

c. Liquid manure will not be applied to land classified as highly erodible according to the conservation compliance provisions of the Federal Food Security Act of 1985, saturated or frozen ground, or during a rainfall event.

Most land applications will be conducted in the spring, summer and fall.

d. Land application will be conducted in a manner which will prevent a discharge or drainage of manure to ground or surface waters of the State.

e. Land application practices are managed so as to reduce or minimize ponding or puddling of liquid manure on the site, contamination of ground or surface waters, and occurrence of nuisance conditions such as odors, flies, and rodents.

f. Land application practices will minimize the possibility of contamination of surface and groundwaters of the State.

7. **Land Application of Liquid Manure**

a. Careful scheduling of the land application activities will reduce the threat of odor emissions to residents near the facility.

b. Days with low humidity are best for land application.

- Applications on holidays and weekends when people are most likely to be outdoors will be avoided when possible.

c. The use of sprinkler for land application will be one of the methods for liquid application. The use of a vactanker and equipment to knife inject or spread the nutrients on top the land for land application will be one of the methods for land application.

8. **Amounts of Nitrogen Applied.**

a. Liquid manure will typically be applied at agronomic rates for nitrogen, however, the phosphorus application will follow the Arkansas Nutrient Manangement Planner phosphorous index risk assessment to ensure that the phosphorus levels are not becoming a risk to surface water pollution.

b. Calculations for quantity of liquid manure that can be applied to agronomic rates to crop production land are performed by the staff soil scientist or or land application formulas prepared by University of Arkansas Extension.

c. Max. application (lbs/ac)/Manure N Content (lbs/ac-in) = Max. manure application (ac-in).

d. Acres for application x Max. manure application (ac-in) x 27154 = Max. pumping volume (gallons).

e. The spreadsheet log for land application can be utilized for land application calculations.

9. **Solid Accumulation in the Retention Storage Pond.**

a. The design and operation of the waste storage pond at the facility provides for desludging during each waste removal.

b. If or when pond desludging becomes necessary, Jason Henson- will land apply the solids at agronomic rates and in accordance with local, state, and federal regulations.

c. Solids will be land farmed utilizing available technology at the time of application.

10. **Check Valves/Safety Switches**
- With the utilization of subsoil land application equipment, the use of check valves/safety switches are not necessary.

11. **Effluent/Solids Easement Agreement.**
Easements are found in Section G

12. **Prevention of Destruction of Endangered or Threatened Species.**

a. Animal manure handling, treatment and management plans are designed with the intention of reducing any harm or destruction of endangered or threatened species or contribute to the taking of any federally endangered or threatened species of plant, fish, or wildlife; nor interfere with or cause harm to migratory birds.
b. C&H Hog Farms will notify the appropriate fish and wildlife agency in the event of any significant fish, wildlife, or migratory bird/endangered species kill or die-off on or near a retention pond or in the field where waste has been applied and which could reasonably have resulted from waste management at the facility.

13. **Setback Requirements.**

a. Manure shall not be applied any closer than a 100 feet to any down-gradient surface waters, open tile line intake structures, sinkholes, agricultural well heads or other conduits to surface waters.
b. Incorporate surface applications of solid forms of manure or some commercial fertilizer nitrogen formulations (i.e. Urea) into the soil within 24 hours of application.
c. When applying liquid forms of manure with irrigation equipment select application conditions when there is high humidity, little/no wind blowing, a forth coming rainfall event, and or other conditions that will minimize volatilization losses into the atmosphere. The basis for applying manure under these conditions shall be documented in the nutrient management plans.

14. **Typical Crops Grown and Crop Yields for the Land Application Areas:**

a. Pasture – 6.5 tons/acre
b. Hay - 6.5 tons/acres

15. **Nutrient Utilization Plan Amendments.**

a. This plan may be amended when it fails to provide for protection of environmental resources or as appropriate.

b. This plan will also need to be amended with Arkansas DEQ approval when one of the following conditions exist:

1) Additional land to which waste will be applies is not described in the approved plans.

2) A procedure will be used that is not described in an approved plan.

3) Land described in an approved plan is no longer available for nutrient application.

Section C: Land Application Calculations

SECTION C. Land Application Calculations

The following Information is attached

1. Land Application Calculation Spreadsheet
2. Phosphorus Index & RUSLE 2 Calclations
3. Yield Goal & Crop Nutrient Uptake

C. Land Application Calculations

C&H Hog Farms
01-Jun-12

1. Estimate the total nutrients (NPK) in the excreted manure.

Nutrients per storage period = # of animals x weight (lbs) x daily nutrient production (lb/day/1,000 lb)

		# of Animals	Average Weight (lbs.)	Daily Nutrient Production (lb/day/1,000 lbs)	Storage Period	Total Nutrients
Nitrogen						
	Farrowing Sows	400	425	0.47	365	29,164
	Breeding/Gestation	2100	375	0.19	365	54,613
	Boars	3	450	0.15	365	74
	Nursery Pigs	4000	10	0.60	365	8,760
	Finisher Pigs	0	150	0.42	365	0
Total Nitrogen		**6,503**				**92,611**
Phosphorus						
	Farrowing Sows	400	425	0.15	365	9,308
	Breeding/Gestation	2100	375	0.063	365	18,109
	Boars	3	450	0.05	365	25
	Nursery Pigs	4000	10	0.25	365	3,650
	Finisher Pigs	0	150	0.16	365	0
Total Phosphorus		**6,503**				**31,091**
Potassium	Lactating Sows	400	425	0.3	365	18,615
	Breeding/Gestation	2100	375	0.123	365	35,355
	Boars	3	450	0.10	365	49
	Nursery Pigs	4000	10	0.35	365	5,110
	Finisher Pigs	0	150	0.22	365	0
Total Potassium		**6,503**				**59,129**

2. Add nutrients contained in wastewater.

Nutrients in the wastewater = Number of animals x daily wastewater production (gal./day/cow) x dail

		# of Animals	Daily Wastewater Production (gal./day/cow)	Daily Nutrient Production (lb/day/1,000 gal)	Storage Period	Total Nutrients
Nitrogen						
	Farrowing Sows	400	0	0	365	0
	Breeding/Gestation	2100	0	0	365	0
	Boars	3	0	0	365	0
	Nursery Pigs	4000	0	0	365	0
	Finisher Pigs	0	0	0	365	0
Total Nitrogen		**6,503**				**0**
Phosphorus						
	Farrowing Sows	400	0	0	365	0
	Breeding/Gestation	2100	0	0	365	0
	Boars	3	0	0	365	0
	Nursery Pigs	4000	0	0	365	0
	Finisher Pigs	0	0	0	365	0
Total Phosphorus		**6,503**				**0**
Potassium	Farrowing Sows	400	0	0	365	0
	Breeding/Gestation	2100	0	0	365	0
	Boars	3	0	0	365	0
	Nursery Pigs	4000	0	0	365	0
	Finisher Pigs	0	0	0	365	0

Total Potassium	**6,503**	**0**

Total Nutrients Produced		
Total N	92,611	lbs
Total P	31,091	lbs
Total K	59,129	lbs

Convert to Fertilizer Form		
Total N	92,611	lbs
Total P_2O_5	71,198	lbs
Total K_2O	71,546	lbs

3. Subtract nutrients lost during storage

Nutrients after storage losses = Total nutrients produced x fraction retained = Amount for land applic

Solids (assume 0% of nutrients retained in solids)

Item	Nutrients (lbs)	Percent of Orig.	Available for Land Application (lbs)
Total N	0	0.65	0
Total P_2O_5	0	0.80	0
Total K_2O	0	0.80	0

Liquids (assume 100% of nutrients retained in liquids)

Item	Nutrients (lbs)	Percent of Orig.	Available for Land Application (lbs)
Total N	92,611	0.73	67,143
Total P_2O_5	71,198	0.85	60,518
Total K_2O	71,546	0.85	60,814

4. Determine the plant available nutrients

Estimate the amount of nutrients that will be available each year after the third consecutive year of a
Plant available nutrients = Amount applied x fraction available

Solids (assume 0% of nutrients retained in solids)

Item	Nutrients (lbs)	Percent Avail.	Available for Land Application (lbs)
Total N	0	0.73	0
Total P_2O_5	0	0.90	0
Total K_2O	0	0.93	0

Liquids (assume 100% of nutrients retained in liquids)

Item	Nutrients (lbs)	Percent Avail.	Available for Land Application (lbs)
Total N	67,143	0.73	49,014
Total P_2O_5	60,518	0.90	54,466
Total K_2O	60,814	0.93	56,557

5. Determine the nutrients required by the crop and soil to produce the yield goal

5a (1). Estimate the amount of nutrients removed by the crop using table 6-6.

Assume using an average of Bermudagrass (3.25 tons/acre) x (2 cuttings)

Nutrient Uptake		
N	244.4	lbs/acre
P	24.7	lbs/acre
K	182	lbs/acre

Convert to Fertilizer Form		
N	244	lbs/acre
P_2O_5	57	lbs/acre
K_2O	220	lbs/acre

5a (2). Add to the plant requirements additional nitrogen to replace anticipated denitrification losses

SECTION C2: DESIGN CALCULATIONS

Waste Production Calculations

A. Facility Information

1. Type of Construction: ☐existing, ☒ proposed-new, or ☐ expansion

2. Building Area, **Barn 1 Gestation Barn** (Proposed): *421.3* feet by *117.5* feet
   Barn 2 Farrowing Barn (Proposed): *367.1* feet by *82.5* feet

3. Animal Capacity (maximum head counts and average weights)

3	head of *Boars*	@ *450*	lbs, *1,350*	lbs Total
2,100	head of *Gestation Sows*	@ *375*	lbs, *787,500*	lbs Total
400	head of *Lactating Sow*	@ *425*	lbs, *170,000*	lbs Total
4,000	head of *Nursery Pig*	@ *10*	lbs, *40,000*	lbs Total
	head of	@	lbs,	lbs Total

Total: *6,503* **head** **Total Animal Weight (TAW):** *998,850* **lbs**

B. Determine Minimum Storage Requirement

The Minimum Storage Requirement is the sum of the animal waste produced (or treatment volume for an anaerobic lagoon), plus the spillage and washwater, plus the pit recharge produced in 180 days. Generally, outside or contributing drainage area runoff is to be diverted. Runoff which is not diverted must be included in the storage requirement.

The following is completed for either Liquid Manure Storage or Anaerobic Lagoon

Liquid Manure Storage

Unit Waste Production (UWP) in cubic feet per day per 1,000 pounds of animal:

Cattle	Swine	Poultry	Other
❒Dairy = 1.3	☒ Nursery Pig = 1.4	❒ Layers = 0.9	❒ Horse = 0.8
❒ Beef = 1.0	❒ Grower/Finisher = 1.0	❒ Broiler = 1.3	❒ Sheep = 0.6
	☒ Boar/Gestating Sow = 0.41	❒ Turkey = 0.7	
	☒ Sow and Litter = 0.97		

(a) Manure produced: (TAW x (UWP x 180 days/1,000)) = *97,979* cubic feet / 1,000 lbs
(TAW x UWP for each type calculated separately and added to find total manure produced)

(b) Spillage and Washwater generated in 180 days: *19,596* cubic feet
(If unknown, 20% of (a) is used)

(c) Total Manure plus Spillage and Washwater, (a)+(b): *117,575* cubic feet.

Rainfall Data

(d) 25 Year- 24 Hour Rainfall Event: *0.58* Feet

(e) Precipitation-Evaporation October 1 – April 1) *0.92* *Feet*
(f) Top of Waste Storage Pond 1 *20,857* Square feet
(g) Top of Waste Storage Pond 2 *35,262* Square feet

(h) Waste Storage Pond 1 25 Yr-24 Hr Storage Requirement (d) x (f): *12,097* cubic feet
(i) Waste Storage Pond 2 25 Yr-24 Hr Storage Requirement (d) x (g): *20,452* cubic feet
(j) Waste Storage Pond 1, 180 Day Net Precip. Requirement (e) x (f): *19,119* cubic feet
(k) Waste Storage Pond 2, 180 Day Net Precip. Requirement (e) x (g): *32324* cubic feet

Recharge Water -The farrowing barn will be pulled once every three weeks and the Gestation Barn will be pulled once every five weeks on a conservative estimate and will be recharged with 2" of fresh water .

(l) Recharge Water Produced Average: *366*(cubic feet per day) x *180* (180 days in storage period) = *65,880* cubic feet per 180 days.

Runoff

(m) Sand Lane and Stacking Pad Area:_____feet x _____feet = _____square feet

(n) Manure Stacking Pad Area:_____feet x _____feet = _____square feet

(o) Feed Stacking Pad Area:_____feet x _____feet = _____square feet

(p) Total Runoff Area:_____square feet

(q) Minimum Runoff (Figure 1 from Appendix):_____inches

NOTE: If a covered storage is used which collects runoff, then the sum of the 25 year, 24 hour storm runoff and the expected runoff for the 180 day storage period is used as the Minimum Runoff in (m).

(r) Minimum Runoff Storage Requirement (l) x (m)/12 = _____cubic feet

Minimum Overall Storage Requirement

(s) Minimum Storage Requirement (c or g) + (h) + (n): *279,436* cubic feet

Waste Storage Calculations

A. Determine Storage Provided

Type of storage: ☐ Earthen Storage Pit ☒ Earthen Lagoon ☐ Concrete Tank
☐ Underfloor Concrete Pit ☐ Outside Concrete Pit
☐ Other (describe) _____

NOTE: A scale drawing, calculations and other supporting information will be included. Indicate the location of all diversions, diversion dimensions, and flow directions of surface runoff for the entire facility. Concrete pit or tank storage is assumed to be covered unless specified otherwise.

Rectangular Concrete Pit or Tank (capacity = length x width x depth)

420.3 feet x *114.3* feet x *1.5* feet = *72,060* cubic feet (Manure Pit #1)
227.3 feet x *76.3* feet x *1.7* feet = *29,483* cubic feet (Manure Pit #2)

= ***101,543*** **cubic feet TOTAL**

Waste Storage Pond 1 Volume = [(4 x sideslope^2 x depth^3) / 3] + (sideslope x bottomlength x depth^2) + (sideslope x bottomwidth x depth^2) + (bottomwidth x bottomlength x depth)

Bottom Length: _____ Bottom Width: _____

Design Full Depth: *9.7* feet, Overflow Depth: *10.7* feet

Side Slopes: *3* :1 and *3* , End Slopes: *3* :1 and *3* :1

Note: Inside slopes for earthen pits or lagoons will be at least 2:1.

Earthen Storage Pit or Lagoon Capacity: *111,122* cubic feet

Waste Storage Pond 2 Volume = [(4 x sideslope^2 x depth^3) / 3] + (sideslope x bottomlength x depth^2) + (sideslope x bottomwidth x depth^2) + (bottomwidth x bottomlength x depth)

Bottom Length: _____ Bottom Width: _____

Design Full Depth: *11.7* feet, Overflow Depth: *12.7* feet

Side Slopes: *3* :1 and *3* , End Slopes: *3* :1 and *3* :1

Note: Inside slopes for earthen pits or lagoons will be at least 2:1.

Earthen Storage Pit or Lagoon Capacity: *254,643* cubic feet

NOTE: A minimum of 1.0 foot of freeboard is required for uncovered storage.

TOTAL STORAGE PROVIDED: ***467,308*** **cubic feet**

NOTE: The Total Storage Provided will meet or exceed the Minimum Storage Requirement (item o) from Waste Productions Calculation

5 Year Crop Rotation & Yield Goal & Crop Nutrient Needs

Table 1. 5 Year Crop Rotation

Years	Fields	Commodity
One-Five	1, 2, & 4	Bermudagrass teamed with Tall Fescue, Rotational Pasture
One-Five	3 & 5-17	Bermudagrass teamed with Tall Fescue, Hay

Table 2. Plant Nutrient Uptake

				*% of the Dry Harvested Material			Nutrient Uptake, lb of nutrients		
County	State	Commodity	#Yield Goals (Tons)	N	P	K	N	P	K
Newton	NORTH DAKOTA	#FORAGE, HAY (BERMUDAGRASS)	6.5	1.88	0.19	1.4	244.4	24.7	182
McHenry	NORTH DAKOTA	#FORAGE, ROTATIONAL PASTURE (BERMUDAGRASS)	6.5	1.88	0.19	1.4	244.4	24.7	182

* From Table 6.6 of Part 651 Agricultural Waste Mangement Field Handbook

#U of A Cooperative Extension Service, yield goal for Northern Arkansas

Table 3. Convert Plant Nutrient Needs (N, P, K) to Fertilizer Form

	Hay	Pasture
N	244.4	244.4
P_2O_5	56.6	56.6
K_2O	220.2	220.2

Comments:

Arkansas Nutrient Managemnt Planner with 2009 PI (ver 3/3/2010)

Planner:	Nathan A. Pesta, P.E.	Date:	5/25/2012
Plan Description:	Jason Henson: Fields 1-10		

This worksheet is intended to assist in the writing of Nutrient Management Plans for the application of manure to pasture and hay land. To do this, the worksheet estimates the litter production for the farm, estimates the P Index risk value for the defined conditions of each field, assists with the allocation of nutrients to the various receiving fields, and estimates the amount of litter available for off farm use. This worksheet is the result of an effort to develop a reliable training/planning tool faithful to the 2009 Arkansas P Index developed by a multi-agency effort. However, no guarantees are made, and any observed problems or suggestions for improvement should be directed to Karl VanDevender at kvan@uaex.edu.

County Information

Farm county	Newton
R	270
10-Yr EI	110
Kf adjusted for frost?	Yes

Nutrient Source and Description Information

Manure Source	Source Type	Amount Available		N Concentration		P2O5 Concentration		K2O Concrentration		Water Extractible P		Alum Used?
WSP#1	Liquid Biosolids	1230	1000 gal	37.60	lb/1000 gal	28.90	lb/1000 gal	29.10	lb/1000 gal	1.90	lb/1000 gal	No
WSP#2	Liquid Manure	1531	1000 gal	30.20	lb/1000 gal	23.20	lb/1000 gal	23.40	lb/1000 gal	0.07	lb/1000 gal	No

Nutrient Loss and Mineralization Factors

Nutrient Source Description	N		P2O5		K2O	
	Storage Losses (%)	Appl. Losses (%)	Storage Losses (%)	Appl. Losses (%)	Storage Losses (%)	Appl. Losses (%)
WSP#1	60%	50%	80%		80%	
WSP#2	60%	50%	80%		80%	

Estimated Plant Available Nutrients

Nutrient Source Description	N			P2O5			K2O			Water Extractible P		
	Concentration		Total (lb)	Concentration		Total (lb)	Concentration		Total (lb)	Concentration		Total (lb)
WSP#1	7.52	lb/1000 gal	9,250	5.78	lb/1000 gal	7,109	5.82	lb/1000 gal	7,159	1.90	lb/1000 gal	2337
WSP#2	6.04	lb/1000 gal	9,247	4.64	lb/1000 gal	7,104	4.68	lb/1000 gal	7,165	0.07	lb/1000 gal	107.17
Totals			18,497			14,213			14,324			2,444

Field P Index Calculations

Field	Soil Test P		Soil Map Unit	Slope Gradient (%)				Slope Length (ft)				Flooding Frequency
	ppm	lb/ac		Min	Max	Rep	Used	Min	Max	Rep	Used	

Comments:

Arkansas Nutrient Managemnt Planner with 2009 PI (ver 3/3/2010)

Planner:	Nathan A. Pesta, P.E.								Date:	5/25/2012		
Plan Description:	Jason Henson: Fields 1-10											
H1	83	110	42	3	8	5	5.5	15	75	45	45	None
H2	72	96	43	8	20	14	14	15	30	20	45	None
H3	42	56	48	0	3	2	14	15	75	45	23	Occasional
H4	50	67	43	8	20	14	14	15	30	20	23	None
H5	65	86	48	#N/A	#N/A	#N/A	0.2	#N/A	#N/A	#N/A	5	#N/A
H6	76	101	48	#N/A	#N/A	#N/A	0.2	#N/A	#N/A	#N/A	4	#N/A
H7	178	237	48	#N/A	#N/A	#N/A	0.2	#N/A	#N/A	#N/A	4	#N/A
H8	46	61	51	2	5	2.5	3.5	15	75	45	12	None
H9	52	69	50	#N/A	#N/A	#N/A	0.2	#N/A	#N/A	#N/A	7	#N/A
H10	69	92	51	2	5	2.5	3.5	15	75	45	15	None

Field	Field Area (ac)	Buffer Length (ft)	Buffer Width (ft)	Appl Area (ac)	Predominate Vegetation	Percent Ground Cover	Conservation Support Practices (P)	RUSLE 1 (ton/ac)	RUSLE 2 (ton/ac)
H1	19.70	1,800	100	15.57	Grass	95-100	None in place	0.12	0.18
H2	19.30	1,000	100	17.00	Grass	95-100	None in place	0.34	6.60
H3	15.90	1,000	100	13.60	Grass	95-100	None in place	0.24	0.01
H4	10.40	700	100	8.79	Grass	95-100	None in place	0.28	5.40
H5	24.90	500	100	23.75	Grass	95-100	None in place		0.05
H6	36.60	900	100	34.53	Grass	95-100	None in place		0.05
H7	79.80	2,400	100	74.29	Grass	95-100	None in place		1.10
H8	15.50			15.50	Grass	95-100	None in place	0.06	1.30
H9	45.10	1,680	100	41.24	Grass	95-100	None in place		0.49
H10	34.30	500	100	33.15	Grass	95-100	None in place	0.06	1.30
	302			277					

Field	Pasture Use	Application Method	Application Timing	Nutrient Source	Application Rate		Pre BMP PI Value	P Index Range	Target Post BMPs PI Values
H1	Rotational Grazing	Surface Applied	March-June	WSP#1	25.00	1000 gal/ac	65	Medium	
H2	Rotational Grazing	Surface Applied	March-June	WSP#1	9.90	1000 gal/ac	80	High	
H3	Hayland	Surface Applied	March-June	WSP#1	10.00	1000 gal/ac	47	Medium	
H4	Rotational Grazing	Surface Applied	March-June	WSP#1	9.90	1000 gal/ac	75	High	
H5	Hayland	Surface Applied	March-June	WSP#2	81.00	1000 gal/ac			
H6	Hayland	Surface Applied	March-June	WSP#2	81.00	1000 gal/ac			
H7	Hayland	Surface Applied	March-June	WSP#2	81.00	1000 gal/ac			
H8	Hayland	Surface Applied	March-June	WSP#2	81.00	1000 gal/ac	56	Medium	
H9	Hayland	Surface Applied	March-June	WSP#2	81.00	1000 gal/ac			
H10	Hayland	Surface Applied	March-June	WSP#1	18.00	1000 gal/ac	52	Medium	

Comments:

Arkansas Nutrient Managemnt Planner with 2009 PI (ver 3/3/2010)

Planner:	Nathan A. Pesta, P.E.	Date:	5/25/2012
Plan Description:	Jason Henson: Fields 1-10		

Best Management Practices

Field	Diversion	Terrace	Pond	Filter Strip	Grassed Waterway	Fencing	Riparian Forest Buffer	Riparian Herbaceous Cover	Field Borderrs	Post BMP PI Value	P Index Range
H1										65	Medium
H2										80	High
H3										47	Medium
H4										75	High
H5											
H6											
H7											
H8										56	Medium
H9											
H10										52	Medium

Field Nutrient Application Planning

Per Acre Basis

Field	Nutrient Source	Application			Nutrient Recommendation (lb/ac)			Nutrients Applied (lb/ac)			Surpluses / Deficits (lb/ac)		
		PI Max	Planned		N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
H1	WSP#1	25.00	25.00	1000 gal/ac	489	57	220	188	145	146	-301	88	-75
H2	WSP#1	9.90	9.90	1000 gal/ac	489	57	220	74	57	58	-415	0	-162
H3	WSP#1	10.00	10.00	1000 gal/ac	489	57	220	75	58	58	-414	1	-162
H4	WSP#1	9.90	9.90	1000 gal/ac	489	57	220	74	57	58	-415	0	-162
H5	WSP#2	81.00	81.00	1000 gal/ac	489	57	220	489	376	379	0	319	159
H6	WSP#2	81.00	81.00	1000 gal/ac	489	57	220	489	376	379	0	319	159
H7	WSP#2	81.00	81.00	1000 gal/ac	489	57	220	489	376	379	0	319	159
H8	WSP#2	81.00	81.00	1000 gal/ac	489	57	220	489	376	379	0	319	159
H9	WSP#2	81.00	81.00	1000 gal/ac	489	57	220	489	376	379	0	319	159
H10	WSP#1	18.00	18.00	1000 gal/ac	489	57	220	135	104	105	-354	47	-115

Per Field Basis

Field	Nutrient Source	Application			Nutrient Recommendation (lbs)			Nutrients Applied (lbs)			Surpluses / Deficits (lb)		
		PI Max	Planned		N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
H1	WSP#1	389.19	389.19	1000 gal	7,613	887	3,425	2,927	2,250	2,265	-4,686	1,362	-1,160
H2	WSP#1	168.34	168.34	1000 gal	8,315	969	3,741	1,266	973	980	-7,049	4	-2,761
H3	WSP#1	136.04	136.04	1000 gal	6,653	775	2,993	1,023	786	792	-5,629	11	-2,201
H4	WSP#1	87.05	87.05	1000 gal	4,300	501	1,934	655	503	507	-3,645	2	-1,428
H5	WSP#2	1923.92	1923.92	1000 gal	11,615	1,354	5,225	11,621	8,927	9,004	6	7,573	3,778
H6	WSP#2	2797.24	2797.24	1000 gal	16,887	1,968	7,597	16,895	12,979	13,091	8	11,011	5,494
H7	WSP#2	6017.52	6017.52	1000 gal	36,328	4,235	16,344	36,346	27,921	28,162	18	23,687	11,818
H8	WSP#2	1255.50	1255.50	1000 gal	7,580	884	3,410	7,583	5,826	5,876	4	4,942	2,466
H9	WSP#2	3340.70	3340.70	1000 gal	20,168	2,351	9,074	20,178	15,501	15,634	10	13,150	6,561
H10	WSP#1	596.74	596.74	1000 gal	16,211	1,890	7,293	4,487	3,449	3,473	-11,724	1,559	-3,820
				Totals	135,669	15,814	61,037	102,981	79,115	79,784	-32,688	63,301	18,747

Comments:

Arkansas Nutrient Managemnt Planner with 2009 PI (ver 3/3/2010)

Planner:	Nathan A. Pesta, P.E.	Date:	5/25/2012
Plan Description:	Jason Henson: Fields 1-10		

Manure Distribution Summary

Units Applied by Field and Source

Field	Source				
	WSP#1 (1000 gal)	WSP#2 (1000 gal)			
H1	389.19				
H2	168.34				
H3	136.04				
H4	87.05				
H5		1,923.92			
H6		2,797.24			
H7		6,017.52			
H8		1,255.50			
H9		3,340.70			
H10	596.74				
Total Applied	1,377	15335			
Available	1,230	1531			
Deficit/Surplus	-147	-13804			

Supplemental Documentation of Inputs and Results for P Index and RUSLE Calculations

Field	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
Soil Map Unit	42	43	48	43	48	48	48	51	50	51
Soil Name	Noark very c	Noark very c	Razort loam,	Noark very c	Soil Name C	Soil Name C	Soil Name C	Spadra loam	Soil Name C	Spadra loam
Primary Litter Source	WSP#1	WSP#1	WSP#1	WSP#1	WSP#2	WSP#2	WSP#2	WSP#2	WSP#2	WSP#1
Source Type	Liquid Biosol	Liquid Biosol	Liquid Biosol	Liquid Biosol	Liquid Manur	Liquid Manur	Liquid Manur	Liquid Manur	Liquid Manur	Liquid Biosol
WEP (lb/ton)	1.9	1.9	1.9	1.9	0.07	0.07	0.07	0.07	0.07	1.9
TP Used (lb/ton)	12.6200873	12.6200873	12.6200873	12.6200873	10.1310044	10.1310044	10.1310044	10.1310044	10.1310044	12.6200873
Litter Appl. Rate (tons/acre)	25	9.9	10	9.9	81	81	81	81	81	18
WEP rate (lb/ac)	47.5	18.81	19	18.81	5.67	5.67	5.67	5.67	5.67	34.2
TP rate (lb/ac)	315.502183	124.938865	126.200873	124.938865	820.611354	820.611354	820.611354	820.611354	820.611354	227.161572
Alum Used	No	No	No	No	No	No	No	No	No	No
Mineralization Coef	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
WEP coef	0.029	0.029	0.029	0.029	0.031	0.031	0.031	0.031	0.031	0.029
WEP Source Value	1.76610317	0.69937685	0.70644127	0.69937685	1.4389291	1.4389291	1.4389291	1.4389291	1.4389291	1.27159428
Soil Test P	110.39	95.76	55.86	66.5	86.45	101.08	236.74	61.18	69.16	91.77
Soil coef	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018
Soil P Source Value	0.198702	0.172368	0.100548	0.1197	0.15561	0.181944	0.426132	0.110124	0.124488	0.165186
Total P Source Value	1.96480517	0.87174485	0.80698927	0.81907685	1.5945391	1.6208731	1.8650611	1.5490531	1.5634171	1.43678028
R factor	270	270	270	270	270	270	270	270	270	270
Kf	0.43	0.43	0.37	0.43				0.37		0.37
Adj Kf For Freezing?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kf Used	0.35	0.35	0.3	0.35				0.3		0.3
Slope Gradient (%)	5.5	14	14	14	0.2	0.2	0.2	3.5	0.2	3.5
Slope Length (ft)	45	45	23	23	5	4	4	12	7	15

Comments:

Arkansas Nutrient Managemnt Planner with 2009 PI (ver 3/3/2010)

Planner:	Nathan A. Pesta, P.E.							Date:	5/25/2012	
Plan Description:	Jason Henson: Fields 1-10									
Rusle LS	0.44	1.2	0.98	0.98	0.05	0.05	0.05	0.26	0.05	0.26
Vegetal Canopy: Type	Grass	Grass	Grass	Grass	Grass	Grass	Grass	Grass	Grass	Grass
Percent of Ground Coverd	95-100	95-100	95-100	95-100	95-100	95-100	95-100	95-100	95-100	95-100
C Factor	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Cons. Support Practices (P)	None in plac	None in plac	None in plac	None in plac	None in plac	None in plac	None in plac	None in plac	None in plac	None in plac
Calc. P Factor?	No	No	No	No	No	No	No	No	No	No
Soil Hydrologic Group	B	B	B	B				B		B
EI	110	110	110	110	110	110	110	110	110	110
P Factor	1	1	1	1	1	1	1	1	1	1
RUSLE 1 (ton/ac)	0.12474	0.3402	0.23814	0.27783				0.06318		0.06318
RUSLE 2 (ton/ac)	0.18	6.6	0.0061	5.4	0.05	0.05	1.1	1.3	0.49	1.3
RUSLE ? Used (ton/ac)	0.18	6.6	0.0061	5.4	0.05	0.05	1.1	1.3	0.49	1.3
Soil Erosion LRV	0	1	0	1	0	0	0.1	0.1	0	0.1
Pasture Use	Rotational G	Rotational G	Hayland	Rotational G	Hayland	Hayland	Hayland	Hayland	Hayland	Hayland
Runoff Curve Numbers	61	61	58	61				58		58
Soil Runoff Class	VL	L	N	L				N		N
Soil Runoff Class LRV	0.15	0.2	0.1	0.2				0.1		0.1
Flooding Frequency	None	None	Occasional	None	#N/A	#N/A	#N/A	None	#N/A	None
Flooding Frequency LRV	0	0	0.5	0				0		0
Application Method	Surface Appl	Surface Appl	Surface Appl	Surface Appl	Surface Appl	Surface Appl	Surface Appl	Surface Appl	Surface Appl	Surface Appl
Application Method LRV	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Application Timing	March-June	March-June	March-June	March-June	March-June	March-June	March-June	March-June	March-June	March-June
Application Timing LRV	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total P Transport Value	0.6	1.65	1.05	1.65				0.65		0.65
Calc PI	0	0	0	0	9	9	9	0	9	0
Pre BMP PI Value	65	80	47	75				56		52
PI Range	Medium	High	Medium	High				Medium		Medium
Diversion %	0	0	0	0	0	0	0	0	0	0
Terrace %	0	0	0	0	0	0	0	0	0	0
Pond %	0	0	0	0	0	0	0	0	0	0
Filter Strip %	0	0	0	0	0	0	0	0	0	0
Grassed WaterWay %	0	0	0	0	0	0	0	0	0	0
Fencing %	0	0	0	0	0	0	0	0	0	0
Riparioan Forst Buffer %	0	0	0	0	0	0	0	0	0	0
Riparian Herbaceous Buffer %	0	0	0	0	0	0	0	0	0	0
Field Borderrs %	0	0	0	0	0	0	0	0	0	0
Total SMV	1	1	1	1	1	1	1	1	1	1
Post BMP PI Value	65	80	47	75				56		52
PI Range	Medium	High	Medium	High				Medium		Medium

Comments:

Arkansas Nutrient Managemnt Planner with 2009 PI (ver 3/3/2010)

Planner:		Date:	5/25/2012
Plan Description:	C&H Hog Farms: Fields 11-17		

This worksheet is intended to assist in the writing of Nutrient Management Plans for the application of manure to pasture and hay land. To do this, the worksheet estimates the litter production for the farm, estimates the P Index risk value for the defined conditions of each field, assists with the allocation of nutrients to the various receiving fields, and estimates the amount of litter available for off farm use. This worksheet is the result of an effort to develop a reliable training/planning tool faithful to the 2009 Arkansas P Index developed by a multi-agency effort. However, no guarantees are made, and any observed problems or suggestions for improvement should be directed to Karl VanDevender at kvan@uaex.edu.

County Information

Farm county	Newton
R	270
10-Yr EI	110
Kf adjusted for frost?	Yes

Nutrient Source and Description Information

Manure Source	Source Type	Amount Available		N Concentration		P2O5 Concentration		K2O Concrentration		Water Extractible P		Alum Used?
WSP#1	Liquid Biosolids	1230	1000 gal	37.60	lb/1000 gal	28.90	lb/1000 gal	29.10	lb/1000 gal	1.90	lb/1000 gal	No
WSP#2	Liquid Manure	1531	1000 gal	30.20	lb/1000 gal	23.20	lb/1000 gal	23.40	lb/1000 gal	0.70	lb/1000 gal	No

Nutrient Loss and Mineralization Factors

Nutrient Source Description	N		P2O5		K2O	
	Storage Losses (%)	Appl. Losses (%)	Storage Losses (%)	Appl. Losses (%)	Storage Losses (%)	Appl. Losses (%)
WSP#1	60%	50%	80%		80%	
WSP#2	60%	50%	80%		80%	

Estimated Plant Available Nutrients

Nutrient Source Description	N			P2O5			K2O			Water Extractible P		
	Concentration		Total (lb)	Concentration		Total (lb)	Concentration		Total (lb)	Concentration		Total (lb)
WSP#1	7.52	lb/1000 gal	9,250	5.78	lb/1000 gal	7,109	5.82	lb/1000 gal	7,159	1.90	lb/1000 gal	2337
WSP#2	6.04	lb/1000 gal	9,247	4.64	lb/1000 gal	7,104	4.68	lb/1000 gal	7,165	0.70	lb/1000 gal	1071.7
Totals			18,497			14,213			14,324			3,409

Field P Index Calculations

	Soil Test P	Soil Map	Slope Gradient (%)	Slope Length (ft)	Flooding

Comments:

Arkansas Nutrient Managemnt Planner with 2009 PI (ver 3/3/2010)

Planner:									Date: 5/25/2012			
Plan Description:	C&H Hog Farms: Fields 11-17											
Field	ppm	lb/ac	Soil Map Unit	Min	Max	Rep	Used	Min	Max	Rep	Used	Flooding Frequency
H11	57	76	43	8	20	14	14	15	30	20	20	None
H12	19	25	50	0	3	2	2	15	75	45	45	Occasional
H13	48	64	43	8	20	14	14	15	30	20	20	None
H14	52	69	43	8	20	14	14	15	30	20	20	None
H15	15	20	43	8	20	14	14	15	30	20	20	None
H16	48	64	50	0	3	2	2	15	75	45	45	Occasional
H17	50	67	1	3	8	5	5.5	15	75	45	45	None

Field	Field Area (ac)	Buffer Length (ft)	Buffer Width (ft)	Appl Area (ac)	Predominate Vegetation	Percent Ground Cover	Conservation Support Practices (P)	RUSLE 1 (ton/ac)	RUSLE 2 (ton/ac)
H11	20.70			20.70	Grass	95-100	None in place	0.28	5.20
H12	28.70	2,200	100	23.65	Grass	95-100	None in place	0.05	0.91
H13	66.90	2,300	100	61.62	Grass	95-100	None in place	0.28	5.20
H14	18.00			18.00	Grass	95-100	None in place	0.28	5.20
H15	66.30	2,300	100	61.02	Grass	95-100	None in place	0.28	5.20
H16	79.60			79.60	Grass	95-100	None in place	0.05	0.91
H17	88.70			88.70	Grass	95-100	None in place	0.12	1.10
	369			353					

Field	Pasture Use	Application Method	Application Timing	Nutrient Source	Application Rate		Pre BMP PI Value	P Index Range	Target Post BMPs PI Values
H11	Hayland	Surface Applied	March-June	WSP#1	9.90	1000 gal/ac	72	High	
H12	Hayland	Surface Applied	March-June	WSP#1	15.00	1000 gal/ac	64	Medium	
H13	Hayland	Surface Applied	March-June	WSP#1	9.90	1000 gal/ac	70	High	
H14	Hayland	Surface Applied	March-June	WSP#1	9.90	1000 gal/ac	71	High	
H15	Hayland	Surface Applied	March-June	WSP#1	9.90	1000 gal/ac	63	Medium	
H16	Hayland	Surface Applied	March-June	WSP#1	14.00	1000 gal/ac	64	Medium	
H17	Hayland	Surface Applied	March-June	WSP#1	18.00	1000 gal/ac	58	Medium	

Comments:

Arkansas Nutrient Managemnt Planner with 2009 PI (ver 3/3/2010)

Planner:		Date:	5/25/2012
Plan Description:	C&H Hog Farms: Fields 11-17		

Best Management Practices

Field	Diversion	Terrace	Pond	Filter Strip	Grassed Waterway	Fencing	Riparian Forest Buffer	Riparian Herbaceous Cover	Field Borderrs	Post BMP PI Value	P Index Range
H11										72	High
H12										64	Medium
H13										70	High
H14										71	High
H15										63	Medium
H16										64	Medium
H17										58	Medium

Field Nutrient Application Planning

Per Acre Basis

Field	Nutrient Source	Application			Nutrient Recommendation (lb/ac)			Nutrients Applied (lb/ac)			Surpluses / Deficits (lb/ac)		
		PI Max	Planned		N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
H11	WSP#1	9.90	9.90	1000 gal/ac	489	57	220	74	57	58	-415	0	-162
H12	WSP#1	15.00	15.00	1000 gal/ac	489	57	220	113	87	87	-376	30	-133
H13	WSP#1	9.90	9.90	1000 gal/ac	489	57	220	74	57	58	-415	0	-162
H14	WSP#1	9.90	9.90	1000 gal/ac	489	57	220	74	57	58	-415	0	-162
H15	WSP#1	9.90	9.90	1000 gal/ac	489	57	220	74	57	58	-415	0	-162
H16	WSP#1	14.00	14.00	1000 gal/ac	489	57	220	105	81	81	-384	24	-139
H17	WSP#1	18.00	18.00	1000 gal/ac	489	57	220	135	104	105	-354	47	-115

Per Field Basis

Field	Nutrient Source	Application			Nutrient Recommendation (lbs)			Nutrients Applied (lbs)			Surpluses / Deficits (lb)		
		PI Max	Planned		N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
H11	WSP#1	204.93	204.93	1000 gal	10,122	1,180	4,554	1,541	1,184	1,193	-8,581	5	-3,361
H12	WSP#1	354.74	354.74	1000 gal	11,565	1,348	5,203	2,668	2,050	2,065	-8,897	702	-3,138
H13	WSP#1	610.04	610.04	1000 gal	30,132	3,512	13,556	4,587	3,526	3,550	-25,545	14	-10,006
H14	WSP#1	178.20	178.20	1000 gal	8,802	1,026	3,960	1,340	1,030	1,037	-7,462	4	-2,923
H15	WSP#1	604.10	604.10	1000 gal	29,839	3,478	13,424	4,543	3,492	3,516	-25,296	14	-9,909
H16	WSP#1	1114.40	1114.40	1000 gal	38,924	4,537	17,512	8,380	6,441	6,486	-30,544	1,904	-11,026
H17	WSP#1	1596.60	1596.60	1000 gal	43,374	5,056	19,514	12,006	9,228	9,292	-31,368	4,172	-10,222

Comments:

Arkansas Nutrient Managemnt Planner with 2009 PI (ver 3/3/2010)

Planner:						Date:	5/25/2012			
Plan Description:	C&H Hog Farms: Fields 11-17									
	Totals	172,758	20,137	77,724	35,066	26,952	27,139	-137,693	6,815	-50,585

Comments:

Arkansas Nutrient Managemnt Planner with 2009 PI (ver 3/3/2010)

Planner:		Date:	5/25/2012
Plan Description:	C&H Hog Farms: Fields 11-17		

Manure Distribution Summary

Units Applied by Field and Source

Field	Source				
	WSP#1 (1000 gal)	WSP#2 (1000 gal)			
H11	204.93				
H12	354.74				
H13	610.04				
H14	178.20				
H15	604.10				
H16	1,114.40				
H17	1,596.60				
Total Applied	4,663				
Available	1,230	1531			
Deficit/Surplus	-3,433				

Supplemental Documentation of Inputs and Results for P Index and RUSLE Calculations

Field	H11	H12	H13	H14	H15	H16	H17			
Soil Map Unit	43	50	43	43	43	50	1			
Soil Name	Noark very c	Spadra loam	Noark very c	Noark very c	Noark very c	Spadra loam	Arkana very			
Primary Litter Source	WSP#1	WSP#1	WSP#1	WSP#1	WSP#1	WSP#1	WSP#1			
Source Type	Liquid Biosol	Liquid Biosol	Liquid Biosol	Liquid Biosol	Liquid Biosol	Liquid Biosol	Liquid Biosol			
WEP (lb/ton)	1.9	1.9	1.9	1.9	1.9	1.9	1.9			
TP Used (lb/ton)	12.6200873	12.6200873	12.6200873	12.6200873	12.6200873	12.6200873	12.6200873			
Litter Appl. Rate (tons/acre)	9.9	15	9.9	9.9	9.9	14	18			
WEP rate (lb/ac)	18.81	28.5	18.81	18.81	18.81	26.6	34.2			
TP rate (lb/ac)	124.938865	189.30131	124.938865	124.938865	124.938865	176.681223	227.161572			
Alum Used	No	No	No	No	No	No	No			
Mineralization Coef	0.05	0.05	0.05	0.05	0.05	0.05	0.05			
WEP coef	0.029	0.029	0.029	0.029	0.029	0.029	0.029			
WEP Source Value	0.69937685	1.0596619	0.69937685	0.69937685	0.69937685	0.98901777	1.27159428			
Soil Test P	75.81	25.27	63.84	69.16	19.95	63.84	66.5			
Soil coef	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018			
Soil P Source Value	0.136458	0.045486	0.114912	0.124488	0.03591	0.114912	0.1197			
Total P Source Value	0.83583485	1.1051479	0.81428885	0.82386485	0.73528685	1.10392977	1.39129428			
R factor	270	270	270	270	270	270	270			
Kf	0.43	0.37	0.43	0.43	0.43	0.37	0.43			
Adj Kf For Freezing?	Yes	Yes	Yes	Yes	Yes	Yes	Yes			
Kf Used	0.35	0.3	0.35	0.35	0.35	0.3	0.35			

Comments:

Arkansas Nutrient Managemnt Planner with 2009 PI (ver 3/3/2010)

Planner:								Date: 5/25/2012		
Plan Description:	C&H Hog Farms: Fields 11-17									
Slope Gradient (%)	14	2	14	14	14	2	5.5			
Slope Length (ft)	20	45	20	20	20	45	45			
Rusle LS	0.98	0.21	0.98	0.98	0.98	0.21	0.44			
Vegetal Canopy: Type	Grass	Grass	Grass	Grass	Grass	Grass	Grass			
Percent of Ground Coverd	95-100	95-100	95-100	95-100	95-100	95-100	95-100			
C Factor	0.003	0.003	0.003	0.003	0.003	0.003	0.003			
Cons. Support Practices (P)	None in plac	None in plac	None in plac	None in plac	None in plac	None in plac	None in plac			
Calc. P Factor?	No	No	No	No	No	No	No			
Soil Hydrologic Group	B	B	B	B	B	B	C			
EI	110	110	110	110	110	110	110			
P Factor	1	1	1	1	1	1	1			
RUSLE 1 (ton/ac)	0.27783	0.05103	0.27783	0.27783	0.27783	0.05103	0.12474			
RUSLE 2 (ton/ac)	5.2	0.91	5.2	5.2	5.2	0.91	1.1			
RUSLE ? Used (ton/ac)	5.2	0.91	5.2	5.2	5.2	0.91	1.1			
Soil Erosion LRV	1	0	1	1	1	0	0.1			
Pasture Use	Hayland	Hayland	Hayland	Hayland	Hayland	Hayland	Hayland			
Runoff Curve Numbers	58	58	58	58	58	58	71			
Soil Runoff Class	N	N	N	N	N	N	L			
Soil Runoff Class LRV	0.1	0.1	0.1	0.1	0.1	0.1	0.2			
Flooding Frequency	None	Occasional	None	None	None	Occasional	None			
Flooding Frequency LRV	0	0.5	0	0	0	0.5	0			
Application Method	Surface Appl	Surface Appl	Surface Appl	Surface Appl	Surface Appl	Surface Appl	Surface Appl			
Application Method LRV	0.2	0.2	0.2	0.2	0.2	0.2	0.2			
Application Timing	March-June	March-June	March-June	March-June	March-June	March-June	March-June			
Application Timing LRV	0.25	0.25	0.25	0.25	0.25	0.25	0.25			
Total P Transport Value	1.55	1.05	1.55	1.55	1.55	1.05	0.75			
Calc PI	0	0	0	0	0	0	0			
Pre BMP PI Value	72	64	70	71	63	64	58			
PI Range	High	Medium	High	High	Medium	Medium	Medium			
Diversion %	0	0	0	0	0	0	0			
Terrace %	0	0	0	0	0	0	0			
Pond %	0	0	0	0	0	0	0			
Filter Strip %	0	0	0	0	0	0	0			
Grassed WaterWay %	0	0	0	0	0	0	0			
Fencing %	0	0	0	0	0	0	0			
Riparioan Forst Buffer %	0	0	0	0	0	0	0			
Riparian Herbaceous Buffer %	0	0	0	0	0	0	0			
Field Borderrs %	0	0	0	0	0	0	0			
Total SMV	1	1	1	1	1	1	1			
Post BMP PI Value	72	64	70	71	63	64	58			
PI Range	High	Medium	High	High	Medium	Medium	Medium			

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 1: SW ¼, Section 25, T 15 N, R 20 W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 42 NOARK VERY CHERTY SILT LOAM, 3 TO 8 PERCENT SLOPES\NOARK very gravelly silt loam 100%
Slope length (horiz): 45 ft
Avg. slope steepness: 5.5 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\Pasture\Cont grz warm seas past cmz17

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 0.18 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 2: SW ¼ Section 25 Township 15N Range 20W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 43 NOARK VERY CHERTY SILT LOAM, 8 TO 20 PERCENT SLOPES\NOARK very gravelly silt loam 100%
Slope length (horiz): 45 ft
Avg. slope steepness: 14 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\Pasture\Rot grz warm seas past cmz17

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 6.6 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 3: SW ¼, Section 25, T 15 N, R 20 W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 48 RAZORT LOAM, OCCASIONALLY FLOODED\RAZORT loam 95%
Slope length (horiz): 20 ft
Avg. slope steepness: 1.5 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\Bermudagrass\Bermudagrass hay; NT, z17*

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 0.0061 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 4: NW ¼ Section 36 Township 15N Range 20W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 43 NOARK VERY CHERTY SILT LOAM, 8 TO 20 PERCENT SLOPES\NOARK very gravelly silt loam 100%
Slope length (horiz): 23 ft
Avg. slope steepness: 14 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\Pasture\Rot grz warm seas past cmz17

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 5.4 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 5: NE1/4 Section 26 Township 15N Range 20W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 48 RAZORT LOAM, OCCASIONALLY FLOODED\RAZORT loam 95%
Slope length (horiz): 5.0 ft
Avg. slope steepness: 0.010 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\ Bermudagrass\Bermudagrass hay; NT, z17*

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 0.050 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 6: NE ¼ Section 26 Township 15N Range 20W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 48 RAZORT LOAM, OCCASIONALLY FLOODED\RAZORT loam 95%
Slope length (horiz): 4.0 ft
Avg. slope steepness: 0.010 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\Bermudagrass\Bermudagrass hay; NT, z17*

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 0.050 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 7: E ½ Section 26 Township 15N Range 20W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 48 RAZORT LOAM, OCCASIONALLY FLOODED\RAZORT loam 95%
Slope length (horiz): 4.0 ft
Avg. slope steepness: 3.0 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\ Bermudagrass\Bermudagrass hay; NT, z17*

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 1.1 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 8: NE ¼ Section 35 Township 15N Range 20W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 51 SPADRA LOAM, 2 TO 5 PERCENT SLOPES\SPADRA loam 95%
Slope length (horiz): 12 ft
Avg. slope steepness: 3.5 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\ Bermudagrass\Bermudagrass hay; NT, z17*

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 1.3 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 9: NE ¼ Section 35 Township 15N Range 20W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 50 SPADRA LOAM, OCCASIONALLY FLOODED\SPADRA loam 95%
Slope length (horiz): 7.0 ft
Avg. slope steepness: 1.0 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\Hay\ Bermudagrass\Bermudagrass hay; NT, z17*

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 0.49 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 10: NE ¼ Section 35 Township 15N Range 20W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 51 SPADRA LOAM, 2 TO 5 PERCENT SLOPES\SPADRA loam 95%
Slope length (horiz): 15 ft
Avg. slope steepness: 3.5 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\ Bermudagrass\Bermudagrass hay; NT, z17*

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 1.3 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 11: N ½ Section 35 Township 15N Range 20W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 43 NOARK VERY CHERTY SILT LOAM, 8 TO 20 PERCENT SLOPES\NOARK very gravelly silt loam 100%
Slope length (horiz): 20 ft
Avg. slope steepness: 14 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\ Bermudagrass\Bermudagrass hay; NT, z17*

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 5.2 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 12: SE ¼ Section 35 Township 15N Range 20W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 50 SPADRA LOAM, OCCASIONALLY FLOODED\SPADRA loam 95%
Slope length (horiz): 45 ft
Avg. slope steepness: 2.0 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\Bermudagrass\Bermudagrass hay; NT, z17*

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 0.91 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 13: South ½ and North ½ of Sections 35 and 2 Township 15N and 14N Range 20W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 43 NOARK VERY CHERTY SILT LOAM, 8 TO 20 PERCENT SLOPES\NOARK very gravelly silt loam 100%
Slope length (horiz): 20 ft
Avg. slope steepness: 14 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\Bermudagrass\Bermudagrass hay; NT, z17*

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 5.2 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 14: SW ¼ Section 35 Township 15N Range 20W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 43 NOARK VERY CHERTY SILT LOAM, 8 TO 20 PERCENT SLOPES\NOARK very gravelly silt loam 100%
Slope length (horiz): 20 ft
Avg. slope steepness: 14 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\Bermudagrass\Bermudagrass hay; NT, z17*

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 5.2 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 15: NE ¼ Section 2 Township 14N Range 20W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 43 NOARK VERY CHERTY SILT LOAM, 8 TO 20 PERCENT SLOPES\NOARK very gravelly silt loam 100%
Slope length (horiz): 20 ft
Avg. slope steepness: 14 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\Bermudagrass\Bermudagrass hay; NT, z17*

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 5.2 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 16: All and SE ¼ Sections 2 and 3 Township 14N Range 20W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 50 SPADRA LOAM, OCCASIONALLY FLOODED\SPADRA loam 95%
Slope length (horiz): 45 ft
Avg. slope steepness: 2.0 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\Bermudagrass\Bermudagrass hay; NT, z17*

Outputs:
T value: 5.0 t/ac/yr
Soil loss for cons. plan: 0.91 t/ac/yr

USDA NRCS

RUSLE2 Erosion Calculation Record

Info: Field 17: NE ¼ and S ½ Sections 3 and 34 Township 14N and 15N Range 20W

profiles\Newton Default

Inputs:
Location: Arkansas\Newton County
Soil: 1 ARKANA VERY CHERTY SILT LOAM, 3 TO 8 PERCENT SLOPES\ARKANA very gravelly silt loam 100%
Slope length (horiz): 45 ft
Avg. slope steepness: 2.0 %
Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)

Base management: a.Single Year/Single Crop Templates\Bermudagrass\Bermudagrass hay; NT, z17*

Outputs:
T value: 2.0 t/ac/yr
Soil loss for cons. plan: 1.1 t/ac/yr

Section D: Phosphorous Based Field List

Section D. Fields Targeted for Phosphorus Based Manure Management

Operator Name C&H Hog Farms **Date** 05/29/2012

Based on current soil test results, there are no fields at this time that are identified as having high and/or very high soil phosphorus (P) levels. Refer to the previous page, including Table 1, for manure management guidelines to avoid further or unnecessary phosphorus buildup. Other management options are also available for consideration.

Sprdsht. Line	Field ID 1/ (Tract & Field)	Legal Description			Acres Available	Soil Phosphorus Test 2/		Date Tested
		Section	Twp.	Range		Mehlich 3 (PPM)		
51	H1	25	15N	20W	15.6	83		2/17/12
52	H2*	25	15N	20W	17.0	72		2/17/12
53	H3	25	15N	20W	13.6	42		2/17/12
54	H4	36	15N	20W	8.8	50		2/17/12
60	H10*	35	15N	20W	33.2	69		2/17/12
51	H11*	35	15N	20W	20.7	57		2/17/12
52	H12*	35	15N	20W	23.7	19		2/17/12
53	H13*	35	15N	20W	61.6	48		2/17/12
54	H14*	35	15N	20W	18.0	52		2/17/12
55	H15*	2	14N	20W	61.0	15		2/17/12
56	H16*	2	14N	20W	79.6	48		2/17/12
57	H17*	34/3	15/14N	20W	88.7	50		2/17/12

1/ Place an asterisk (*) next to fields not owned by operator.

2/ An increase or decrease in phosphorus levels should be monitored with future soil tests to determine any needed manure application rate adjustments.

Section E: Inventory of Water Wells

Inventory of Water Wells

Field ID	Location (Legal)	Well Depth (Ft.)	Use of Well 1/	Required Setback Distance From Well For Manure Application (Ft.)	
				Distance From Field	State Rule
4	SW/4 of, Sec 25, T 15N, R 20 W	846	Private	NA	100
10	SE/4 of, Sec 35 T 15 N, R 20 W	700	Private	NA	100
14	SW/4, Sec 35, T 15 N, R 20 W	1035	Private	NA	100

1/ Well Use Categories:

- Producer (Owned)
- Private
- Public
- Irrigation

Section F: Land Treatment Information and Land Application Maps

SECTION F. Land Treatment Information and Land Application Maps

The following Information is attached

1. Waste Utilization Summary Spreadsheet
2. Overall Site Map
3. WQRA Maps
4. Soil Survey Maps

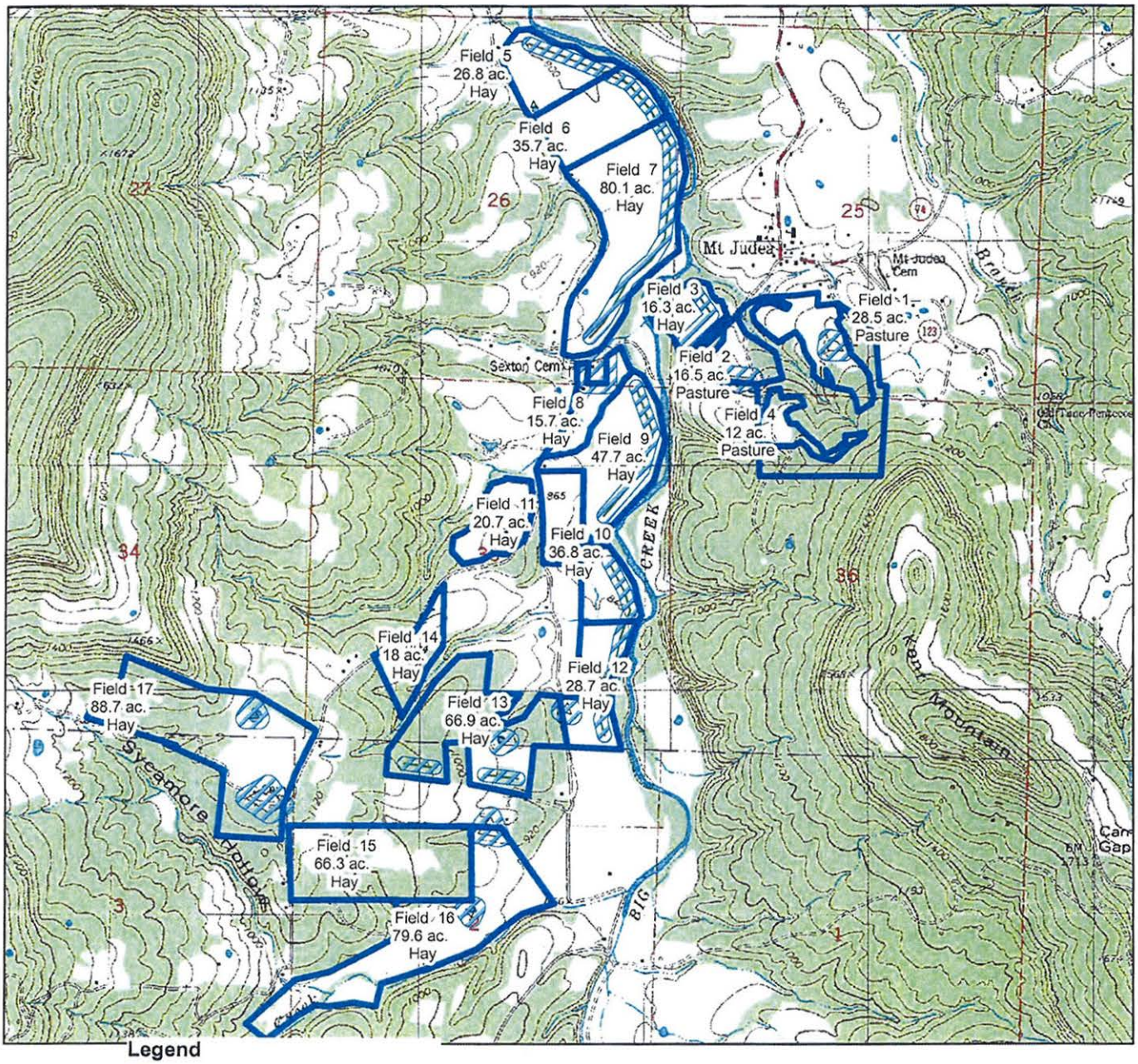
F.1 Waste Utilization Summary Spreadsheet

Field ID Area	Acreage (Acres)	Setbacks (Acres)	Useable Acreage (Acres)	Land Use	Quarter	Section	Township	Range	County	Owner of Land
1	19.7	4.1	15.6	Grassland	SW 1/4	25	15N	20W	Newton	Jason Henson
2	19.3	2.3	17.0	Grassland	SW 1/4	25	15N	20W	Newton	Jason Henson
3	15.9	2.3	13.6	Grassland	SW 1/4	25	15N	20W	Newton	Charles Campbell
4	10.4	1.6	8.8	Grassland	NW 1/4	36	15N	20W	Newton	Jason Henson
5	24.9	1.2	23.8	Grassland	NE 1/4	26	15N	20W	Newton	Sean Crickets/Rickets
6	36.6	2.1	34.5	Grassland	NE1/4	26	15N	20W	Newton	William Rickets/Crickets
7	79.8	5.5	74.3	Grassland	E 1/2	26	15N	20W	Newton	E.G. Campbell
8	15.5	0.0	15.5	Grassland	NE 1/4	35	15N	20W	Newton	Charles Campbell
9	45.1	3.9	41.2	Grassland	NE 1/4	35	15N	20W	Newton	Charles Campbell
10	34.3	1.2	33.2	Grassland	NE 1/4	35	15N	20W	Newton	Charles Campbell
11	20.7	0.0	20.7	Grassland	N 1/2	35	15N	20W	Newton	Barbara Hufley
12	28.7	5.1	23.7	Grassland	SE 1/4	35	15N	20W	Newton	Barbara Hufley
13	66.9	5.3	61.6	Grassland	S 1/2 & N 1/2	35&2	15N&14N	20W	Newton	Charles Campbell
14	18.0	0.0	18.0	Grassland	SW1/4	35	15N	20W	Newton	Barbara Hufley
15	66.3	5.3	61.0	Grassland	NW 1/4	2	14N	20W	Newton	Clayel Criner
16	79.6	0.0	79.6	Grassland	All &SE 1/4	2&3	15N&14N	20W	Newton	Barbara Hufley
17	88.7	0.0	88.7	Grassland	NE 1/4&S 1/2	3&34	15N&14N	20W	Newton	Jason Criner
Total	670.4	39.7	630.7							

Topographic

Customer(s): JASON HENSON

Approximate Acres: 685



Legend

- Henson
- Buffer_Output5.shp
- Resource Inventory (Line)
- Buffer_Output.shp
- Resource Inventory (Polygon)
- Resource Inventory (Line)

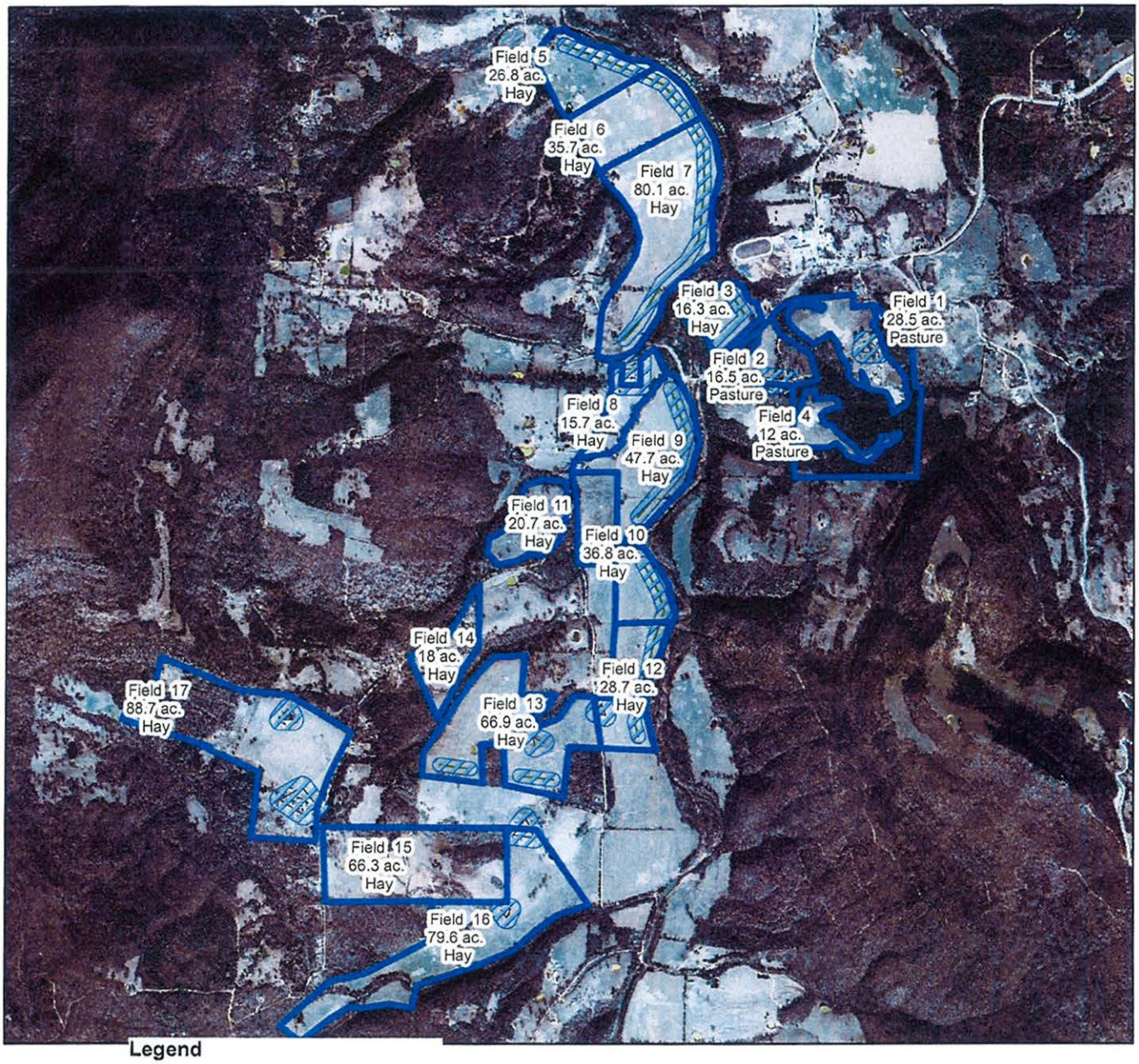
1,250 0 1,250 2,500 3,750 5,000 Feet

N

Conservation Map

Customer(s): JASON HENSON

Approximate Acres: 685



Legend

- Henson
- Buffer_Output5.shp
- Resource Inventory (Line)
- Buffer_Output.shp
- Resource Inventory (Polygon)
- Resource Inventory (Line)

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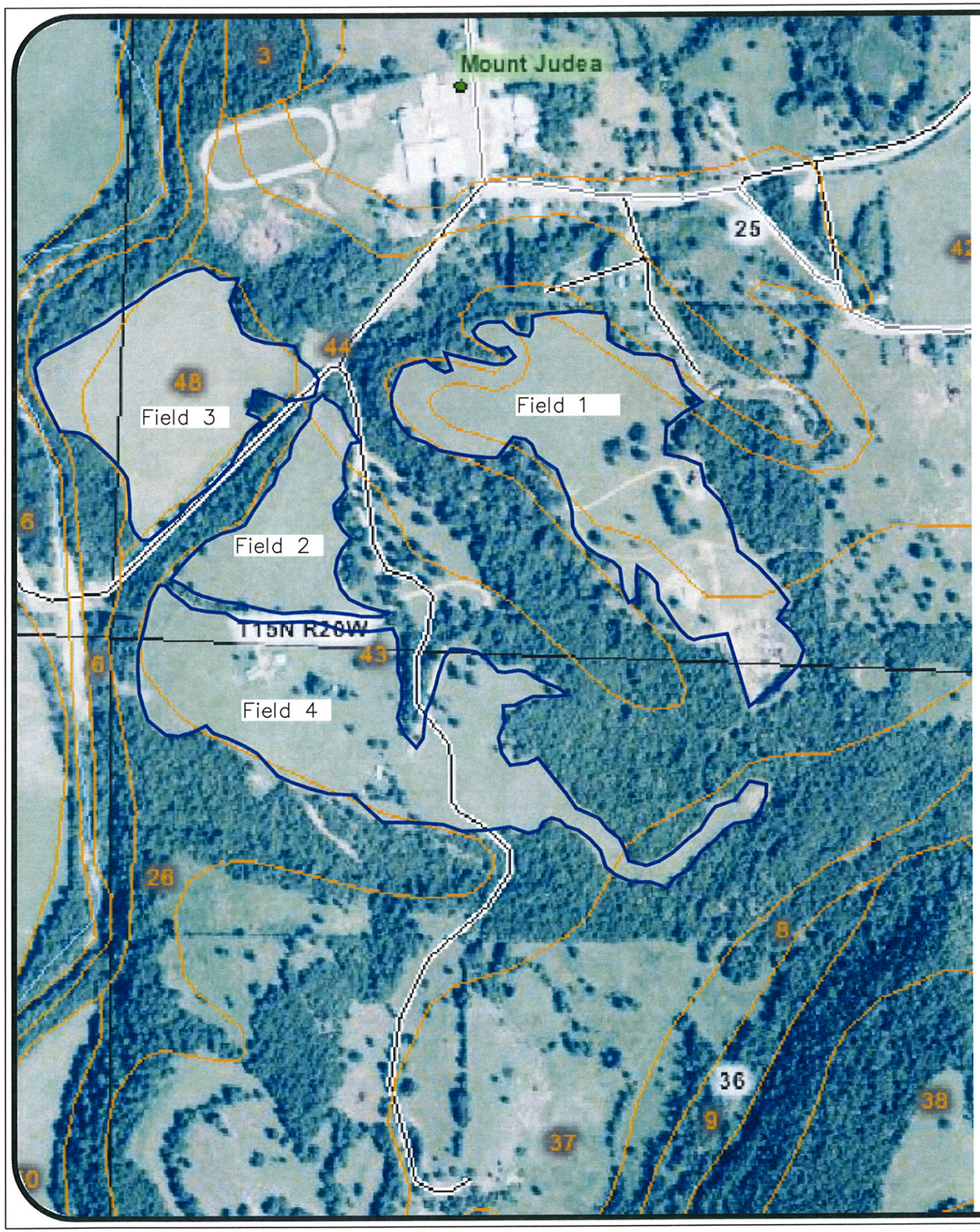
N



LEGEND

2 Arkana–Moko complex, 8 to 20 percent slopes
3 Arkana–Moko complex, 20 to 40 percent slopes
6 Ceda–Kenn complex, frequently flooded
7 Clarksville very cherty silt loam, 20 to 50 percent slopes
8 Eden–Newnata complex, 8 to 20 percent slopes
9 Eden–Newnata complex, 20 to 40 percent slopes
15 Enders–Leesburg stony loams, 8 to 20 percent slopes
16 Enders–Leesburg stony loams, 20 to 40 percent slopes
26 Moko–Rock outcrop complex, 15 to 50 percent slopes
37 Nella–Steprock complex, 8 to 20 percent slopes
38 Nella–Steprock–Mountainburg very stony loams, 20 to 40 percent slopes
39 Nella–Steprock–Mountainburg very stony loams, 40 to 60 percent slopes
42 Noark very cherty silt loam, 3 to 8 percent slopes
43 Noark very cherty silt loam, 8 to 20 percent slopes
44 Noark very cherty silt loam, 20 to 40 percent slopes
48 Razort loam, occasionally flooded
50 Spadra loam, occasionally flooded
51 Spadra loam, 2 to 5 percent slopes
54 Water

GENERAL NOTES

N

SCALE, FEET
0 250 500 750 1,000

No.	Revision/Issue	Date

DeHaan, Grabs & Associates, LLC
Consulting Engineers
PO Box 522, Mandan, ND 58554
(701) 663-1116, FAX: (701) 667-1356
www.dgaengineering.com

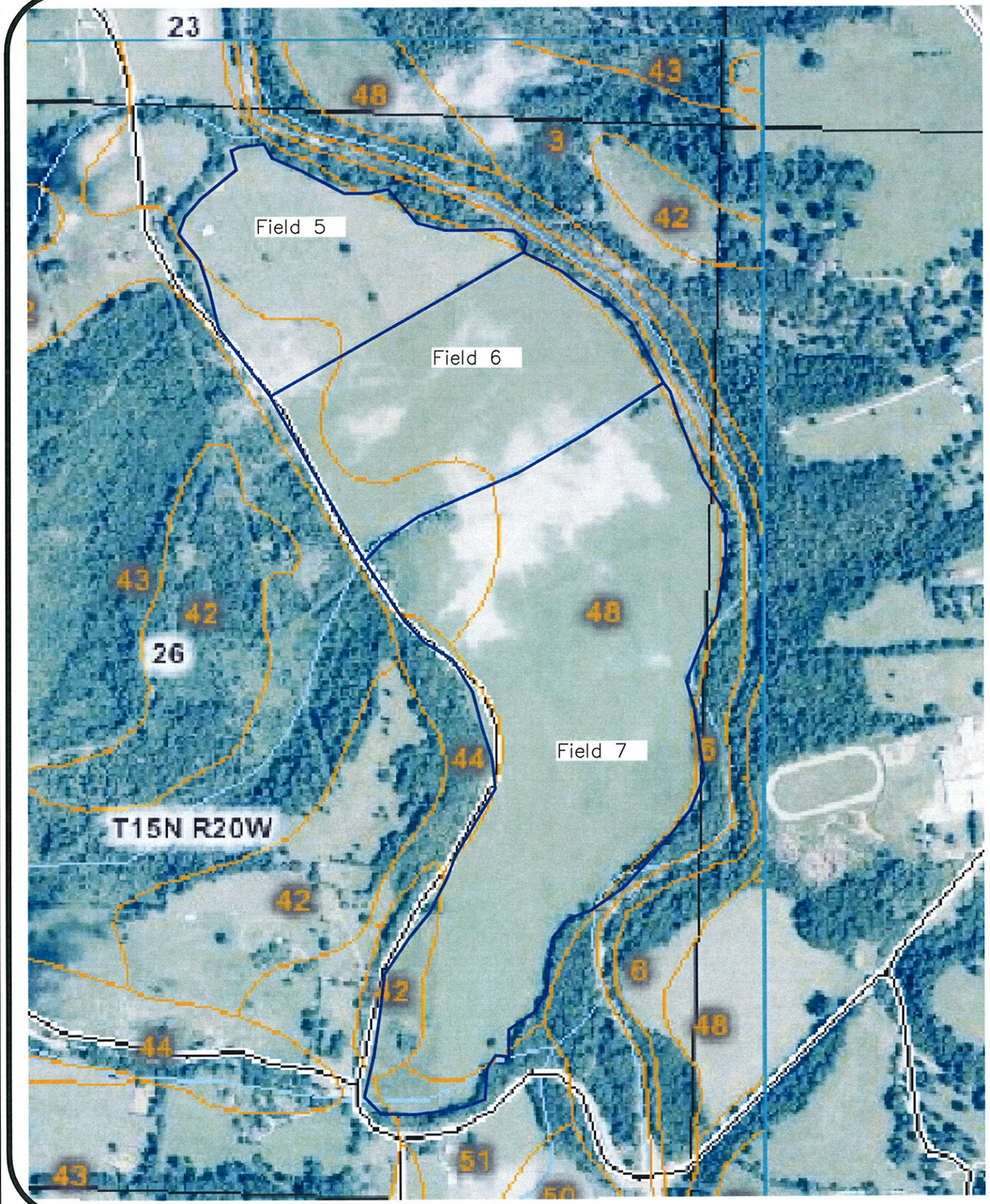
C&H HOG FARMS
GESTATION-FARROWING FARM

SECTION 25 AND 36, T 15 N, R 20 W
NEWTON COUNTY, AR

FIELDS 1-4

DATE: MAY 29, 2012	SHEET: 1
SCALE: 1" = 500'	
DRAWN BY: NAP	
CHECKED BY: DLD	

FILE NAME: OS PROJECT FILES/SWINE/HENSON/CFILES/PLAN



LEGEND

3 Arkana–Moko complex, 20 to 40 percent slopes
6 Ceda–Kenn complex, frequently flooded
11 Enders gravelly loam, 3 to 8 percent slopes
13 Enders stony loam, 3 to 20 percent slopes
26 Moko–Rock outcrop complex, 15 to 50 percent slopes
35 Nella–Enders stony loams, 8 to 20 percent slopes
42 Noark very cherty silt loam, 3 to 8 percent slopes
43 Noark very cherty silt loam, 8 to 20 percent slopes
44 Noark very cherty silt loam, 20 to 40 percent slopes
48 Razort loam, occasionally flooded
50 Spadra loam, occasionally flooded
51 Spadra loam, 2 to 5 percent slopes
54 Water

GENERAL NOTES

N

SCALE, FEET
0 300 600 900 1200

No.	Revision/Issue	Date

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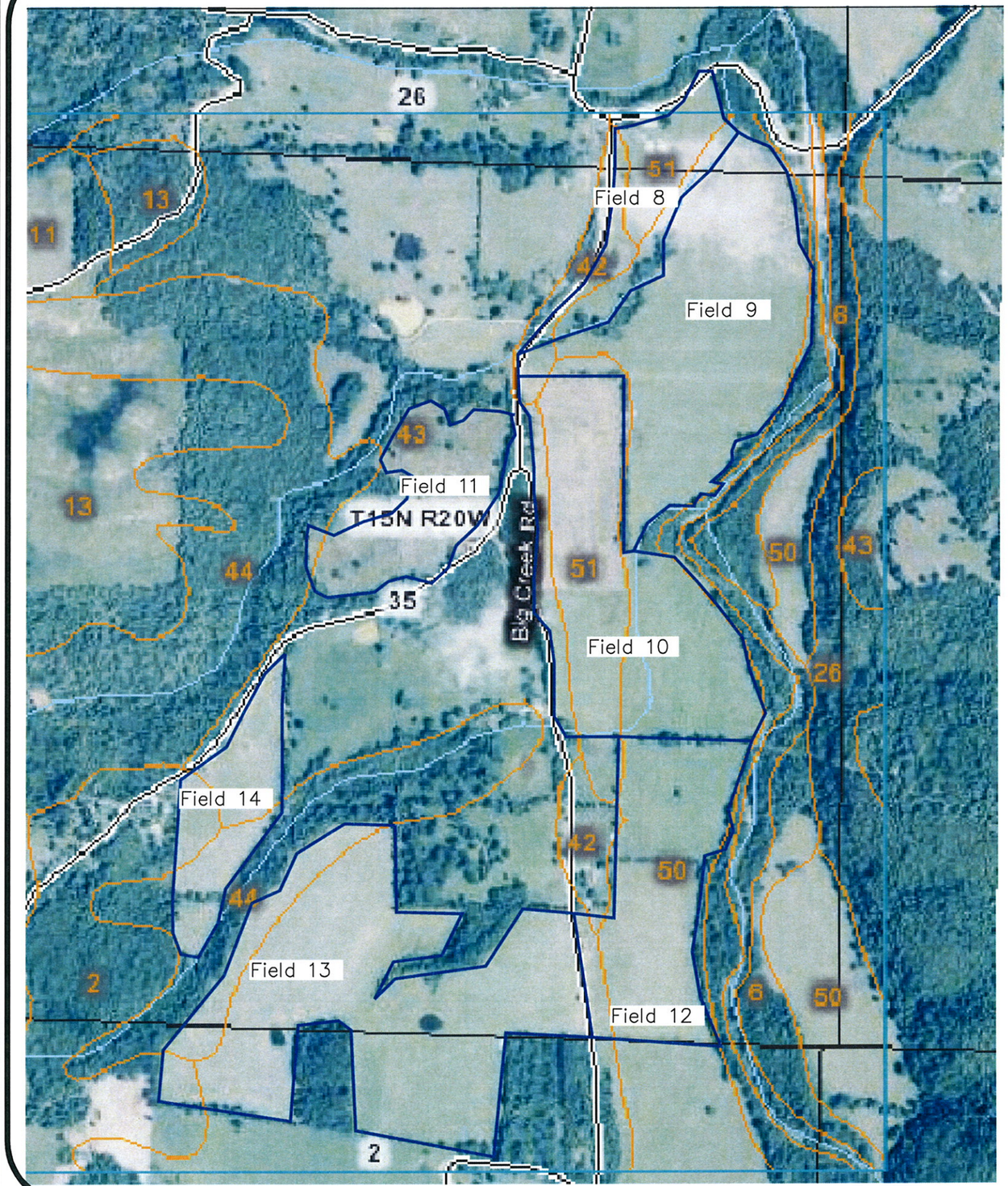
C&H HOG FARMS
GESTATION-FARROWING FARM

SECTION 26, T 15 N, R 20 W
NEWTON COUNTY, AR

FIELDS 5-7

DATE: MAY 29, 2012	SHEET: 2
SCALE: 1" = 600'	
DRAWN BY: NAP	
CHECKED BY: DLD	

FILE NAME: OS PROJECT FILES/SWINE/HENSON/CFILES/PLAN



LEGEND

1 Arkana very cherty silt loam, 3 to 8 percent slopes
2 Arkana–Moko complex, 8 to 20 percent slopes
6 Ceda–Kenn complex, frequently flooded
11 Enders gravelly loam, 3 to 8 percent slopes
13 Enders stony loam, 3 to 20 percent slopes
26 Moko–Rock outcrop complex, 15 to 50 percent slopes
35 Nella–Enders stony loams, 8 to 20 percent slopes
37 Nella–Steprock complex, 8 to 20 percent slopes
42 Noark very cherty silt loam, 3 to 8 percent slopes
43 Noark very cherty silt loam, 8 to 20 percent slopes
44 Noark very cherty silt loam, 20 to 40 percent slopes
48 Razort loam, occasionally flooded
50 Spadra loam, occasionally flooded
51 Spadra loam, 2 to 5 percent slopes
54 Water

GENERAL NOTES

N

SCALE, FEET
0 300 600 900 1200

No.	Revision/Issue	Date

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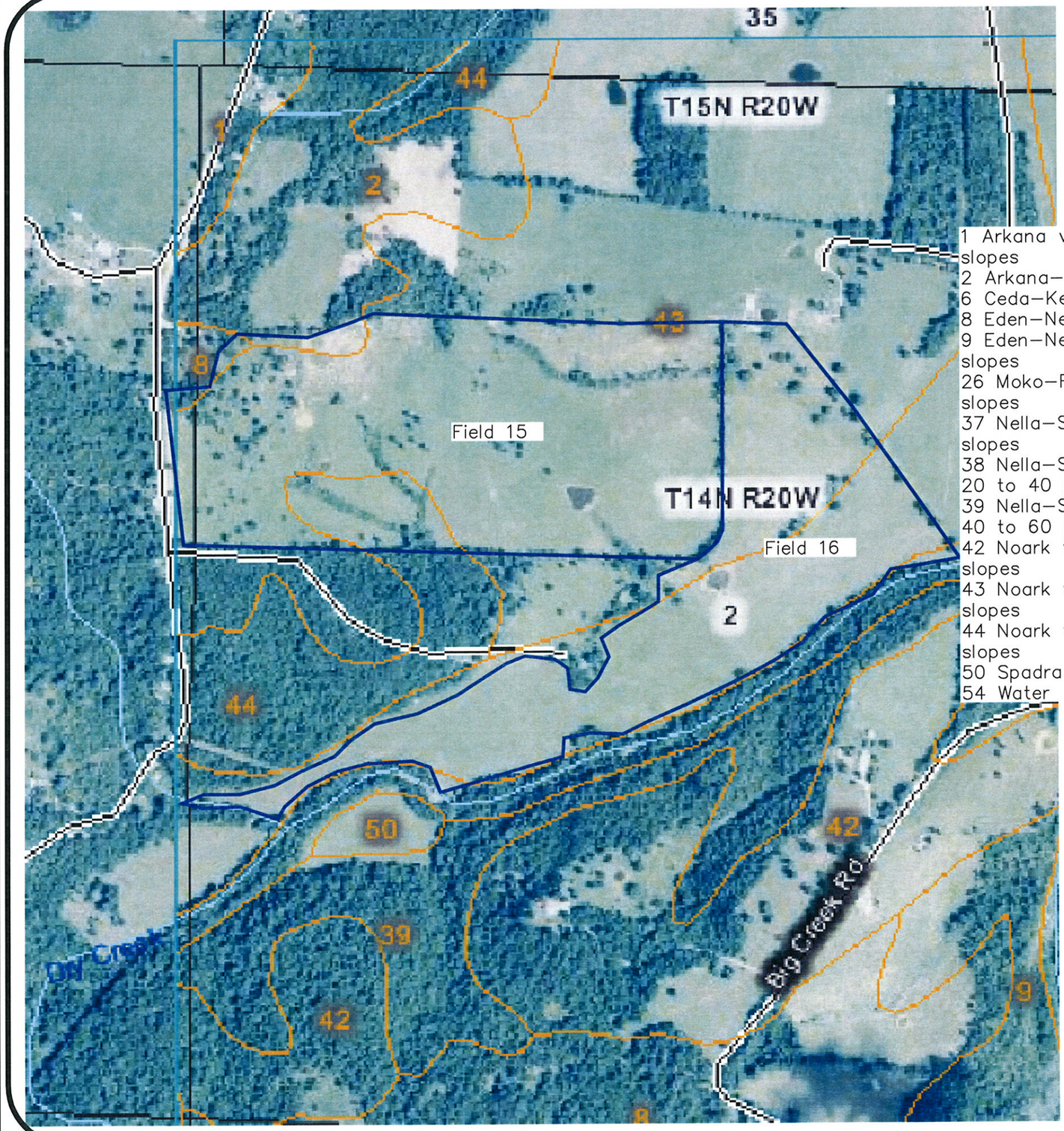
C&H HOG FARMS
GESTATION-FARROWING FARM

SECTION 26, T 15 N, R 20 W
NEWTON COUNTY, AR

FIELDS 8-15

DATE: MAY 29, 2012	SHEET: 3
SCALE: 1" = 600'	
DRAWN BY: NAP	
CHECKED BY: DLD	

FILE NAME: OS PROJECT FILES/SWINE/HENSON/CFILES/PLAN



LEGEND

1 Arkana very cherty silt loam, 3 to 8 percent slopes
2 Arkana–Moko complex, 8 to 20 percent slopes
6 Ceda–Kenn complex, frequently flooded
8 Eden–Newnata complex, 8 to 20 percent slopes
9 Eden–Newnata complex, 20 to 40 percent slopes
26 Moko–Rock outcrop complex, 15 to 50 percent slopes
37 Nella–Steprock complex, 8 to 20 percent slopes
38 Nella–Steprock–Mountainburg very stony loams, 20 to 40 percent slopes
39 Nella–Steprock–Mountainburg very stony loams, 40 to 60 percent slopes
42 Noark very cherty silt loam, 3 to 8 percent slopes
43 Noark very cherty silt loam, 8 to 20 percent slopes
44 Noark very cherty silt loam, 20 to 40 percent slopes
50 Spadra loam, occasionally flooded
54 Water

GENERAL NOTES

N

SCALE, FEET
0 250 500 750 1000

No.	Revision/Issue	Date

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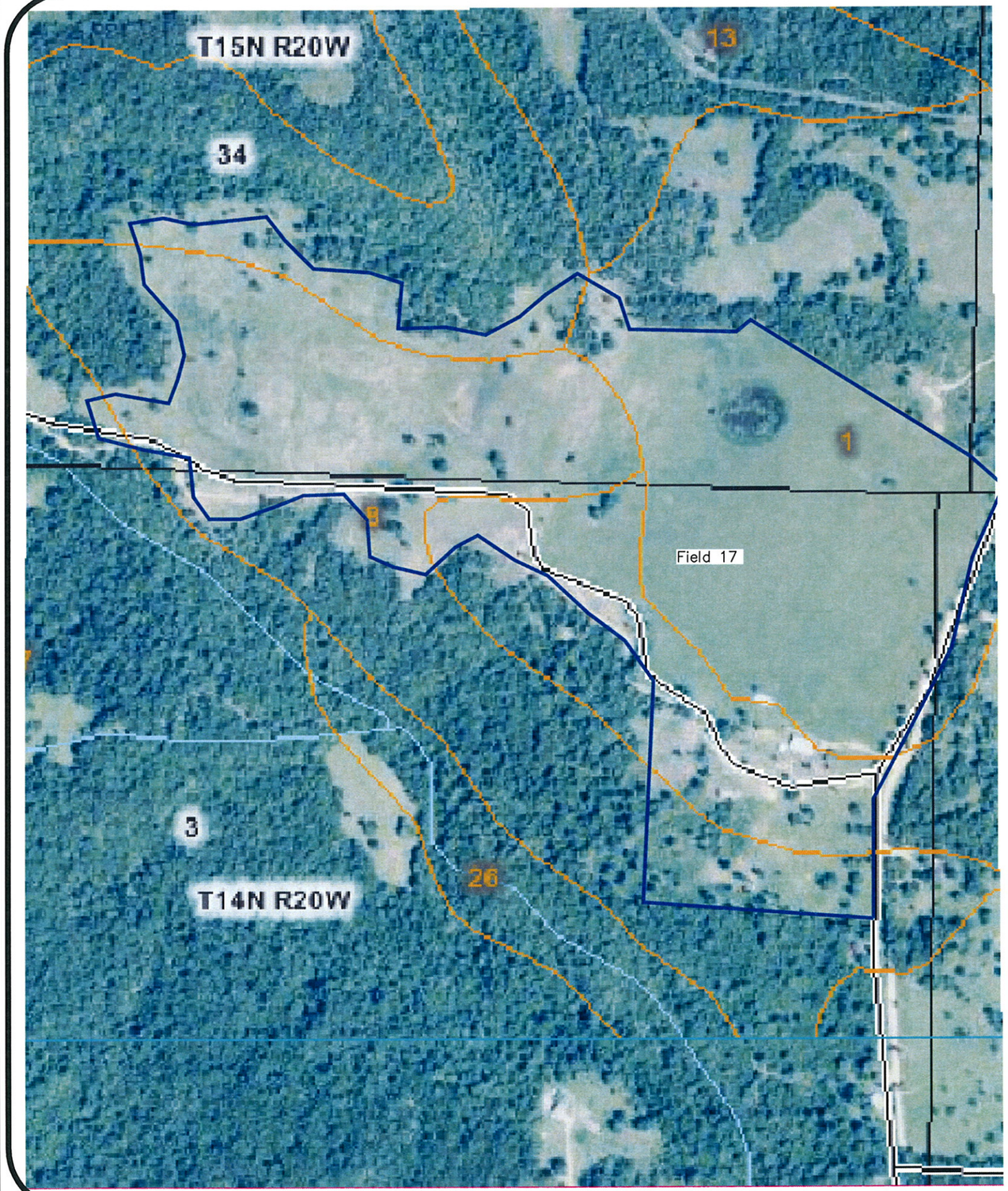
C&H HOG FARMS
GESTATION-FARROWING FARM

SECTION 3, T 14 N, R 20 W
NEWTON COUNTY, AR

FIELDS 15-16

DATE: MAY 29, 2012	SHEET: 4
SCALE: 1" = 500'	
DRAWN BY: NAP	
CHECKED BY: DLD	

FILE NAME: OS PROJECT FILES/SWINE/HENSON/CFILES/PLAN



LEGEND

1 Arkana very cherty silt loam, 3 to 8 percent slopes
2 Arkana–Moko complex, 8 to 20 percent slopes
8 Eden–Newnata complex, 8 to 20 percent slopes
13 Enders stony loam, 3 to 20 percent slopes
26 Moko–Rock outcrop complex, 15 to 50 percent slopes
36 Nella–Enders stony loams, 20 to 40 percent slopes
37 Nella–Steprock complex, 8 to 20 percent slopes
39 Nella–Steprock–Mountainburg very stony loams, 40 to 60 percent slopes
43 Noark very cherty silt loam, 8 to 20 percent slopes
44 Noark very cherty silt loam, 20 to 40 percent slopes

GENERAL NOTES

N

SCALE, FEET
0 250 500 750 1000

No.	Revision/Issue	Date

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C&H HOG FARMS
GESTATION-FARROWING FARM

SECTION 3, T 14 N, R 20 W
NEWTON COUNTY, AR

FIELD 17

DATE: MAY 29, 2012	SHEET: 5
SCALE: 1" = 500'	
DRAWN BY: NAP	
CHECKED BY: DLD	

FILE NAME: OS PROJECT FILES/SWINE/HENSON/CFILES/PLAN

Section G: Signed Manure Application Lease Agreements

SECTION G. SIGNED MANURE APPLICATION LEASE AGREEMENTS

Signed easements are shown for Fields 1-17.

Attachment I

LAND USE CONTRACT

I, Loretta Ricketts (Landowner), agree to allow Jason Henson (Operation Owner) to land apply waste from his/her Hog Farm (Type of Operation) operation located in the ____ (1/4 Section) 1/4 of Section 26 (Section) in Township 15 N (Township) and Range 20W (Range) in Newton (County of Operation) County to 34.5 (Total Acreage Available) acres of my property located in Newton (County of Application Site) County. A description of the areas to be used as land application sites are as follows:

Site No.	¼ Section	Section	Township	Range	Latitude	Longitude	Available Acreage*
6	NE	26	15 N	20W	35.926	-93.069	34.5

*Available acreage is the total acreage minus buffer zone areas.

I am also aware that the land applicator or the owner of the operation is to apply waste according to the management plan and guidelines and conditions set forth by the Arkansas Department of Environmental Quality.

In addition to these guidelines, the following requirements must also be satisfied when applying waste to my land:

_____

_____

_____

_____

_____ _____ Loretta Ricketts 5-19-12

Operation Owner Signature Date Landowner Signature Date

Attachment 1

LAND USE CONTRACT

I, Shan Ricketts (Landowner), agree to allow Jason Henson (Operation Owner) to land apply waste from his/her Hog Farm (Type of Operation) operation located in the ____ (1/4 Section) 1/4 of Section 26 (Section) in Township 15N (Township) and Range 20W (Range) in Newton (County of Operation) County to 23.8 (Total Acreage Available) acres of my property located in Newton (County of Application Site) County. A description of the areas to be used as land application sites are as follows:

Site No.	¼ Section	Section	Township	Range	Latitude	Longitude	Available Acreage*
5	NE	26	15N	20W	35.928	-93.071	23.8

*Available acreage is the total acreage minus buffer zone areas.

I am also aware that the land applicator or the owner of the operation is to apply waste according to the management plan and guidelines and conditions set forth by the Arkansas Department of Environmental Quality.

In addition to these guidelines, the following requirements must also be satisfied when applying waste to my land:

_____

_____

_____

_____

Operation Owner Signature	Date	Shan Ricketts Landowner Signature	5-19-12 Date

Attachment 1

LAND USE CONTRACT

I, Jacen Criner (Landowner), agree to allow Jason Henson (Operation Owner) to land apply waste from his/her Hog Farm (Type of Operation) operation located in the ____ (1/4 Section) 1/4 of Section 26 (Section) in Township 15 N (Township) and Range 20 W (Range) in Newton (County of Operation) County to 88.7 (Total Acreage Available) acres of my property located in Newton (County of Application Site) County. A description of the areas to be used as land application sites are as follows:

Site No.	¼ Section	Section	Township	Range	Latitude	Longitude	Available Acreage*
17	NE	3	14N	20W	35.901	-93.087	88.7
and	SW	34	15N	20W			
and	SE	34	15N	20W			

*Available acreage is the total acreage minus buffer zone areas.

I am also aware that the land applicator or the owner of the operation is to apply waste according to the management plan and guidelines and conditions set forth by the Arkansas Department of Environmental Quality.

In addition to these guidelines, the following requirements must also be satisfied when applying waste to my land:

Operation Owner Signature ____ Date ____

Jacen Criner
Landowner Signature ____ Date ____

Attachment 1

LAND USE CONTRACT

I, Jason Henson (Landowner), agree to allow Jason Henson (Operation Owner) to land apply waste from his/her Hog Farm (Type of Operation) operation located in the ____ (1/4 Section) 1/4 of Section 26 (Section) in Township 15 N (Township) and Range 20 W (Range) in Newton (County of Operation) County to 41.4 (Total Acreage Available) acres of my property located in Newton (County of Application Site) County. A description of the areas to be used as land application sites are as follows:

Site No.	¼ Section	Section	Township	Range	Latitude	Longitude	Available Acreage*
1	SW	25	15 N	20W	35.917	-93.058	15.6
2	SW	25	15N	20W	35.916	-93.062	17.0
4	NW	36	15N	20W	35.914	-93.062	8.8

*Available acreage is the total acreage minus buffer zone areas.

I am also aware that the land applicator or the owner of the operation is to apply waste according to the management plan and guidelines and conditions set forth by the Arkansas Department of Environmental Quality.

In addition to these guidelines, the following requirements must also be satisfied when applying waste to my land:

JASON Henson — Operation Owner Signature — 3-21-12 — Date

Jason Henson — Landowner Signature — 3-21-12 — Date

Attachment 1

LAND USE CONTRACT

I, E. G. Campbell (Landowner), agree to allow Jason Henson (Operation Owner) to land apply waste from his/her Hog Farm (Type of Operation) operation located in the ____ (1/4 Section) 1/4 of Section 26 (Section) in Township 15N (Township) and Range 20W (Range) in Newton (County of Operation) County to 74.3 (Total Acreage Available) acres of my property located in Newton (County of Application Site) County. A description of the areas to be used as land application sites are as follows:

Site No.	¼ Section	Section	Township	Range	Latitude	Longitude	Available Acreage*
7	NE	26	15N	20W	35.922	-93.067	74.3
and	SE						

*Available acreage is the total acreage minus buffer zone areas.

I am also aware that the land applicator or the owner of the operation is to apply waste according to the management plan and guidelines and conditions set forth by the Arkansas Department of Environmental Quality.

In addition to these guidelines, the following requirements must also be satisfied when applying waste to my land:

Jason Henson — Operation Owner Signature
3-21-12 — Date
E. G. Campbell — Landowner Signature
3-21-12 — Date

Attachment 1

LAND USE CONTRACT

I, Charles W. Campbell (Landowner), agree to allow Jason Henson (Operation Owner) to land apply waste from his/her Hog Farm (Type of Operation) operation located in the ____ (1/4 Section) 1/4 of Section 26 (Section) in Township 15 N (Township) and Range 20 W (Range) in Newton (County of Operation) County to 103.5 (Total Acreage Available) acres of my property located in Newton (County of Application Site) County. A description of the areas to be used as land application sites are as follows:

Site No.	¼ Section	Section	Township	Range	Latitude	Longitude	Available Acreage*
3	SW	25	15N	20W	35.918	-93.065	13.6
8	NE	35	15N	20W	35.914	-93.071	15.5
9	NE	35	15N	20W	35.911	-93.068	41.2
10	NE	35	15N	20W	35.910	-93.071	33.2

*Available acreage is the total acreage minus buffer zone areas.

I am also aware that the land applicator or the owner of the operation is to apply waste according to the management plan and guidelines and conditions set forth by the Arkansas Department of Environmental Quality.

In addition to these guidelines, the following requirements must also be satisfied when applying waste to my land:

Jason Henson — Operation Owner Signature
10-24-11 — Date
Charles W Campbell — Landowner Signature
10-24-11 — Date

Attachment 1

LAND USE CONTRACT

I, Charles W. Campbell (Landowner) agree to allow Jason Henson (Operation Owner) to land apply waste from his/her Hog Farm (Type of Operation) operation located in the ____ (1/4 Section) 1/4 of Section 26 (Section) in Township 15N (Township) and Range 20W (Range) in Newton (County of Operation) County to 61.6 (Total Acreage Available) acres of my property located in Newton (County of Application Site) County. A description of the areas to be used as land application sites are as follows:

Site No.	¼ Section	Section	Township	Range	Latitude	Longitude	Available Acreage*
13	SW	35	15N	20W	35.902	-93.076	61.6
and	SE	35	15N	20W			
and	NW	2	14N	20W			
and	NE	2	14N	20W			

*Available acreage is the total acreage minus buffer zone areas.

I am also aware that the land applicator or the owner of the operation is to apply waste according to the management plan and guidelines and conditions set forth by the Arkansas Department of Environmental Quality.

In addition to these guidelines, the following requirements must also be satisfied when applying waste to my land:

Jason Henson — Operation Owner Signature
10-24-11 — Date
Charles W Campbell — Landowner Signature
10-24-11 — Date

Attachment 1

LAND USE CONTRACT

I, Barbara Hufley (Landowner), agree to allow Jason Henson (Operation Owner) to land apply waste from his/her Hog Farm (Type of Operation) operation located in the ____ (1/4 Section) 1/4 of Section 26 (Section) in Township 15 N (Township) and Range 20 W (Range) in Newton (County of Operation) County to 63.4 (Total Acreage Available) acres of my property located in Newton (County of Application Site) County. A description of the areas to be used as land application sites are as follows:

Site No.	¼ Section	Section	Township	Range	Latitude	Longitude	Available Acreage*
11	NW	35	15 N	20 W	35.910	-93.074	20.7
and	NE	35	15 N	20 W			
12	SE	35	15 N	20 W	35.901	-93.069	23.7
14	SW	35	15 N	20 W	35.905	-93.078	18.0

*Available acreage is the total acreage minus buffer zone areas.

I am also aware that the land applicator or the owner of the operation is to apply waste according to the management plan and guidelines and conditions set forth by the Arkansas Department of Environmental Quality.

In addition to these guidelines, the following requirements must also be satisfied when applying waste to my land:

Jason Henson — Operation Owner Signature
11/1/11 — Date
Barbara Hufley — Landowner Signature
11/1/11 — Date

Attachment 1

LAND USE CONTRACT

I, Barbara Hufley (Landowner), agree to allow Jason Henson (Operation Owner) to land apply waste from his/her Hog Farm (Type of Operation) operation located in the ____ (1/4 Section) 1/4 of Section 26 (Section) in Township 15N (Township) and Range 20W (Range) in Newton (County of Operation) County to 79.6 (Total Acreage Available) acres of my property located in Newton (County of Application Site) County. A description of the areas to be used as land application sites are as follows:

Site No.	¼ Section	Section	Township	Range	Latitude	Longitude	Available Acreage*
16	All	2	14N	20W	35.894	-93.076	79.6
and	SE	3	14N	20W			

*Available acreage is the total acreage minus buffer zone areas.

I am also aware that the land applicator or the owner of the operation is to apply waste according to the management plan and guidelines and conditions set forth by the Arkansas Department of Environmental Quality.

In addition to these guidelines, the following requirements must also be satisfied when applying waste to my land:

JASonHenson — Operation Owner Signature — 11/1/11 — Date

Barbara Hufley — Landowner Signature — 11/1/11 — Date

Attachment 1

LAND USE CONTRACT

I, Clayel Criner (Landowner), agree to allow Jason Henson (Operation Owner) to land apply waste from his/her Hog Farm (Type of Operation) operation located in the ____ (1/4 Section) 1/4 of Section 26 (Section) in Township 15N (Township) and Range 20W (Range) in Newton (County of Operation) County to 61 (Total Acreage Available) acres of my property located in Newton (County of Application Site) County. A description of the areas to be used as land application sites are as follows:

Site No.	¼ Section	Section	Township	Range	Latitude	Longitude	Available Acreage*
15	NW	2	14N	20W	35.896	-93.078	61

*Available acreage is the total acreage minus buffer zone areas.

I am also aware that the land applicator or the owner of the operation is to apply waste according to the management plan and guidelines and conditions set forth by the Arkansas Department of Environmental Quality.

In addition to these guidelines, the following requirements must also be satisfied when applying waste to my land:

JASON Henson — Operation Owner Signature
3-21-12 — Date
Clayel Criner — Landowner Signature
3-21-12 — Date

Attachment 1

LAND USE CONTRACT

I, Barbara Hufley (Landowner), agree to allow Jason Henson (Operation Owner) to land apply waste from his/her Hog Farm (Type of Operation) operation located in the _____ (1/4 Section) 1/4 of Section 15 W (Section) in Township 20 (Township) and Range _____ (Range) in _____ (County of Operation) County to _____ (Total Acreage Available) acres of my property located in _____ (County of Application Site) County. A description of the areas to be used as land application sites are as follows:

Site No.	¼ Section	Section	Township	Range	Latitude	Longitude	Available Acreage*

*Available acreage is the total acreage minus buffer zone areas.

I am also aware that the land applicator or the owner of the operation is to apply waste according to the management plan and guidelines and conditions set forth by the Arkansas Department of Environmental Quality.

In addition to these guidelines, the following requirements must also be satisfied when applying waste to my land:

_____

_____

_____

_____

JASon Henson
Operation Owner Signature

_____
Date

Barbara Hufley 11/1/11
Landowner Signature Date

Attachment 1

LAND USE CONTRACT

I, Billy F. Cheatham (Landowner), agree to allow Jason Henson (Operation Owner) to land apply waste from his/her Hog Farm (Type of Operation) operation located in the _____ (1/4 Section) 1/4 of Section _____ (Section) in Township 15 N (Township) and Range 20 W (Range) in Newton (County of Operation) County to _____ (Total Acreage Available) acres of my property located in Newton (County of Application Site) County. A description of the areas to be used as land application sites are as follows:

Site No.	¼ Section	Section	Township	Range	Latitude	Longitude	Available Acreage*

*Available acreage is the total acreage minus buffer zone areas.

I am also aware that the land applicator or the owner of the operation is to apply waste according to the management plan and guidelines and conditions set forth by the Arkansas Department of Environmental Quality.

In addition to these guidelines, the following requirements must also be satisfied when applying waste to my land:

_____

_____

_____

_____

JASON HENSON
Operation Owner Signature

_____
Date

Billy F. Cheatham
Landowner Signature

11-1-2011
Date

Section H: Soil Test Reports

SECTION H. SOIL TESTS REPORTS

Land application soil tests for nutrient application are attached. Prior to application the results will be recorded in the analysis sheets.

UofA UNIVERSITY OF ARKANSAS DIVISION OF AGRICULTURE

Cooperative Extension Service
Soil Analysis Report
Soil Testing And Research Laboratory
Marianna, AR 72360

http://www.uark.edu/depts/soiltest

JASON HENSON		Client ID:	8706881318
HC 72 BOX 10			
MTN JUDEA	AR		72655

Date Processed:	2/17/2012
Field ID:	1
Acres	23
Lime Applied in the last 4 years:	No
Leveled in past 4 years:	No
Irrigation:	Unknown
County:	Pope
Lab Number:	36722
Sample Number:	931074

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	83	166	Above Optimum
K	191	382	Above Optimum
Ca	1397	2794	--
Mg	114	228	--
SO4-S	16	32	--
Zn	4.4	8.8	--
Fe	123	246	--
Mn	205	410	--
Cu	1.0	2.0	--
B	0.0	0.0	--
NO3-N	24	48	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	6.6	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	11	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silt Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
77.2	63.6	8.7	4.5	0.5

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	lb/acre						
Crop 1	Warm-Season Grasses (MNT) (207)	60	0	0	0	0	0	0
Crop 2	Warm-Season Grasses (MNT) (207)	60	0	0	0	0	0	0
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.

5. Crop 2 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.

6. Crop 3 Notes:

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Cooperative Extension Service
Soil Analysis Report
Soil Testing And Research Laboratory
Marianna, AR 72360
http://www.uark.edu/depts/soiltest

JASON HENSON		Client ID:	8706881318
HC 72 BOX 10			
MTN JUDEA	AR		72655
Date Processed:	2/17/2012		
Field ID:	2		
Acres	20		
Lime Applied in the last 4 years:	No		
Leveled in past 4 years:	No		
Irrigation:	Unknown		
County:	Pope		
Lab Number:	36723		
Sample Number:	931075		

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	72	144	Above Optimum
K	224	448	Above Optimum
Ca	1247	2494	--
Mg	90	180	--
SO4-S	15	30	--
Zn	3.5	7.0	--
Fe	96	192	--
Mn	235	470	--
Cu	0.8	1.6	--
B	0.0	0.0	--
NO3-N	31	62	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	6.6	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	10	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silt Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
75.3	61.6	7.4	5.7	0.6

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	---------- lb/acre ----------						
Crop 1	Warm-Season Grasses (MNT) (207)	60	0	0	0	0	0	0
Crop 2	Warm-Season Grasses (MNT) (207)	60	0	0	0	0	0	0
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.

5. Crop 2 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.

6. Crop 3 Notes:

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Soil Testing And Research Laboratory
Marianna, AR 72360

http://www.uark.edu/depts/soiltest

JASON HENSON		Client ID:	8706881318
HC 72 BOX 10			
MTN JUDEA	AR		72655
Date Processed:	2/17/2012		
Field ID:	3		
Acres	30		
Lime Applied in the last 4 years:	No		
Leveled in past 4 years:	No		
Irrigation:	Unknown		
County:	Pope		
Lab Number:	36724		
Sample Number:	931076		

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	42	84	Optimum
K	65	130	Low
Ca	3329	6658	--
Mg	59	118	--
SO4-S	11	22	--
Zn	6.1	12.2	--
Fe	95	190	--
Mn	152	304	--
Cu	1.6	3.2	--
B	0.0	0.0	--
NO3-N	10	20	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	7.5	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	19	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silty Clay Loam - Clay Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
89.7	85.8	2.5	0.9	0.4

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	lb/acre						
Crop 1	Warm-Season Grasses (MNT) (207)	60	0	110	0	0	0	0
Crop 2	Warm-Season Grasses (MNT) (207)	60	0	110	0	0	0	0
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.
If S deficiency has occurred previously on this field apply 20 lb SO4-S/Acre.

5. Crop 2 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.
If S deficiency has occurred previously on this field apply 20 lb SO4-S/Acre.

6. Crop 3 Notes:

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Marianna, AR 72360
http://www.uark.edu/depts/soiltest

JASON HENSON		Client ID:	8706881318
HC 72 BOX 10			
MTN JUDEA	AR		72655
Date Processed:	2/17/2012		
Field ID:	4		
Acres	13		
Lime Applied in the last 4 years:	No		
Leveled in past 4 years:	No		
Irrigation:	Unknown		
County:	Pope		
Lab Number:	36725		
Sample Number:	931077		

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	50	100	Optimum
K	120	240	Medium
Ca	1230	2460	--
Mg	118	236	--
SO4-S	12	24	--
Zn	2.7	5.4	--
Fe	135	270	--
Mn	46	92	--
Cu	0.7	1.4	--
B	0.0	0.0	--
NO3-N	15	30	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	5.6	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	12	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silt Loam - Silty Clay Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
62.5	51.3	8.2	2.6	0.4

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	lb/acre						
Crop 1	Warm-Season Grasses (MNT) (207)	60	0	60	0	0	0	4000
Crop 2	Warm-Season Grasses (MNT) (207)	60	0	60	0	0	0	4000
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.
If S deficiency has occurred previously on this field apply 20 lb SO4-S/Acre.

5. Crop 2 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.
If S deficiency has occurred previously on this field apply 20 lb SO4-S/Acre.

6. Crop 3 Notes:

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JASON HENSON		Client ID:	8706881318
HC 72 BOX 10			
MTN JUDEA	AR		72655
Date Processed:	2/17/2012		
Field ID:	5		
Acres	40		
Lime Applied in the last 4 years:	No		
Leveled in past 4 years:	No		
Irrigation:	Unknown		
County:	Pope		
Lab Number:	36726		
Sample Number:	931078		

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	65	130	Above Optimum
K	108	216	Medium
Ca	2507	5014	--
Mg	118	236	--
SO4-S	12	24	--
Zn	6.1	12.2	--
Fe	134	268	--
Mn	128	256	--
Cu	1.7	3.4	--
B	0.0	0.0	--
NO3-N	15	30	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	6.7	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	17	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silty Clay Loam - Clay Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
82.2	74.4	5.8	1.6	0.3

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	lb/acre						
Crop 1	Warm-Season Grasses (MNT) (207)	60	0	60	0	0	0	0
Crop 2	Warm-Season Grasses (MNT) (207)	60	0	60	0	0	0	0
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.
If S deficiency has occurred previously on this field apply 20 lb SO4-S/Acre.

5. Crop 2 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.
If S deficiency has occurred previously on this field apply 20 lb SO4-S/Acre.

6. Crop 3 Notes:

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Soil Testing And Research Laboratory
Marianna, AR 72360

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JASON HENSON	Client ID:	8706881318
HC 72 BOX 10		
MTN JUDEA	AR	72655
Date Processed:	2/17/2012	
Field ID:	6	
Acres	40	
Lime Applied in the last 4 years:	No	
Leveled in past 4 years:	No	
Irrigation:	Unknown	
County:	Pope	
Lab Number:	36727	
Sample Number:	931079	

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	76	152	Above Optimum
K	136	272	Optimum
Ca	876	1752	--
Mg	59	118	--
SO4-S	13	26	--
Zn	2.1	4.2	--
Fe	128	256	--
Mn	188	376	--
Cu	0.5	1.0	--
B	0.0	0.0	--
NO3-N	15	30	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	6.2	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	8	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silt Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
67.8	56.4	6.3	4.5	0.6

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	lb/acre						
Crop 1	Warm-Season Grasses (MNT) (207)	60	0	0	0	0	0	0
Crop 2	Warm-Season Grasses (MNT) (207)	60	0	0	0	0	0	0
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.

5. Crop 2 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.

6. Crop 3 Notes:

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JASON HENSON		Client ID:	8706881318
HC 72 BOX 10			
MTN JUDEA	AR		72655

Date Processed:	2/17/2012
Field ID:	7
Acres	150
Lime Applied in the last 4 years:	No
Leveled in past 4 years:	No
Irrigation:	Unknown
County:	Pope
Lab Number:	36728
Sample Number:	931080

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	178	356	Above Optimum
K	207	414	Above Optimum
Ca	1228	2456	--
Mg	154	308	--
SO4-S	14	28	--
Zn	14.5	29.0	--
Fe	218	436	--
Mn	168	336	--
Cu	3.2	6.4	--
B	0.0	0.0	--
NO3-N	12	24	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	6.3	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	11	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silt Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
72.8	55.7	11.6	4.8	0.7

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	lb/acre						
Crop 1	Warm-Season Grasses (MNT) (207)	60	0	0	0	0	0	0
Crop 2	Warm-Season Grasses (MNT) (207)	60	0	0	0	0	0	0
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.

5. Crop 2 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.

6. Crop 3 Notes:

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Cooperative Extension Service
Soil Analysis Report
Soil Testing And Research Laboratory
Marianna, AR 72360

http://www.uark.edu/depts/soiltest

JASON HENSON		Client ID:	8706881318
HC 72 BOX 10			
MTN JUDEA	AR		72655
Date Processed:	2/17/2012		
Field ID:	8		
Acres	12		
Lime Applied in the last 4 years:	No		
Leveled in past 4 years:	No		
Irrigation:	Unknown		
County:	Pope		
Lab Number:	36729		
Sample Number:	931081		

trient Availability Index

utrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
	46	92	Optimum
	45	90	Very Low
	1948	3896	--
	52	104	--
S	8	16	--
	2.1	4.2	--
	124	248	--
	193	386	--
	0.8	1.6	--
	0.0	0.0	--
%	6	12	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	7.0	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	12	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silt Loam - Silty Clay Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
83.8	78.9	3.5	0.9	0.5

commendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

	Crop	N	P2O5	K2O	SO4S	Zn	B	Lime
Crop	Pasture (207)	lb/acre						
1	Warm-Season Grasses (MNT) (207)	60	0	160	0	0	0	0
2	Warm-Season Grasses (MNT) (207)	60	0	160	0	0	0	0
3								

op 1 Notes:

e recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional
Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.
iency has occurred previously on this field apply 20 lb SO4-S/Acre.

op 2 Notes:

e recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional
Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.
iency has occurred previously on this field apply 20 lb SO4-S/Acre.

op 3 Notes:

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Marianna, AR 72360

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JASON HENSON		Client ID:	8706881318
HC 72 BOX 10			
MTN JUDEA	AR		72655
Date Processed:	2/17/2012		
Field ID:	9		
Acres	40		
Lime Applied in the last 4 years:	No		
Leveled in past 4 years:	No		
Irrigation:	Unknown		
County:	Pope		
Lab Number:	36730		
Sample Number:	931082		

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	52	104	Above Optimum
K	45	90	Very Low
Ca	2276	4552	--
Mg	59	118	--
SO4-S	9	18	--
Zn	1.6	3.2	--
Fe	121	242	--
Mn	109	218	--
Cu	1.3	2.6	--
B	0.0	0.0	--
NO3-N	7	14	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	7.2	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	14	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silt Loam - Silty Clay Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
85.8	81.0	3.5	0.8	0.4

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	lb/acre						
Crop 1	Warm-Season Grasses (MNT) (207)	60	0	160	0	0	0	0
Crop 2	Warm-Season Grasses (MNT) (207)	60	0	160	0	0	0	0
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.
If S deficiency has occurred previously on this field apply 20 lb SO4-S/Acre.

5. Crop 2 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.
If S deficiency has occurred previously on this field apply 20 lb SO4-S/Acre.

6. Crop 3 Notes:

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HC 72 BOX 10			
MTN JUDEA	AR		72655

Date Processed:	2/17/2012
Field ID:	10
Acres	35
Lime Applied in the last 4 years:	No
Leveled in past 4 years:	No
Irrigation:	Unknown
County:	Pope
Lab Number:	36731
Sample Number:	931083

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	69	138	Above Optimum
K	114	228	Medium
Ca	2153	4306	--
Mg	99	198	--
SO4-S	13	26	--
Zn	3.8	7.6	--
Fe	157	314	--
Mn	135	270	--
Cu	1.3	2.6	--
B	0.0	0.0	--
NO3-N	132	264	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	6.8	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	14	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silty Clay Loam - Clay Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
82.7	74.4	5.7	2.0	0.6

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	lb/acre						
Crop 1	Warm-Season Grasses (MNT) (207)	60	0	60	0	0	0	0
Crop 2	Warm-Season Grasses (MNT) (207)	60	0	60	0	0	0	0
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.

5. Crop 2 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.

6. Crop 3 Notes:

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JASON HENSON		Client ID:	8706881318
HC 72 BOX 10			
MTN JUDEA	AR		72655
Date Processed:	2/17/2012		
Field ID:	11		
Acres	20		
Lime Applied in the last 4 years:	No		
Leveled in past 4 years:	No		
Irrigation:	Unknown		
County:	Pope		
Lab Number:	36732		
Sample Number:	931084		

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	57	114	Above Optimum
K	292	584	Above Optimum
Ca	737	1474	--
Mg	170	340	--
SO4-S	17	34	--
Zn	2.9	5.8	--
Fe	132	264	--
Mn	92	184	--
Cu	0.6	1.2	--
B	0.0	0.0	--
NO3-N	46	92	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	5.3	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	10	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silt Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
56.8	35.4	13.6	7.2	0.6

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	lb/acre						
Crop 1	Warm-Season Grasses (MNT) (207)	60	0	0	0	0	0	5000
Crop 2	Warm-Season Grasses (MNT) (207)	60	0	0	0	0	0	5000
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.

5. Crop 2 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.

6. Crop 3 Notes:

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JASON HENSON	Client ID:	8706881318
HC 72 BOX 10		
MTN JUDEA	AR	72655
Date Processed:	2/17/2012	
Field ID:	12	
Acres	30	
Lime Applied in the last 4 years:	No	
Leveled in past 4 years:	No	
Irrigation:	Unknown	
County:	Pope	
Lab Number:	36715	
Sample Number:	931063	

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	19	38	Low
K	52	104	Very Low
Ca	1173	2346	--
Mg	26	52	--
SO4-S	8	16	--
Zn	1.6	3.2	--
Fe	101	202	--
Mn	326	652	--
Cu	0.8	1.6	--
B	0.0	0.0	--
NO3-N	12	24	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	6.9	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	9	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silt Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
71.5	66.9	2.5	1.5	0.6

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	lb/acre						
Crop 1	Warm-Season Grasses (MNT) (207)	60	70	160	0	0	0	0
Crop 2								
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.
If S deficiency has occurred previously on this field apply 20 lb SO4-S/Acre.

5. Crop 2 Notes:

6. Crop 3 Notes:

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MTN JUDEA	AR	72655

Date Processed:	2/17/2012
Field ID:	13
Acres	60
Lime Applied in the last 4 years:	No
Leveled in past 4 years:	No
Irrigation:	Unknown
County:	Pope
Lab Number:	36716
Sample Number:	931064

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	48	96	Optimum
K	165	330	Optimum
Ca	1626	3252	--
Mg	131	262	--
SO4-S	15	30	--
Zn	5.6	11.2	--
Fe	84	168	--
Mn	409	818	--
Cu	0.7	1.4	--
B	0.0	0.0	--
NO3-N	29	58	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	7.1	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	12	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silt Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
82.9	69.6	9.3	3.6	0.3

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	lb/acre						
Crop 1	Warm-Season Grasses (MNT) (207)	60	0	0	0	0	0	0
Crop 2								
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.

5. Crop 2 Notes:

6. Crop 3 Notes:

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JASON HENSON		Client ID:	8706881318
HC 72 BOX 10			
MTN JUDEA	AR		72655

Date Processed:	2/17/2012
Field ID:	14
Acres	15
Lime Applied in the last 4 years:	No
Leveled in past 4 years:	No
Irrigation:	Unknown
County:	Pope
Lab Number:	36717
Sample Number:	931065

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	52	104	Above Optimum
K	144	288	Optimum
Ca	2840	5680	--
Mg	89	178	--
SO4-S	12	24	--
Zn	10.8	21.6	--
Fe	83	166	--
Mn	254	508	--
Cu	1.3	2.6	--
B	0.3	0.6	--
NO3-N	27	54	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	7.8	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	17	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silty Clay Loam - Clay Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
88.5	81.8	4.3	2.1	0.2

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	lb/acre						
Crop 1	Warm-Season Grasses (MNT) (207)	60	0	0	0	0	0	0
Crop 2								
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.
If S deficiency has occurred previously on this field apply 20 lb SO4-S/Acre.

5. Crop 2 Notes:

6. Crop 3 Notes:

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JASON HENSON		Client ID:	8706881318
HC 72 BOX 10			
MTN JUDEA	AR		72655
Date Processed:	2/17/2012		
Field ID:	15		
Acres	65		
Lime Applied in the last 4 years:	No		
Leveled in past 4 years:	No		
Irrigation:	Unknown		
County:	Pope		
Lab Number:	36718		
Sample Number:	931066		

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	15	30	Very Low
K	86	172	Low
Ca	525	1050	--
Mg	50	100	--
SO4-S	11	22	--
Zn	1.8	3.6	--
Fe	110	220	--
Mn	382	764	--
Cu	0.4	0.8	--
B	0.0	0.0	--
NO3-N	10	20	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	5.8	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	7	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silt Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
45.3	35.9	5.7	3.0	0.8

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	lb/acre						
Crop 1	Warm-Season Grasses (MNT) (207)	60	100	110	0	0	0	0
Crop 2								
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 50 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.
If S deficiency has occurred previously on this field apply 20 lb SO4-S/Acre.

5. Crop 2 Notes:

6. Crop 3 Notes:

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JASON HENSON		Client ID:	8706881318
HC 72 BOX 10			
MTN JUDEA	AR		72655
Date Processed:	2/17/2012		
Field ID:	16		
Acres	60		
Lime Applied in the last 4 years:	No		
Leveled in past 4 years:	No		
Irrigation:	Unknown		
County:	Pope		
Lab Number:	36719		
Sample Number:	931067		

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	48	96	Optimum
K	160	320	Optimum
Ca	632	1264	--
Mg	89	178	--
SO4-S	11	22	--
Zn	2.4	4.8	--
Fe	136	272	--
Mn	142	284	--
Cu	0.8	1.6	--
B	0.0	0.0	--
NO3-N	6	12	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	5.4	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	9	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silt Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
49.2	35.6	8.4	4.6	0.6

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	lb/acre						
Crop 1	Warm-Season Grasses (MNT) (207)	60	0	0	0	0	0	5000
Crop 2								
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.
If S deficiency has occurred previously on this field apply 20 lb SO4-S/Acre.

5. Crop 2 Notes:

6. Crop 3 Notes:

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JASON HENSON		Client ID:	8706881318
HC 72 BOX 10			
MTN JUDEA	AR		72655
Date Processed:	2/17/2012		
Field ID:	17		
Acres	110		
Lime Applied in the last 4 years:	No		
Leveled in past 4 years:	No		
Irrigation:	Unknown		
County:	Pope		
Lab Number:	36720		
Sample Number:	931068		

1. Nutrient Availability Index

Nutrient	Concentration		Soil Test Level (Mehlich 3)
	ppm	lb/acre	
P	50	100	Optimum
K	57	114	Very Low
Ca	1641	3282	--
Mg	49	98	--
SO4-S	10	20	--
Zn	3.6	7.2	--
Fe	139	278	--
Mn	181	362	--
Cu	1.0	2.0	--
B	0.0	0.0	--
NO3-N	15	30	--

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	7.5	---
Soil EC (1:2 soil-water)		umhos/cm
Soil ECEC	11	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Silt Loam	

Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
81.5	75.9	3.8	1.4	0.5

3. Recommendations

(Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P2O5	K2O	SO4S	Zn	B	Lime
Last Crop	Pasture (207)	lb/acre						
Crop 1	Warm-Season Grasses (MNT) (207)	60	0	160	0	0	0	0
Crop 2								
Crop 3								

4. Crop 1 Notes:

Apply the recommended rates of N, P, and K, in spring when night temperatures are > 60 degrees F for 1 week. For higher production, topdress an additional 60 lb N/Acre after every 4 to 6 weeks of grazing. For fall grazing apply 50 lb N/Acre in early August. Do not apply N after September 1.
If S deficiency has occurred previously on this field apply 20 lb SO4-S/Acre.

5. Crop 2 Notes:

6. Crop 3 Notes:

Section I: Nutrient Test Results and How to

SECTION I. NUTRIENT TESTS RESULTS & HOW TO

The nutrient tests have not been conducted at this time; however, the nutrient tests will be conducted prior to application and recorded on the log forms shown in Section N.

Laboratories Providing Manure Testing Services

- Agvise Laboratories
  902 13th St. N, P.O. Box 187
  Benson, MN 56215
  (320) 843-4109
  http://www.agviselabs.com

- A&L Heartland Labs, Inc.
  111 Linn Street, P.O. Box 455
  Atlantic, IA 50022
  (800) 434-0109
  (712) 243-5213
  http://allabs.com

- Servi-Tech Laboratories
  1602 Park Dr. West
  Hastings, NE 68902
  (402) 463-3522
  (800) 557-7509
  http://www.servitechlabs.com

- Ward Laboratories
  4007 Cherry Ave., P.O. Box 788
  Kearney, NE 68848
  (308) 234-2418
  (800) 887-7645
  http://www.wardlab.com/

- Midwest Laboratories
  13611 "B" St.
  Omaha, NE 68144
  (402) 334-7770
  https://www.midwestlabs.com/

- Stearns DHIA Laboratories
  825 12th Street South, PO Box 227
  Sauk Centre, MN 56378
  (320) 352-2028
  http://www.stearnsdhialab.com/

- University of Arkansas
  1366 West Altheimer Dr
  Fayetteville, AR 72704
  (479) 575-3908

How to Sample Manure for Nutrient Analysis

A field-by-field nutrient management program requires multiple components to maintain adequate fertility for crop growth and development. A well-designed soil sampling plan, including proper soil test interpretations along with manure sampling, manure nutrient analysis, equipment calibration, appropriate application rates and application methods are all necessary components of a nutrient management plan. Implementing these components allows manure to be recognized and used as a credible nutrient resource, potentially reducing input costs and the potential of environmental impacts.

Animal manure has long been used as a source of nutrients for crop growth. Standard nutrient values are guides to determine the amount of nutrients that animal manure will supply as a fertilizer source. Iowa State University Extension publication, *Managing Manure Nutrients for Crop Production* (PM 1811), recommends manure nutrient content and credits by type of animal, handling system and application methods.

While "book values" like those in PM-1811 are reasonable average values, an individual farm's manure analyses can vary from those averages by 50 percent or more. Species, age of animal, feed rations, water use, bedding type, management, and other factors make every farm's manure different. Two key factors affecting the nutrient content of manure are manure handling and type of storage structures used. Each handling system results in different types of nutrient losses—some unavoidable and others that can be controlled to a certain degree. Because every livestock production and manure management system is unique, the best way to assess manure nutrients is by sampling and analyzing the manure at a laboratory.

This publication describes how to sample solid, semi-solid, and liquid manure. Manure with greater than 20 percent solids (by weight) is classified as dry manure and is handled as a solid, usually with box-type spreaders. Manure with 10 to 20 percent solids is classified as semi-solid manure and can usually be handled as a liquid. Semi-solid manure usually requires the use of chopper pumps to provide thorough agitation before pumping. Manure with less than 10 percent solids is classified as liquid manure and is handled with pumps, pipes, tank wagons, and irrigation equipment.

A representative manure sample is needed to provide an accurate reflection of the nutrient content. Unfortunately, manure nutrient content is not uniform within storage structures, so obtaining a representative sample can be challenging. Mixing and sampling strategies should therefore insure that samples simulate as closely as possible the type of manure that will be applied.

When to Sample Manure

Sampling manure prior to application will ensure that you receive the analysis in time to adjust nutrient application rates based on the nutrient concentration of the manure. However, sampling manure prior to application may not completely reflect the nutrient concentration of the manure due to storage and handling losses if long periods of time pass before application begins or when liquid storage facilities are not adequately agitated while sampling. "Pre-sampling" such as dipping samples off the top of storage structure for nitrogen (N) and potassium (K) concentrations, can be done to estimate application rates. (See page 3 for more on pre-sampling). Producers must remember to go back and determine the actual nutrient rates applied by using manure samples collected during application and calculating volumes.

For best results, manure should be sampled at the time of application or as close as possible to application. Sampling during application will help to ensure that samples are well-mixed and representative of the manure being applied. Because manure nutrient analysis typically takes several days at a lab, sampling at the time of application will not provide immediate manure nutrient recommendations. The results can, however, be used for subsequent manure applications and to adjust commercial fertilizer application. This is why it is important to develop a manure sampling history and use those analyses in a nutrient management plan. A manure sampling history will also help you recognize if unplanned changes have occurred to your system if management and other factors have remained constant. A manure sampling history will give you confidence in using manure, and show you how consistent nutrient concentration is from year to year.

Take manure samples annually for three years for new facilities, followed with samples every three to five years, unless animal management practices, feed rations, or manure handling and storage methods change drastically from present methods. If you apply manure several times a

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year, take samples when you plan to apply the bulk of manure. For example, it may be appropriate to sample in the spring when manure that has accumulated all winter will be applied. If storages are emptied twice a year, it may be necessary to sample in both spring and fall since the different storage temperatures in summer versus winter will affect manure nutrient levels. *NOTE: Implementation of future federal regulations may require concentrated animal feeding operations (> 1,000 animal units) to sample annually. Please check state and federal requirements to determine sampling frequency.*

How to Sample Semi-Solid or Liquid Manure

In liquid and semi-solid systems, settled solids can contain over 90 percent of the phosphorus (P), so complete agitation is needed to accurately sample the entire storage if all the manure in the storage structure is going to be applied. If, however, solids will purposely be left on the bottom of the storage structure when the manure is pumped out, as is sometimes the case with lagoons, then complete agitation during sampling may generate artificially high nutrient values. In this case agitation of the solids or sludge on the bottom of a lagoon is not needed for nutrient analysis.

Liquid manure is best sampled during land application, for it is potentially more difficult and dangerous to sample from liquid storage facilities than dry manure systems. When sampling manure during application is not possible, or pre-application analysis is desired for determining rates, refer to the section on sampling from a storage facility. If sampling from a liquid storage facility, use caution to prevent accidents, such as falling into the manure storage facility or being overcome with hazardous gases produced by manure. Have two people present at all times. Never enter confined manure storage spaces without appropriate safety gear such as a self-contained breathing apparatus.

Ideally, liquid manure should be agitated so a representative sample can be obtained for laboratory analysis. When agitating a storage pit below a building, be sure to provide adequate ventilation for both animals and humans. When agitating outdoor unformed pits, monitor activities closely to prevent erosion of berms or destruction of pit liners.

Liquid Manure Sample Preparation

All liquid samples should be handled as follows:

- Prior to sampling label a plastic bottle with your name, date and sample identification number using a waterproof pen.
- If the sample cannot be mailed or transported to a laboratory within a few hours, it should be frozen. Place the container in a tightly sealed plastic bag and keep it cold or frozen until it arrives at the laboratory.
- Most manure analysis laboratories do have plastic bottles available for sample collection. Do not use glass containers, as expansion of the gases in the sample can cause the container to break.

Liquid Manure Sampling During Land Application

Liquid Manure Applied with Tank Wagons

- Since settling begins as soon as agitation stops, samples should be collected as soon as possible after the manure tank wagon is filled unless the tanker has an agitator.
- Immediately after filling the tank wagon, use a clean plastic pail to collect manure from the loading or unloading port or the opening near the bottom of the tank. Be sure the port or opening does not have a solids accumulation from prior loads.
- Use a ladle to stir the sample in the bucket to get the solids spinning in suspension. While the liquid is spinning remove a ladle full and carefully pour in the sample bottle. See Figure 1.
- Repeat this procedure and take another sample until the sample bottle is three-quarters full (Make sure the manure solids have not settled to the bottom of the bucket as each ladle is extracted; it is important to include the solids in the sample). Screw the lid on tightly.

Figure 1. Collecting a liquid manure sample.

Liquid Manure Applied by Irrigation Systems

- Place catch pans or buckets randomly in the field to collect liquid manure that is applied by an irrigation system. Inexpensive aluminum roasting pans or plastic buckets can be used as catch pans. Use several pans at different distances from the sprinkler head.
- Immediately after the manure has been applied, collect manure from catch pans or buckets and combine the manure in one bucket to make one composite sample.
- Use a ladle to stir the sample in the bucket. While the liquid is spinning remove a ladle full and carefully pour into a sample bottle. See Figure 1.
- Repeat this procedure and take another sample until the sample bottle is three-quarters full. Screw the lid on tightly.

Liquid Manure Sampling from Storage Facilities

For best sampling results, samples should be taken with a sampling probe or tube (see Figure 2). Probes can be constructed out of 1.5-inch diameter PVC pipe. Cut the PVC pipe a foot longer than the depth of the pit. Run a 1/4 -inch rod or string through the length of the pipe and attach a plug such as a rubber stopper or rubber ball (see Figure 3). The rod or the string must be longer than the pipe. If using a rod, bend the top over to prevent it from falling out of the pipe.

- Insert the pipe slowly into the pit or lagoon, with the stopper open, to the full depth of the pit.

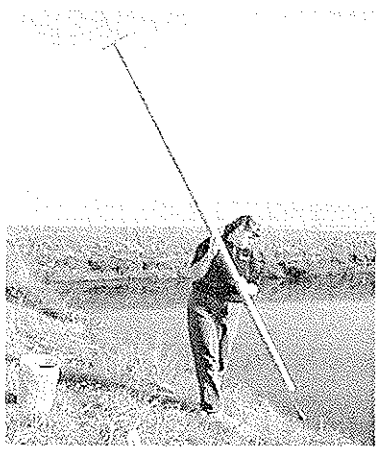

Figure 2. Sampling earthen basin with sampling probe.

- Pull the string or rod to close the bottom of the pipe and extract the vertical profile sample inside the pipe (be careful not to tip the pipe and dump the sample).
- Release the sample carefully into a bucket.
- Repeat the process at least three times around the pit or lagoon creating a composite sample in the bucket.
- Use a ladle to stir the sample in the bucket to get the solids spinning in suspension. While the liquid is spinning,

take a ladle full and carefully pour into a sample bottle.

- Repeat again and take another sample until sample bottle is three-quarters full. Make sure the manure solids have not settled to the bottom of the bucket as each dipper is extracted; it is important to include the solids in the sample. Screw the lid on tightly.

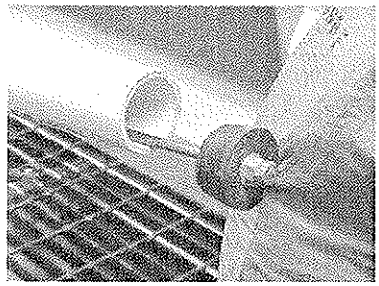

Figure 3. Rubber stopper attached to a metal rod to serve as a stopper for PVC manure sampling tube.

Pre-Sampling Nitrogen and Potassium from Liquid Manure

If the procedures described above for sampling liquid manure are impractical due to lack of sampling equipment, or the inability to agitate the manure, manure samples can be dipped off the top of stored liquid manure to analyze for N and K concentrations. Research has shown that top-dipped liquid samples represent approximately 90 percent of the N concentration measured in mixed, field-collected samples. Multiply the results of the N concentration from top-dipped samples by 1.1 for a better estimate of the N concentration of the liquid storage facility. Dipping a sample from the surface of a liquid storage pit does NOT provide a good estimate of P concentration in the pit and is not recommended.

How to Sample Dry or Solid Manure

In solid manure handling systems, many of which include bedding, the proportions of fecal matter, urine, and bedding will vary from one location to another within sites, and often from season to season as well. It is necessary to take samples from various places in the manure pile, stack, or litter to obtain a representative sample for analysis. It may even be beneficial to sample several times per year based on the bedding content.

Manure sampling is best done in the field as manure is applied. This ensures that losses that occur during handling, storage, and application are taken into account and that manure is better mixed, reducing stratification found during sampling storage facilities. As with field sampling of liquid manure, results will not be available in time to adjust current application rates. However, sampling during application will still allow producers to adjust any planned future commercial fertilizer rates and manure application in subsequent years. The following method describes a procedure for collecting dry or solid manure samples from the field.

Dry Manure Sampling During Land Application

Collect manure samples according to the following field sampling procedure.

- Spread a sheet of plastic or tarp on the field. A 10-feet-by-10-feet sheet works well for sampling manure.
- Fill the spreader with a load of manure.
- Drive the tractor and manure spreader over the top of the plastic to spread manure over the sheet.
- Collect subsamples as described below (Steps 1-3, Composite Sample Collection).
- Samples should be collected to represent the first, middle and last part of the storage facility or loads applied and should be correlated as to which loads are applied on certain fields to track changes in nutrient concentrations throughout the storage facility.

Sampling from Dry or Solid Storage Facilities and Open Lots

Manure should be sampled at the time of application, but if time and management practices prevent this, manure samples can be collected from the storage facility. Sampling from storages is not generally recommended due to difficulty in collecting a representative sample. Although solid manure storages are generally not fully enclosed and gases are somewhat diluted, always exercise caution when sampling from storage facilities. If you have to enter a confined storage facility, follow the safety recommendations described previously in the section on sampling liquid manure storages.

Open Paved Lots

Manure that accumulates on paved feedlots and is scraped and hauled to the field is classified as scrape-and-haul feedlot manure. Manure is usually removed from the feedlot daily or several times a week.

- Collect manure by scraping a shovel across approximately 25 feet of the paved feedlot. This process should be repeated ten or more times, taking care to sample in a direction that slices through the large-scale variations of moisture, bedding, depth, age, etc. (See Figure 4). Avoid manure that is excessively wet (near waterers) or contains unusual amounts of feed and hay.
- Use the shovel to thoroughly mix manure by continuously scooping the outside of the pile to the center of the pile.
- Collect subsamples from this pile using the hand-in-bag method that is described below (Steps 1-3 Composite Sample Collection).
- This may need to be done several times to collect several composite samples for analysis.

Figure 4. Sampling a feed-lot for manure sample.

Barn Gutter

Manure that accumulates in a barn or housing facility, is temporarily stored in a gutter, and then removed by a barn cleaner is classified as barn gutter manure. Manure is usually removed from the barn once or twice daily.

- Shovel a vertical "slice" of manure from the gutter, making sure the shovel reaches to the bottom of the gutter.
- Remove manure from the gutter and pile it on the barn floor. Mix the manure with a shovel or pitchfork to ensure that bedding is mixed thoroughly with manure. When collecting samples from a gutter, be sure to include the liquid that accumulates in the gutter's bottom. Discard foreign material and also take care not to add large amounts of barn lime.
- Repeat steps one and two from various locations along the gutter.
- Mix each pile thoroughly and collect subsamples from each pile using the hand-and-bag method that is described below (Steps 1-3, Composite Sample Collection).

Dry Stack and Manure with Litter

Manure that is stored outside in a solid waste storage facility, such as a stacking shed or horizontal concrete silo located above ground, is classified as a dry stack. These facilities are usually covered to prevent the addition of extra water. Dry

manure with litter should also be sampled in the following manner.

- Remove manure from 10 to 20 locations throughout the dry stack and place it in a pile using a pitchfork or shovel. Manure should be collected from the center of the stack as well as from near the outside walls, to get samples that represent all ages and moisture levels of manure in the stack. A bucket loader can cut a path into the center of the pile to provide access for sampling. Subsamples should be collected to the depth the litter will be removed for application.
- Thoroughly mix manure with the shovel by continuously scooping the outside of the pile to the center of the pile.
- Collect a composite manure sample as described below (Steps 1-3, Composite Sample Collection).

Composite Sample Collection for Dry or Solid Samples

1. Whether collecting from a plastic tarp in the field, a feedlot, a storage facility, or a barn, sample in a grid pattern so that all areas are represented. Combine 10 to 20 subsamples in a bucket or pile and mix thoroughly. More subsamples will produce more accurate results and are often required to produce a composite that best represents nutrient levels.
2. The final composite sample that will be submitted for nutrient analysis should be collected using the hand-in-bag method. To collect a composite sample from the mixed subsamples, place a one-gallon resealable freezer bag turned inside out over one hand. With the covered hand, grab a representative handful of manure and turn the freezer bag right side out over the sample with the free hand. Be careful not to get manure in the sealable tracks.
3. Squeeze excess air out of the bag, seal, and place it in another plastic bag to prevent leaks. Label the bag with your name, date, and sample identification number with a waterproof pen and freeze it immediately to prevent nutrient losses and minimize odors. For manure with a high degree of variability, multiple samples may need to be analyzed. Manure samples should be mailed or delivered to the laboratory as soon as possible after sampling.

Manure samples should be sent to a lab for chemical analysis as quickly as possible to avoid nutrient losses. For a list of commercial laboratories, please call your ISU Extension office or visit the Web at: http://extension.agron.iastate.edu/immag/sp.html.

Table 1. Conversion Factors

To switch from	Multiply by	To get
mg/l	1.0	ppm
ppm	0.0001	percent
ppm	0.00834	lb/1,000 gal
ppm	0.002	lb/ton
ppm	0.2265	lb/acre-inch
lb/1,000 gal	0.012	percent
lb/ton	0.05	percent
percent	83.4	lb/1,000 gal
percent	20.0	lb/ton
percent	2265	lb/acre-inch
P (elemental)	2.29	P_2O_5
K (elemental)	1.2	K_2O

Additional Information and Resources

Basic manure analyses determined by laboratories include total nitrogen, total phosphorus, and total potassium. Results from commercial laboratories are presented either as a percent of the sample weight, as pounds per ton, as pounds per 1,000 gallons of manure, or in parts per million (ppm). Table 1 shows factors used to convert between measurements. Usually, nutrients are expressed as N, P_2O_5, or K_2O on a wet or "as received" basis, but some labs may instead report data on an elemental (P instead of P_2O_5, K instead of K_2O) or dry (without water) basis; so, be sure to confirm the units. In any case, manure values from commercial laboratories express nutrients as the total amount of nutrient in the manure sample. Some primary nutrients, such as N and P, may not be completely available for plant growth the first year manure is applied. A portion of some nutrients present in manure are in an organic form and unavailable for immediate plant uptake. Organic forms require transformation to an inorganic form to be available for plant uptake. This transformation is dependent on temperature, moisture, chemical environment, and time. Availability of nutrients can be limited by field losses, which are affected by the type of manure and by manure application methods. These losses are not accounted for in laboratory results. Refer to the ISU Extension publication *Managing Manure Nutrients for Crop Production* (PM 1811) for nutrient availability estimates and losses due to types of manure application methods.

PM 1518k *Manure Storage Poses Invisible Risks*
PM 1941 *Calibration and Uniformity of Solid Manure Spreaders* (12/03)
PM 1948 *Calibrating Liquid Manure Applicators* (02/04)
PM 1811 *Managing Manure Nutrients for Crop Production*

Additional resources may be found on the Iowa Manure Management Action Group (IMMAG) Web page at: http://extension.agron.iastate.edu/immag/default.htm

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Section J: Mortality Disposal Actions

SECTION J. Livestock Mortality Management Plan

Mortalities will be disposed with an incinerator. The use of an incinerator to dispose of the carcasses uses propane or diesel. The ashes are land applied. Incinerators reduce carcasses to ashes. The Incinerator meets state requirements for burners and emissions. Minimum incinerator capacity shall be based on the average daily weight of animal mortality and the length of time the incinerator will be operated each day.

In the case of emergency when it may not be possible for the incinerator to keep up a proposed emergency burial site will be used.

The primary method of carcass disposal in the future may be In-Vessel Composter called a BIOvator.

The following is an Excerpt from Act 87 of 1963-Code 2-33-101 and Act 150 of 1985-Code 19-6-448 by the Arkansas Livestock and Poultry Commission

Carcasses may be buried at a site at least 100 yards away from a well and in a place where a stream cannot be contaminated. Anthrax carcasses are to be covered with 1 inch of lime. Other carcasses may be covered with lime, particularly when needed to control odors. All carcasses are to be covered with at least 2 feet of dirt. Carcasses are not to be buried in a landfill, without prior approval of the State Veterinarian.

Act 87 of 1963, Act 150 of 1985, and Act 522 of 1993: ***Disposal of carcass of animal dying from contagious or infectious disease.***

9141. Any person that has the care or control of any animal that dies from any contagious disease shall immediately cremate or bury the animal.

9142. An animal which has died from any contagious disease shall not be transported, except to the nearest crematory. The transportation of the animal to the crematory shall be pursuant to such regulations as the director may adopt.

9143. An animal which has died from any contagious disease shall not be used for the food of any human being, domestic animal, or fowl.

Section K: Livestock Feed Management

The Professional Animal Scientist 13:99–111

Environmental Nutrition: Nutrient Management Strategies to Reduce Nutrient Excretion of Swine

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Abstract

Intensive production of swine has brought an increase in the volume of manure produced on farms with limited land area. Exceeding the capacity of soil and crops to handle this volume of manure results in nutrient accumulation in and on the soil that can produce leakage of nutrients to the environment and pollution could result. Environmental nutrition is defined as the concept of formulating cost-effective diets and feeding animals to meet their minimum mineral needs for acceptable performance, reproduction, and carcass quality with minimal excretion of minerals. Pigs normally excrete 45 to 60% of N, 50 to 80% of Ca and P, and 70 to 95% of K, Na, Mg, Cu, Zn, Mn, and Fe when fed diets containing commonly used feedstuffs. Although it is not possible to make pigs 100% efficient in utilization of nutrients, it is possible to reduce the amount of nutrients excreted through careful nutrient management. Several strategies are possible for reducing nutrients excreted: 1) improvements in feed efficiency, 2) more accurate nutrient requirement information for animals and compositional data for feed ingredients, 3) reduced feeding of excess nutrients through overformulation, 4) feeding for optimal rather than maximum performance, 5) use of crystalline amino acids and high quality protein, 6) improving the availability of P and some other minerals, 7) use of phase feeding and separate-sex feeding, and 8) reduced feed waste. Some strategies have a much greater potential for reducing nutrients excreted than other strategies. In the future, diet formulation and feeding must be integrated into total production systems so that swine production systems are environmentally safe as well as economically viable.

(Key Words: Environment, Nutrient Management, Pigs.)

Introduction

Pigs traditionally have been fed to maximize performance with little or no regard for nutrients excreted. During the past decades, advances in genetics, nutrition, housing, physiology, disease control, and management have resulted in major improvements in the efficiency of swine production. Along with these improvements has been an increase in the size and intensity of production units to maximize the benefits from these improvements and to optimize the use of capital, labor, and facilities. This large increase in size of animal units, however, has led to an overall increase in environmental burdens, such as excessive amounts of waste and odor. Commercial swine production is an essential component of our food supply. However, this important agricultural enterprise is being restricted in some countries and will be restricted in other countries if solutions to the problem of manure disposal and odor control are not developed and implemented.

Because of the high nutrient content of manure, and thus fertilizing value, land application has been the major means of manure disposal. However, there are limits to the amount of manure that can be applied to the land because of nutrient build-up in and on the soil. The potential environmental impact of nutrient contamination of the environment is perceived as a major issue facing livestock producers in many countries (15, 19, 40, 90). A major concern for surface water quality is the eutrophication of lakes and streams (20), and P, not N, is the limiting nutrient for algae and other aquatic plant growth (75, 80). Also, an excessive build-up of nutrient levels in the soil is of long-term concern because of potential pollution through ground water and soil

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erosion and run-off, as well as a potential reduction in crop yield.

To avoid leakage to the environment and potential pollution, governments in many countries are passing legislation requiring nutrient management plans for each farm, thus the amount of manure that can be applied to the land is being regulated (35). Most states in the U.S. are starting to monitor farms where large numbers of food-producing animals are maintained on a small acreage. Coffey (15) has stated that technology does exist for concentrated production of livestock in an environmentally sound manner. However, he also said that even though good technology exists today, there are opportunities for reducing nutrients excreted, and thus reducing land requirements.

Managing manure in swine confinement systems has always been a problem, and it will be a much greater problem and challenge in the future because the volume of manure per production unit has increased as production units have increased in size and intensity. Also, environmental concerns have increased and will continue to increase in the future as indicated by all trade magazines and newspapers for livestock and poultry agriculture. Two equally important approaches must be taken in dealing with this challenge: First, the amount of nutrients being excreted must be reduced; and second, the nutrients that are excreted must be recycled in a manner that is not damaging to the environment. It was stated in 1981 by the Agricultural Research Council (4) that the concept of a minimum requirement of a mineral that sustains an acceptable standard performance of pigs needed to be developed and should be cost-beneficial. Environmental nutrition is defined as the concept of formulating cost-effective diets and feeding animals to meet their minimum mineral needs for acceptable performance, reproduction, and carcass quality with minimal excretion of minerals. This paper discusses methods of reducing nutrient excretion in manure as an important component of the solution to this environmental problem.

Assumptions and Nutrients of Concern

There are four basic assumptions in this concept of environmental nutrition. 1) All animals will excrete some nutrients; therefore, 100% efficiency will not be reached. 2) The total farm production system must be sustainable and nutrients should not become detrimental to the environment. 3) Manure is biodegradable — it is made up of various organic and inorganic nutrients and can serve as a source of nutrients for both plants and animals when managed properly. 4) Swine producers want to contribute to a healthy environment; consumers, however, must recognize that additional production costs may result and must ultimately be paid by them.

Digestion and retention coefficients for N and several minerals are given in Table 1 for various sizes of pigs. Generally, pigs only retain from 20 to 55% of the N consumed. The amount of Ca and P retained can vary from 20 to 72% with slightly more Ca retained than P. The retention of Mg, Na, and K vary from 5 to 38% of that consumed. The retention of Zn, Cu, Fe, and Mn is also low, with values ranging from 8 to 45% of the intake. Younger animals may be slightly more efficient than older animals, but there is also a larger database for the younger animals. Other factors can influence the retention of N and minerals. The amount of minerals retained as a percentage of intake decreases as intake increases. The retention of chemically bound forms of some minerals will be increased if they are released in the digestive tract. For example, phytase can enhance the retention of Ca, P, and Zn. Fiber is known to decrease the retention of some minerals. Therefore, the bioavailability of the mineral source will influence the retention of minerals.

Of the nutrients present in manure, N, P, K, and trace minerals (probably Cu and Zn) are of greatest concern. There is general agreement that P and N are currently the two elements in manure that limits the rate of land application, but there is disagreement as to which one is of greatest concern. In the Netherlands, manure disposal is a major concern on swine and poultry farms because of the small land base of these farms (28). However, within Dutch animal agriculture, the dairy and swine industries are the largest contributors to manure production. In the Netherlands, there are laws that regulate the amount and method of waste disposal. These regulations will become more restrictive by the yr 2000 (28).

Nitrogen is used as the base to regulate the amount of manure that can be applied to the land in many areas, including the U.S. However, in the future it is likely that N and P will be the nutrients that limit land application of manure in more intensive swine and poultry producing areas. Results of a recent livestock nutrient assessment in North Carolina (7) supports the position that P may well be the nutrient that determines the amount of manure that can be applied to many soils and crops. Barker and Zublena (7) reported that statewide animal and poultry manure could provide about 20% of the N and 66% of the P requirements of all nonlegume agronomic crops and forage. However, these researchers found that 3 of 100 counties in North Carolina had enough manure to exceed all crop N requirements, and 18 counties had enough manure to exceed crop P needs.

High P levels in the soil have also been reported for many states. Sweeten (86) estimated that for the 145.5 metric tons of manure produced annually by livestock and poultry in the U.S., pigs excrete about 23% of the P and poultry excrete about 13%. Dairy cattle excreted 12% of the total P in all manure. Sims (84) reported that

TABLE 1. Digestion and retention of nitrogen and minerals by different classes of pigs.

Minerals	Class or size of pigs			
	Young	Finishing	Gestating	Lactating
Nitrogen				
Digested, %	75 to 88	75 to 88	88	–
Retained, %	40 to 50	40 to 50	35 to 45	20 to 40
Calcium				
Digested, %	55 to 75	40 to 50	10 to 37	19 to 26
Retained, %	40 to 72	25 to 50	35	–
Phosphorus				
Digested, %	20 to 70	20 to 50	3 to 45	1 to 35
Retained, %	20 to 60	20 to 45	20 to 35	20
Magnesium				
Digested, %	20 to 45	28 to 38	14 to 21	7 to 18
Retained, %	20 to 38	15 to 26	–	–
Sodium				
Digested, %	–	35 to 70	–	–
Retained, %	–	13 to 26	–	–
Potassium				
Digested, %	–	60 to 80	–	–
Retained, %	5 to 10	10 to 20	–	5
Zinc digested, %	20 to 45	10 to 20	–	–
Copper digested, %	18 to 25	10 to 20	–	–
Iron digested, %	30 to 35	5 to 35	–	–
Manganese digested, %	17 to 40	8 to 18	–	–

Data for this table was adapted from Adeola (1), Adeola et al. (2), Apgar and Kornegay (3), Bruce and Sundstal (11), Coppoolse et al. (18), Dungelhoef et al. (29), Everts (32), Jongbloed (43), Jongbloed et al. (46, 47), Kornegay et al. (56), Kornegay (50), Kornegay and Kite (54), Kornegay and Qian (55), Lantzsch and Drochner (58), Lindemann et al. (62), Moore et al. (64), Näsi (66), Pallauf et al. (71, 72, 73, 74), Qian et al. (76), Swinkels et al. (87), Verstegen (91), Vipperman et al. (94), Yi et al. (98).

recent surveys reveal that several states had found greater than 50% of the soil samples tested for crop production to be rated high or excessive in P. These states include Maine, Connecticut, Delaware, Maryland, Michigan, Minnesota, Virginia, North Carolina, South Carolina, Ohio, Iowa, Idaho, Indiana, Illinois, Utah, Wisconsin, Wyoming, Arizona, and Washington. The impact of high P levels in the soil has been reviewed recently by Pierzynski et al. (75), Sharpley (79), Sharpley et al. (80, 81), and Crenshaw and Johanson (20). Phosphorus currently is the nutrient that regulates the amount of waste that can be applied to the land in some countries and will probably replace N in other countries, but in the long-term Cu and Zn may be of concern.

Soil analyses of a Sampson County, NC, bermudagrass pasture that was fertilized with swine lagoon effluent to satisfy N requirements showed approximately a 400% increase in P and Zn, a 100% increase in K, and a 300% increase in Cu to a depth of 91 cm during the 3-yr period of application (Table 2; 65).

Starting in 1978 through 1992, the application of Cu-rich pig manure (from pigs fed 255 ppm Cu as $CuSO_4$) at an average annual rate of 80 ton/acre (22.4% DM) to three soil types increased the soil DTPA (diethylenetriaminepentaacetic acid) extractable concentration of P, Cu, and Zn in the Ap and upper B horizon (D. C. Martens and E. T. Kornegay, unpublished data). The average annual rate of application per acre was 21.9 lb of Cu, 7.1 lb of Zn, and 378.6 lb of P. The application of a similar amount of Cu from $CuSO_4$ resulted in similar increases in Cu. For example, high quality deep core soil samples taken in the spring of 1996 revealed that the increases varied based on soil type and treatment (Table 3). There were 9.0-, 19.6-, and 3.6-fold increases in extractable Cu for silt loam (0 to 12 in), sandy loam (0 to 10 in), and clay loam (0 to 4 in) soils, respectively, in the Ap horizon when Cu-rich pig manure and $CuSO_4$ were added. There were 2.1-, 2.5-, and 2.6-fold increases in extractable Zn, respectively, when Cu-rich pig manure was added. Also, there were 2.4-, 5.7-, and 11.7-fold increases in extractable P, respectively, when Cu-rich pig manure was added. There were some increases in the upper B or A_2 horizons, but the magnitude of the increases was much less and the total concentration for all soils and treatments was much less. Little effect of treatments for the different soil types was observed below the upper B or A_2 horizon. The Cu (2.3 to 2.6 ppm) and Zn (16.8 to 20.3 ppm) concentrations of the grain grown on these soils were not changed. Corn ear leaf tissue had a slightly higher Cu concentration (113 to 172% of controls) but Zn concentrations were similar. Phosphorus was not measured in plant tissue and grain. Grain yield was not decreased by Cu application during any year on the three soil types.

Strategies for Reducing Nutrients Excreted

The following strategies for reducing nutrients excreted will be briefly discussed and examples given: 1) Improvement of feed efficiency; 2) Reduction of "overformulation" or nutrient excesses; 3) More accurate

TABLE 2. Soil analyses for a Sampson County, NC bermuda-grass pasture fertilized with swine lagoon effluent[a].

	P[b]		K[b]		Zn		Cu	
Depth	1990	1992	1990	1992	1990	1992	1990	1992
(cm)	(ppm)							
0 to 15	118	212	147	191	1.28	5.28	0.47	2.65
15 to 30	39	190	184	183	0.38	2.39	0.48	1.65
30 to 61	4	46	355	1389	0.20	1.38	0	1.78
61 to 91	3	14	298	797	0.26	1.02	0	1.21

[a]Swine lagoon effluent was added at a rate to meet the N needs of the bermudagrass pasture. Initial sample was taken June 28, 1990 and final sample taken December 2, 1992. Adapted from Mueller et al. (65).

[b]Assumed P_2O_5 contained 43.64% P and K_2O contained 82.98% K.

nutrient requirements of animals and compositional information for feed ingredients; 4) Feeding for optimal rather than maximum performance; 5) Use of crystalline amino acids and high quality protein; 6) Improvement of the availability of P and some other minerals; 7) Use of phase feeding and separate-sex feeding; and 8) Reduction of feed waste. Other strategies, such as controlling disease and parasites, providing a comfortable environment, and reducing stress are also very important and can lead to improved efficiency, but will not be discussed in this paper. Some strategies have a much greater potential for reducing nutrients excreted than others, and some strategies will be more applicable than others depending on the individual farm situation.

Improvement of Feed Efficiency. Improvements in overall feed efficiency can produce a major reduction in the excretion of nutrients. Coffey (15) reported that a reduction in the feed to gain ratio of 0.25 percentage units (i.e., 3.00 vs 3.25), would reduce N excretion by 5 to 10%. Henry and Dourmad (40) reported for growing-finishing pigs that for each 0.1 percentage unit decrease in feed to gain ratio there was a 3% decrease in N output. Feed efficiency can be improved in several ways: 1) Improvements in the genetic potential of animals can have a tremendous impact on feed efficiency. 2) Proper formulation of diets using high quality ingredients will also improve feed efficiency. 3) The use of certain processing and feeding methods can further improve feed efficiency. 4) Although sometimes controversial, the use of repartitioning agents can result in improvements in feed efficiency and major improvements in carcass muscling.

Reduction of Overformulation or Nutrient Excesses. The amount of nutrients excreted can be reduced by decreasing "overformulation" or the inclusion of excess levels of nutrients in the diet. Traditionally, the main consideration of diet formulation was to maximize the growth and health of the animal. Little concern was shown for excess nutrients excreted. Results of numerous surveys of the nutrient composition of diets being fed indicate that excesses of several nutrients continues to be included in the diet. Some nutritionists refer to these excesses as a safety factor. Excess nutrients may be included in the diet to account for the variability of nutrient composition of feed ingredients, or to make up for a lack of knowledge concerning the availability of the nutrients in the feed ingredients used. More recently, it has been argued that higher nutrient levels are required because of possible genetic differences in nutrient requirements. Whether this is true or not remains to be proven. Results of surveys reported by Cromwell (22) of the Ca and P recommendations of several universities and feed companies indicated that feeding excess P may be a common practice (Table 4). The average range of university recommendations were 110 to 120% of NRC (69) guidelines, whereas the average range of industry recommendations were 120 to 130% of NRC (69) guidelines. Spears (85) reported results of diets analyzed by the North Carolina Feed Testing Laboratory for sows and finishing pigs (Table 5). Excesses of most minerals were observed. The median levels as a percentage of NRC (69) guidelines were 140 to 192 for Ca, P, and Na; 390 to 525 for K and Mg; 334 to 776 for Cu, Fe, and Zn; and 770 to 3,100 for Mn. Minerals such as P, Cu, and Zn may be of greater environmental concern. Other surveys in the past have reported similar results of the inclusion of excess nutrients in the diet.

A large decrease in the excretion of minerals can be obtained by diet formulation to more accurately meet nutrient requirements. Latimer and Pointillart (59) reported that finishing pigs fed diets containing 0.5% P grew as fast and as efficiently as those fed 0.6% P, but P excretion was 33% less for pigs fed the lower level of P. Walz et al. (95) reported that supplemental amino acids (lysine, methionine + cystine, threonine, and tryptophan) improved protein retention of pigs fed a low protein diet (25% less than recommended by German guidelines); N excretion was reduced approximately 30%. The use of more precise composition and nutrient availability data for feed ingredients, and better defined nutrient requirements for animals, will allow for the formulation of diets that better meet the needs of the animal at the various stages of production. A reduction in the amount of excess

TABLE 3. Mehlich-3 extractable Cu, Zn, and P concentrations in three soil types after 16 annual applications of Cu-rich manure and $CuSO_4$.

			Cu			Zn			P		
Horizon	Depth	Class[a]	Control	Cu manure	Cu sulfate	Control	Cu manure	Cu sulfate	Control	Cu manure	Cu sulfate
	(cm)		(ppm[b])			(ppm[b])			(ppm[b])		
					Bertie						
A_p	0 to 29	fsl	4.3[d]	35.3[c]	42.1[c]	15.8[d]	32.7[c]	15.1[d]	295.0[d]	697.5[c]	295.0[d]
Upper B	30 to 61	fsl	0.4[d]	2.2[c]	1.5[c]	0.8[d]	1.6[c]	0.8[c]	9.1[d]	230.2[c]	11.9[d]
Lower B	62 to 86	fsl	0.4[c]	0.3[c]	0.3[c]	0.5[c]	0.4[c]	0.6[c]	0.8[c]	11.4[c]	0.1[c]
Upper C	87 to 112	sil	0.3[c]	0.2[c]	0.4[c]	0.4[c]	0.4[c]	0.4[c]	0.1[c]	0.9[c]	0.1[c]
Lower C	113 to 133	sil	0.2[c]	0.5[c]	0.4[c]	0.4[c]	0.6[c]	0.5[c]	0.1[c]	0.9[c]	0.1[c]
					Guernsey						
A_p	0 to 25	sil	3.1[d]	59.6[c]	62.2[c]	19.5[d]	49.4[c]	21.2[d]	176.3[d]	1011.7[c]	199.1[d]
Upper B	26 to 50	sic	0.6[d]	3.0[c]	1.6[cd]	1.1[d]	2.2[c]	0.8[d]	15.4[d]	83.2[c]	19.1[d]
Middle B	51 to 75	sicl	1.1[c]	0.7[c]	0.7[c]	0.9[c]	0.5[c]	0.5[c]	1.9[c]	1.2[c]	3.6[c]
Lower B	76 to 100	sic	0.6[c]	1.2[c]	1.4[c]	0.5[c]	0.7[c]	0.7[c]	0.1[c]	0.1[c]	0.1[c]
					Starr-Dyke						
A_p	0 to 11	sicl	14.8[d]	53.7[c]	54.2[c]	16.9[d]	43.2[c]	23.1[d]	38.3[d]	447.9[c]	77.2[d]
A_2	12 to 25	sic	1.8[d]	9.8[c]	9.2[c]	2.5[d]	7.6[c]	3.4[d]	0.2[d]	130.7[c]	0.3[d]
Upper B	26 to 50	c	1.0[c]	1.1[c]	1.2[c]	1.0[c]	0.9[c]	0.8[c]	0.1[c]	2.0[c]	0.1[c]
Middle B	51 to 75	c	0.5[c]	0.5[c]	0.5[c]	0.5[c]	0.4[c]	0.4[c]	0.1[c]	0.1[c]	0.1[c]
Lower B	76 to 100	c	0.8[c]	0.6[c]	0.7[c]	1.0[c]	0.5[d]	0.7[cd]	0.1[c]	0.1[c]	0.1[c]

[a]Fsl = fine sandy loam, scl = sandy clay loam, sil = silt loam, sicl = silty clay loam, and c = clay.
[b]ppm = mg/dm^3. Multiply mg/dm^3 (ppm) by 1.78 to get lb/acre.
[cd]Means on the same line with different superscipt letters are different ($P<0.05$).

nutrients fed will reduce the amount of nutrients excreted.

More Accurate Estimates of Animal Nutrient Requirements and Compositional Information for Feed Ingredients. Recommended nutrient requirements have been published for the various classes of pigs in a number of countries, including the U.S. (69), United Kingdom (4), Australia (78), Netherlands (12, 13), and France (42). However, these recommendations often vary and, in many cases, are only estimates for an "average" type of animal under "average" environmental conditions. Some of the variation in the estimated nutrient requirements developed by the different countries could be explained by differences in genetic potential, feeding methods, environmental conditions, ingredients used, animal response criteria, and even the philosophy of the authors. With the exception of P, nutrient requirements are generally based on the total nutrient rather than the available nutrient. In some cases, such as NRC (69), nutrient requirements are based on corn-soybean meal diets or diets with similar availabilities of nutrients as in a corn-soybean meal diet. Also, these requirements are often based upon the use of certain feed-grade mineral sources. In pigs, the use of the "ideal protein" concept as first proposed by ARC (4) is being developed and may be incorporated in a new revision of U.S. NRC nutrient guidelines for swine. Reassessment of "ideal protein" continues as indicated by recent publications (5, 6, 9, 33). Along with the use of ideal protein is the use of ileal digestibility values of amino acids (8, 61, 88), which allow for more precise dietary formulation when using a variety of feed ingredients.

Available nutrient requirements of animals can only be accurately met if the compositional data of feed ingredients are expressed on an available nutrient compositional basis. Thus, more knowledge of the availability of the nutrients in ingredients will be required to take the full benefit of more precisely balancing the needs of animals.

Pig type has changed during the last decade because of strong consumer pressure for leaner, heavier muscled carcasses. For example, the nutrient needs of the high lean growth lines of pigs may be greater than those of pigs with lower potential for lean growth. Daily feed intake could influence the percentage composition of nutrients required,

TABLE 4. Comparison of Ca and P requirements and allowances recommended by universities and feed companies[a].

Mineral	Growing-Finishing 20 to 50 kg	Growing-Finishing 50 to 100 kg	Gestation	Lactation
	(%)			
Calcium				
NRC (69)	0.60	0.50	0.75	0.75
1986 Survey[a]				
Universities	0.66	0.59	0.82	0.79
Feed industry	0.74	0.63	0.95	0.93
1988 Survey[b]				
Universities	0.64	0.58	0.84	0.84
Feed industry	0.73	0.62	0.93	0.90
Phosphorus				
NRC (69)	0.50	0.40	0.60	0.60
1986 Survey[a]				
Universities (n=25)	0.55	0.49	0.66	0.63
Feed industry (n=35)	0.60	0.52	0.77	0.76
1988 Survey[b]				
Universities (n=7)	0.54	0.49	0.68	0.68
Feed industry (n=21)	0.60	0.52	0.76	0.74

[a]Overfield (70) reported by Cromwell (22).
[b]Survey conducted in 1988 (Cromwell, 22).

and it may be necessary to increase the percentage composition if pigs eat less than the predicted feed intakes. However, most of this information must be developed and tested. Also, the requirements of barrows, gilts and boars are probably different, especially during the finishing phase of production.

Feeding for Optimal Rather than Maximum Performance. In the future, diets can be formulated so that animals perform at slightly less than maximum because the benefit of adding additional units of a nutrient to achieve maximum performance produces benefits at a decreasing rate. This practice increases nutrient costs per unit of performance improvement at an increasing rate as the animal approaches maximum performance. As the maximum response is reached, or as the performance curve reaches a plateau, a greater amount of the nutrient is required to get a change in the response (Figure 1). In a series of three trials, Combs et al. (16) fit asymptotic models of the effect of total Ca+P intake (varied above and below NRC recommended requirement) and days on test (weaning to market). Diminishing returns in response to Ca-P input are shown in Figure 2 for performance measurements. This principle of diminishing returns in response to nutrient input is not new. Heady et al. (38) reported that in 14 of 16 yr, swine diets formulated using the diminishing return concept would have produced greater profits than diets formulated for maximum gain. Diminishing returns were also observed when Kornegay (52) fit asymptotic models to combined data from a number of research trials conducted from 1969 to 1986 to evaluate the Ca+P needs of growing-finishing swine. More recently, Gahl et al. (34) reported that the most economical daily weight gain does not necessarily occur when daily weight gain is maximized and would change as feedstuffs and input costs change. Diminishing returns for N gain of pigs fed six levels of lysine from three supplemental sources (Figure 3) has been demonstrated by Gahl et al. (34); their paper includes a good discussion of the diminishing returns in response to nutrient input.

Another consideration in evaluating nutrient addition is the response criteria measured. It is well known that the amount of P required to maximize growth is less than the amount required to maximize bone integrity (69). Perhaps, from the perspective of animal well-being, attempts to maximize bone integrity are most important. But from an environmental perspective, attempts to maximize bone integrity results in excessive excretion of P (20). Combs et al. (17) observed that growing-finishing pigs fed diets that provided NRC (69) requirements for Ca and P maintained approximately 100% of maximum growth and feed efficiency, but approximately 120 to 130% of the NRC (69) Ca and P requirement was required to maximize bone development. Although maximizing bone development is not necessary for the production of a market pig, a more difficult question is how much bone development is required to prevent damage to the carcass during mechanical processing that occurs during slaughter. As the

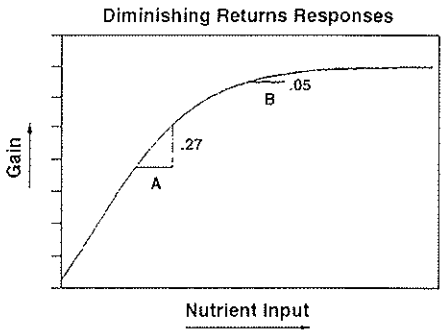


Figure 1. Example of diminishing returns for nutrient inputs as the level of nutrient fed increases. Adapted from Crenshaw et al. (21). At point A, one unit of input produces 0.27 units of gain, whereas, at point B, one unit of input produces 0.05 units of gain.

TABLE 5. Mineral concentrations in sow and finishing swine diets[a].

Minerals	Sow: Requirement NRC (69)	Sow: Range	Sow: Median[b]	Sow: Median requirement
Calcium, %	0.75	0.62 to 2.01	1.21	1.61
Phosphorus, %	0.60	0.45 to 1.17	0.84	1.40
Sodium, %	0.15	0.13 to 0.45	0.22	1.47
Magnesium, %	0.04	0.12 to 0.44	0.21	5.25
Potassium, %	0.20	0.43 to 1.15	0.78	3.90
Copper, ppm	5	12 to 222	22	4.40
Iron, ppm	80	162 to 698	376	4.70
Manganese, ppm	10	28 to 203	77	7.70
Zinc, ppm	50	79 to 497	167	3.34

Minerals	Finishing swine: Requirement	Finishing swine: Range	Finishing swine: Median[b]	Finishing swine: Median requirement
Calcium, %	0.50	0.57 to 1.38	0.96	1.92
Phosphorus, %	0.40	0.45 to 0.78	0.62	1.55
Sodium, %	0.10	0.13 to 0.29	0.19	1.90
Magnesium, %	0.04	0.13 to 0.21	0.16	4.00
Potassium, %	0.17	0.48 to 0.93	0.72	4.23
Copper, ppm	3	9 to 281	20	6.67
Iron, ppm	40	131 to 503	311	7.76
Manganese, ppm	2	37 to 160	62	31.0
Zinc, ppm	50	103 to 205	149	2.98

[a]Results are from analyses conducted recently at the North Carolina Feed Testing Laboratory (n=26 for sow and n=17 for finishing diets). Adapted from Spears (85).
[b]The median level for each mineral indicates that 50% of the sample analyzed were below and 50% were above the median value.

cost of disposing of P increases, the Ca and P levels fed will decrease. In the future, nutritionists will formulate for 95 to 98% of maximum response rather than trying to approach 100% of maximum response. Therefore, the industry will feed below rather than above the nutrient requirements of animals to maximize growth and bone development. How much of a safety margin will be desirable will depend upon the availability of accurate knowledge of the requirements and compositional information for the feedstuffs.

Use of Crystalline Amino Acids and High Quality Protein. The concept of ideal protein and the use of crystalline amino acids are now widely accepted. The use of crystalline amino acids in nonruminant feeding can substantially reduce the amount of N excreted without affecting performance (23, 41, 49, 89). Henry and Dourmad (41) and Van der Honing et al. (89) reported that N excretion can be reduced 15 to 20% when crude protein levels are reduced two percentage units and crystalline amino acids are added to correct amino acid balance. Cromwell (23) reported that the crude protein level of swine diets can be reduced about two percentage units (i.e., 14 vs 16% crude protein) by using crystalline lysine; this can result in a 22% decrease in N excreted (Table 6). The crude protein level of corn-soybean meal diets can be reduced about four percentage units (i.e., 10 vs 14% crude protein) by using four amino acids (lysine, threonine, tryptophan, and methionine); this can result in a 41% decrease in N excreted. After summarizing the results of 10 studies, Kerr and Easter (49) suggested that for each 1 percentage unit reduction in dietary protein combined with crystalline amino acid supplementation, total N losses (fecal and urinary) could be reduced approximately 8%. The use of low quality protein sources such as hydrolyzed hog hair meal, and high levels of crude fiber increase N excretion (50, 51). Also, as nonruminant animals are fed more precisely to meet their amino acid needs, feed efficiency will be improved, which can further reduce N excreted as well as the excretion of other nutrients.

Improve the Availability of P and Some Other Minerals. The amount of P excreted can be significantly decreased, if the availability of the bound (or unavailable) P, known as phytate P, in plants is improved. It has been demonstrated in pigs and poultry that the use of an exogenous enzyme, phytase, can improve plant P availability, thereby reducing P excretion. For example, in a corn soybean meal diet, commonly used for pigs and poultry, two-thirds of the P is bound and is unavailable (24). However, by using the appropriate amount of microbial phytase, 20 to 50% of the bound P can be released and made available to the animal. Thus, the amount of inorganic P that must be added to meet the P requirement is reduced. If total dietary P levels are decreased, then the amount of P excreted can be decreased 20 to 50% (27, 46, 47). Estimates of reductions in fecal P resulting from different levels of supplemental phytase representing 25 studies and 17 references (26, 29, 30, 31, 37, 39, 55, 60, 63, 66, 67, 68, 72, 82, 83, 93, 96) were used in a data set (Kornegay, unpublished data) to determine the relationship between supplemental phytase levels and fecal P reduction.

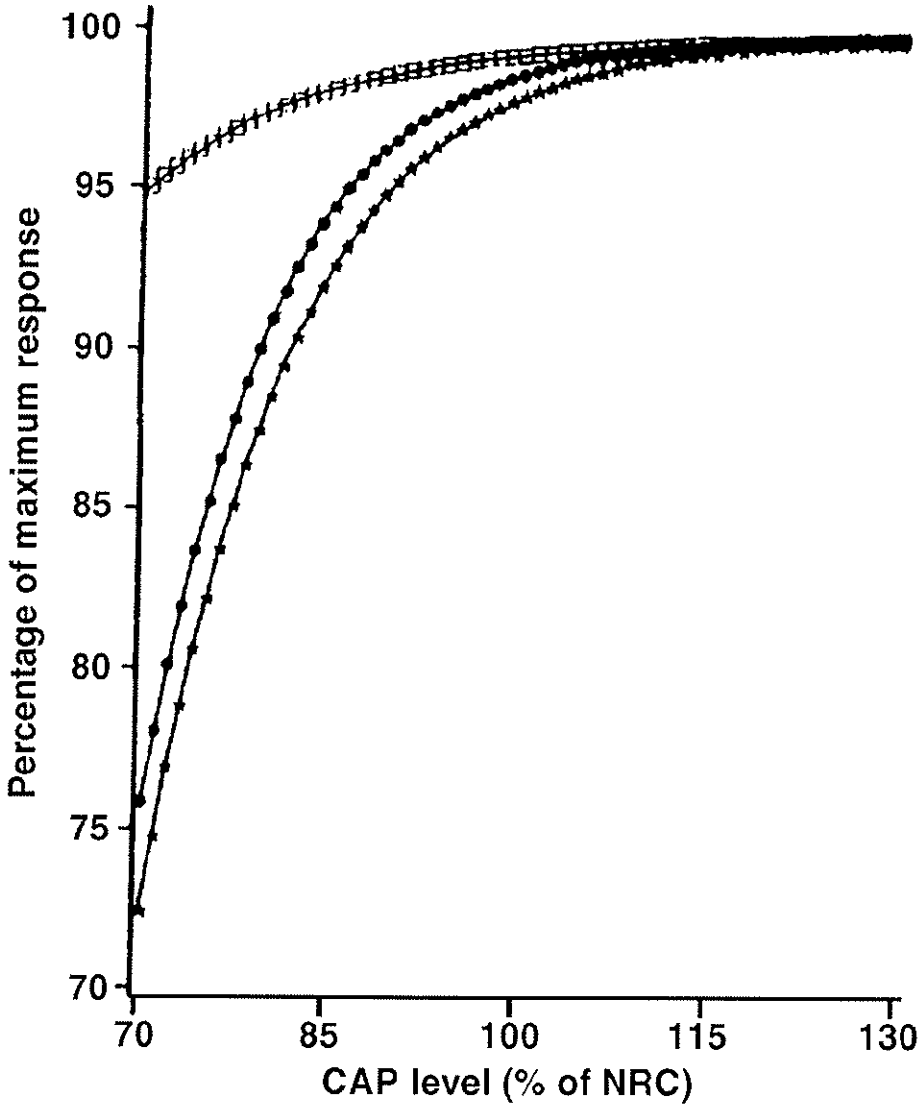


Figure 2. Percentage of maximum average daily gain (*) average daily feed intake (•) and gain:feed ratio (□) associated with each increase in average daily Ca and P (CAP) intake for growing-finishing pigs. Taken from Combs et al. (16).

The model included study as a fixed effect and the linear and quadratic effects of phytase level (units per kilogram). The quadratic effect was not significant ($P<0.97$) and was removed from the model used to derive the following equation: $Y = 25.57 + 0.0106X$, $R^2 = 0.95$, where Y equals the fecal P reduction (percentage of adequate P level), and X = supplemental phytase level (units per kilogram). Based on this equation, 500 U/kg of dietary phytase would result in a 30.9% decrease in fecal P, which is higher than 21.5% observed in a recent growing-finishing study (37). Assuming that a 21% reduction in P excretion results in a similar reduction in P content of land applied manure, then 21% less application area would be needed under a given P loading rate.

The nutritional, environmental, and economic considerations for using phytase in pig and poultry diets were recently reviewed (53). Based on response surface equations and nonlinear and linear equations calculated from the data, it was concluded that the magnitude of the response to microbial phytase is influenced by the dietary level of available P (and total P including phytate P), the amount of phytase activity added, and the Ca to available P ratio. Currently in the U.S., based on replacement values of inorganic P by microbial phytase calculated from nonlinear and linear equations, the cost of adding phytase range from one to three times the cost of an equivalent amount of inorganic P (53). This cost, however, does not include any cost for P disposal. Based on a representative feeder-to-finish swine farm generated from the Duplin County, NC Swine Database, Zhu et al. (99) estimated that for a 20% reduction in P excretion, with the inclusion of 500 U/kg of phytase, the savings in manure disposal cost would be $0.42 per hog with a net advantage of $0.16 per hog for using phytase. A genetically engineered microbial phytase is now being marketed in the several countries, including the U.S. The addition of microbial phytase to high phytate diets also releases Ca (57, 77, 78, 92), Zn (10, 60, 96), and some amino acids (48, 97) that may be bound by the phytate complex.

Use of Phase Feeding and Separate-Sex Feeding. The requirement of animals for most available amino acids and minerals, expressed as a percentage of the total diet, decreases as the animals grow heavier. Phase feeding, as some have described it, is a way to more precisely meet the nutrient needs of growing and finishing pigs. This concept applied to dietary crude protein is illustrated in Table 7 and Figure 4. It is known that nutrient requirements change (perhaps weekly) as pigs grow; if a producer is able to change the formulation of the diet as the nutrient requirements change, then the nutrient needs of the animal can be met more precisely, thereby, reducing the total quantity of nutrients excreted. Henry and Dourmad (41) reported that N excretion could be reduced approximately 15% when

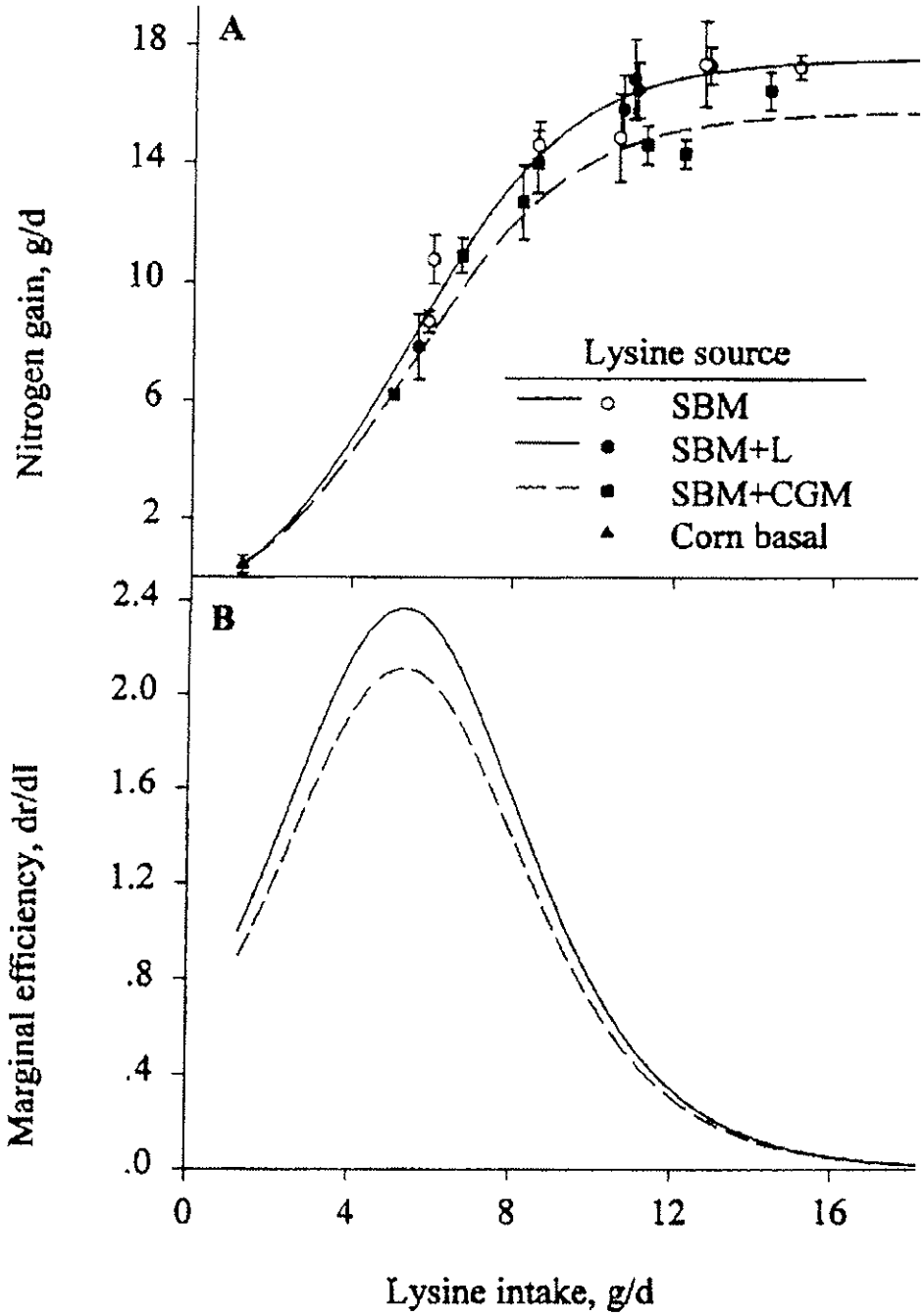


Figure 3. Diminishing returns in nitrogen gain (grams per day) of pigs fed diets with graded concentrations of lysine. Panel A: Predicted curves estimated using a logistic equation. Data points ± SE (n = 4) for each treatment group. Panel B: Marginal efficiency of nitrogen gain with respect to lysine intake calculated as the first derivative of the predicted curves in Panel A. Marginal efficiency is defined as the incremental response in nitrogen gain to an incremental unit of lysine intake. Taken from Gahl et al. (34).

the feeding of 14% CP diet was initiated at 60 kg body weight, rather than the continuous feeding of 16% CP grower diet to market weight. In a further study, Chauvel and Ganier (14) reported a 9% reduction in N excretion between a multiphase system in which the proportions of an 18.9 and 14.9% CP (4.1 and 2.6 g digestible lysine/Mcal net energy, respectively) were changed weekly from 24 to 107 kg vs a two-phase system, in which an 18.1% CP (3.6 g lysine/Mcal net energy) diet was fed to 66 kg and a 16.1% CP (3.1 g lysine/Mcal net energy) diet was fed to 107 kg. Also, the excretion of P and other minerals would be reduced a similar amount, if the finishing diet contained a lower level of these minerals. Henry and Dourmad (41) suggested that this change could be made gradually by changing the ratio in which a "high" protein and P (and other minerals) grower diet is mixed with a "low" protein and P (and other minerals) finishing diet.

Separate-sex or split-sex feeding of swine can further improve feed efficiency. It is well established that gilts consume less feed on an ad libitum basis and require greater diet nutrient density than barrows (25). By penning and feeding gilts and barrows separately, producers can more precisely formulate diets for specific sexes and avoid overfortification and excessive excretion of nutrients. Furthermore, increased fat deposition and decreased rate of lean deposition occurs at an earlier growth stage in barrows than in gilts; therefore, dietary protein and amino acid levels can be more precisely changed at different growth stages for each sex. Under such precise feeding conditions, the total quantity of N and other minerals fed and excreted can be reduced.

Reduction of Feed Waste. Another simple, yet sometimes difficult and overlooked way to improve feed efficiency is to improve design and operation of feeders, so that feed waste is minimized. Studies have shown that feed waste accounts for up to 3 to 8% of the feed fed. The impact that feed waste has on feed efficiency and income loss, as well as the amount of N and P excreted in pigs is shown in Table 8 (36). A 5% level of feed waste can result in an income loss of $1.77 per market pig depending on market condition, and an additional 327 g of N and 82 g of P excreted per pig. The use of proper feeder designs, regular maintenance,

TABLE 6. Theoretical model of the effects of reducing dietary protein and supplementing with amino acids on N excretion by 90-kg finishing pigs[a].

N balance	14 % CP	12% CP + Lys	10% CP + Lys + Thr + Trp + Met
N intake, g/d	67	58	50
N digested and absorbed, g/d	60	51	43
N excreted in feces, g/d	7	7	7
N retained, g/d	26	26	26
N excreted in urine, g/d	34	25	17
N excreted, total, g/d	41	32	24
Reduction in N excretion, %	–	22	41

[a]Assumes an intake of 3,000 g/d, a growth rate of 900 g/d, a carcass lean tissue gain of 400 g/d, a carcass protein gain of 100 g/d (or 16 g of N/d), and that carcass N retention represents 60% of the total N retention. Adapted from Cromwell (23).

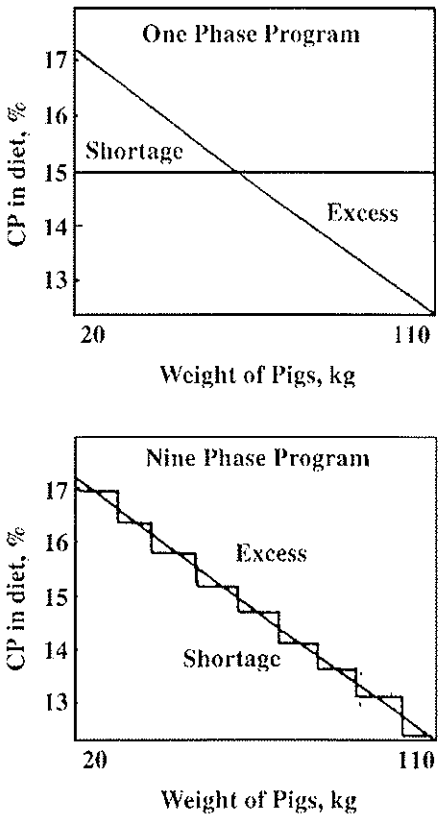


Figure 4. Example of a one phase and a nine phase feeding program for the growing and finishing phase.

TABLE 7. Effect of feeding strategy during the growing-finishing period (25 to 105 kg) on N output[a].

Item	Single-feed 17% CP	Two-feeds[b] 17-15% CP	Three-feeds[c] 17-15-13% CP
N output, g/d	31.9	29.0	26.7
Percentage of two-feed strategy	110	100	92

[a]Adapted from Henry and Dourmad (40).
[b]Crude protein changed at 55 kg.
[c]Crude protein changed at 50 and 75 kg.

TABLE 8. Feed waste impacts on nutrient management[a].

Feed waste	Feed loss per pig	Income loss per pig	Feed N waste per pig	Feed P waste per pig
(%)	(kg)	($)	(g)	
1	2.8	0.36	63	18
3	8.2	1.07	195	50
5	13.6	1.77	327	82
7	19.1	2.48	459	114

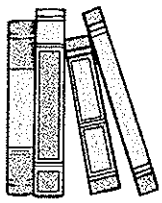
[a]Based on growing-finishing pigs from 22.7 to 113.5 kg body weight, 3:1 feed:gain ratio, 2.4% N and 0.60% P in the diet and $0.13/kg diet cost. Adapted from Harper (36).

and careful adjustment of feeders is essential for the prevention of excessive feed waste.

Conclusions

As swine production units have become larger and more intensive, the need for environmentally sound methods to use and dispose of excreted nutrients has increased. Safe and effective disposal of waste nutrients in swine production depends on reducing the quantity of nutrients excreted by the animals coupled with recycling of the excess nutrients in a manner that is not harmful to the environment. In the future, swine feed formulators must focus on optimizing swine performance while reducing or minimizing nutrient excretion. This review describes existing and emerging

technologies that would allow this goal to be achieved. Some individual technologies will have a greater impact on reduced nutrient excretion than others. Furthermore, employing these technologies together in an environmental nutrition approach to swine feeding has the potential to significantly reduce excess nutrients for disposal in swine production.



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Section K: Livestock Feed Management

Section L: Odor Control

RECOMMENDED STRATEGIES FOR ODOR CONTROL IN CONFINEMENT SWINE OPERATIONS

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Summary:

Odors coming off a swine facility are generated from three different sources: the unit itself, from the storage facility, or the land on which the manure is applied.

To reduce the total amount of odor generated from a swine facility, odor generation and emission by each of these three sources needs to be reduced. Within each area, several options for odor reduction are available. Practices that have been proven to be effective and that can be immediately implemented are listed in Table 1. Other options are being developed or tested. Research into these practices will reveal whether or not they can be successfully implemented in the future.

Table 1 is organized in four sections covering practices that:

1. reduce odor generation in barns,
2. reduce odor emission from facilities and storage units,
3. increase odor dispersion, and
4. reduce odor emission from manure application.

For each practice, advantages and disadvantages are listed. The effectiveness and the cost of implementing each practice is indicated using odor generation from a standard swine facility as a base line. This unit is assumed to be constructed using state-of-the-art recommendations including deep pits or an uncovered manure storage facility, curtain sidings or mechanical ventilation, and no dietary modifications to reduce odor generation.

To obtain an overall reduction in odors from a facility, reductions need to be made in odor generated by the unit itself, the storage facility, and from land application.

Some practices listed in Table 1 are best management practices (BMP). These are practices with well-documented beneficial effects on sustainability of a production system. Their implementation should be encouraged even without considering their potential for odor reduction.

The cost of each practice is indicated. A "low" cost is assumed to be less than $0.50 per GF pig produced ($1.25/Animal Unit); "moderate" is assumed to add $0.50-$1.50 per GF pig produced ($1.25-3.75/Animal Unit), and "high" is assumed to add more than $1.50 per GF pig produced ($3.75/Animal Unit) to total production costs, as compared to the base line unit.

Conclusions and Recommendations

A number of practices are available to reduce odor from swine facilities. A reduction in odor coming off a swine facility is achieved only if the odors emitted by the unit itself, from the storage facility, and from the land application of the manure are reduced.

At this time, the following practices are recommended:

1. The odor from the unit itself can be reduced by a combination of dietary practices and the installation of a biofilter.
2. The odor from the storage facility can be reduced by installing an effective lagoon cover. In larger units this may be combined with a manure separator and (or) a methane digester.
3. The odor from the land application of manure can be reduced by injecting the manure into the soil.

Research into odor reduction is ongoing, and many new technologies are being developed. As independent research using these technologies becomes available, some of these technologies may prove to be even more effective than the ones listed in the table. SDSU swine research being conducted at the Southeast Research Farm near Beresford has demonstrated that biofilters reduce odor emissions from confined buildings by 96%.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the USDA. Larry Tidemann, director of CES, associate dean, College of Agriculture & Biological Sciences, South Dakota State University, Brookings. South Dakota State University is an Affirmative Action/Equal Opportunity Employer and offers all benefits, services, education, and employment without regard for race, color, creed, religion, national origin, ancestry, citizenship, age, gender, sexual orientation, disability, or Vietnam Era veteran status. SZZ803-B: Printed at cost of $.16 each.

Table 1: Odor Reduction Practices for Swine Operations

Section 1: Reduce generation of odor						
Practice	Description	Advantages	Disadvantages	Effectiveness	Cost	Comments
a. Low protein diets	Diets are lowered 3-4% in CP compared to NRC rec. Crystalline AA are added to diets so that AA levels follows NRC rec	Avoid overfeeding CP. Fewer problems with enteric diseases in pigs. Reduced N in manure, reduced ammonia emission	Reduced consumption of byproducts and alternative ingredients	Moderate	Low. (Sometimes the cost of LP diets are actually lower than regular diets)	Cost offset by increased productivity and more efficient nutrient use. Should be considered a BMP
b. Low sulfur diets	Diets using no micro-minerals on sulfate form and no excess sulfur containing AA	Reduced production of H_2S	Some restrictions apply to the mineral sources that can be used	Moderate	Low	Should be considered a BMP
c. Phase feeding	Diets are changed frequently during the production phases to match the nutrient requirement of the pigs	Overfeeding and underfeeding with nutrients can be reduced	More diets are required on the farm	Low	Low	Should be considered a BMP
d. Precision diet formulation	Diets are formulated based on digestible contents of amino acids and minerals and the net energy content of the diets. Also, the ideal protein concept is used in diet formulation	Diets that more precisely match the requirement of the animals can be formulated. Reduction of excess nutrients in diets and thus in manure	Research is needed to establish digestible contents of nutrients in feed ingredients and the animals requirements for digestible nutrients	Low	Low	At least 3-5 years of research needed before concept can be implemented
e. Pelleting diets	All diets used in the operation are pelleted prior to use	Reduces dust generation and decreases amount of feed wasted in the manure pit	None	Low	Low ($10/ton for mixing, this cost offset by increased nutrient digestibility)	

Table 1. Odor reduction practices for swine operations (cont.)

Section 2: Decrease Emission of Odor						
Practice	Description	Advantages	Disadvantages	Effectiveness	Cost	Comments
a. Flush systems for manure removal	Removes manure frequently by flushing all the pits	Effective in reducing emission from pit	Increased labor, need for outside storage	Moderate	Moderate	
b. Pit systems w/ reduced manure surface	Sloped bottom of pits make sure manure surface is reduced	Reduces emission from pits	None	Moderate	Moderate	Usually combined with increased flushing
c. Oil spraying	Vegetable oil sprayed in facilities at regular intervals	Bound dust also odors present in the dust	More slicky surface	Moderate	Moderate	Reduces health risk for human workers in barns
d. Biofilters	Air exhausted through a biofilter made from organic material that captures the odors. Clean, odorless air is released.	Very effective. Simple to construct. Environmentally friendly	Building design. Aesthetics	High	Low to moderate	Odor reduced by 96% in SDSU research. Cannot be used with curtain-sided barns
e. Storage additives	Additives added to manure storage facility	Supposed to reduce odor generation	Not a proven technique	Low	High	Questionable technique
f. Rigid manure storage covers	Mechanical cover is applied to the manure storage unit	Very effective	Can be costly	High	High	
g. Flexible manure storage cover	Flexible material applied on top of storage facility. May be textile or plastic membrane or floating clay balls		Can cause problems when agitating manure, support structure may be needed	High	Moderate	Several different materials can be used
h. Biodegradable manure storage cover	Straw is applied on top of storage facilities	Inexpensive	Needs to be filled every three months. More difficult to agitate storage unit	Moderate	Low	Effectiveness highly dependent on how the cover is managed
i. Manure separators	Separates manure into a solid and a liquid fraction	Decreases odor generation from storage	Relatively expensive, only applicable to large operations	Moderate	High	More effective separators are available in Europe
k. Methane digesters	Treat waste with 3 to 10% total solids. Biogas methane production from manure	Manure treatment can decrease odor at application time. Generation of electricity can help pay for treatment costs	Costs: $250,000 O + M = $7,500/year Cost effectiveness dependent on contract with electrical company.	High	High	May be combined with manure separators

Table 1. Odor reduction practices for swine operations (cont.)

Section 3: Increase Dispersion of Odor						
Practice	Description	Advantages	Disadvantages	Effectiveness	Cost	Comments
a. Shelterbelts	Create a vegetation barrier for dust and odorous compounds emitted from the building exhaust	Cost. Environment. Aesthetics	Requires planning and time	Low	Low	
b. Windbreak walls	Solid or porous wall constructed 10 to 15 feet from the exhaust fans will cause dust to settle	Rapid implementation	Cost. Aesthetics	Low	Low to moderate	
c. Setback distances	Optimize distance between odor emission sources and urban areas.	Cost.	Not applicable for facilities currently in operation	High	Variable	Effectiveness can be calculated through the OFFSET model (Univ. of Minn.)

Section 4: Land Application of Manure						
Practice	Description	Advantages	Disadvantages	Effectiveness	Cost	Comments
a. Manure injection or incorporation	Manure injected directly into soil. Can be done in pasture or bare soil or into a growing crop	No emission of odors from manure when applied to soil	Takes more horsepower and more sophisticated equipment	Very high	Low	Should be considered a BMP

Section M: Waste Storage Pond Pumping Plan

SECTION M. MANAGEMENT OF WASTE STORAGE PONDS

Waste Storage ponds are an efficient and practical means to collect and store manure effluent from a confined livestock farm. A properly designed pond must store, at a minimum 180 days of manure effluent including a 25 year 24 hour storm event. Waste storage ponds should never be full and always have sufficient storage for the next precipitation event.

Runoff collected from the livestock farm contains various amounts of manure nutrients, bacteria, and other materials. Every livestock operation is unique when taking into account the amount and intensity of different rainfall events, and number and species of animals.

Livestock operators have difficulty in dealing with the collected wastewater when there are larger than normal amounts of runoff. Operators can find themselves faced with full waste storage ponds and often less than ideal conditions for land applying or otherwise utilizing the wastewater.

Producers who operate a facility with a waste storage pond must be ready to handle emergency situations when the pond may become full or near overflowing. Eliminating pond overflows is a critical factor in reducing pollutants from entering streams and other water bodies.

Following are important recommendations to implement when operating a facility with a waste storage pond:

- Foremost, routinely monitor the level of the pond to assure there is enough storage remaining (plus freeboard) to hold the designed volume of a 25 year 24 hour storm event. This must Pumpdown level should be marked with a permanent depth gauge in the pond. If wastewater is above this line, the operator normally must pump the pond down below this level within 14 pump-able days.

- Plan ahead and develop a pumping plan. Identify specific fields and equipment needs for the pumping plan.

- Consider using cropping practices that will expand the "window of opportunity" for land application during the growing season. Decide on field access alternatives during wet weather conditions.

- Review and follow the Operation & Maintenance (O & M) guidelines provided with your manure management system design and constructions plans.

- Contact the Arkansas Department of Environmental Quality (501-682-7890) within 24 hours concerning a wastewater discharge.

Plan for Pumping Waste Storage Ponds

Operator Name C&H Hog Farms **Date** 01/24/15

County Newton **Pond ID or Legal Description** Waste Storage Pond 1 & 2

- **Method Selected for Land Application of Wastewater**

  _X_ Pipeline/Sprinkler System (Permanent): *Waste Storage Pond 2*
  _____ Big Gun Sprinkler (Temporary)
  _____ Drag Hose System
  _X_ Tank Wagon: *Waste Storage Pond 1 and 2*
  _____ Other (Explain)

- **Pre-Arranged Source of Application Equipment (List all necessary equipment and access to it).**

Type Equip.	Obtain Where
Pump	Proposed to Field 5-9
Pipe	Proposed to Field 5-9
Sprinkler	Proposed to Field 5-9
Vac Tanker	Fields 1-4 and 7-17

- **Fields Available for Land Application of Wastewater in an Emergency**

Legal Description	Landuse	Acres Available	Predom. Soil
Sec. 26, T15N, R20W	Grass	74.3	48

- **Holding Capacity of Ponds at Must Pumpdown Level** 2,469,903 **gallons**
  Bottom of 25-year, 24-hour storage level. Pond is to be pumped within 10 days below level.

- **Holding Capacity of Ponds at High Water Line** 3,495,464 **gallons**
  Top of 25-year, 24-hour storage level (bottom of freeboard)(Includes Concrete Pits).

- **Holding Capacity of Ponds between Freeboard and Must Pumpdown Elevation** 35,564 **gallons**
  Bottom of freeboard- Must Pumpdown Elevation.

- **Application Rates**

  The fertilizer value of wastewater in waste storage ponds is variable. Prior to land application, it is recommended to collect a representative sample from the pond and sent to a testing laboratory for analysis. If time does not permit waiting for test results, estimates of the nutrient content can be made from data previously collected at other facilities or from publications.

The land application rate should be calculated based on (1) the nutrient content of the wastewater, (2) current soil tests, (3) crop needs and (4) the water intake capacity (inches/hour) of the soil if an irrigation system is used.

For more information and/or assistance in calculating application rates, contact your local NRCS and Conservation District Office.

Section N: Record Keeping and Land Application Log Forms

SECTION N. LAND APPLICATION LOG FORMS

The following log forms are enclosed:

1. Manure Source Details
2. Annual Report Form For Permitted Confined Animal Facilities
3. Previous Manure Applications and Nitrogen Credits
4. Calculating Residual/Supplemental Nitrogen Amounts
5. Fertilizer Recommendations and Crop Requirements
6. Determining the Manure Application Rate
7. Animal Waste Land Application Record For Permitted Confined Animal Facilities

Manure source details

Storage identification _____

Manure form (solid/liquid) _____

Year	Manure Analysis						Sample ID/Date	Estimated Volume to be Spread	Actual Volume Spread
	Total N	Organic N	Ammonium N	P2O5	K2O	% Moisture Content		ton or gal	ton or gal
	lb/ton, or lb/1000 gal								
CALCULATION/ REFERENCE:		(1)-(3)	(1)-(2)						AE-1188
COLUMN:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

Arkansas Department of Environmental Quality
Permits Branch, Water Division
5301 Northshore Drive
North Little Rock, AR 72118

ANNUAL ANIMAL WASTE LAND APPLICATION REPORT

PERMITTEE NAME: _____ **PERMIT NUMBER:** _____

Field Name or/and Number	Crop Type	Total* Area Applied (acres)	Total** Volume Applied (gallons)	Total*** Nitrogen (lbs/1000 gal.)	Calculated Nitrogen Applied (lbs/ac)
(1)	(2)	(3)	(4)	(5)	(6)

* Total available area is the area where manure was applied during the reporting period (this data can be obtained from the management plan).
** Total volume applied is the total volume applied to the field during the whole reporting period (this data can be obtained from record sheet).
*** Total Nitrogen concentration (lbs/1000 gallons) can be obtained from the wastewater analysis sheet.

Column (6) = Nitrogen Applied (lbs/ac) = Column(4) X Column(5) ÷ Column (3) ÷ 1,334

NOTE: You may make additional copies of this table as needed.

Mail complete annual report form and annual application report to:
Arkansas Department of Environmental Quality
Permits Branch, Water Division
5301 Northshore Drive
North Little Rock, AR 72118

Previous manure applications and nitrogen credits.

Date / /

Field	Nitrogen credit from application before last season's crop				Nitrogen credit from application before crop 2 seasons ago				Previous Manure Credit (PMC)
	Manure N Analysis lb/ton or lb/1000 gal	Application Rate ton/a or 1000 gal/a	% Available (Year 2)	N Credit lb/a	Manure N Analysis lb/ton or lb/1000 gal	Application Rate ton/a or 1000 gal/a	% Available (Year 3)	N Credit lb/a	lb/a
CALCULATION/ REFERENCE:	AE-1189 SHEET 1, COL 1	AE-1189 SHEET 2, COL 4	TABLE 2	(1)x(2)x(3)/100	AE-1189 SHEET 1, COL 1	AE-1189 SHEET 2, COL 4	TABLE 2	(5)x(6)x(7)/100	(4)+(8)
COLUMN:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

Calculating residual/supplemental nutrient amounts

Date / /

Field	Actual Application Rate	Actual Manure Analysis			Actual Nutrient Application Rate			Difference			Years to Next Application	
		N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O	P2O5	K2O
	ton/a or 1000 gal/a	lb/ton, or lb/1000 gal			lb/a			lb/a			lb/a	
CALCULATION/ REFERENCE:	AE-1189				(1)X(2)X SHEET 3, COL 7/100	(1)X(3)X SHEET 3, COL 8/100	(1)X(4)X SHEET 3, COL 9/100	(5)-SHEET 3, COL 1	(6)-SHEET 3, COL 2	(7)-SHEET 3, COL 3	(6)/SHEET 3, COL 2	(7)/SHEET 3, COL 3
COLUMN:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)

Fertilizer recommendations and crop requirements.

Date / /

Field	Crop	Target Yield bu/a, ton/a or lb/a	Nitrogen Requirement lb/a	Soil Test Nitrogen (STN) lb/a	Sampling Date Adjustment (SDA) lb/a	Previous Crop Credits (PCC) lb/a	Previous Manure Credit (PMC) lb/a	Nutrient Requirements lb/a		
								Net N	P2O5	K2O
CALCULATION/ REFERENCE:			SF 882	SF 882	SF 882	SF 882	SHEET 1, COL 9	(3)-[(4)+(5)+6)+(7)]	SF 882 or TABLE 4	SF 882 or TABLE 4
COLUMN:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

Determining the manure application rate.

Date / /

Field	Nutrient Requirement			Estimated Manure Analysis			% Availability			Nutrient Available			Target Manure Application Rate		
	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
	lb/a			lb/ton, or lb/1000 gal			%			lb/ton, or lb/1000 gal			ton/a, or lb/1000 gal		
CALCULATION/ REFERENCE:	SHEET 2, COL. 8	SHEET 2, COL. 9	SHEET 2, COL. 10	AE-1189 SHEET 1, COL. 1	AE-1189 SHEET 1, COL. 4	AE-1189 SHEET 1, COL. 5	TABLE 2	TABLE 3	TABLE 3	(4)X(7) /100	(5)X(8) /100	(6)X(9) /100	(1)/(10)	(2)/(11)	(3)/(12)
COLUMN:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)

ANIMAL WASTE LAND APPLICATION RECORD FOR PERMITTED CONFINED ANIMAL FACILITIES

PERMITTEE:_____ PERMIT NUMBER:_____

APPLICATION METHOD:_____

Field Name or/and Number	Date Applied	Crop Type	Area Applied (acres)	Volume Applied (gallons)

NOTE: Facility record; **DO NOT MAIL THIS**; Keep this record at the facility.
Make additional copies of this table as needed.

From:	C H Hog Farms, Inc.
To:	Bailey, John; Water Permit Application; Yarberry, Katherine
Cc:	Richard Gray; David Brown (Cargill Pork Production)
Subject:	NMP Modification Request for C & H Hog Farms - Utilization of Waste Storage Pond 2 - Email #1
Date:	Thursday, February 26, 2015 4:19:30 PM
Attachments:	Signed 2-26-15 Letter to ADEQ re Major Modification - Utilization of Pond 2.pdf Signed 2-26-15 Revised NOI.pdf

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C & H Hog Farms is in receipt of ADEQ's incompletion letter pertaining to our modification request for the utilization of Waste Storage Pond 2.

Please see the attached letter. A revised Notice of Intent (NOI) is included in this email. A full copy of the revised NMP is also being sent; however, due to the size of the document, the NMP has been broken into sections and will be emailed in separate, subsequent emails.

Thank you for reviewing this request.

Regards,
Jason Henson

From:	C H Hog Farms, Inc.
To:	Bailey, John; Water Permit Application; Yarberry, Katherine
Cc:	Richard Gray; David Brown (Cargill Pork Production)
Subject:	NMP Modification Request for C & H Hog Farms - Utilization of Waste Storage Pond 2 - Email #2
Date:	Thursday, February 26, 2015 4:20:54 PM
Attachments:	NMP Sections A-F.zip

This email accompanies our modification request. It includes Sections A-F of the NMP. The remainder of the Section F maps are being sent in a subsequent email.

Thanks,
Jason Henson